





**BAFFINLAND IRON MINES CORPORATION  
MARY RIVER PROJECT**

**FISH HABITAT MONITORING  
2019 ANNUAL REPORT  
EARLY REVENUE PHASE - TOTE ROAD UPGRADES**

2019-12-31	0		
		C. Devereaux	C. Murray
<b>Date</b>	<b>Rev.</b>	<b>Prepared By</b>	<b>Reviewed By</b>

## **ACKNOWLEDGEMENTS**

This report was prepared by Baffinland Iron Mines Corporation with support from North/South Consultants (NSC) Inc. of Winnipeg, Manitoba. NSC provided fisheries field work, reporting, design services, and technical review.

**TABLE OF CONTENTS**

	<u>Page</u>
<b>SECTION 1.0 - INTRODUCTION .....</b>	<b>1</b>
1.1 MARY RIVER PROJECT .....	1
1.2 AUTHORIZATION FOR WORKS .....	1
1.3 REPORTING .....	2
<b>SECTION 2.0 - PROJECT DESCRIPTION .....</b>	<b>3</b>
2.1 CONSTRUCTION WORK.....	3
2.2 FISH HABITAT ASSESSMENT .....	3
2.3 FISH HABITAT COMPENSATION .....	4
<b>SECTION 3.0 - AQUATIC MONITORING .....</b>	<b>5</b>
3.1 CONSTRUCTION AND TURBIDITY MONITORING .....	5
3.2 WATER QUALITY MONITORING OF BASELINE FISHERIES CULVERTS .....	5
3.3 FISH USE ASSESSMENTS .....	5
3.4 COMPENSATION WORKS .....	7
3.5 REMEDIATION WORKS .....	7
<b>SECTION 4.0 - AUTHORIZED HADD CROSSING INSTALLATION SUMMARY .....</b>	<b>9</b>
<b>SECTION 5.0 - REFERENCES .....</b>	<b>10</b>

### **TABLES**

TABLE 1	SUMMARY OF CHANGES TO TOTE ROAD CROSSINGS AT FISH-BEARING STREAMS COMPLETED FROM DECEMBER 31, 2018 TO DECEMBER 31, 2019
TABLE 2	WATER QUALITY MONITORING OF BASELINE FISHERIES, 2005, 2006, 2015-2019
TABLE 3	LIST OF HADD SITES FROM THE AUGUST 2007 FISHERIES ACT AUTHORIZATION, STREAM CROSSINGS COVERED BY LETTERS OF ADVICE (LOA), AND COMPENSATION SITES (COMP) FOR THE MILNE INLET TOTE ROAD SURVEYED IN SPRING 2019
TABLE 4	ARCTIC CHAR CATCH DATA FROM FISH-BEARING STREAM CROSSINGS ALONG THE TOTE ROAD, SPRING 2019
TABLE 5	NINESPINE STICKLEBACK CATCH DATA FROM FISH-BEARING STREAM CROSSINGS ALONG THE TOTE ROAD, SPRING 2019
TABLE 6	SUMMARY OF FISH HABITAT STATUS, FISH PASSAGE, AND REMEDIATION WORK ALONG THE TOTE ROAD IN 2019
TABLE 7	INSTALLATION SUMMARY OF REMAINING HADD AND HABITAT COMPENSATION SITES ALONG THE TOTE ROAD

### **FIGURES**

FIGURE 1	MAP OF TOTE ROAD SITES SURVEYED DURING SPRING 2019 FISH AND FISH HABITAT ASSESSMENT SURVEYS
----------	---

### **APPENDICES**

APPENDIX A	DFO AUTHORIZATIONS AND AMMENDMENTS
APPENDIX B	PHOTOGRAPHIC LOG OF CHANGES OF TOTE ROAD CROSSINGS AT FISH-BEARING STREAMS COMPLETED IN 2019
APPENDIX C	PHOTOGRAPHIC LOG OF HABITAT ASSESSMENTS AT TOTE ROAD CROSSINGS, SPRING 2019
APPENDIX D	PHOTOGRAPHIC LOG OF TOTE ROAD REMEDIATION WORKS, 3-4 SEPTEMBER 2019



## SECTION 1.0 - INTRODUCTION

### 1.1 MARY RIVER PROJECT

The Mary River Project (the Project) is an iron ore mining project operated by Baffinland Iron Mines Corporation (Baffinland) located in the North Baffin region of Baffin Island, Nunavut. The Mary River Mine Site coordinates are approximately latitude 71° 19' 35" North and longitude 79° 22' 30" West. Detailed descriptions of the Project and annual activities can be found in reports from Knight Piésold (2007b, 2008) and Baffinland (2009 to 2018, incl.).

The Tote Road was first established in the 1960s and extends approximately 100 kilometres between the Mary River Mine Site (Mine Site) and Milne Port. Currently, the Tote Road is used as a means of transport of iron ore, personnel, equipment, and supplies between the Mine Site and Milne Port. Since 2013, there have been ongoing upgrades to sections of the Tote Road as part of the construction and operation of the Early Revenue Phase (ERP) for the Project and in an effort to mitigate sedimentation and erosion concerns, and to safely and efficiently transport iron ore from the Mine Site to Milne Port. Tote Road upgrades have included the following activities:

- Free-span bridges were constructed in 2014 replacing sea container crossings;
- Widening, straightening and realignment of the Tote Road at strategic locations;
- Addition of protective armouring on road embankments and erosion mitigation measures; and
- Continued installation, movement and/or extension of culverts at identified stream crossings to improve transportation safety and minimize erosion/sedimentation, while maintaining fish passage.

A Tote Road Earthworks Execution Plan (TREETP) was developed in April 2017 (Golder 2017) to address outstanding concerns (damaged culverts, embankment erosion, etc.) along the Tote Road. The TREETP outlined the planned sedimentation mitigation measures to be completed along the Tote Road in 2017 and subsequent years. Work executed by Baffinland in 2019 followed the guidance, recommendations and designs presented in the TREETP as well as the original 2013 designs prepared by Hatch Limited (Hatch).

### 1.2 AUTHORIZATION FOR WORKS

Fisheries and Oceans Canada (DFO) (1998) defined Harmful Alteration, Disruption or Destruction (HADD) as: "any meaningful change in one or more habitat components that can reasonably be expected to cause a real reduction in the capacity of the habitat to support the life requisites of

fish”. A HADD occurs when the physical, chemical, or biological features of a water body are sufficiently altered, such that habitat becomes less suitable for one or more life history processes of fish. Detailed descriptions of the 2007 HADD authorization and any related amendments and Letters of Advice can be found in previous annual reports (Knight Piésold 2007b, 2008; Baffinland 2009 to 2018, incl.) and the Fish Habitat No Net Loss and Monitoring Plan as described by Knight Piésold (2007a). Habitat compensation is defined by DFO (1998) as “the replacement of natural habitat, increase in the productivity of existing habitat, or maintenance of fish production by artificial means in circumstances dictated by social and economic conditions, where mitigation techniques and other measures are not adequate to maintain habitats for Canada’s fisheries resources”.

A total of sixty (60) crossings that were originally identified as HADD (August 2007 *Fisheries Act* Authorization), potential compensation, and Letter of Advice (LOA) sites in the August 2007 No Net Loss and Monitoring Plan and/or subsequent amendments were re-surveyed in spring 2019. This included the twenty-five (25) fish-bearing crossings monitored annually since 2008/2009 and the thirty-five (35) fishless crossings that have been periodically surveyed to confirm continued lack of fish use. The locations of these crossings along the Tote Road are presented in Figure 1. In addition, sites requiring remediation for potential fish passage issues (e.g., perched culverts) were identified and a remediation plan was prepared and implemented in early fall 2019.

### 1.3 REPORTING

A written report summarizing the monitoring results is to be submitted to the specified office locations of the Department of Fisheries and Oceans, Fish Habitat Management, Eastern Arctic Area, on or before December 31 of each year. Annual reports have already been submitted for the years 2007 to 2018 (Knight Piésold 2007b, 2008 and Baffinland 2009 to 2018, incl.).

This 2019 Annual Report, herein, covers the period of activity up to and including December 31, 2019. It summarizes the fish habitat monitoring results and provides a record for additional works or undertakings completed in accordance with the approved No Net Loss and Monitoring Plan (Knight Piésold 2007a) and conditions of the authorization, subsequent amendments, and Letters of Advice. The report also summarizes 2019 remediation works.

## SECTION 2.0 - PROJECT DESCRIPTION

### 2.1 CONSTRUCTION WORK

Design summaries and descriptions of work along the Tote Road completed up to the end of 2009 are presented, in detail, in Knight Piésold (2007c) and Baffinland (2009). Road construction activities and installation of fish access improvement structures at some crossings are described in Baffinland's annual reports to DFO (2010 to 2018, incl.).

In order to safely and efficiently transport iron ore from the Mine Site to Milne Port during the early operational period of the mine, the existing Tote Road has been further upgraded (sections were straightened, widened and/or moved) to accommodate large haul trucks and in efforts to mitigate sedimentation and erosion. The first phase of the upgrades involved replacement of sea container crossings with bridges. Bridge installation was completed during the winter of 2013/14 and seacan container crossings were removed at all locations by early 2017. Modifications to accommodate upgrades to the Tote Road and specific water crossings to support the ERP of the Project commenced in 2013 and remain ongoing. Baffinland has received approvals from DFO in the form of LOAs (Appendix A) and email correspondence to proceed with these changes.

Work completed since the previous annual report (Baffinland 2018) included extensions/repairs of two (2) culvert crossings at fish bearing sites CV-078 and CV-111. Details of these works are presented in Table 1 and a photo summary is presented in Appendix B. Future Tote Road improvements/realignments required in support of on-going operations and future expansion projects will continue to follow the historical LOAs, original Hatch 2013 drawings and the TREEP. Baffinland will work with DFO as necessary to ensure planned modifications to fish bearing crossings are in compliance of the *Fisheries Act*.

### 2.2 FISH HABITAT ASSESSMENT

Watercourses initially identified as HADD (n = 25), compensation (n = 12), and LOA (n = 23) sites (Knight Piésold 2007a) were each assessed for the quality of available fish habitat at least once between 2006 and 2009 (Baffinland 2009). Three sites originally identified as potential compensation at the onset of the program (CV-183, CV-181, and BG-16) were not revisited in 2019. Sites CV-183 and CV-181 no longer exist (initial construction upgrades in the winter of 2008/2009 removed these crossings). Site BG-16, originally identified as a compensation site, was subsequently dropped as it had been incorrectly identified as fish habitat. Sites providing confirmed fish habitat were monitored annually from 2010-2018 while non fish-bearing sites have been monitored periodically, including in 2019, to confirm the continued presence of natural fish barriers to fish use of crossing area habitat (Knight Piésold 2007b, 2008, Baffinland 2009 to 2018, incl.).

In 2019, monitoring was conducted at annually monitored fish-bearing crossings and, additionally, at fishless HADD, compensation, and LOA sites. The purpose of resurveying fishless sites was to confirm there have been no changes in accessibility (i.e., natural barriers remain in place) or fish use since the last visit to each site. The emphasis of the 2019 spring monitoring program was to assess the presence of fish, habitat quality, and upstream accessibility through installed culverts at all surveyed sites and identify any potential impacts from sedimentation or erosion as a result of upgrades or general road maintenance. The objective of the program conducted in fall 2019 was to identify and implement remediation measures for crossings in which potential fish passage issues were identified during the spring program.

Habitat surveys involved observations of substrate, flow characteristics, and potential fish use along 50 m reaches upstream and downstream of each applicable crossing. Fish presence was determined through visual surveys and the use of a backpack electrofisher. In previous years, both methods have proven to be highly reliable techniques for determining fish presence/absence in the clear, shallow streams that are typical of the study area. Descriptions of habitat and condition of culverts were noted and photographs were taken. Results of aquatic monitoring are presented in Section 3.0 and a photo log for each site is provided in Appendix C.

Monitoring will continue in 2020 with descriptions of changes and potential impacts from any ongoing works in fish bearing streams and on the success of the 2019 remediation program.

### 2.3 FISH HABITAT COMPENSATION

Compensation works completed for the Tote Road prior to 2009 are described in detail in Knight Piésold (2007a) and the results of recent compensation works (e.g., rustic fishway at BG-30) and detailed fish habitat and fish use surveys from 2009 to 2018 are presented in Baffinland (2009 to 2018, incl.). Following successful completion of habitat works at BG-30 (Baffinland 2012), there was a net habitat gain of approximately 1,050 km<sup>2</sup>, which together with other gains met the compensation goals described in Knight Piésold (2007a). Fish presence upstream of the fishway in BG-30 has been confirmed during site visits from 2013-2019, indicating continuous structural integrity and successful fish passage.

## SECTION 3.0 - AQUATIC MONITORING

An aquatic monitoring program was developed to ensure that all measures and works specified in the No Net Loss and Monitoring Plan (Knight Piésold 2007a), as well as the *Fisheries Act* Authorization and amendments, and the TREP have been implemented and are functioning as intended. Details of aquatic monitoring conducted up to 2018 are provided in Knight Piésold (2007b, 2008) and Baffinland (2009 to 2018, incl.). Aquatic monitoring in 2019 focused on assessing any changes to fish distribution, habitat, and accessibility at all fish-bearing crossings.

### 3.1 CONSTRUCTION AND TURBIDITY MONITORING

There was no in-stream construction work in 2019 during periods of flow that required turbidity monitoring.

### 3.2 WATER QUALITY MONITORING OF BASELINE FISHERIES CULVERTS

Water quality monitoring data from Knight Piésold baseline monitoring work performed during 2005 and 2006, in conjunction with monitoring of the same crossings from 2015-2019 are presented in Table 2.

### 3.3 FISH USE ASSESSMENTS

Spring fish use assessments were conducted at sixty (60) sites along the Tote Road from 28 June to 1 July 2019 (Table 3). Tables 4 and 5 summarize catch statistics for sites where electrofishing was conducted during spring 2019. Table 6 summarizes habitat and fish use assessments for all sites, descriptions of any potential fish passage or habitat issues noted in the spring survey and descriptions of remedial actions conducted in fall 2019. A detailed summary of issues and remedial actions is provided in Section 3.5. A photographic log of habitat at each surveyed crossing is provided in Appendix B.

Results of previous surveys were confirmed for the non-fish-bearing sites; twenty-three (23) of the surveyed sites were not fish-bearing (Table 3), due to the presence of natural barriers between the road crossings and overwintering habitat. Most of these fishless sites are located at the north end of the Tote Road near Milne Port where the presence of steep slopes and vertical drops prevent upstream access from Phillips Creek. Some are also perennially dry channels. There is fish-bearing habitat downstream of CV-166, but the crossing itself is inaccessible due to a rocky barrier downstream of the culvert.

Two (2) additional sites (CV-115 and CV-102) that have been previously identified as fish-bearing were dry during the spring 2019 survey. The stream at CV-115 has not been wetted during survey periods since 2016 when it consisted of isolated pools, within which were a few stranded juvenile

Arctic Char (Baffinland 2016). In contrast, CV-102 has typically provided early summer fish habitat, but an unusually low freshet in 2019 resulted in dry conditions by the time of the survey at the end of June. In addition, although not dry, water levels in the stream at CV-001 were very low (0.01-0.02 m) and no fish were captured during electrofishing surveys.

All other surveyed streams were fish-bearing in 2019 (Table 3). Electrofishing surveys captured nine hundred and sixty-four (964) juvenile Arctic Char and forty-six (46) Ninespine Stickleback at thirty-one (31) crossings (Tables 4 and 5). Fish were also observed, but not captured, at three (3) bridge crossings (CV-128, CV-217, and CV-223) and at CV-187. Arctic Char were identified in all of these streams, while Ninespine Stickleback were found in seven (7) streams, all within the southern half of the road alignment where they consistently have been more common within the study area. Site-specific Arctic Char catches ranged from one fish at the CV-106 crossing to eighty-eight (88) juveniles in the stream crossed by BG-01, a tributary of Camp Lake. Ninespine Stickleback were most common in streams near Muriel Lake (CV-030, BG-32, and CV-216) with a maximum of twenty-seven (27) found at site CV-030. Juvenile Arctic Char catch-per-unit-effort (CPUE) ranged from 0.27 to 8.88 fish/minute and Ninespine Stickleback CPUE ranged from 0.09 to 3.67 fish/minute.

Arctic Char and/or Ninespine Stickleback were captured upstream of culverts at all but four (4) crossings (CV-111, CV-106, CV-104, and BG-30). At crossing CV-104, juvenile Arctic Char were observed swimming upstream within the culvert, and though none were captured or observed upstream of the road, there were no apparent fish passage issues. At crossing BG-30, many juvenile Arctic Char (total count not obtained) were observed in the large, deep upstream pond, but they could not be captured and quantified with the electrofisher. The remaining two (2) crossings with no fish upstream (CV-111 and CV-106) appeared to have potential fish passage issues at the culvert crossings. The details of these and other issues observed during the 2019 survey are discussed in Section 3.5.

The fork length of captured Arctic Char ranged from 34-280 mm (Table 4). More than 63% of the catch was 50-99 mm with a mode of 60-69 mm. Relatively few Arctic Char were larger than 179 mm. Ninespine Stickleback ranged in size from 33-68 mm (Table 5). Although there are observed differences in CPUE and mean lengths between upstream and downstream catches at some sites, these are not necessarily indicative of fish passage issues at the culvert crossings. Additional factors can influence fish distribution within a stream such as differences in natural microhabitat features, water levels, and flows. For example, CPUE was higher downstream and mean fork lengths were higher upstream at sites BG-27 and BG-24, but these differences are not the result of fish passage issues. These streams both flow into David Lake from steep hills on the upstream (west) side of the road and both have natural upstream barriers in the form of subsurface flows

emerging from a steep, rocky cliff (300-500 m upstream). Downstream of the road, habitat is relatively low gradient with deeper pools and runs that, combined with proximity to David Lake, provide abundant habitat for all sizes of juvenile Arctic Char. Upstream of the culverts, habitat steepens and water velocities increase effectively limiting access to fewer large juveniles.

In contrast, the differences in upstream and downstream catches at CV-111 and CV-225 suggested fish passage issues. Habitat upstream and downstream of the road at these two (2) crossings is similar, suggesting no natural barriers or uneven distribution of preferred habitat types that could be affecting fish movements. It was, therefore, determined that the highly perched culvert at CV-111 and the combination of perched culvert and high culvert velocities at CV-225 were limiting or obstructing fish movements. Details of the issues and remediation actions taken in fall 2019 for these crossings are included in Section 3.5.

#### 3.4 COMPENSATION WORKS

All compensation works completed prior to 2019 remain successful, including fish use of the rustic fishway installed at BG-30. For more details on habitat compensation activities, see Baffinland (2009 to 2015, incl.)

#### 3.5 REMEDIATION WORKS

Tote Road monitoring in 2018 identified eleven (11) sites with potential fish passage issues at the culvert crossings (Baffinland 2018). Two of these (CV-111 and BG-29) involved physical obstructions in the form of instream road aggregate, which were subsequently removed and access was restored in summer 2018. Two other crossings (BG-01 and CV-099) had high culvert velocities suspected to restrict use of upstream habitat to larger juveniles. The low water levels in spring 2019 eliminated, at least temporarily, these velocity barriers, though they could reoccur with larger freshets and/or higher flow conditions. A damaged culvert at CV-104 was successfully repaired in 2018 and the slight perch at BG-24 was remediated with placement of rocks to create a backflooding effect. The remaining issues identified in 2018 (at crossings CV-129, CV-114, CV-106, BG-50, and CV-225) had not yet been sufficiently remediated at the time of the spring 2019 survey.

During spring 2019 fisheries assessments, an additional four (4) sites along the Tote Road were identified as having potential issues regarding fish passage and/or habitat use at the crossings. Of the nine (9) total sites with identified issues, seven (7) crossings had perched culverts of varying heights. The remaining two sites contained instream rip rap/road aggregate material blocking or partially blocking fish movements. To improve conditions at each of these sites, remediation actions were planned and implemented in early September 2019 (Table 6; Appendix D). A general



description of the remediation works along with before and after photographs for each of these sites is provided in Appendix D. A brief summary of the remediation is provided below.

At sites BG-29 and BG-01, instream road aggregate/rip rap was removed from the channel and full accessibility was restored. Fish movements are expected to be unhindered; however, sites should be revisited to ensure no additional material enters the watercourse.

At sites with small perches (generally less than 5 cm height; CV-129, CV-216), materials were placed in stream to create a backwater effect, raising water levels at the downstream end of the culverts and eliminating the vertical drops. Installed structures also created a step-pool approach to the culverts to enhance fish passage upstream. These works appeared to be largely successful, but will require revisiting in spring 2020 to confirm that issues have been corrected.

Sites CV-114, CV-106, and BG-50 had moderately high perches that were mitigated through the installation of step-pool rocky ramps to improve fish access (Table 6; Appendix D). Ramps were initially installed at CV-114 and CV-106 in summer 2018 following identification of perching during the 2018 survey. However, the spring 2019 survey indicated additional work was required on both ramps to correct persistent passage issues. Installation/modification of ramps at these three crossings in fall 2019 appeared to be successful at eliminating the perches and providing fish passage. However, CV-106 and one of the two perched culverts at BG-50 were dry in fall 2019 and flow patterns down these ramps could therefore not be determined at the time of the remediation.

Remediation could not be completed at two sites (CV-111 and CV-225) in 2019 (Table 6; Appendix D). The culvert at CV-111 was reinstalled during winter 2018/2019 to replace two culverts with a single culvert and reduce erosion of the embankment. However, the new culvert had a 0.25 m perch, preventing upstream access for fish. A rocky ramp was constructed to improve fish access to the culvert and upstream habitat in fall 2019. Unfortunately, though access has likely been improved, due to the height of the original perch, such a drop could not be completely eliminated by this method. Additional/alternative works may be required for all of the size classes of juvenile Arctic Char found downstream of this crossing to have full access to upstream habitat.

The perches at both CV-225 culverts are 0.1-0.2 m with relatively high velocity flows, likely limiting upstream access to larger juvenile Arctic Char (Tables 4 and 6). There is also a large, deep (1.5 m) scour pool downstream of the culverts that prevented manual construction of instream works. As a result, this site could not be safely remediated during fall 2019. An alternative plan will be developed and implemented in 2020.



#### SECTION 4.0 - AUTHORIZED HADD CROSSING INSTALLATION SUMMARY

The locations for current authorized HADD crossings and habitat compensation sites are presented in Figure 1. As of November 30, 2008, all authorized HADD water crossings were installed. Remedial work up to August 2009 at the habitat compensation sites was substantially completed, and by October 2011, additional habitat compensation investigations and access structure installation were complete at select crossings. In 2012, new culverts were installed at two HADD crossings (BG-04 and BG-32) and habitat compensation works were completed at BG-30. No additional work was completed in 2013 due to pending potential upgrades to large portions of the Tote Road as part of the ERP of the Project. In 2013/14, bridges were installed at four (4) crossings and culvert replacement/extension was initiated on another crossing. The now obsolete sea containers were removed from the CV-223 crossing during late fall 2014 and from BG-50 in late 2016, and from the remaining two (2) crossings in early 2017. During winter 2018/2019, culverts were extended at HADD crossing CV-078 and two (2) improperly installed culverts at HADD site CV-111 were replaced with a single culvert. A complete and updated list of the HADD crossings and habitat compensation sites, including crossing IDs, is provided in Table 7. The data in this table reflect those that were presented in detail in previous reports (Knight Piésold 2007b and 2008, Baffinland 2009), as well as the results from the most recent Tote Road surveys that were completed since 2010 (Baffinland 2010 to 2018, incl.).

## SECTION 5.0 - REFERENCES

- Baffinland Iron Mines Corporation. 2009. Mary River Project Bulk Sampling Program - Tote Road Upgrades, Fish Habitat Monitoring 2008 Annual Report to Department of Fisheries and Oceans.
- Baffinland Iron Mines Corporation. 2010. Mary River Project Bulk Sampling Program - Tote Road Upgrades, Fish Habitat Monitoring 2010 Annual Report to Department of Fisheries and Oceans.
- Baffinland Iron Mines Corporation. 2011. Mary River Project Bulk Sampling Program - Tote Road Upgrades, Fish Habitat Monitoring 2011 Annual Report to Department of Fisheries and Oceans.
- Baffinland Iron Mines Corporation. 2012. Mary River Project Bulk Sampling Program - Tote Road Upgrades, Fish Habitat Monitoring 2012 Annual Report to Department of Fisheries and Oceans.
- Baffinland Iron Mines Corporation. 2013. Mary River Project Bulk Sampling Program - Tote Road Upgrades, Fish Habitat Monitoring 2013 Annual Report to Department of Fisheries and Oceans.
- Baffinland Iron Mines Corporation. 2014. Mary River Project Early Revenue Phase - Tote Road Upgrades, Fish Habitat Monitoring 2014 Annual Report to Department of Fisheries and Oceans.
- Baffinland Iron Mines Corporation. 2015. Mary River Project Early Revenue Phase - Tote Road Upgrades, Fish Habitat Monitoring 2015 Annual Report to Department of Fisheries and Oceans.
- Baffinland Iron Mines Corporation. 2016. Mary River Project Early Revenue Phase - Tote Road Upgrades, Fish Habitat Monitoring 2016 Annual Report to Department of Fisheries and Oceans.
- Baffinland Iron Mines Corporation. 2017. Mary River Project Early Revenue Phase - Tote Road Upgrades, Fish Habitat Monitoring 2017 Annual Report to Department of Fisheries and Oceans.
- Baffinland Iron Mines Corporation. 2018. Mary River Project Early Revenue Phase - Tote Road Upgrades, Fish Habitat Monitoring 2017 Annual Report to Department of Fisheries and Oceans.
- Department of Fisheries and Oceans (DFO). 1998. Decision framework for the determination and authorization of harmful alteration, disruption or destruction of fish habitat. DFO Habitat Management and Environmental Science, Habitat Management Branch, Ottawa Ontario.
- Golder Associates Limited (Golder). 2017. Tote Road Earthworks Execution Plan and Design Report. Report No. 1667708, Rev. 0. Issued April 2017 by Golder Associates Limited.
- Knight Piésold. 2007a. Baffinland Iron Mines Corporation, Mary River Project Bulk Sampling Program, Fish Habitat No Net Loss and Monitoring Plan (Ref. No. NB102-00181/10-4). A report prepared by Knight Piésold Ltd.

