Appendix 14-A

Fish and Aquatic Habitat Baseline

HARPER CREEK PROJECT

Application for an Environmental Assessment Certificate / Environmental Impact Statement

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

FISH AND AQUATIC HABITAT BASELINE

PREPARED FOR:

Harper Creek Mining Corp.
730 - 800 West Pender Street
Vancouver, BC V6C 2V6

PREPARED BY:

Knight Piésold Ltd.
Suite 1400 – 750 West Pender Street
Vancouver, BC   V6C 2T8 Canada
p. +1.604.685.0543 • f. +1.604.685.0147

VA101-458/15-1
Rev 1
August 22, 2014

Knight Piésold
CONSULTING
www.knightpiesold.com

ISO 9001 - FS 64925
ISO 14001 - EMS 550121
OHSAS 18001 - OHS 550122

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

FISH AND AQUATIC HABITAT BASELINE
VA101-458/15-1

Rev	Description	Date	Approved
0	Issued in Final	August 1, 2014	KJB
1	Issued in Final	August 22, 2014	K.

Knight Piésold Ltd.
Suite 1400
750 West Pender Street
Vancouver, British Columbia Canada V6C 2T8
Telephone: (604) 685-0543
Facsimile: (604) 685-0147
www.knightpiesold.com

Knight Piésold CONSULTING

EXECUTIVE SUMMARY

The Harper Creek Project (the Project) is a proposed open pit copper mine located in south-central British Columbia (BC), approximately 150 km northeast by road from Kamloops. The Project has an estimated 28-year mine life based on a process plant throughput of 70,000 tonnes per day. The Proponent, Harper Creek Mining Corporation, is a wholly owned subsidiary of Yellowhead Mining Inc., which is a public BC junior mineral development company trading on the Toronto Stock Exchange.

The purpose of this document is to report on fisheries and aquatic life information collected during the 2011 through 2013 field seasons as a component of baseline studies for the Harper Creek Project. This baseline information will be used to identify and assess the potential impacts of the Harper Creek Project on fish and aquatic habitat and as reference information to inform future monitoring activities. Knight Piésold Ltd. was engaged by Harper Creek Mining Corp. during May 2011 to undertake fish and aquatic habitat baseline studies for the Harper Creek Project. Field work was initiated during June 2011 and a portion of this study continued through to late September 2013.

The primary focus of the study is to determine the diversity, relative abundance, and distribution of fish species within the Local Study Area in relation to physical stream habitat conditions. Fish ageing structures as well as muscle and liver tissue samples were collected from a subsample of resident bull trout and rainbow trout inhabiting Project watersheds. Fish habitat assessments were completed to document physical habitat characteristics in streams draining the Project Site, with additional emphasis placed on fish-bearing waters. The aquatic survey explored periphyton diversity and abundance, chlorophyll-a biomass, benthic invertebrate diversity and abundance, and aquatic sediment samples were also collected from the study area.

The Project sits on the watershed divide between Harper Creek and the Barriere River to the west and south, and the North Thompson River to the north. Proposed mining and processing infrastructure is sited almost exclusively in the Harper Creek watershed, although a small portion of the Open Pit overlaps upper Baker Creek draining to the North Thompson River. The Project Site (4,700 ha) is defined as the area within a one km buffer around the Open Pit and all planned mining and ore processing infrastructure on the plateau above Vavenby, BC.

Harper Creek contains the highest fish diversity of the study area watersheds surveyed and the diversity closely matches that observed in past studies and the historic literature. The ranking of relative fish abundance in Harper Creek suggests that bull trout are the most abundant fish species, followed by coho (fry and parr), rainbow trout, mountain whitefish, torrent sculpin, and longnose dace. The distribution of dace and sculpin are limited to the very lowest reaches of Harper Creek while coho juveniles, rainbow trout, and mountain whitefish were observed in mainstem locations in the lower third of the watershed.

Bull trout are distributed throughout Harper Creek below river km 24.5 and in the lower portions of accessible tributaries. The upper hanging valley of an unnamed tributary to upper Harper Creek is the proposed location for the Tailings Management Facility. This tributary has been assigned the reference name “T-Creek” for use in this report. The upper portion of second unnamed tributary to upper Harper Creek overlaps the proposed Open Pit. This second tributary has been assigned the reference name “P-Creek” for use in this report. T-Creek and P-Creek both have fish barriers

located 336 m and 469 m, respectively, upstream of their confluences with upper Harper Creek. Multiple surveys upstream of the fish barriers located in T-Creek and P-Creek, where project development is proposed, did not yield any fish captures and all stream reaches in Project Site are considered fishless.

Migratory bull trout spawners were first observed in portions of lower Harper Creek during late July and early August and observations became more frequent as the September spawning season approached. The highest numbers of migratory spawners were observed holding in pools in a high gradient stretch of river immediately downstream of a series of cascades and waterfalls that form a migration obstacle at river km 18.5 during late August through to mid-September. Directed observations at the same river locations during late September, coupled with the observation of completed spawning redds suggested that these spawners were no longer present and had likely out-migrated from Harper Creek.

The detection of migratory bull trout and spawning sites (redds) upstream of the river km 18.5 falls confirms migratory bull trout can ascend the migration obstacle. Migratory bull trout in the region typically initiate their migration in early July or August and it appears that these falls are passable at higher creek flows prior to the onset of low flows during late summer.

The lowermost sections of Jones Creek and Baker Creek below the Lost-Creek-Birch Island Lost-Creek Road contain a mix of fish species common to the North Thompson River (coho juveniles, rainbow trout, torrent sculpin, and bull trout) while only rainbow trout were sampled upstream of the road crossings. Both Jones Creek and Baker Creek are both relatively high gradient streams which both have barriers (series of cascades or waterfalls) that limit fish to the lower 1.8 km of their respective watersheds. The relative abundance of rainbow trout in Jones Creek and Baker Creek was almost twice that observed in lower Harper Creek.

The summary statistics and community indices for periphyton and benthic invertebrates in the study area were consistent across the years of baseline sampling. In general, the ranges of values across sites for many of the statistics and metrics were narrow. As a result, while it is possible to ascertain which sites had relatively lower or higher values each year, it is important to note that the values between sites were often quite similar.

Of the 30 elemental metals analyzed in the sediment samples, seven metals reported above CCME, ISQG, and PEL guideline limits and ten sediment samples reported above the BC (ISQG and PEL) guideline limit. The highest loading of those metals that reported above both aquatic sediment CCME and BC guideline standards originated from P-Creek and these observations can be partially explained given the watersheds proximity to the proposed mine pit location.

In summary, the present study has identified new information that confirms the distribution of fish species as well as the relative abundance and diversity of aquatic biota in the streams draining the Project Site. The headwater streams within the Project Site have been confirmed as fishless although surface and sub-surface runoff from these streams flows into fish-bearing waters in upper Harper Creek (lowermost T-Creek and P-Creek), lower Baker Creek, and lower Jones Creek.

TABLE OF CONTENTS

PAGE

TABLES

FIGURES

APPENDICES

GLOSSARY AND ABBREVIATIONS

AIR	Application Information Requirements
BC EAA	British Columbia Environmental Assessment Act
BC EAO	British Columbia Environmental Assessment Office
BC	British Columbia
CCME	Canadian Council of Ministers of the Environment
CEA Agency	Canadian Environmental Assessment Agency
CEAA, 1992	Canadian Environmental Assessment Act, 1992
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPUE	Catch Per Unit Effort
CVAFA	Cold Vapour Atomic Fluorescence Spectrometry
DFO	Department of Fisheries and Oceans
DO	Dissolved Oxygen
EA	Environmental Assessment
ECOCAT	Ecological Reports Catalogue
EEM	Environmental Effects Monitoring
EIS	Environmental Impact Statement
EPT	Ephemeroptera, Plecoptera, and Trichoptera
FBI	Family Biotic Index
FISS	The Fisheries Information Summary System
ha	Hectare
HCMC	Harper Creek Mining Corporation
ICPMS	Inductively Coupled Plasma Mass Spectrometry
ISQG	Interim Sediment Quality Guidelines
km	Kilometre
LEL	Lowest Effect Level
LSA	Local Study Area
m	Metre
MDL	Method Detection Limit
MELP	Ministry of Environment, Lands and Parks
mg/kg	Milligrams per Kilogram
MOE	Ministry of Environment
MOF	Ministry of Forests
MMER	Metal Mining Effluent Regulations
N.A.	Not Applicable
NTU	Nephelometric Unit
PAG	Potentially Acid Generating
PEL	Probable Effects Level
Project, the	The Harper Creek Mining Project
Proponent, the	Harper Creek Mining Corporation
PTI	Pollution Tolerance Index
RSA	Regional Study Area
SARA	Species at Risk Act
SEL	Severe Effects Level
TMF	Tailings Management Facility
TOC	Total Organic Carbon
TSS	Total Suspended Solids
TSX	Toronto Stock Exchange
YMI	Yellowhead Mining Inc.

1 – INTRODUCTION

The purpose of this document is to report on fisheries and aquatic life information collected during the 2011, 2012, and 2013 field seasons as a component of baseline studies for the Harper Creek Project. Historical fish data available through regulatory agency sources and recent consultancy reports are also reported. The objectives of the study are as follows:

- To determine fish species occurrence, distribution, and relative abundance in the streams draining the Project Site including the identification of any regionally important, threatened, or endangered species.
- To identify fish species/life stages present and investigate their temporal distribution.
- To investigate baseline information on metal concentrations in fish tissues from the baseline study area.
- To investigate/document aquatic habitat and related physical variables such as water quality.
- To assess and document physical barriers to upstream fish migration.
- To collect baseline aquatic information (chlorophyll-a, periphyton, benthic invertebrates, and aquatic sediment) to assist in aquatic habitat characterization and for aquatic effects monitoring.

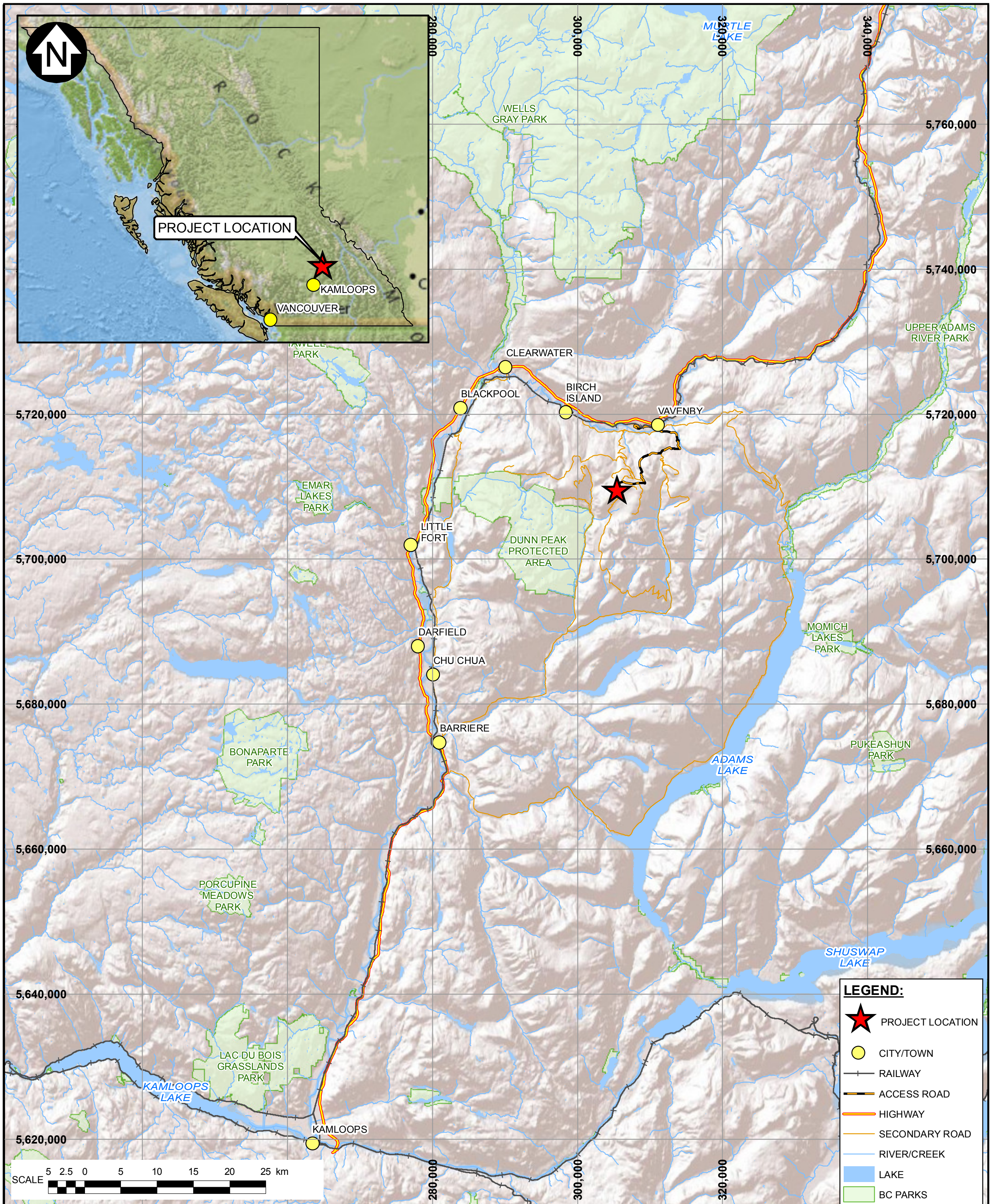
The baseline information presented in this document will be used to identify and assess the potential impacts of the Harper Creek Project on fish and aquatic habitat and as reference information to inform future monitoring activities.

1.1 PROJECT DESCRIPTION

Harper Creek Mining Corporation (HCMC) proposes to construct and operate the Harper Creek Project (the Project), an open pit copper mine near Vavenby, British Columbia (BC). The Project has an estimated 28-year mine life based on a process plant throughput of 70,000 tonnes per day (25 million tonnes per year). Ore will be processed on site through a conventional crushing, grinding and flotation process to produce a copper concentrate, with gold and silver by-products, which will be trucked from the Project Site along approximately 24km of existing access roads to a rail load-out facility located at Vavenby. The concentrate will be transported via the existing Canadian National Railway network to the existing Vancouver Wharves storage, handling and loading facilities located at the Port of Vancouver for shipment to overseas smelters.

The Project consists of an open pit mine, on-site processing facility, tailings management facility (TMF) (for tailings solids, subaqueous storage of PAG waste rock, and recycling of water for processing), waste rock stockpiles, low grade and overburden stockpiles, a temporary construction camp, ancillary facilities, mine haul roads, sewage and waste management facilities, a 24km access road between the Project Site and a rail load-out facility located on private land owned by HCMC in Vavenby, and a 12km power line connecting the Project Site to the BC Hydro transmission line corridor in Vavenby. The Project Location is shown in (Figure 1.1.1) and the Project infrastructure is shown in (Figure 1.1.2).

This report describes the baseline conditions for fish and aquatic organisms for the purposes of the Application for an Environmental Assessment (EA) Certificate under the British Columbia Environmental Assessment Act (BC EAA) and the Environmental Impact Statement (EIS) under the Canadian Environmental Assessment Act (CEAA), in accordance with the Approved Project Application Information Requirements (AIR) issued October 21, 2011.



SAVED: M:\1\01\00458\15\A\GIS\Figs\Report1_FishAquaticBaseline\Rev1\Fig1-1-1_ProjectLocation_r1.mxd; Aug 21, 2014 9:52 AM; cczembor

NOTES:

1. BASE MAP: TRIM AND NTS MAPPING, ESRI ARCGIS ONLINE SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:750,000 FOR 8.5x11 (LETTER) PAPER.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
1	21AUG'14	ISSUED WITH REPORT	CAC	CAC	PMT	KJB

HARPER CREEK MINING CORP.

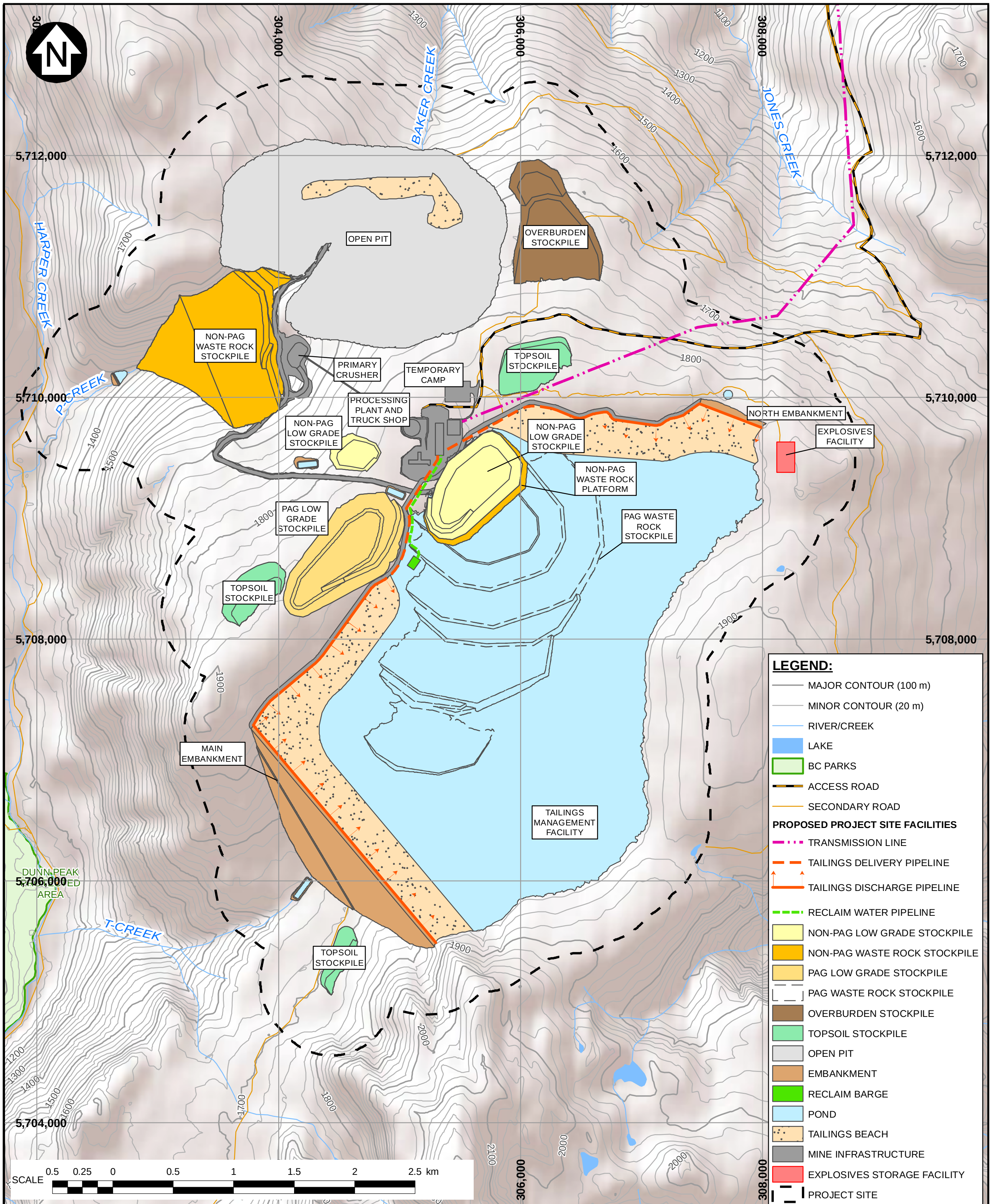
HARPER CREEK PROJECT

PROJECT LAYOUT - YEAR 24

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-458/15	1

FIGURE 1.1.1 REV 1



NOTES:

1. BASE MAP: TRIM AND NTS MAPPING, ESRI ARCGIS ONLINE SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:45,000 FOR 8.5x11 (LETTER) PAPER.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
1	21AUG'14	ISSUED WITH REPORT	CAC	CAC	PMT	KJB

HARPER CREEK MINING CORP.

HARPER CREEK PROJECT

PROJECT LAYOUT - YEAR 24

Knight Piésold CONSULTING

P/A NO. VA101-458/15

REF NO. 1

FIGURE 1.1.2

REV 1

SAVED: M:\1\01\00458\15\A\GIS\Figs\Report1_FishAquaticBaseline\Rev1\Fig1-1-2_ProjectLayoutY24_r1.mxd; Aug 26, 2014 10:17 AM; cczembor

1.2 PROJECT LOCATION

The Project is located in the Thompson-Nicola area of BC, approximately 150km north-east of Kamloops along Yellowhead Highway #5, approximately 10 km southwest of the unincorporated municipality of Vavenby, BC. The Project is located within National Topographic System (NTS) map sheets 82M/5 and 82M/12, is geographically centred at 51º30'N latitude and 119º48'W longitude, and is situated at approximately 1800 Metres above sea level (masl). The mineral claims comprising the Project cover an area of 42,636.48 hectares.

1.3 PROJECT PROPONENT

The Proponent of the Project is HCMC, a wholly owned subsidiary of Yellowhead Mining Inc. (YMI). YMI was formed in 2005 as a private British Columbia company specifically to acquire, explore and, if feasible, develop the Harper Creek deposit. YMI is now a publicly owned BC mineral exploration and development company trading on the Toronto Stock Exchange (TSX) in Canada. HCMC's development strategy is to engineer, permit, finance, construct, and operate the Harper Creek Project.

1.4 PROJECT SETTING

The historic literature identified describing the fish fauna and habitat characteristics of Harper Creek and the North Thompson drainages associated within the Project LSA is limited, and only two studies have been directed at select sites within the Harper Creek and greater Barriere River watersheds (e.g., Grinton 1994 and Hagen and Baxter 1992).

North Barriere and Saskum Lakes are important recreational angling locations proximate to the Project and the Dunn Peak Protected Area stretches from the North Thompson River in the west, to include the alpine areas of Dunn Peak, and reaching east to the bottom of Harper Creek in the Shuswap Highlands.

Private agricultural and livestock lands located along the North Thompson River and Birch Island Lost-Creek Road have water abstraction facilities on Baker and Jones Creek which have the potential to affect flows, especially during flow summer conditions.

1.5 STUDY OBJECTIVES

The purpose of this document is to report on fisheries and aquatic life information collected during the 2011, 2012, and 2013 field season as a component of baseline studies for the Harper Creek Project. Historical fish data available through regulatory agency sources and recent consultancy reports are also reported. The objectives of the study are as follows:

- To determine fish species occurrence, distribution, and relative abundance in the streams draining the Project Site including the identification of any regionally important, threatened, or endangered species.
- To identify fish species/life stages present and investigate their temporal distribution.
- To investigate baseline information on metal concentrations in resident fish tissues from the baseline study area.
- To investigate/document aquatic habitat and related physical variables such as water quality.
- To assess and document physical barriers to upstream fish migration.

- To collect baseline aquatic information (chlorophyll-a, periphyton, benthic invertebrates, and aquatic sediment) to assist in aquatic habitat characterization and for aquatic effects monitoring.

A literature and database review was focused on fish presence/absence and distribution within the overall Project footprint and the surrounding area, with an emphasis on those watersheds that may potentially be impacted by the Project. Existing information for Harper Creek and other proximate water bodies was compiled from a variety of sources such as Fisheries Oceans Canada, the Ministry of Environment, watershed restoration reports, consultancy reports and existing databases (e.g., Fisheries Information Summary System (FISS) and the Ecological Reports Catalogue (EcoCat). Fish species listed on Schedule 1 of SARA and/or species of Special Concern under COSEWIC with the potential to occur within the study area are also reported upon.

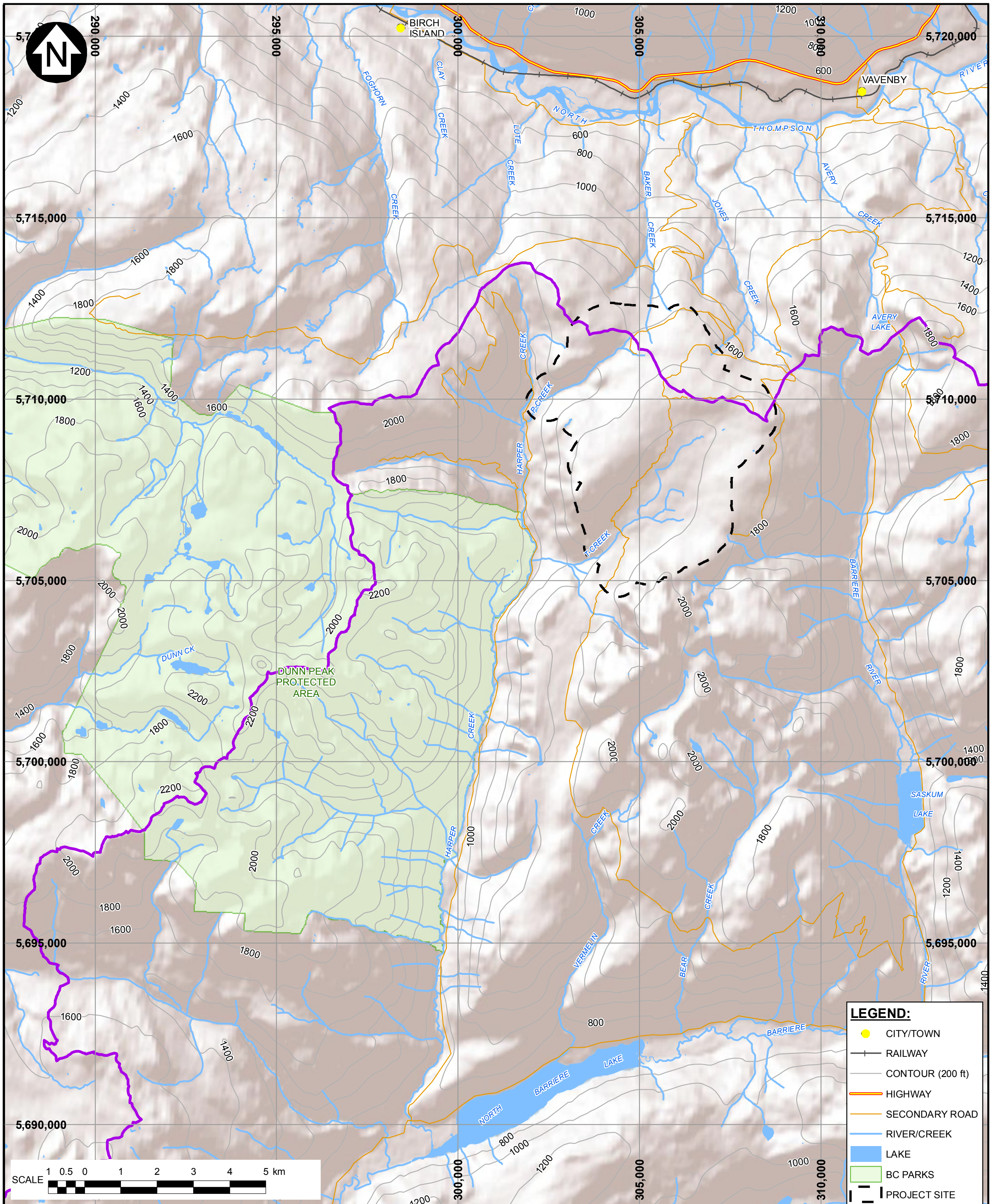
The baseline information presented in this document will be used to identify and assess the potential impacts of the Harper Creek Project on fish and aquatic habitat and as reference information to inform future monitoring activities.

1.6 BASELINE STUDY AREA

The Project sits on the watershed divide between Harper Creek and the Barriere River to the west and south, and the North Thompson River to the north. Proposed mining and processing infrastructure is sited almost exclusively in the Harper Creek watershed, although a small portion of the Open Pit overlaps upper Baker Creek (see Figure 1.6.1) draining to the North Thompson. Harper Creek flows south from the Project Site and discharges into the western end of North Barriere Lake, just upstream of the lake outlet. The Barriere River flows out of the lake, with its valley oriented in a southwesterly direction for approximately 25 km before meeting North Thompson River 58 km north-northeast of Kamloops, BC.

The Harper Creek Project is located within the Shuswap Highlands, which are part of the western foothills of the Columbia Mountains and represent a transitional region between the interior plateaus and the Rocky Mountain ranges. Elevations in the Harper Creek watershed range from approximately 640 masl near the confluence with North Barriere Lake to over 2,200 masl at the apex of Granite Mountain. Most of the Project infrastructure is located on the eastern side of the Harper Creek watershed at elevations between approximately 1,600 masl and 1,800 masl.

Weather systems typically track from west to east over the region. Regional data indicate that both precipitation and runoff increase with elevation, as weather systems are forced up and over the Columbia Mountains. Regional runoff patterns are characterized by low flows during the winter months when precipitation falls almost exclusively as snow, high flows during the spring and early summer snowmelt freshet, low flows during the dry late summer months, and sustained flows during the fall months, as precipitation increases. The change in runoff with elevation is also quite evident with lower runoff from lower elevation watersheds and an earlier onset of the spring freshet resulting from warm spring temperatures arriving earlier at the lower elevations. The annual hydrograph in the baseline study area has a uni-modal shape, with the majority of runoff occurring in May and June during the snowmelt freshet.



NOTES:

1. BASE MAP: TRIM AND NTS MAPPING, ESRI ARCGIS ONLINE SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:150,000 FOR 8.5x11 (LETTER) PAPER.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
1	21AUG'14	ISSUED WITH REPORT	CAC	CAC	PMT	KJB

HARPER CREEK MINING CORP.

HARPER CREEK PROJECT

PROJECT WATERSHEDS

Knight Piésold CONSULTING

P/A NO. VA101-458/15

REF NO. 1

FIGURE 1.6.1

REV 1

1.6.1 Local and Regional Study Area

The spatial and temporal boundaries for the Aquatic Environment assessment are discussed in the AIR (YMI 2011) for inclusion to the Application. The Aquatic Environment spatial boundary is defined by a Local Study Area (LSA) and Regional Study Area (RSA) as shown on Figure 1.6.2.

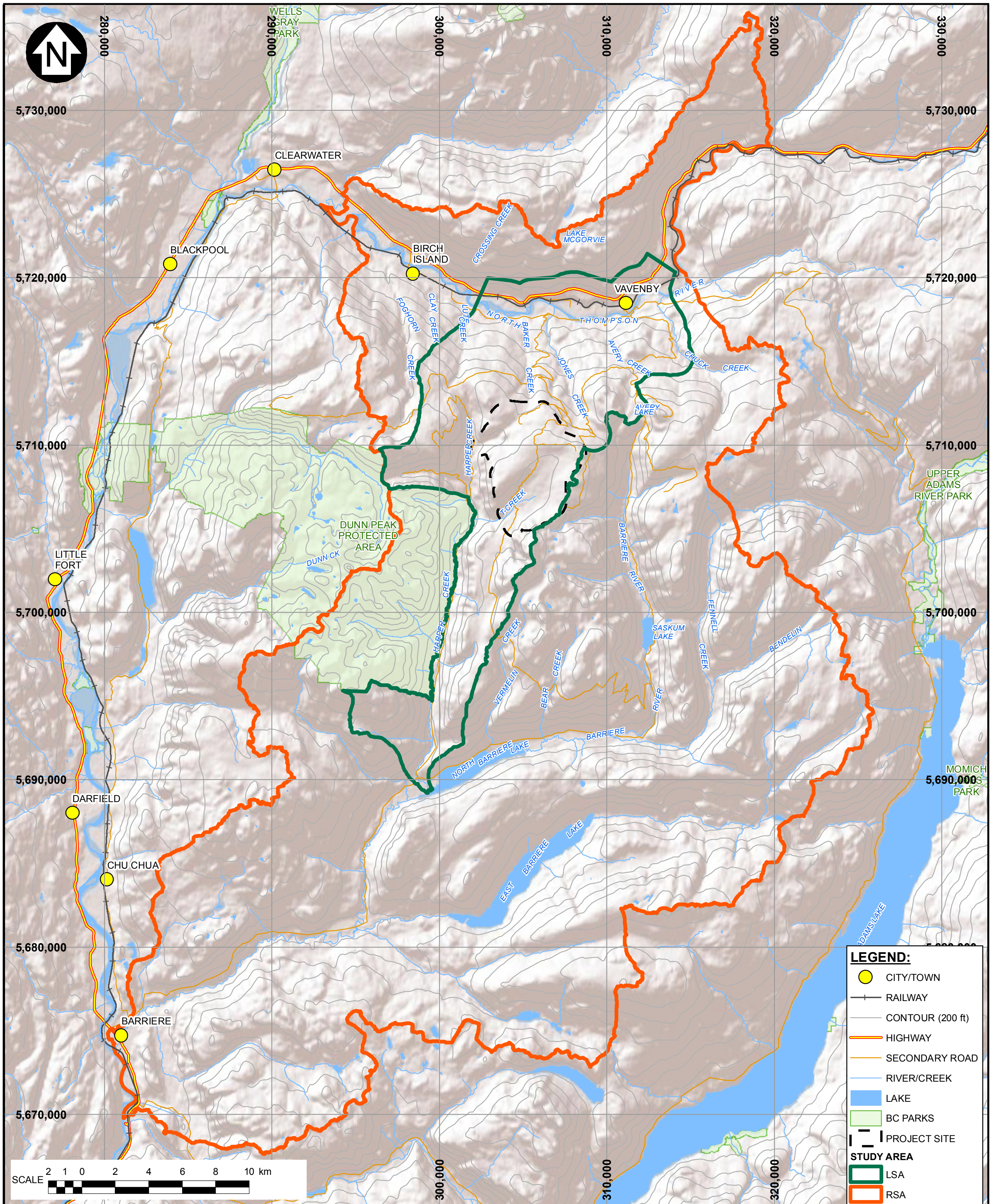
The LSA includes the Project footprint and surrounding area within which there is a reasonable potential for direct impacts to occur due to Project components or activities. It includes the catchment boundaries of Harper Creek, Lute Creek, Jones Creek, Baker Creek, Avery Creek, and lower Chuck Creek and incorporates a section of the North Thompson River and its adjacent north slope.

The RSA incorporates a broader geographic area where there is potential for indirect impacts or baseline information that may be relevant to the LSA and the effects assessment. It is based on the Vavenby and Barriere Landscape Unit boundaries and includes the Barriere River watershed and a portion of the North Thompson River valley near Vavenby, BC.

There are six main watercourses that may potentially be impacted by the Project (Table 1.6.1). None of the watercourses are classified as international and/or trans-boundary waters. Adjacent water bodies are also identified in Table 1.6.1.

Table 1.6.1 Summary of Watercourses and Waterbodies in the Study Area

Drainage	Project Site Drainages	Adjacent Watercourses and Waterbodies
Northern Drainage (Watercourses flowing north into the North Thompson River)	• Jones Creek • Baker Creek • Avery Creek	• Foghorn Creek • Lute Creek (west of site) • Chuck Creek
Southern Drainage (Watercourses flowing south into the Barriere River)	• Harper Creek (entire watershed) • T-Creek (tributary to Harper Creek) • P-Creek (tributary to Harper Creek)	• Barriere River • Saskum Lake • North Barriere Lake



SAVED: M:\1\01\00458\15\A\GIS\Figs\Report1_FishAquaticBaseline\Rev1\Fig1-6-2_StudyAreas_r1.mxd; Aug 21, 2014 9:52 AM; cczembor

NOTES:

1. BASE MAP: TRIM AND NTS MAPPING, ESRI ARCGIS ONLINE SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:325,000 FOR 8.5x11 (LETTER) PAPER.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
1	21AUG'14	ISSUED WITH REPORT	CAC	CAC	PMT	KJB

HARPER CREEK MINING CORP.

HARPER CREEK PROJECT

FISH AND AQUATIC ENVIRONMENT STUDY AREAS

Knight Piésold CONSULTING

P/A NO. VA101-458/15

REF NO. 1

FIGURE 1.6.2

REV 1

2 – BACKGROUND REVIEW

2.1 LEGISLATION, REGULATIONS, AND GUIDELINES

The Project is subject to both provincial and federal EAs under the BC Environmental Assessment Act (2002) and Canadian Environmental Assessment Act 1992 (CEAA 1992). The EA will undergo a coordinated review in accordance with the 2004 Canada-BC Agreement on Environmental Assessment Cooperation. The requirements for the EA are defined in the AIR for the Project, approved by the BC Environmental Assessment Office (EAO) on October 21, 2011. This baseline report has been prepared to support the submission of the Application/EIS.

The methods used to enumerate fish and fish habitat followed procedures outlined in the Reconnaissance (1:20 000) Fish and Fish Habitat Inventory Standards and Procedures (RIC 2001), Fish Collection Methods and Standards (RIC 1997a), Fish-stream Identification Guidebook (MOF 1998), Watershed Restoration Program Fisheries Habitat Assessment Procedures (FHAP) (Johnson and Slaney 1996), and Guidelines for the collection and analysis of fish and fish habitat data for the purpose of assessing impacts from small scale hydro power projects in British Columbia (Hatfield et al. 2007). Technical guidance for the design of the sampling program and data collection methods was obtained from MOE (2012), Environment Canada (2010), and direction provided by provincial and federal agency staff. Aquatic habitat studies were implemented according to British Columbia Freshwater Biological Sampling Manual (RIC 1997b), and British Columbia Field Sampling Manual for Biological Sample Collection: Freshwater (Clark 1996).

2.2 LISTED FISH SPECIES

Two species encountered in the fisheries assessment for the Project have received updated Provincial and Federal conservation status. Bull trout (*Salvelinus confluentus*) in British Columbia are considered a Species of Special Concern and are considered vulnerable to extirpation or extinction (ranked as S3 – Blue) and are listed as a candidate for the short-list for upcoming COSEWIC assessment (BC Conservation Data Centre, COSEWIC 2012). Coho salmon (*Oncorhynchus kisutch)* originating from the interior Fraser River watershed, which includes drainages confluent with the North Thompson River are considered an endangered population that is facing imminent extirpation or extinction, however the status of coho populations within British Columbia as a whole are considered stable (ranked as S4 – Yellow) (CDC 2012, Irvine et al. 1999, COSEWIC 2002).