- Knight Piésold. 2007b. Baffinland Iron Mines Corporation, Mary River Project Bulk Sampling Program - Tote Road Upgrades, Fish Habitat Monitoring 2007 Annual Report to Department of Fisheries and Oceans (Ref. No. NB102-00181/10-8). A report prepared by Knight Piésold Ltd.
- Knight Piésold. 2007c. Baffinland Iron Mines Corporation, Mary River Project Bulk Sampling Program, Road Upgrade Design Summary (Ref. No. NB102-00181/10-1). A report prepared by Knight Piésold Ltd.
- Knight Piésold. 2008. Baffinland Iron Mines Corporation, Mary River Project Bulk Sampling Program, Road Upgrades. Fish Habitat Monitoring 2008 Annual Report to Department of Fisheries and Oceans (Ref. No. NB102-00181/13-1). A report prepared by Knight Piésold Ltd.

## **TABLES AND FIGURES**

**TABLE 1. SUMMARY OF CHANGES TO TOTE ROAD CROSSINGS AT FISH-BEARING STREAMS COMPLETED FROM DECEMBER 31, 2018 TO DECEMBER 31, 2019<sup>1</sup>**

Location ID	UTM <sup>2</sup>		Completed Work	Date Completed	Current Crossing Configuration	Fisheries Survey Conducted 28-June – 1-July 2019
	Easting	Northing				
CV111	521,355	7,954,524	Existing culverts were replaced with a single new culvert	19-Feb-2019	1 X 1m diameter	Issues with culvert installation which summer remediation activities attempted to rectify. May require reinstallation of culvert. See tables 6 and 7 for additional detail.
CV078A	525,852	7,936,787	Existing culvert was extended	7-Jan-2019	2 X 1.2m diameter	No potential project-related fish passage or habitat issues identified.
CV078B	525,852	7,936,787	Existing culvert was extended	7-Jan-2019	2 X 1m diameter	No potential project-related fish passage or habitat issues identified.
CV078C	525,852	7,936,787	Existing culvert was extended	7-Jan-2019	1 X 1m diameter	No potential project-related fish passage or habitat issues identified.
CV078D	525,852	7,936,787	Existing culvert was extended	7-Jan-2019	1 X 2m diameter	No potential project-related fish passage or habitat issues identified.

1 - Culvert design basis is Hatch (2013)

2 - NAD 83, Zone 17W

**TABLE 2. WATER QUALITY MONITORING OF BASELINE FISHERIES, 2005, 2006, 2015-2019**









Table 2.2 Water Quality Monitoring Of Baseline Fisheries Culverts Surface Water Quality Summary For Sample Site N1-050 (CV099)

Parameters	Units	Method Detection Limit		LOR					CCME Guideline	Dates																Dates							
		2005	2006	2015	2016	2017	2018	2019		13-Jun-05	06-Aug-05	09-Sep-05	14-Jun-06	03-Aug-06	08-Sep-06	03-Jul-15	03-Jul-15	12-Aug-15	12-Aug-15	30-Jun-16	30-Jun-16	25-Aug-16	25-Aug-16	29-Jun-17	29-Jun-17	03-Jul-18	03-Jul-18	02-Sep-18	02-Sep-18	21-Jun-19	21-Jun-19	11-Aug-19	11-Aug-19
		2005	2006	2015	2016	2017	2018	2019		13-Jun-05	06-Aug-05	09-Sep-05	14-Jun-06	03-Aug-06	08-Sep-06	03-Jul-15	03-Jul-15	12-Aug-15	12-Aug-15	30-Jun-16	30-Jun-16	25-Aug-16	25-Aug-16	29-Jun-17	29-Jun-17	03-Jul-18	03-Jul-18	02-Sep-18	02-Sep-18	21-Jun-19	21-Jun-19	11-Aug-19	11-Aug-19
Molybdenum	mg/L	0.0003	0.005	0.0005	0.0005	0.0005	0.0005	0.0005	0.073	<0.0003	<0.0003	<0.0003	<0.005	<0.005	<0.005	<0.00050	<0.00050	<0.00050	<0.00050	0.000131	0.000141	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0001	0.0001	<0.00050	<0.00050	0.000132	0.000133
Nickel	mg/L	0.001	0.005	0.001	0.0005	0.0005	0.0005	0.0005	0.025 - 0.150 <sup>3</sup>	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
Phosphorus	mg/L	-	-	-	0.05	0.05	0.05	0.05	-	-	-	-	-	-	-	-	-	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	
Potassium	mg/L	0.02	0.01	1	0.05	0.05	0.05	0.05	-	0.53	0.45	0.54	0.52	0.34	0.52	<1.0	<1.0	0.614	0.626	0.339	0.389	0.69	0.686	0.337	0.325	0.334	0.332	0.544	0.54	0.410	0.404	0.671	0.675
Rubidium	mg/L	-	-	-	0.0002	0.0002	0.0002	0.0002	-	-	-	-	-	-	-	-	-	-	0.00033	0.00036	0.00057	0.00061	0.0005	0.00048	0.00048	0.00033	0.00045	0.00045	0.00034	0.00039	0.00067	0.00067	
Selenium	mg/L	0.005	0.001	0.0004	0.00005	0.00005	0.00005	0.00005	0.001	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001	<0.00040	<0.00040	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
Silicon	mg/L	-	-	-	0.05	0.05	0.1	0.10	-	-	-	-	-	-	-	-	-	-	0.501	0.471	0.709	0.945	0.4	0.4	0.53	0.52	0.81	0.83	0.60	0.60	0.74	0.75	
Silver	mg/L	0.0001	0.0001	-	0.00005	0.00005	0.00005	0.00005	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
Sodium	mg/L	0.05	0.05	0.5	0.5	0.5	0.05	0.05	-	0.39	0.67	1.15	0.37	0.67	1.61	0.76	0.75	2.64	2.55	0.66	0.71	4.03	4.02	<0.50	0.63	2.29	2.23	0.839	0.831	3.36	3.38		
Strontium	mg/L	0.001	0.001	-	0.001	0.001	0.001	0.001	-	0.0068	0.0140	0.0198	0.010	0.018	0.022	-	-	-	-	0.0074	0.0072	0.0242	0.0242	0.0041	0.0038	0.0108	0.0105	0.0225	0.02	0.0118	0.0117	0.0269	0.0269
Sulfur	mg/L	-	-	-	0.5	0.5	0.5	0.5	-	-	-	-	-	-	-	-	-	-	-	0.59	<0.50	2.79	3.04	<0.50	<0.50	1.77	1.63	0.63	0.58	1.78	1.97		
Tellurium	mg/L	-	-	-	0.0002	0.0002	0.0002	0.0002	-	-	-	-	-	-	-	-	-	-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	
Thallium	mg/L	0.0002	-	0.0003	0.00001	0.00001	0.00001	0.00001	0.0008	<0.0002	<0.0002	<0.0002	-	-	-	<0.00030	<0.00030	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Thorium	mg/L	-	-	-	0.0001	0.0001	0.0001	0.0001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Tin	mg/L	0.001	0.01	-	0.0001	0.0001	0.0001	0.0001	-	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Titanium	mg/L	0.003	-	-	0.0003	0.0003	0.0003	0.0003	-	<0.003	<0.003	<0.003	-	-	-	-	-	-	-	0.0009	0.0007	<0.00030	0.00033	0.00499	0.00417	<0.00030	0.000630	<0.00030	<0.00030	0.00049	<0.00030	<0.00030	
Tungsten	mg/L	-	-	-	0.0001	0.0001	0.0001	0.0001	-	-	-	-	-	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Uranium	mg/L	-	-	0.001	0.00001	0.00001	0.00001	0.00001	0.015	-	-	-	-	-	-	<0.0010	<0.0010	0.000982	0.001040	0.000173	0.000137	0.00122	0.00117	0.000046	0.000064	0.000291	0.000318	0.001010	0.000998	0.000381	0.000391	0.0012	0.00124
Vanadium	mg/L	0.0009	0.001	-	0.0005	0.0005	0.0005	0.0005	-	<0.0009	<0.0009	<0.0009	<0.001	<0.001	0.001	-	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
Zinc	mg/L	0.001	0.01	0.003	0.003	0.003	0.003	0.003	0.03	0.002	<0.001	<0.001	<0.01	<0.01	<0.01	<0.0030	0.0044	<0.0030	0.0193	0.0045	<0.0030	0.007	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0037	<0.0030	<0.0030	<0.0030	
Zirconium	mg/L	-	-	-	0.0003	0.0003	0.0003	0.0002	-	-	-	-	-	-	-	-	-	-	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	
<b>Dissolved Metals and Non-Metals</b>																																	
Aluminum	mg/L	0.004	0.005	0.005	-	-	-	-	-	0.004	<0.004	<0.004	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-	-	-	-	-	-	-	-	-	-	
Antimony	mg/L	0.0004	-	0.0001	-	-	-	-	-	<0.0004	<0.0004	<0.0004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Arsenic	mg/L	0.005	0.001	-	-	-	-	-	-	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001	<0.00010	<0.00010	0.00011	0.00010	-	-	-	-	-	-	-	-	-	-	-	-	-	
Barium	mg/L	0.001	0.01	-	-	-	-	-	-	0.002	0.004	0.005	<0.01	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Beryllium	mg/L	0.005	-	0.00001	-	-	-	-	-	<0.005	<0.005	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Bismuth	mg/L	0.0003	0.05	-	-	-	-	-	-	<0.0003	<0.0003	<0.0003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Boron	mg/L	0.05	0.01	-	-	-	-	-	-	<0.05	0.02	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cadmium	mg/L	0.0001	0.0001	-	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.000010	<0.000010	<0.000010	<0.000010	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calcium	mg/L	0.05	1	0.002	-	-	-	-	-	12.3	29.7	37.4	15	33	37	18.4	18.8	34.7	34.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium	mg/L	0.001	0.001	0.01	-	-	-	-	-	<0.001	0.002	0.002	<0.001	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	mg/L	0.0003	0.0002	0.00005	-	-	-	-	-	<0.0003	<0.0003	<0.0003	<0.0002	<0.0002	<0.0002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	mg/L	0.0008	0.001	0.05	-	-	-	-	-	<0.0008	<0.0008	<0.0008	<0.001	<0.001	<0.001	0.00030	0.00031	0.00050	0.00055	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron	mg/L	0.02	0.03	0.0005	-	-	-	-	-	<0.05	<0.02	<0.02	<0.03	<0.03	<0.03	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead	mg/L	0.0002	0																														

Table 2.3 Water Quality Monitoring Of Baseline Fisheries Culverts Surface Water Quality Summary For Sample Site N1-053 (CV093)

Parameters	Units	Method Detection Limit		LOR					CCME Guideline	Dates															
		2005	2006	2015	2016	2017	2018	2019		14-Jun-06	03-Aug-06	08-Sep-06	12-Aug-15	12-Aug-15	30-Jun-16	30-Jun-16	29-Jun-17	29-Jun-17	03-Jul-18	03-Jul-18	21-Jun-19	21-Jun-19	27-Jul-19	27-Jul-19	
<b>In Situ Parameters</b>																									
Temperature	°C	-	-	-	-	-	-	-	-	-0.08	9.96	5.77	5.5	5.9	11.3	5.6	3.2	3.8	0.5	2.2	3.4	7.6	4.8	8.9	
Specific Conductance	mS/cm	-	-	-	-	-	-	-	-	0.148	0.160	0.182	0.340	0.320	11.570	11.570	0.197	0.182	0.211	0.197	0.2043	0.2032	0.2934	0.2754	
Dissolved Oxygen	mg/L	-	-	-	-	-	-	-	5.5-9.5	13.70	10.81	12.46	-	-	-	-	-	-	-	-	-	-	-	-	
Dissolved Oxygen	%	-	-	-	-	-	-	-	-	-	-	-	99.4	101.1	99.4	99.0	101.8	102.0	97.4	98.1	100.8	99.8	97.5	99.2	
pH	pH units	-	-	-	-	-	-	-	6.5 - 9.0	8.32	8.15	8.24	8.42	8.43	8.02	7.99	7.90	7.85	8.12	8.12	8.22	8.40	8.21	8.40	
Wetted Width	m	-	-	-	-	-	-	-	-	20	33	28	2.5	2.5	-	-	1.3	3.8	0.2	1.1	-	-	-	-	
Average Depth	m	-	-	-	-	-	-	-	-	0.15	0.20	0.20	0.50	0.50	-	-	0.09	0.06	0.04	0.03	-	-	-	-	
Flow Rate	m <sup>3</sup> /s	-	-	-	-	-	-	-	-	2	4.62	6.85	-	-	-	-	0.02223	0.10944	0.002	0.015	-	-	-	-	
<b>Physical Parameters</b>																									
pH	pH units	-	-	0.01	0.1	0.1	0.1	0.1	6.5 - 9.0	7.91	7.84	7.64	8.36	8.26	8.27	8.2	8.13	8.15	8.15	8.17	8.2	8.36	8.08	8.31	
Conductivity	µS/cm	1	5	-	-	-	-	-	-	161	165	190	-	-	-	-	-	-	-	-	-	-	-	-	
Turbidity	NTU	0.1	0.1	0.1	0.1	0.1	.1	0.1	-	0.5	0.2	-	0.19	1.22	0.92	1.31	0.31	1.74	0.66	0.99	0.23	0.74	0.20	2.20	
Hardness	mg/L as CaCO <sub>3</sub>	0.5	1	10	10	10	10/20	0.5	-	85	86	95	152	158	99	100	81	84	112	108	128	123	-	-	
TSS	mg/L	-	-	2	2	2	2	2	-	-	-	-	<2.0	2.0	<2.0	4.4	2.1	5.5	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	
TDS	mg/L	30	5	20	20	20	10	20	-	105	107	123	147	159	115	105	89	86	128	116	143	139	138	149	
<b>Dissolved Anions</b>																									
Alkalinity	mg/L as CaCO <sub>3</sub>	2	5	10	10	10	10	10	-	80	85	93	155	163	103	99	77	81	99	98	117	115	-	-	
Br <sup>-</sup>	mg/L	0.3	0.05	-	-	-	-	-	-	<0.05	<0.05	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	
Cl <sup>-</sup>	mg/L	0.2	1	0.5	0.5	0.5	0.5	0.5	-	<1	<1	<1	0.74	3.07	0.61	0.57	<0.50	0.6	1.10	1.95	1.16	2.72	-	-	
Fluoride	mg/L	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-	0.036	0.03	0.028	0.027	0.053	0.035	-	-	-	-	
SO <sub>4</sub> <sup>-2</sup>	mg/L	0.5	1	0.3	0.3	0.3	0.3	-	-	3	2	7	2.66	3.9	1.22	1.24	0.62	1	3.02	2.04	-	-	-	-	
<b>Nutrients</b>																									
NH <sub>3</sub> +NH <sub>4</sub>	mg/L N	0.1	0.02	0.15	0.15	0.15	-	-	0.021 - 231 <sup>1</sup>	0.04	<0.02	<0.02	0.23	<0.15	<0.15	<0.15	-	-	-	-	-	-	-	-	
NO <sub>2</sub> (Nitrite)	mg/L N	0.06	0.005	-	-	-	-	0.01	0.06	<0.005	<0.005	0.015	-	-	-	-	-	-	-	-	<0.010	<0.010	-	-	
NO <sub>3</sub> (Nitrate)	mg/L N	0.05	0.1	0.02	0.02	0.02	0.02	0.02	2.9	<0.10	<0.10	<0.10	0.023	0.026	<0.020	0.023	<0.020	<0.020	0.054	0.040	0.038	0.032	-	-	
NO <sub>2</sub> +NO <sub>3</sub>	mg/L N	0.06	0.1	-	-	-	-	0.022	-	<0.10	<0.10	<0.10	-	-	-	-	-	-	-	-	0.038	0.032	-	-	
Ammonia total as N	mg/L	-	-	0.05	0.02	0.02	0.02	0.01	Variable <sup>1</sup>	-	-	-	-	-	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.010	0.010	-	-	
Total Phosphorus	mg/L	0.02	0.01	0.003	0.003	0.003	0.003	0.003	-	<0.01	<0.01	<0.01	<0.0030	0.0037	0.0216	0.0657	0.0042	0.0046	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	
Dissolved Phosphorus	mg/L	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>Organic Compounds</b>																									
Phenols	mg/L	0.001	0.001	-	-	-	-	-	0.004	<0.001	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	
DOC	mg/L	-	-	1	1	0.5	0.5	0.50	-	-	-	-	1.8	2.4	<1.0	<1.0	1.18	1.05	1.17	1.34	1.71	1.74	-	-	
TOC	mg/L	-	-	1	1	0.5	0.5	0.50	-	-	-	-	1.8	2.1	1.2	<1.0	1.41	2.72	1.49	1.46	2.28	2.63	-	-	
TKN	mg/L	-	-	0.15	0.15	0.15	0.15	-	-	0.15	0.15	0.15	0.23	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	-	-	
Chlorophyll-a	mg/m3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pheophytin-a	mg/m3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>Total Metals and Non-Metals</b>																									
Aluminum	mg/L	0.004	0.005	0.01	0.01	0.005	0.005	0.005	0.005 - 0.100 <sup>2</sup>	<0.005	<0.005	0.007	0.018	0.012	0.025	0.139	0.0133	0.048	0.0315	0.0346	0.0211	0.0332	-	-	
Antimony	mg/L	0.0004	-	-	0.0001	0.0001	0.0001	0.0001	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-	
Arsenic	mg/L	0.005	0.001	0.001	0.0001	0.0001	0.0001	0.0001	0.005	<0.001	<0.001	<0.001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-	
Barium	mg/L	0.001	0.01	-	0.0002	0.0002	0.0001	0.0001	-	<0.01	<0.01	<0.01	-	-	0.00459	0.00434	0.00172	0.00297	0.0019	0.00283	0.00229	0.00415	-	-	
Beryllium	mg/L	0.005	-	-	0.0001	0.0001	0.0001	0.0001	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-	
Bismuth	mg/L	0.0003	-	-	0.00005	0.00005	0.00005	0.00005	-	-	-	-	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-	
Boron	mg/L	0.05	0.01	-	0.01	0.01	0.01	0.01	-	<0.01	<0.01	<0.01	-	-	<0.010	<0.010	<0.010	<0.010	0.011	<0.010	<0.010	<0.010	-	-	
Cadmium	mg/L	0.0001	0.0001	0.00009	0.00001	0.00001	0.000005	0.000005	0.000017	<0.0001	<0.0001	<0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	-	
Calcium	mg/L	0.05	1	0.5	0.5	0.5	0.05	0.05	-	24	25	27	44	43.6	31.2	31.6	26.8	26.9	35.4	34.8	38.4	37.7	-	-	
Cesium	mg/L	-	-	-	0.00001	0.00001	0.00001	0.00001	-	-	-	-	-	-	<0.000010	0.000018	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	-	
Chromium	mg/L	0.001	0.001	-	0.0005	0.0005	0.0005	0.0005	-	<0.001	<0.001	<0.001	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-	
Cobalt	mg/L	0.0003	0.0002	-	0.0001	0.0001	0.0001	0.0001	-	<0.0002	<0.0002	<0.0002	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-	
Copper	mg/L	0.0008	0.001	0.001	0.001	0.001	0.001	0.001	0.002 - 0.004 <sup>3</sup>	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Iron	mg/L	0.02	0.03	0.05	0.05	0.05	0.01	0.01	0.3	<0.03	<0.03	<0.03	<0.050	<0.050	<0.050	0.179	<0.050	0.057	0.022	0.026	0.021	0.023	-	-	
Lead	mg/L	0.0002	0.001	0.0005	0.0001	0.0001	0.00005	0.00005	0.001 - 0.007 <sup>3</sup>	<0.001	<0.001	<0.001	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Lithium	mg/L	-	-	-	0.001	0.001	0.001	0.001	-	-	-	-	-	-	<0.0010	<0.0010	<0.0010	<0.0010	0.002	0.0014	0.0026	0.0024	-	-	
Magnesium	mg/L	0.005	1	0.5	0.05	0.05	0.005	0.005	-	6.0	5.0	6.0	11.8	13.8	5.02	5.19	3.5	4.13	5.74	5.15	6.60	6.10	-	-	
Manganese	mg/L	0.0007</																							



Table 2.4 Water Quality Monitoring Of Baseline Fisheries Culverts Surface Water Quality Summary For Sample Site N1-060 (CV078)

Parameters	Units	Method Detection Limit								CCME Guideline	Date																Dates										
		2005	2006	2011	2015	2016	2017	2018	2019		LOR																Dates										
																		13-Jun-05	06-Aug-05	09-Sep-05	13-Jun-06	02-Aug-06	08-Sep-06	12-Aug-15	12-Aug-15	30-Jun-16	30-Jun-16	25-Aug-16	25-Aug-16	29-Jun-17	29-Jun-17	03-Jul-18	03-Jul-18	02-Sep-18	02-Sep-18	22-Jun-19	22-Jun-19
In Situ Parameters																																					
Temperature	°C	-	-	-	-	-	-	-	-	-	0.22	9.28	4.02	-0.06	13.05	3.95	9.6	9.3	8.16	9.36	9.8	10	3.8	4.4	5.2	5.5	6.0	6.0	5.6	4.3	3.9	13.6	13.6				
Specific Conductance	mS/cm	-	-	-	-	-	-	-	-	-	0.079	0.222	0.284	0.097	0.237	0.267	0.314	0.315	7.264	7.264	0.299	0.297	0.154	0.123	0.1668	0.1668	0.237	0.2367	0.2371	0.1616	0.1619	0.3037	0.3044				
Dissolved Oxygen	mg/L	-	-	-	-	-	-	-	-	5.5-9.5	13.48	10.95	12.72	14.17	11.43	12.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Dissolved Oxygen	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
pH	pH units	-	-	-	-	-	-	-	-	6.5-9.0	7.36	8.30	7.96	8.22	8.26	8.36	8.53	8.48	7.81	7.93	8.24	8.25	7.65	7.87	8.19	8.18	8.39	8.39	8.3	8.22	8.23	8.26	8.36				
Wetted Width	m	-	-	-	-	-	-	-	-	-	-	-	-	ice	9	9	3	3	-	-	-	-	-	-	11	10	12.4	12.7	4.5	4.5	4.3	-	-				
Average Depth	m	-	-	-	-	-	-	-	-	-	-	-	-	0.15	0.25	0.2	0.1	0.1	-	-	-	-	-	-	2	0.19	0.1	0.12	0.08	0.08	0.12	-	-				
Flow Rate	m <sup>3</sup> /s	-	-	-	-	-	-	-	-	-	-	-	-	0.74	0.96	-	-	-	-	-	-	-	-	2.90	2.78	1.11	0.75	0.10	0.10	0.08	-	-					
Physical Parameters																																					
pH	pH units	-	-	-	0.01	0.1	0.1	0.1	0.1	6.5-9.0	-	-	-	7.56	8.10	8.10	8.16	8.32	8.09	8.09	8.42	8.42	7.93	7.91	8.18	8.17	8.42	8.37	8.41	8.24	8.22	8.39	8.46				
Conductivity	µS/cm	1	5	5	-	-	-	-	-	-	83	234	269	104	244	277	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Turbidity	NTU	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-	0.40	<0.10	<0.10	0.5	<0.10	-	1.45	0.24	0.26	0.17	0.13	0.14	0.5	0.37	0.29	0.56	<0.10	<0.10	<0.10	0.13	0.14	0.15	0.21				
Hardness	mg/L as CaCO <sub>3</sub>	0.5	1	0.5	10	10	10	10	10/20	0.5	41.0	124	160	52	137	141	156	152	60	59	165	163	46	44	91	90	146	150	147	106	105	153	156				
TSS	mg/L	30	5	1	2	2	2	2	2	-	-	-	-	-	-	-	2.4	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0					
TDS	mg/L	-	-	2	20	20	20	20	20	-	63	123	120	68	159	180	159*	143*	65	70	152	148	50	56	102	101	140	155	155	99	103	163	166				
Dissolved Anions																																					
Alkalinity	mg/L as CaCO <sub>3</sub>	2	5	5	10	10	10	10	10	-	40	120	141	51	132	146	158	152	61	64	161	158	41	43	85	82	149	146	149	103	104	166	171				
Br <sup>-</sup>	mg/L	0.3	0.05	0.25	-	-	-	-	-	-	<0.3	<0.3	<0.3	<0.05	<0.05	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Cl <sup>-</sup>	mg/L	0.2	1	1	0.5	0.5	0.5	0.5	0.5	-	0.9	0.2	0.6	<1	<1	<1	3.08	0.79	<0.50	<0.50	1.19	1.19	<0.50	<0.50	0.69	0.7	0.98	0.99	1.16	0.59	0.64	1.21	1.41				
Fluoride	mg/L	-	-	-	-	0.02	0.02	0.02	-	-	-	-	-	-	-	-	-	-	<0.020	<0.020	0.023	0.024	<0.020	<0.020	0.023	0.023	0.037	0.038	0.037	-	-	-	-				
SO <sub>4</sub> <sup>2-</sup>	mg/L	0.5	1	1	0.3	0.3	0.3	0.3	-	-	0.6	0.8	1.9	2.0	1.0	5.0	3.84	2.68	<0.30	0.31	3.37	3.35	<0.30	<0.30	0.62	0.62	2.02	2.02	2.03	-	-	-	-				
Nutrients																																					
NH <sub>3</sub> +NH <sub>4</sub>	mg/L N	0.1	0.02	0.02	0.15	0.15	0.15	-	-	0.021-0.231 <sup>1</sup>	0.2	0.6	0.8	<0.02	<0.02	<0.02	0.24	0.25	<0.15	<0.15	<0.15	<0.15	-	-	-	-	-	-	-	-	-	-					
NO <sub>2</sub> (Nitrite)	mg/L N	0.06	0.005	0.1	-	-	-	-	0.01	0.06	<0.06	<0.06	<0.06	<0.005	<0.005	0.018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
NO <sub>3</sub> (Nitrate)	mg/L N	0.05	0.1	0.1	0.02	0.02	0.02	0.02	0.02	2.9	<0.05	<0.05	<0.05	<0.10	<0.10	<0.10	0.030	0.026	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020					
NO <sub>3</sub> +NO <sub>2</sub>	mg/L N	0.06	0.1	0.1	-	-	-	-	0.022	-	<0.06	<0.06	<0.06	<0.10	<0.10	<0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Ammonia total as N	mg/L	-	-	-	0.05	0.02	0.02	0.02	0.01	'Variable' <sup>1</sup>	-	-	-	-	-	-	<0.050	<0.050	0.021	<0.020	0.027	0.041	<0.020	<0.020	<0.020	<0.020	-	-	-	<0.010	<0.010	0.014	<0.010				
Total Phosphorus	mg/L	0.02	0.01	0.003	0.003	0.003	0.003	0.003	0.003	-	<0.02	<0.02	<0.10	<0.01	<0.01	<0.01	0.0044	<0.0030	0.0193	0.0282	0.01	0.0139	0.0085	0.0304	<0.0030	<0.0030	0.015	<0.0030	<0.0030	<0.0030	<0.0030	0.012	<0.0030				
Dissolved Phosphorus	mg/L	0.02	-	-	-	-	-	-	-	-	<0.02	<0.02	<0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Organic Compounds																																					
Phenols	mg/L	0.001	0.001	0.001	-	-	-	-	-	0.004	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
DOC	mg/L	-	-	0.5	1	1	0.5	0.5	0.50	-	-	-	-	-	-	-	2.4	1.9	1	<1.0	1.5	1.5	1.75	1.78	1.75	1.74	1.72	1.86	1.72	1.73	1.81	1.62	1.7				
TOC	mg/L	-	-	0.5	1	1	0.5	0.5	0.50	-	-	-	-	-	-	-	2.2	1.8	1.1	1.0	1.6	1.6	2.24	2.13	2.13	1.76	2.01	2.45	2.62	2.34	2.54	3.39	2.23				
TKN	mg/L	-	-	0.1	0.15	0.15	0.15	0.15	-	-	-	-	-	-	-	-	0.24	0.25	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.18	<0.15	-	-	-	-				
Chlorophyll-a	mg/m3	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Pheophytin-a	mg/m3	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Total Metals and Non-Metals																																					
Aluminum	mg/L	0.004	0.005	0.003	0.01	0.01	0.005	0.005	0.005	0.005-0.100 <sup>2</sup>	0.006	<0.004	<0.004	0.006	<0.005	<0.005	0.059	0.016	0.011	0.016	<0.010	<0.010	0.0271	0.024	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.009	0.0097	0.0053	0.0074				
Antimony	mg/L	0.0004	-	0.0001	-	0.0001	0.0001	0.0001	0.0001	-	<0.0004	<0.0004	<0.0004	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010				
Arsenic	mg/L	0.005	0.001	0.0001	0.001	0.0001	0.0001	0.0001	0.0001	0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001	0.00011	<0.00010	<0.00010	<0.00010	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010				
Barium	mg/L	0.001	0.01	0.00005	-	0.00002	0.00002	0.00001	0.0001	-	<0.001	0.002	0.003	<0.01	<0.01	<0.01	-	-	0.00166	0.0019	0.00389	0.00385	0.00131	0.00128	0.00202	0.00213	0.00349	0.00348	0.00351	0.00236	0.00260	0.00459	0.0045				
Beryllium	mg/L	0.005	-	0.0005	-	0.0001	0.0001	0.0001	0.0001	-	<0.005	<0.005	<0.005	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010				
Bismuth	mg/L	0.0003	-	0.0005	-	0.00005	0.00005	0.00005	0.00005	-	<0.0003	<0.0003	<0.0003	-	-	-	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050				
Boron	mg/L	0.05	0.01	0.01	-	0.01	0.01	0.01	0.01	-	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010				
Cadmium	mg/L	0.0001	0.0001	0.00001	0.00009	0.00001	0.00001	0.0000050	0.0000050	0.000017	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050				
Calcium	mg/L	0.05	1	0.05	0.5	0.5	0.5	0.05	0.05	-	13.2	35.5	44.7	17	41	41	45	43.1	17.4	16.8	45.9	45.6	12.6	1													