The Pacific population of Pacific mountain sucker (*Catostomus platyrhynchus*) is listed as a species of special concern by COSEWIC. Several records of Pacific mountain sucker are known from the lower North Thompson River (COSEWIC 2010).

2.3 EXISTING FISHERIES INFORMATION

2.3.1 Introduction

Fisheries Information Summary System (FISS), Ecological Reports Catalogue (EcoCat) databases, and other literature sources were searched for previous governmental or consultancy reports that contained fish diversity and distribution information pertinent to the Project. A list of seven salmonid and eight non-salmonid species present within the study area are presented in Table 2.3.1. The species are typical of those observed in the North Thompson River watershed (McPhail and Carveth 1994).

Table 2.3.1 Documented Fish Species in the Study Area Drainages

Fish Species	Barriere Drainages				North Thompson Drainages				
	North Barriere Lake	Saskum Lake	Harper Creek (lower)	Harper Creek (Upper)	Baker Creek	Jones Creek	Avery Creek	Lute Creek	Chuck Creek
Salmonids									
Rainbow trout	X	X	X		X	X	X	X	X
Bull trout	X	X	X	X	X (LOWER)				
Brook trout	X	X							
Lake trout*	X	X							
Mountain whitefish	X	X	X						
Sockeye/ Kokanee salmon*	X	X	X						
Coho Salmon	X	X	X		X (LOWER)	X (LOWER)		X	
Non -Salmonids									
Burbot*	X								
Bridgelip sucker*	X								
Largescale sucker*	X								
Longnose dace	X		X						
Redside shiner*	X	X							
Pikemouth minnow*	X								
Prickly sculpin*	X	X	X						
Torrent Sculpin	X	X	X			X			

NOTES:
1. *Species noted in FISS database, but not observed during field surveys.
2. Upper and lower Harper Creek are separated by a migratory fish obstacle.

2.3.2 Barriere River and Fennel Creek

The Barriere River originates west of Vavenby Mountain (elevation 1,990 masl) and flows in a south westerly direction for approximately 73 km before reaching its confluence with the North Thompson River near the town of Barriere. The course of the mainstem Barriere River flows through two large lakes: North Barriere and Saskum, located 35 km and 49.3 km, respectively, upstream of the North Thompson River. Fennel Creek is a 21.9 km long tributary to the Barriere River and has its confluence located approximately 8.5 km upstream of the eastern end of North Barriere Lake (Grinton 1994).

The Barriere River supports populations of pink (*Oncorhynchus gorbuscha)*, chinook (*O. tshawytscha)*, sockeye (*O. nerka),* and coho (*O. kisutch)* salmon as well as migratory rainbow trout, bull trout, mountain whitefish (*Prosopium williamsoni*) and other non-salmonid fish species. The Barriere River above North Barriere Lake and lower Fennel Creek are the primary producers of salmon and currently supports both coho and sockeye salmon populations. Fennel Creek coho salmon are currently enumerated as a part of DFO's ongoing stock assessment program in western portions of Barriere River drainage where populations of up to 2,600 spawners have been historically noted (DFO, H. Olynyk pers. comm.; Irvine et al. 1999). The extant sockeye salmon population of

Fennell Creek was established after 1952 when timber harvesting dams in the Barriere River system were removed. Between 1956 and 1960, over three million Raft River sockeye eggs were transplanted into the Barriere River system, with 490,000 of them being transplanted into Fennell Creek in 1959 (Withler et al. 2000). Currently, sockeye spawning takes place exclusively in the Barriere River above North Barriere Lake and lower Fennel Creek. DFO historic escapement records report an average of 5,800 spawners have returned annually, although as many as 32,000 returning spawners were estimated during 1996 (DFO 1995, Hobbs and Wolfe 2008).

2.3.3 North Barriere and Saskum Lakes

A number of historical fisheries surveys have been conducted on North Barriere Lake and Saskum Lake since 1950 (FISS/EcoCat). Due to their large size and habitat complexity the fish fauna in these systems is the most diverse of those drainages surveyed in the Regional Study Area. The habitats among the two lakes are similar and migratory trout, char, salmon, and whitefish inhabit both systems through their connection via the Barriere River. Both North Barriere Lake and Saskum Lake contain sizable populations of bull trout and past surveys suggest that populations are relatively healthy and may be the source of adfluvial spawners for portions of Harper Creek and the Barriere River near Saskum Lake (Grinton 1994, Harding and Offin 1970).

2.3.4 Harper Creek

The historic fisheries literature for Harper Creek is limited beyond those sampling sessions reported in FISS that identify rainbow trout, bull trout, and sockeye salmon as being present during sampling efforts spanning 1979 through to 1994. During late September 1994, MELP (Grinton 1994) conducted some fish and habitat surveys throughout the Harper Creek drainage that describe the presence of rainbow trout and sculpin in river reaches downstream of river km 6.5 and only sub-adult bull trout (0+,1+, and 2+) in upstream reaches below river km 25.5. Hagen and Baxter (1992) conducted a brief survey directed at bull trout in Harper Creek during the fall of 1992 and noted the presence of fry, juveniles, and a spawned out mature bull trout (730 mm) near river km 17.0 that was subsequently aged to be greater than 15 years old.

2.3.5 North Thompson Drainages

Very little historic fish distribution information exists for the drainages that are confluent with the North Thompson River near Vavenby and Birch Island. Hagen and Baxter (1992) noted the presence of relatively high densities of rainbow trout and bull trout juveniles in the lower reaches of Chuck Creek and during 2008 sampling Dillon Consulting sampled rainbow trout in the lower reaches of Baker Creek.

2.4 FISH SPECIES DESCRIPTIONS

2.4.1 Introduction

Fish species descriptions are provided for four salmonid species and two non-salmonid species (sculpin and dace) expected to occur in streams draining the Project Site. Additional life-history details detail is provided for bull trout and rainbow trout as these species are widely distributed among Project watersheds.

2.4.2 Bull Trout (*Salvelinus confluentus*)

The literature concerning the life history ecology and habitat requirements of bull trout is reviewed in Ford et al. (1995) and McPhail and Baxter (1996) and summarized as follows:

2.4.2.1 General

Bull trout are an endemic western North American char whose historical range extends from northern California to the southeastern headwaters of the Yukon River. East of the Continental Divide, they are found in the upper Peace River, Liard River, and Rocky Mountain foothills of Alberta and Montana. In British Columbia, bull trout are mainly an interior species, although they are present in several coastal drainages.

Bull trout adults spawn during fall in response to decreasing water temperature/photoperiod and their eggs incubate in the gravel over the winter, normally hatching before the end of January. Alevin absorb their yolk sacs over a period of two to three months and emerge from the gravel as fry in late spring. During the summer growing season, behaviour is characterized by the establishment of feeding stations in proximity to cover and abundant food supply. Like other salmonids, they respond to decreasing water temperature/photoperiod in late fall by moving to deep pools, off-channel ponds, and/or cover elements such as coarse substrates where they remain relatively inactive until spring.

Ford et al. (1995) tabulated a summary of bull trout habitat preferences, environmental tolerances, and life history parameters by life stage (see Table 2.4.1). This information is discussed in the following sections.

2.4.2.2 Eggs and Incubation

Bull trout are better adapted to cold conditions than other salmonids and their eggs can tolerate temperatures just above freezing (0°C). Laboratory studies recorded incubation times of 34 days at 12°C, 74 days at 6°C, and 125 days at 2°C. Optimal incubation temperatures are approximately 2°C to 4°C. Yolk adsorption by the alevin normally requires 65 days to 90 days, although laboratory studies have recorded emergence as early as three weeks after hatching. Bull trout egg survival is linked to the quality of spawning bed material and studies found 0% egg survival at fine substrate compositions exceeding 50% and 40% survival with 0% fines.

2.4.2.3 Rearing, Food, and Growth

Bull trout fry emerge from the gravel approximately six months after egg deposition and after achieving neutral buoyancy, they move to low velocity channel margins, side-channels, and small pools for the remainder of the summer. Recently emerged fry remain in close proximity to the substrate and prefer water velocities averaging 9 cm/s. Juveniles (Age 1+, 2+, and 3+) show a preference for slow velocity stream side habitats with current velocities less than 50 cm/s, and depths to 1 m. Optimal temperatures for bull trout growth are less than 9°C.

Adult bull trout are generally opportunistic piscivores while smaller juveniles and fry consume primarily aquatic insects and secondarily terrestrial insects and other benthic invertebrates. Typically, stream-resident bull trout occupy focal sites near the bottom of deep pools or habitats with adequate instream cover. Growth rates are highly variable between populations and geographic localities, with stream-resident populations in cold, glacial systems near the low end of the size-at-age range. Stream-resident adults are usually dwarfed and average between 200 mm and 300 mm.

2.4.2.4 Maturity, Adult Migration, and Spawning

Bull trout reach maturity between Ages 3+ and 6+ although stream-resident populations may mature one or two years earlier. Size-at-maturity is highly variable, with stream-resident forms maturing near the low end of the size range (200 mm). Bull trout are iteroparous (repeat spawners) and may return to spawn in consecutive years after reaching maturity. Stream-resident bull trout typically conduct short distance migrations to preferred spawning sites between mid-September and late October, with the onset of migration coinciding with a temperature threshold of 9°C. Fluvial and adfluvial populations may migrate from large rivers or lakes to cool water tributary streams to spawn. These fish are typically in the length range of 500 mm to 700 mm.

Spawning sites are typically associated with low gradient areas and groundwater sources, probably as an adaptive mechanism to reduce freezing and subsequent egg mortality. Proximity to cover types such as overhanging terrestrial vegetation, pools, and cutbanks is characteristic of most spawning sites. In general, fecundity of stream resident and adfluvial females ranges from 660 eggs to 6,750 eggs and is a function of body size. In general, preferred spawning conditions are associated with current velocities of 25 cm/s to 65 cm/s, depths of 15 cm to 84 cm, cobble-gravel substrates with less than 10% fines, and temperatures below 9°C.

2.4.2.5 Bull Trout Abundance

In general, bull trout population size is controlled by many of the same variables that control population size in other salmonids such as rainbow trout. However, differences in life history timing, habitat preferences, food sources, and temperature thresholds between bull trout and rainbow trout likely influence the carrying capacity of co-existing populations differently. For example, bull trout eggs are susceptible to freezing in winter while rainbow trout eggs are vulnerable to scouring during spring freshet.

Flow regime, water temperature, and available cover are some of the most important factors influencing bull trout carrying capacity in stream environments. Among the complex interactions that influence population size, low flow conditions are often cited as the most limiting factor in trout/char streams. In summer, low flow conditions may result in unfavourably high water temperatures or dewatering of usable habitat. Winter low flows are often associated with low water temperatures, ice formation, reductions in suitable overwintering habitat, and limited food availability.

Bull trout densities are usually lower than co-existing species, and typically comprise less than 5% of the total catch during broad faunal surveys. Juvenile densities in streams are low and quantitative estimates of fry density are complicated by their propensity to hide in the substrate during the day. Bull trout juvenile production may be limited by the amount of low velocity side-channels and margin areas in confined stream systems where lateral habitat is scarce. Spawning often occurs in small, widely dispersed pockets, suggesting that bull trout are highly selective in their choice of spawning sites. Thus, bull trout populations may be limited by spawning habitat.

The most productive stream environments are typically those that provide optimal habitat conditions year-round or during critical life history stages. Optimal habitat conditions for stream-resident bull trout are characterized by clear, cold water (<12.8°C in summer); winter water temperatures between 2°C and 4°C; abundant lateral habitats with cobble adequate year-round access and cobble substrates to provide cover; cobble-gravel substrates with a silt content of less than 10%; low gradient spawning sites associated with groundwater upwelling; abundant instream cover including deep pool habitat; well-vegetated, stable stream banks; abundant juvenile fish and benthic invertebrate food sources; and relatively stable stream flow and temperature regimes.

Table 2.4.1 Observed Habitat Use and Selected Biological Characteristics by Life Stage for Bull Trout

Eggs	
Temperature tolerance range	0°C to 8°C
Optimum incubation temperature	2°C to 4°C
Recommended oxygen concentration	9.5 mg/L
Lower lethal oxygen concentration	NA
Range of incubation time	34 to 125 days
Incubation at optimum temperature days	95 to 125 days
Lower lethal pH	NA
Recommended current velocity	below level causing gravel scour
Juveniles	
Temperature tolerance range	0°C to 8°C
Optimum temperature for growth	< 12°C
Recommended oxygen concentration	7.75 mg/L
Lower lethal oxygen concentration	NA
Habitat type preference	pools
Preferred current velocity	to 1.0 m
Substrate	<0.5 m/s
Cover	cobble and boulder
Turbidity tolerance	cobble and fine debris
Primary food category	NA
Secondary food taxa	benthic insects
	drift
Adults	
Temperature tolerance range	0°C to 12.8°C
Optimum temperature for growth	NA
Recommended oxygen concentration	NA
Lower lethal oxygen concentration	NA
Habitat type preference	lake or large river
Observed depth preference	varies, up to at least 18 m
Preferred current velocity	none
Substrate	NA (primarily in lakes)
Cover	depth
Turbidity tolerance	NA
Primary food type	fish
Secondary food type	benthic insects
Form of reproduction	iteroparous
Nest construction	yes
Spawning habitat type	small streams
Preferred spawning temperature	< 9°C
Preferred spawning depth	0.15 m to 0.84 m
Preferred spawning substrate	cobble / gravel
Preferred spawning current velocity	25 cm/s to 65 cm/s
Range of first age-at-maturity	(precocious males age 3) age 5
Range of fecundity	660 to 6,750 eggs/female
	or 920 eggs/kg @ 600 mm FL

NOTES:

1. Source: Ford et al. (1995)

2.4.3 Rainbow Trout (*Oncorhynchus mykiss*)

The literature concerning the life history ecology and habitat requirements of rainbow trout is reviewed in Ford et al. (1995) and Raleigh et al. (1984) and summarized as follows:

2.4.3.1 General

Rainbow trout are native to the Pacific slope drainages of North America from northern Mexico to Bristol Bay, Alaska and the Peace and Athabasca Rivers. They may be the most widely introduced fish species in the world and reproducing populations have been established on every continent with the exception of Antarctica. Both sanctioned and unsanctioned stocking of rainbow trout has also occurred throughout British Columbia. For example, between 1988 and 1990 an average of 6.4 million rainbow trout were stocked in approximately 740 lakes and rivers in the Province.

Rainbow trout are more closely related to salmon than the "true" trouts (*Salmo* sp.) and as a result, they were reclassified from *Salmo gairdneri* to *Oncorhynchus mykiss* in 1988. Two distinct lineages of rainbow trout reside in BC, the coastal form and the interior red-band form. The coastal form is present throughout the Pacific slope drainages while the red-band rainbow trout is native to the Interior, including the Columbia Basin, the Fraser system above Hope, and the headwaters of the Peace and Liard Rivers.

Rainbow trout adults spawn during late spring in response to increasing water temperature/photoperiod and their fry emerge from the gravel in mid-summer. During the summer growing season, rainbow trout behaviour is characterized by the establishment of feeding stations in proximity to cover and abundant food supply. In the fall, rainbow trout respond to decreasing water temperature/photoperiod by moving to deep pools, off-channel ponds, and/or cover elements such as coarse substrates where they remain relatively inactive until spring.

Ford et al. (1995) tabulated a summary of rainbow trout habitat preferences, environmental tolerances, and life history parameters by life stage (see Table 2.4.2). The information in this table is discussed in the following sections.

2.4.3.2 Eggs and Incubation

Rainbow trout egg incubation time is temperature dependent, with an optimum incubation temperature of approximately 11°C. Laboratory studies recorded 50% fry emergence after 32 days at 14°C and 102 days at 5°C. Incubation temperatures of 2°C resulted in 100% egg mortality. Egg survival is also dependent on oxygen supply to the redds. Substrate permeability, inter-gravel current velocities, and groundwater influences potentially affect egg development and survival. For example, studies indicate that if fine substrate composition exceeds 30%, egg survival is greatly reduced and emergence of alevins is compromised through physical obstruction. Optimal egg survival and alevin emergence is suspected to occur at substrate compositions consisting of less than 5% fines and average particle sizes between 15 mm and 100 mm in diameter.

2.4.3.3 Rearing, Food, and Growth

Rainbow trout fry emerge from the gravel 45 days to 75 days after egg deposition and move into riffle areas to rear for the remainder of the summer. Recently emerged fry are typically associated with water velocities less than 30 cm/s and prefer velocities less than 8 cm/s, moving to deeper, faster water as they grow. Juveniles (Age 1+ and 2+) show a preference for cobble and boulder substrates between 10 cm and 40 cm in diameter, current velocities between 8 cm/s and 20 cm/s, and depth ranges from 0.3 m to 1.2 m. Optimal temperatures for rainbow trout growth range from 10°C to 14°C.

Stream-resident fry, juveniles, and adults are opportunistic drift feeders that consume primarily aquatic insects and secondarily terrestrial insects and other benthic invertebrates. Typically, rainbow trout occupy feeding stations in proximity to higher current velocities as an energetically advantageous behaviour where proportionately more drift is delivered to the resting location. Feeding from a low energy location with good cover also decreases the risk of predation. Growth rates are highly variable between populations and geographic localities, with stream-resident populations in cold, glacial systems near the low end of the size-at-age range. In general, growth is sub-optimal where stream temperatures are below 8°C to 10°C for most of the summer and less than 2°C to 4°C for long periods in winter.

2.4.3.4 Maturity, Adult Migration, and Spawning

Rainbow trout reach maturity between Ages 3+ and 5+ although some males may mature earlier and some females later. Size-at-maturity is highly variable, with stream-resident forms maturing near the low end of the size range (150 mm to 250 mm). Rainbow trout are potentially iteroparous (repeat spawners), a life history adaptation that is more common among Interior populations. Stream resident rainbow trout typically conduct short distance migrations to preferred spawning sites between mid-April and late June, with the onset of migration coinciding with elevated water levels and a temperature threshold of 5°C.

Spawning sites are typically located at the head of riffles, where the downstream hydraulic gradient induces downwelling at the tail of the upstream pool, run, or glide. Upwelling locations in suitable gravel also provide good spawning areas. Females must be able to physically move gravels and other particles to excavate a depression in the streambed. As females construct redds, they also displace fine sediments and potentially improve spawning gravel quality. Fecundity ranges from 200 eggs to 9,000 eggs, with a reported mean of 1,500 eggs, and is strongly influenced by fish size. Fecundity estimates for stream resident females ranged from 500 eggs to 3,161 eggs. Preferred spawning conditions are associated with current velocities of 30 cm/s to 90 cm/s, depths of 15 cm to 25 cm, gravel substrates between 4 mm to 100 mm, and temperatures between 7.2°C and 13.3°C.

2.4.3.5 Rainbow Trout Abundance

First-year survival for rainbow trout is typically less than 1% of the total number of fry that successfully emerge from the gravel. The availability and quality of spawning habitat, egg incubation conditions, and alevin survival determine fry production per spawning female. Fry that survive their first year have a much greater chance of survival during following years, although factors such as the need for increased space and territory, harvesting pressures, and limited space during low flow periods may prejudice adult survival.

The most productive stream environments are typically those that provide optimal habitat conditions year-round or during critical life history stages. Optimal habitat conditions for stream-resident rainbow trout are characterized by clear, cold water (10°C to 14°C); cobble-gravel substrates with a silt content of less than 5%; an approximate pool-to-riffle ratio of 1:1; abundant instream cover including deep pool habitat; well-vegetated, stable stream banks; and relatively stable stream flow and temperature regimes.

Knight Piésold CONSULTING

Table 2.4.2 Observed Habitat Use and Selected Biological Characteristics by Life Stage for Rainbow Trout

Eggs -	-
Temperature tolerance range	2°C - 20°C
Optimum incubation temperature	11°C
Recommended oxygen concentration	>5.35 mg/L
Lower lethal oxygen concentration	4.3 mg/L
Range of incubation time	18 - 102 days
Incubation time at optimum temperature	28 - 49 days
Lower lethal pH	5.3
Recommended intergravel current velocity (yields 50% mort @ 5.3 mg/L DO)	2 cm/s
Optimal depth	NA
Substrate	gravel with < 5% fine
Juveniles -	-
Temperature tolerance range	0°C to 24°C
Optimum temperature for growth	10°C - 14°C
Recommended oxygen concentration	> 7 mg/L
Lower lethal oxygen concentration	3 mg/L
Habitat type preference	margins of lakes or streams
Depth preference	3 m to 6 m in lakes, 0.3 - 1.2 m in streams
Preferred current velocity	8 cm/s - 20 cm/s
Substrate	cobble/boulder and rubble
Cover	cobble, woody debris
Turbidity tolerance	NA
Primary food category	benthic invertebrates and terrestrial insect larvae
Secondary food taxa	zooplankton, adult insects
Adults -	-
Temperature tolerance range	0 - 28°C
Optimum temperature for growth	10°C - 14°C
Recommended oxygen concentration	> 7mg/L if < 15°C, > 9 mg/L if > 15°C
Lower lethal oxygen concentration	3 mg/L
Habitat type preference	lakes and streams
Depth preference	variable, based on water temperature
Preferred current velocity	20 - 30 cm/s
Substrate	cobble to boulder
Cover	light intensity, debris, boulders
Turbidity tolerance	NA
Primary food type	terrestrial insect larvae, benthic invertebrates
Secondary food type	fish
Form of reproduction	iteroparous
Nest construction	yes
Spawning habitat type	small streams
Preferred spawning temperature	7.2°C - 13.3°C
Preferred spawning depth	0.15 m - 2.5 m
Preferred spawning substrate	typically 4 mm - 100 mm
Preferred spawning current velocity	30 cm/s - 90 cm/s
Range of first age-at-maturity	1 - 4 yrs
Range of fecundity	200 - 13,000 eggs/kg

NOTES:

1. Source: Ford et al. (1995)

2.4.4 Coho Salmon (*Oncorhynchus kisutch*)

2.4.4.1 General Life History

Most coho salmon return to freshwater in the fall and spawn during fall and early winter and all fish die after spawning. Fry emerge from the gravel the following spring and usually reside in freshwater for a year before migrating to sea as smolts. Most coho spend 18 months at sea before returning to freshwater and therefore have a 3-year life cycle. Variations on this general life cycle include juveniles that emigrate to sea immediately upon emergence, juveniles that emigrate as 2-year-old smolts, and precocious male coho that return to spawn after only six months at sea (jacks). More detailed general descriptions are provided in Scott and Crossman (1973) and Sandercock (1991).

Interior Fraser River coho are smaller than most similar aged coho and most (93%) interior Fraser coho make seaward migrations in their second year, with a small proportion (7%) remaining in freshwater for one or two more years (COSEWIC 2002). Almost all adult Interior Fraser River coho returned to freshwater after the one winter at sea.

2.4.4.2 Spawning and Juvenile Rearing

The seasonality of river entry and spawning varies among coho populations, and is largely temperature and flow dependent. Typical runs enter freshwater in September to October and spawn during late October through to December once water temperatures reach 1°C to 8°C (McPhail 2007).

The distribution of spawning habitat for coho salmon is usually clumped within watersheds, often at the heads of riffles in small streams, and in side channels of larger rivers. Females generally construct nests in shallow (30 cm) areas where the gravel is less than 15 cm diameter and has good circulation of well-oxygenated water (Sandercock 1991). Low or high flows, freezing temperatures, siltation, predation, and disease can reduce egg survival.

Major episodes of fry dispersal include spring movements away from spawning sites and pre-winter movements into small tributaries and off-channel habitat. Juvenile densities are generally higher in pools than riffles, although as the fish grow they will occupy areas of faster moving water. Juvenile coho tend to cluster in areas of suitable habitat, most frequently in streams with gradients less than 3%. Structurally complex habitats (large organic debris and large substrate), and habitats with slow moving water are both necessary to ensure high overwinter survival of young coho. Coho utilize lakes for rearing less frequently than streams, and are usually restricted to the littoral regions of lakes.

2.4.4.3 Interior Fraser Coho Abundance

Coho salmon originating from the interior Fraser River watershed, which includes drainages confluent with the North Thompson River, are considered an endangered population (COSEWIC 2002). Interior Fraser coho return to spawn primarily within the traditional territories of the Secwepemc people (North and South Thompson and Clearwater rivers) and of the Nlaka'pmux, Sce'exmx, and Okanagan people of the upper Fraser canyon and Nicola valley. The recent size of the total interior Fraser coho population was estimated by averaging spawner estimates for each subpopulation (area) during 1998 to 2000. Slightly more than half of recent estimates of the total population of 24,000 occur within the North and South Thompson watersheds. Natural spawning is thought to be responsible for producing most of the fish escaping to the Interior Fraser in recent years (~20,000 of 24,000 adult fish total) although in the lower Thompson/Nicola area, hatchery-origin fish outnumber wild coho (COSEWIC 2002).

2.4.5 Mountain Whitefish (*Prosopium williamsoni*)

Mountain whitefish (*Prosopium williamsoni*) occur only in western North America. In BC they are widely distributed along both slopes of the Rocky Mountains from Idaho and Wyoming in the south, to the Mackenzie River in the north. On the east slope of the Rockies they rarely extend out onto the Great Plains; however, west of the Continental Divide, mountain whitefish occur in suitable environments throughout most of Idaho, Washington, Oregon, north-central California, and British Columbia (McPhail and Troffe 1998).

Over most of its geographic range, the mountain whitefish is a riverine species. In British Columbia, however, there are three distinct life-history patterns: a lacustrine pattern where the life cycle is completed entirely within a lake, a riverine pattern where the life cycle is completed entirely within flowing water, and an adfluvial pattern where the life cycle involves migrations between lakes and rivers.

Mountain whitefish usually mature when they are three to four years old. Spawning takes place during the fall over unprepared gravel when water temperatures reach 5°C to 7°C and is often preceded by late summer foraging migrations into smaller creeks and tributaries of larger river systems (McPhail 2007). Breeding fish aggregate in step-off riffles in rivers or along gravelly margins in lakes. Early reports have suggested that spawning is a nocturnal activity. Eggs hatch in the early spring, and juveniles can be found along the edge and backwaters for several weeks after hatching before moving into deeper water (McPhail and Troffe 1998).

2.4.6 Torrent Sculpin (*Cottus rhotheus*)

The torrent sculpin (*Cottus rhotheus*) is a unique western North American species endemic to British Columbia, Washington, Oregon, Idaho, and portions of northwestern Montana (Scott and Crossman 1973). Torrent sculpins are most common in swift streams, although they may be found in lakes along beach margins. Stream dwellers live in fast waters with gravel and cobble substrates and are often one of the larger cottid species present. This species is phenotypically and behaviourally variable throughout its range, and is often observed with other sculpin species. Many populations isolated above waterfalls along the tributaries of the lower Columbia River exhibit differences in prickle patterns and spawning activities (McPhail and Carveth 1994).

Spawning occurs from May to July in animals two years and older. The fecundity of females is quite low, with large females usually producing less than 500 eggs a season (McPhail 2007). As the spawning season approaches, territorial males turn melanistic and the tip of the first dorsal fin becomes bright orange. Young torrent sculpins forage for planktonic crustaceans and move to an aquatic insect larvae diet as they grow. Adults 70 mm or longer forage almost exclusively for juvenile cyprinids and other fish (Scott and Crossman 1973). Torrent sculpins are one of the longer-lived cottid species, and can live up to seven years and reach a maximum size of about 155 mm.

2.4.7 Longnose Dace (*Rhinichthys cataractae*)

Longnose dace (*Rhinichthys cataractae*) is a small, wedge-shaped bottom-oriented fish that inhabits the rocky interstices of swift streams and edge zones of some larger lakes throughout north central

North America. In British Columbia longnose dace are found throughout the North Thompson River tributaries and are most commonly observed in riffles with surface velocities of up to 1.8 m/s with substrates comprised of loose cobble and larger gravel (McPhail 2007).

Unlike many cyprinid species longnose dace is not a schooling species and is generally found alone, even while coming into condition during the reproductive season. Typically longnose dace reach sexual maturity in their second summer. Spawning time is variable but generally occurs during May and June when water temperatures rise above 10°C. There is some evidence to suggest that two or more cohorts may be produced per spawning year. Males defend a territory and guard over the adhesive, nearly invisible eggs deposited by a single female (McPhail 2007).

3 – METHODOLOGY

Knight Piésold Ltd. was engaged by the Proponent during May 2011 to undertake fish and aquatic habitat baseline studies for the Harper Creek Project. Field work was initiated during June 2011 and continued through to September 2013. Previous fish sampling had been undertaken for the project by Dillon Consulting during September 2008.

3.1 AQUATIC HABITAT

Fish habitat assessments were completed to document physical habitat characteristics in streams draining the Project Site, with additional emphasis placed on fish-bearing watersheds. The aquatic habitat data collected will be used to inform the environmental and to assist in the identification of potential impacts and mitigation. Methods for habitat assessments were implemented following the general guidelines outlined in:

- Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures - Version 2.0 (RIC 2001)
- Fish Habitat Assessment Procedures (Johnston and Slaney 1996), and
- Guidelines for the collection and analysis of fish and fish habitat data for the purpose of assessing impacts from small scale hydro power projects in British Columbia (Hatfield et al. 2007).

Fish habitat assessments were completed to document physical habitat characteristics in streams draining the Project Site, with additional emphasis placed on fish-bearing waters.

3.1.1 Sampling Methods

3.1.1.1 Stream Reaches

Stream reaches were delineated in streams draining the Project Site from stream channel profiles, satellite imagery, air photos, and field reconnaissance in consideration of protocols developed by MOF (1998).

Barriers to upstream fish migration were identified in all streams draining the Project Site. Field reconnaissance surveys to assess and document barriers involved helicopter overview flights and repeated ground surveys. Field measurements of vertical heights of waterfalls, gradients, and slope distances were recorded. Stream gradients upstream and downstream of barriers were also measured using a Suunto clinometer. GPS coordinates of these barriers were recorded using a Garmin handheld GPS unit. Select site photos of habitat available in Project watersheds are presented in Appendix A.

3.1.1.2 Sampling Locations

Stream channel morphology was characterized for 98 stream locations draining the Project Site using a combination of aerial imagery, helicopter overflights, and foot surveys (Figure 3.2.1; Appendix B). The simplest stream morphology types (i.e., mesohabitats) are based on a two-category system of fast water and slow water. For the present study fast water is characterized as either cascade (high gradient) or riffle (low gradient) and slow water as either pool (laminar flow and deep) or glide (laminar flow and shallow).

Detailed Level 1 fish habitat surveys were conducted in the lower fish-bearing sections of T-Creek and P-Creek during late summer low flow conditions (late August 2012), and additional surveys were conducted in upper Harper Creek and Baker Creek during September 2013 (Figure 3.2.1; Appendix C). Survey methods were adopted from those outlined in Simonson et al. (1994) and Johnston and Slaney (1996). At each habitat site, stream length and stream width (i.e., wetted and bankfull width) was measured with surveyor's measuring tape. Gradient was measured with a Sunnto clinometer. Stream depth was measured with a metre stick.

The following parameters were documented during Level 1 Habitat surveys:

- Identification and documentation of any side channels or off channel habitat
- Habitat type (riffle, pool, glide, cascade)
- Stream gradient
- Mean bankfull and wetted widths
- Mean bankfull and wetted depths
- Residual pool depth
- Dominant and subdominant stream bed substrate material
- Large woody debris (LWD)
- Available instream cover and type, and
- Riparian vegetation type, structure, and canopy closure.

3.1.1.3 Water Quality

In-Situ Parameters

In-situ water quality data were collected at a subset of fish and aquatic habitat sites using a YSI 556 MPS handheld logger and multi-parameter Sonde. The parameters collected included:

- Dissolved Oxygen (% and mg/L)
- Temperature (°C)
- Conductivity (mS/cm)
- Salinity (ppt)
- pH
- Oxidation-Reduction Potential (ORP) (mV), and
- Total Dissolved Solids (TDS) (g/L).

3.1.2 Data analysis

Fish habitat assessments were completed to document physical habitat characteristics in streams draining the Project Site, with additional emphasis placed on fish-bearing waters. Watershed sub-catchments in streams draining the Project Site were delineated from TRIM data and contour maps developed for the mine infrastructure. Satellite imagery and air photos were used to examine valley profiles and identify watershed features (streams, lakes, terrain, vegetation cover, etc.). Stream channel profiles were developed from TRIM contours to identify channel length and slope. Stream parameters including water temperature, in-situ pH and dissolved oxygen data were compared to the guidelines for the protection of freshwater aquatic life (CCME 2007) and published accounts of life-history parameters for the focus fish species within the baseline study area.

3.1.3 Limitations and Assumptions

Habitat assessments were conducted under low flow conditions and the habitat information presented may change under different years, season or hydraulic conditions. The correct identification of fish habitat and watershed attributes is dependent on the skill and experience of the practitioner undertaking the assessment.

3.2 FISH FAUNA

3.2.1 Sampling Methods

Prior to field based investigations a desktop survey of fisheries information was conducted to inform sampling efforts. Fisheries Information Summary System (FISS), Ecological Reports Catalogue (EcoCat) databases, and other literature sources were searched for previous governmental or consultancy reports that contained fish diversity and distribution information pertinent to the Project.

During 2008, 2011, 2012 and 2013 site-specific studies were completed to determine fish presence/absence, spatial distribution, abundance, and fish habitat values. The methods used to enumerate fish and fish habitat followed procedures outlined in the Reconnaissance (1:20 000) Fish and Fish Habitat Inventory Standards and Procedures (RIC 2001), Fish Collection Methods and Standards (RIC 1997a), Fish-stream Identification Guidebook (MOF 1998), Watershed Restoration Program Fisheries Habitat Assessment Procedures (FHAP) (Johnson and Slaney 1996), and direction provided by provincial and federal agency staff (especially for bull trout sampling).

During field investigations, fish sampling was primarily conducted using Smith Root Model 12 backpack electrofisher used in conjunction with a ¼ inch mesh two person pole seine or similarly fine mesh dip nets in sites with limited channel width. Electrofishing was the primary method utilized as some size and age classes of bull trout are known to avoid passive minnow traps, and preliminary sampling during 2011 confirmed this bias. Single-pass and spot fishing methods were primarily used, and the technique involved walking the stream in an upstream direction repeatedly sweeping the stream from each wetted bank with the wand (anode) of the electrofishing unit. Electrofishing effort was not pre-determined due to differences in site length. Electrofisher voltage (V), duty cycle (%) and frequency (Hz) settings were consistent between sites in each stream.

During low flow conditions estimates of bull trout density in P-Creek and T-Creek were conducted by enumerating total catches within a netted off portion of the creek. Fine mesh stop nets were deployed at the upstream and downstream portion of the sample site and a single pass removal technique was used applied. Captured fish were removed from the electrofishing site and held in a covered bucket until processing.

Additional information directed at locating the presence of spawning bull trout or redds was conducting via visual assessments.

3.2.1.1 2008 Fish Study

Initial baseline fisheries data were collected within the Harper Creek drainage and select project related creeks confluent with the North Thompson River by Dillon Consulting during September 24 to 27, 2008. For those drainages confluent with the North Thompson River electrofishing efforts were focused at sites within Baker Creek (upper and lower) and Jones Creek (lower only). Sites within

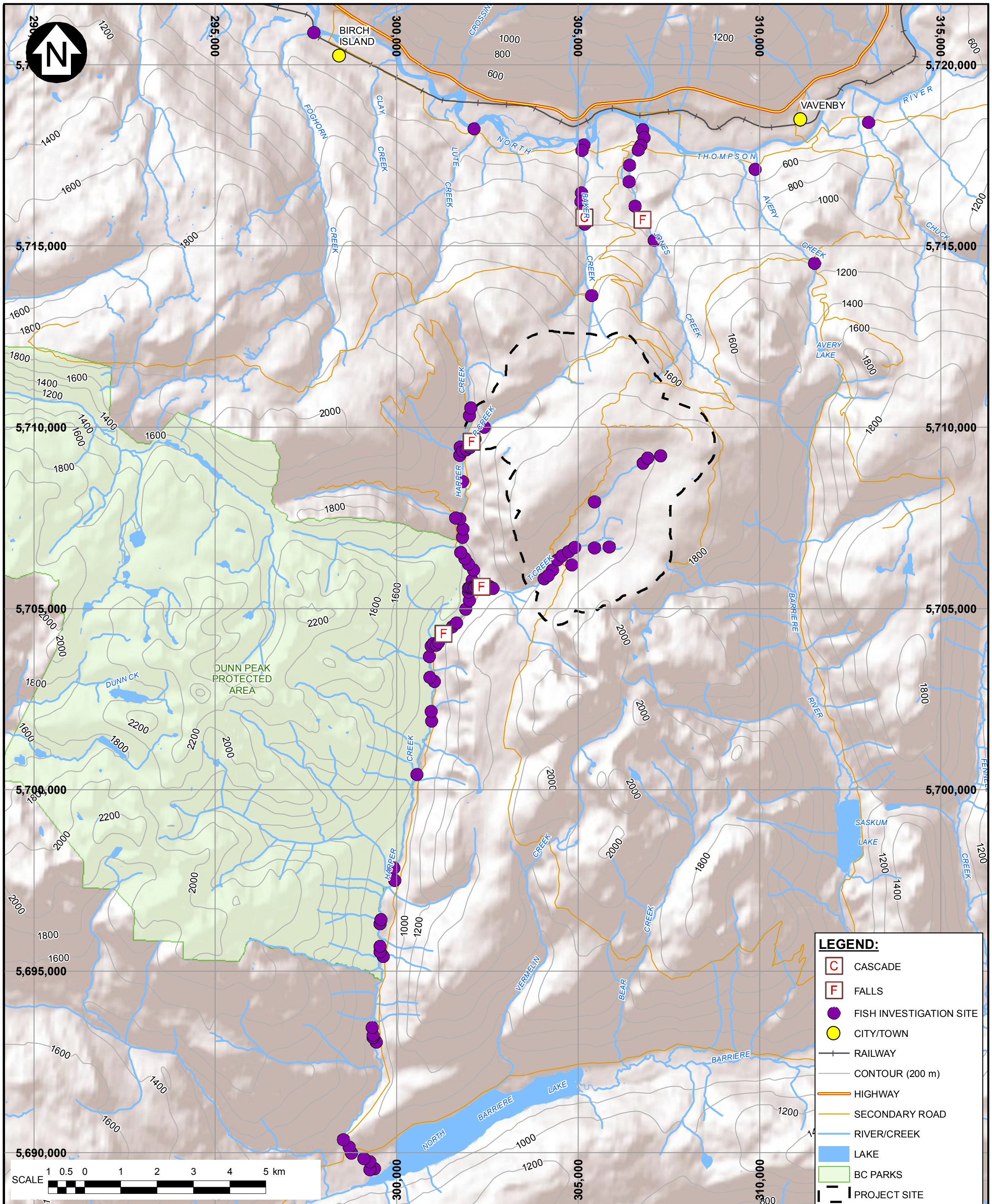
Harper Creek included four sites in the upper watershed and one location in the lower watershed near the creek's confluence with North Barriere Lake.

3.2.1.2 2011-2013 Fish Studies

Field crew members included Knight Piésold fisheries biologists, hydrologists, and members of the Simpcw and Adams Lake First Nations. Sites along Harper Creek and associated tributaries were accessed along the Harper Creek Forest Service Road and those watersheds confluent with the North Thompson River were accessed through public roads and a network of service roads associated within the Project Exploration property.

Fisheries investigations were conducted from early June, 2011 (freshet) through to late September; and a similar level of effort was applied during 2012 at locations throughout the Local Study Area (Figure 3.2.1). These surveys were focused on determining the distribution of fish fauna in the LSA and RSA and an additional winter survey investigating stream flow, and degree of ice cover in Harper Creek and T-Creek was conducted at select sampling locations during January 24 to 26, 2012.

During September 2013 surveys for adfluvial bull trout spawning were conducted in Harper Creek, a survey for fish presence at sites selected for Fish Habitat offsetting potential was conducted, and several locations within the Project Site within the upper portions of P-Creek and T-Creek and Avery Creek watersheds were surveyed to confirm their non-fish bearing status.



NOTES:

1. BASE MAP: TRIM AND NTS MAPPING, ESRI ARCGIS ONLINE SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:150,000 FOR 8.5x11 (LETTER) PAPER.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
1	21AUG'14	ISSUED WITH REPORT	CAC	CAC	PMT	KJB

HARPER CREEK MINING CORP.

HARPER CREEK PROJECT

FISHERIES INVESTIGATION LOCATIONS (2011-2013)

Knight Piésold CONSULTING

P/A NO. VA101-458/15 | REF NO. 1

FIGURE 3.2.1 | REV 1

3.2.1.3 Non Fish Bearing Status

The fish bearing status within Project Site water courses were assessed during sampling efforts during 2011-2013. Repeated sampling efforts were directed at sites within upper Harper Creek, upstream of documented physical barriers in T-Creek and P-Creek, locations within the Project Site and high gradient portions of Avery, Jones, and Baker Creeks.

3.2.1.4 Fish Tissue

Fish tissue samples were collected to establish background levels of metals in areas that may be affected by Project activities. Tissue analyses are also used to characterize naturally occurring background (pre-mine development) metal accumulations in resident (i.e. non-migratory within watershed) rainbow and bull trout somatic (muscle) and liver tissues and will form a baseline for future comparisons.

Fish tissues (muscle and liver tissues) were collected during mid-to-late September 2011 and 2012 and analyzed for metals, including mercury, and all concentration detection limits complied with those outlined by MOE (2012). All required permits were obtained prior to lethal sampling and fish collections were completed by experienced professionals in accordance with established protocols and standards. An annual collection limit of ten sub-adult bull trout specimens was permitted (MFLNRO-Kamloops) within the Harper Creek watershed (i.e., 10 for 2011, and 10 for 2012). For other North Thompson River drainages, five rainbow trout specimens were collected during 2011 and 2012 from each tributary potentially influenced by Project activities (total N=30).

Fish tissue samples were collected from the following locations during 2011 and 2012:

- Harper Creek Tributaries
  - T-Creek – 10 bull trout (132 mm to 200 mm), and
  - P-Creek – 10 bull trout (103 mm to 238 mm).
- North Thompson Tributaries
  - Jones Creek – 10 rainbow trout (112 mm to 174 mm)
  - Baker Creek – 10 rainbow trout (112 mm to 153 mm), and
  - Lute Creek – 10 rainbow trout (112 mm to 190 mm).

During 2011 and 2012, fish tissue samples were not collected from species in North Barriere Lake or from the Harper Creek mainstem downstream of the Project immediate receiving environment, however, after receiving feedback regarding the Project design a fish tissue collection program has been under taken during 2014 to address the needs of an Aquatic Effect Monitoring Program (AEMP). The focus of the 2011 and 2012 baseline fish tissue sampling was to characterize the metal concentrations in select tissues and the focus of the 2014 AEMP tissue sampling regime, which outside the scope of this report, will focus on metals analysis of the whole fish body in support of a the development of a selenium guideline.

Technical guidance for the design of the resident fish tissue program and data collection methods was obtained from MOE (2012), Environment Canada (2010), and direction provided by provincial and federal agency staff. While wearing sterile gloves, each fish was measured to the nearest millimeter (fork length) and weighed to the nearest 0.1 g before being placed into a sterile, labeled Whirl-pack™ container. Whole specimens were frozen immediately after field collection and maintained at in a frozen state until delivered for analysis.

3.2.1.5 Fish Ageing

During the 2011 investigations, fish specimens collected for tissue analysis were also sampled for ageing structures. Analysis of the ageing structures (otoliths and scales) was performed by Stamford Environmental (Mike Stamford, Gibsons, BC).

Lateral scales were collected from rainbow trout that had been collected in each of Lute Creek, Jones Creek, and Baker Creek during 2011. Approximately seven scales to ten scales were removed from each fish with forceps just behind the dorsal fin along the lateral surface of the specimens' body following standard practices. Scale samples from individual fish were then placed in a sleeve of waterproof paper and inserted into individually labelled envelopes for later analysis. Once in the laboratory, scales from each fish were carefully removed from the envelopes, cleaned, and mounted between glass microscope slides and visually interpreted using a microfiche reader.

Otoliths were removed from sub-adult bull trout in both the P-Creek and T-Creek (Harper Creek tributaries) and one spawned-out adult bull trout mortality measuring 450 mm fork length discovered near river km 18.0 in Harper Creek. After the fish were euthanized in a solution of clove oil the head of fish selected for age analysis were bisected and the left and right side otoliths were removed with forceps. Otoliths were preserved in vials containing glycerin with a fungicide solution until they were mounted, ground and viewed under a compound microscope for age analysis.

3.2.2 Sampling Locations

Fish investigations were conducted within Harper Creek and North Thompson tributaries within the Project LSA. The majority of fish assessments were conducted along the length of Harper Creek, P-Creek and T-Creek, along with sampling in North Thompson Tributaries, which include Baker, Jones, and Avery creeks. Limited fish sampling also occurred in Lute and Chuck creeks.

An overview of sampling locations for fisheries investigations conducted during 2011-2013 is illustrated on Figure 3.2.1.

3.2.3 Data Analysis

3.2.3.1 Fish Abundance and Density Comparisons

Relative fish abundance in the study area was determined using a catch per unit effort (CPUE) index, defined as the number of fish caught per second of electrofishing effort. Comparisons of bull trout density in P-Creek and T-Creek were calculated by dividing the total number of fish captured for a defined sampling area and overall average densities were compared bull trout densities from the Wigwam, Skookumchuk, and White rivers in British Columbia's East Kootenay region.

3.2.3.2 Historic Bull Trout Ages

A considerable amount of historic age data exists for bull trout populations within the Regional Study Area. To augment the samples collected from Harper Creek ageing data was compiled from Hagen and Baxter (1992), Grinton (1994), and other EcoCat data files to illustrate the age structure of bull trout populations from Harper Creek, Saskum Lake, and North Barriere Lake.

3.2.3.3 Fish Condition Factor

Fish condition was calculated using the Fulton condition factor for bull trout sampled the Harper Creek, P-Creek, and T-Creek and rainbow trout in lower Harper Creek and Baker and Jones Creeks. Condition factor is a simple weight-length relation that is generally thought to be one of several indices of healthy fish (Nielson and Johnson 1983). Fulton (1902) established the weight-length relation equation that was used to estimate *K*-factors in this study.

The Fulton condition factor equation used is as follows:

$$K= (W/L3)*X$$

Where:

K = metric condition factor
W = weight in grams
L = length in millimeters
X = Arbitrary scaling constant (for our purposes 10^5 was used)

3.2.3.4 Fish Tissue Analysis

Dissection and analysis of frozen fish tissues (dorso-lateral muscle and liver) was conducted by Analytical Services Laboratories Ltd. in Burnaby, BC. No composite samples were required, and each muscle and liver sample from individual fish was analyzed separately. All metal concentrations were determined by Inductively Coupled Plasma Mass Spectrometry (ICPMS), except Mercury which was determined by Cold Vapour Atomic Fluorescence Spectrometry (CVAFA). All metal concentrations were reported in mg/kg wet weight.

The concentrations of each metal were reported by watershed and compared to various guidelines for the protection of aquatic and piscivorous wildlife, as well as to Health Canada standards for mercury levels in fish. Currently, information is lacking for developing safe metal concentration levels for bull trout or rainbow trout, with guidelines available only for selenium and mercury. The selenium concentration guideline of 4 mg/kg is an interim guideline prescribed by the British Columbia Ministry of Environment (MOE) (2014) for the protection of freshwater aquatic life, with the aim of preventing selenium bioaccumulation up the food chain (MOE 2001). However, the guideline should be interpreted with caution as the Canadian Council of Ministers of the Environment (CCME) has indicated that currently there is insufficient information required for the development of a full guideline.

3.2.4 Limitations and Assumptions

At the time this document was being developed the Project did not fall under Metal Mining Effluent Regulation (MMER) and it was anticipated wit be a zero discharge Project. Given this, fish investigations focused on the presence of deformities and parasites or sampling for health indices such as gonadosomatic index, liver-somatic index and reproductive investment in accordance with a baseline Environmental Effects Monitoring (EEM), as outlined in MMER guidelines was not undertaken.

Quality Control for the laboratory results for fish tissue samples was based on replicate analysis of three randomly chosen tissue samples and the relative proportional differences (differences/mean values expressed as a percent) among samples were reported. All replicates were well within the acceptable relative difference limit of 30% which is considered industry standard.

Single pass electrofishing Catch-Per-Unit-Effort (CPUE) was calculated as an index of relative abundance for all life history stages. The assumptions of the assessment were that (Johnson et al. 2007):

- No fish movement in/out of site during the assessment
- Rate of fish catch is proportional to abundance, and
- Capture efficiency is independent of field conditions within each creek.

3.3 PERIPHYTON

Periphyton includes an assemblage of organisms including attached algae, fungi, and bacteria, their secretions, and detritus (MOE 2012). Periphyton is commonly measured during baseline studies as an indicator of water quality and primary productivity; community structure (taxonomy) and biomass (chlorophyll-a) are generally the parameters of most interest (MOE 2012).

3.3.1 Sampling Methods

The study design and sampling methods were developed based on the following guidance documents:

- Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators. Ministry of Environment. October 11, 2012.
- Metal Mining Technical Guidance for Environmental Effects Monitoring. Environment Canada. 2012.
- Freshwater Biological Sampling Manual. BC Ministry of Environment, Lands and Parks, Wildlife Branch. Resources Inventory Committee. 1997.
- British Columbia Field Sampling Manual For Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples. Ministry of Water, Land and Air Protection. Part C Biological Testing. 2003 Edition.

Biomass and taxonomic composition of periphyton can be used as additional indicators to assess magnitude of an effect on the benthic invertebrate community (EC 2012).

3.3.1.1 Periphyton Taxonomic Sampling Methodology

Periphyton sampling was conducted during September 2011 and September 2013 at 10 river sites, as shown on Figure 3.3.1 and Table 3.3.1. Every effort was made to standardize stream morphology, substrate type, depths, gradients, and velocities at each site to reduce sample variability.

General sampling methodology involves brushing or scraping a sample from a defined area on the top of submerged rocks, with the area delineated using a circular template pressed against the rock surface (MOE 2012). The use of replicates and subsamples at each site helps account for natural variability (MOE 2012).

At eight of the ten sites, three replicates were collected, and at two of the ten sites five replicates were collected. Each replicate was comprised of a composite of subsamples. Each subsample was composed of periphyton scraped from a circular area approximately 2.5 cm in diameter, for an area of 4.91 cm^2. In 2011, a total of 15 subsamples were composited in each replicate; therefore, each replicate represents periphyton coverage in a total surface area of 73.6 cm^2. In 2013 a total of five subsamples were composited in each replicate; therefore, each replicate represents periphyton coverage in a total surface area of 24.6 cm^2.

At each site, sampling points (replicates and field subsamples) were randomly chosen as described in MWLAP (2003). Cobbles and boulders were randomly selected from the channel, working in an upstream direction. Periphyton subsamples were collected by scraping the algae from the rock surface (using a toothbrush and forceps) within a 2.5 cm diameter circular area outlined by a rubber plunger pressed against the rock. The algae scraped from the rock were transferred to a pre-labelled wide-mouthed sample container using de-ionized water from a squirt bottle. Samples were preserved in the field with Lugol's solution. Samples were labelled with sample site name, date, time, and replicate number. Samples were kept in a clean, cool and dry location with minimum exposure to light and forwarded to Fraser Environmental Services for taxonomic identification.

The same laboratory and taxonomic keys were used for periphyton identification in 2011 and 2013 by Fraser Environmental Services. In both years, sub-samples (approximately 100 ml) were dispensed into Utermohl-type settling chambers and allowed to settle for a 24-hour period. Each sub-sample was first scanned at increasing magnification under an inverted microscope and all organisms encountered were identified to the lowest possible taxonomic level. Organisms were enumerated by counting the number of organisms within at least 10 random fields of view until a total count of at least 100 organisms was enumerated for dominant species.

3.3.1.2 Periphyton Biomass Sampling Methodology

Attached algal samples for analysis of biomass were collected from natural substrates using the same methodology described for the collection of periphyton taxonomy samples. Samples were collected during September 2011, 2012, and 2013 from the same 10 sites noted in the previous section (Figure 3.3.1).

Algae from a total area of 24.5 cm^2 (five subsamples) were collected in a sample jar at each site. The samples were preserved in the field with $MgCO_3$ prior to being filtered through a 45 µm Whatman type membrane filter. The filter was then folded over inside a larger diameter filter, which was labelled with date, site, replicate number, and area sampled following methodology outline by MOE (1997). The samples were kept in a cooler and transported to ALS Environmental in Vancouver, BC. for analysis of chlorophyll-a concentration.

3.3.1.3 Quality Assurance/Quality Control

Replicate samples were collected from the same substrate/habitat at each site to minimize heterogeneity of the samples, provide an estimate of the precision of the data, and provide a check on reproducibility of sampling. Samples were collected working in an upstream direction to prevent disturbance of the substrate and associated algae.

To prevent cross-contamination of samples, all brushing, scraping and collecting tools were rinsed in site water and examined for any algal residue.

Sample and relevant site information were recorded in a field logbook. Labels and field notes were reviewed for accuracy and completion prior to leaving the site.

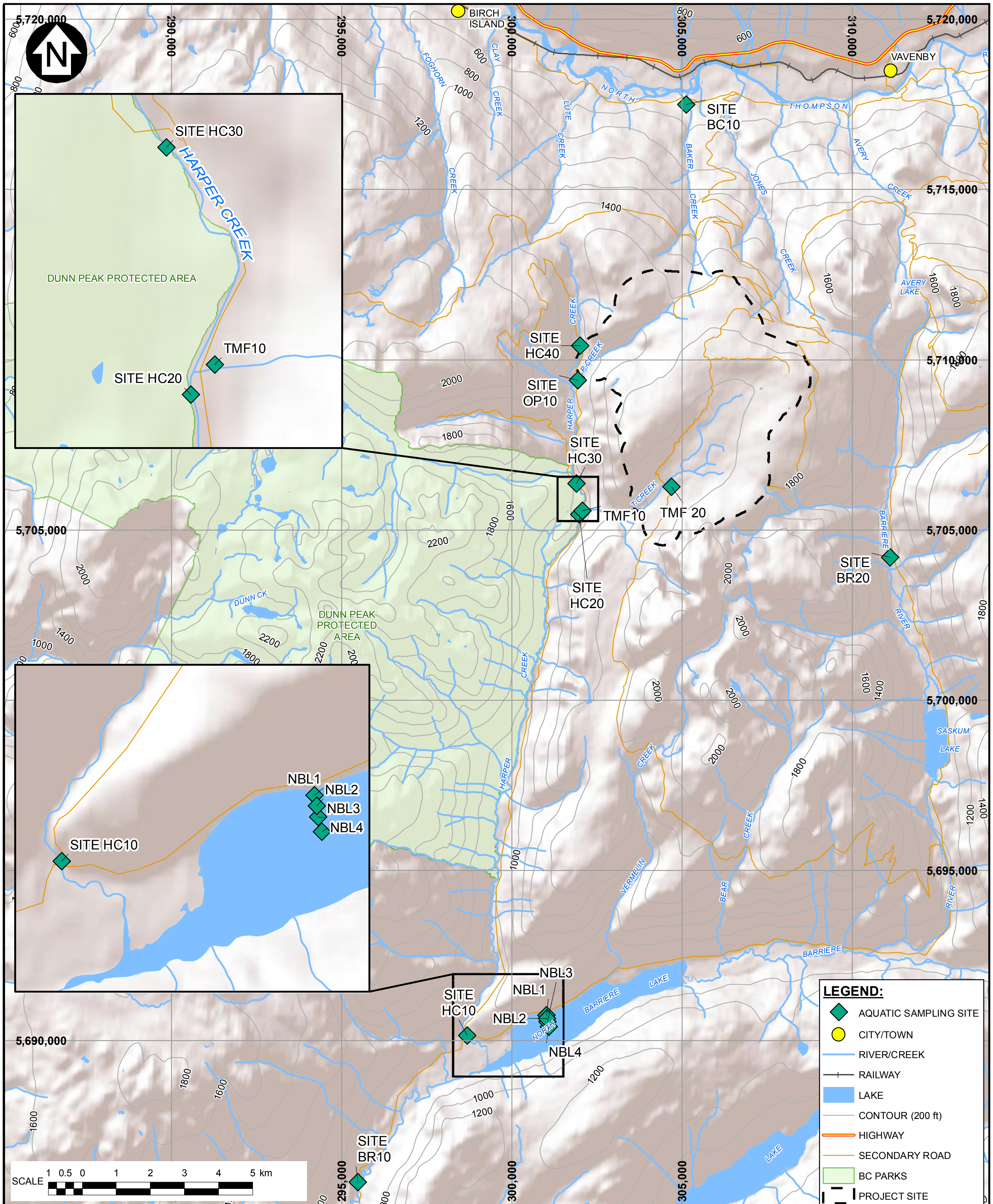
3.3.2 Sampling Locations

During September 2011, 2012 and 2013 aquatic sediment samples were collected at ten stream sample sites within the Project LSA and RSA (Table and Figure 3.3.1). Seven of the sampling locations are located in the Harper Creek Watershed and include four locations in the Harper Creek mainstem and three sampling sites within the P-Creek and T-Creek watersheds, including one immediately within the TSF area.

Channel widths ranged from 3.4 m (TMF-20) to 65 m (BR-10), with wetted widths ranging from 1.8 m to 28.2 m. The sites were classified primarily as riffle, followed by pools and runs. Water temperatures during the 2011-2013 sampling event ranged from a low of 5.8°C at the upper most site on Harper Creek at HC-40 to a high of 12.7°C at the wide open sampling site in the lower Barriere River at siteBR-10. Cobbles dominated the substrate at all sites. A qualitative visual assessment of the amount of periphyton in the creeks ranged from very low at site HC-40; low at sites TMF-20, BC-10, OP-10, and HC-20; moderate at TMF-10, BR-20, HC-30, and HC-10; and high at BR-10.

Table 3.3.1 Aquatic Sampling Sites

Waterbody	Reach Number	Site Code	Mainstem km	UTM Zone	UTM Easting	UTM Northing
Barriere River	N.A.	BR-10	N.A.	11U	295379	5685806
Barriere River	N.A.	BR-20	N.A.	11U	311114	5704126
Harper Creek	3	HC-10	1.70	11U	298721	5690231
Harper Creek	12	HC-20	20.20	11U	301982	5705461
Harper Creek	14	HC-30	21.20	11U	301896	5706363
Harper Creek	17	HC-40	25.60	11U	302010	5710433
T-Creek	1	TMF-10	0.08	11U	302069	5705572
T-Creek	4	TMF-20	3.10	11U	304646	5706333
P-Creek	1	OP-10	0.18	11U	301917	5709397
Baker Creek	2	BC-10	0.20	11U	305120	5717641



NOTES:

1. BASE MAP: TRIM AND NTS MAPPING, ESRI ARCGIS ONLINE SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:160,000 FOR 8.5x11 (LETTER) PAPER.

HARPER CREEK MINING CORP.

HARPER CREEK PROJECT

AQUATIC SAMPLING INVESTIGATION LOCATIONS

Knight Piésold CONSULTING

P/A NO. VA101-458/15 | REF NO. 1

FIGURE 3.3.1 REV 1

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
1	21AUG'14	ISSUED WITH REPORT	CAC	CAC	PMT	KJB

SAVED: M:\1\01\00458\15\A\GIS\Figs\Report1_FishAquaticBaseline\Rev1\Fig3-3-1_AquaticSampling_r1.mxd; Aug 21, 2014 9:53 AM; cczembor

3.3.3 Data Analysis

3.3.3.1 Periphyton Taxonomy

Taxonomy samples were identified to the lowest possible taxonomic level in the laboratory (MOE 2012). Different levels of classification were achieved in the laboratory analysis. In order to include as many organisms as possible in the statistical analysis, in cases where organisms could not be identified to the species level it was assumed that all organisms in the higher level taxa, regardless of quantity, belonged to only one species. The same method was applied to unidentified individuals within an order. Samples with cell counts that were enumerated to be “less-than” a value during analysis were standardized by assigning a value of half the “less-than” value in order to include as many taxa as possible in the density calculations and descriptive statistics.

The periphyton community descriptors are the same as those recommended by Environment Canada (2012) for the benthic invertebrate study: density, taxa richness, and evenness index. In addition, Shannon Wiener Diversity Index was calculated. Mean values plus or minus one standard error were recorded for the metrics listed above.

The mean total periphyton density per site was calculated as cells/cm^2. Mean species richness per site was calculated based on counts of the number of species present at each site. The mean number of individuals per phylum was calculated for each site and then divided by the mean total number of individuals per site to determine percent.

The Shannon Wiener Diversity Index and Evenness Index were evaluated for each site to assess the composition and diversity of the periphyton communities. The Shannon Wiener Diversity Index quantifies biodiversity by measuring the probability of two individuals in a sample belonging to the same taxon while accounting for taxonomic richness and abundance patterns. The higher the index the greater the biodiversity and the less likely that two individuals will belong to the same taxon. Evenness measures the similarity in population size of the different taxa (species in this case). Evenness values closer to 1 indicate that organisms of different taxa are similar in quantity and an evenness value of 0 indicates that only one taxon is present.

Shannon-Wiener’s H’ Diversity Index (Molles 1999):

$$H' = -\sum_{i=1}^{S}(p_i log_e p_i)$$

Where p_i is the proportion of individuals from each taxon (species) i, and k is the total number of individuals. Evenness, J’, was calculated using the following equation:

$$J' = H'/H'_{max}$$

Where H'_{max} is the theoretical maximum value of H’ = ln(k), and where k is the total number of individuals in the sample.

A pollution tolerance index was calculated for the diatoms in the samples from each site based on the tolerance categories discussed in Lange-Bertalot (1979); additional tolerance values were assigned based on Muscio (no date). Lange-Bertalot assigns a number of Bacillariophyceae species a value between 1 and 3, with 1 being most tolerant to pollution and 3 being the least tolerant to pollution. A higher PTI therefore indicates good water quality. A pollution tolerance index (PTI) value was calculated for each site based on the following equation:

$$PTI = (\sum_{n=1}^{K}(n_i t_i)) \div N$$

Where n_i is the number of cells counted for species i, t_i is the tolerance value of species i, and N is the total number of cells counted (Barbour et al, 1999). Only diatom species that are assigned tolerance values are included in this calculation.

3.3.3.2 Periphyton Biomass

The mean chlorophyll-a concentrations and standard error of the subsamples were calculated and compared against the BC Water Quality Criteria for Nutrients and Algae (Nordin 2001). The water quality criterion for aquatic life in streams is set at 100 mg/m^2 (10 µg/cm^2). The maximum chlorophyll-a concentration for recreation in streams is 50 mg/m^2 (5 µg/cm^2).

3.3.4 Limitations and Assumptions

The assumptions used for data analysis are discussed in Section 3.3. The results of the analyses are limited to the information presented in this report.

3.4 BENTHIC INVERTEBRATES

Benthic invertebrates are measured during baseline studies as an indicator of water quality and productivity to support fish (MOE 2012). Guidelines specify that benthic invertebrates sampled should include mayflies, stoneflies, caddis flies, and worms, with the primary parameters of interest being taxa abundance, diversity, and community structure.

The study design, sampling methods, and data analyses were developed based on the following guidance documents:

- Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators. Ministry of Environment. October 11, 2012.
- Metal Mining Technical Guidance for Environmental Effects Monitoring. Environment Canada. 2012.
- Freshwater Biological Sampling Manual. BC Ministry of Environment, Lands and Parks, Wildlife Branch. Resources Inventory Committee. 1997.

3.4.1 Sampling Locations

Benthic invertebrate sampling was conducted during the month of September in 2011, 2012, and 2013 at ten sites throughout the RSA. Sample locations are shown on Figure 3.3.1 and a summary of sampling locations is presented in Table 3.3.1. As per MOE (2012), surveys were conducted at sites upstream, downstream, and near to the project site.

Seven of the sampling locations are located in the Harper Creek Watershed, with four sampling sites in the Harper Creek mainstem and three sampling sites within the P-Creek and T-Creek watersheds, including one immediately within the TSF area. Two other sampling sites occur in the Barriere River, and the final sampling site is north of the Project in Baker Creek.

3.4.2 Sampling Methods

Benthic invertebrates were sampled using a 250 µm mesh Surber Sampler following sampling protocols outlined in RIC (1997b). The square Surber Sampler frame was 0.30 m on each side, and samples were taken to a depth of approximately 0.1 cm. Every effort was made to standardize stream morphology, substrate type, depths, gradients, and velocities at each site to reduce sample variability. In particular, sampling was focused within riffle and run habitat with cobble gravel substrates at water depths between 15-25 cm.

At eight of the ten sample sites, three replicate samples were collected at each site. At the other two sample sites (HC-20 and HC-30), five replicate samples were collected. For each of the three or five replicates, three Surber sub-samples were taken and combined.

A buffered formalin solution (37% formaldehyde solution with Borax as buffer) was added to the benthic samples upon collection in order to preserve the organisms. The ratio of formalin solution to sample water was approximately 1:10. Once the formalin was added to the sample, the bottles were sealed and inverted several times to ensure full mixing. Each sample bottle was affixed with a label containing sample information including project name and number, site name, replicate number, and date. A small label containing site name, replicate number, and date information was also inserted into each bottle. The samples were recorded on a benthic chain of custody form and sent to invertebrate biologist, Lesley Davenport, in Victoria, British Columbia for taxonomic identification and enumeration.

Several methods of sub-sampling are utilized depending on the nature of the sample. Methods include a Folsom plankton splitter, Motodo plankton splitter, Caton trays, Marchant box, weight and volume. The subsampled fraction is sorted into a fresh vial and the unsorted portion is stored in formalin or alcohol in a closed container until the taxonomist is satisfied it will not be required for further analysis. The criteria for the minimum number of organisms collected for sub-sampling are typically a minimum of 300 organisms. If there are few enough organisms and volume that sub-sampling is not required, then all material are sorted into a single vial. Where subsampling has taken place, the numbers from the subsample are extrapolated to have the number reported reflect what would have been present in the entire sample and these numbers are used in the analysis procedure. Further information regarding the methods utilized for sub-sampling are outlined in Appendix G.

3.4.3 Data Analysis

Efforts were made to include as many taxa as possible in the statistical analyses and the taxonomic groups included in the data analysis were guided by those outlined for freshwater environments in Environment Canada (2012) and are presented in Appendix G. Different levels of classification were achieved in the laboratory analysis, from the species level to the phylum level, with most individuals being identified to family. Given that metrics should compare taxa from the same classification level, organisms with higher level classifications were assumed to belong to one family. The same method was applied to unidentified individuals within an order; all unidentified individuals were assumed to be from one family. This assumption was made for several organisms in order to accurately represent the variety of taxa within the study.

Several metrics were examined to characterize benthic communities at each sample site and for each family, following the methodology provided in Environment Canada (2012). The metrics calculated include basic site summaries, such as total invertebrate density (abundance per sampling volume), family richness, and the EPT Index. In addition, biological indices that incorporate both abundance and family richness were calculated for each site, including the Simpson's and Shannon-Wiener Diversity Indices, the Simpson's and Shannon-Wiener Evenness Indices. The Hilsenhoff FBI (Family Biotic Index), which calculates water quality based on family-level tolerance values, was also calculated for each site. Finally, the average density, proportion, and presence/absence for each family in the area were calculated. Descriptive statistics were generated for each metric; means, standard deviations, standard errors, and minimum/maximum values are also presented.

3.4.3.1 Taxonomic Summary Statistics: Density and Abundance

Summary statistics for each family in the area were calculated by year. These included the mean density (abundance/m^3), mean proportional abundance, and presence/absence of each family at each site replicate in the area. Means and standard errors were calculated.

3.4.3.2 Site Summary Statistics: Density, Composition, Richness, and EPT Index

Mean taxonomic composition by order was determined for each site. The mean number of individuals per order was calculated for each site and then divided by the mean total number of individuals per site to determine the mean percent of each order.

The mean total invertebrate density per site was calculated as organism/m^3. The sample area was calculated based on the area of the Surber Sampler (0.093 m^2) multiplied by the depth of the sample (0.10 m) multiplied by the three sub-samples, and was equal to 0.028 m^3.

Mean family richness per site was calculated based on counts of the number of families present at each site.

The EPT index is the number of taxa belonging to the orders Ephemeroptera, Plecoptera, and Trichoptera; or mayflies, stoneflies, and caddisflies. Organisms within these orders are sensitive to pollution; therefore, the EPT index generally increases with increasing water quality (RIC 1998), with values above 8 being considered the highest quality (Table 3.4.1). The EPT index was calculated based on the mean number of families from the Ephemeroptera, Plecoptera, and Trichoptera present at each site and compared to the EPT indices presented in Taccogna and Munro (1995).

Table 3.4.1 EPT Index Values

EPT INDEX			
Good	Acceptable	Marginal	Poor
>8	5-8	2-5	0-1

3.4.3.3 Community Metrics: Diversity and Evenness Indices

Taxonomic composition measures (Simpson's and Shannon-Weiner Diversity and Evenness Indices) were calculated for each sampling site. Composition measures consider both species diversity and the relative contribution of each species to the total abundance. Healthy and stable benthic communities typically have an even proportional representation, though individual abundance may vary in magnitude (Barbour et al. 1999).

Simpson's Diversity Index and Evenness were evaluated for each site to assess the abundance and richness of the benthic communities. The Simpson's Index is calculated by determining for each family at a site, the proportion of individuals that contribute to the total of the station (Krebs 1985):

$$D = 1 - \sum_{i=1}^{S} (p_i)^2$$

Where *D* is Simpson's index of diversity; *S* is the total number of families at the site, and p_i is the proportion of the i^{th} family at the station. Simpson's D increases as diversity increases.

Simpson's Evenness (or Equitiblity) is Simpson's index as a proportion of the maximum value D could assume if individuals in the community were completely evenly distributed (Smith and Wilson 1996):

$$E = 1/\sum_{i=1}^{S} (p_i)^2 / S$$

Where *E* is Simpson's evenness, *S* is the total number of families at the site, and p_i is the proportion of the i^{th} family at the station. Evenness takes a value between 0 and 1, with 1 being complete evenness.

The Shannon-Weiner Diversity Index and Evenness were evaluated for each site to contribute additional information regarding the composition and diversity of the benthic communities. Because multiple diversity indices have strengths and weaknesses, it is optimal to calculate more than one index. The Shannon-Weiner Diversity Index quantifies biodiversity by measuring the probability of two individuals in a sample belonging to the same family, while accounting for taxonomic richness and abundance patterns. The higher the index, the greater the biodiversity and the less likely that two individuals will belong to the same taxon.

Shannon-Wiener's H' Diversity Index (Molles 1999):

$$H' = -\sum_{i=1}^{S} (p_i log_e p_i)$$

Where *H'* is the Shannon-Wiener diversity index, *S* is the total number of families at the site, p_i is the proportion of the i^{th} family at the station, and $log_e p_i$ is the natural log (or ln) of p_i.

Shannon-Wiener Evenness, J', was calculated using the following equation:

$$J^i = {H^i}/{H'_{max}} = {H^i}/{\ln(S)}$$

Where H'_{max} is the theoretical maximum value of *H'* [i.e. *ln(S)*], and where *S* is the total number of families at the site. Evenness measures the similarity in abundance of different taxa (family in this case); values closer to 1 indicate that organisms of different taxa are similar in abundance and an evenness value of 0 indicates that only one taxon is present.

3.4.3.4 Biotic Index: Hilsenhoff FBI

Rapid Bioassessment Protocols for use in Streams and Wadeable Rivers, developed by the Environmental Protection Agency (Barbour et al. 1999) present tolerance designations for benthic invertebrates, based on region, in order to calculate the Hilsenhoff Family Biotic Index (FBI). The northwest region tolerance values were adopted for this assessment, which were developed by the Idaho Department of Environmental Protection. These values were developed to assess water quality by assigning a tolerance value to different families. The values range from 0 to 10, with 0 indicating organisms most sensitive to pollution and 10 being the most pollution tolerant.

The water quality at each site was then evaluated through the use of the family-level biotic index (FBI; Hilsenhoff 1988). The index is calculated for each site using the following equation:

$$FBI = \frac{\sum(n_i * t_i)}{N}$$

Where n_i is the number of individuals of each family *i*, t_i is the tolerance value of family *i*, and N is the total number of organisms at the site.

Each site was then compared against an evaluation of water quality using the family-level biotic index (Hilsenhoff 1988) values in Table 3.4.2 below:

Table 3.4.2 Family-Level Biotic Index

Family Biotic Index	Water Quality	Degree of Organic Pollution
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.00	Very poor	Severe organic pollution likely

3.4.4 Limitations and Assumptions

The assumptions used for data analysis are discussed in Section 3.4.3. The results of the analyses are limited to the information presented in this report.

3.4.4.1 Quality Assurance/Quality Control

In terms of quality control in field methodology, all field personnel were adequately trained; sampling methods and timing were consistent across years; samples were correctly collected, labelled, and preserve; equipment was properly cleaned; and detailed field notes were taken. Upon completion of field sampling, chain of custody forms were completed and safe shipping and storage methods were used. Analytical QA/QC measures are presented in Appendix G.

3.5 AQUATIC SEDIMENT

3.5.1 Sampling Methods

During September 2011, 2012 and 2013 aquatic sediment samples were collected at ten stream sample sites. In October 2011 four lake samples were collected along a transect in North Barriere Lake. The sediment samples were collected in accordance with the MOE (1997) and consistent and rigorous quality assurance and quality control measures were followed to ensure the data was scientifically defensible and representative. At eight of the ten streams sites and the four lake sites three replicates were collected within each site, with three subsamples making up each replicate. Lake samples were collected using an Ekman dredge.

Sediment samples were collected using laboratory supplied acid-washed glass sample jars. Care was taken by the sampler to not disturb or stir up the area before obtaining the samples. Samples were collected from depositional areas of the stream, near the stream bank, at approximately 10-20 cm depth. Samples were collected from the top 4-6 cm layer and filled 120 ml sized jars. Effort was made to collect only the finest materials and that the area sampled had a surface layer that appeared to be intact and relatively flat.

Laboratory quantification of metals (2011, 2012, and 2013) and hydrocarbons (2011 only) in fine sediments (<63 um fraction) was conducted by Analytical Laboratories Services Ltd (ALS) in Burnaby, BC. A summary of the sediment quality parameters analyzed, see Table 3.5.1.