Table 2.5 Water Quality Monitoring Of Baseline Fisheries Culverts Surface Water Quality Summary For Sample Site N1-070 (BG50)

Parameters	Units	Method Detection Limit		LOR					CCME Guideline	Dates																Dates									
		2005	2006	2015	2016	2017	2018	2019		07-Jun-05	06-Aug-05	09-Sep-05	13-Jun-06	02-Aug-06	08-Sep-06	03-Jul-15	03-Jul-15	11-Aug-15	11-Aug-15	30-Jun-16	30-Jun-16	25-Aug-16	25-Aug-16	29-Jun-17	29-Jun-17	03-Jul-18	03-Jul-18	03-Jul-18	02-Sep-18	02-Sep-18	22-Jun-19	22-Jun-19	09-Aug-19	09-Aug-19	
		US		DS		US		DS		US		DS		US		DS		US		DS		US		DS		US		DS		US		DS			
In Situ Parameters																																			
Temperature	°C	-	-	-	-	-	-	-	-	0.26	9.75	6.05	-0.05	13.74	8.53	-	11.4	11.3	10.4	7.2	11.5	11.3	5.9	8.5	6.3	6.3	6.5	7.9	7.9	3.1	3.1	15.6	15.6		
Specific Conductance	mS/cm	-	-	-	-	-	-	-	-	0.067	0.139	0.145	0.112	0.137	0.152	-	0.130	0.084	0.183	0.180	6.109	6.213	0.175	0.175	0.126	0.171	0.104	0.104	0.1041	0.1394	0.1418	0.1177	0.1177	0.1707	0.1736
Dissolved Oxygen	mg/L	-	-	-	-	-	-	-	-	5.5-9.5	13.06	10.71	11.89	13.58	10.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Dissolved Oxygen	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	101.5	101.9	98.5	99.4	101.4	100.5	102.4	111.7	96.1	96.1	96.6	100.4	101.2	99.0	99.1	102.5	102.7		
pH	pH units	-	-	-	-	-	-	-	-	6.5-9.0	7.58	8.03	7.70	8.02	8.1	8.16	8.20	8.17	8.42	8.42	6.21	7.47	8.22	8.15	7.78	7.76	8.17	8.17	8.06	8.37	8.40	8.16	8.12	8.31	8.36
Wetted Width	m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	6	-	-	-	-	-	-	5	10.6	-	-	-	-	-	-	-	-	
Average Depth	m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Flow Rate	m³/s	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Physical Parameters																																			
pH	pH units	-	-	0.01	0.1	0.1	0.1	0.1	0.1	6.5-9.0	-	-	-	7.7	7.61	7.64	7.98	7.99	8.20	8.17	7.86	7.94	8.32	8.28	7.94	7.92	7.97	7.95	7.99	8.34	8.39	8.09	8.11	8.14	7.78
Conductivity	µS/cm	1	5	-	-	-	-	-	-	72	149	143	124	140	171	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	0.1	0.1	0.1	0.1	0.1	.1	0.1	-	0.33	0.25	0.16	0.5	0.3	-	0.29	0.28	0.2	0.2	0.6	0.46	0.28	0.26	0.44	0.72	0.63	0.8	0.6	0.24	0.23	0.23	0.25	0.30	0.37	
Hardness	mg/L as CaCO <sub>3</sub>	0.5	1	10	10	10	10/20	0.5	-	32.4	79.5	82.0	61	75	80	63	62	80	81	48	48	85	93	55	55	52	52	53	81	85	74	74.2	84.8	87.4	
TSS	mg/L	-	-	2	2	2	2	2	-	-	-	-	-	-	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	
TDS	mg/L	30	5	20	20	20	20	20	-	54	74	86	81	91	111	70	73	86*	84*	60	65	83	84	66	66	68	72	55	90	95	77	80	104	112	
Dissolved Anions																																			
Alkalinity	mg/L as CaCO <sub>3</sub>	2	5	10	10	10	10	10	-	33	74	71	62	74	87	63	63	82	80	47	50	84	89	51	50	43	51	47	83	85	73	74	89	83	
Br	mg/L	0.3	0.05	-	-	-	-	-	-	<0.3	<0.3	<0.3	<0.05	<0.05	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cl	mg/L	0.2	1	0.5	0.5	0.5	0.5	0.5	-	0.9	0.8	0.9	<1	<1	2	1.29	1.30	2.06	2.20	1.26	1.26	1.89	1.88	1.29	1.3	1.12	1.13	1.16	1.55	1.76	1.46	1.45	1.62	2.20	
Fluoride	mg/L	-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-	-	-	-	-	-	-	-	<0.020	<0.020	0.024	0.025	<0.020	<0.020	<0.020	<0.020	<0.020	0.03	0.029	-	-	-	
SO <sub>4</sub>	mg/L	0.5	1	0.3	0.3	0.3	0.3	-	-	0.7	0.5	0.6	2	<1	3	0.82	1.03	1.55	2.28	0.65	0.62	1.25	1.21	0.64	0.61	0.58	0.58	0.6	0.84	0.91	-	-	-		
Nutrients																																			
NH <sub>4</sub> +NH <sub>3</sub>	mg/L N	0.1	0.02	0.15	0.15	0.15	-	-	0.021 - 231 <sup>1</sup>	0.2	0.1	<0.10	0.04	0.11	<0.02	<0.15	<0.15	0.28	0.22	<0.15	<0.15	0.2	<0.15	-	-	-	-	-	-	-	-	-	-	-	
NO <sub>2</sub> (Nitrite)	mg/L N	0.06	0.005	-	-	-	-	0.01	0.06	<0.06	<0.06	<0.06	0.013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.010
NO <sub>3</sub> (Nitrate)	mg/L N	0.05	0.1	0.02	0.02	0.02	0.02	0.02	2.9	0.06	<0.05	<0.05	<0.10	<0.10	<0.10	<0.020	0.035	<0.020	0.052	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.154	2.62	
NO <sub>2</sub> +NO <sub>3</sub>	mg/L N	0.06	0.1	-	-	-	-	0.022	-	0.06	<0.06	<0.06	<0.10	<0.10	<0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.022	
Ammonia total as N	mg/L	-	-	0.05	0.02	0.02	0.02	0.01	'Variable' <sup>1</sup>	-	-	-	-	-	-	-	-	-	-	<0.020	0.054	0.061	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	-	-	<0.010	<0.010	<0.010	<0.010	
Total Phosphorus	mg/L	0.02	0.01	0.003	0.003	0.003	0.003	0.003	-	<0.02	<0.02	<0.10	<0.01	<0.01	<0.01	0.0043	0.0058	0.0040	0.0038	0.0044	0.0032	0.0231	0.0088	0.0061	0.0066	0.004	0.0037	0.004	<0.0030	<0.0030	0.0119	0.0033	0.0049	<0.0030	
Dissolved Phosphorus	mg/L	0.02	-	-	-	-	-	-	-	<0.02	<0.02	<0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Organic Compounds																																			
Phenols	mg/L	0.001	0.001	-	-	-	-	-	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
DOC	mg/L	-	-	1	1	0.5	0.5	0.50	-	-	-	-	-	-	-	2.1	2.1	2.5	2.6	2.1	1.9	2.1	2.3	2.24	2.14	1.9	2.07	1.87	2.48	2.41	2.68	2.79	2.33	2.44	
TOC	mg/L	-	-	1	1	0.5	0.5	0.50	-	-	-	-	-	-	-	2.1	1.9	2.7	2.6	2.3	2.2	2.5	2.2	2.48	2.79	2.16	2.18	2.08	3.19	3.00	3.39	3.27	2.79	2.64	
TKN	mg/L	-	-	0.15	0.15	0.15	0.15	-	-	-	-	-	-	-	-	<0.15	<0.15	0.28	0.22	<0.15	<0.15	0.2	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
Chlorophyll-a	mg/m <sup>3</sup>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pheophytin-a	mg/m <sup>3</sup>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total Metals and Non-Metals																																			
Aluminum	mg/L	0.004	0.005	0.01	0.01	0.005	0.005	0.005	0.005 - 0.100 <sup>2</sup>	0.008	<0.004	<0.004	<0.005	<0.005	0.006	<0.010	<0.010	<0.010	<0.010	0.018	0.014	<0.010	<0.010	0.0282	0.0269	0.0063	0.0067	0.0085	<0.0050	0.0058	0.0183	0.0086	0.0101	0.0503	
Antimony	mg/L	0.0004	-	-	0.0001	0.0001	0.0001	0.0001	-	<0.0004	<0.0004	<0.0004	-	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic	mg/L	0.005	0.001	0.001	0.0001	0.0001	0.0001	0.0001	0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium	mg/L	0.001	0.01	-	0.0002	0.0002	0.0001	0.0001	-	0.001	0.004	0.004	<0.01	<0.01	<0.01	-	-	-	-	0.00347	0.0034	0.00545	0.00569	0.00391	0.00394	0.00328	0.00337	0.00336	0.00532	0.00527	0.00484	0.00471	0.00594	0.0069	
Beryllium	mg/L	0.005	-	-	0.0001	0.0001	0.0001	0.0001	-	<0.005	<0.005	<0.00																							







Table 2.6 Water Quality Monitoring Of Baseline Fisheries Culverts Surface Water Quality Summary For Sample Site N1-080 (CV040)

Parameters	Units	Method Detection Limit		LOR						CCME Guideline	Dates												Dates													
		2005	2006	2015	2016	2017	2018	2019	13-Jun-05		06-Aug-05	09-Sep-05	13-Jun-06	13-Jun-06	02-Aug-06	08-Sep-06	03-Jul-15	03-Jul-15	11-Aug-15	11-Aug-15	29-Jun-16	29-Jun-16	25-Aug-16	25-Aug-16	29-Jun-17	29-Jun-17	04-Jul-18	04-Jul-18	03-Sep-18	03-Sep-18	03-Sep-18	22-Jun-19	22-Jun-19	09-Aug-19	09-Aug-19	
		US		DS		US		DS			US		DS		US		DS		US		DS		US		DS		US		DS		US		DS		US	
In Situ Parameters																																				
Temperature	°C	-	-	-	-	-	-	-	-	-	0.07	10.80	4.78	-0.1	-0.1	14.96	4.91	-	-	12.8	12.7	15.7	16	-	11.1	3.8	2.4	8.1	8.5	3.4	3.3	3.3	2.70	2.50	17	16.2
Specific Conductance	mS/cm	-	-	-	-	-	-	-	-	-	0.047	0.243	0.318	0.084	0.084	0.264	0.306	0.130	0.125	0.387	0.390	0.151	0.151	-	0.391	0.177	0.101	0.2026	0.1968	0.3137	0.3133	0.31	0.1952	0.1936	0.3854	0.3800
Dissolved Oxygen	mg/L	-	-	-	-	-	-	-	-	-	5.5-9.5	13.48	10.39	12.74	13.65	13.65	10.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Oxygen	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pH	pH units	-	-	-	-	-	-	-	-	-	6.5 - 9.0	6.99	8.39	8.05	7.97	8.37	8.50	8.32	8.16	8.61	8.65	8.19	8.23	-	8.26	7.64	7.84	8.24	8.24	8.24	8.24	8.24	8.24	8.24	8.24	8.24
Wetted Width	m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Average Depth	m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Flow Rate	m <sup>3</sup> /s	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Physical Parameters																																				
pH	pH units	-	-	0.01	0.1	0.1	0.1	0.1	0.1	0.1	6.5 - 9.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Conductivity	µS/cm	1	5	-	-	-	-	-	-	-	54	257	303	92	93	273	321	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Turbidity	NTU	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.37	0.13	<0.10	0.6	0.5	0.2	-	0.44	0.54	0.19	0.15	1.48	1.05	0.28	0.33	0.77	0.71	0.62	0.64	0.5	0.27	<0.10	0.17	0.22	0.33	0.44
Hardness	mg/L as CaCO <sub>3</sub>	0.5	1	10	10	10	10/20	0.5	-	-	25.1	138	178	48	48	153	159	95	94	168	169	68	69	193	202	35	37	106	102	176	182	<10	121	121	180	187
TSS	mg/L	-	-	2	2	2	2	2	2	2	-	-	-	-	-	-	-	<2.0	<2.0	<2.0	<2.0	2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	
TDS	mg/L	30	5	20	20	20	20	20	20	20	46	126	200	60	61	177	209	77	90	178*	170*	65	65	208	201	44	46	112	118	195	205	<20	133	127	208	204
Dissolved Anions																																				
Alkalinity	mg/L as CaCO <sub>3</sub>	2	5	10	10	10	10	10	10	10	24	130	167	45	45	147	167	112	99	175	177	68	75	187	191	32	27	103	100	171	168	<10	120	118	182	188
Br <sup>-</sup>	mg/L	0.3	0.05	-	-	-	-	-	-	-	<0.3	<0.3	<0.3	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cl <sup>-</sup>	mg/L	0.2	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.9	0.7	2.4	<1	<1	1	5	2.48	2.28	8.34	8.66	1.81	1.84	13.5	13.8	0.57	0.57	3.16	2.91	13.5	13.8	<0.50	4.08	4.52	16.8	14.4
Fluoride	mg/L	-	-	-	0.02	0.02	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SO <sub>4</sub> <sup>2-</sup>	mg/L	0.5	1	0.3	0.3	0.3	0.3	-	-	-	0.6	0.8	2.1	2	2	<1	4.00	1.58	1.47	4.81	5.36	0.76	0.84	0.026	0.023	6.52	0.30	1.3	0.89	3.62	3.52	<0.30	-	-	-	-
Nutrients																																				
NH <sub>3</sub> +NH <sub>4</sub>	mg/L N	0.1	0.02	0.15	0.15	0.15	-	-	-	0.021 - 231 <sup>1</sup>	0.2	0.5	0.6	0.05	0.09	0.04	<0.02	0.17	<0.15	0.37	0.28	<0.15	<0.15	0.24	0.17	-	-	-	-	-	-	-	-	-	-	
NO <sub>2</sub> (Nitrite)	mg/L N	0.06	0.005	-	-	-	-	0.01	0.06	<0.06	<0.06	<0.06	<0.005	<0.005	<0.005	0.015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NO <sub>3</sub> (Nitrate)	mg/L N	0.05	0.1	0.02	0.02	0.02	0.02	0.02	2.9	<0.05	<0.05	<0.05	<0.10	<0.10	<0.10	<0.10	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	
NO <sub>2</sub> +NO <sub>3</sub>	mg/L N	0.06	0.1	-	-	-	-	0.022	-	<0.06	<0.06	<0.06	<0.10	<0.10	<0.10	<0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Ammonia total as N	mg/L	-	-	0.05	0.02	0.02	0.02	0.01	Variable <sup>1</sup>	-	-	-	-	-	-	-	<0.050	<0.050	<0.050	<0.050	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	
Total Phosphorus	mg/L	0.02	0.01	0.003	0.003	0.003	0.003	0.003	-	0.030	<0.02	<0.10	<0.01	<0.01	<0.01	<0.01	<0.01	0.0040	0.0032	<0.0030	<0.0030	0.0067	0.0038	0.0048	0.0034	0.0158	0.0159	<0.0030	0.0031	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030		
Organic Compounds																																				
Phenols	mg/L	0.001	0.001	-	-	-	-	-	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
DOC	mg/L	-	-	1	1	0.5	0.5	0.50	-	-	-	-	-	-	-	-	2.2	2.2	3.4	3.5	1.6	1.4	3.2	3	3.93	3.56	3.2	3.05	3.27	3.16	0.51	3.00	3.00	3.34	3.1	
TOC	mg/L	-	-	1	1	0.5	0.5	0.50	-	-	-	-	-	-	-	-	2.4	2.5	3.6	3.5	1.9	2.1	3.2	3.3	4.45	4.17	3.4	3.28	4.01	3.61	0.62	4.10	3.85	3.83	3.73	
TN	mg/L	-	-	0.15	0.15	0.15	0.15	-	-	-	-	-	-	-	-	-	0.17	<0.15	0.37	0.28	<0.15	<0.15	0.24	0.17	0.29	0.26	<0.15	<0.15	0.18	0.27	<0.15	-	-	-	-	
Chlorophyll-a	mg/m3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pheophytin-a	mg/m3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total Metals and Non-Metals																																				
Aluminum	mg/L	0.004	0.005	0.01	0.01	0.005	0.005	0.005	0.005	0.005 - 0.100 <sup>7</sup>	0.005	<0.004	<0.004	0.006	0.005	<0.005	<0.005	0.019	0.025	0.011	<0.010	0.096	0.042	0.024	0.02	0.0527	0.065	0.0092	0.0121	0.0239	0.011	<0.0050	0.0067	0.0113	0.0224	0.0225
Antimony	mg/L	0.0004	-	-	0.0001	0.0001	0.0001	0.0001	0.0001	<0.0004	<0.0004	<0.0004	-	-	-	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic	mg/L	0.005	0.001	0.001	0.0001	0.0001	0.0001	0.0001	0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium	mg/L	0.001	0.01	-	0.0002	0.0002	0.0001	0.0001	-	0.001	0.006	0.007	<0.01	<0.01	-	-	-	0.0055	0.0052	0.0119	0.0118	0.0066	0.0052	0.0119	0.0118	0.0066	0.0074	0.00574	0.00561	0.0101	0.0104	<0.0010	0.0064	0.00648	0.0123	0.0125
Beryllium	mg/L	0.005	-	-	0.0001	0.0001	0.0001	0.0001	-	<0.005	<0.005	<0.005																								











**TABLE 3. LIST OF HADD SITES FROM THE AUGUST 2007 FISHERIES ACT AUTHORIZATION, STREAM CROSSINGS COVERED BY LETTERS OF ADVICE (LOA), AND COMPENSATION SITES (COMP) FOR THE MILNE INLET TOTE ROAD SURVEYED IN SPRING 2019**

Location ID <sup>1</sup>	Authorization Type	UTM <sup>2</sup>		2019 Survey Date	Fish Habitat at Crossing (Y/N)	Comments
		Easting	Northing			
CV-176	COMP	503587	7975136	28-Jun	N	This site is now part of the access road to the Milne Port Quarry; Tote Road was moved farther west
CV-170	COMP	505015	7972930	28-Jun	N	
CV-167	LOA	505538	7972370	28-Jun	N	No longer a culvert at this location; water diverted to CV-166
CV-166	COMP	505538	7972370	28-Jun	N	
CV-159	COMP	506920	7970839	28-Jun	N	
CV-157	COMP	507367	7970512	28-Jun	N	
CV-156	COMP	507531	7970286	28-Jun	N	
CV-154	COMP	507629	7970074	28-Jun	N	
CV-153	LOA	508173	7969723	28-Jun	N	
CV-152	COMP	508231	7969686	28-Jun	N	
CV-151	LOA	508295	7969583	28-Jun	N	
CV-129	HADD	512381	7966783	28-Jun	Y	
CV-128	HADD	513556	7965889	28-Jun	Y	
CV-125	LOA	515296	7963851	28-Jun	N	
CV-120	LOA	517355	7961693	28-Jun	N	
CV-119	LOA	517762	7961153	28-Jun	N	
CV-115	LOA	519222	7958135	28-Jun	Y	
CV-114	HADD	520278	7956528	28-Jun	Y	
CV-113	COMP	520747	7955659	29-Jun	N	
CV-112	LOA	521033	7954935	29-Jun	Y	
CV-111	HADD	521355	7954524	29-Jun	Y	
CV-202	LOA	521603	7953731	29-Jun	N	
CV-106	LOA	521663	7953392	29-Jun	Y	
CV-104	HADD	521732	7952788	29-Jun	Y	
CV-203	LOA	521741	7952440	29-Jun	N	
CV-102	LOA	521934	7950591	29-Jun	Y	
CV-099	HADD	521886	7948843	29-Jun	Y	
CV-094	HADD	522805	7945397	29-Jun	N	
CV-086	LOA	523746	7940983	29-Jun	N	

Location ID <sup>1</sup>	Authorization Type	UTM <sup>2</sup>		2019 Survey Date	Fish Habitat at Crossing (Y/N)	Comments
		Easting	Northing			
CV-082	LOA	525254	7938131	29-Jun	N	
CV-079	HADD	525538	7937314	29-Jun	Y	
CV-078	HADD	525852	7936787	29-Jun	Y	
CV-076	LOA	526586	7935498	29-Jun	Y	
CV-072	HADD	526897	7934576	29-Jun	Y	
CV-060	HADD	527622	7930342	30-Jun	Y	
CV-059	LOA	528094	7929347	30-Jun	Y	
CV-058	LOA	528322	7928839	30-Jun	Y	
CV-057	LOA	528379	7928657	30-Jun	Y	
BG-50	HADD	529294	7926852	30-Jun	Y	
CV-049	HADD	529654	7926545	30-Jun	Y	
CV-048	HADD	530415	7925875	30-Jun	N	
CV-046	LOA	531686	7924265	30-Jun	N	
CV-040	HADD	535168	7920326	30-Jun	N	
CV-030	LOA	540123	7921310	30-Jun	Y	
BG-32	HADD	540729	7921597	30-Jun	Y	
CV-217	HADD	542321	7922189	30-Jun	Y	
CV-216	HADD	542764	7921724	30-Jun	Y	
BG-30	COMP	546070	7919844	01-Jul	Y	
BG-29	LOA	546229	7919877	01-Jul	Y	
BG-27	LOA	547876	7919355	01-Jul	Y	
BG-24	HADD	548766	7918878	01-Jul	Y	
BG-17	HADD	550703	7917643	01-Jul	Y	
BG-04	HADD	553250	7915100	01-Jul	Y	
CV-001	COMP	553544	7914897	01-Jul	Y	
CV-223	HADD	555705	7914676	01-Jul	Y	
CV-224	HADD	556238	7915044	01-Jul	Y	
CV-225	HADD	557421	7915187	01-Jul	Y	
BG-01	HADD	558000	7914928	01-Jul	Y	
CV-186	LOA	560705	7913498	01-Jul	Y	
CV-187	COMP	560957	7913414	01-Jul	Y	

1 - Two sites originally identified as potential compensation at the onset of the program (CV-183 and CV-181) no longer exist. One additional site (BG-16) originally identified as a compensation site was subsequently dropped as it had been incorrectly identified as fish habitat.