Table 3.5.1 Sediment Quality Parameters Analyzed

Sample Type	Parameters		
Sediment	Conventional Parameters and Organics	Alkalinity (Total as CaCO3) %	
		Total Organic Carbon %	
		Total Inorganic Carbon %	
		Moisture %	
		pH	
	Total Metals (mg/kg)	Aluminum	Mercury
		Antimony	Molybdenum
		Arsenic	Nickel
		Barium	Phosphorus
		Beryllium	Potassium
		Bismuth	Selenium
		Boron	Silver
		Cadmium	Sodium
		Calcium	Strontium
		Chromium	Thallium
		Cobalt	Tin
		Copper	Titanium
		Iron	Uranium
		Lead	Vanadium
		Magnesium	Zinc
		Manganese	-
	Polycyclic Aromatic Hydrocarbons (PAHs)	2-Methylnaphthalene	Chrysene
		Acenaphthene	Chrysene-d12 %
		Acenaphthene-d10 %	Dibenzo (a/h) anthracene
		Acenaphthylene	Fluoranthene
		Anthracene	Fluorene
		Benzo (a) anthracene	High Molecular Weight PAHs
		Benzo (a) pyrene	Indeno(1/2/3-cd)pyrene
		Benzo (A) pyrene-d12	Naphthalene
		Benzo (b) fluoranthene	Naphthalene-d8 %
		Benzo (b/j) fluoranthene	Phenanthrene
		Benzo (g/h/i) perylene	Phenanthrene-d10 %
		Benzo (k) fluoranthene	Pyrene

3.5.2 Sampling Locations

Sediment quality samples were collected in streams throughout the Harper Creek baseline study area, tributaries to the North Thompson River and in North Barriere Lake. The majority of sediment quality samples were collected along the length of Harper Creek and adjoining tributaries (P-Creek and T-Creek) with two reference sites in the Barriere River and one sample site in the Baker Creek catchment. An overview of sampling locations for sediment investigations conducting during 2011-2013 are listed below and a detailed map of the sediment sampling locations can be found in Figure 3.3.1.

- NBL-1 North Barriere Lake
- NBL-2 North Barriere Lake
- NBL-3 North Barriere Lake
- NBL-4 North Barriere Lake
- TMF-10 T-Creek (Harper Creek tributary downstream of the Project Site)
- TMF-20 T-Creek (Harper Creek tributary in the Project Site
- OP-10 P-Creek downstream of Project Site
- HC-10 Harper Creek before inlet of North Barriere Lake
- HC-20 Harper Creek downstream of P-Creek inlet
- HC-30 Harper Creek downstream of T-Creek inlet
- HC-40 uppermost sampling location on Harper Creek
- BR-10 Barriere River downstream of North Barriere Lake and inlet of Harper Creek
- BR-20 Barriere River upstream of North Barriere Lake
- BC-10 Baker Creek before the outlet to North Thompson River

3.5.3 Applicable Guidelines

Specific federal and provincial (working) guidelines were used to detect if baseline freshwater sediment quality parameters were elevated in comparison to the prescribed guidelines. Sediment quality data were compared to both CCME or BC sediment quality guidelines (MOE 2006; CCME 1999). For most metals, BC guidelines are based on those from CCME and are called interim sediment quality (ISQ) guidelines or probable effect level (PEL) guidelines. The exceptions to this are iron and nickel in the BC guidelines, which do not have CCME equivalents, and are based on concentrations that provide a lowest effect level (LEL) and severe effect level (SEL). Metal concentrations in the sediment that are greater than the CCME PEL or SEL may have a negative impact on aquatic life, particularly for sensitive species within the aquatic community. For a list of parameters and their corresponding guidelines, see Table 3.5.2.

Table 3.5.2 Federal and Provincial Sediment Quality Guidelines used in Baseline Studies

Sediment Metals	BC-LEL (mg/kg) limit	BC-SEL (mg/kg) limit	CCME-ISQG (mg/kg) limit	CCME-PEL (mg/kg) limit
Arsenic	5.9	17	5.9	17
Cadmium	0.6	3.5	0.6	3.5
Chromium	37.3	90	37.3	90
Copper	35.7	197	35.7	197
Iron	21200	43766	-	-
Lead	35	91	35	91.3
Manganese	460	1100	-	-
Mercury	0.17	0.486	0.17	0.486
Nickel	16	75	-	-
Zinc	123	315	123	315

3.5.4 Data Analysis

During 2011, baseline aquatic sediment chemistry samples were collected within the Aquatic RSA at North Barriere Lake (four sites), Harper Creek (hour sites, Harper Creek (one site), Barriere River (two sites), P-Creek (one site) and T-Creek (two sites). During 2012 and 2013, baseline aquatic sediment samples were collected from the same sampling locations with the exception that no samples were obtained from North Barriere Lake.

3.5.5 Limitations and Assumptions

A limitation of sediment quality sampling in a proposed mine environment includes the inability to find a suitable lotic stream to collect fine sediments for proper metals analysis. The replicate samples that were collected for each sample site should be representative of the immediate area, but each sample is assumed to incorporate variability. The location of the sample collection is important to reduce variability in sample composition between sites (i.e., distance from shore, depth of water, and distance from any obstructions that induce deposition of material on the river bed).

4 – RESULTS AND DISCUSSION

4.1 AQUATIC HABITAT

Fish habitat assessments were completed to document physical habitat characteristics in streams draining the Project Site, with additional emphasis placed on fish-bearing waters. The aquatic habitat data collected will be used to inform the environmental assessment concerning fish species distribution, relative abundance, and life history and to assist in the identification of potential impacts and mitigation.

4.1.1 Watershed Characterization Parameters

The North Thompson River is the largest river system common to all receiving waters down gradient from the Harper Creek Project. In general, surface runoff originating in the Project Site flows south through Harper Creek and the Barriere River to the North Thompson River at Barriere, or north through Baker Creek and Jones Creek to the North Thompson River near Vavenby. A portion of surface runoff from the mine access road and powerline corridors also flows towards Avery Creek and Chuck Creek. The North Thompson River flows from east to west, as it passes Clearwater and Vavenby, and eventually turns south where it flows towards Kamloops and becomes confluent with the South Thompson River.

Water of Survey of Canada reports an upstream catchment area of 1,140 km^2 at its hydrometric station located near the mouth of the Barriere River. Figure 1.6.1 shows sub catchment boundaries for the upper Barriere River (575 km^2) from below the outlet of North Barriere Lake at its confluence with Birk Creek. Harper Creek comprises 186 km^2 or 32% of the upper Barriere River catchment area. Also shown on Figure 1.6.1 are catchment areas for Baker Creek (14.4 km^2) and Jones Creek (18.4 km^2) that drain the south slope of the North Thompson valley above Vavenby to the North Thompson River.

North Barriere Lake (497 ha) and Saskum Lake (114 ha) are the two main lakes in the upper Barriere River catchment.

4.1.2 Stream Reaches

4.1.2.1 Harper Creek

Eighteen reaches were identified on the mainstem of Harper Creek from its confluence with North Barriere Lake to its headwaters approximately 28.9 km upstream Table 4.4.1; Appendix B). The average gradient of Harper Creek is 2.8%. The Harper Creek valley is V-shaped and Harper Creek follows a straight channel pattern and is confined throughout much of it length before crossing a low gradient fan and discharging to the outlet of North Barriere Lake. Riparian vegetation consists primarily of subalpine fir, Engelmann spruce, western red cedar, black cottonwood, Salix spp., Vaccinium spp., and mosses.

The dominant stream morphology in Harper Creek is confined cascade-pool, although intermittent low gradient stepped sections occur where the morphology is riffle-pool and the channel is less confined. Alluvial bed materials consisting primarily of cobbles interspersed with boulders and gravels occur throughout Harper Creek. Large woody debris accumulations (log jams) are important features in Harper Creek for trapping gravels and increasing habitat complexity for fish and aquatic life. Reach 10 (river km 18.5 to km 19.9) at 9.0% is the steepest section in Harper Creek. The upper end of Reach 10 includes a 2 m falls with the channel confined by a bedrock canyon. Several reaches with channel slopes between 1% and 2% occur both above and below these falls. Reach 1 and 2 at the mouth of Harper Creek have channel slopes less than 1%.

An unnamed tributary to upper Harper Creek drains a catchment area of 23.4 km^2. The upper hanging valley portion of this tributary is the proposed location for the Harper Creek Project Tailings Management Facility. The tributary has been assigned the reference name “T-Creek” for use in this report. The confluence of T-Creek and Harper Creek is at river km 20.3 of Harper Creek at the upper end of Harper Creek Reach 12. Six reaches were identified on the mainstem of T-Creek from its confluence with Harper Creek to its headwaters approximately 9.1 km upstream (Table 4.1.1, Appendix B). The average channel gradient of T-Creek is 7.7%. Reach 2 of T-Creek (creek km 0.3 to km 2.2) has an average channel gradient of 23.8%. The upper end of Reach 1 is bounded by a 1.8 m high waterfall followed by cascades into the lower portion of Reach 2. The dominant stream morphology in T-Creek is confined cascade-pool. Alluvial bed materials are coarser than in Harper Creek and consist primarily of boulders and cobbles with some gravels.

A second unnamed tributary to upper Harper Creek drains a catchment area of 7.7 km^2. The upper portion of this tributary overlaps the proposed Open Pit for the Harper Creek Project. The tributary has been assigned the reference name “P-Creek” for use in this report. The confluence of P-Creek and Harper Creek is at river km 24.4 of Harper Creek at the upper end of Harper Creek Reach 16. Four reaches were identified on the mainstem of P-Creek from its confluence with Harper Creek to its headwaters approximately 4.4 km upstream (Table 4.1.1; Appendix B). The average channel gradient of P-Creek is 10.1%. Reach 1 has an average channel slope of 5.5%. The upper end of Reach 1 is bounded by a 3 m high cascade and confined section of bedrock. Reach 2 has an average channel of 9.9%. The dominant stream morphology in P-Creek is confined cascade-pool. Alluvial bed materials are coarser than T-Creek and consist of primarily of angular cobbles and gravels.

Table 4.1.1 Harper Creek, T-Creek, and P-Creek Stream Reaches

Stream Name	Reach Number	Reach Break Elevation Lower (m)	Reach Break Elevation Upper (m)	Elevation Difference (m)	Distance from Mouth (m)	Channel Length (m)	Channel Slope (%)	Mean Channel Width (m)
Harper Creek	1	639	641	2	549	549	0.4%	25
Harper Creek	2	641	649	8	1460	911	0.9%	28
Harper Creek	3	649	707	58	3600	2140	2.7%	19
Harper Creek	4	707	756	49	4720	1120	4.4%	20
Harper Creek	5	756	834	78	9200	4480	1.7%	17
Harper Creek	6	834	898	64	11000	1800	3.6%	19
Harper Creek	7	898	1013	115	15100	4100	2.8%	13
Harper Creek	8	1013	1057	44	18000	2900	1.5%	15
Harper Creek	9	1057	1071	14	18400	400	3.5%	9
Harper Creek	10	1071	1080	9	18500	100	9.0%	7
Harper Creek	11	1080	1136	56	19900	1400	4.0%	19
Harper Creek	12	1136	1140	4	20300	400	1.0%	15
Harper Creek	13	1140	1155	15	20900	600	2.5%	14
Harper Creek	14	1155	1159	4	21200	300	1.3%	10
Harper Creek	15	1159	1185	26	22400	1200	2.2%	15
Harper Creek	16	1185	1256	71	24400	2000	3.6%	10
Harper Creek	17	1256	1329	73	25700	1300	5.6%	10
Harper Creek	18	1329	1459	130	28900	3200	4.1%	5
Totals:	**18**			**820**		**28900**	**2.8%**	**15**
T-Creek	1	1141	1162	21	280	280	7.5%	7
T-Creek	2	1162	1630	468	2250	1970	23.8%	7
T-Creek	3	1630	1658	28	2940	690	4.1%	6
T-Creek	4	1658	1681	23	3850	910	2.5%	7
T-Creek	5	1681	1772	91	6820	2970	3.1%	5
T-Creek	6	1772	1843	71	9090	2270	3.1%	3
Totals:	**6**			**702**		**9090**	**7.7%**	**6**
P-Creek	1	1256	1277	21	380	380	5.5%	7
P-Creek	2	1277	1333	56	944	564	9.9%	6
P-Creek	3	1333	1602	269	3640	2696	10.0%	4
P-Creek	4	1602	1697	95	4370	730	13.0%	3
Totals:	**4**			**441**		**4370**	**10.1%**	**5**

4.1.2.2 North Thompson Tributaries

Four reaches were identified on the mainstem of Baker Creek from its confluence with the Thompson River to its headwaters approximately 6.7 km upstream (Table 4.1.2; Appendix B). The average channel gradient of Baker Creek is 18.4%. The dominant stream morphology in Baker Creek is confined cascade-pool. Alluvial bed materials consist primarily of cobbles and gravels. Potential fish barriers were identified at the upper end of Reach 1 (culvert under Birch Island-Lost-Creek Road at creek km 0.12) and the upper end of Reach 2 (steep cascades at creek km 1.75).

Five reaches were identified on the mainstem of Jones Creek from its confluence with the Thompson River to its headwaters approximately 8.7 km upstream. The average channel gradient of Jones Creek is 15.0% (Table 4.1.2 ; Appendix B). The dominant stream morphology in Jones Creek is confined cascade-pool with some riffle-pool morphology in lower sections. Alluvial bed materials consist primarily of cobbles and gravels. Potential fish barriers were identified at the upper end of

Reach 1 (hanging culvert under Birch Island-Lost-Creek Road at creek km 0.63) and the upper end of Reach 2 (steep bedrock constriction at creek km 1.78).

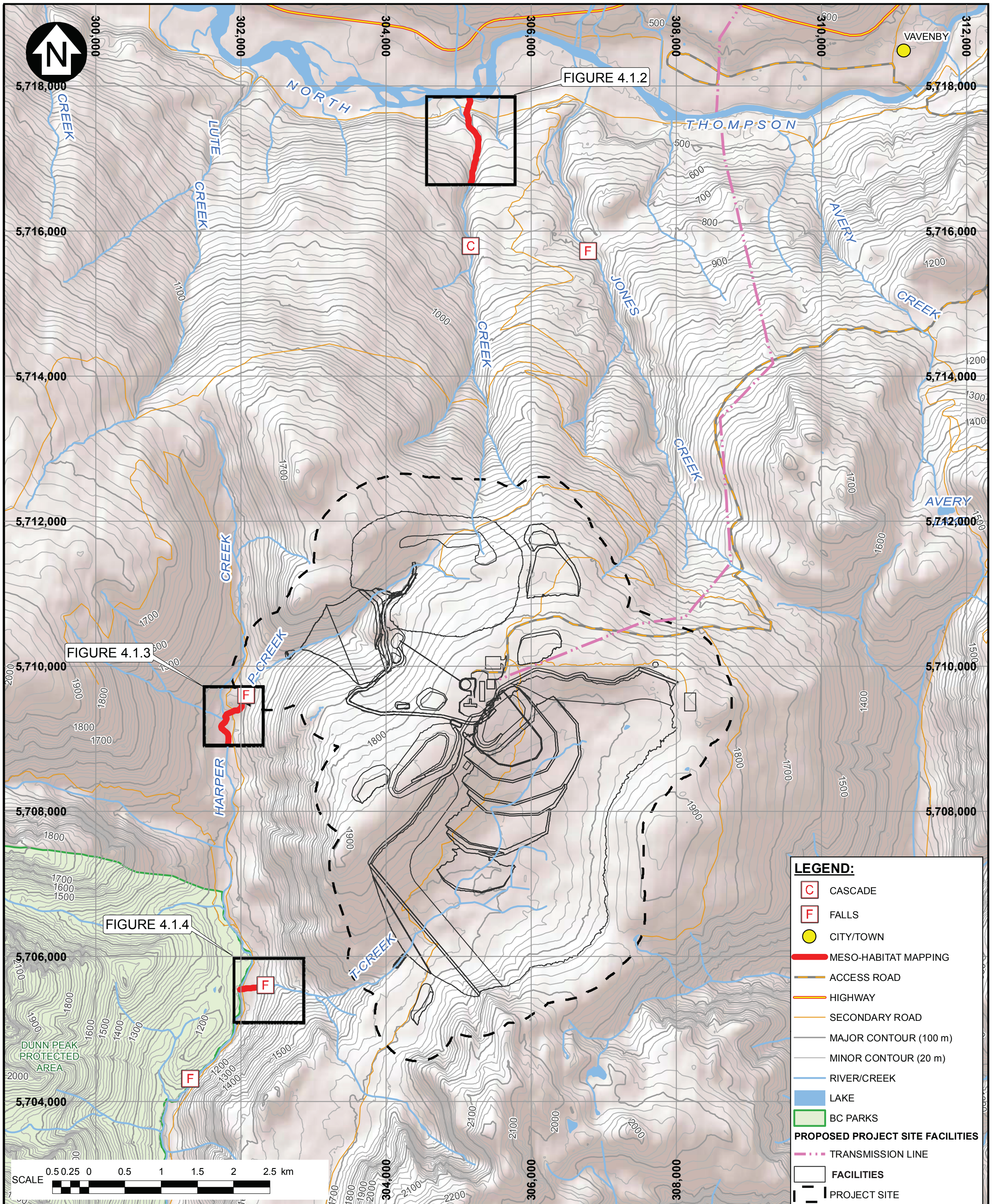
Nine reaches were identified on the mainstem of Chuck Creek from its confluence with the Thompson River to its headwaters approximately 11.9 km upstream. The average channel gradient of Chuck Creek is 7.2% (Table 4.1.2; Appendix B). Running Bear Lake (6.2 ha) is located at the headwater of Chuck Creek at elevation 1,300 masl.

Table 4.1.2 Baker Creek, Jones Creek, and Chuck Creek Stream Reaches

Stream Name	Reach Number	Reach Break Elevation Lower (m)	Reach Break Elevation Upper (m)	Elevation Difference (m)	Distance from Mouth (m)	Channel Length (m)	Channel Slope (%)	Mean Channel Width (m)
Baker Creek	1	435	452	17	119	119	14.3%	6
Baker Creek	2	452	631	179	1750	1631	11.0%	4
Baker Creek	3	631	997	366	4030	2280	16.1%	4
Baker Creek	4	997	1663	666	6680	2650	25.1%	3
Totals:	**4**			**1228**		**6680**	**18.4%**	**4**
Jones Creek	1	432	455	23	630	630	3.7%	7
Jones Creek	2	455	547	92	1780	1150	8.0%	5
Jones Creek	3	547	872	325	4360	2580	12.6%	5
Jones Creek	4	872	1227	355	6660	2300	15.4%	4
Jones Creek	5	1227	1739	512	8730	2070	24.7%	3
Totals:	**5**			**1307**		**8730**	**15.0%**	**5**
Chuck Creek	1	444	460	16	192	192	8.3%	6
Chuck Creek	2	460	653	193	2000	1808	10.7%	8
Chuck Creek	3	653	880	227	4710	2710	8.4%	8
Chuck Creek	4	880	996	116	6500	1790	6.5%	6
Chuck Creek	5	996	1224	228	9030	2530	9.0%	5
Chuck Creek	6	1224	1264	40	10400	1370	2.9%	4
Chuck Creek	7	1264	1264	0	10685	285	0.0%	Lake
Chuck Creek	8	1264	1296	32	11469	784	4.1%	4
Chuck Creek	9	1296	1296	0	11904	435	0.0%	Lake
Totals:	**9**			**852**		**11904**	**7.2%**	**6**

4.1.3 Stream Channel Characterization

Level 1 mesohabitat assessments were completed for the fish bearing portions of T-Creek and P-Creek during August, 2012. Additional mesohabitat assessments were conducted for the lower 1.25 km section of Baker Creek and a 0.45 km section of the upper Harper Creek mainstem immediately downstream of the P-Creek confluence during September 2013. Details for these assessments are presented in the mesohabitat overview presented in Figure 4.1.1 (Appendix C) and a summary of the creek characterizations is offered below.



NOTES:

1. BASE MAP: TRIM AND NTS MAPPING, ESRI ARCGIS ONLINE SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:75,000 FOR 8.5x11 (LETTER) PAPER.

HARPER CREEK MINING CORP.

HARPER CREEK PROJECT

MESO-HABITAT ASSESSMENTS: KEY MAP

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-458/15	1

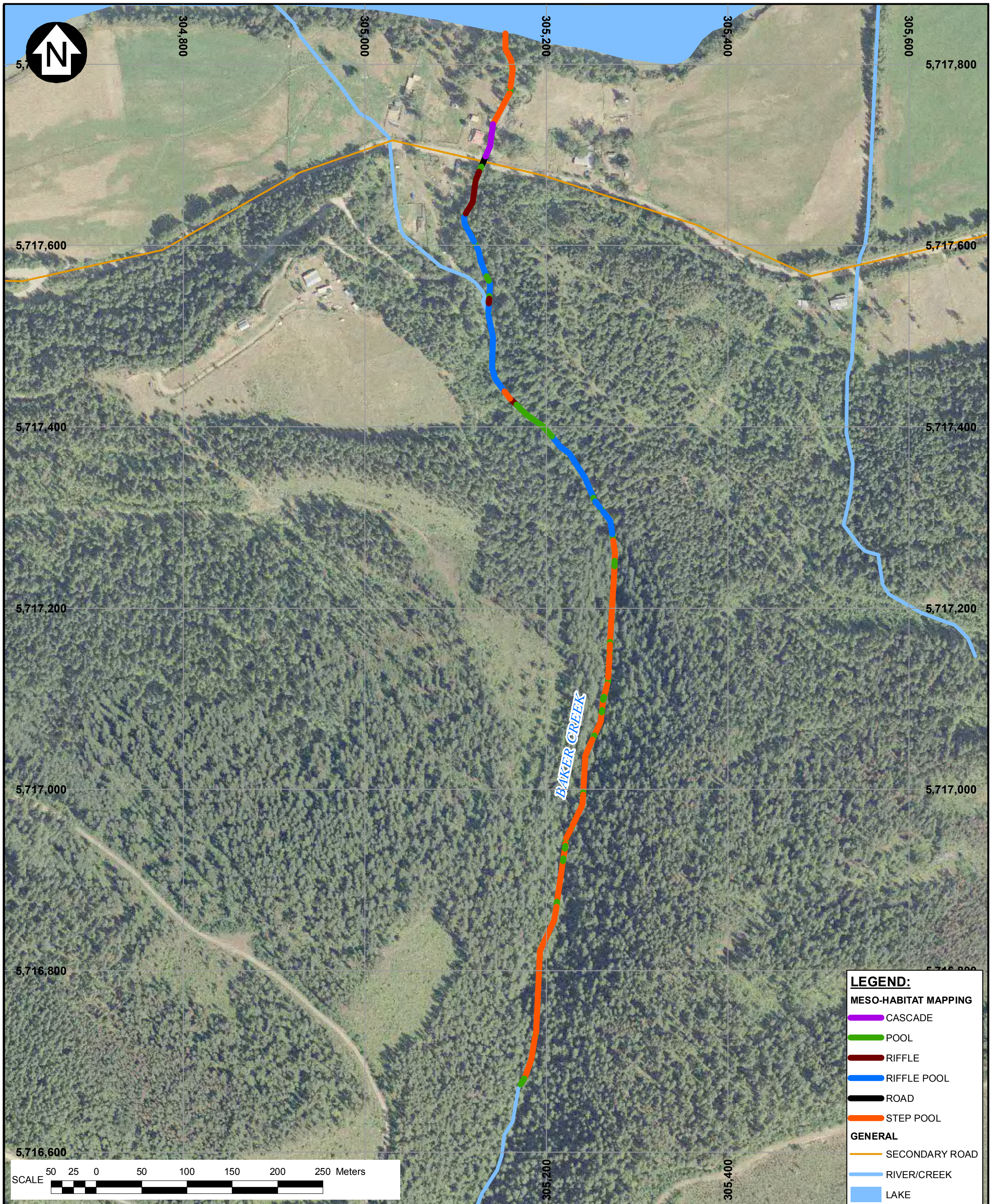
FIGURE 4.1.1 REV 1

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
1	21AUG'14	ISSUED WITH REPORT	CAC	CAC	PMT	KJB

SAVED: M:\1\01\00458\15\A\GIS\Figs\Report1_FishAquaticBaseline\Rev1\Fig4-1-1_MesoHabitat-Key_r1.mxd; Aug 26, 2014 10:18 AM; cczembor

4.1.3.1 Baker Creek

A total of 1250 m of fish bearing habitat within Baker Creek was categorized into 66 different mesohabitat units and details are presented on Figure 4.1.2 and in Appendix C. The most frequent habitat was classified as small pools (45%) which had an average length of approximately 4.8 m, with an average maximum and residual depth of 0.58 m and 0.12 m respectively. Step pools (34%) were the next most common mesohabitat and the units averaged approximately 29.9 m in length with a mean residual depth of 0.34 m. Riffle-pools and riffles accounted for 12% and 8% of the habitat mapped with a mean length of 38.2 m and 14.8 m in length, respectively. Cascades accounted for 2% of the remaining habitat and these units averaged 41 m in length. Bed material in Baker Creek is dominated by coarse materials with the majority being classified as either boulder (45%), followed by cobble (44%), with a small proportion of gravels (11%). The dominant forms of fish cover are provided by overhanging riparian vegetation (56%), undercut banks (20%) and large woody debris (21%), with a small proportion of instream boulders (3%).



NOTES:

1. BASE MAP: TRIM AND NTS MAPPING, ESRI ARCGIS ONLINE SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:6,000 FOR 8.5x11 (LETTER) PAPER.

HARPER CREEK MINING CORP.

HARPER CREEK PROJECT

MESO-HABITAT ASSESSMENTS: BAKER CREEK

Knight Piésold CONSULTING

P/A NO. VA101-458/15

REF NO. 1

FIGURE 4.1.2

REV 1

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
1	21AUG'14	ISSUED WITH REPORT	CAC	CAC	PMT	KJB

SAVED: M:\1\01\00458\15\A\GIS\Figs\Report1_FishAquaticBaseline\Rev1\Fig4-1-2_MesoHabitat-Baker_r1.mxd; Aug 21, 2014 9:54 AM; cczembor

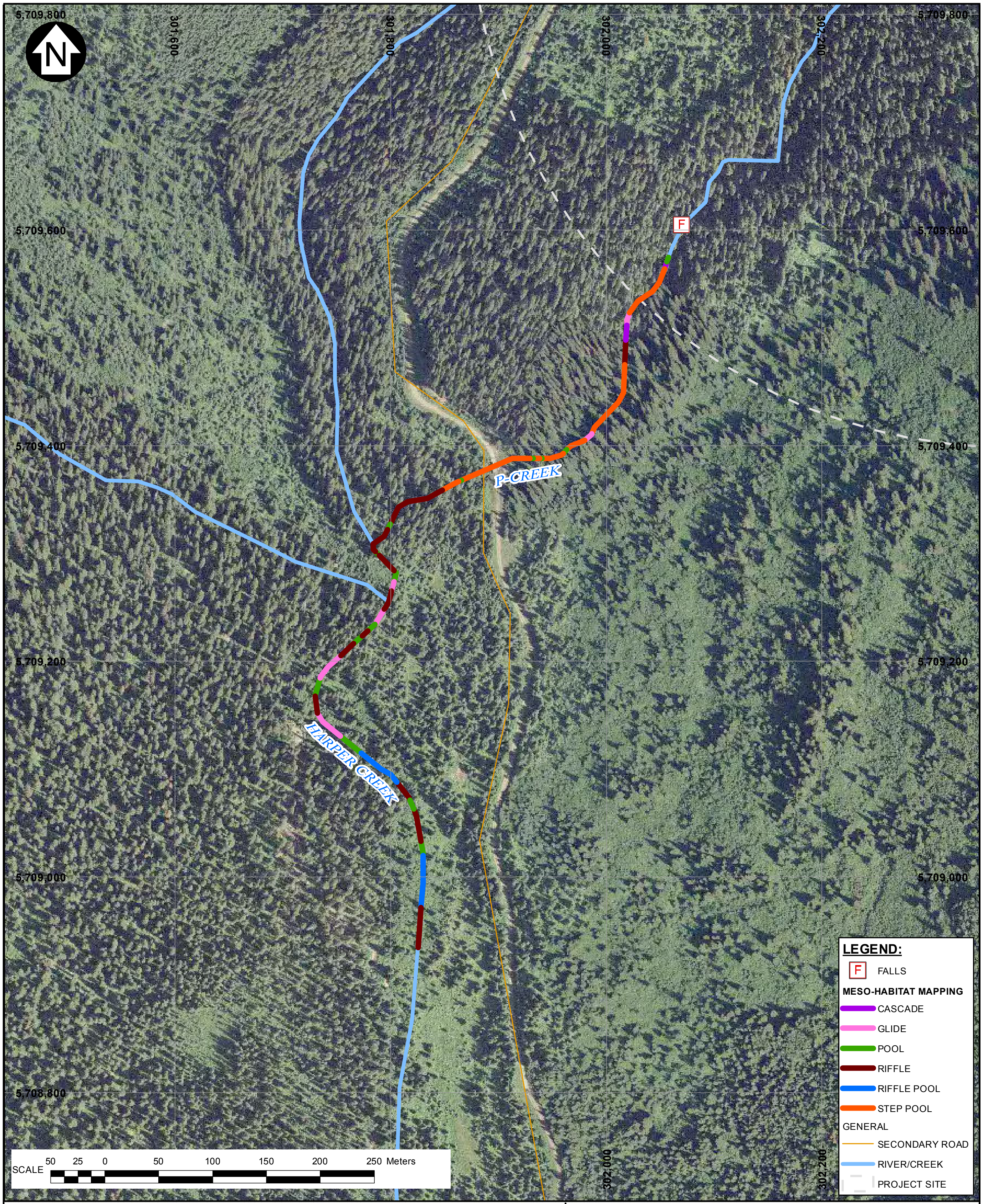
4.1.3.2 P-Creek

The 429 m of fish bearing habitat within P-Creek was categorized into 20 different mesohabitat units and details are presented on Figure 4.1.3 and in Appendix C. The most frequent habitat was classified as step-pools (37%) which had an average length of approximately 37 m and an average gradient of about 8%. Short pools (32%) were the next most common mesohabitat and the units averaged approximately 3.8 m in length with a mean residual depth of 0.34 m. Riffles and glides accounted for 16% and 11% of the habitat mapped with a mean length of 42.5 m and 10.5 m in length, respectively. Cascades accounted for 11% of the remaining habitat and these units averaged 10.5 m in length.

Bed material in P-Creek is dominated by coarse materials with the vast majority being classified as angular cobble (65%), followed by boulder (30%), with a small proportion of sandy fines (5%). The dominant forms of fish cover are provided by overhead riparian vegetation (overhanging alder), boulders, and large woody debris with some sub-dominant cover being provided by instream woody debris.

4.1.3.3 Upper Harper Creek

A total of 452 m of fish bearing habitat within upper Harper Creek immediately downstream of the P-Creek confluence was categorized into 24 different mesohabitat units and details are presented on Figure 4.1.3 and in Appendix C. The most frequent habitat was classified as riffles (38%) which had an average length of approximately 21.1 m. Pools (33%) were the next most common mesohabitat and the units averaged approximately 12.5 m in length with an average maximum and residual depth of 0.52 m and 0.10 m respectively. Glides and riffle-pools accounted for 17% and 13% of the habitat mapped with a mean length of 21.5 m and 30.6 m, respectively. The dominant bed material in upper Harper Creek is cobble (76%), followed by gravel (26%). The dominant forms of fish cover are provided by large woody debris (36%), deeper pools (37%), overhanging riparian vegetation in the form of overhanging alder (18%), and undercut banks (9%).



NOTES:

1. BASE MAP: TRIM AND NTS MAPPING, ESRI ARCGIS ONLINE SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:5,000 FOR 8.5x11 (LETTER) PAPER.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
1	21AUG'14	ISSUED WITH REPORT	CAC	CAC	PMT	KJB

HARPER CREEK MINING CORP.

HARPER CREEK PROJECT

MESO-HABITAT ASSESSMENTS: UPPER HARPER CREEK AND P-CREEK

Knight Piésold CONSULTING

P/A NO. VA101-458/15 | REF NO. 1

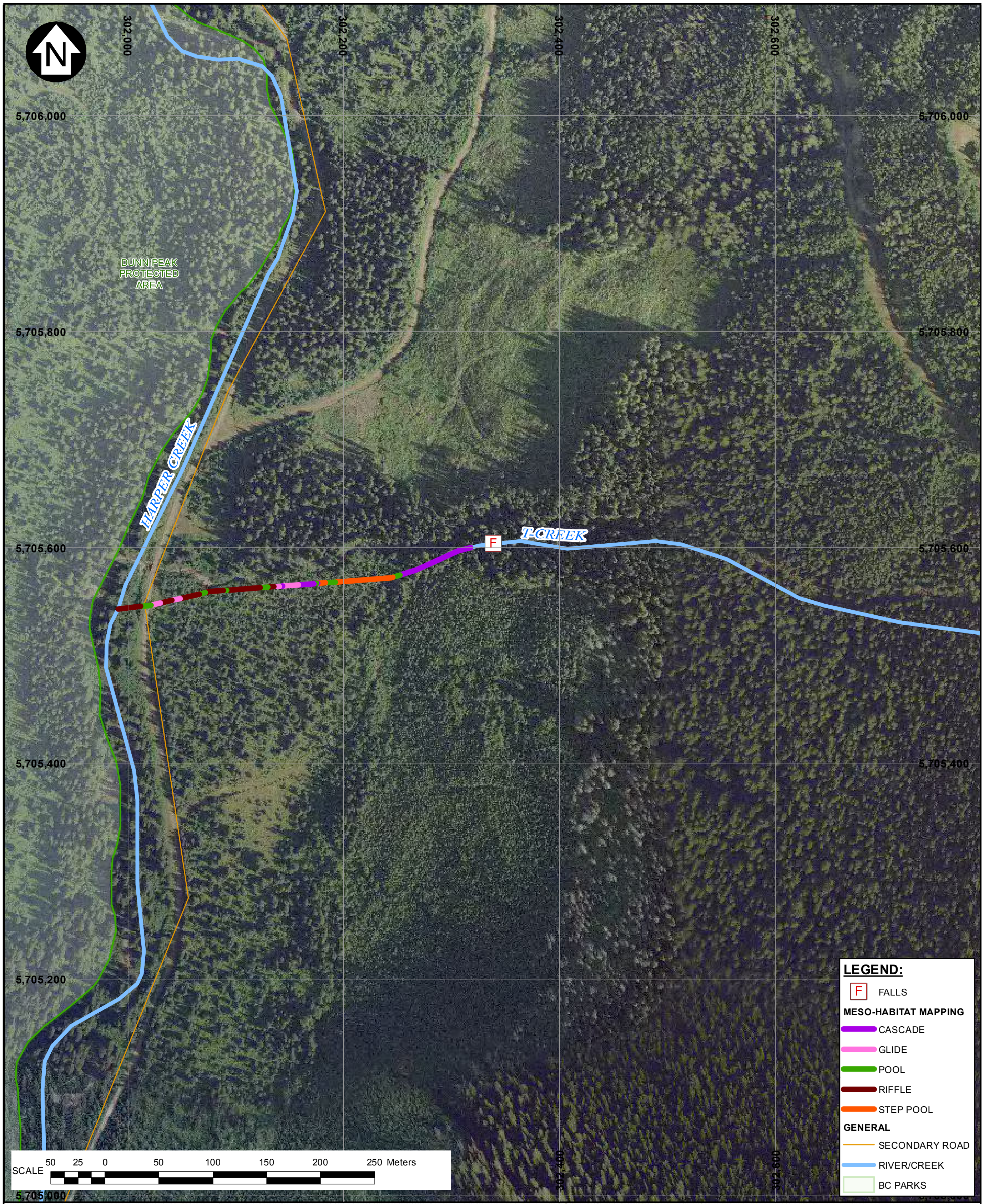
FIGURE 4.1.3 | REV 1

SAVED: M:\1\01\00458\15\A\GIS\Figs\Report1_FishAquaticBaseline\Rev1\Fig4-1-3_MesoHabitat-PandHarper_r1.mxd; Aug 21, 2014 10:06 AM; cczembor

4.1.3.4 T-Creek

The 336 m fish bearing portion of T-Creek was categorized into 22 mesohabitat units and details are presented on Figure 4.1.4 and in Appendix C. The most frequent habitat was classified as short pools (32%) which averaged approximately 6.4 m in length with a mean residual depth of 0.38 m. Riffles and glides accounted for 23% and 18% of the habitat mapped with a mean length of 17.3 m and 9.3 m in length, respectively. Cascades and step-pools accounted for approximately 27% of the remaining habitat and these habitats averaged 6.0 to 7.0 m in length although the final 129 m of the fish bearing reach was classified as a high gradient step-pool or cascade with an approximate gradient of between 22% and 27%.

Bed material in T-Creek is dominated by coarse materials with the vast majority being classified as boulder/cobble (71%), followed by boulder (19%), boulder/gravel (5%) and cobble/boulder (5%). The dominant forms of fish cover are provided by overhead riparian vegetation (overhanging alder) and boulders, with some sub-dominant cover being provided by undercut banks and instream woody debris.



NOTES:

1. BASE MAP: TRIM AND NTS MAPPING, ESRI ARCGIS ONLINE SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:5,000 FOR 8.5x11 (LETTER) PAPER.

HARPER CREEK MINING CORP.

HARPER CREEK PROJECT

MESO-HABITAT ASSESSMENTS: T-CREEK

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-458/15	1

FIGURE 4.1.4 REV 1

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
1	21AUG'14	ISSUED WITH REPORT	CAC	CAC	PMT	KJB

SAVED: M:\1\01\00458\15\A\GIS\Figs\Report1_FishAquaticBaseline\Rev1\Fig4-1-4_MesoHabitat-T_r1.mxd; Aug 21, 2014 10:06 AM; cczembor

4.1.4 Water Quality

In-situ water quality data were collected at a subset of fish and aquatic habitat sites between July 2011 and September 2012 at sites on lower Harper Creek, T-Creek, upper Harper Creek, P-Creek, Baker Creek, Lute Creek, Foghorn Creek, Jones Creek, and the Barriere River. The results are presented in Table 4.1.3 and described as follows.

At sites within the regional study area, spring through fall water temperatures ranged from 4.4°C to 16.0°C and dissolved oxygen ranged from 8.6 mg/L to 12.9 mg/L. Conductivity ranged from 22 µS/cm to 299 µS/cm and pH ranged from 6.54 to 10.22. Total dissolved solids ranged from 0.020 g/L to 0.256 g/L.

Lower temperatures (~4°C to 9°C) tended to occur in upper Harper Creek during all three months, likely due to the influence of cold glacial runoff from mountains to the west of Harper Creek. Higher temperatures (~9°C to 10°C) tended to occur in T-Creek in July and August. This could be attributed to the lower elevation of the sampling sites and the relative absence of glacial melt to cool stream temperatures. Highest and lowest temperatures were recorded in September in the Barriere River at Site BR-10 (16.0°C) and in upper Harper Creek at Site HC-F390 (4.4°C).

Dissolved oxygen levels averaged 10.7± 1.0 mg/L (S.D.) in rivers and creeks within in the Project study area during the early summer and fall months of 2011 and 2012. Dissolved oxygen level ranged from a low of 8.6 mg/L during warm water conditions during late September 2012 in the Barriere River through to a high of 12.9 mg/L in upper T-Creek during late August, 2011.

Conductivity was higher (over 100 µS/cm) in portions of upper Harper Creek, Foghorn Creek, Baker Creek, Lute Creek, and Jones Creek. At 299 and 270 µS/cm, Baker Creek and Foghorn Creek, respectively, recorded significantly higher conductivity than any of the other creeks. Sites in lower Harper Creek, P-Creek, T-Creek, and the Barriere River recorded lower conductivity (between 20 and 98 µS/cm).

The pH of creeks and rivers in the baseline study area were slightly alkali with an average pH of 8.0 ± 0.77. At 10.2 (in September 2011), pH was significantly more alkali in Foghorn Creek than at other sites and pH was also relatively high (~8.2 to 9.5) at sites in Baker Creek. At 6.54, pH was the most acidic in lower Harper Creek (in August 2011).

Total dissolved solids were highest in Foghorn Creek, recorded at 0.256 g/L. Total dissolved solids were also relatively high (above 0.1 g/L) at sites in portions of upper Harper Creek, Baker Creek, Jones Creek, and Lute Creek. Total dissolved solid observations were lowest in lower T-Creek.

Table 4.1.3 2011-2012 Study Area In-Situ Water Quality

Watercourse	Fish/Habitat Site	Sample Date	UTM - Easting (Zone 11U)	UTM - Northing (Zone 11U)	Water Temperature (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Redox Potential (ORP)	Conductivity (µS/cm)	pH	Salinity (PPS)	Total Dissolved Solids (g/L)
Baker Creek	BC-F020	29-Jul-11	305106	5717639	9.0	8.9	95.3	95.0	156	8.27	0.11	0.145
Baker Creek	BC-F020	22-Sep-11	305106	5717639	9.7	8.9	100.2	156.6	211	9.45	0.14	0.194
Baker Creek	BC-F060	28-Sep-11	305176	5715605	5.4	9.0	102.3	85.1	149	9.13	0.11	0.155
Baker Creek	BC-F020	25-Sep-12	305106	5717639	9.9	10.4	91.8	65.2	299	8.29	0.14	0.195
Barriere River	BR-10	22-Sep-11	295475	5685835	12.7	9.3	94.7	101.3	54	8.19	0.03	0.046
Barriere River	BR-10	25-Sep-12	295475	5685835	16.0	8.6	87.5	46.9	66	8.05	0.03	0.043
Barriere River	BR-20	21-Sep-11	311114	5704126	7.5	9.5	91.7	104.2	70	8.45	0.05	0.068
Barriere River	BR-20	26-Sep-12	311114	5704126	6.18	10.96	88.4	79.1	98	7.62	0.05	0.064
Foghorn Creek	TC-F010	28-Sep-11	297708	5720888	8.6	9.8	107.8	162.0	270	10.22	0.19	0.256
Harper Creek (lower)	HC-F090	28-Jul-11	299347	5693173	10.4	10.0	90.5	210.6	25	7.55	0.01	0.022
Harper Creek (lower)	HC-F060	18-Aug-11	298691	5690155	9.6	10.1	97.0	131.4	37	6.54	0.02	0.034
Harper Creek (lower)	HC-F110	19-Aug-11	299324	5693454	6.5	10.2	99.1	59.5	32	7.18	0.02	0.033
Harper Creek (lower)	HC-F090	24-Aug-11	299347	5693173	11.7	10.3	97.6	103.5	38	6.95	0.02	0.033
Harper Creek (lower)	HC-F060	21-Sep-11	298691	5690155	7.5	10.6	91.7	104.2	70	8.45	0.05	0.068
Harper Creek (lower)	HC-F060	26-Sep-12	298691	5690155	7.5	11.0	92.3	95.2	66	7.87	0.03	0.053
Harper Creek (upper)	HC-F340	27-Jul-11	301979	5705578	7.7	10.9	86.1	112.1	48	7.51	0.03	0.047
Harper Creek (upper)	HC-F340	26-Sep-12	301979	5705578	6.9	10.4	85.7	42.0	108	7.70	0.05	0.071
Harper Creek (upper)	HC-F460	28-Jul-11	302011	5710320	6.5	10.9	10.6	132.0	78	7.81	0.06	0.078
Harper Creek (upper)	HC-F460	22-Aug-11	302011	5710320	6.1	11.0	96.5	61.3	89	7.04	0.07	0.090
Harper Creek (upper)	HC-F330	25-Aug-11	301980	5705453	8.7	11.0	97.3	98.2	66	6.83	0.04	0.062
Harper Creek (upper)	HC-F390	27-Sep-12	301884	5706380	4.4	11.1	85.8	59.9	103	7.45	0.05	0.067
Harper Creek (upper)	HC-F390	20-Sep-11	301884	5706380	6.0	11.1	92.0	123.3	66	8.82	0.05	0.067
Harper Creek (upper)	HC-F330	20-Sep-11	301980	5705453	6.7	11.1	90.7	150.6	72	8.47	0.05	0.072
Harper Creek (upper)	HC-F460	21-Sep-11	302011	5710320	5.8	11.1	97.7	97.7	104	8.73	0.08	0.107

Watercourse	Fish/Habitat Site	Sample Date	UTM - Easting (Zone 11U)	UTM - Northing (Zone 11U)	Water Temperature (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Redox Potential (ORP)	Conductivity (µS/cm)	pH	Salinity (PPS)	Total Dissolved Solids (g/L)
Harper Creek (upper)	HC-F460	27-Sep-12	302011	5710320	5.6	10.3	82.5	45.8	161	7.88	0.08	0.105
Jones Creek	JC-F030	29-Jul-11	306737	5717783	9.5	11.2	95.6	156.4	124	8.15	0.08	0.115
Lute Creek	LC-F010	28-Sep-11	302138	5718243	5.5	11.3	94.7	101.9	144	8.49	0.11	0.149
P-Creek	PC-F020	28-Jul-11	301920	5709410	8.1	11.4	86.3	113.5	54	7.71	0.04	0.052
P-Creek	PC-F020	22-Aug-11	301920	5709410	7.7	11.4	93.2	70.6	66	6.86	0.05	0.064
P-Creek	PC-F020	27-Aug-12	301920	5709410	6.2	10.2	82.5	69.5	121	7.79	0.06	0.078
P-Creek	PC-F020	21-Sep-11	301920	5709410	6.4	11.6	95.6	130.5	76	8.23	0.06	0.077
T-Creek (lower)	TC-F010	26-Jul-11	302026	5705581	10.1	11.8	82.5	148.1	23	7.59	0.01	0.021
T-Creek (lower)	TC-F020	27-Jul-11	302069	5705572	10.1	11.9	84.2	92.9	22	7.67	0.01	0.020
T-Creek (lower)	TC-F020	20-Sep-11	302069	5705572	6.0	12.0	92.8	150.1	36	8.62	0.03	0.037
T-Creek (lower)	TC-F020	27-Sep-11	302069	5705572	6.5	12.2	90.1	50.3	38	8.40	0.03	0.038
T-Creek (lower)	TC-F020	26-Sep-12	302069	5705572	6.9	10.3	84.4	61.6	49	7.58	0.02	0.032
T-Creek (lower)	TC-F120	25-Sep-12	304427	5706343	6.3	9.9	80.4	95.0	76	7.62	0.04	0.050
T-Creek (upper)	TC-F120	16-Aug-11	304427	5706343	10.4	12.6	9.6	103.8	44	6.60	0.03	0.040
T-Creek (upper)	TC-F120	23-Aug-11	304427	5706343	8.9	12.9	84.9	91.6	52	8.53	0.03	0.049

4.2 FISH FAUNA

Fisheries assessments and associated habitat surveys were conducted from early June, 2011 (freshet) through to late September, 2013 (low flow). Assessments were conducted in Harper Creek and those North Thompson River watersheds within the Projects aquatic environment Local Study Area. A compilation of all fish captures by individual sampling location are presented in Appendix D. A number of barriers or obstacles (waterfalls and high gradient cascades) to fish distribution were found to limit the distribution of fish species in the Project study area. For the purposes of this survey the seasonal migratory bull trout fish obstacle located in Harper Creek at river km 18.5 delineates upper from lower Harper Creek. Key information and coordinates of barriers or obstacles that have the potential to influence fish distribution are provided below:

Harper Creek: 11U 301300 E / 5704313 N

- A series of waterfalls located at river km 18.5
- Presence of falls delineates upper and lower Harper Creek study areas
- Limits upstream distribution of all fish except adfluvial and resident bull trout, and
- Seasonally passible by adfluvial bull trout (flow dependent).

T-Creek (Tributary to upper Harper Creek): 11U 302243 E / 5705600 N

- 1.8 m waterfall and high gradient cascades
- Located approximately 336 m upstream of the confluence with Harper Creek, and
- No fish present above barrier and in Project Site located in the upper watershed.

P-Creek (Tributary to upper Harper Creek): 11U 302070 E / 5709605 N

- A series of waterfalls, a 3 m bedrock falls, and a series of high gradient cascades
- Located approximately 469 m upstream of the confluence with Harper Creek, and
- No fish present above barrier and in Project Site located in the upper watershed.

Baker Creek: 305089 E / 5716204 N

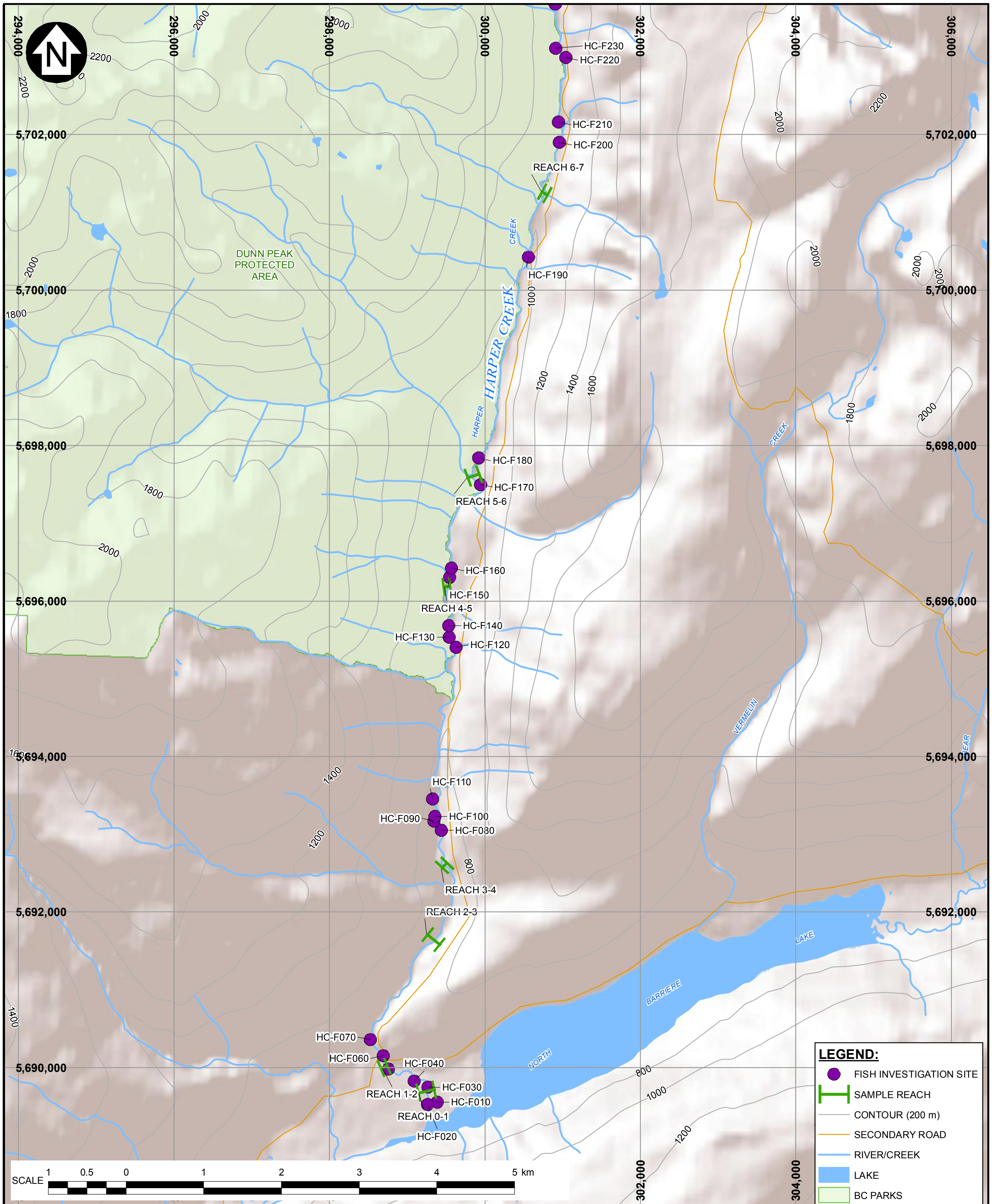
- A series of high gradient cascades located approximately 1,750 m upstream of confluence with the North Thompson River, and
- No fish present above barrier.

Jones Creek: 306401 E / 5716731 N

- A waterfall located approximately 1,780 m upstream of confluence with the North Thompson River, and
- No fish present above barrier.

4.2.1 Lower Harper Creek

This survey area extends from the Harper Creek confluence at North Barriere Lake (river km 0.0) upstream through to the adfluvial bull trout obstacle at river km 18.5 (Figure 4.2.1). A total of 17,141 seconds of electrofishing were conducted on 13 sampling dates spanning 2008 through to September 2013 (Table 4.2.1). In general more resident, sessile species (longnose dace, torrent sculpin) were captured only in the low gradient lower reaches (< river km 2.0) of lower Harper Creek, while more motile species (rainbow trout, mountain whitefish and coho) were observed downstream of river km 9.5. Adult, sub-adult and young-of-the-year bull trout were observed throughout lower Harper Creek (river km 0.0 to 18.5) and were the only fish species present upstream of river km 9.5.



NOTES:

1. BASE MAP: TRIM AND NTS MAPPING, ESRI ARCGIS ONLINE SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:70,000 FOR 8.5x11 (LETTER) PAPER.

HARPER CREEK MINING CORP.

HARPER CREEK PROJECT

FISHERIES INVESTIGATION LOCATIONS
LOWER HARPER CREEK

Knight Piésold CONSULTING

P/A NO. VA101-458/15 | REF NO. 1

FIGURE 4.2.1 REV 1

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
1	21AUG'14	ISSUED WITH REPORT	CAC	CAC	PMT	KJB

SAVED: M:\1\01\00458\15\A\GIS\Figs\Report1_FishAquaticBaseline\Rev1\Fig4-2-1_FisheriesLocations-LowerHarper_r1.mxd; Aug 21, 2014 9:55 AM; cczembor

Table 4.2.1 Fish Sampling Results

Watershed	Electrofishing Effort (s)	# of Sites Sampled	Bull Trout (juveniles or resident adults)	Bull Trout (adfluvial spawners)	Coho (juveniles)	Rainbow Trout (all life stages)	Mountain Whitefish (adult)	Longnose Dace (all life stages)	Torrent Sculpin (all life stages)	Total # of Fish
2008 Fish Studies:										
Lower Harper Creek	634	1			3	2		1	1	7
Upper Harper Creek	1449	3	10							10
Lower T-Creek	300	1	6							6
Jones Creek	775	1								NFC
Baker Creek	895	2				4				4
2008 Totals:	**4053**	**8**	**16**	**0**	**3**	**6**	**0**	**1**	**1**	**27**
2011 Fish Studies:										
Lower Harper Creek	12385	28	86	10	54	15	11	6	10	192
Upper Harper Creek	11162	20	261	5						266
Lower T-Creek	4462	5	116	1						117
Upper T-Creek	2924*	13								NFC
Lower P-Creek	1585	6	23							23
Jones Creek	2386	7			2	56			2	60
Baker Creek	2883	7	1		1	64				66
Avery Creek	325*	1								NFC
Foghorn Creek	725	1			22	15				37
Lute Creek	231	1				5				5
Chuck Creek	296	1				1				1
2011 Totals:	**39364**	**90**	**487**	**16**	**79**	**156**	**11**	**6**	**12**	**767**
2012 Fisheries Studies:										
Lower Harper Creek	2205	2	10	7	7	1	1	2	2	30
Upper Harper Creek	0	2		2						2
Lower T-Creek	1651	6	35							35
Upper T-Creek	1775*	4								NFC
Upper P-Creek	890*	2								NFC
Lower P-Creek	3625	5	26							26
Jones Creek	326, 356*	2				9				9
Baker Creek	397, 376*	3				9				9
Avery Creek	329*	2								NFC
Lute Creek	327	1			10	24				34
2012 Totals:	**12257**	**29**	**71**	**9**	**17**	**43**	**1**	**2**	**2**	**145**
2013 Fisheries Studies:										
Lower Harper Creek	1917	4	25		10	5		1	15	60
Upper Harper Creek	3186	6	57							63
Lower T-Creek	823	6	27							27
Upper T-Creek	1442*	4								NFC
Upper P-Creek	569*	1								NFC
Lower P-Creek	1651	5	11							11
Avery Creek	239*	1								NFC
2013 Totals:	**9827**	**27**	**120**	**0**	**10**	**5**	**0**	**1**	**15**	**161**

NOTES:

1. * Electrofishing effort in non-fish bearing reaches.
2. NFC – No Fish Captured.

4.2.1.1 Salmonids

Mountain Whitefish

Adult mountain whitefish (235 mm to 300 mm fork length) were rarely captured during electrofishing surveys in lower Harper Creek. The absence of sub-adults or young-of-the-year suggests that mountain whitefish do not utilize Harper Creek as a spawning or rearing location. A total of 11 adult mountain whitefish were captured during sampling in lower Harper Creek during 2011 and a single fish was captured during 2012 representing a total Catch Per Unit Effort (CPUE) of 0.0008 and 0.00005 fish/second, respectively (Table 4.2.2). All mountain whitefish were observed in stream reaches below river km 9.5 and were encountered in relatively fast water among boulders and at the head of pools below sections of riffles.

Table 4.2.2 2011-2013 Fish Catch per Unit Effort

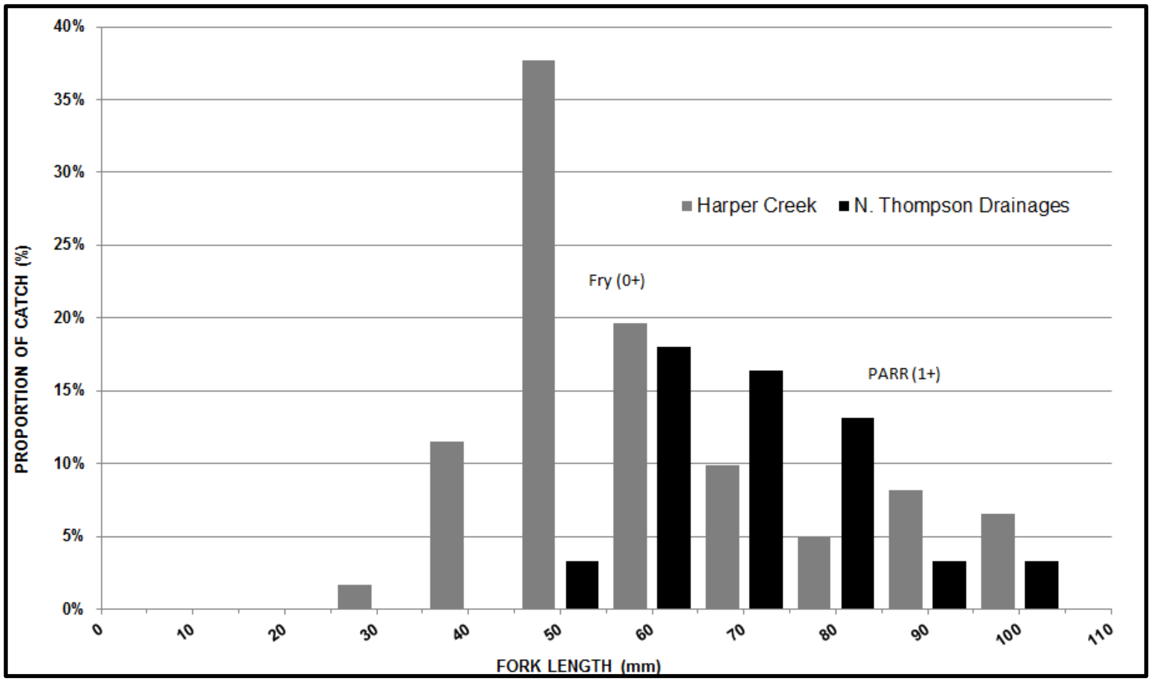
Regions	Electrofishing Effort (s)	Bull Trout (juveniles or resident)	Bull Trout (spawners)*	Coho (juveniles)	Rainbow Trout (all life stages)	Mountain Whitefish (adult)	Longnose Dace (all life stages)	Torrent Sculpin (all life stages)
2011 Studies								
Lower Harper Creek	12385	86 (0.007)	10	54 (0.0043)	15 (0.0012)	11 (0.0008)	6 (0.0005)	10 (0.0008)
Upper Harper Creek	11162	254 (0.023)	5					
T-Creek (lower)	4462	116 (0.026)	1					
P-Creek (lower)	1585	23 (0.015)						
Jones Creek	2386			2 (0.007)	56 (0.023)			2 (0.0008)
Baker Creek	2883	1 (0.03)		1 (0.003)	64 (0.022)			
Lute Creek	231				5 (0.022)			
Foghorn Creek	725			22 (0.03)	15 (0.021)			
Chuck Creek	296				1 (0.003)			
2012 Studies								
Lower Harper Creek	2205	10 (0.005)	7	7 (0.003)	1 (0.0005)	1 (0.0005)	2 (0.0009)	2 (0.0009)
Upper Harper Creek	0		2					
T-Creek (lower)	1651	35 (0.021)						
P-Creek (lower)	3625	26 (0.007)						
Jones Creek	326				9 (0.027)			
Baker Creek	397				9 (0.022)			
Lute Creek	327			10 (0.03)	24 (0.07)			
2013 Studies								
Lower Harper Creek	1917	25 (0.013)		10 (0.005)	5 (0.003)		1 (0.0005)	15 (0.008)
Upper Harper Creek	3186	57 (0.18)						
T-Creek (lower)	823	27 (0.032)						
P-Creek(lower)	1651	11 (0.007)						

NOTES:
1. Catch Per Unit Effort (CPUE) calculated based on fish captures per second of electrofishing effort.
2. *Bull trout spawners visually surveyed (no CPUE data).

Coho Salmon

Coho salmon juveniles (25 mm to 97 mm fork length) were captured during electrofishing surveys at sites downstream of river km 9.5 in lower Harper Creek. The majority of coho fry were observed in a section off channel habitat located near river km 8.5 (near Sites HC-F130 to HC-F160); while the majority of coho parr were observed in the bottom 1.5 km (Sites HC-F030 to HC-F050) of lower Harper Creek below the Forest Service Road. The presence of two juvenile cohorts (fry and age 1+

parr) at low densities suggest that in recent years (2009 to 2012) a small number of coho adults have spawned in lower Harper Creek (Figure 4.2.2). A total of 71 juvenile coho were captured during 2011-2013 efforts and CPUE ranged from of 0.003 to 0.005 fish/second. (Table 4.2.2).



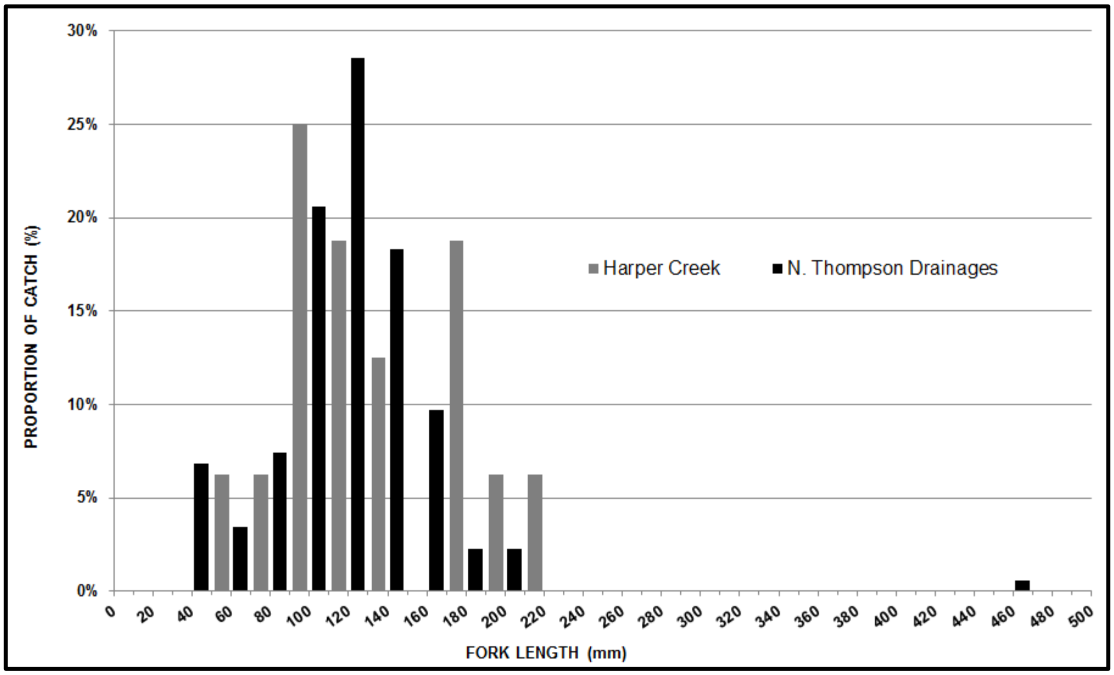
NOTES:

1. Coho fry downstream of River km 9.5
2. Coho parr downstream of River KM 1.5

Figure 4.2.2 Length Frequency of Coho Fry and Parr Sampled in Harper Creek and N. Thompson River Tributaries (2011 and 2012)

Rainbow Trout

Rainbow trout (33 mm to 219 mm fork length) were, like mountain whitefish rarely captured during electrofishing surveys in lower Harper Creek. The presence of sub-adults and young-of-the year fish suggest that some rainbow trout may utilize portions of lower Harper Creek as a spawning location; however, no adults in spawning condition were observed (Figure 4.2.3). A total of 21 rainbow trout were captured during 2011-2013 sampling with CPUE ranging from 0.0005 to 0.0012 fish/second (Table 4.2.2). All rainbow trout in lower Harper Creek were observed in stream reaches below river km 9.5 (downstream of Site HC-F160).



NOTE:

1. One adult rainbow trout (470 mm) observed in lower Jones Creek below the Birch-Island Lost Creek Road.

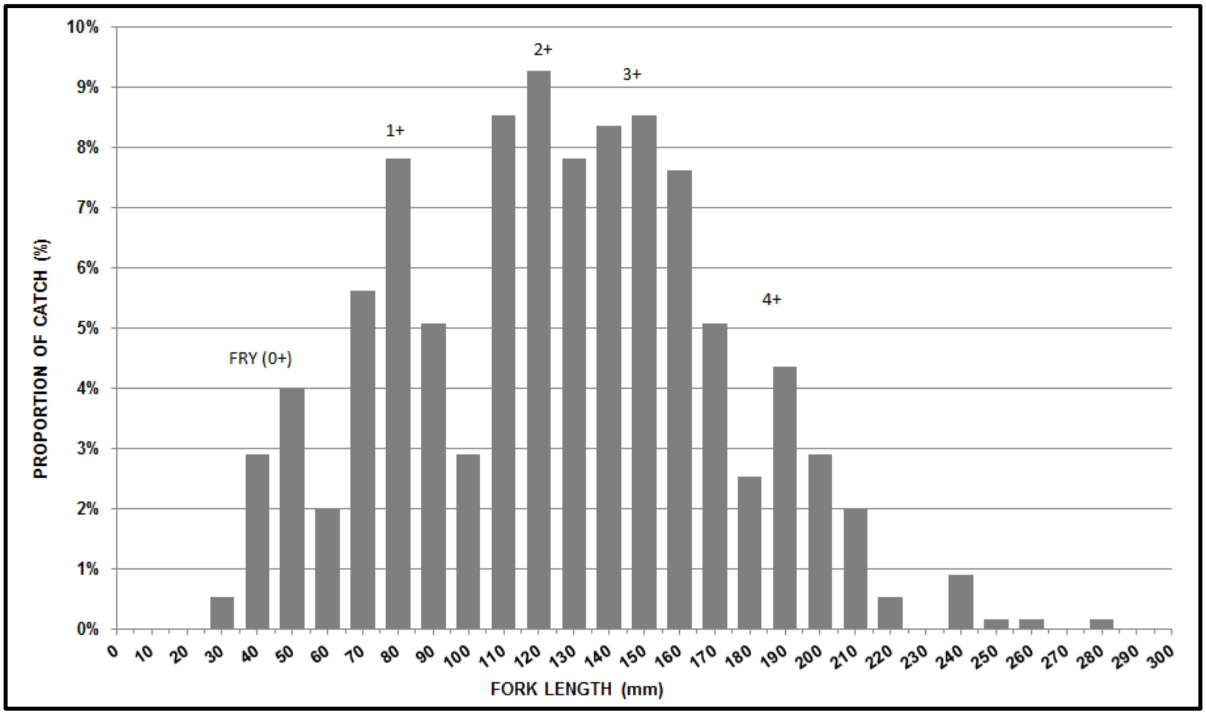
Figure 4.2.3 Length Frequency Distribution of Rainbow Trout in Harper Creek and N. Thompson River Tributaries (2011 and 2012)

Bull Trout

Bull trout fry, juveniles, and spawning adfluvial adults were captured (or visually observed for adults) during electrofishing surveys downstream of the seasonal fish obstacle located at river km 18.5 that delineates upper and lower Harper Creek. A total of 121 bull trout juveniles were captured during 2011-2013 sampling with CPUE ranging from 0.0005 to 0.013 fish/second (Table 4.2.2). The presence of multiple cohorts (ages 0+ to 4+) except larger sub-adults (fish >300 mm) suggests that portions of Harper Creek are used for juvenile rearing and spawning, while sub-adult fish likely out-migrate to North Barriere Lake and rear for several years before returning as mature adfluvial spawners (Figure 4.2.4).

A solitary adult adfluvial bull trout (estimated 500 mm to 600 mm fork length) was observed holding in a pool with cover near river km 5.5 (Site HC-F090) on July 27, 2011. As spawning season approached (mid to late September) higher densities of adult spawners were observed transiting through confined sections of lower Harper Creek, to a section of river with spawning habitat between river km 17.0 and the seasonal barrier located at river km 18.5 (Sites HC-F220 to HC-F280). During early through mid-September several adfluvial bull trout in spawning dress were visually observed holding in pools below the migration barrier and several unattended bull trout redds were observed during late September 2012-2013. Spawners were no longer present in these stream reaches during the last week of September (2011, 2012, 2013) and during 2011 a spawned out male kelt (450 mm fork length) was observed along the river margin providing evidence that the spawning window was complete and adfluvial kelts had migrated out of Harper Creek.

The majority of freshly emerged lower Harper Creek bull trout fry (30 mm to 40 mm fork length) were observed in low gradient sections of river with good spawning habitat between river km 17.0 and the migration obstacle located at river km 18.5 (Sites HC-F220 to HC-F280). The observations of relatively high densities of post-emergent fry at these locations during the spring, coupled with the presence of mature spawners and completed redds suggest that this location is an important spawning reach for adfluvial bull trout.



NOTES:

1. Some male bull trout > 240 mm were in spawning condition during late August 2011.

Figure 4.2.4 Length Frequency Distribution of Bull Trout Observed in Harper Creek (2011 and 2012)

4.2.1.2 Non-Salmonids

Adult and juvenile longnose dace (63 mm to 113 mm total length) and torrent sculpin (35 mm to 103 mm total length) were observed only in low gradient portions of lower Harper Creek below river km 2.0 (Sites HC-F010 to HC-F070). Adults of both species were observed in fast riffles while juveniles were collected in shallow habitats along the river margins. During 2011-2013 a total of nine longnose dace and 27 torrent sculpins were captured during sampling in lower Harper Creek representing a total CPUE of 0.0005-0.0009 fish/second and 0.0008-0.008 fish/second, respectively (Table 4.2.2).

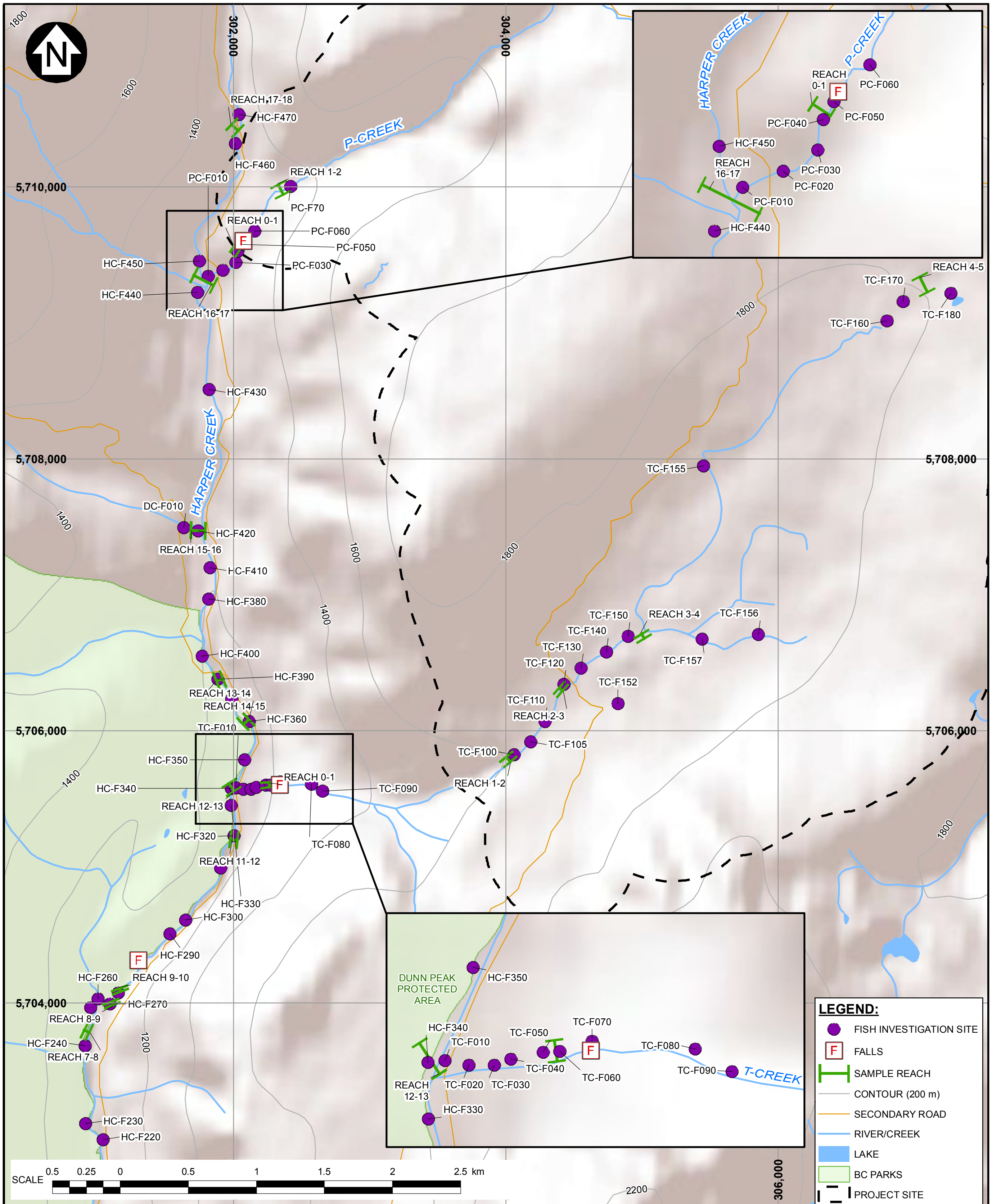
4.2.2 Upper Harper Creek

This fisheries survey area extends from the seasonal fish obstacle located at river km 18.5 upstream through to the origin of Harper Creek near river km 28.0 (Sites HC-F290 to HC-F470). Bull trout were the only fish species observed in upper Harper Creek mainstem and its associated tributaries.

There are two unnamed tributaries to upper Harper Creek (T-Creek and P-Creek) with fish barriers in their lower reaches that have the potential to be influenced by project activities. These tributaries join the eastern side of Harper Creek at river km 24.2 and km 20.2 of Harper Creek (Figure 3.2.1 and Figure 4.2.5).