2 - NAD 83, Zone 17W



**TABLE 4. ARCTIC CHAR CATCH DATA FROM FISH-BEARING STREAM CROSSINGS ALONG THE TOTE ROAD, SPRING 2019**

Location ID	Transect <sup>1</sup>	Electrofishing Duration (s)	Total Catch <sup>2</sup>	CPUE <sup>3</sup>	Fork Length (mm) <sup>4</sup>				
					n	Mean	SD	Min	Max
CV-129	DS	150	14	5.60	2	229.0	8.49	223	235
	US	151	3	1.19	1	165.0	-	-	-
	Total	301	17	3.39	3	207.7	37.43	165	235
CV-114	DS	162	5	1.85	2	97.0	1.41	96	98
	US	181	2	0.66	2	81.0	1.41	80	82
	Total	343	7	1.22	4	89.0	9.31	80	98
CV-112	DS	310	14	2.71	4	56.5	6.45	50	63
	US	267	5	1.12	5	64.6	10.24	56	80
	Total	577	19	1.98	9	61.0	9.29	50	80
CV-111	DS	260	21	4.85	18	56.3	17.43	42	109
	US	261	0	0.00	0	-	-	-	-
	Total	521	21	2.42	18	56.3	17.43	42	109
CV-106	DS	72	1	0.83	1	85.0	-	-	-
	US	153	0	0.00	0	-	-	-	-
	Total	225	1	0.27	1	85.0	-	-	-
CV-104	DS	361	14	2.33	14	60.9	15.06	40	93
	US	287	0	0.00	0	-	-	-	-
	Total	648	14	1.30	14	60.9	15.06	40	93
CV-099	DS	350	8	1.37	8	101.8	36.07	65	160
	US	321	11	2.06	1	95.0	-	-	-
	Total	671	19	1.70	9	101.0	33.81	65	160
CV-079	DS	459	28	3.66	15	80.2	17.92	53	112
	US	324	26	4.81	16	112.4	24.49	70	145
	Total	783	54	4.14	31	96.8	26.80	53	145
CV-078	DS	373	32	5.15	6	109.8	18.15	88	135
	US	477	15	1.89	5	126.0	65.47	78	240
	Total	850	47	3.32	11	117.2	44.16	78	240
CV-076	DS	291	16	3.30	9	66.0	15.46	44	91
	US	293	15	3.07	13	71.3	20.89	38	105
	Total	584	31	3.18	22	69.1	18.64	38	105
CV-072	DS	261	17	3.91	12	58.0	10.18	42	75
	US	313	9	1.73	9	91.1	14.04	74	121
	Total	574	26	2.72	21	72.2	20.44	42	121
CV-060	DS	136	24	10.59	2	65.5	24.75	48	83
	US	418	35	5.02	4	107.8	29.27	81	140

Location ID	Transect <sup>1</sup>	Electrofishing Duration (s)	Total Catch <sup>2</sup>	CPUE <sup>3</sup>	Fork Length (mm) <sup>4</sup>				
					n	Mean	SD	Min	Max
	Total	554	59	6.39	6	93.7	33.36	48	140
CV-059	DS	168	22	7.86	4	68.3	8.54	61	80
	US	190	31	9.79	8	92.5	35.60	59	162
	Total	358	53	8.88	12	84.4	31.13	59	162
CV-058	DS	287	11	2.30	2	81.5	4.95	78	85
	US	285	26	5.47	10	77.3	11.32	60	92
	Total	572	37	3.88	12	78.0	10.48	60	92
CV-057	DS	250	4	0.96	4	102.8	22.35	83	130
	US	407	22	3.24	10	80.5	30.26	58	149
	Total	657	26	2.37	14	86.9	29.29	58	149
BG-50	DS	269	6	1.34	0	-	-	-	-
	US	420	2	0.29	2	95.0	35.36	70	120
	Total	689	8	0.70	2	95.0	35.36	70	120
CV-049	DS	280	14	3.00	14	117.6	9.85	102	135
	US	535	6	0.67	6	154.7	33.45	123	211
	Total	815	20	1.47	20	128.7	25.79	102	211
CV-030	DS	112	1	0.54	1	100.0	-	-	-
	US	330	2	0.36	2	103.5	19.09	90	117
	Total	442	3	0.41	3	102.3	13.65	90	117
BG-32	DS	112	9	4.82	1	280.0	-	-	-
	US	338	23	4.08	3	213.0	16.70	198	231
	Total	450	32	4.27	4	229.8	36.17	198	280
CV-216	DS	210	2	0.57	2	85.0	36.77	59	111
	US	63	0	0.00	0	-	-	-	-
	Total	273	2	0.44	2	85.0	36.77	59	111
BG-30	DS	165	17	6.18	5	68.0	11.47	58	87
	US <sup>5</sup>	173	0	0.00	0	-	-	-	-
	Total	338	17	3.02	5	68.0	11.47	58	87
BG-29	DS	223	37	9.96	7	95.1	26.63	55	125
	US	68	5	4.41	2	105.5	27.58	86	125
	Total	291	42	8.66	9	97.4	25.45	55	125
BG-27	DS	251	44	10.52	44	67.8	22.66	38	170
	US	256	12	2.81	12	111.9	26.86	60	146
	Total	507	56	6.63	56	77.2	29.66	38	170
BG-24	DS	515	65	7.57	65	75.4	26.95	45	170
	US	186	11	3.55	11	122.4	33.22	83	165
	Total	701	76	6.50	76	82.2	32.31	45	170

Location ID	Transect <sup>1</sup>	Electrofishing Duration (s)	Total Catch <sup>2</sup>	CPUE <sup>3</sup>	Fork Length (mm) <sup>4</sup>				
					n	Mean	SD	Min	Max
BG-17	DS	260	25	5.77	10	86.9	34.85	62	168
	US	128	7	3.28	2	179.0	100.41	108	250
	Total	388	32	4.95	12	102.3	56.53	62	250
BG-04	DS	217	29	8.02	6	123.3	69.76	60	251
	US	252	6	1.43	6	110.7	19.27	90	141
	Total	469	35	4.48	12	117.0	49.24	60	251
CV-001	DS	105	0	0.00	0	-	-	-	-
	US	97	0	0.00	0	-	-	-	-
	Total	202	0	0.00	0	-	-	-	-
CV-224	DS	319	28	5.27	20	62.9	20.92	34	102
	US	147	14	5.71	9	90.6	20.94	50	120
	Total	466	42	5.41	29	71.4	24.34	34	120
CV-225	DS	240	26	6.50	16	89.3	27.06	54	163
	US	222	12	3.24	5	117.4	30.44	90	163
	Total	462	38	4.94	21	96.0	29.75	54	163
BG-01	DS	486	41	5.06	26	105.9	36.28	61	175
	US	200	47	14.10	7	119.6	15.95	98	147
	Total	686	88	7.70	33	108.8	33.29	61	175
CV-186	DS	213	36	10.14	11	59.6	10.02	44	76
	US	192	6	1.88	0	-	-	-	-
	Total	405	42	6.22	11	59.6	10.02	44	76
CV-187 <sup>6</sup>	DS	Not Fished	-	-	-	-	-	-	-
	US	Not Fished	-	-	-	-	-	-	-
	Total	Not Fished	-	-	-	-	-	-	-

1 - DS = 50-m transect downstream of the Tote Road crossing; US = 50-m transect upstream of the Tote Road crossing

2 - Includes fish that were shocked, but not netted before they escaped

3 - CPUE = Catch-per-unit-effort (# fish/minute)

4 - n = number of fish measured for fork length (may not equal total catch); SD = standard deviation

5 - Fish observed US in BG-30, but could not be captured or accurately counted in large deep pool habitat

6 - Site was not fished but it is a second crossing of the CV-186 stream and several juvenile Arctic Char were observed US and DS of the culvert at CV-187 in spring and fall 2019

**TABLE 5. NINESPINE STICKLEBACK CATCH DATA FROM FISH-BEARING STREAM CROSSINGS ALONG THE TOTE ROAD, SPRING 2019**

Location ID	Transect <sup>1</sup>	Electrofishing Duration (s)	Total Catch <sup>2</sup>	CPUE <sup>3</sup>	Fork Length (mm) <sup>4</sup>				
					n	Mean	SD	Min	Max
CV-030	DS	112	22	11.79	2	54.0	12.73	45	63
	US	330	5	0.91	0	-	-	-	-
	Total	442	27	3.67	2	54.0	12.73	45	63
BG-32	DS	112	6	3.21	1	100.0	-	100	100
	US	338	0	0.00	2	103.5	19.09	90	117
	Total	450	6	0.80	3	102.3	13.65	90	117
CV-216	DS	210	3	0.86	3	38.0	4.36	33	41
	US	63	5	4.76	1	68.0	-	68	68
	Total	273	8	1.76	4	45.5	15.42	33	68
BG-29	DS	223	1	0.27	1	59.0	-	59	59
	US	68	0	0.00	0	-	-	-	-
	Total	291	1	0.21	0	59.0	-	59	59
BG-04	DS	217	1	0.28	1	59.0	-	59	59
	US	252	1	0.24	1	55.0	-	55	55
	Total	469	2	0.26	2	57.0	2.83	55	59
CV-224	DS	319	1	0.19	1	45.0	-	45	45
	US	147	0	0.00	0	-	-	-	-
	Total	466	1	0.13	1	45.0	-	45	45
BG-01	DS	486	1	0.12	1	43.0	-	43	43
	US	200	0	0.00	0	-	-	-	-
	Total	686	1	0.09	1	43.0	-	43	43

1 - DS = 50-m transect downstream of the Tote Road crossing; US = 50-m transect upstream of the Tote Road crossing

2 - Includes fish that were shocked, but not netted before they escaped

3 - CPUE = Catch-per-unit-effort (# fish/minute)

4 - n = number of fish measured for fork length (may not equal total catch); SD = standard deviation

**TABLE 6. SUMMARY OF FISH HABITAT STATUS, FISH PASSAGE, AND REMEDIATION WORK ALONG THE TOTE ROAD IN 2019**

Location ID	Fish Habitat at Crossing (Y/N)	Fish Captured / Observed DS in 2019	Fish Captured / Observed US in 2019	Potential Project-Related Fish Passage or Habitat Issues	Fall 2019 Remediation Actions
CV-176	N	N	N	NONE - No natural access to crossing	N/A
CV-170	N	N	N	NONE - No natural access to crossing	N/A
CV-167	N	N	N	NONE - No natural access to crossing	N/A
CV-166	N	N	N	NONE - No natural access to crossing	N/A
CV-159	N	N	N	NONE - No natural access to crossing	N/A
CV-157	N	N	N	NONE - No natural access to crossing	N/A
CV-156	N	N	N	NONE - No natural access to crossing	N/A
CV-154	N	N	N	NONE - No natural access to crossing	N/A
CV-153	N	N	N	NONE - No natural access to crossing	N/A
CV-152	N	N	N	NONE - No natural access to crossing	N/A
CV-151	N	N	N	NONE - No natural access to crossing	N/A
CV-129	Y	Y	Y	YES - Culvert was slightly perched (0.03 m) and CPUE was higher downstream. Fish may access crossing from potential upstream overwintering lake, but access from Phillips Creek may be an issue for smaller fish.	Installed large rocks around the downstream end of the culvert and filled spaces with small cobble to remove perch and create a more natural approach to the culvert.
CV-128	Y	Y	Y	NONE	N/A
CV-125	N	N	N	NONE - No natural access to crossing	N/A
CV-120	N	N	N	NONE - No natural access to crossing	N/A
CV-119	N	N	N	NONE - No natural access to crossing	N/A
CV-115	Y	N	N	NONE - Stream dry in 2019	N/A
CV-114	Y	Y	Y	YES - Both culverts were perched and CPUE was higher DS.	Created small pool by placing rocks downstream of the culvert to improve access. A slight perch remained after remediation and additional rocks may need to be placed to improve backwater effect.
CV-113	N	N	N	NONE - Always dry	N/A
CV-112	Y	Y	Y	NONE	N/A

Location ID	Fish Habitat at Crossing (Y/N)	Fish Captured / Observed DS in 2019	Fish Captured / Observed US in 2019	Potential Project-Related Fish Passage or Habitat Issues	Fall 2019 Remediation Actions
CV-111	Y	Y	N	YES - Culvert recently reinstalled with a 0.25 m perch and no fish captured upstream.	Gravel was added to the pool at the downstream end of the culvert to provide a solid surface for the construction of a rocky ramp out of cobble and boulders. However, this remediation action was insufficient to eliminate the perch. The height of the drop from the culvert may be too great for a ramp or creation of backwater to be effective at this site. May require reinstallation of culvert.
CV-202	N	N	N	NONE - No natural access to crossing	N/A
CV-106	Y	Y	N	YES - Ramp installed in 2018 to mitigate a slight perch was not designed to maintain surface flows during periods of low water, resulting in intermittent access to the culvert.	Moved rock off surface of ramp downstream of the culvert to eliminate sub-surface flow. Created small pools as steps up to culvert. As the stream was dry at the time of remediation, effectiveness of the remediation actions could not yet be assessed. Will require assessment during spring 2020.
CV-104	Y	Y	N	NONE - Fish observed swimming up the culvert. Despite a lack of fish captured upstream, there are no obvious restrictions to movement.	N/A
CV-203	N	N	N	NONE - Always dry	N/A
CV-102	Y	N	N	NONE - Stream dry in 2019 following weak freshet, but no culvert issues.	N/A
CV-099	Y	Y	Y	NONE	N/A
CV-094	N	N	N	NONE - No natural access to crossing	N/A
CV-086	N	N	N	NONE - Always dry	N/A
CV-082	N	N	N	NONE - No natural access to crossing	N/A
CV-079	Y	Y	Y	NONE	N/A
CV-078	Y	Y	Y	NONE	N/A
CV-076	Y	Y	Y	NONE	N/A
CV-072	Y	Y	Y	NONE	N/A
CV-060	Y	Y	Y	NONE	N/A
CV-059	Y	Y	Y	NONE	N/A

Location ID	Fish Habitat at Crossing (Y/N)	Fish Captured / Observed DS in 2019	Fish Captured / Observed US in 2019	Potential Project-Related Fish Passage or Habitat Issues	Fall 2019 Remediation Actions
CV-058	Y	Y	Y	NONE	N/A
CV-057	Y	Y	Y	NONE	N/A
BG-50	Y	Y	Y	YES - Left channel has good upstream access at bridge crossing, but right channel culverts with consistently high perches prevent all upstream movements.	Constructed step-pool ramp for both culverts. Efforts appeared to be successful at the left culvert, but there was insufficient flow through the right culvert to properly assess effectiveness of the constructed ramp at the time of the program. To be reassessed in spring 2020.
CV-049	Y	Y	Y	NONE	N/A
CV-048	N	N	N	NONE - No natural access to crossing	N/A
CV-046	N	N	N	NONE - No natural access to crossing	N/A
CV-040	N	N	N	NONE - No natural access to crossing	N/A
CV-030	Y	Y	Y	NONE	N/A
BG-32	Y	Y	Y	NONE	N/A
CV-217	Y	Y	Y	NONE	N/A
CV-216	Y	Y	Y	YES - A small perch of the culvert may prevent upstream access by young-of-the-year Arctic Char that typically use this stream during summer.	Built up a deeper pool with channel leading out of it (~30 cm across) to create backwater area up to the culvert. Armoured bottom with large, flat rocks (depth ~40 cm) to prevent additional scouring. Placed rocks under culvert to fill open space. Backwatering was successful and access to the culvert was improved.
BG-30	Y	Y	Y	NONE	N/A
BG-29	Y	Y	Y	YES - Rocky berm installed upstream of culvert partially blocking movements between stream and overwintering lake.	Berm at upstream end of culvert was removed.
BG-27	Y	Y	Y	NONE	N/A
BG-24	Y	Y	Y	NONE	N/A
BG-17	Y	Y	Y	NONE	N/A
BG-04	Y	Y	Y	NONE	N/A
CV-001	Y	Y	Y	NONE	N/A

Location ID	Fish Habitat at Crossing (Y/N)	Fish Captured / Observed DS in 2019	Fish Captured / Observed US in 2019	Potential Project-Related Fish Passage or Habitat Issues	Fall 2019 Remediation Actions
CV-223	Y	Y	Y	NONE	N/A
CV-224	Y	Y	Y	NONE	N/A
CV-225	Y	Y	Y	YES - Culverts are moderately perched and have high velocity flows, which may limit passage of smaller juveniles.	None. Pool was too deep to safely wade. Large amount of material will be required to fill scour pool and build up a backwater area. Sides of existing pool will also require addition of material. Requires further assessment and remedial action.
BG-01	Y	Y	Y	YES - Rip rap US of culvert blocking access to a small tributary of this stream.	Rip rap blockage removed.
CV-186	Y	Y	N	NONE - Despite lack of fish captured upstream in 2019, there are no accessibility issues.	N/A
CV-187	Y	Y	Y	NONE	N/A



**TABLE 7. INSTALLATION SUMMARY OF REMAINING HADD AND HABITAT COMPENSATION SITES ALONG THE TOTE ROAD**

Location ID	UTM <sup>1</sup>		Crossing Size Classification	Authorization (HADD or Compensation) <sup>2</sup>	Initial Work Completion Date <sup>3</sup>	Additional Work Completion Date <sup>4</sup>	Years Monitored	Additional Monitoring Required
	Easting	Northing						
CV-183 <sup>5</sup>	-	-	Extra-large	Compensation - RH	Oct-08	N/A	2009-2010	None
CV-181 <sup>5</sup>	-	-	Medium	Compensation - RH	24-Jul-09	N/A	2008-2010	None
CV-129	512381	7966783	Large	HADD	17-Sep-07	July 2011 Winter 2014/15 September 2019	2008-2019	Monitor new rocky ramp for successful passage
CV-128	513556	7965889	Extra-large	HADD	23-Sep-07	Winter 2013/14 March 2017	2009-2019	Routine Only
CV-114	520278	7956528	Medium	HADD	29-Sep-07	July 2011 September 2019	2009-2019	Monitor upgraded rocky ramp for successful passage
CV-111	521355	7954524	Medium	HADD	28-Sep-07	Winter 2018/19 September 2019	2009-2019	Monitor new rocky ramp for successful passage and potential need for further remediation
CV-104	521732	7952788	Medium	HADD	01-Oct-07	November 2016	2009-2019	Routine Only
CV-099	521886	7948843	Large	HADD	04-Oct-07	Winter 2014/15 December 2017	2008-2019	Routine Only
CV-079	525538	7937314	Large	HADD	08-Jul-08	June 2018	2008-2019	Routine Only
CV-078	525852	7936787	Large	HADD	09-Jul-08	N/A	2008-2019	Routine Only
CV-072	526897	7934576	Large	HADD	05-Mar-08	N/A	2009-2019	Routine Only
CV-060	527622	7930342	Medium	HADD	27-Feb-08	N/A	2009-2019	Routine Only
BG-50	529294	7926852	Extra-large	HADD	30-Oct-07	Winter 2013/14 Winter 2014/15 November 2016 September 2019	2008-2019	Monitor two new rocky ramps for successful passage
CV-049	529654	7926545	Large	HADD	10-Mar-08	N/A	2009-2019	Routine Only
BG-32	540729	7921597	Large	HADD	04-Apr-08	August 2012 September 2017	2009-2019	Routine Only
CV-217	542321	7922189	Extra-large	HADD	17-Apr-08	Winter 2013/14 Winter 2014/15 March 2017	2009-2019	Routine Only

Location ID	UTM <sup>1</sup>		Crossing Size Classification	Authorization (HADD or Compensation) <sup>2</sup>	Initial Work Completion Date <sup>3</sup>	Additional Work Completion Date <sup>4</sup>	Years Monitored	Additional Monitoring Required
	Easting	Northing						
CV-216	542764	7921724	Large	HADD	08-Jun-08	October 2017 September 2019	2009-2019	Monitor backwatering structure for effectiveness and fish passage
BG-30	546070	7919844	Small	Compensation - RA	2012	August 2012	2010-2019	Routine monitoring and maintenance of constructed fishway
BG-24	548766	7918878	Medium	HADD	15-May-08	N/A	2008-2019	Routine Only
BG-17	550703	7917643	Large	HADD	09-May-08	N/A	2009-2019	Routine Only
BG-16 <sup>5</sup>	-	-	Extra-small	Compensation - HE	Oct-08	N/A	2009-2010	None
BG-04	553250	7915100	Medium	HADD	05-May-08	August 2012 February 2018 June 2018	2009-2019	Routine Only
CV-001	553544	7914897	Small	Compensation - RH	08-May-08	Winter 2014/15	2009-2019	Routine Only
CV-223	555705	7914676	Extra-large	HADD	03-May-08	Winter 2013/14	2008-2019	Routine Only
CV-224	556238	7915044	Medium	HADD	04-May-08	January 2018	2008-2019	Routine Only
CV-225	557421	7915187	Large	HADD	21-Sep-07	August 2010 Winter 2014/15	2008-2019	Monitoring for passage upstream of perched culvert and prepare and implement remediation works
BG-01	558000	7914928	Medium	HADD	20-Sep-07	August 2010 October 2017 September 2019	2008-2019	Monitoring for passage in high culvert water velocity and monitor for instream deposition of road aggregate
CV-187	560957	7913414	Small	Compensation - RH	14-Jun-08	N/A	2008-2019	Routine Only

1 - NAD 83, Zone 17W

2 - Includes only current HADD and compensation sites and not those eliminated from calculations following 2010 surveys; HE = habitat enhancement, RA = restored access, RH = restored habitat

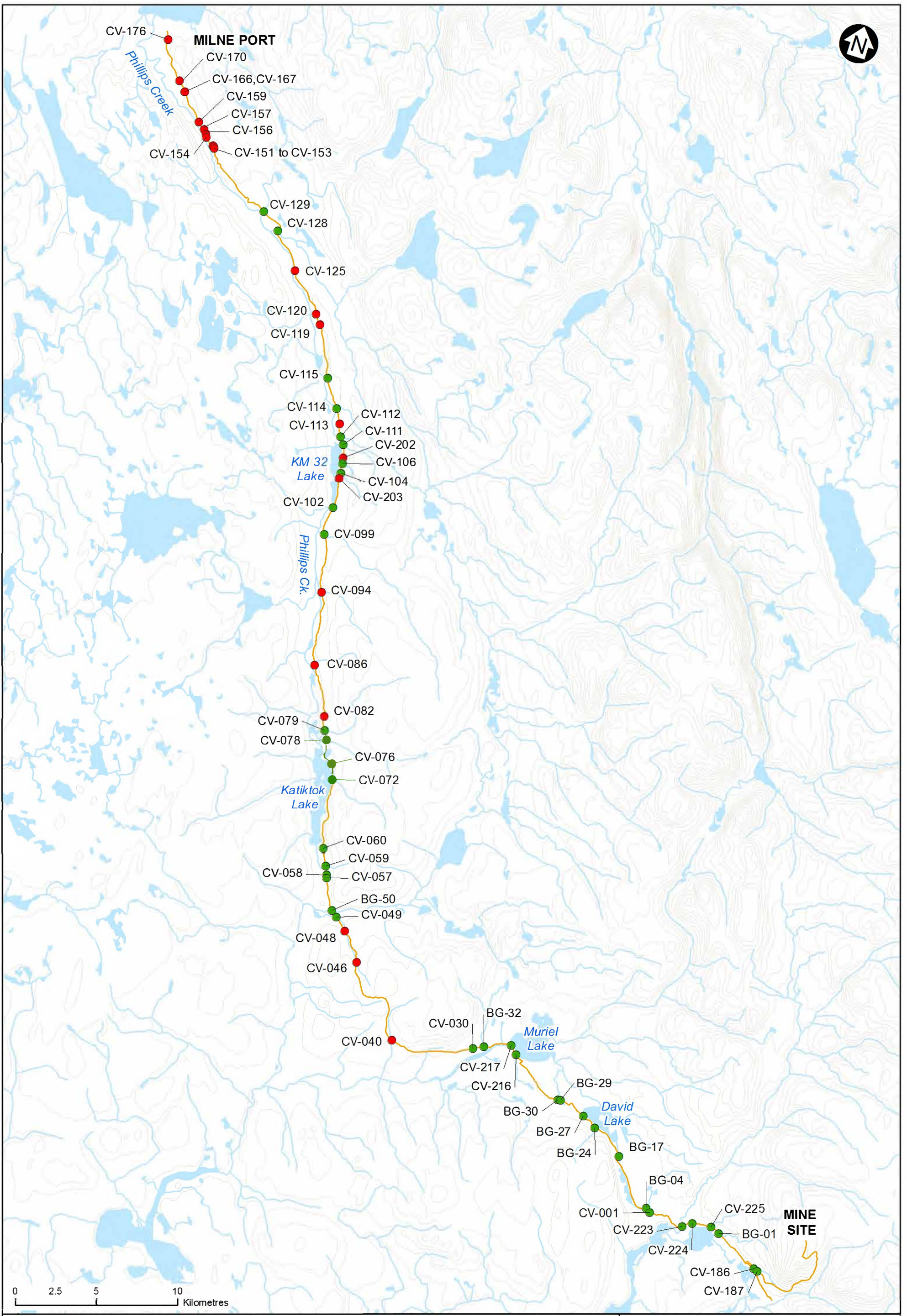
3 - Includes work outlined during the initial planning and construction phase

4 - Includes repair work, installation of fish access improvement structures, and ERP upgrades

5 - Two sites originally identified as potential compensation at the onset of the program (CV-183 and CV-181) no longer exist. One additional site (BG-16) originally identified as a compensation site was subsequently dropped as it had been incorrectly identified as fish habitat.



Document Path: W:\PROJETS\BIM - Baffinland Iron Mine\BIM - Tote Road Monitoring - short\_2019 - MCGIS\Mxd\Report\_Maps\2019\ToteRdSites\_Overview\_cp.mxd



<p><b>ARCTIC CHAR HABITAT</b></p> <p>● YES</p> <p>● NO</p> <p>— TOTE ROAD</p>	<p><b>NOTES:</b></p> <p>1. BASE DATA SOURCE: CANVEC 1:250 000</p> <p>2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.</p>	<p>BAFFINLAND IRON MINES CORPORATION</p> <p>MARY RIVER PROJECT</p> <p><b>TOTE ROAD 2019 LOCATIONS OVERVIEW</b></p>
		<p>North/South Consultants Inc. DATE CREATED: 12/11/2019</p> <p>Aquatic Environment Specialists</p>

**FIGURE 1. MAP OF TOTE ROAD SITES SURVEYED DURING SPRING 2019 FISH AND FISH HABITAT ASSESSMENT SURVEYS**



**APPENDIX A**  
**DFO AUTHORIZATIONS AND AMMENDMENTS**



301-5204 50<sup>th</sup> Avenue  
Yellowknife, NT  
X1A 1E2

September 20, 2013

*our file*      *Voire référence*

*Our file*      *Noire référence*  
07-HCAA-CA7-00050

Oliver Curran  
Baffinland Iron Mines Corporation  
2275 Upper Middle Road East, Suite 300  
Oakville, ON  
L6H 0C3

Dear Mr. Curran:

**Subject:** Proposal not likely to result in impacts to fish and fish habitat.

Fisheries and Oceans Canada – Fisheries Protection Program (DFO) received your proposal on August 29, 2013. Please refer to the file number and title below:

DFO File No.: **07-HCAA-CA7-00050**  
Title:            **Mary River Iron Ore Project, Baffin Island (Baffinland), Nunavut**

You may be aware of changes to the *Fisheries Act*, however these have not affected the review of your project at this time. For more information on current changes to the *Fisheries Act* please refer to the DFO website at [www.dfo-mpo.gc.ca/media/infocus-alaune/2012/habitat-en.g.htm](http://www.dfo-mpo.gc.ca/media/infocus-alaune/2012/habitat-en.g.htm).