A total of 13,079 seconds of electrofishing was conducted at 20 sampling location along the upper Harper Creek mainstem on 11 sampling dates spanning June 2011 through to September 2013 (Table 4.2.1). A total of 279 bull trout were captured during sampling in the mainstem portion of upper Harper Creek representing a CPUE ranging from 0.013 to 0.023 fish/second (Table 4.2.2). The modality of the length frequency analysis illustrated in Figure 4.2.4 identifies the potential for up to five age classes of bull trout less than 300 mm to be present within Harper Creek. All life history phases of bull trout were observed in upper Harper Creek including freshly emergent fry (30 mm to 40 mm), rearing juveniles, mature residents (males < 280 mm) and a few adfluvial spawners (>400 mm). The highest densities of bull trout fry and rearing juveniles were observed in lower gradient reaches with large woody debris between river km 19.5 and river km 24.0 (Sites HC-F310 to HC-F440). No fish were observed or captures during repeated sampling efforts upstream of river km 24.5 (Site HC-F450), which is upstream of the confluence of P-Creek with Harper Creek.

The waterfall obstacle located at river km 18.5 (Site HC-F280) of Harper Creek was originally thought to be a barrier to adfluvial bull trout due to the size of the water falls and the fact that a number of adfluvial fish were observed holding below the ‘barrier’, and only resident size spawners (i.e. <280 mm) were observed upstream of this site. However, after the first week in September during 2011 and 2012, a total of seven adfluvial bull trout spawners were observed between river km 19 and 22.1 (Sites HC-F310 to HC-F430) and a series of completed redds were observed near river km 20.0 (Site HC-F330). During late September 2013 one adfluvial bull trout redds was observed near HC-F400. The presence of these migratory spawners in upper Harper Creek suggests that the waterfall obstacle at the divide between upper and lower Harper Creek may be only passible at certain river discharges and may differentially select for early adfluvial migrants or large bodied individuals that are able to surmount the waterfalls. No mature resident bull trout spawners (<300 mm) were observed in lower Harper Creek and the presence of mature small bodied spawners in upper Harper Creek suggests that bull trout progeny in the upper watershed may be parented by both resident and migratory adfluvial spawners.



NOTES:

1. BASE MAP: TRIM AND NTS MAPPING, ESRI ARCGIS ONLINE SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:40,000 FOR 8.5x11 (LETTER) PAPER.

HARPER CREEK MINING CORP.

HARPER CREEK PROJECT

FISHERIES INVESTIGATIONS
UPPER HARPER CREEK, P-CREEK, T-CREEK

Knight Piésold CONSULTING

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
1	21AUG'14	ISSUED WITH REPORT	CAC	CAC	PMT	KJB

P/A NO. VA101-458/15 | REF NO. 1

FIGURE 4.2.5 | REV 1

SAVED: M:\1\01\00458\15\A\GIS\Figs\Report1_FishAquaticBaseline\Rev1\Fig4-2-5_FisheriesLocations-UpperHarper_r1.mxd; Aug 21, 2014 9:55 AM; cczembor

4.2.2.1 T-Creek

T-Creek becomes confluent with the mainstem of upper Harper Creek near river km 20.2 and has the potential to be influenced by Project activities because its origin is located within the Project footprint (Figure 3.2.1 and Figure 4.2.5). The upper portion of T-Creek drains a wetland before flowing down a high gradient (approximately 20%) mountain slope that delineates the eastern portion of the Harper Creek Valley. The tributary has been separated into an upper and lower sections based on the presence of a fish proof waterfall barrier located approximately 336 m upstream of the upper Harper Creek confluence. Bull trout were observed below the fish barrier (Sites TC-F010 to TC-F060) and no fish were observed upstream of the barrier (SitesTC-F070 to TC-F180). The gradient in the lower 100 m of the watercourse near the Harper Creek confluence is low gradient (i.e. <5%), but the creek quickly climbs the eastern portion of the Harper Creek valley upstream of the barrier.

A total of 6,936 seconds of electrofishing was conducted within lower portions of T-Creek. Sampling was comprised of a total of ten sampling events between July 2011 through to September 2013 (Table 4.2.1; Table 4.2.2). A total of 178 bull trout were captured during sampling, with a CPUE ranging from 0.026 to 0.032 fish/second (Table 4.2.2). Fish density and CPUE varied by sampling date and suggest that densities of bull trout were higher later in the sampling season (August–September), with values ranging 0.007 fish/m^2 to 0.050 fish/m^2 and 0.008 fish/second to 0.046 fish/second, respectively (Figure 4.2.6).

The majority of bull trout observed in Lower T-Creek were parr and older juveniles (50 mm to 200 mm), although some fry (<40 mm) were observed near slower low gradient sections near the Harper Creek confluence. One male bull trout in spawning condition (~500 mm) was observed in the tributary during the first week of September 2011 at Site TC-F050.

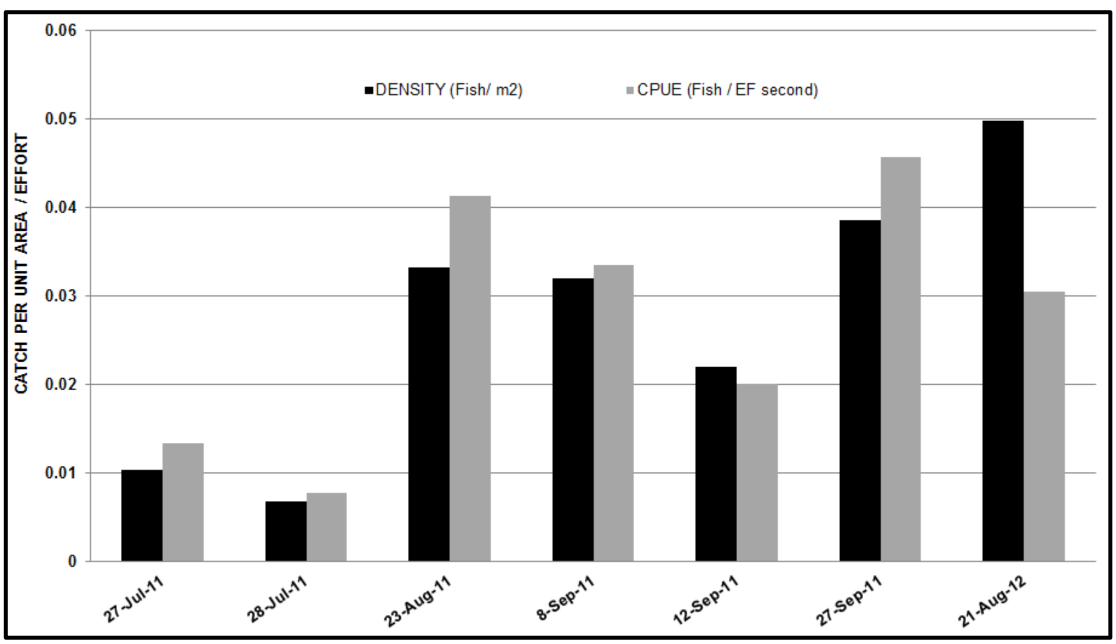


Figure 4.2.6 T-Creek Bull Trout Density and Catch per Unit Effort (2011 and 2012)

4.2.2.2 P-Creek

The origin of P-Creek is located approximately 3.5 km upstream of Harper Creek within the Project footprint. Like T-Creek, the majority of P-Creek flows down a high gradient portion of the eastern Harper Creek Valley and the distribution of bull trout is restricted to the relatively low gradient lower 469 m section below a series of impassable waterfalls (Figure 3.2.1 and Figure 4.2.5).

Early in the sampling regime (June, 2011) no fish were sampled in portions of the Harper Creek mainstem just downstream of the P-Creek confluence. High flow precluded sampling within P-Creek during June 2011, however, bull trout were later observed within P-Creek during sampling efforts between August and September, 2011 (Table 4.2.1).

A total of 60 bull trout were captured at fish sampling sites below the fish proof barrier (PC-F010 to PC-F050) during 2011-2013. A total of 6,861 seconds of electrofishing effort were applied to lower P-Creek, and CPUE ranged from 0.007 to 0.015 fish/second (Table 4.2.2).

Bull trout Catch Per Unit Area and Catch Per Unit Effort varied by sampling date with values ranging 0.010 fish/m^2 to 0.024 fish/m^2 and 0.01 fish/second to 0.024 fish/second, respectively (Figure 4.2.7). The vast majority of bull trout observed were juveniles and sub adults (73 mm to 238 mm), however, one fry was observed within the lower reaches of P-Creek during mid- August, 2012. No mature adults were observed within P-Creek during 2011-2013 investigations.

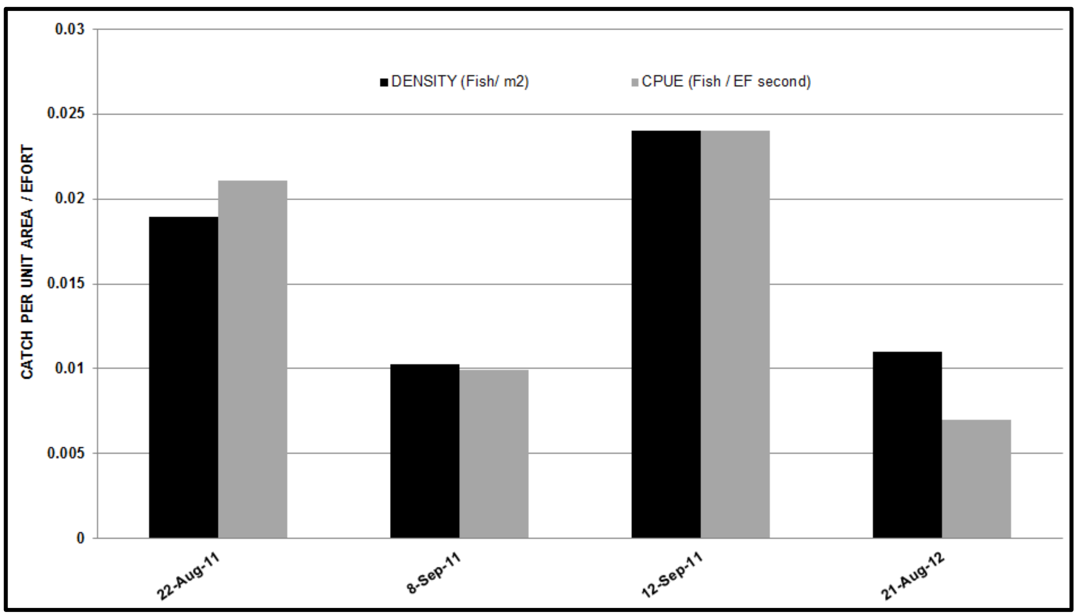
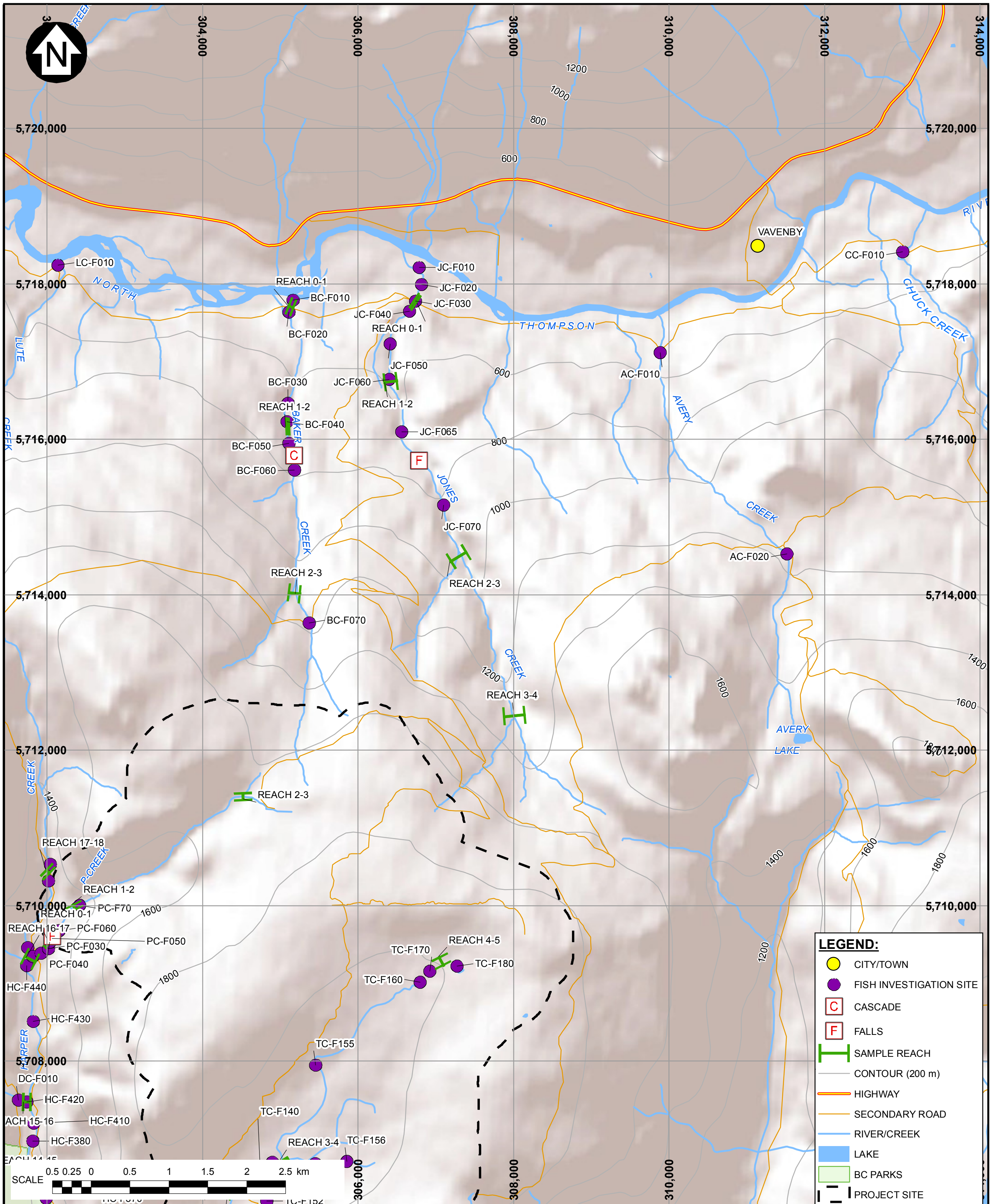


Figure 4.2.7 P-Creek Bull Trout Density and Catch per Unit Effort (2011 and 2012)

4.2.3 North Thompson Drainages

Tributaries in the northern portion of the Aquatic Environment Local Study Area are confluent with the North Thompson River and drain the northern slope of Foghorn and Vavenby Mountains. The uppermost reaches of Jones Creek and Baker Creek are located within the Project site area, while Chuck Creek, Avery Creek, and Lute Creek are proximate to Project activities (Figure 3.2.1 and Figure 4.2.8). Fisheries surveys within these watersheds were directed at understanding the species composition and distribution within the northern portion of the Local Study Area.



NOTES:

1. BASE MAP: TRIM AND NTS MAPPING, ESRI ARCGIS ONLINE SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:70,000 FOR 8.5x11 (LETTER) PAPER.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
1	21AUG'14	ISSUED WITH REPORT	CAC	CAC	PMT	KJB

HARPER CREEK MINING CORP.

HARPER CREEK PROJECT

FISHERIES INVESTIGATION LOCATIONS
NORTH THOMPSON DRAINAGES

Knight Piésold CONSULTING

P/A NO. VA101-458/15 | REF NO. 1

FIGURE 4.2.8 | REV 1

SAVED: M:\1\01\00458\15\A\GIS\Figs\Report1_FishAquaticBaseline\Rev1\Fig4-2-8_FisheriesLocations-NThompson_r1.mxd; Aug 21, 2014 9:56 AM; cczembor

4.2.3.1 Jones Creek

Jones Creek was sampled for fish distribution at seven locations (JC-F010 to JC-F070) on five sampling dates spanning June 23, 2011 through to September 12, 2012. A total of 2,712 seconds of electrofishing was applied to the fish bearing reaches and the CPUE for rainbow trout in the fish bearing reaches of Jones Creek was 0.023 fish/second during 2011 and 0.027 fish/second during 2012 (Table 4.2.2).

The 600 m portion of the creek downstream of the Birch Island Lost-Creek Road crossing is low gradient and flows through a section of private land before discharging into the North Thompson River. Coho (age 0+), rainbow trout (fry, juveniles and a 460 mm adult), and torrent sculpin were observed in the lowest reaches of Jones Creek below the culvert crossing which is currently a barrier to upstream fish passage (Site JC-F040). During mid-September, 2012 no creek flow was observed in the bottom 600 m of Jones Creek due to an irrigation water abstraction intake located approximately 1.25 km upstream of the confluence of with the North Thompson River.

Only rainbow trout (fry, juveniles and adults) were observed upstream of the culvert crossing (Sites JC-F040 to JC-F065) and their distribution continued upstream along a rising stream gradient until a series of waterfalls limited their distribution approximately 1.75 km upstream from the road and culvert crossing (Figure 4.2.8). Electrofishing efforts upstream of the series of waterfall (Site JC-F065 to JC-F070) did not yield any fish captures and sections of Jones Creek upstream of JC-F065 are considered non-fish bearing.

The length distribution of rainbow trout for North Thompson River drainages was similar to those observed from Harper Creek, however, the relative abundance in Jones Creek (CPUE 0.023 fish/second) during 2011 was almost twice that observed in Harper Creek (CPUE 0.012 fish/second) (Figure 4.2.3; Table 4.2.2).

4.2.3.2 Baker Creek

Baker Creek was sampled for fish distribution at seven different sampling sites on six different sampling events from September 2011 through September 2012. A total of 3,280 seconds of electrofishing effort was applied to the reaches of Baker Creek and the CPUE for rainbow trout, bull trout, and coho ranged 0.022, 0.003 and 0.003 fish/electrofishing second respectively (Table 4.2.1 and Table 4.2.2). The relative abundance and size distribution of rainbow trout within Baker Creek were very similar to the fish bearing sections of Jones Creek, and almost double of what was sampled in lower Harper Creek (Figure 4.2.3; Table 4.2.2).

The 150 m portion of the creek downstream of the Birch Island Lost-Creek Road crossing is of moderately high gradient and flows through a section of private land before discharging into the North Thompson River. A single coho (age 1+), rainbow trout (juveniles) and a single bull trout juvenile were observed in the lowest reaches of Baker Creek below the road crossing curvet which is a barrier to upstream fish passage (Sites BC-F010 to BC-F020). Only rainbow trout (fry, juveniles and adults) were observed upstream of the culvert crossing and their distribution continued upstream along a rising stream gradient similar to that observed in Jones Creek until a series of high gradient cascades limited their distribution approximately 1.75 km upstream from the road crossing (BC-F040 to BC-F050). Electrofishing efforts between Site BC-F060 to BC-F070, located 2.4 km upstream of the cascade barrier, did not yield any fish captures and this reach is considered non-fish bearing.

4.2.3.3 Chuck Creek, Avery Creek, Lute Creek, and Foghorn Creek

Chuck Creek, Avery Creek, and Lute Creek were each sampled on one occasion during the 2011 field program and Avery Creek resampled during 2012 and 2013 to confirm that the water shed does not contain fish. Moderate levels of electroshocking effort were conducted in these drainages given that they are not likely to be influenced by Project activities.

A total of 296 seconds of electrofishing was conducted in the lower end of Chuck Creek (Site CC-F010) on June 23, 2001, yielded a single rainbow trout capture suggesting that at that time rainbow densities might be quite low at that time of year (CPUE 0.003 fish/second) (Table 4.2.1 and Table 4.2.2).

Limited sampling on Avery Creek just above Birch Island Lost-Creek Road (Site AC-F010) during low water conditions on September 30, 2011 yielded no fish and it was suspected that flows in the creek at this time of year might be too low to sustain fish. These observations were supported during September 2012, and 2013, when the stream channel at site AC-F010 was dry. Stream flow was observed approximately 4.0 km upstream where the project site access road crosses Avery Creek (Site AC-F020), however, electrofishing efforts during 2012 (329 seconds), and 2013 (229 seconds) confirm that this portion of the watershed does not support a fish population (Table 4.2.2).

Limited electrofishing sampling at Lute Creek (Site LC-F010) was conducted during September 28, 2011 and on September 12, 2012. The lower portions of the creek have a direct connection to the North Thompson River and during 2011 five rainbow trout were collected for tissue samples (Table 4.2.1 and Table 4.2.2). Sampling for more fish tissue samples during September 12, 2012 approximately 100 m upstream of the North Thompson River confluence yielded catches of both young-of-the-year coho and multiple cohorts of rainbow trout at CPUE's of 0.03 and 0.07 fish/ electrofishing second respectively (Table 4.2.1 and Table 4.2.2).

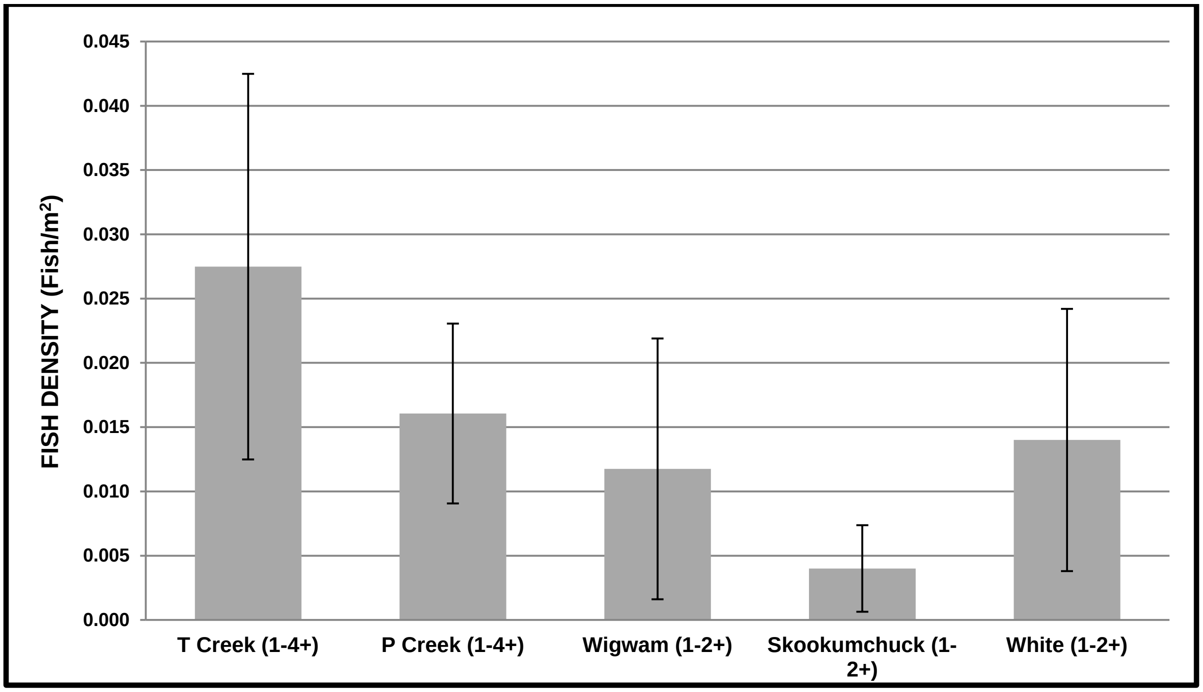
The lowermost portions of Foghorn Creek downstream of the Birch Island Lost-Creek Road crossing were electrofished for 725 seconds on September 28, 2011 at Site FC-F010. This section of creek, which has a direct connection to the North Thompson River yielded catches of coho (0+ fry and 1+ parr) and rainbow trout with CPUE densities of 0.03 and 0.21 fish/second, respectively (Table 4.2.1 and Table 4.2.2).

4.2.4 Bull Trout Density Comparisons

To allow comparisons of the density of resident bull trout in P-Creek and T-Creek the average density of fish during 2011 and 2012 were compared to average August density estimates for bull trout juveniles at index sites on three East Kootenay watersheds including the Wigwam, Skookumchuck, and White rivers during 1997 and 2000-2005 (Cope 2007). The comparisons among watershed are focused on slightly different age classes with the East Kootenay watersheds offering density information for age 1 and 2+ cohorts while the Harper Creek estimates include a few older fish (e.g., 3 and 4+).

The average densities in T-Creek were between approximately twice those observed in the Wigwam and White Rivers, and over six time those observed higher than those observed for the Skookumchuck River (Figure 4.2.9). Average bull trout densities in P-Creek were nearly half those observed in T- Creek, however densities were markedly higher than the White and Wigwam rivers and over four times higher than densities observed in the Skookumchuck River (Figure 4.2.9).

These results suggest that the densities of bull trout in tributaries of upper Harper Creek are consistently higher when compared to reference drainages in the East Kootenays and suggest that tributaries of upper Harper Creek are a productive environment for resident bull trout.



NOTES:

1. Wigwam, Skookumchuck, and White rivers bull trout densities from Cope (2007)

Figure 4.2.9 Bull Trout Density (±S.D) in T-Creek and P-Creek and three West Kootenay Region Reference Drainages

4.2.5 Condition Factor

For salmonids, like bull trout and rainbow trout Fulton's Condition Factor (*K*) is commonly used as an indicator of fish health and fitness and calculated values typically fall between 0.8 and 2.0 depending on the local habitat conditions. Typically fish with a *K*-Value of less than 1.0 suggests that individual fish may be in poor condition, while fish with K-values greater than 1.0 are considered to be in higher condition and in good health (Nielson and Johnson 1983).

The scale used for salmonid *K*-Values in Nielson and Johnson (1983) is as follows:

- less than 0.99 = Poor
- 1.00 – 1.19 = Fair
- 1.20 – 1.39 = Healthy
- Greater than 1.40 = Exceptional.

The condition of bull trout in Harper Creek (upper and lower) and associated tributaries (P-Creek and T-Creek) were considered fair, and average condition ranged from 1.04 to 1.07 were observed for fish captured in these watersheds (Table 4.2.3).

The condition of rainbow trout Baker and Jones Creeks was considered healthy, and fish in these watersheds had average K-Values of 1.26 and 1.21, respectively (Table 4.2.3). The rainbow trout captured in lower Harper Creek, had an average *K*-Value of 1.11, which was lower than those observed in the North Thompson watersheds, however fish from all watersheds are still considered to be in fair health (Table 4.2.3).

Table 4.2.3 Fulton's Condition Factor for Bull Trout and Rainbow Trout

Location	Fish Species	Average Condition (*K*)	S.D. Condition (*K*)	Minimum	Maximum
Upper Harper Creek	Bull Trout	1.07	0.21	0.67	1.86
Lower Harper Creek	Bull Trout	1.06	0.12	0.91	1.42
P-Creek	Bull Trout	1.06	0.15	0.81	1.52
T-Creek	Bull Trout	1.04	0.14	0.69	1.73
Baker Creek	Rainbow Trout	1.26	0.14	1.09	1.66
Jones Creek	Rainbow Trout	1.21	0.14	1.01	1.35
Lower Harper Creek	Rainbow Trout	1.11	0.15	0.81	1.31

4.2.6 Fish Tissue

The concentrations of 38 different metals (including mercury), percent moisture content, and lipid content (muscle tissue only) in muscle and liver tissue were assayed and the results for these are arranged by individual watershed and presented in Appendix E along with detetion limits for the samples. The average bull trout and rainbow trout muscle concentration of metals typically identified as having potential toxicological or human health effects are outlined below in Table 4.2.4 and Table 4.2.5.

Select metals are required for fish physiological processes but may become toxic above certain thresholds (e.g., copper, selenium, zinc). In contrast, there are several non-essential metals which have no determined biological role and may be toxic even at low concentrations (e.g. cadmium and nickel). The only guidelines currently available to determine safe metal concentrations in rainbow trout are for selenium, lead and mercury. As there are no other guidelines developed, differences among watersheds may not provide insight into adverse metal effects. However, as guidelines may be developed in the future, it is important to characterize baseline metal concentrations within the Project study area prior to development.

Further details for mercury, lead, and selenium in both muscle and liver tissues are outlined below and details are presented in Figure 4.2.10 through Figure 4.2.12.

Table 4.2.4 Selected Metal Concentrations in Bull Trout Muscle Tissue, Harper Creek Project, 2011-2012

Analyte	T-Creek (mg/kg)		P-Creek(mg/kg)		Guidelines(mg/kg)	
	2011	2012	2011	2012	Wildlife	Human Health
Aluminum	0.46	0.43	0.61	1.0		
Arsenic	0.05	0.04	0.04	0.04		
Barium	0.04	0.04	0.02	0.02		
Cadmium	0.029	0.01	0.011	0.009		
Copper	0.37	0.25	0.27	0.38		
Iron	3.43	2.94	3.79	3.86		
Lead	<0.004	0.004	<0.04	0.01		0.8[3]
Mercury	0.02	0.04	0.03	0.02		0.2-0.5[1]
Manganese	0.29	0.14	0.22	0.13		
Molybdenum	0.01	0.005	0.01	<0.004		
Nickel	<0.02	0.05	<0.04	0.02		
Selenium	0.45	0.26	0.26	0.50	4.0[2]	
Strontium	0.21	0.08	0.20	0.06		
Thallium	0.003	0.004	0.004	0.003		
Zinc	7.17	6.01	7.31	6.45		

NOTES:
1. Health Canada mercury guidelines range from 0.2-0.5 mg/kg for subsistence consumers and maximum allowable level for sale (Canadian Food Inspection Agency 2012).
2. BC MOE Companion Document to: Ambient Water Quality Guidelines for Selenium Update (2014).
3. Canadian Food Inspection Agency (CFIA 2012).

Table 4.2.5 Selected Average Metal Concentrations in Rainbow Trout Muscle Tissue, Harper Creek Project, 2011-2012

Analyte	Baker Creek (mg/kg)		Jones Creek (mg/kg)		Lute Creek (mg/kg)		Guidelines (mg/kg)	
	2011	2012	2011	2012	2011	2012	Wildlife	Human Health
Aluminum	1.07	0.78	0.60	<0.4	1.04	0.48		
Arsenic	0.07	0.15	0.08	0.13	0.11	0.07		
Barium	0.04	0.02	0.04	0.13	0.14	0.02		
Cadmium	0.01	0.004	0.011	0.003	0.019	0.008		
Copper	0.43	0.40	0.39	0.33	0.60	0.51		
Iron	5.89	3.25	5.20	5.14	6.02	3.92		
Lead	0.01	0.04	0.01	0.05	0.01	0.01		0.8[3]
Mercury	0.02	0.02	0.04	0.03	0.03	0.02		0.2-0.5[1]
Manganese	0.31	0.11	0.14	0.13	1.07	0.17		
Molybdenum	0.01	0.02	0.01	<0.004	0.01	<0.004		
Nickel	<0.07	0.02	<0.06	0.20	<0.07	<0.01		
Selenium	0.50	0.46	0.40	0.48	0.49	0.79	4.0[2]	
Strontium	0.38	0.17	0.42	0.25	2.72	0.31		
Thallium	0.034	0.002	0.002	0.002	0.004	0.002		
Zinc	8.23	6.75	7.21	7.46	10.75	7.47		

NOTES:
1. Health Canada mercury guidelines range from 0.2-0.5 mg/kg for subsistence consumers and maximum allowable level for sale (Canadian Food Inspection Agency 2012).
2. BC MOE Companion Document to: Ambient Water Quality Guidelines for Selenium Update (2014).
3. Canadian Food Inspection Agency (CFIA 2012).

4.2.6.1 Mercury

Mercury concentrations in bull trout tissues from Harper Creek tributaries (T-Creek and P-Creek) were low (i.e. <0.05 mg/kg) and regardless of tissue type or collection location, all samples were well below accepted Provincial and Canada Food Agency guideline limits (0.2 mg/kg to 0.5 mg/kg wet weight) (Figure 4.2.10).

Average mercury concentrations in rainbow trout tissues (112 mm to 172 mm fork length) from those tributaries confluent with the North Thompson River (Baker Creek, Lute Creek, and Jones Creek) were mixed among sample years and tissue types, but values were all low (i.e. <0.04 mg/kg. Again, similar to the results for the Harper Creek tributaries, regardless of tissue type or collection location, all samples collected from North Thompson drainages were well below accepted Provincial and Canada Food Agency guideline limits (Figure 4.2.10; Appendix E).

4.2.6.2 Lead

Lead concentrations in bull trout tissues from Harper Creek tributaries (T-Creek and P-Creek) were higher in liver tissues (<0.008 mg/kg to 0.0216 mg/kg) than muscle tissues (<0.004 mg/kg) and average concentrations of lead in liver tissues in samples from P-Creek were approximately twice those observed in T-Creek. Regardless of tissue type or collection location, all samples obtained from these Harper Creek tributaries were well below (<37 times) accepted Provincial and Canada Food Agency guideline limits (0.8 mg/kg wet weight) (Figure 4.2.11).

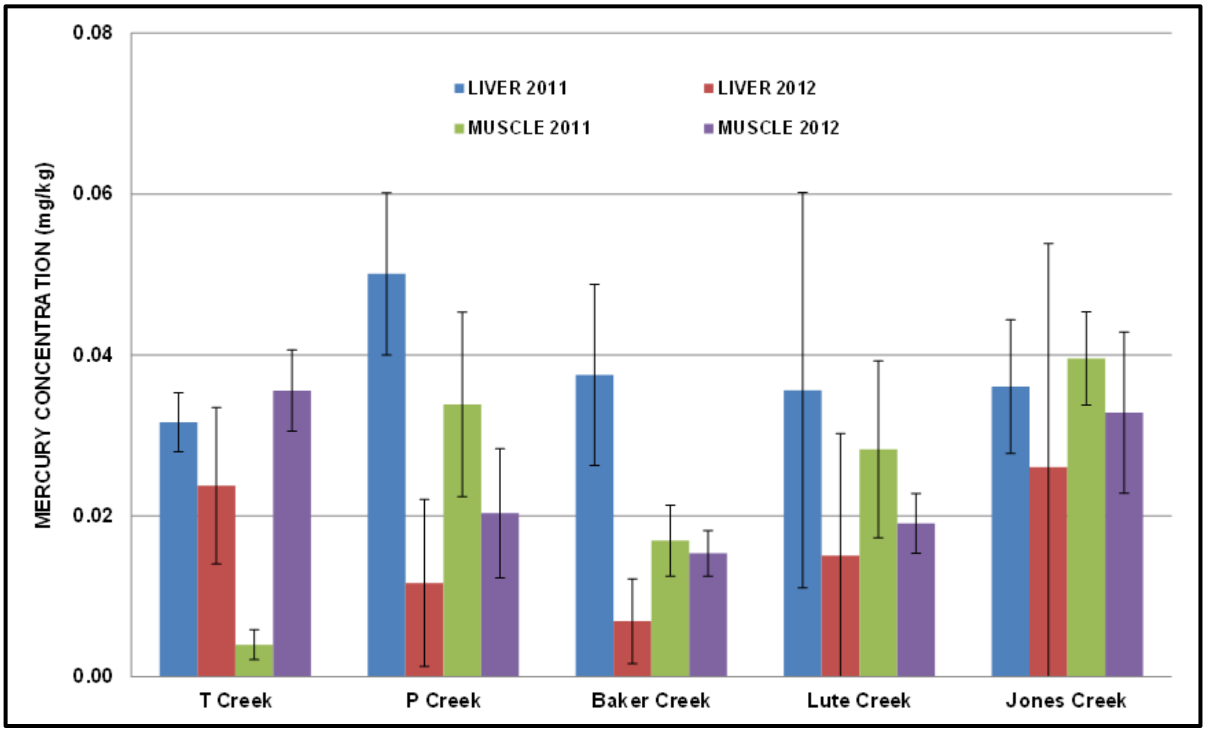
Average lead concentrations in rainbow trout tissues from those tributaries confluent with the North Thompson River (Baker Creek, Lute Creek, and Jones Creek) were markedly higher in liver tissues than muscle tissues and all but one fish liver from Lute Creek had lead concentrations well below the well below accepted Provincial and Canada Food Agency guideline limits (0.8 mg/kg wet weight). The one fish from Lute Creek (4.68 mg/kg) had lead liver concentrations over five times the guideline limits and over 90 times greater than the average of other liver samples collected concurrently (Figure 4.2.11; Appendix E).

4.2.6.3 Selenium

Average selenium concentrations in bull trout muscle tissues (122 mm to 200 mm fork length) from Harper Creek tributaries (T-Creek and P-Creek) ranged from 0.25 mg/kg to 0.49 mg/kg and none of the muscle tissue samples collected during 2011 and 2012 reported above guideline limits for selenium (4.0 mg/kg – MOE 2014).

Figure 4.2.12 highlights the average concentrations of selenium from bull trout muscle and liver tissue during 2011 and 2012 and raw data presented for each fish sampled are offered in Appendix E. The MOE 2014 guideline values are based on muscle tissue or whole body selenium and while liver selenium was higher than those observed for muscle tissue (a commonly observed trend in fish tissues) it is difficult to interpret as there are no available selenium guideline values for liver tissues in salmonid fish.

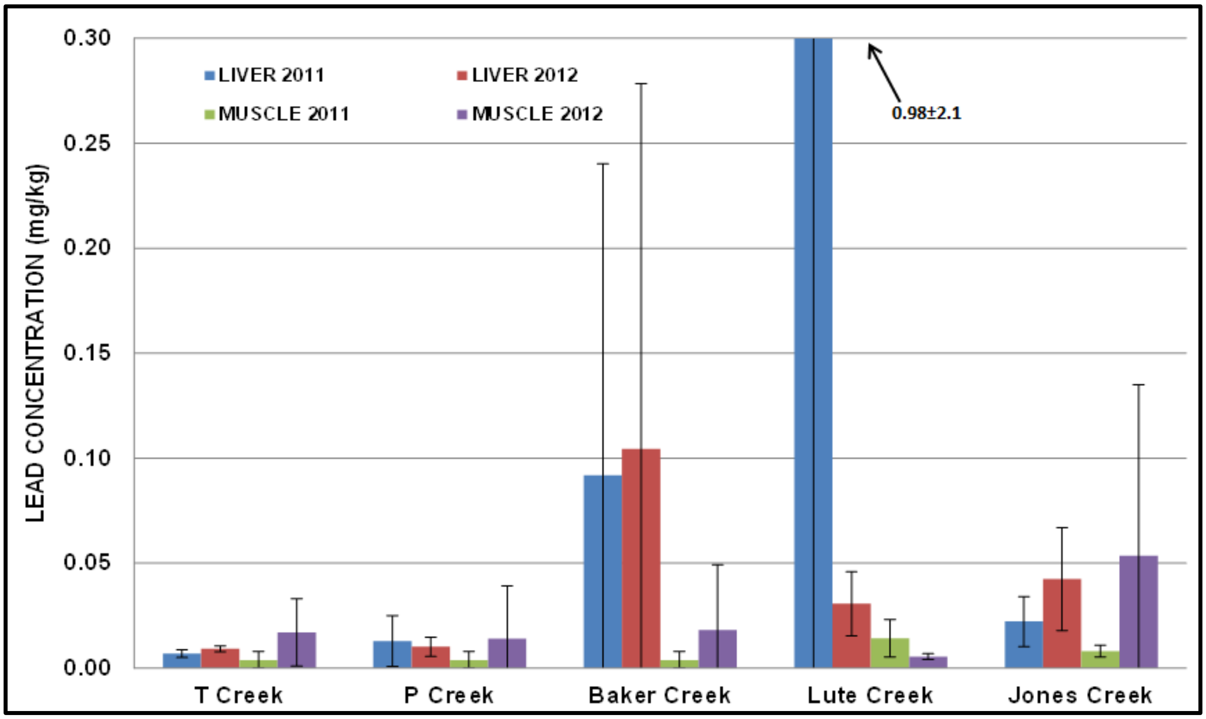
Average 2011 and 2012 selenium concentrations in rainbow trout muscle tissues (112 mm to 172 mm fork length) from those tributaries confluent with the North Thompson River (Baker Creek, Lute Creek, and Jones Creek) reported below guideline limits for selenium (4.0 mg/kg) (Figure 4.2.12, Appendix E).



NOTES:

1. T-Creek and P-Creek tissue samples from bull trout.
2. Baker, Lute and Jones creeks tissue samples form rainbow trout.
3. BC Criterion Limit =0.1 mg/kg, Canadian Food Inspection Guideline= 0.5 mg/kg.

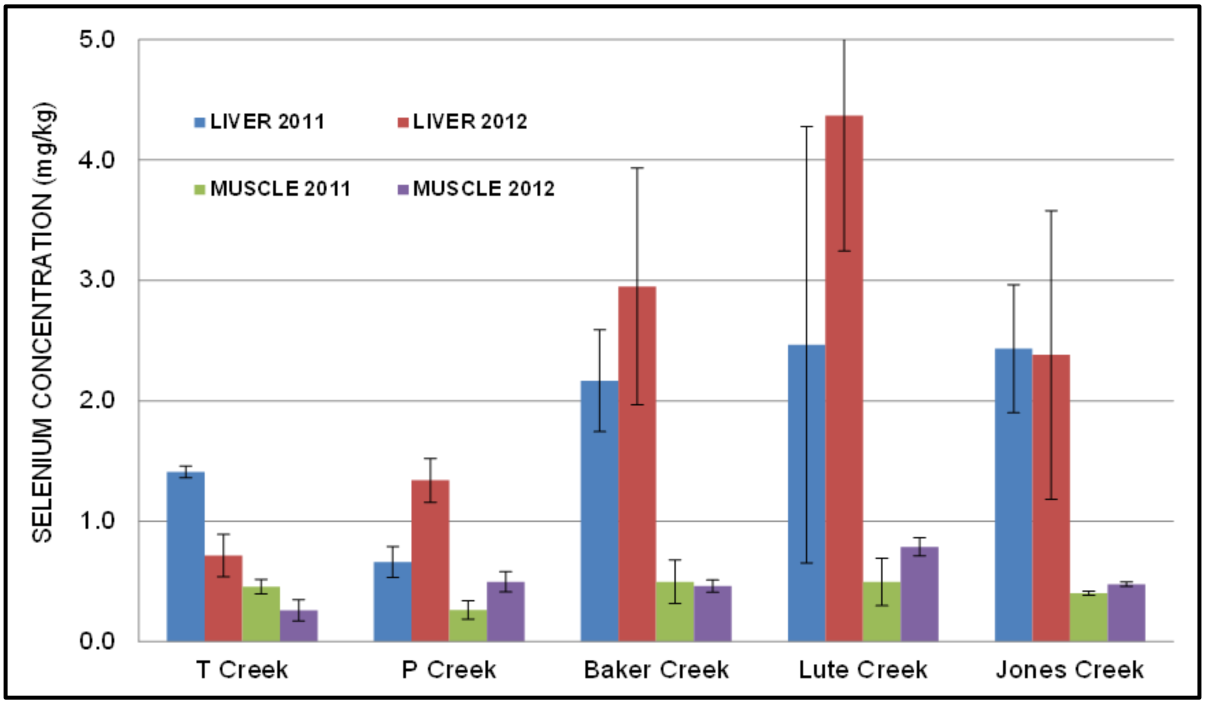
Figure 4.2.10 Mercury Concentration in Fish Liver and Muscle Tissues (Averages ± S.D.)



NOTES:

1. T-Creek and P-Creek tissue samples from bull trout.
2. Baker, Lute, and Jones creeks tissue samples form rainbow trout.
3. BC Criterion limit = 0.8 mg/kg (Alert Level for edible portions of fish for human consumption).

Figure 4.2.11 Lead Concentration in Fish Liver and Muscle Tissues (Averages ± S.D.)



NOTES:

1. T-Creek and P-Creek tissue samples from bull trout.
2. Baker, Lute and Jones creeks tissue samples form rainbow trout.
3. British Columbia Ministry of Environment: Ambient Water Quality Guidelines for Selenium Update (2014) identifies 4.0 mg/kg as a wildlife consumption limit.

Figure 4.2.12 Selenium Concentration in Fish Liver and Muscle Tissues (Averages ± S.D.)

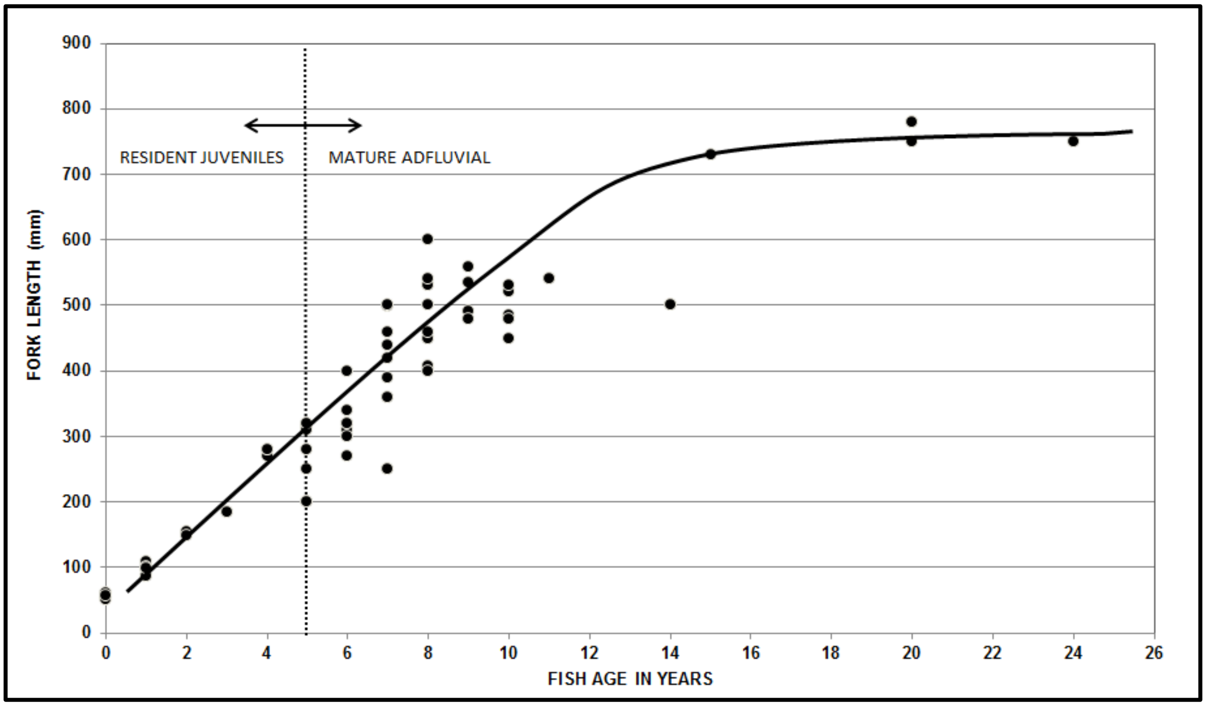
4.2.7 Fish Ages

A considerable amount of historic length data exists for bull trout populations within the Aquatic Environment Regional Study Area. Ageing data were compiled from Hagen and Baxter (1992), Grinton (1994), and other EcoCat data files to illustrate the age structure of bull trout populations from Harper Creek, Saskum Lake, and North Barriere Lake.

The historic ageing data and length frequency analysis of bull trout observed during 2011 suggests that the majority of resident fish observed in upper Harper Creek are less than four to five years old, and the larger fish (300 mm to 600 mm fork length) displaying migratory colouration (adfluvial fish) are generally older than five to six years (Figure 4.2.4 and Figure 4.2.13).

Scale samples from a total of 15 rainbow trout collected among the North Thompson tributaries for tissue analysis were also analyzed for age validation. The ages of fish from Baker Creek (112 mm to 152 mm fork length), Lute Creek (109 mm to 147 mm fork length) and Jones Creek (134 mm to 172 mm fork length) spanned two to five years and are consistent with rainbow trout length at age data from other small bodied stream resident populations (McPhail 2007).

A total of ten sub-adult bull trout collected for tissue analysis were sampled for otoliths from T-Creek (132 mm to 200 mm fork length) and P-Creek (122 mm to 183 mm fork length) and the ages spanned two to six years and two to four years respectively. The validated length at age of these fish suggest that bull trout in T and P-Creek are similar in age profile to other bull trout collected and aged within the local study area (Figure 4.2.13).



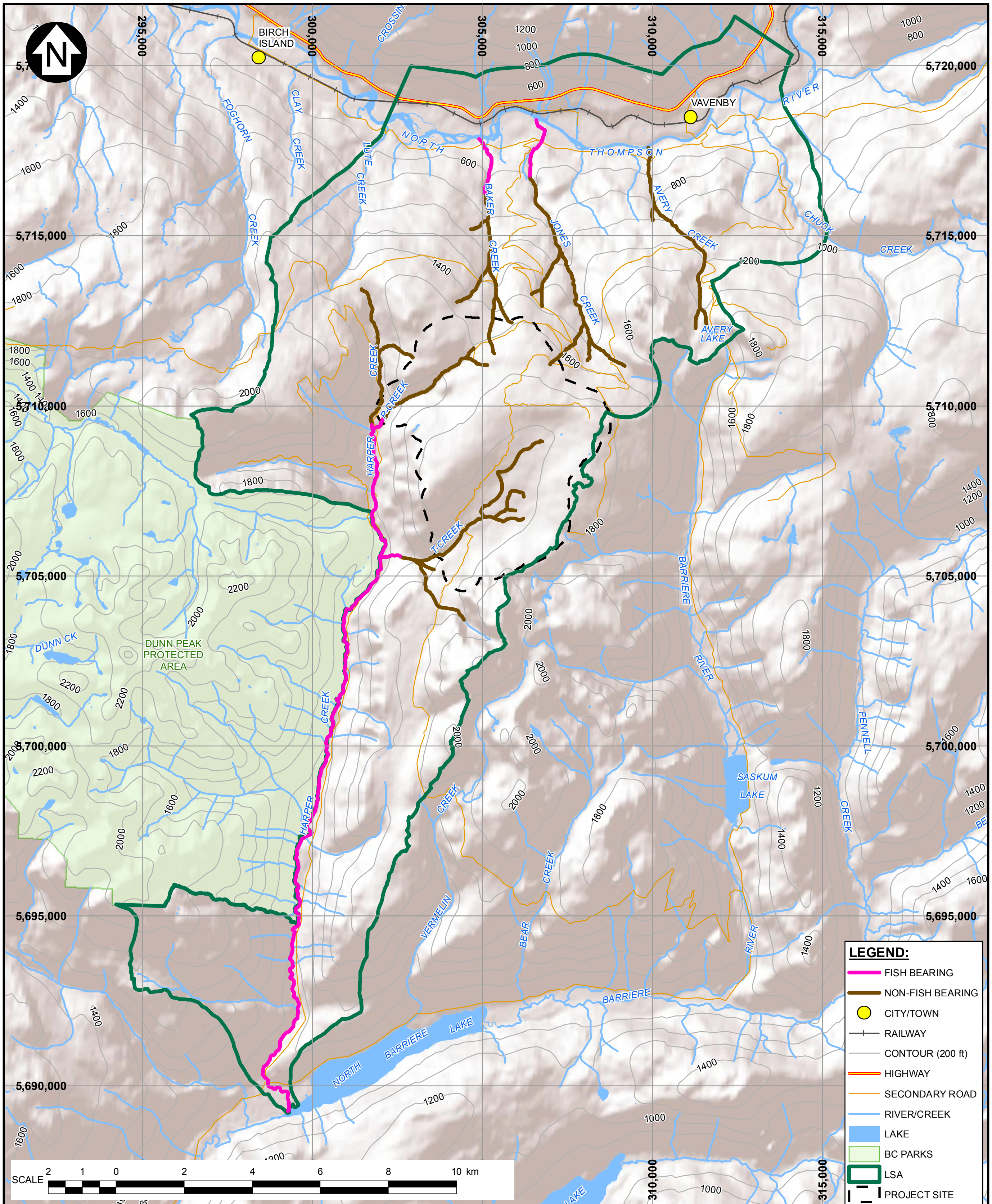
NOTES:

1. Length at age compiled from Baxter and Hagen (1992), Grinton (1994), and other EcoCat datafiles (http://www.env.gov.bc.ca/ecocat/)

Figure 4.2.13 Length at Age for Bull Trout (North Thompson Drainages, Including Harper Creek, Saskum Lake and North Barriere Lakes)

4.2.8 Non Fish Bearing Status

The upper portion of Harper Creek, T-Creek, P-Creek, Baker Creek, Jones Creek, and Avery Creek have barriers or habitat features that limit the upstream distribution of fish and these portions of the watersheds have been assessed as being non-fish bearing. The following sections describe the limits of fish use in watersheds that have the potential to be affected for Project activities.



NOTES:

1. BASE MAP: TRIM AND NTS MAPPING, ESRI ARCGIS ONLINE SHADED RELIEF.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:160,000 FOR 8.5x11 (LETTER) PAPER.

HARPER CREEK MINING CORP.

HARPER CREEK PROJECT

NON-FISH BEARING HABITAT WITHIN THE PROJECT LSA

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-458/15	1

FIGURE 4.2.14 REV 1

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
1	21AUG'14	ISSUED WITH REPORT	CAC	CAC	PMT	KJB

SAVED: M:\1\01\00458\15\A\GIS\Figs\Report1_FishAquaticBaseline\Rev1\Fig4-2-14_Non-FishHabitat_r1.mxd; Aug 21, 2014 9:55 AM; cczembor

Table 4.2.6 Summary of Non-Fish Bearing Aquatic Habitat

Watershed	Years sampled	Number of sites	Electrofishing effort (seconds)	Type of Barrier	Fish Bearing (Y/N)
Upper Harper Creek	2012,2013	2	1,400	Unsuitable habitat	No
Upper T- Creek	2011,2012,2013	14	5,659	Waterfall	No
Upper P- Creek	2012,2013	3	1,459	Waterfall	No
Upper Baker Creek	2011,2012	2	1,086	Cascades	No
Upper Jones Creek	2011,2012	2	960	Waterfall/cascades	No
Avery Creek	2012, 2013	2	924	Unsuitable habitat	No

4.2.8.1 Upper Harper Creek

The portion of upper Harper Creek within Reach 17 is non-fish bearing. The limit of fish bearing habitat in Harper Creek habitat ends in Reach 16 just upstream of the P-Creek confluence. Above Reach 16 the bed material is comprised of angular cobble and bedrock and summer and fall stream flows are markedly lower when compared to downstream reaches. A total of 460 and 940 seconds of electrofishing effort was applied to sites HCF-460 and 470, during August 2011 and September 2013 respectively, and no fish were observed or captured during these investigations and this portion of Harper Creek is considered non-fish bearing (Table 4.2.6 and Figure 4.2.14).

4.2.8.2 T-Creek

The portion of T- Creek upstream of Reach 1 is not fish bearing. The limit of fish bearing habitat in Harper Creek ends at the ends at a 1.8 m waterfall located 336 m upstream from the Harper Creek confluence.

Sections of Reach 1 (sites TCF070-90) and Reach 2 (sites TC-F100-110) upstream of the waterfall barrier were sampled on four separate visits during July-September 2011, 2012 and 2013. A total of 2,919 seconds of electrofishing effort was applied to this high gradient (23.8%), cascading portion of the creek and no fish were observed or captured (Table 4.2.6 and Figure 4.2.14).

Further sampling was conducted in Reaches 3-6 the upper portion of the T-Creek watershed within the Project Site footprint that will contain the Tailings Management Facility. In this portion of the watershed is low gradient (2.5 -4.1 %) and channels flow through a series of wetland areas. A total of 2,740 seconds of electrofishing effort was applied at ten different sampling locations throughout Reaches 3-6 (site TCF120-180) during September 2011, July 2012 and September 2013 and no fish were observed or captured at any of these upper T-Creek sampling locations(Table 4.2.6 and Figure 4.2.14).

4.2.8.3 P-Creek

Portions of P-Creek are largely comprised of high gradient sections of creek that flow through small canyons that contain accumulations of debris that form the eastern side of the Harper Creek Valley. During late June, 2011 no fish were observed in the lowest reaches of P-Creek, however, later in the sampling regime juvenile bull trout were observed through the lower portion of P-Creek up to an impassible barrier located approximately 469 m upstream of the upper Harper Creek confluence. A total of 1,459 seconds effort was applied to Reaches 1 and 2 immediately above the falls to site PC-F60 and further upstream between sites PC-F60-70 above the barrier during August and September, 2012, and again during September 2013. No fish were observed or captured during any of these sampling events (Table 4.2.6 and Figure 4.2.14).

4.2.8.4 Baker Creek

The upper limit of fish distribution in Baker Creek is series of high gradient cascades approximately 1.75 km upstream from the North Thompson River confluence. Rainbow trout were observed below the cascades at sites BC-F50, however, their relative abundance gradually declined as the stream gradient increased and creek flows decreased and no fish were observed or captured during 1,086 seconds of electrofishing effort at sites in Reach 3 and 4 (sites BC-F60-70) during September 2011 and August 2012 (Table 4.2.6 and Figure 4.2.14).

4.2.8.5 Jones Creek

The limit of fish distribution in Jones Creek is series small waterfalls approximately 1.78 km upstream from the North Thompson River confluence. Rainbow trout were observed below the series of waterfalls near sites JC-F65, however, like Baker Creek their relative abundance gradually declined as the stream gradient increased and creek flows decreased. No fish were observed or captured during a total of 960 seconds of electrofishing effort at sites in Reach 2 (between site JC-F60 and 70) during September 2011 and 2012 (Table 4.2.6 and Figure 4.2.14).

4.2.8.6 Avery Creek

Avery Creek was sampled at two different locations, and no fish were captured or observed at either location. The first site was sampled during very low flow conditions during September 2011 at site AC-F010 just upstream of the Birch Island Lost-Creek Road crossing where 325 seconds of electrofishing effort was applied and no fish were captured or observed. No creek flow was visible at this sampling location during late summer 2012 and 2013 to support fish or aquatic life.

The second sampling location was located approximately 3.6 km upstream from the Birch Island Lost-Creek Road at site AC-F020 at the Avery-Jones Forest Service Road crossing which will form part of the Mine Access Road. This site was sampled during September 2012 and September 2013 and a total of 568 electrofishing seconds were applied to habitat immediately upstream of the road culvert crossing and no fish were observed or captured (Table 4.2.6 and Figure 4.2.14).

4.3 PERIPHYTON

Analytical results can be found in Appendix F (periphyton taxonomy and periphyton biomass). The following sections discuss the statistical analysis of the results.

4.3.1 Periphyton Taxonomy

4.3.1.1 2011 Results

Eight periphyton phyla were identified in the samples in 2011:

- Bacillariophycae: diatoms

- Chlorophyta: green algae
- Chrysophyta: golden-brown or golden algae
- Cryptophyta
- Cyanophyta: blue-green algae
- Euglenophyta
- Pyrrhophyta, and
- Rhodophyta: red algae.

The Cyanophyte species *Homoeothrix varians* (Order Oscillatoriales) was the predominant species in most of the samples, followed by *Achnanthes minutissima* (Phylum Bacillariophycae, Order Pennales). The raw data can be found in Appendix F. The least common organisms belonged to the phyla Euglenophyta, with Trachelomonas species being found at site TMF-20, and Pyrrhophyta, with Peridinium species found at site BR-10. Cryptophyta were only found at sites BR-10 and BR-20 (unidentified Cryptomonadales).

The periphyton community metrics and descriptive statistics calculated for each site are summarized in Table 4.3.1 and are presented on Figure 4.3.1 through Figure 4.3.4. The calculations to derive the results are provided in Appendix F. The highest cell density was noted at site HC-20 (Harper Creek downstream of T-Creek), while the lowest cell density was noted at site TMF-20, the uppermost site on T-Creek within the Project Site.

Table 4.3.1 2011 Periphyton Taxonomy Results Summary Table

Site	Density (cells/cm^2)	Species Richness	Shannon Wiener Diversity Index	Evenness Index	Pollution Tolerance Index	Taxonomic Composition (%)	
BR-10	1,335,269	88	2.59	0.40	2.94	Bacillariophycae	63.05
						Cyanophyta	35.30
						Chlorophyta	1.41
						Chrysophyta	0.10
BR-20	690,121	35	1.21	0.24	3.00	Cyanophyta	93.19
						Bacillariophycae	5.90
						Chlorophyta	0.59
						Rhodophyta	0.22
						Chrysophyta	0.09
TMF-10	506,914	62	1.58	0.27	2.95	Cyanophyta	71.53
						Bacillariophycae	24.76
						Chlorophyta	3.29
						Rhodophyta	0.35
						Chrysophyta	0.02
TMF-20	453,432	76	2.05	0.33	2.57	Cyanophyta	70.82
						Bacillariophycae	28.49
						Chrysophyta	0.23
						Chlorophyta	0.22
						Rhodophyta	0.09
OP-10	1,840,725	36	1.39	0.27	2.95	Cyanophyta	85.16
						Bacillariophycae	12.44
						Chrysophyta	2.35
						Rhodophyta	0.03
						Chlorophyta	0.01
BC-10	830,610	44	1.14	0.21	3.00	Cyanophyta	85.66
						Bacillariophycae	7.10
						Chrysophyta	7.06
						Rhodophyta	0.15
						Chlorophyta	0.02
HC-10	757,116	54	1.11	0.20	2.97	Bacillariophycae	74.96
						Cyanophyta	17.53
						Chlorophyta	7.01
						Chrysophyta	0.40
						Rhodophyta	0.05
HC-20	2,939,121	52	0.77	0.14	2.96	Bacillariophycae	96.90
						Cyanophyta	2.55
						Chrysophyta	0.41
						Unidentified	0.08
						Chlorophyta	0.04
						Rhodophyta	0.02
HC-30	1,093,739	52	1.64	0.29	2.97	Cyanophyta	63.37
						Bacillariophycae	31.38
						Chrysophyta	3.74
						Chlorophyta	1.43
HC-40	1,385,231	40	1.04	0.20	2.99	Cyanophyta	94.18
						Bacillariophycae	3.66
						Chlorophyta	1.38
						Rhodophyta	0.52
						Chrysophyta	0.24

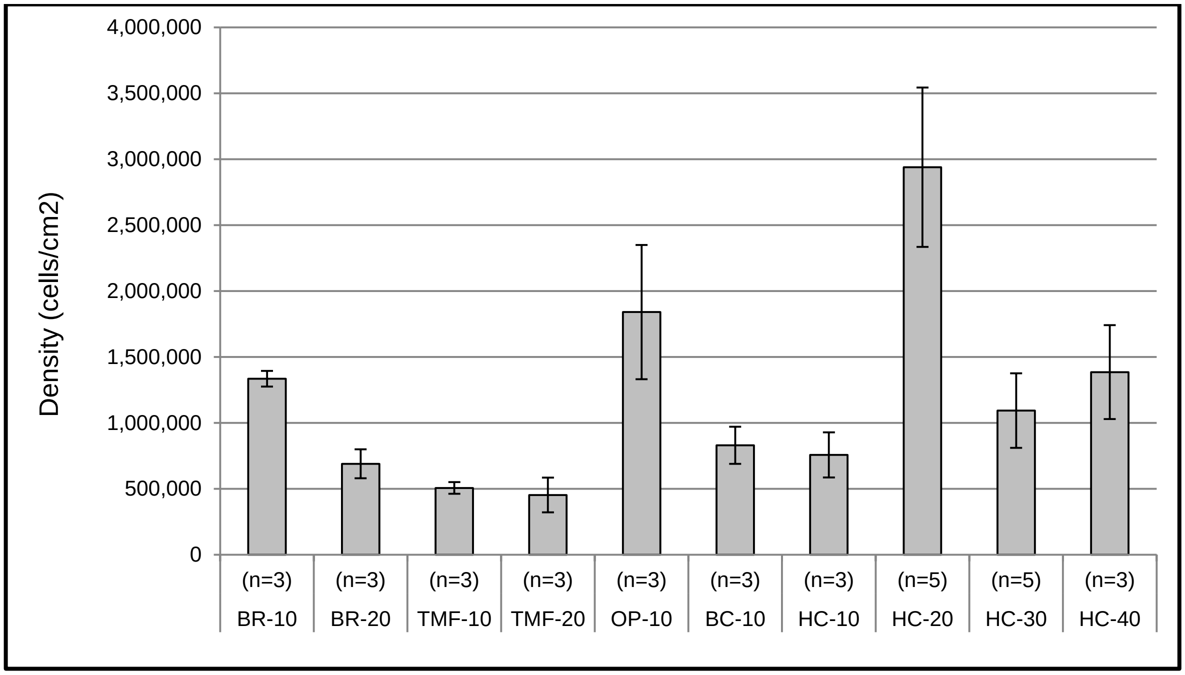


Figure 4.3.1 2011 Mean Periphyton Density (±S.E.)

In general, where more than one site was located on the same creek or river, cell densities were higher at the upstream sites compared to the downstream sites; the exception to this is within Harper Creek, where the lowest cell density was noted at site HC-10 in Reach 3 and the highest cell density was recorded at site HC-20 in Reach 17 (Figure 4.3.1). Taxa richness (number of species) is higher at the downstream sites compared to the upstream sites on the Barriere River and Harper Creek, but higher at the upstream site on T-Creek (Figure 4.3.2).

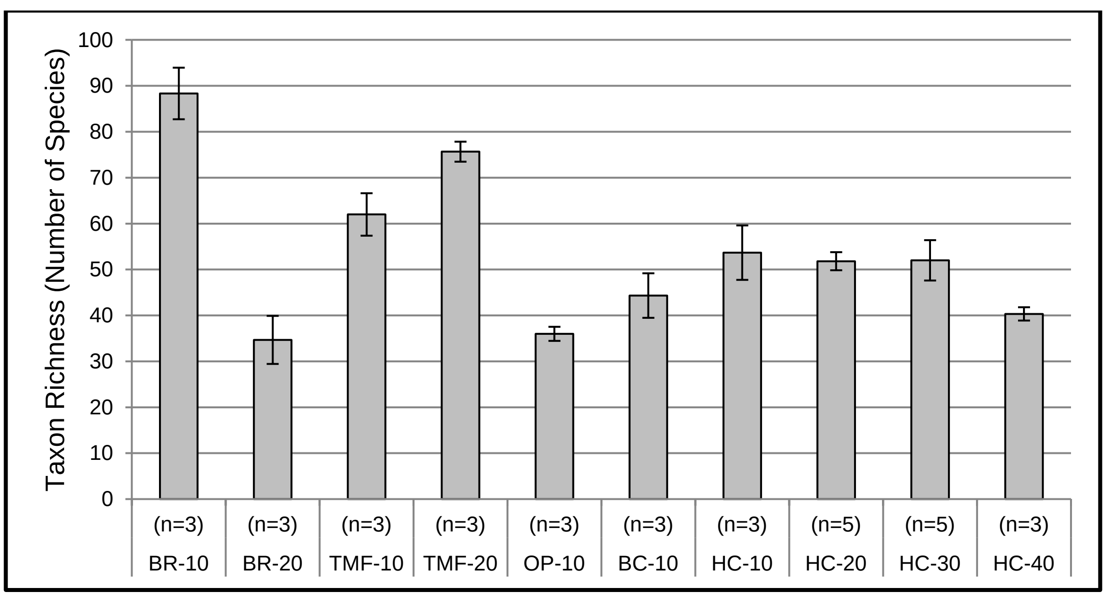


Figure 4.3.2 2011 Mean Periphyton Taxon Richness (±S.E.)

Species diversity and evenness, as measured by the Shannon Wiener Diversity and Evenness indices, respectively, is variable: diversity and evenness are higher at the upper site on the Barriere River and at the lower site on T-Creek. Despite the fact that site HC-20 had the highest density of cells in 2011, it exhibited the lowest diversity and evenness, with 96% of the samples comprised of species from the Bacillariophycae phylum (Figure 4.3.3). The PTI at all sites range between 2.5 and 3, indicating good water quality (Figure 4.3.4).

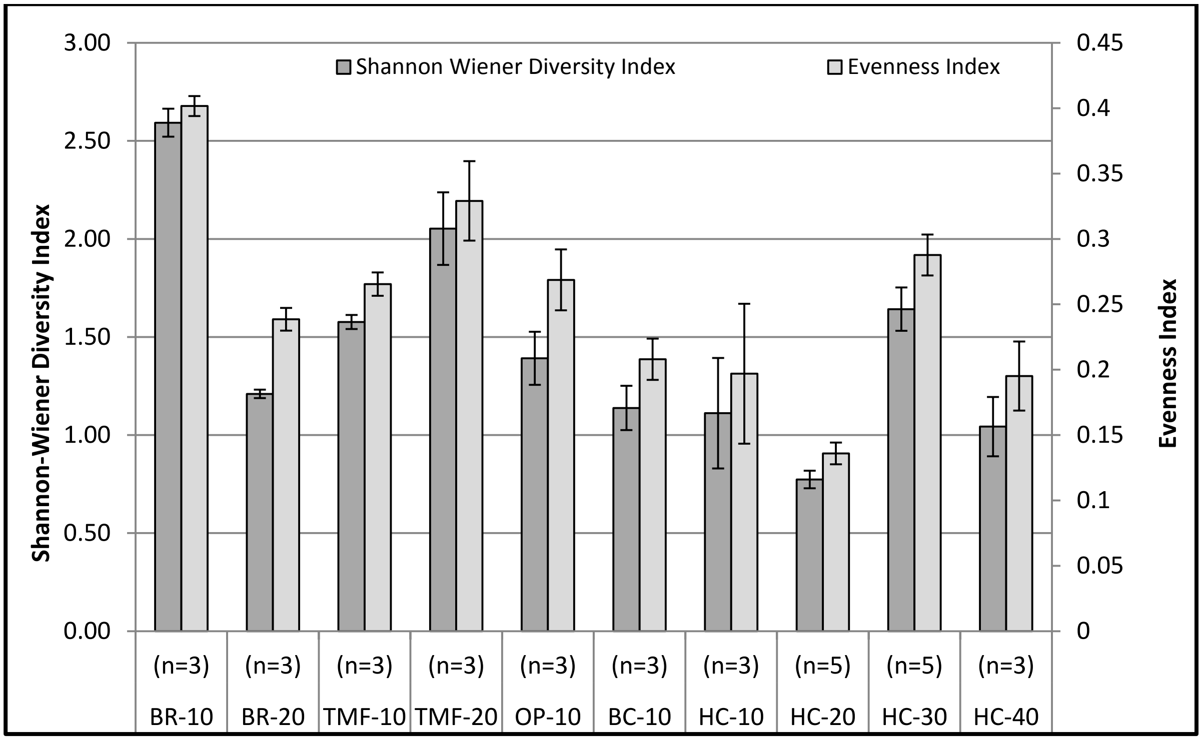


Figure 4.3.3 2011 Periphyton Shannon Wiener Diversity Index and Evenness Index (±S.E.)

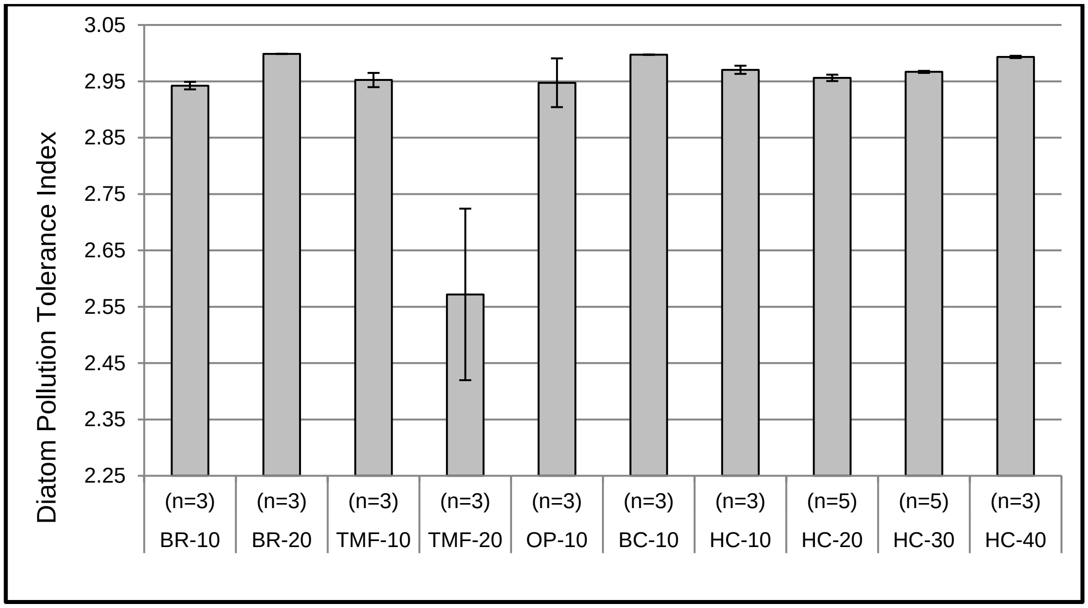


Figure 4.3.4 2011 Diatom Pollution Tolerance Index (±S.E.)

4.3.1.2 2013 Results

The same periphyton phyla found in the 2011 samples were also identified in the 2013 samples. Species from the Chamaesiphon genus (Phylum Cyanophyta, Order Chamaesiphonales) were the predominant organisms in most of the samples, followed by *Homoeothrix varians* (Phylum Cyanophyta, Order Oscillatoriales), and *Achnanthes minutissima* (Phylum Bacillariophycae, Order Pennales). The least common organisms belonged to the phyla Pyrrhophyta, with an unidentified Dinoflagellate species found only at site BR-10, and Euglenophyta, with Trachelomonas species being found at sites BR-10, HC-20, and HC-40. The raw data can be found in Appendix F.

The periphyton community metrics and descriptive statistics calculated for the 2013 samples are summarized in Table 4.3.2 and are presented on Figure 4.3.5 through Figure 4.3.8. The calculations to derive the results are provided in Appendix F. Mean density was highest at site OP-10 on P- Creek and lowest at site BR-10 on the Barriere River in 2013.

Periphyton density was lower at the downstream sites on the Barriere River and T-Creek compared to the upstream sites in the same systems; no pattern was seen in the Harper Creek sites but the lowest density was found at site HC-10, the furthest site downstream (Figure 4.3.5).