Your proposal has been reviewed to determine whether it is likely to result in impacts to fish and fish habitat which are prohibited by the habitat protection provisions of the *Fisheries Act* or those prohibitions of the *Species at Risk Act* that apply to aquatic species.\*

Our review consisted of:

Changes to Culverts along the Tote Road, Submission dated August 29, 2013 from Oliver Curran - Baffinland Iron Mines Corporation

Freshwater Aquatic Baseline Synthesis Report 2005-2011 (January 2012), Baffinland Iron Mines Corporation, Mary River Project, Prepared by North/South Consultants Inc.

\*Those sections most relevant to the review of development proposals include 20, 22, 32 and 35 of the *Fisheries Act* and sections 32, 33 and 58 of the *Species at Risk Act*. For more information please visit [www.dfo-mpo.gc.ca](http://www.dfo-mpo.gc.ca).

We understand that you propose to carry out the following culvert upgrades along the Tote Road:

Culvert ID	Proposed Culvert Diameter (m)	Proposed Culvert Length (m)	Area of Rip Rap (m <sup>2</sup> )	Proposed Culvert Upgrade
BG31A	1.2	19.5	24.96	Extend 1m left & 2.5m right
BG30	1	22	17.33	Extend 7m right
BG29	1	31	0	Extend 7.5m left & 8.5m right
BG27B	0.5	31	4.33	Extend 5m left & 8m right
BG27C	0.5	31	0	Extend 5m left & 8m right
BG27A	0.5	31	0	Extend 4.5m left & 8.5m right
BG17A	1.2	36.5	24.96	Extend 8m left & 13.5m right
BG17B	1.2	37.5	24.96	Extend 15.5m left & 7m right
BG04A	1.2	24	0	Extend 5.5m left & 3.5m right
BG04B	1.2	24	0	Extend 5m left & 4m right
CV224A	1	26	0	Extend 6m left & 5m right
CV224B	1	26.5	0	Extend 6.5m left & 5m right
CV225B	1.2	18	0	Replace with new length of 18m
CV225A	1	18.5	17.33	Replace with new length of 18.5m
BG01C	1.2	37	24.96	Extend 11m left & 8m right
BG01A	1.2	36.5	24.96	Extend 11.5m left & 7m right
BG01B	1.2	37	24.96	Extend 12m left & 7m right
BG01D	0.5	10	0	New Culvert
BG01F	0.5	18	0	New Culvert
BG01E	1.0	10	0	New Culvert
BG01G	0.5	23	0	New Culvert
CV186	1	27	0	Extend 6m left
CV187A	0.5	20.5	0	Extend 6m left & 4.5m right
CV187B	0.5	16	0	New Culvert
CV166A	1	23.5	17.33	Extend 8.5m right
CV166B	0.5	22.5	0	Extent 7.5m right
CV115A	0.5	17.5	0	Extend 2.5m left
CV115B	1	17	0	Extend 2m left

Provided that your plans are implemented as described DFO has concluded that your proposal is not likely to result in impacts to fish and fish habitat.

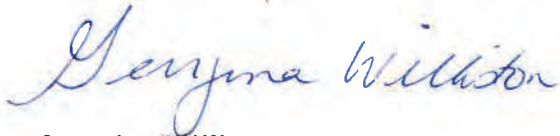
You will not need to obtain a formal approval from DFO in order to proceed with your proposal.

If the plans have changed or if the description of your proposal is incomplete you should contact this office to determine if the advice in this letter still applies.

Please be advised that any unauthorized impacts to fish and fish habitat which result from a failure to implement this proposal as described could lead to corrective action such as enforcement.

If you have any questions please contact the undersigned at (867) 669-4927 or by email at [Georgina.Williston@dfo-mpo.gc.ca](mailto:Georgina.Williston@dfo-mpo.gc.ca).

Yours sincerely,

A handwritten signature in blue ink that reads "Georgina Williston". The signature is written in a cursive style.

Georgina Williston  
Fisheries Protection Biologist

cc. Stuart Niven- Fisheries and Oceans Canada  
Jim Millard- Baffinland Iron Mines Corporation  
Bevin LeDrew- Sikumiut Environmental Management Ltd.



301-5204 50th Ave  
Yellowknife, NT  
X1A 1E2

*Our file*      *Notre référence*  
NU-07-0050

December 16, 2013

Baffinland Iron Mines Corp.  
275 Upper Middle Road East Suite 300  
Oakville, ON L6H 0C3

Dear Mr. Curran:

**Subject: Implementation of mitigation measures to avoid and mitigate serious harm to fish.**

The Fisheries Protection Program (the Program) of Fisheries and Oceans Canada received your proposal on August 28, 2013.

Your proposal has been reviewed to determine whether it is likely to result in serious harm to fish which is prohibited under subsection 35(1) of the *Fisheries Act*.

Our review consisted of:

Baffinland Submission: Tote Road Upgrade-Four Seacan Bridge Replacements, Tote Road Upgrade- Fish Bearing Culvert submission, Attachments 1 &2, August 2013.

We understand that you propose to: Upgrade the following crossings along the Tote Road.

The following seacan crossings will be removed and replaced with clear span bridges

- STA 17 (CV 128)
- STA 62 (BG50)
- STA 80 (CV 217)
- STA 97 (CV223)



The following culvert crossings will be upgraded as follows:

Culvert ID	Proposed Culvert Diameter (m)	Proposed Culvert Length (m)	Area of Rip Rap (m2)	Proposed works to be completed
CV217B	1.2	16	24.96	Extend 1m right
CV217C	1.2	16	24.96	Extend 1m right
CV217A	1.2	16	24.96	Extend 1m right
CV217D	0.15		0	Abandon
CV216B	1.2	17.5	0	Extend 1.5m left & 1m right
CV216C	1.2	16.5	0	Extend 1.5m left
CV216A	1.2	18.5	0	Extend 1.5m left & 2m right
CV216D	0.5	14.5	0	Replace with new length of 14.5m
CV216E	0.5	14	0	Abandon and replace with new length of 14m
CV216F	0.5	12	0	Replace with new length of 12m
CV223B	1.2	28	24.96	Extend 13m left
CV223C	1.2	28	24.96	Extend 13m left
CV223D	1.2	29	24.96	Extend 14m left
CV223A	2	24	69.33	Extend 14m left
CV223E	1.2	19.5	0	Extend 4.5m left
CV223F	1.2	19	0	Extend 4m left
CV115C	0.5	15.5	0	Extend 3.5m right
CV115D	0.5	17	4.33	Extend 8m left
CV114A	1	15.5	17.33	Extend 0.5m right
CV114B	0.5	14	0	Extend 5m left
CV114C	0.5	11	4.33	Replace with new length of 11m
CV114D	0.5	11.5	4.33	Extend 2m left & 0.5m right
CV112A	1.2	17.5	24.96	Extend 2.5m right
CV112B	0.5	24	0	Extend 9m right
CV112C	0.5	21	4.33	Extend 9m left
CV111	1	24	17.33	Extend 4.5m left & 1.5m right
CV106	1	19	17.33	Extend 4m left
CV104A	1.2	19	24.96	Extend 4m left
CV104B	1.2	19	24.96	Extend 4m left
CV102A	1	22.5	17.33	Extend 7.5m left
CV102B	0.5	21.5	0	Extend 6.5m left
CV102C	0.5	21.5	0	Extend 6.5m left
CV102D	0.5	20.5	0	Extend 5.5m left
CV099B	1.2	17	24.96	Replace with new length of 17m

Culvert ID	Proposed Culvert Diameter (m)	Proposed Culvert Length (m)	Area of rip rap (m <sup>2</sup> )	Proposed works to be completed
CV099A	1.2		0	Remove culvert
CV099C	2	18.5	69.33	Replace with new length of 18.5m
CV099D	0.5		0	Remove culvert
CV099E	0.5		0	Remove culvert
CV099F	0.5	14	0	Extend 2m right
CV087B	1.2	19	24.96	Extend 6.5m left & 0.5m right
CV087A	1.2	18.5	24.96	Extend 6m left & 0.5m right
CV087C	0.5	18	0	Extend 6m right
CV079B	1.2	16.5	0	Extend 1.5m left
CV079A	1.2	16.5	0	Extend 1.5m left
CV079C	0.15		0	Remove culvert
CV079D	0.15		0	Remove culvert
CV078A	1.2	16.5	0	Extend 1.5m left
CV078B	1	19.5	0	Extend 1.5m left
CV078C	1	19.5	0	Extend 1.5m left
CV078D	2	22	0	Extend 2m right
CV076	1	11.5	0	Replace with new length of 11.5m
CV072B	1.2	17.5	0	Replace with new length of 17.5m
CV072C	1.2	17.5	0	Replace with new length of 17.5m
CV072A	1.2	17.5	0	Replace with new length of 17.5m
CV060A	1	16.5	0	Extend 1.5m left
CV060B	1	16.5	0	Extend 1.5m left
CV059B	0.5	16.5	0	Extend 3.5m left & 1m right
CV059A	0.5	16	0	Extend 3m left & 1m right
CV059C	0.5	16.5	0	Extend 4m left & 0.5m right
CV059D	0.5	16.5	0	Extend 4m left & 0.5m right
CV057B	0.5	16.5	0	Extend 1.5m left
CV057C	0.5	16.5	0	Extend 1.5m left
CV057A	0.5	16.5	0	Extend 1.5m left
BG50A	1.2	33.5	24.96	Extend 15.5m left
BG50B	1.2	32	24.96	Extend 14m left
CV049A	1.2	24.5	24.96	Extend 5.5m left & 4m right
CV049B	1.2	24.5	24.96	Extend 4.5m left & 5m right
CV030A	1	16	0	Extend 1m left
CV030B	0.5	16	0	Extend 1m left

To avoid the potential of serious harm to fish and their habitat, we are recommending that the following mitigation measures be included into your plans.

- If in-stream work is required during the open water season it should be completed in the dry by de-watering the work area and diverting and/or pumping flows around cofferdams placed at the limits of the work area.
- Existing stream flows should be maintained downstream of the de-watered work area without interruption, during all stages of the work.
- A fish stranding program should be implemented if necessary by a qualified fisheries person, who is experienced in this area, immediately following isolation and prior to de-watering to ensure that fish are removed from any dewatered area and released alive immediately downstream of the work area.
- Flow dissipaters and/or filter bags, or equivalent, should be placed at water discharge points to prevent erosion and sediment release.
- Silt or debris that has accumulated around the temporary cofferdams should be removed prior to their withdrawal.

Provided that these mitigation measures are incorporated into your plans, the Program is of the view that your proposal will not result in serious harm to fish. No formal approval is required from the Program under the *Fisheries Act* in order to proceed with your proposal.

If your plans have changed or if the description of your proposal is incomplete, or changes in the future, you should consult our website (<http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html>) or consult with a qualified environmental consultant to determine if further review is required by the Program.

Please notify this office at least 10 days before starting your project. A copy of this letter should be kept on site while the work is in progress.

If you have any questions, please contact Georgina Williston at our Yellowknife office at 867-669-4927, by fax at 867-669-4940 or by email at [geogina.williston@dfo-mpo.gc.ca](mailto:geogina.williston@dfo-mpo.gc.ca). Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,



Stu Niven  
Senior Fisheries Protection Biologist  
Fisheries and Oceans Canada

Georgina Williston- Fisheries and Oceans Canada  
Bevin LeDrew- Sikumiut Environmental Management Ltd.  
Tessa Mackay- Hatch



Suite 301 – 5204 59<sup>th</sup> Ave.  
Yellowknife NT, X1A 1E2

*Our file Notre référence*  
NU-07-0050

February 20, 2015

James Millard  
Environmental Manager  
Baffinland Iron Mines Corp.  
275 Upper Middle Road East Suite 300  
Oakville, ON L6H 0C3

Dear Mr. Millard:

**Subject: Implementation of mitigation measures to avoid and mitigate serious harm to fish – Mary River Project, Tote Road Realignment.**

The Fisheries Protection Program of Fisheries and Oceans Canada received your proposal on February 15, 2015.

Your proposal has been reviewed to determine whether it is likely to result in serious harm to fish which is prohibited under subsection 35(1) of the *Fisheries Act*.

Your proposal has also been reviewed to determine whether it will adversely impact listed aquatic species at risk and contravene sections 32, 33 or 58 of the *Species at Risk Act (SARA)*.

Our review considered the following:

- Letter from Baffinland Iron Mines Re: Mary River Project – Request for Advice on Realignment of Tote Road at Culvert CV076, Km 53 Tote Road, DFO File dated February 15, 2015 and submitted by James Millard with 1 attachment.
- Attachment 1 - Mark-up of proposed field change, Drawing H349000-3000-10-012-0073

We understand that you propose to:

- Realign the existing Tote Road at Culvert CV076, 160 meters upstream from the existing crossing and install one culvert which is 1.2m in diameter and 18 m in length.
- Install culverts during the winter months when the stream is frozen to bottom.
- Remove existing culvert from the old Tote Road alignment.

Since there are no *SARA* species or their habitats identified in the project area, no additional approvals under *SARA* will be required for your proposed activities.

To avoid the potential for serious harm to fish that is prohibited under the *Fisheries Act*, the mitigation measures set out in your project plans are to be followed.

Provided that you implement the required mitigation measures for your project, and follow the guidance available on the DFO website at <http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/index-eng.html>, the Program is of the view that your proposal should not result in serious harm to fish or contravene sections 32, 33 or 58 of the *Species at Risk Act*. No formal approval is required from the Program under the *Fisheries Act* or the *Species at Risk Act* in order to proceed with your proposal.

It remains your responsibility to ensure you avoid causing serious harm to fish in compliance with the *Fisheries Act*, and that you meet the requirements under the *Species at Risk Act* as it may apply to your project. If your plans have changed or if the description of your proposal is incomplete, or changes in the future, you should consult our website (<http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html>) or consult with a qualified environmental consultant to determine if further review is required by the Program.

Please be advised that it is also your *Duty to Notify* DFO if you have caused, or are about to cause, serious harm to fish that are part of or support a commercial, recreational or Aboriginal fishery. Such notifications should be directed to <http://www.dfo-mpo.gc.ca/pnw-ppe/violation-infraction/index-eng.html>.

A copy of this letter should be kept on site while the work is in progress. It remains your responsibility to meet all other federal or territorial requirements that apply to your project.

If you have any questions, please contact Georgina Williston at our Yellowknife office at (867) 669-4927, by fax at (867) 669-4940, or by email at [georgina.williston@dfo-mpo.gc.ca](mailto:georgina.williston@dfo-mpo.gc.ca). Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,



Julie Dahl  
Regional Manager, Regulatory Reviews  
Fisheries Protection Program

cc.  
Georgina Williston- Fisheries and Oceans Canada  
Oliver Curran-Baffinland Iron Mines Corp.  
Erik Madsen-Baffinland Iron Mines Corp.



5204-50<sup>th</sup> Avenue  
Yellowknife, NT  
X1A 1E2

December 9, 2014

*Your file*      *Votre référence*

*Our file*      *Notre référence*  
NU-07-0050

Baffinland Iron Mines Corp.  
Attention: Jim Millard, Environmental Manager  
2275 Upper Middle Road, Suite 300  
Oakville, ON  
L6H 0C3

Dear Mr. Millard:

**Subject: Implementation of mitigation measures to avoid and mitigate impacts to fish and fish habitat and listed aquatic species at risk – Mary River Project**

The Fisheries Protection Program (the Program) of Fisheries and Oceans Canada received your proposal on November 27, 2014.

Your proposal has been reviewed to determine whether it is likely to result in serious harm to fish which is prohibited under subsection 35(1) of the *Fisheries Act*.

Your proposal has also been reviewed to determine whether it will adversely impact listed aquatic species at risk and contravene sections 32, 33 or 58 of the *Species at Risk Act (SARA)*.

Our review considered the following:

- Letter from Baffinland Iron Mines RE: Realignment of Tote Road at Culvert CV099. Dated November 27, 2014 and submitted by James Millard, with 1 attachment.
- Attachment 1- Mark up of proposed field change, Drawing H349000-3000-10-012-0052

We understand that you propose to:

- Realign the existing Tote Road and install one 2 metre diameter culvert in the stream bed and two 1.2 metre overflow culverts. Culverts will be approximately 27 metres in length.



- Install culverts during the winter months when the stream is frozen to bottom.
- Remove existing culverts along the old Tote Road alignment.

Since there are no *SARA* species or their habitats identified in the project area, no additional approvals under *SARA* will be required for your proposed activities.

To avoid the potential for serious harm to fish that is prohibited under the *Fisheries Act*, the mitigation measures set out in your project plans are to be followed.

Provided that you implement the required mitigation measures for your project, and follow the guidance available on the DFO website at <http://www.dfo-mpo.gc.ca/pnw-ppe/measure/index-eng.html>, the Program is of the view that your proposal should not result in serious harm to fish or contravene sections 32, 33 or 58 of the *Species at Risk Act*. No formal approval is required from the Program under the *Fisheries Act* or the *Species at Risk Act* in order to proceed with your proposal.

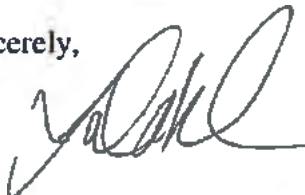
It remains your responsibility to ensure you avoid causing serious harm to fish in compliance with the *Fisheries Act*, and that you meet the requirements under the *Species at Risk Act* as it may apply to your project. If your plans have changed or if the description of your proposal is incomplete, or changes in the future, you should consult our website (<http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html>) or consult with a qualified environmental consultant to determine if further review is required by the Program.

Please be advised that it is also your *Duty to Notify* DFO if you have caused, or are about to cause, serious harm to fish that are part of or support a commercial, recreational or Aboriginal fishery. Such notifications should be directed to <http://www.dfo-mpo.gc.ca/pnw-ppe/violation-infraction/index-eng.html>.

A copy of this letter should be kept on site while the work is in progress. It remains your responsibility to meet all other federal or territorial requirements that apply to your project.

If you have any questions, please contact Georgina Williston at our Yellowknife office at 867-669-4927 or by email at [Georgina.Williston@dfo-mpo.gc.ca](mailto:Georgina.Williston@dfo-mpo.gc.ca). Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,



Julie Dahl  
Regional Manager, Regulatory Reviews  
Fisheries Protection Program

cc. Oliver Curran- Baffinland Iron Mines  
Erik Madsen – Baffinland Iron Mines



Fisheries and Oceans  
Canada

Pêches et Océans  
Canada

5204-50<sup>th</sup> Avenue  
Yellowknife, NT  
X1A 1E2

October 27, 2014

Your file      Votre référence

Our file      Notre référence  
NU-07-0050

Baffinland Iron Mines Corp.  
Attention : Jim Millard, Environmental Manager  
2275 Upper Middle Road, Suite 300  
Oakville, ON  
L6H 0C3

Dear Mr. Millard:

**Subject: Implementation of mitigation measures to avoid and mitigate impacts to fish and fish habitat and listed aquatic species at risk – Mary River Project**

The Fisheries Protection Program (the Program) of Fisheries and Oceans Canada received your proposal on October 17, 2014.

Your proposal has been reviewed to determine whether it is likely to result in serious harm to fish which is prohibited under subsection 35(1) of the *Fisheries Act*.

Your proposal has also been reviewed to determine whether it will adversely impact listed aquatic species at risk and contravene sections 32, 33 or 58 of the *Species at Risk Act (SARA)*.

Our review considered the following:

- Letter from Baffinland Iron Mines RE: Realignment of Tote Road at Culvert CV225B. Dated October 16, 2014 and submitted by James Millard, with 2 attachments.
- Attachment 1- Mark of proposed field change, Drawing H349000-3000-10-012-0139
- Attachment 2- Project Wide, Civil Standard Drawing, Typical Culvert Detail, H349000-1000-10-041-0003

We understand that you propose to:

- Realign the existing Tote Road and install two new 1.2 metre culverts in the stream bed and one 1.0 metre culvert 45 m away as an overflow. Culverts will be approximately 27metres in length.



- Install culverts during the winter months when the stream is frozen to bottom.
- Remove the two existing 1.2m culverts along the old Tote Road alignment.

Since there are no *SARA* species or their habitats identified in the project area, no additional approvals under *SARA* will be required for your proposed activities.

To avoid the potential for serious harm to fish that is prohibited under the *Fisheries Act*, the mitigation measures set out in your project plans are to be followed.

Provided that you implement the required mitigation measures for your project, and follow the guidance available on the DFO website at <http://www.dfo-mpo.gc.ca/pnw-ppe/measure/index-eng.html>, the Program is of the view that your proposal should not result in serious harm to fish or contravene sections 32, 33 or 58 of the *Species at Risk Act*. No formal approval is required from the Program under the *Fisheries Act* or the *Species at Risk Act* in order to proceed with your proposal.

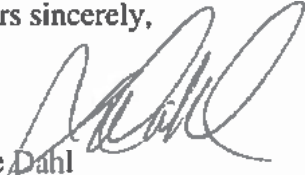
It remains your responsibility to ensure you avoid causing serious harm to fish in compliance with the *Fisheries Act*, and that you meet the requirements under the *Species at Risk Act* as it may apply to your project. If your plans have changed or if the description of your proposal is incomplete, or changes in the future, you should consult our website (<http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html>) or consult with a qualified environmental consultant to determine if further review is required by the Program.

Please be advised that it is also your *Duty to Notify* DFO if you have caused, or are about to cause, serious harm to fish that are part of or support a commercial, recreational or Aboriginal fishery. Such notifications should be directed to <http://www.dfo-mpo.gc.ca/pnw-ppe/violation-infraction/index-eng.html>.

A copy of this letter should be kept on site while the work is in progress. It remains your responsibility to meet all other federal or territorial requirements that apply to your project.

If you have any questions, please contact Georgina Williston at our Yellowknife office at 867-669-4927 or by email at [Georgina.Williston@dfo-mpo.gc.ca](mailto:Georgina.Williston@dfo-mpo.gc.ca). Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,



Julie Dahl  
Regional Manager, Regulatory Reviews  
Fisheries Protection Program

cc. Oliver Curran- Baffinland Iron Mines  
Erik Madsen – Baffinland Iron Mines  
Stu Niven – Fisheries and Oceans Canada

**APPENDIX B**

**PHOTOGRAPHIC LOG OF CHANGES OF TOTE ROAD CROSSINGS AT FISH-BEARING STREAMS  
COMPLETED IN 2019**

2018/2019 Tote Road Culvert Works – CV-111 at KM 32

Photos



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1:** Photographs of the culvert crossing at CV-111 (KM 32) (A-C) before, (D-H) during, and (I-L) after construction works to replace existing culverts with a single new culvert. Work was completed on 19 February 2019.

## 2018/2019 Tote Road Culvert Works – CV-111 at KM 32

### Photos



**G**



**H**



**I**



**J**



**K**



**L**

**Photos 1:** Continued.



## 2018/2019 Tote Road Culvert Works – CV-078 at KM 51

### Photos



A



B



C



D



E



F

**Photos 2:** Photographs of the culvert crossing at CV-078 (KM 51) (A-E) during and (F) after construction works to add extensions to existing culverts. Work was completed on 7 January 2019.

**APPENDIX C**

**PHOTOGRAPHIC LOG OF HABITAT ASSESSMENTS AT TOTE ROAD CROSSINGS,  
SPRING 2019**

## Tote Road Site CV-170

**UTM Coordinates:** 17W 505015 E 7972930 N

**Date Surveyed:** 28-Jun-19

**Summary:** This small stream has several natural steep gradient and vertical drop barriers downstream that prevent fish access to the crossing area from Phillips Creek. There is no upstream overwintering habitat.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-170: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) a vertical barrier preventing fish access.




**Tote Road Site CV-166**

**UTM Coordinates:** 17W 505538 E 7972370 N **Date Surveyed:** 28-Jun-19

**Summary:** Anadromous juvenile Arctic Char occasionally use habitat downstream of the Tote Road, but a steep gradient at the crossing and a rocky barrier immediately downstream prevent access to the crossing and upstream habitat.



**Photos 1.** Photographs downstream of the Tote Road crossing CV-166: (A) looking upstream; (B) looking downstream; and (C) looking across.

<b>Baffinland Iron Mines</b> <b>Mary River Project</b>		<b>Fish Habitat</b>	<b>Arctic Char - No</b> <b>Ninespine Stickleback – No</b>
---	---	---------------------	--

## Tote Road Site CV-159

**UTM Coordinates:** 17W 506920 E 7970839 N **Date Surveyed:** 28-Jun-19

**Summary:** This small stream has several natural steep gradient and vertical drop barriers downstream that prevent fish access to the crossing area from Phillips Creek. There is no upstream overwintering habitat.



**A**




**B**



**C**

**Photos 1.** Photographs downstream of the Tote Road crossing CV-159: (A) looking upstream; (B) looking downstream; and (C) a vertical barrier preventing fish access to the crossing.

<p><b>Baffinland Iron Mines</b> <b>Mary River Project</b></p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - No</b> <b>Ninespine Stickleback – No</b></p>
---	---	----------------------------	--

## Tote Road Site CV-157

**UTM Coordinates:** 17W 507367 E 7970512 N

**Date Surveyed:** 28-Jun-19

**Summary:** This small stream has several natural steep gradient and vertical drop barriers downstream that prevent fish access to the crossing area from Phillips Creek. There is no upstream overwintering habitat.



**A**



**B**






**C**



**D**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-157: (A) looking upstream; (B) looking downstream; (C) looking across; and (D) photograph downstream of the Tote Road looking downstream.

Tote Road Site CV-156				
UTM Coordinates: 17W 507531 E 7970286 N		Date Surveyed: 28-Jun-19		
<p><b>Summary:</b> This small runoff stream is typically dry and has several natural steep gradient and vertical drop barriers downstream that prevent fish access to the crossing area from Phillips Creek. There is no upstream overwintering habitat.</p>				
 <p><b>A</b></p>	 <p><b>B</b></p>			
<p><b>Photos 1.</b> Photographs downstream of the Tote Road crossing CV-156: (A) looking downstream; and (B) looking across.</p>				
<p><b>Baffinland Iron Mines</b> <b>Mary River Project</b></p>			<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - No</b> <b>Ninespine Stickleback – No</b></p>



## Tote Road Site CV-154

**UTM Coordinates:** 17W 507629 E 7970074 N

**Date Surveyed:** 28-Jun-19

**Summary:** This small stream typically has low natural water levels and lacks connectivity at the confluence with Phillips Creek, preventing fish access to the crossing. There is no upstream overwintering habitat.



**A**



**B**

**Photos 1.** Photographs downstream of the Tote Road crossing CV-154: (A) looking upstream; and (B) looking downstream.

**Baffinland Iron Mines  
Mary River Project**



**Fish Habitat**

**Arctic Char - No**

**Ninespine Stickleback – No**

**Tote Road Site CV-153**

**UTM Coordinates:** 17W 508173 E 7969723 N

**Date Surveyed:** 28-Jun-19

**Summary:** This small runoff stream typically has minimal natural surface flow or is dry and permanently lacks connectivity to Phillips Creek. There is no upstream overwintering habitat.



**Photos 1.** Photograph of the Tote Road crossing CV-153 (red arrow). Note distance from crossing due to lack of areas to safely access the site from the road.

**Baffinland Iron Mines**  
**Mary River Project**



**Fish Habitat**

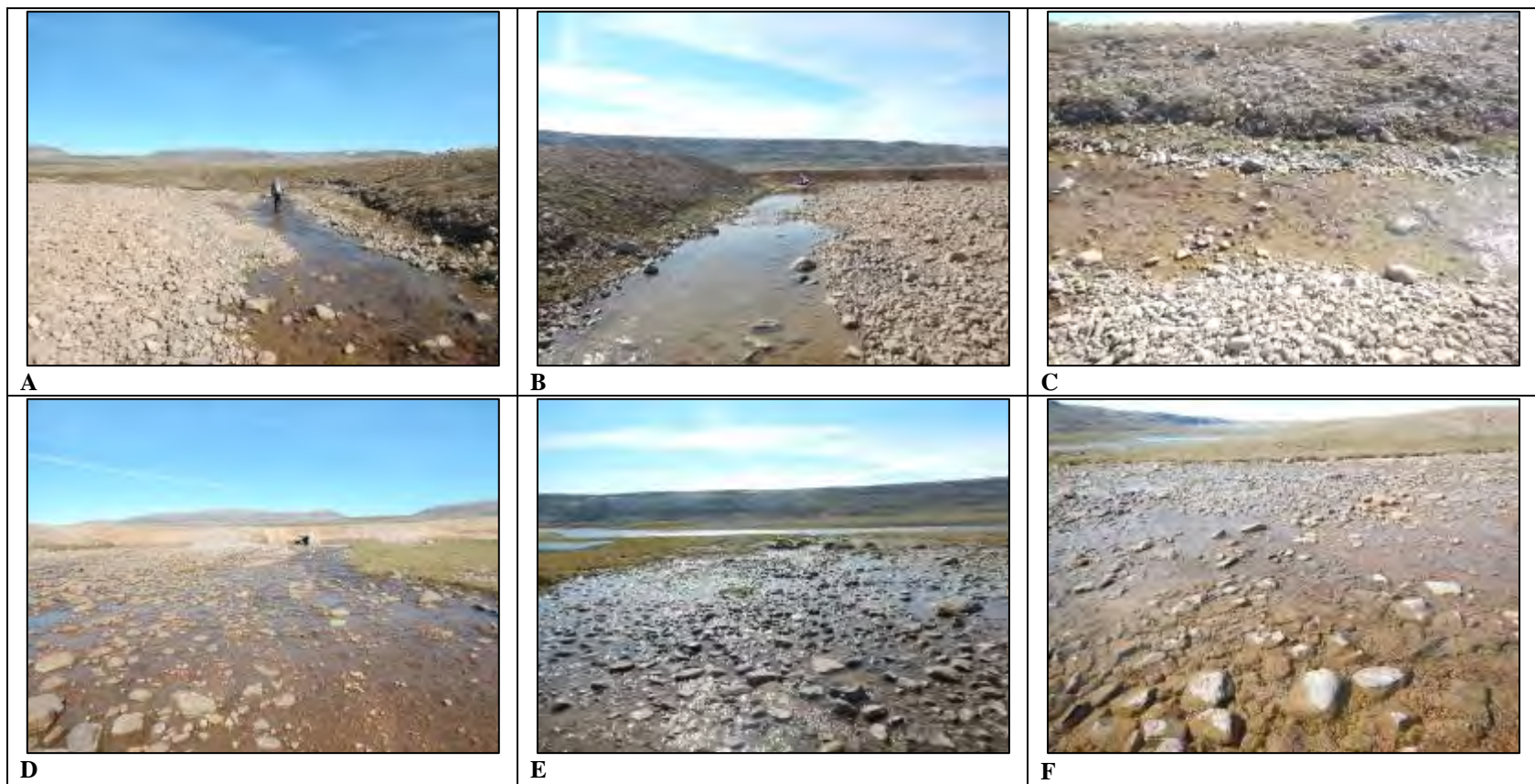
**Arctic Char - No**

**Ninespine Stickleback – No**


## Tote Road Site CV-129

**UTM Coordinates:** 17W 512381 E 7966783 N **Date Surveyed:** 28-Jun-19

**Summary:** This site has consistently provided good quality summer rearing habitat for juvenile Arctic Char and is the first large stream upstream of the impassable falls on Phillips Creek (i.e., fish use is restricted to land-locked Arctic Char). Small culvert perch was remediated in fall 2019. Upstream overwintering lake provides additional habitat, so fall upstream movements could be as important as downstream, requiring full culvert access.



**Photos 1.** Photographs upstream of the Tote Road crossing CV-129: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> <b>Mary River Project</b></p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback - Yes</b></p>
---	--	----------------------------	--



**Tote Road Site CV-128**

**UTM Coordinates:** 17W 513556 E 7965889 N **Date Surveyed:** 28-Jun-19

**Summary:** A bridge crossing of a major river that has consistently provided abundant fish habitat with no passage issues.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-128: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> <b>Mary River Project</b></p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – Yes</b></p>
---	--	----------------------------	--



**Tote Road Site CV-125**

**UTM Coordinates:** 17W 515296 E 7963851 N **Date Surveyed:** 28-Jun-19

**Summary:** Some ponding upstream of the Tote Road culvert, but no channel and no surface water downstream. There is no access from Phillips Creek.



**A**



**B**



**C**

**Photos 1.** (A) Photograph upstream of the Tote Road crossing CV-125 looking upstream; and photographs downstream of the Tote Road crossing CV-125: (B) looking upstream; and (C) looking downstream.

**Baffinland Iron Mines  
Mary River Project**



**Fish Habitat**

**Arctic Char - No**  
**Ninespine Stickleback – No**

## Tote Road Site CV-120

**UTM Coordinates:** 17W 517355 E 7961693 N

**Date Surveyed:** 28-Jun-19

**Summary:** Some ponding upstream of the Tote Road culvert, but no channel and no surface water downstream. There is no connection to or access from Phillips Creek.



**Photos 1.** Photograph of the Tote Road crossing CV-120 from downstream.

**Baffinland Iron Mines**  
**Mary River Project**



**Fish Habitat**

**Arctic Char - No**

**Ninespine Stickleback – No**

**Tote Road Site CV-119**

**UTM Coordinates:** 17W 517762 E 7961153 N **Date Surveyed:** 28-Jun-19

**Summary:** No channel downstream of the Tote Road and surface water shallow and dispersed over terrestrial grasses. No natural connectivity to Phillips Creek.



**A**



**B**



**C**



**D**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-119: (A) looking upstream; (B) looking downstream; and photographs downstream of the Tote Road: (C) looking upstream; and (D) looking downstream.

<b>Baffinland Iron Mines Mary River Project</b>		<b>Fish Habitat</b>	<b>Arctic Char - No</b>
			<b>Ninespine Stickleback – No</b>

**Tote Road Site CV-115**

**UTM Coordinates:** 17W 519222 E 7958135 N **Date Surveyed:** 28-Jun-19

**Summary:** Stream has been regularly surveyed and is dry most years, including 2019. When wetted, small numbers of fish have been observed at the crossing.



**Photos 1.** Photographs upstream of the Tote Road crossing CV-115: (A) looking upstream; (B) looking downstream; and photographs downstream of the Tote Road: (C) looking upstream; and (D) looking downstream.



**Tote Road Site CV-114**

**UTM Coordinates:** 17W 520278 E 7956528 N **Date Surveyed:** 28-Jun-19

**Summary:** This stream provides habitat for juvenile Arctic Char. Perched culverts that may affect upstream access were remediated in fall 2019, but may require additional work.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-114: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> <b>Mary River Project</b></p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – No</b></p>
---	--	----------------------------	---

**Tote Road Site CV-113**

**UTM Coordinates:** 17W 520747 E 7955659 N **Date Surveyed:** 29-Jun-19

**Summary:** Site is dry with no natural channel and never has connectivity with Phillips Creek.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-113: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.



**Tote Road Site CV-112**

**UTM Coordinates:** 17W 521033 E 7954935 N **Date Surveyed:** 29-Jun-19

**Summary:** This stream provides summer rearing habitat for juvenile Arctic Char. There are no fish passage issues.



**A**



**B**



**C**



**D**




**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-112: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> Mary River Project</p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – No</b></p>
--	--	----------------------------	---

**Tote Road Site CV-111**

**UTM Coordinates:** 17W 521355 E 7954524 N **Date Surveyed:** 29-Jun-19

**Summary:** This stream provides summer rearing habitat for juvenile Arctic Char. Culvert was recently reinstalled and is now perched. See remediation Appendix for details.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-111: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> Mary River Project</p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – No</b></p>
--	--	----------------------------	---



**Tote Road Site CV-202**

**UTM Coordinates:** 17W 521603 E 7953731 N **Date Surveyed:** 29-Jun-19

**Summary:** Site has no natural channel downstream, little surface flow, and is never connected to Phillips Creek.




**A**



**B**

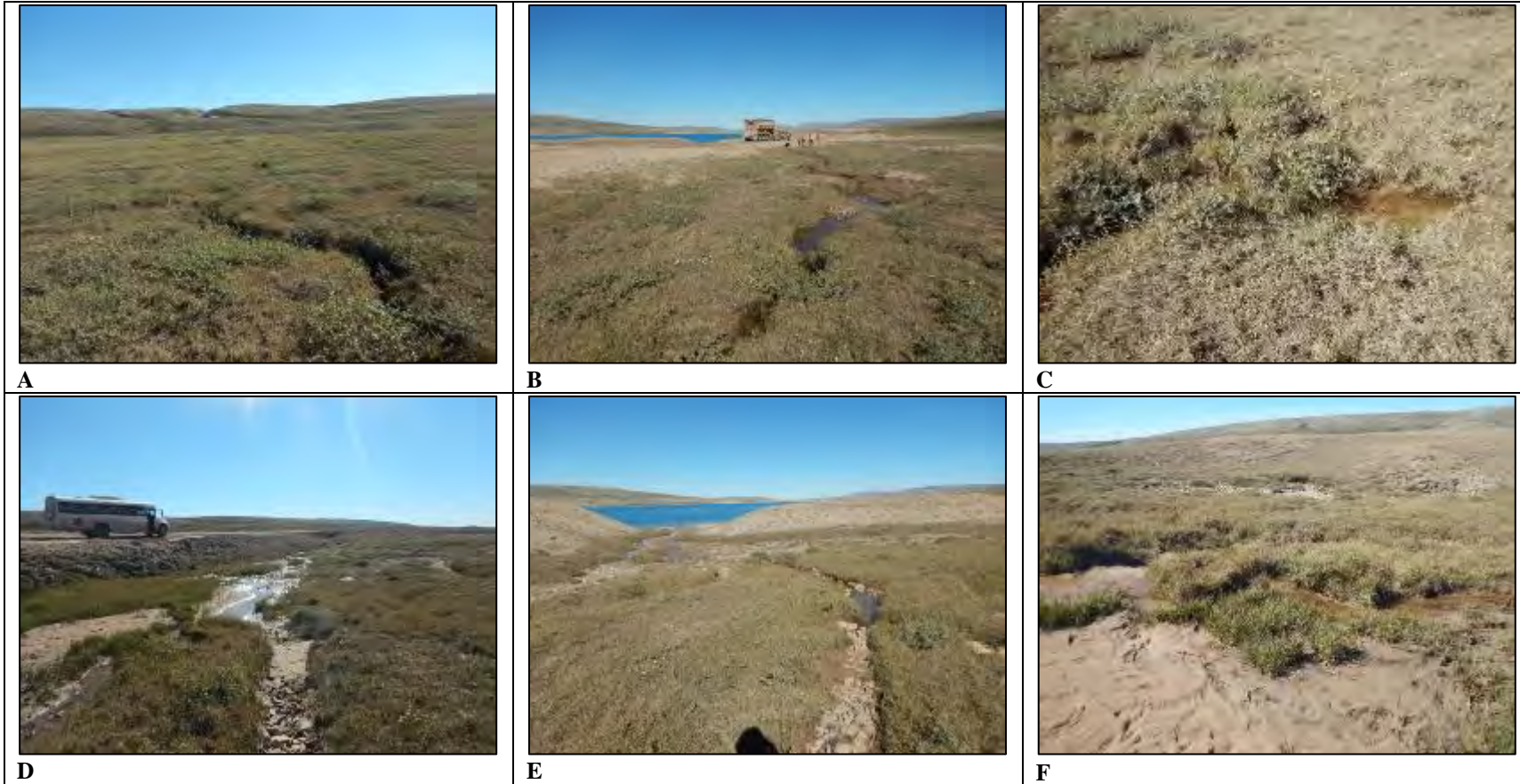
**Photos 1.** Photographs of the Tote Road crossing CV-202: (A) upstream end of culvert; and (B) downstream end of culvert.

<b>Baffinland Iron Mines</b> <b>Mary River Project</b>		<b>Fish Habitat</b>	<b>Arctic Char - No</b>
			<b>Ninespine Stickleback – No</b>


**Tote Road Site CV-106**

**UTM Coordinates:** 17W 521663 E 7953392 N **Date Surveyed:** 29-Jun-19

**Summary:** Stream provides summer rearing habitat for juvenile Arctic Char, though it dries up downstream of the culvert during periods of low water, as was observed in early summer 2019. An existing ramp (2018) designed to improve access received additional modifications in 2019.



**Photos 1.** Photographs upstream of the Tote Road crossing CV-106: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> <b>Mary River Project</b></p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – No</b></p>
---	--	----------------------------	---



## Tote Road Site CV-104

**UTM Coordinates:** 17W 521732 E 7952788 N

**Date Surveyed:** 29-Jun-19

**Summary:** Though water levels are occasionally low (as in 2019), this stream provides summer rearing habitat for juvenile Arctic Char. No passage issues were identified in spring 2019.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-104: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

**Baffinland Iron Mines  
Mary River Project**



**Fish Habitat**

**Arctic Char - Yes**

**Ninespine Stickleback – No**

**Tote Road Site CV-203**

**UTM Coordinates:** 17W 521741 E 7952440 N **Date Surveyed:** 29-Jun-19

**Summary:** Stream has been typically dry when surveyed and has no natural channel or habitat downstream and no connectivity to Phillips Creek.




**A**



**B**

**Photos 1.** Photographs of the Tote Road crossing CV-203: (A) upstream end of culvert; and (B) downstream end of culvert.

<b>Baffinland Iron Mines</b> Mary River Project		<b>Fish Habitat</b>	<b>Arctic Char - No</b> <b>Ninespine Stickleback – No</b>
--	---	---------------------	--



## Tote Road Site CV-102

**UTM Coordinates:** 17W 521934 E 7950591 N

**Date Surveyed:** 29-Jun-19

**Summary:** This stream typically provides summer rearing habitat for juvenile Arctic Char, but low water levels in spring 2019 restricted fish use.



**A**



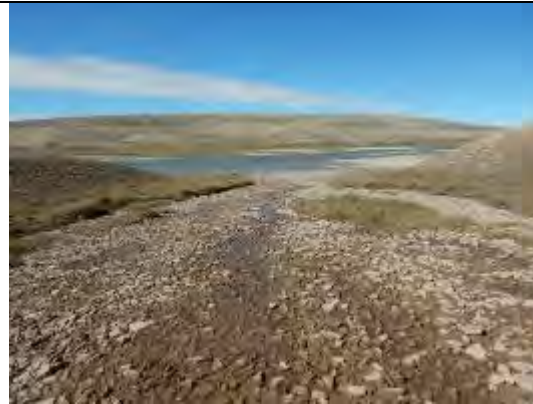
**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-102: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

## Tote Road Site CV-099

**UTM Coordinates:** 17W 521886 E 7945397 N

**Date Surveyed:** 29-Jun-19

**Summary:** A large stream with abundant fish habitat. Water velocities in the culverts appeared to have restricted upstream access to larger juveniles during some annual surveys, but no fish passage issues were identified in spring 2019.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-099: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.



## Tote Road Site CV-094

**UTM Coordinates:** 17W 522805 E 7945397 N

**Date Surveyed:** 29-Jun-19

**Summary:** Site provides good quality summer rearing habitat for juvenile Arctic Char but a natural downstream vertical barrier prevents access from overwintering habitat. Fish cannot naturally access upstream habitat.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-094: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) a vertical barrier preventing fish access.


## Tote Road Site CV-086




<b>UTM Coordinates:</b> 17W 523746 E 7940983 N	<b>Date Surveyed:</b> 29-Jun-19
--	---------------------------------

**Summary:** No natural channel or surface water and not connected to overwintering habitat.



**Photos 1.** Photograph of the Tote Road crossing CV-086 from downstream looking upstream.

<b>Baffinland Iron Mines Mary River Project</b>		<b>Fish Habitat</b>	<b>Arctic Char - No</b> <b>Ninespine Stickleback – No</b>
---	---	---------------------	--

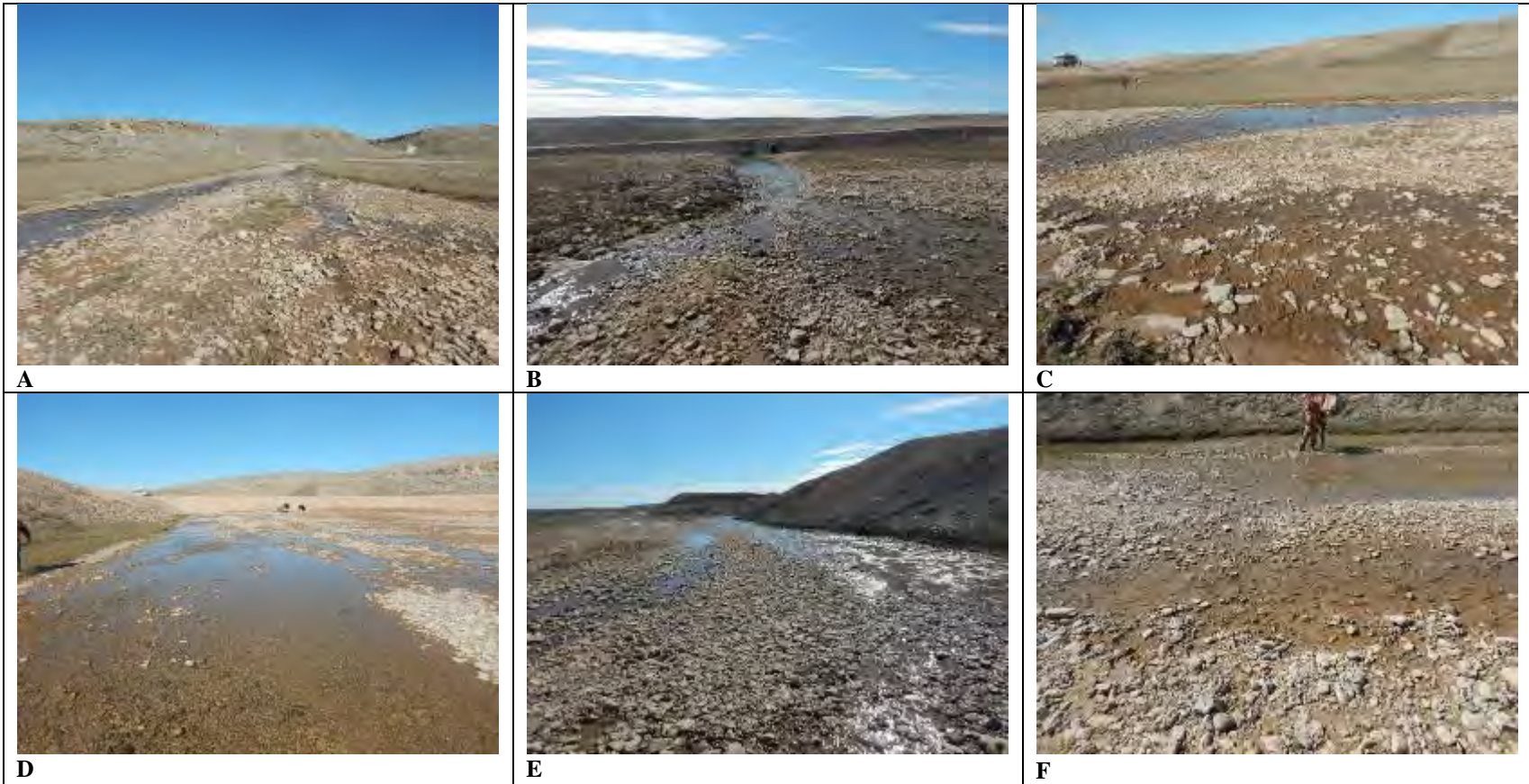
Tote Road Site CV-082			
UTM Coordinates: 17W 525254 E 7938131 N		Date Surveyed: 29-Jun-19	
<p><b>Summary:</b> There is consistently very little water, no natural channel, and a steep downstream gradient all of which prevent access from overwintering habitat.</p>			
<b>A</b>		<b>B</b>	
<p><b>Photos 1.</b> Photographs downstream of the Tote Road crossing CV-082: (A) looking upstream; and (B) looking downstream at subflow barrier.</p>			
<p><b>Baffinland Iron Mines</b> <b>Mary River Project</b></p>			<p><b>Fish Habitat</b></p>
			<p><b>Arctic Char - No</b> <b>Ninespine Stickleback – No</b></p>




**Tote Road Site CV-079**

**UTM Coordinates:** 17W 525538 E 7937314 N **Date Surveyed:** 29-Jun-19

**Summary:** Site provides abundant summer rearing habitat for juvenile Arctic Char. There were no fish passage issues identified in spring 2019.



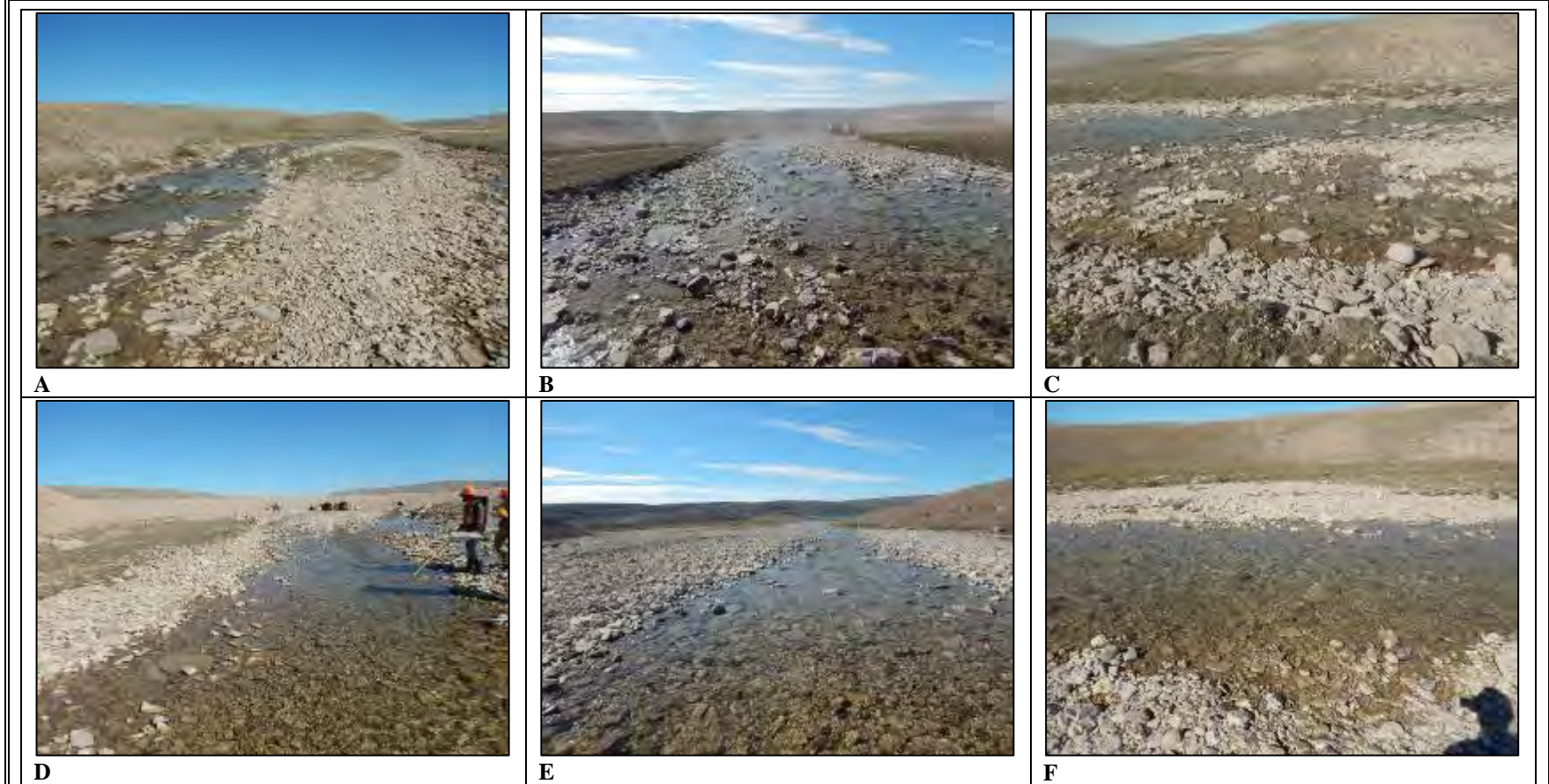
**Photos 1.** Photographs upstream of the Tote Road crossing CV-079: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<b>Baffinland Iron Mines</b> <b>Mary River Project</b>		<b>Fish Habitat</b>	<b>Arctic Char - Yes</b>
			<b>Ninespine Stickleback – No</b>


**Tote Road Site CV-078**

**UTM Coordinates:** 17W 525852 E 7936787 N **Date Surveyed:** 29-Jun-19

**Summary:** Site provides abundant summer rearing habitat for juvenile Arctic Char. There were no fish passage issues identified in spring 2019.



**Photos 1.** Photographs upstream of the Tote Road crossing CV-078: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

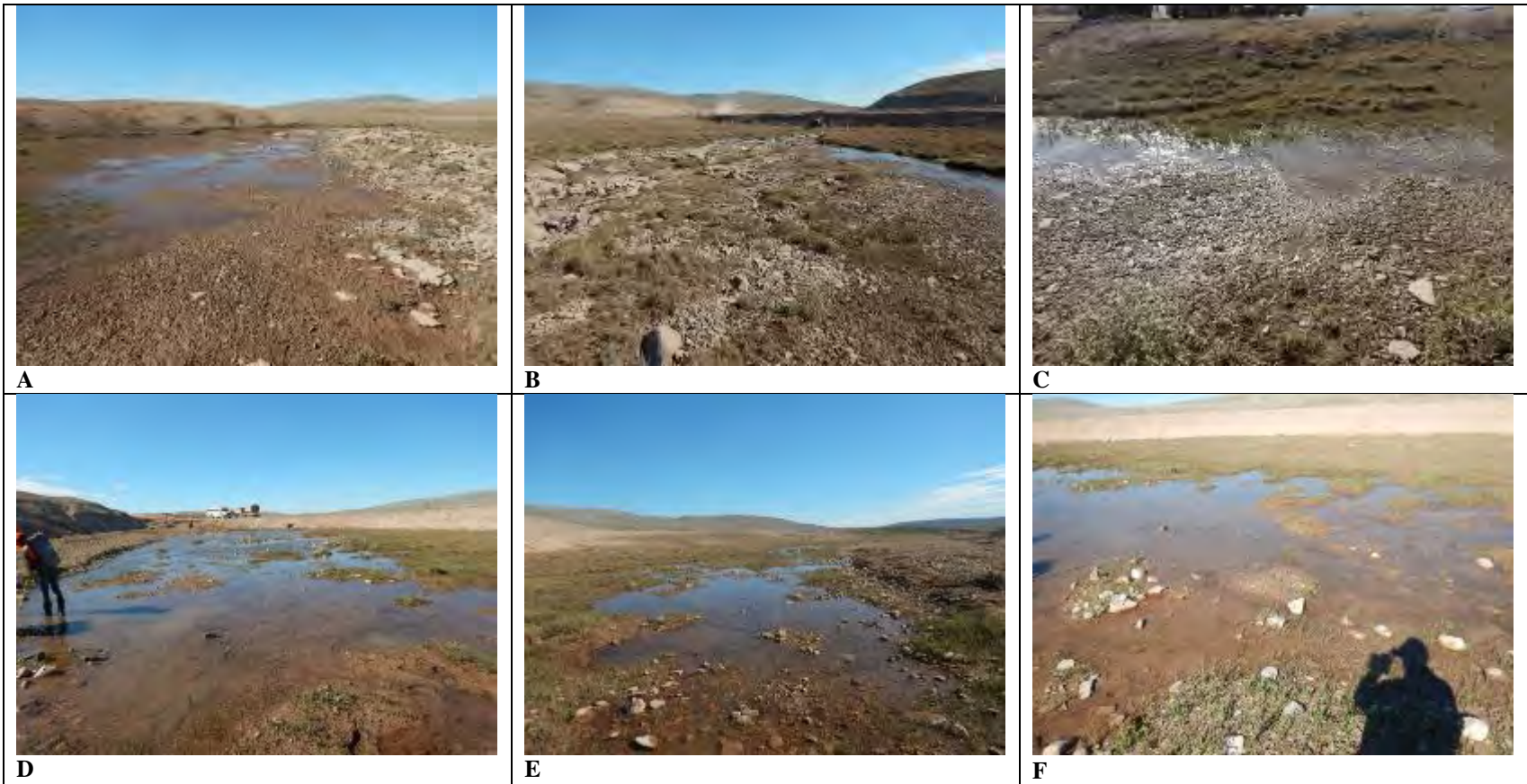
<b>Baffinland Iron Mines Mary River Project</b>		<b>Fish Habitat</b>	<b>Arctic Char - Yes</b>
			<b>Ninespine Stickleback – No</b>




**Tote Road Site CV-076**

**UTM Coordinates:** 17W 526586 E 7935498 N **Date Surveyed:** 29-Jun-19

**Summary:** Small stream providing summer rearing habitat for juvenile Arctic Char. There were no fish passage issues identified in spring 2019.



**Photos 1.** Photographs upstream of the Tote Road crossing CV-076: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> <b>Mary River Project</b></p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – No</b></p>
---	--	----------------------------	---



**Tote Road Site CV-072**

**UTM Coordinates:** 17W 526897 E 7934576 N **Date Surveyed:** 29-Jun-19

**Summary:** Site provides abundant summer rearing habitat for juvenile Arctic Char. There were no fish passage issues identified in spring 2019.



**A**



**B**



**C**



**D**




**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-072: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> Mary River Project</p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – No</b></p>
--	--	----------------------------	---

**Tote Road Site CV-060**

**UTM Coordinates:** 17W 527622 E 7930342 N **Date Surveyed:** 30-Jun-19

**Summary:** Site provides abundant summer rearing habitat for juvenile Arctic Char. There were no fish passage issues identified in spring 2019.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-060: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<b>Baffinland Iron Mines Mary River Project</b>		<b>Fish Habitat</b>	<b>Arctic Char - Yes</b>
			<b>Ninespine Stickleback – No</b>



**Tote Road Site CV-059**

**UTM Coordinates:** 17W 528094 E 7929347 N **Date Surveyed:** 30-Jun-19

**Summary:** Site provides abundant summer rearing habitat for juvenile Arctic Char. There were no fish passage issues identified in spring 2019.



**A**



**B**



**C**



**D**




**E**



**F**

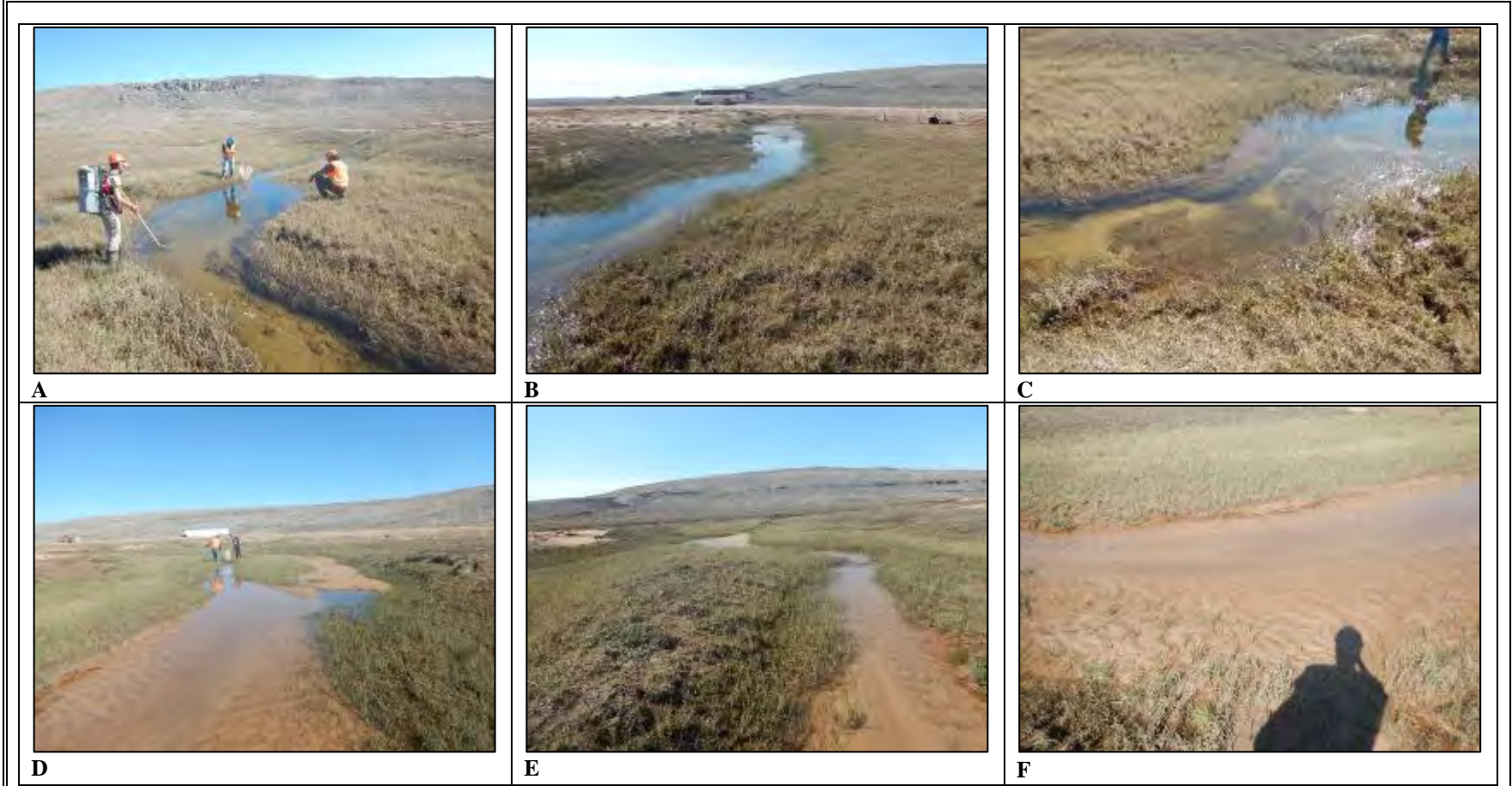
**Photos 1.** Photographs upstream of the Tote Road crossing CV-059: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> Mary River Project</p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – No</b></p>
--	--	----------------------------	---

**Tote Road Site CV-058**

**UTM Coordinates:** 17W 528322 E 7928839 N **Date Surveyed:** 30-Jun-19

**Summary:** Site provides abundant summer rearing habitat for juvenile Arctic Char. There were no fish passage issues identified in spring 2019.



**Photos 1.** Photographs upstream of the Tote Road crossing CV-058: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

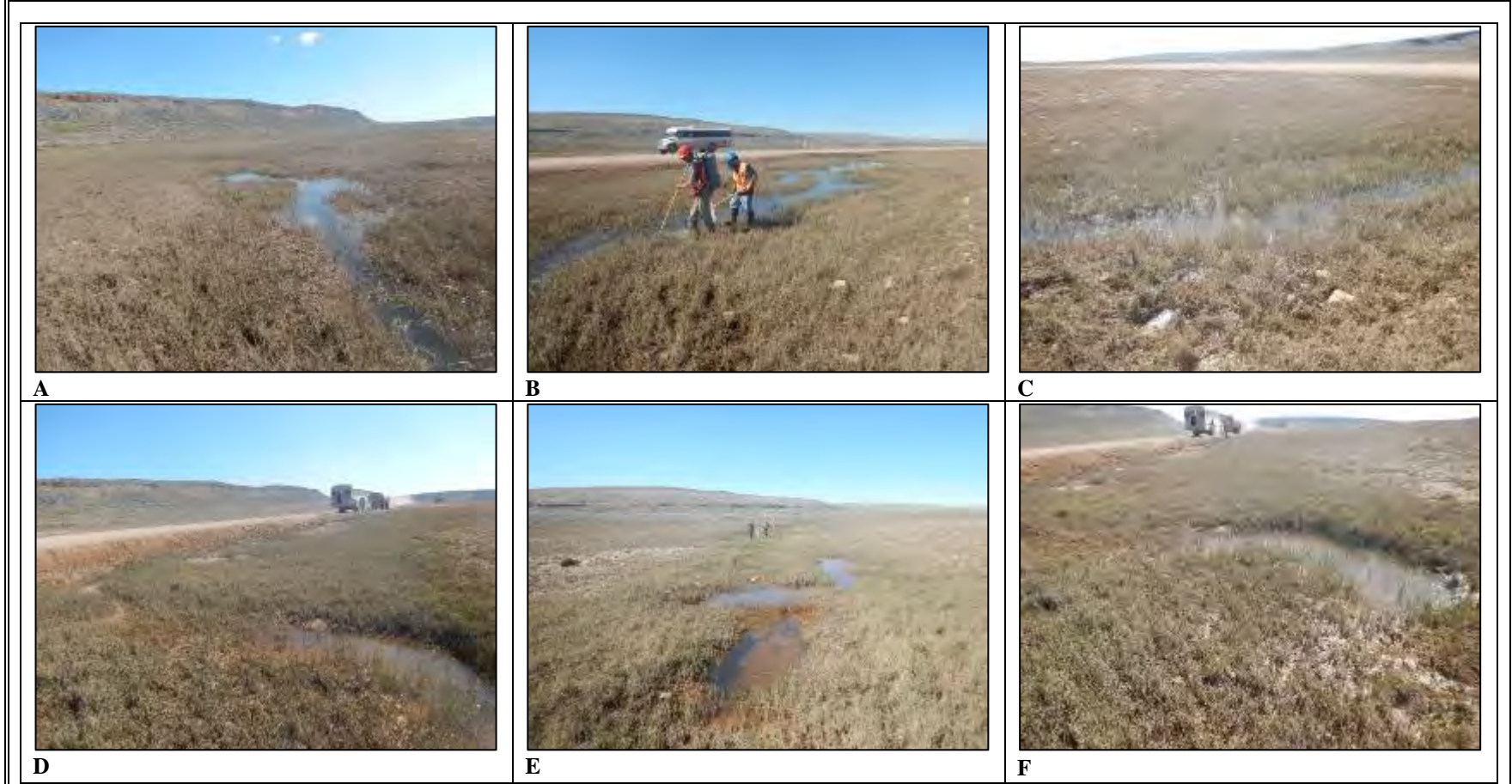
<p><b>Baffinland Iron Mines</b> Mary River Project</p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – No</b></p>
--	--	----------------------------	---



**Tote Road Site CV-057**

**UTM Coordinates:** 17W 528379 E 7928657 N **Date Surveyed:** 30-Jun-19

**Summary:** Site provides some summer rearing habitat for juvenile Arctic Char. There were no fish passage issues identified in spring 2019.



**Photos 1.** Photographs upstream of the Tote Road crossing CV-057: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> Mary River Project</p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – No</b></p>
--	--	----------------------------	---

**Tote Road Site BG-50**

**UTM Coordinates:** 17W 529294 E 7926852 N **Date Surveyed:** 30-Jun-19

**Summary:** Large river with abundant habitat for both species. One channel is crossed by a bridge and the other with two culverts. Culverts were perched, blocking fish movements, in spring 2019 and remediation work was conducted in fall 2019.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing BG-50: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

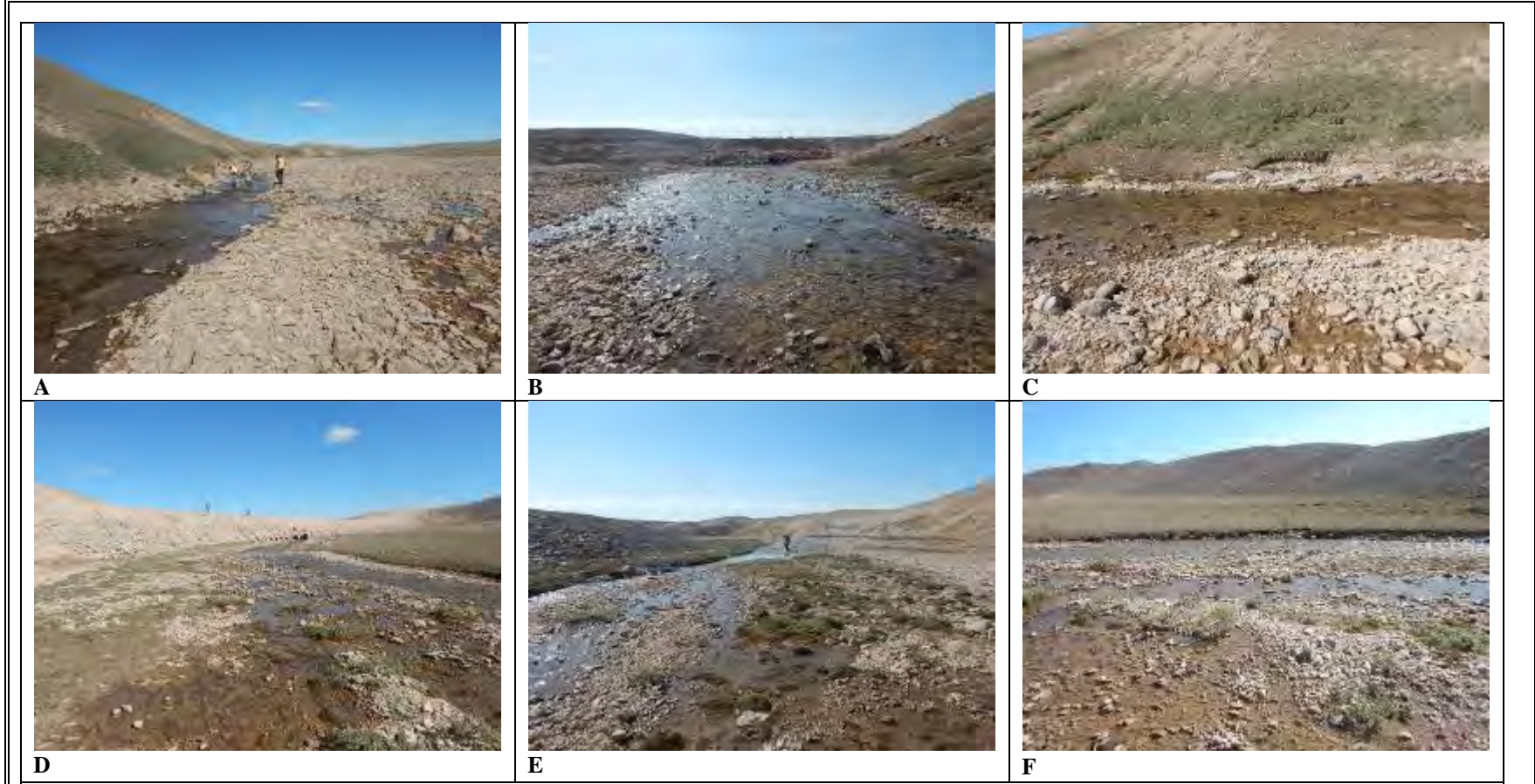
<p><b>Baffinland Iron Mines</b> Mary River Project</p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – Yes</b></p>
--	--	----------------------------	--



**Tote Road Site CV-049**

**UTM Coordinates:** 17W 529654 E 7926545 N **Date Surveyed:** 30-Jun-19

**Summary:** Site provides abundant summer rearing habitat for juvenile Arctic Char. There were no fish passage issues identified in spring 2019.



**Photos 1.** Photographs upstream of the Tote Road crossing CV-049: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> <b>Mary River Project</b></p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – No</b></p>
---	--	----------------------------	---

**Tote Road Site CV-048**

**UTM Coordinates:** 17W 530415 E 7925875 N **Date Surveyed:** 30-Jun-19

**Summary:** Stream provides aquatic habitat at the Tote Road crossing, but a persistent natural downstream subsurface flow barrier near its confluence with CV-049 prevents access from downstream overwintering lakes.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-048: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.



**Tote Road Site CV-046**

**UTM Coordinates:** 17W 531686 E 7924265 N **Date Surveyed:** 30-Jun-19

**Summary:** Stream provides aquatic habitat at the Tote Road crossing, but a persistent natural downstream subsurface flow barrier near its confluence with CV-049 prevents access from downstream overwintering lakes.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-046: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

**Tote Road Site CV-040**

**UTM Coordinates:** 17W 535168 E 7920326 N **Date Surveyed:** 30-Jun-19

**Summary:** There is consistent surface flow at the crossing, but natural annual subsurface flows several hundred meters downstream, combined with large distance to overwintering habitat prevent fish access to the crossing.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-040: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.



## Tote Road Site CV-030

**UTM Coordinates:** 17W 540123 E 7921310 N

**Date Surveyed:** 30-Jun-19

**Summary:** Arctic Char use of this stream is minimal due to consistently low water levels and lack of a clearly defined channel, but Ninespine Stickleback are typically abundant. There were no fish passage issues identified in spring 2019.



**A**



**B**



**C**



**D**

**Photos 1.** Photographs downstream of the Tote Road crossing CV-030: (A) showing the culvert; (B) looking upstream; (C) looking downstream; and (D) looking across.



**Tote Road Site BG-32**

**UTM Coordinates:** 17W 540729 E 7921597 N **Date Surveyed:** 30-Jun-19

**Summary:** Consistently provides abundant, good quality rearing habitat for both species. There were no fish passage issues identified in spring 2019.



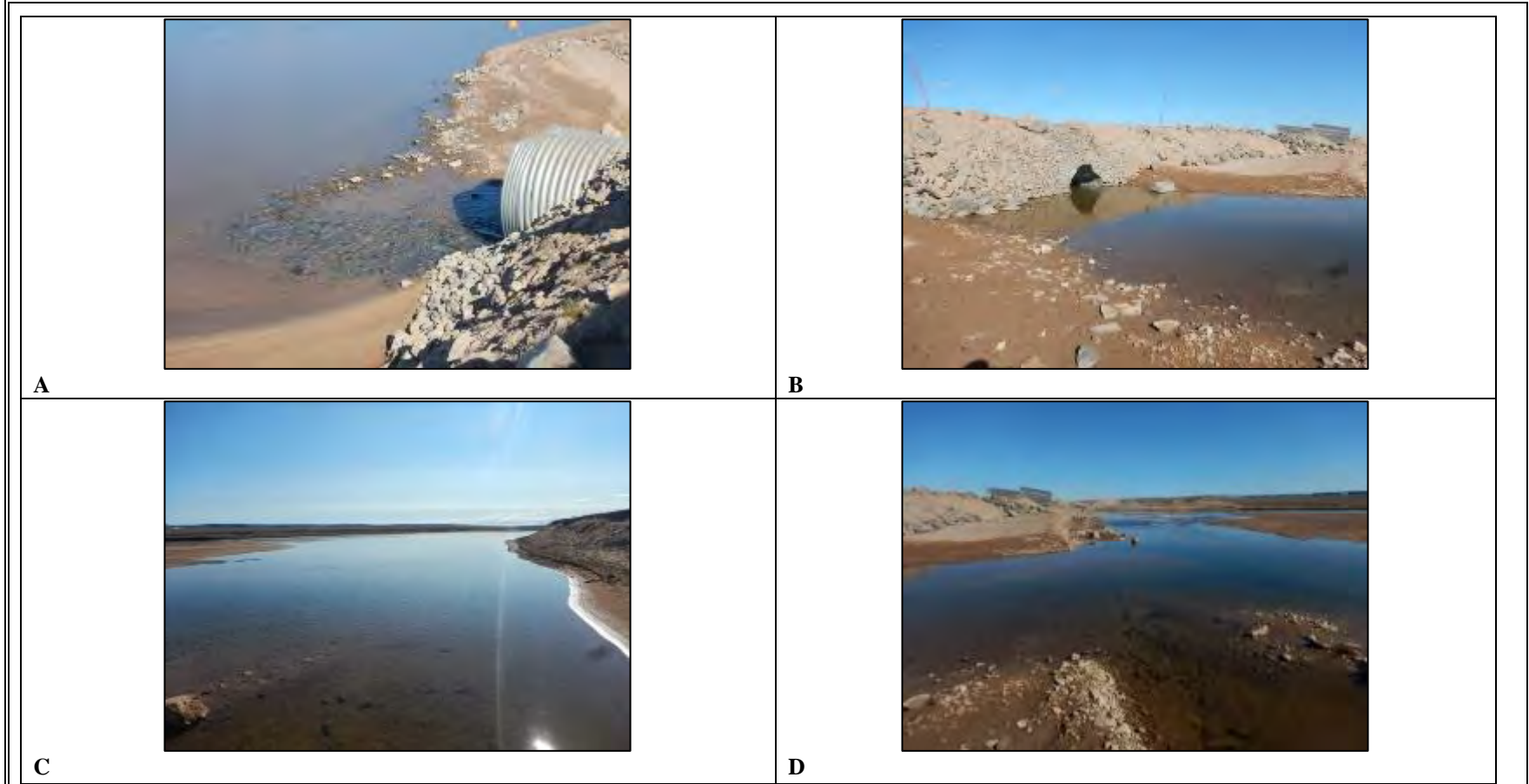
**Photos 1.** Photographs upstream of the Tote Road crossing BG-32 (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> Mary River Project</p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – Yes</b></p>
--	--	----------------------------	--

**Tote Road Site CV-217**

**UTM Coordinates:** 17W 524321 E 7922189 N **Date Surveyed:** 30-Jun-19

**Summary:** A bridge and culvert crossing with abundant habitat for both species. No fish passage issues were identified for either the bridge or culvert crossings in spring 2019.



**Photos 1.** Photograph upstream of the Tote Road crossing CV-217: (A) showing the culvert; and photographs downstream of the Tote Road: (B) looking upstream; (C) looking downstream; and (D) looking across.

<p><b>Baffinland Iron Mines</b> Mary River Project</p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – Yes</b></p>
--	--	----------------------------	--

**Tote Road Site CV-216**

**UTM Coordinates:** 17W 542764 E 7921724 N **Date Surveyed:** 30-Jun-19

**Summary:** A small stream that provides habitat for Ninespine Stickleback and small juvenile Arctic Char (especially young-of-the-year from Muriel Lake). A slight perch was remediated in 2019.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-216: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> Mary River Project</p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b></p>
			<p><b>Ninespine Stickleback – Yes</b></p>



**Tote Road Site BG-30**

**UTM Coordinates:** 17W 546070 E 7919844 N **Date Surveyed:** 1-Jul-19

**Summary:** Stream provides abundant rearing habitat, particularly upstream of the road in a large pond. Access to the upstream pond was created with a rocky ramp as part of the Tote Road Compensation Plan. There were no fish passage issues identified in spring 2019.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing BG-30: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> Mary River Project</p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – No</b></p>
--	--	----------------------------	---



**Tote Road Site BG-29**

**UTM Coordinates:** 17W 546229 E 7919877 N **Date Surveyed:** 1-Jul-19

**Summary:** Stream provides abundant summer rearing habitat for both species. Road aggregate partially blocked the upstream end of the culvert in spring 2019. Blockage was removed and full access restored in fall 2019.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing BG-29: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> Mary River Project</p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – Yes</b></p>
--	--	----------------------------	--

**Tote Road Site BG-27**

**UTM Coordinates:** 17W 547876 E 7919355 N **Date Surveyed:** 1-Jul-19

**Summary:** Site provides summer rearing habitat for juvenile Arctic Char. There were no fish passage issues identified in spring 2019.



**A**



**B**



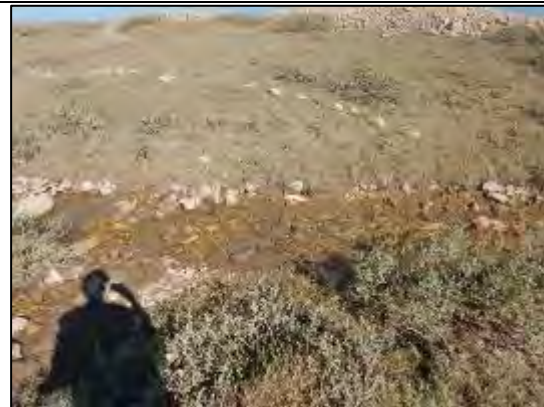
**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing BG-27: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

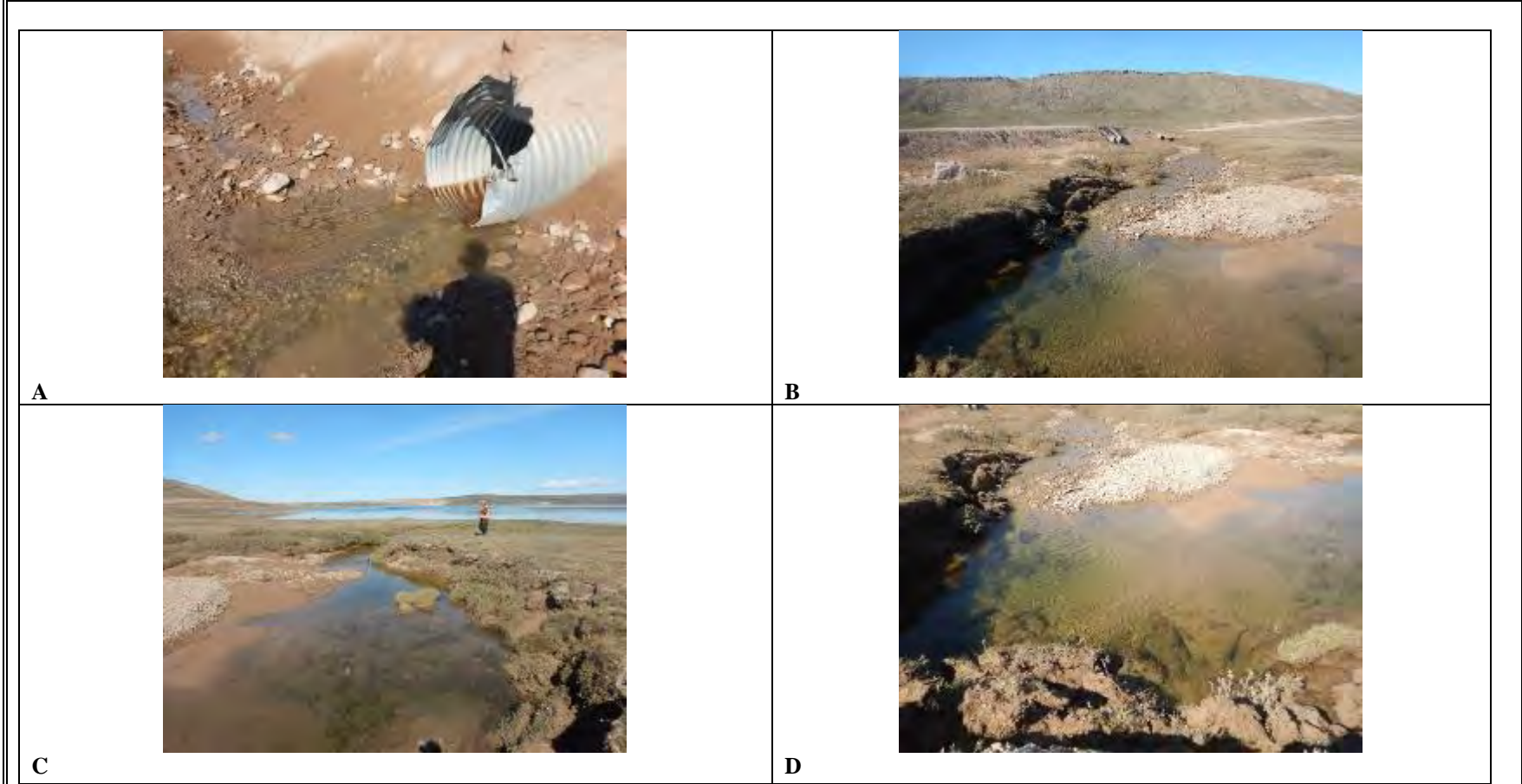
<p><b>Baffinland Iron Mines</b> Mary River Project</p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b></p>
			<p><b>Ninespine Stickleback – No</b></p>




**Tote Road Site BG-24**

**UTM Coordinates:** 17W 548766 E 7918878 N **Date Surveyed:** 1-Jul-19

**Summary:** Site provides summer rearing habitat for juvenile Arctic Char. There were no fish passage issues identified in spring 2019.



**Photos 1.** Photographs upstream of the Tote Road crossing BG-24: (A) showing the culvert; and photographs downstream of the Tote Road: (B) looking upstream; (C) looking downstream; and (D) looking across.

<p><b>Baffinland Iron Mines</b> Mary River Project</p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – No</b></p>
--	--	----------------------------	---

## Tote Road Site BG-17

**UTM Coordinates:** 17W 550703 E 7917643 N

**Date Surveyed:** 1-Jul-19

**Summary:** Site provides summer rearing habitat for both species. There were no fish passage issues identified in spring 2019.



**A**



**B**



**C**



**D**



**E**



**F**

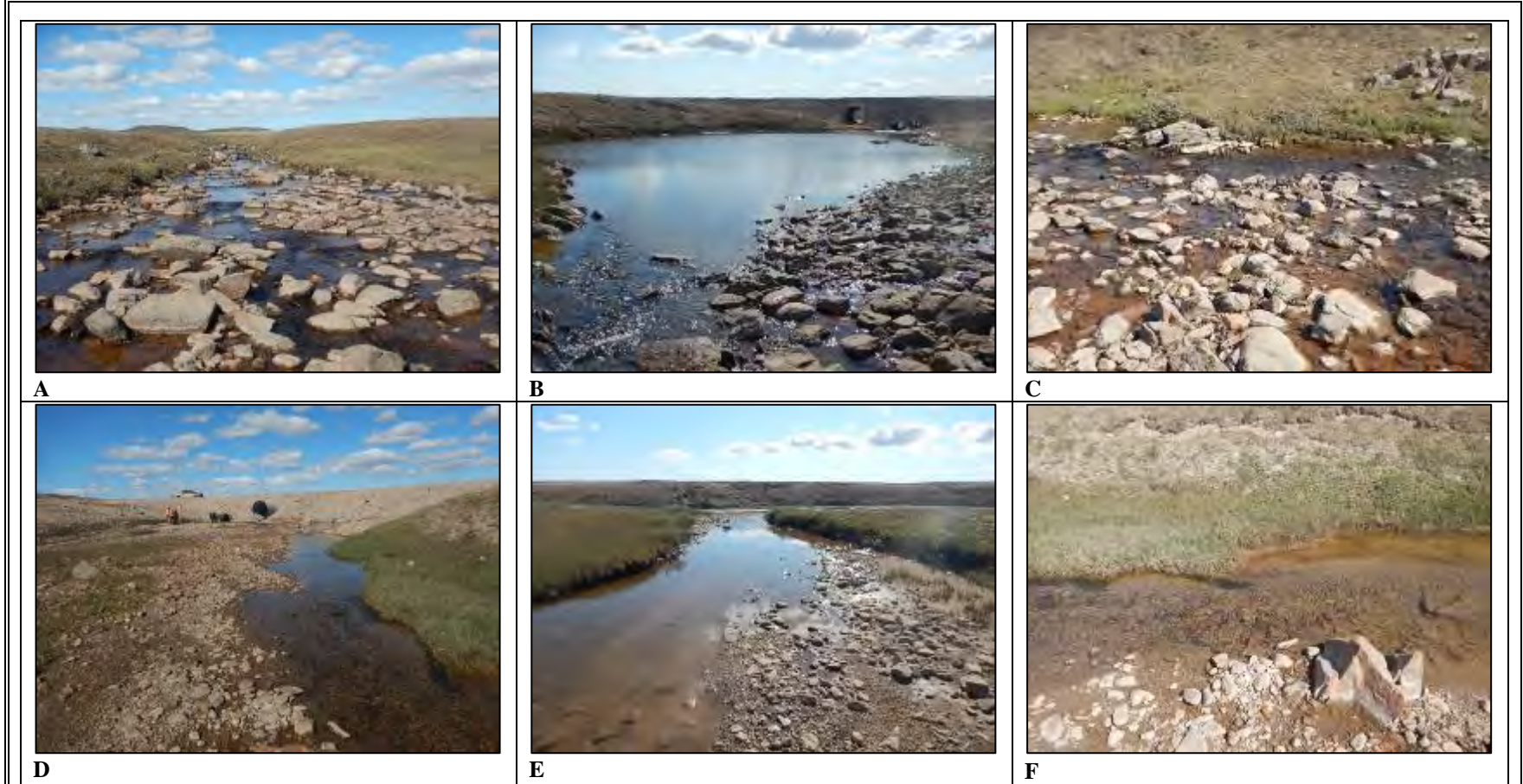
**Photos 1.** Photographs upstream of the Tote Road crossing BG-17: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.



**Tote Road Site BG-04**

**UTM Coordinates:** 17W 553250 E 7915100 N **Date Surveyed:** 1-Jul-19

**Summary:** Site provides summer rearing habitat for both species. There were no fish passage issues identified in spring 2019.



**Photos 1.** Photographs upstream of the Tote Road crossing BG-04: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> <b>Mary River Project</b></p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – Yes</b></p>
---	--	----------------------------	--

**Tote Road Site CV-001**

**UTM Coordinates:** 17W 553544 E 7914897 N **Date Surveyed:** 1-Jul-19

**Summary:** Fish were not present in spring 2019 due to naturally low water levels; however, this stream has typically provided summer rearing habitat for both species when surveyed. There were no fish passage issues identified in spring 2019.



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-001: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<p><b>Baffinland Iron Mines</b> Mary River Project</p>		<p><b>Fish Habitat</b></p>	<p><b>Arctic Char - Yes</b> <b>Ninespine Stickleback – Yes</b></p>
--	--	----------------------------	--



## Tote Road Site CV-223

UTM Coordinates: 17W 555705 E 7914676 N

Date Surveyed: 1-Jul-19

**Summary:** This large river (Tom River) includes both bridge and culvert crossings. All channels provide abundant summer rearing habitat for Arctic Char. There were no fish passage issues identified in spring 2019.



A



B

**Tote Road Site CV-223 (continued)**



**C**



**D**



**E**



**F**



**G**



**H**

**Photos 1.** Photographs upstream of the Tote Road crossing CV-223: left channel downstream of the Tote Road crossing CV-223: (C) looking upstream; (D) looking downstream; (E) looking across; and photographs of right channel downstream of the Tote Road: (F) looking upstream; (G) looking downstream; and (H) looking across.

**Baffinland Iron Mines  
 Mary River Project**



**Fish Habitat**

**Arctic Char - Yes**

**Ninespine Stickleback – No**



**Tote Road Site CV-224**

**UTM Coordinates:** 17W 556238 E 7915044 N **Date Surveyed:** 1-Jul-19

**Summary:** Site provides summer rearing habitat for both species. There were no fish passage issues identified in spring 2019.



**A**



**B**



**C**



**D**



**E**



**F**

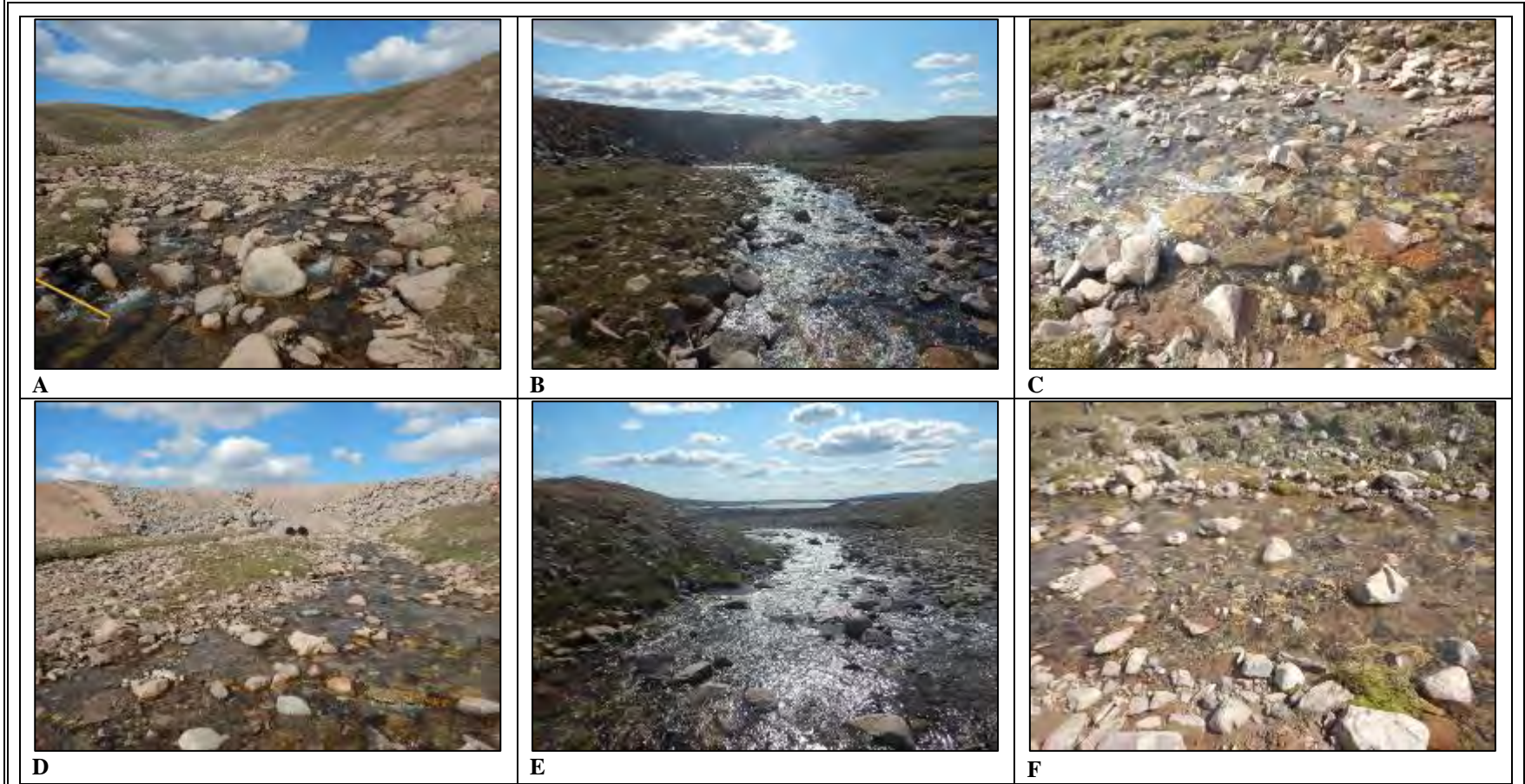
**Photos 1.** Photographs upstream of the Tote Road crossing CV-224: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.



## Tote Road Site CV-225

**UTM Coordinates:** 17W 557421 E 7915187 N **Date Surveyed:** 1-Jul-19

**Summary:** Site provides summer rearing habitat for both species. The culverts were slightly perched and measured velocities were too high for smaller fish at the downstream end of the culverts (0.91-1.42 m/s). Remediation has not yet been completed at this site.



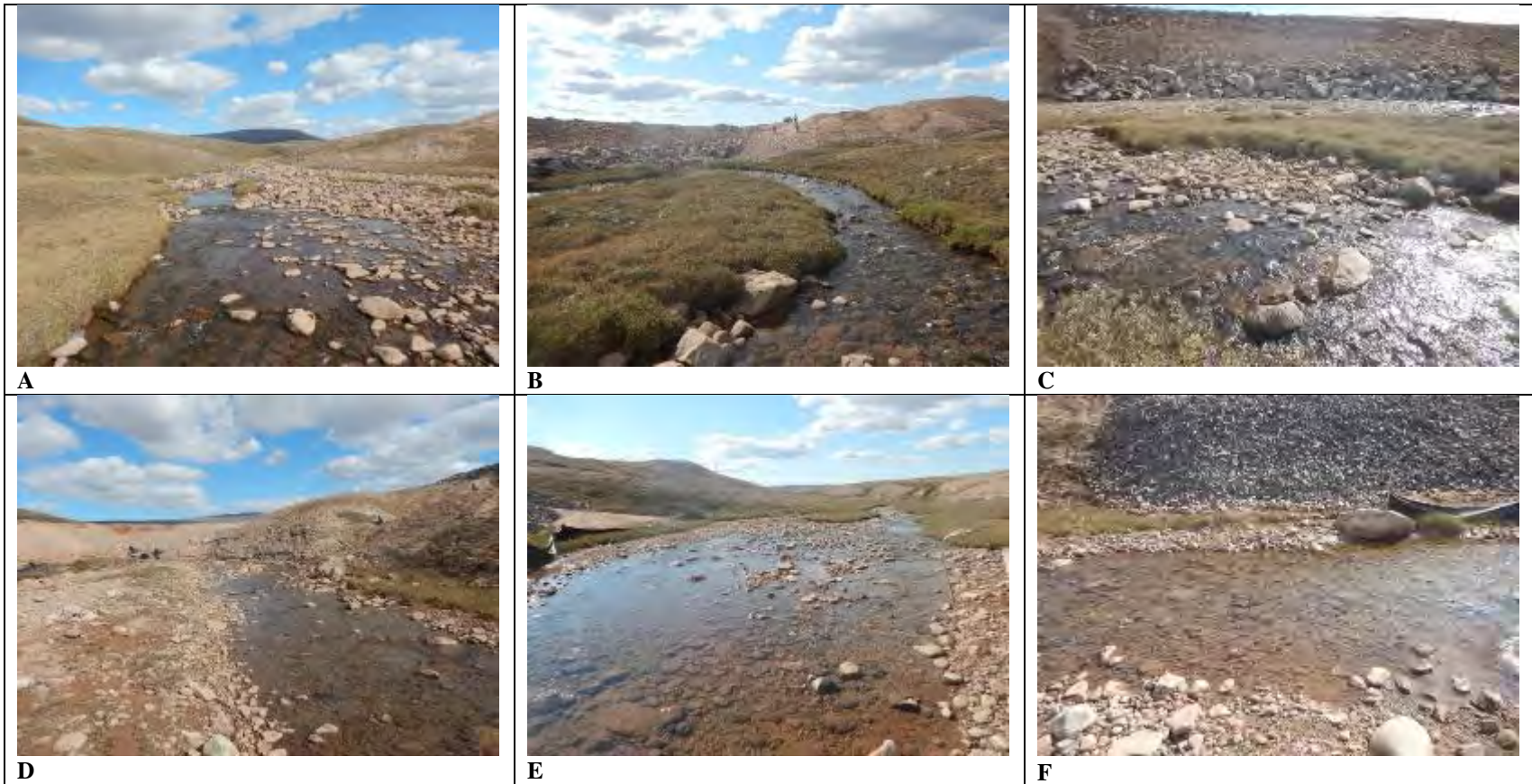
**Photos 1.** Photographs upstream of the Tote Road crossing CV-225: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<b>Baffinland Iron Mines</b> Mary River Project		<b>Fish Habitat</b>	<b>Arctic Char - Yes</b> <b>Ninespine Stickleback – Yes</b>
--	--	---------------------	--

**Tote Road Site BG-01**

**UTM Coordinates:** 17W 558000 E 7914928 N **Date Surveyed:** 1-Jul-19

**Summary:** This stream provides summer rearing habitat for both species. Upstream of the road, rip rap had blocked fish access to a smaller tributary stream. Rip rap was removed and access restored in fall 2019.



**Photos 1.** Photographs upstream of the Tote Road crossing BG-01: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<b>Baffinland Iron Mines</b> Mary River Project		<b>Fish Habitat</b>	<b>Arctic Char - Yes</b>
			<b>Ninespine Stickleback – Yes</b>




**Tote Road Site CV-186**

**UTM Coordinates:** 17W 560705 E 7913498 N **Date Surveyed:** 1-Jul-19

**Summary:** Site provides summer rearing habitat for both species. There were no fish passage issues identified in spring 2019.



**Photos 1.** Photographs upstream of the Tote Road crossing CV-186: (A) looking upstream; (B) looking downstream; (C) looking across; and photographs downstream of the Tote Road: (D) looking upstream; (E) looking downstream; and (F) looking across.

<b>Baffinland Iron Mines</b> Mary River Project		<b>Fish Habitat</b>	<b>Arctic Char - Yes</b>
			<b>Ninespine Stickleback – Yes</b>



**APPENDIX D**

**PHOTOGRAPHIC LOG OF TOTE ROAD REMEDIATION WORKS, 3-4 SEPTEMBER 2019**

## 2019 Tote Road Stream Crossing Remediation – CV-129

### Photos



A



B



C



D

**Photos 1:** Photographs of the downstream end of the perched culvert before remediation at CV-129: (A) showing of the slightly perched culvert; (B) showing the pool under the perched culvert; and photographs after remediation: (C) showing water flowing over constructed step-pool habitat; and D) showing a close-up of large rocks and cobble placed in the former pool to fill spaces, creating riffle habitat.

## 2019 Tote Road Stream Crossing Remediation – CV-114

### Photos



A



B



C



D



E



F

**Photos 2:** Photographs of the downstream end the perched culvert before remediation at CV-114: (A) showing the slightly perched left culvert; (B) showing the slightly perched right culvert; (C) showing both perched culverts; and photographs after remediation (D) showing the first pool constructed by placing rocks in semi-ring formation to create a slight backwater effect; (E) showing riffle access to culvert pool; and (F) showing slightly increased water level at downstream end of the culverts with slight perch remaining.



## 2019 Tote Road Stream Crossing Remediation – CV-111

### Photos



A



B



C



D



E



F

**Photos 3:** Photographs of the downstream end the perched culvert before remediation at CV-111: (A) and (B) showing highly perched culvert; (C) showing the pool partway built and photographs after remediation (D) showing the pool and rock ramp constructed immediately below the culvert to create a backwater effect and lessen the perch; (E) showing the system of rock steps constructed to assist with accessibility; and (F) showing two constructed channels with a small perch remaining.



## 2019 Tote Road Stream Crossing Remediation – CV-106

### Photos



A



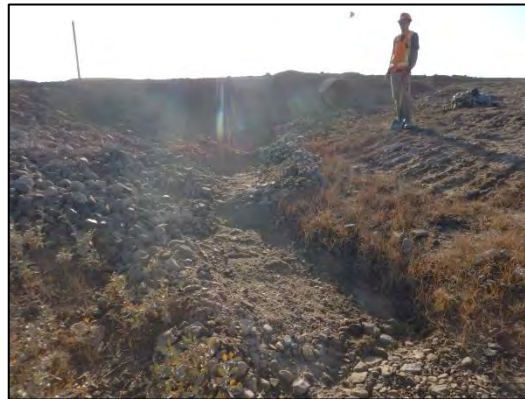
B



C



D



E



F

**Photos 4:** Photographs of the downstream end the perched culvert before remediation at CV-106: (A) showing the dry channel with ineffective fish ramp that cannot maintain surface flow when water is present and photographs after remediation (B) Pool constructed immediately below the culvert at CV-106; (C-F) System of step-pools constructed below the culvert with cobble and gravel to help eliminate sub-flow problems.

## 2019 Tote Road Stream Crossing Remediation – BG-29

### Photos



**A**



**B**

**Photos 5:** Photographs of the upstream end of the perched culvert partway through remediation at BG-29: (A) showing the remaining berm blocking the culvert and photographs after remediation, and (B) showing the rocky material was removed to expose the culvert and improve fish access.

## 2019 Tote Road Stream Crossing Remediation – CV-216

### Photos



A



B



C



D



E



F

**Photos 6:** Photographs of the downstream end the perched culvert before remediation at CV-216: (A) and (B) showing a slightly perched right culvert and dry perched left culvert; and photographs after remediation: (C) and (D) showing the boundary of the constructed pool around the right culvert, creating a backwater effect with passage through the center of the boundary; (E) showing the backwater effect created by the constructed boundary successfully removing the perch; and (F) showing rocky substrate added under the right culvert to fill empty space.



## 2019 Tote Road Stream Crossing Remediation – BG-50

### Photos



**A**



**B**



**C**



**D**



**E**



**F**

**Photos 7:** Photographs of the downstream end the perched culvert before remediation at BG-50: (A-C) showing ineffective fish ramp at left culvert and dry right culvert with flow under the rocks; and photographs after remediation: (D) and (E) showing system of step pools and channels constructed to connect left culvert to stream below, improving fish access; and (F) showing a similar rocky ramp on right culvert, but insufficient water levels to determine effectiveness.



## 2019 Tote Road Stream Crossing Remediation – CV-225

### Photos



**Photos 8:** Photograph of the downstream end the perched culvert before remediation at CV-225. Remediation could not be completed in 2019.