Table 4.3.2 2013 Periphyton Taxonomy Results Summary Table

Site	Density (cells/cm^2)	Species Richness	Shannon Wiener Diversity Index	Evenness Index	Pollution Tolerance Index	Taxonomic Composition (%)	
BR-10	557,582	88.33	2.53	0.57	2.97	Bacillariophycae	55.0
						Cyanophyta	41.2
						Chlorophyta	2.6
						Chrysophyta	0.6
BR-20	1,116,088	37.00	1.53	0.42	3.00	Bacillariophycae	10
						Cyanophyta	86
						Chrysophyta	3.51
						Rhodophyta	0.13
						Chlorophyta	0.01
TMF-10	1,122,106	45.67	1.11	0.29	2.99	Cyanophyta	89.3
						Bacillariophycae	10.0
						Chlorophyta	0.48
						Chrysophyta	0.10
						Rhodophyta	0.08
TMF-20	1,909,670	44.33	1.32	0.35	3.00	Cyanophyta	80.32
						Bacillariophycae	19.27
						Chrysophyta	0.16
						Rhodophyta	0.13
OP-10	2,873,228	32.33	1.05	0.30	3.00	Cyanophyta	94.86
						Bacillariophycae	4.10
						Chrysophyta	1.02
						Rhodophyta	0.01
BC-10	1,589,088	26.67	0.90	0.28	3.00	Cyanophyta	94.59
						Bacillariophycae	5.06
						Rhodophyta	0.20
						Chrysophyta	0.15
						Chlorophyta	0.01
HC-10	681,555	50.33	1.80	0.46	2.98	Cyanophyta	79.98
						Bacillariophycae	18.98
						Chrysophyta	0.72
						Rhodophyta	0.23
						Chlorophyta	0.07
HC-20	2,091,375	62.40	1.52	0.37	2.91	Bacillariophycae	77.22
						Cyanophyta	19.38
						Chrysophyta	3.30
						Chlorophyta	0.03
HC-30	1,842,495	34.40	1.16	0.33	2.98	Cyanophyta	90.86
						Chrysophyta	4.99
						Bacillariophycae	4.12
						Rhodophyta	0.02
						Chlorophyta	0.01
HC-40	1,679,645	40.67	1.31	0.36	3.00	Cyanophyta	77.59
						Bacillariophycae	17.58
						Chrysophyta	4.43
						Rhodophyta	0.35
						Chlorophyta	0.04

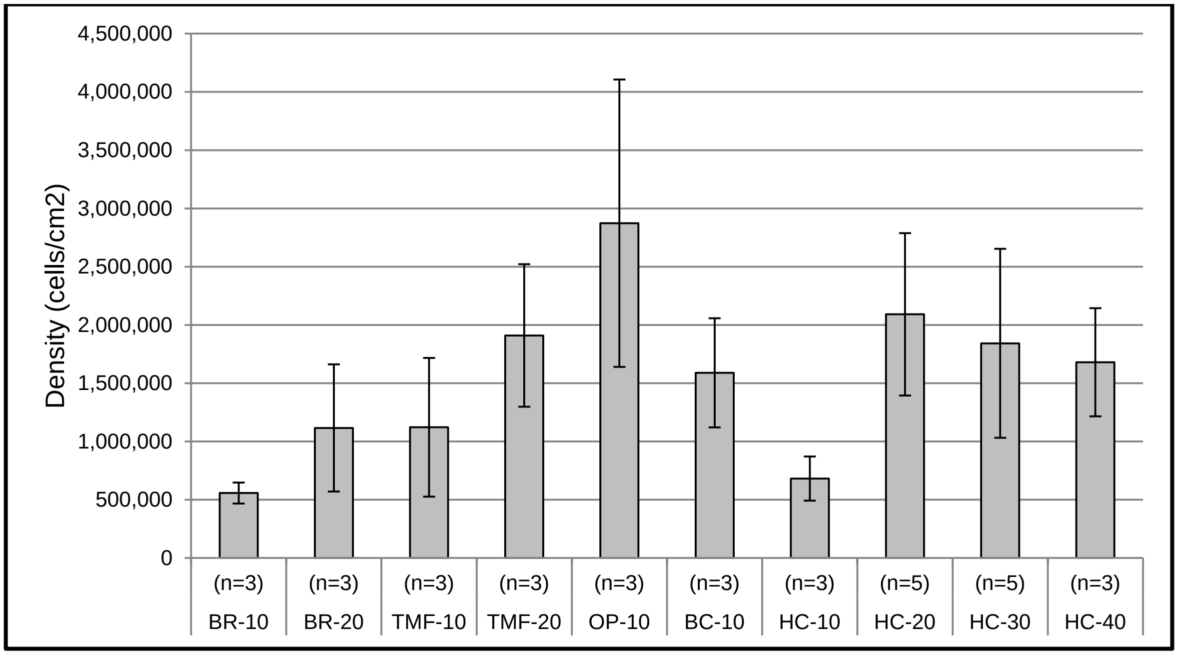


Figure 4.3.5 2013 Mean Periphyton Density (±S.E.)

Although cell density was lowest at site BR-10, the highest Species Richness value was noted at this site in 2013 (Figure 4.3.6). The lowest Species Richness value was noted at site BC-10, on Baker Creek near the community of Vavenby. Diversity and evenness values were also highest at site BR-10 in 2013, with organisms from the Bacillariophycae and Cyanophyta phylum making up approximately 55% and 41%, respectively, of the samples (Figure 4.3.7). The pollution tolerance index at all sites ranged between 2.8 and 3 (Figure 4.3.8).

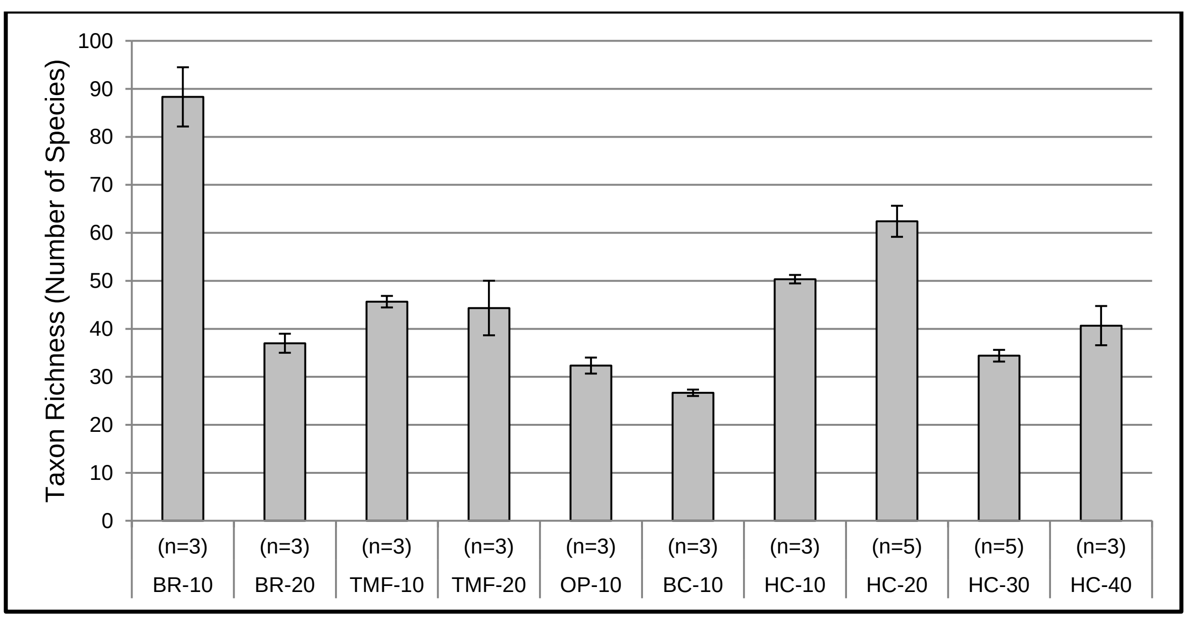


Figure 4.3.6 2013 Mean Periphyton Taxon Richness (±S.E.)

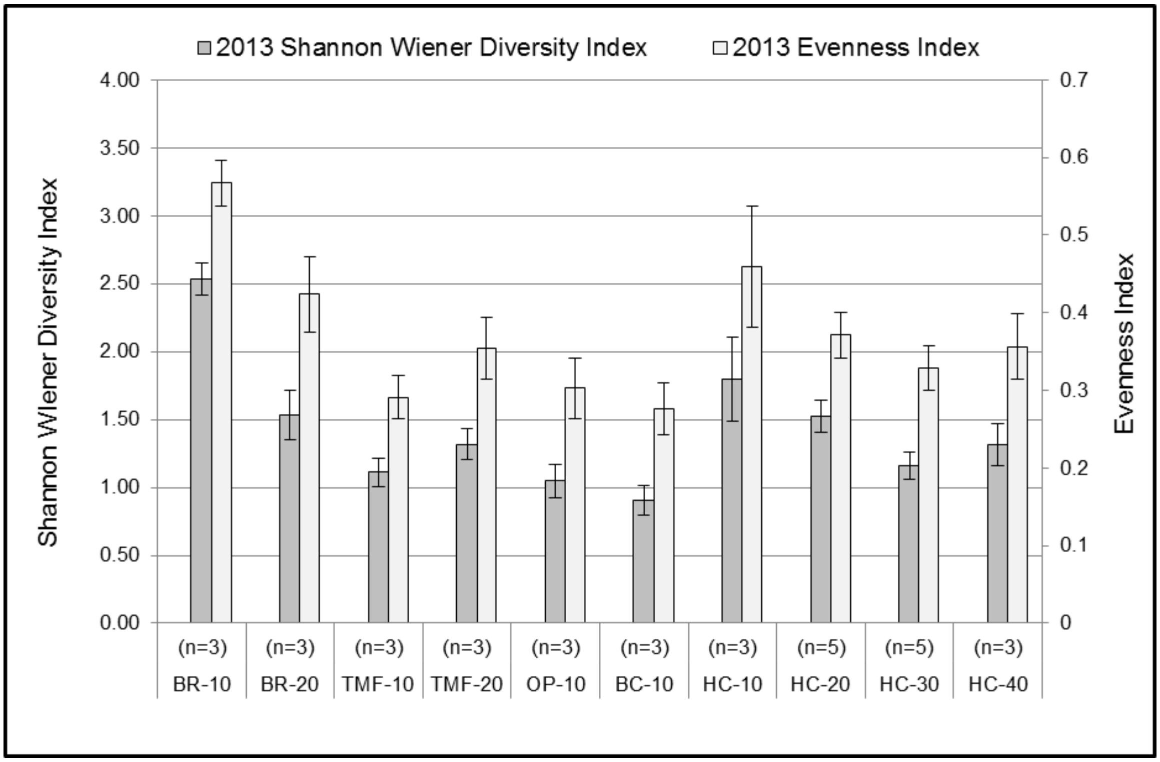


Figure 4.3.7 2013 Periphyton Shannon Wiener Diversity Index and Evenness Index (±S.E.)

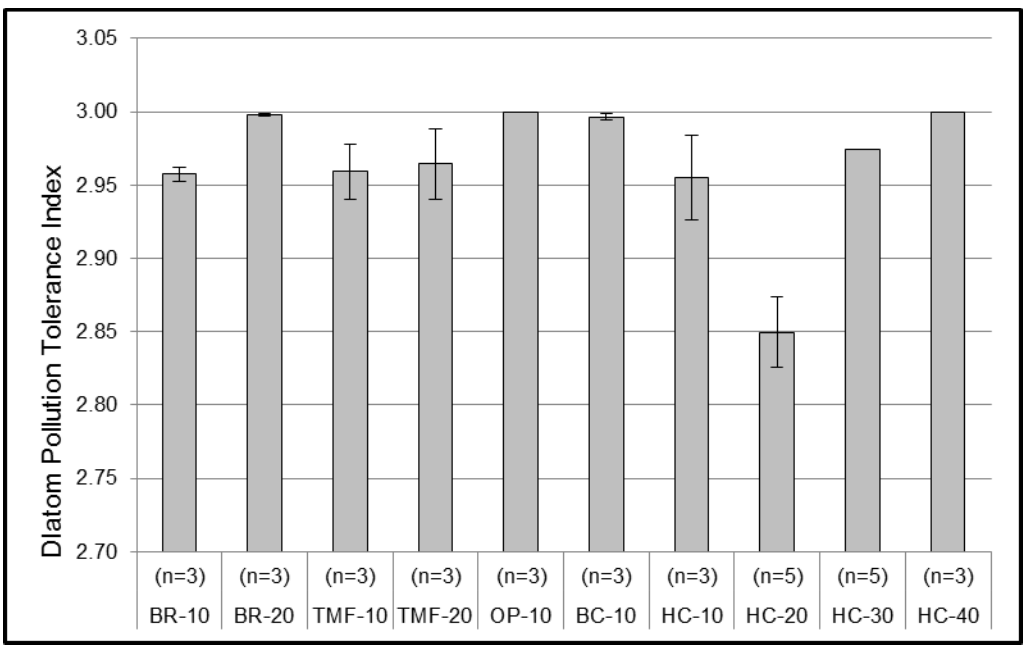


Figure 4.3.8 2013 Diatom Pollution Tolerance Index (±S.E.)

4.3.1.3 Discussion

Organisms from the Cyanophyta phylum were predominant at the majority of sites in both 2011 and 2013; exceptions were noted at sites BR-10 (Barriere River downstream of North Barriere Lake), HC-10 (the furthest site downstream on Harper Creek), and HC-20 (Harper Creek downstream of T-Creek) in 2011; and BR-10 and HC-20 in 2013, where organisms from the Bacillariophycae phylum were dominant (Appendix F).

The highest density of organisms was found at site HC-20 in 2011 and at site OP-10 (P-Creek) in 2013 (Figure 4.3.9). Lowest densities were noted at site TMF-20 (T-Creek) in 2011 and in BR-10 in 2013.

The highest Species Richness values were found at site BR-10 in both 2011 and 2013; this site also had the highest Shannon Wiener Diversity Index and Evenness Index values in both years (Figure 4.3.10 to Figure 4.3.12). The lowest Species Richness value was noted at site BR-20 (Barriere River upstream of Saskum Lake) in 2011. The lowest Shannon Wiener Diversity Index and Evenness Index values were observed at site HC-20 in 2011 (Figure 4.3.11 and Figure 4.3.12). Lowest Species Richness and lowest Shannon Wiener Diversity Index and Evenness Index values were all found at site BC-10 in 2013 (Figure 4.3.10 to Figure 4.3.12).

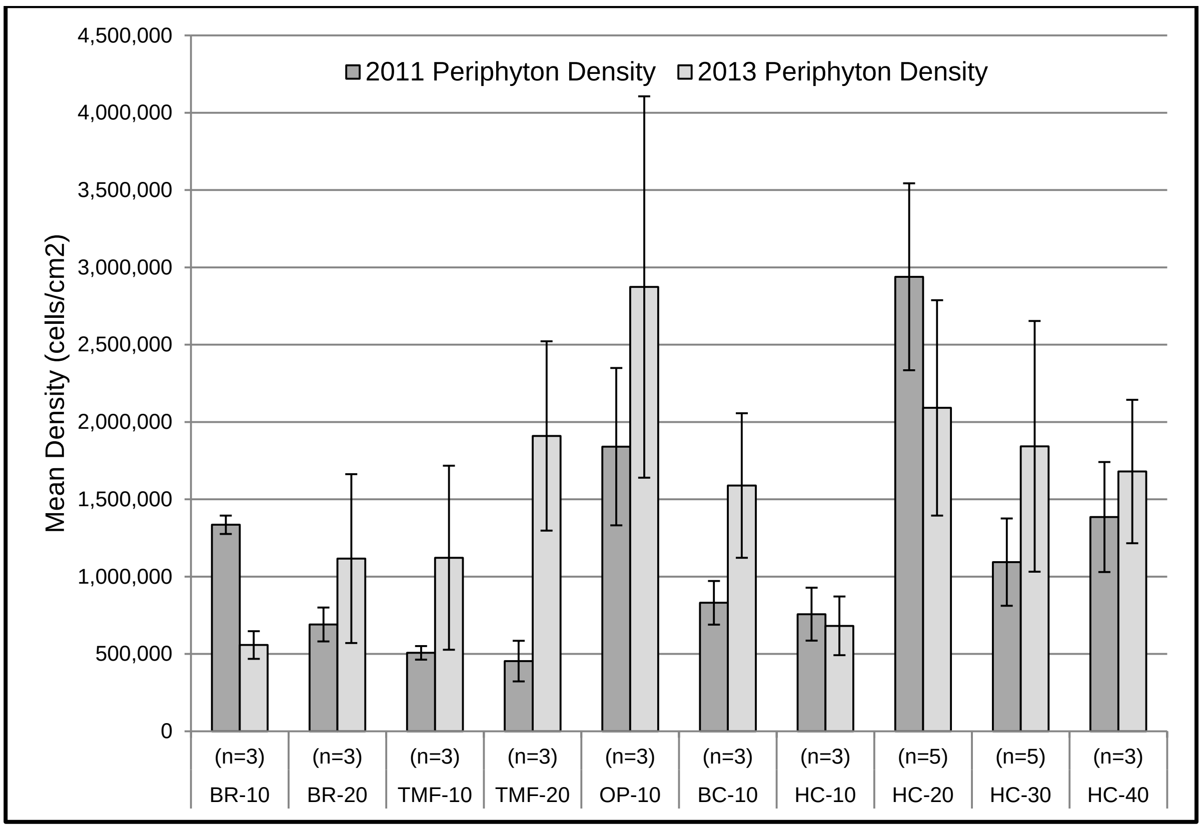


Figure 4.3.9 2011-2013 Mean Periphyton Density (±S.E.)

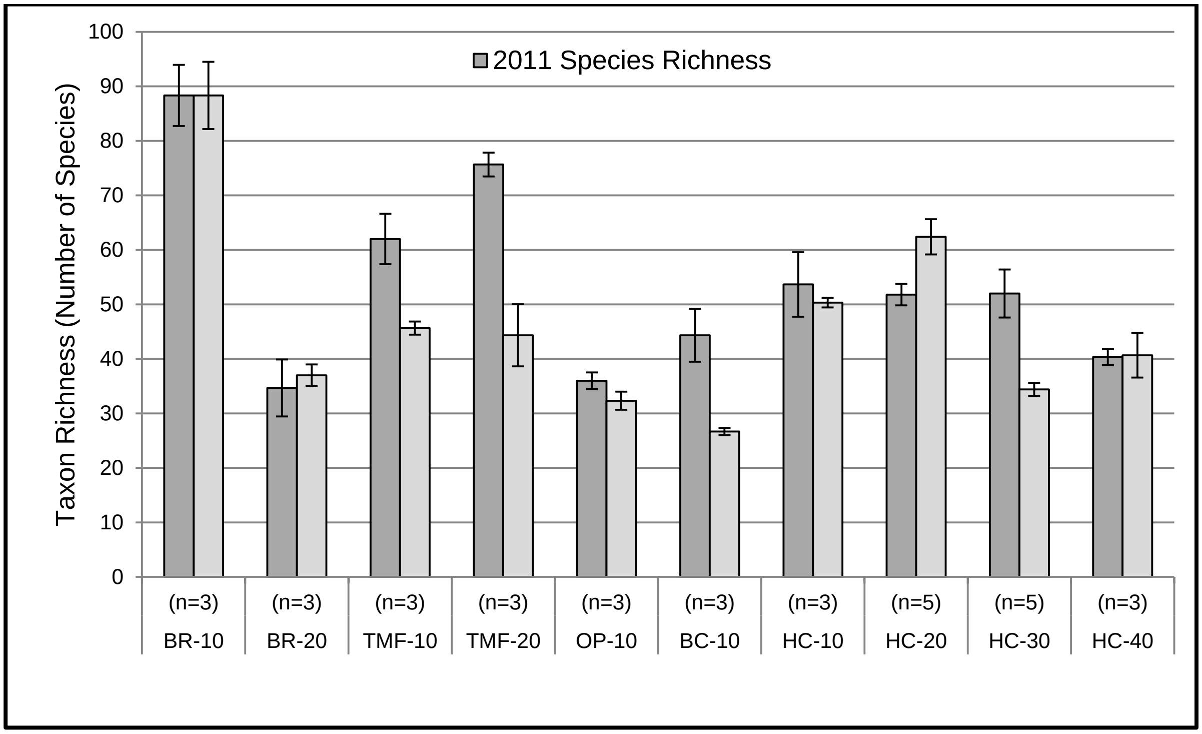


Figure 4.3.10 2011 - 2013 Mean Periphyton Taxon Richness (±S.E.)

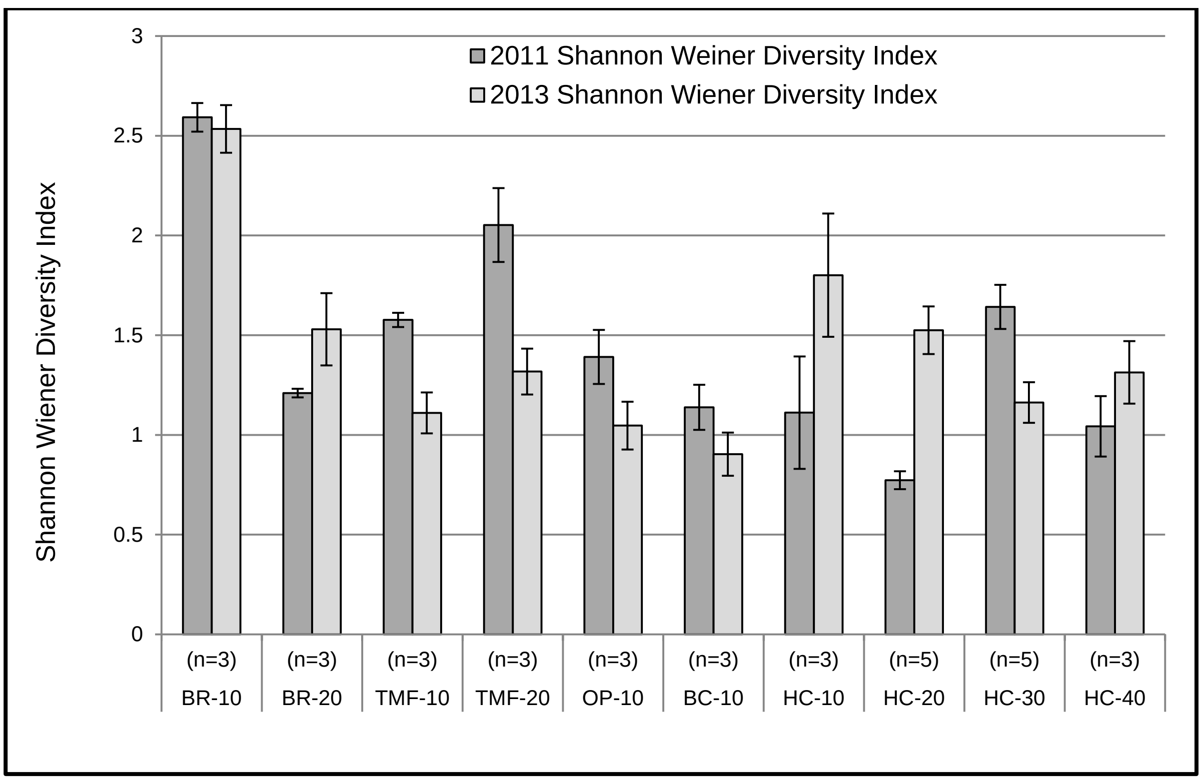


Figure 4.3.11 2011 - 2013 Periphyton Shannon Wiener Diversity Index (±S.E.)

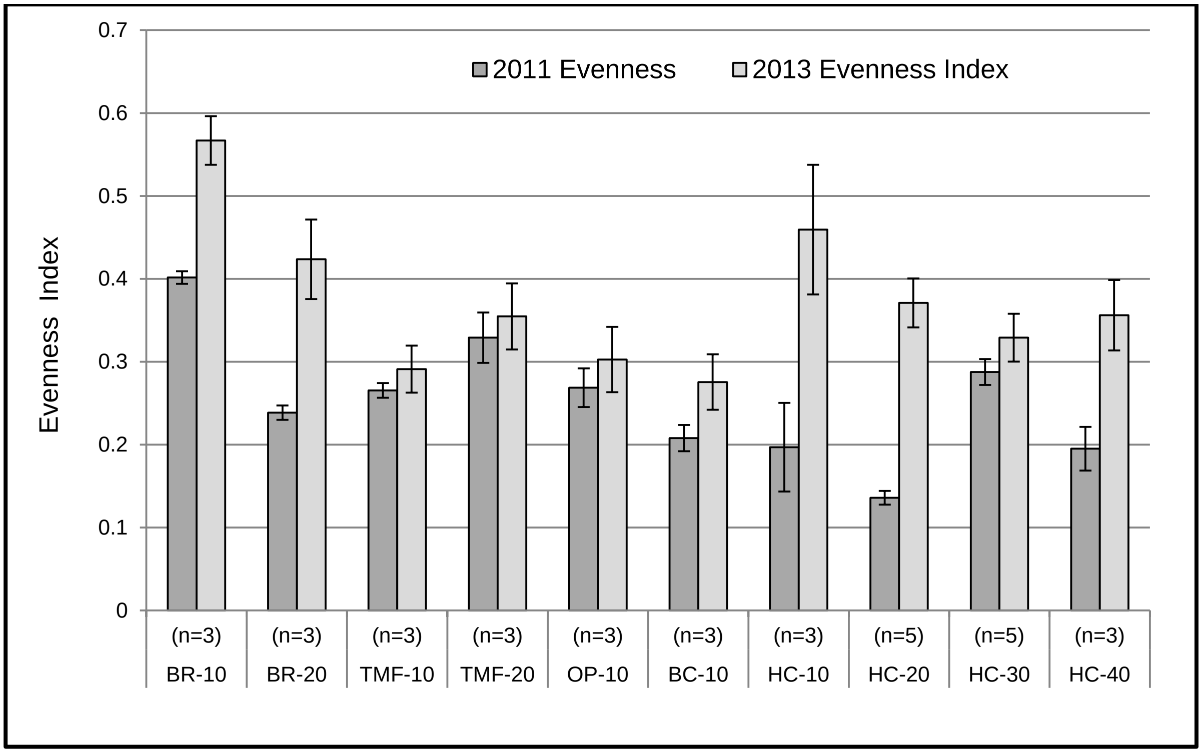


Figure 4.3.12 2011-2013 Periphyton Evenness Index (±S.E.)

Organisms from the Bacillariophycae and Cyanophyta phyla comprise approximately 63% and 35%, respectively, of the total organisms at site BR-10 in 2011, similar to the values noted in 2013 (55% Bacillariophycae and 41% Cyanophyta). This contrasts with site HC-20, where organisms from the Bacillariophycae phylum comprise approximately 96% of the total in 2011, and site BC-10, where organisms from the Cyanophyta phylum comprised approximately 95% of the total in 2013.

Cell density was higher at site BR-10 than at site BR-20 in 2011; the opposite was noted in 2013. As previously noted, the highest Species Richness, Shannon Wiener Diversity Index and Evenness Index values of all sites were noted at site BR-10 in both 2011 and 2013, indicating both a greater number of taxa and greater number of individuals within each taxon. Site BR-20 had the lowest Species Richness value of all sites in 2011. Species Richness at site BR-20 is less than half the value noted at site BR-10.

The Pollution Tolerance Index is slightly lower at site BR-10 compared to site BR-20 in both years, indicating good water quality at both sites.

4.3.2 Periphyton Biomass

4.3.2.1 2011 Results

Mean periphyton biomass in 2011, measured as chlorophyll-a, was highest at site BC-10, on Baker Creek near the community of Vavenby, and lowest at site OP-10, on P-Creek. Values ranged from 0.31 µg/cm^2 to 1.7 µg/cm^2 (Figure 4.3.13). The analytical results can be found in Appendix F.

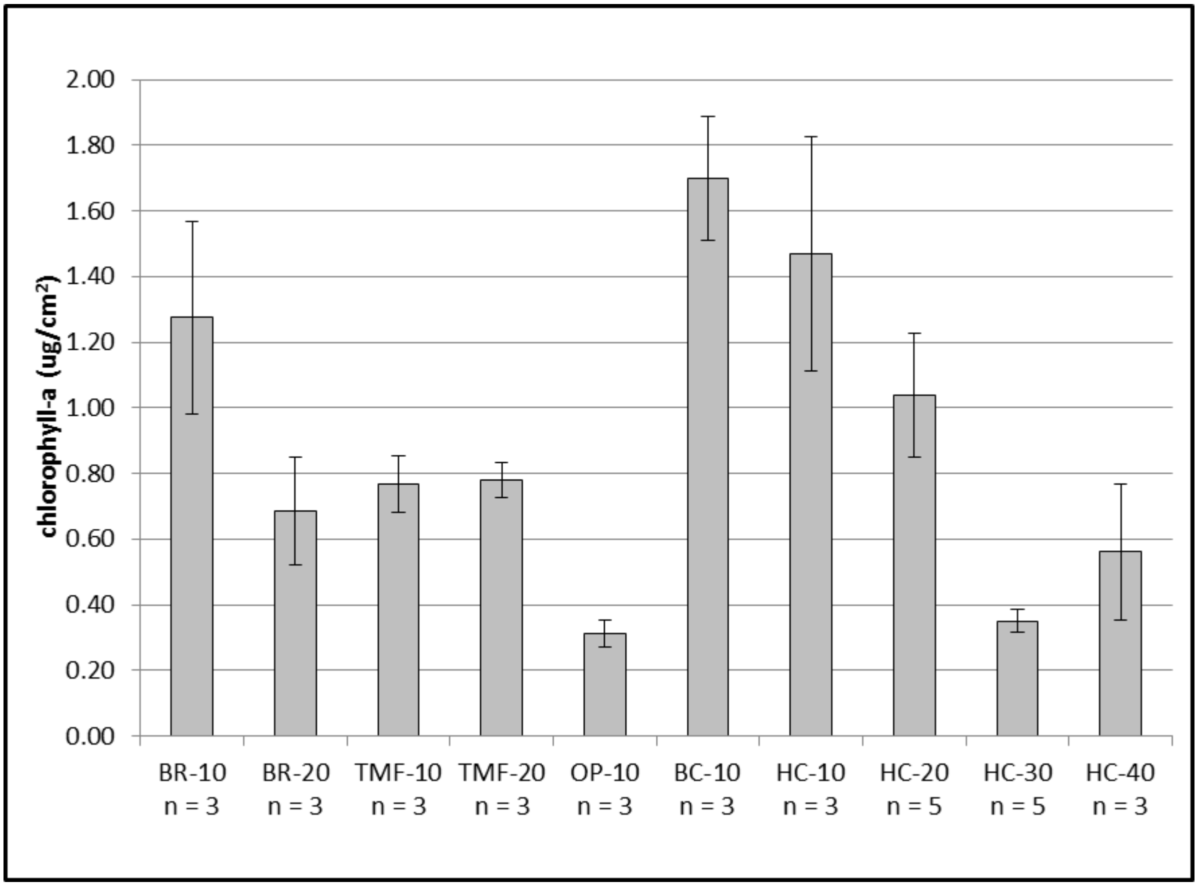


Figure 4.3.13 2011 Mean Periphyton Biomass (±S.E.)

4.3.2.2 2012 Results

Periphyton biomass in 2012 was highest at site BR-10 in the Barriere River downstream of North Barriere Lake, and lowest at site BC-10 (Figure 4.3.14). Values ranged from 0.07 µg/cm^2 to 0.77 µg/cm^2.

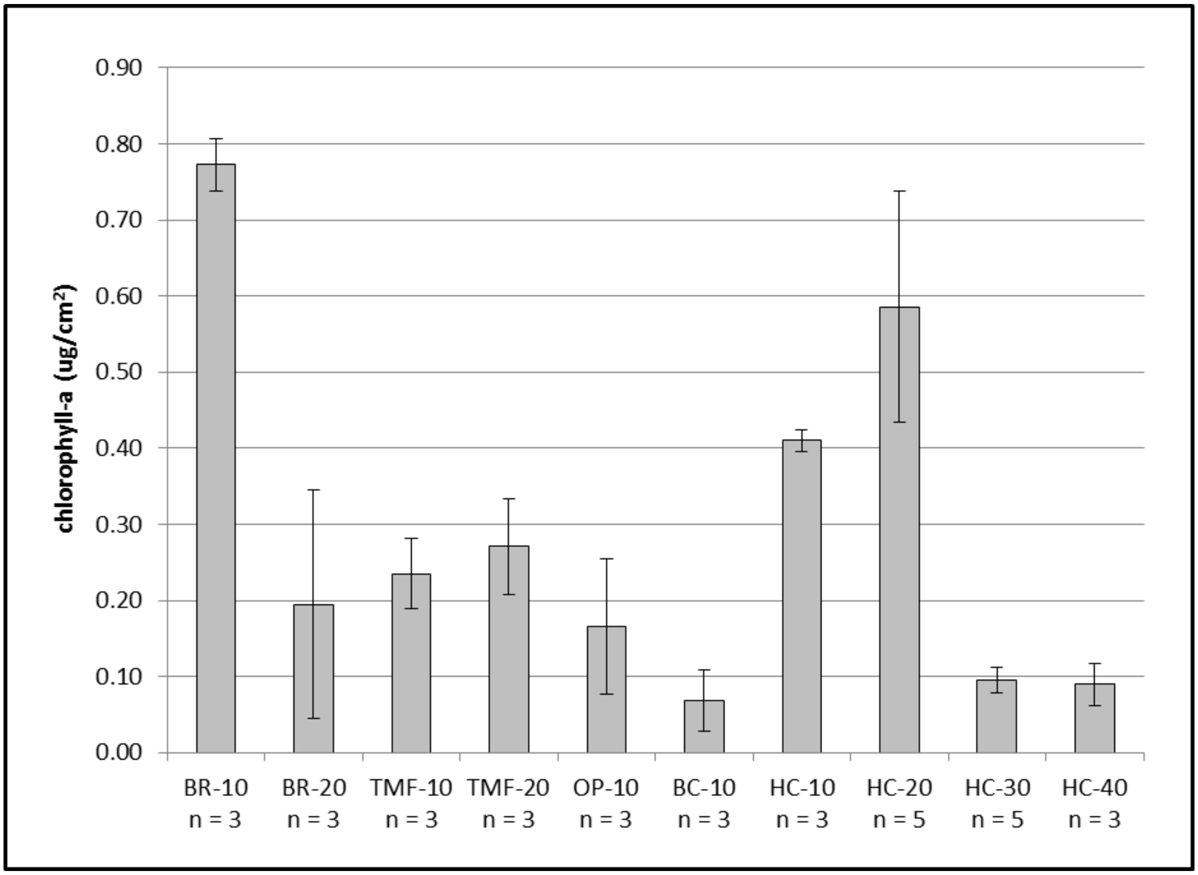


Figure 4.3.14 2012 Mean Periphyton Biomass (±S.E.)

4.3.2.3 2013 Results

Periphyton biomass was highest at site HC-20 (Harper Creek downstream of the confluence with T-Creek) and lowest at site TMF-10 (T-Creek) (Figure 4.3.15). Values ranged from 0.18 µg/cm^2 to 1.78 µg/cm^2.

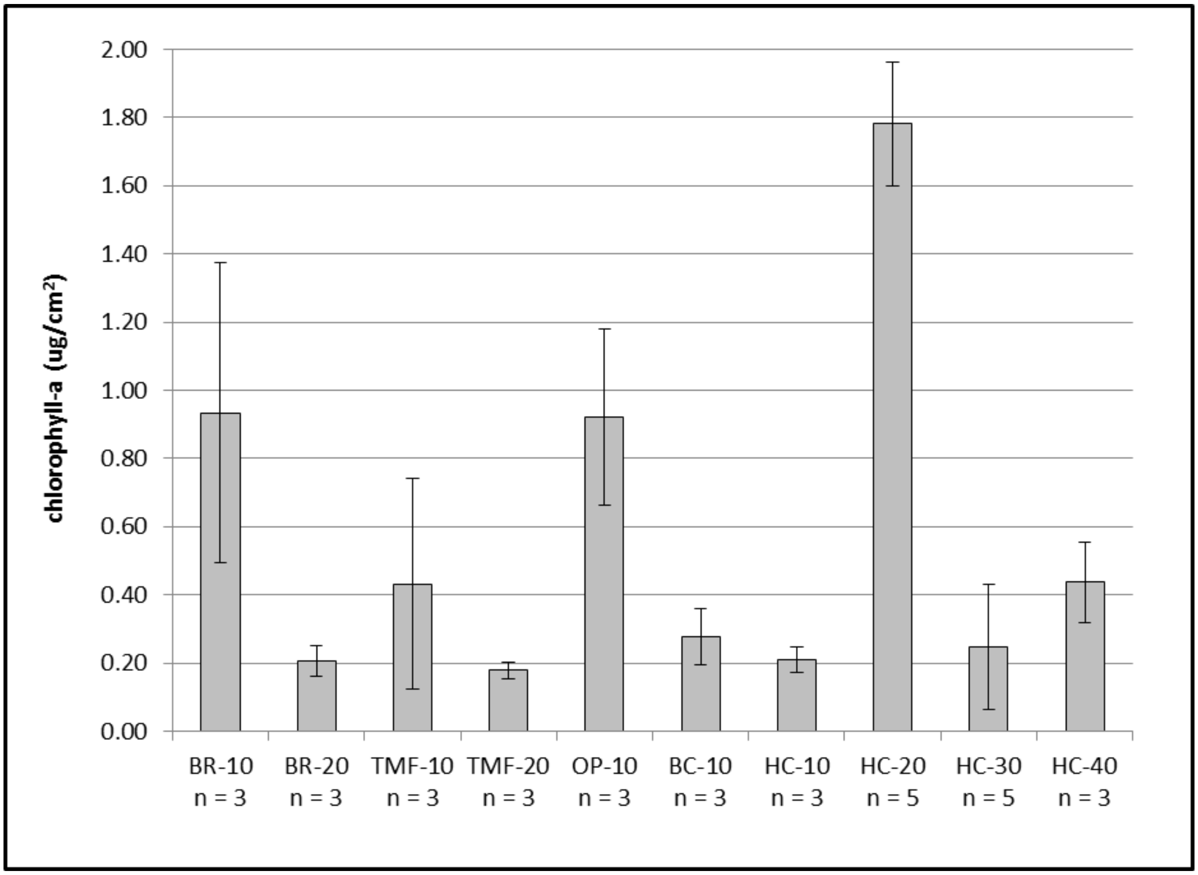


Figure 4.3.15 2013 Mean Periphyton Biomass (±S.E.)

4.3.2.4 Discussion

Periphyton biomass measured as chlorophyll-a directly relates to the productivity and trophic status of a body of water. Periphyton biomass is highly variable, both spatially and temporally, in the study area. There is no relationship between biomass at upstream and downstream sites within the same systems. The highest concentration at most sites was recorded in 2011, with the exception of sites OP-10 and HC-20, where values were highest in the 2013 samples (Table 4.3.3). Similarly, the lowest concentrations were observed in the 2012 samples at all sites except for sites TMF-20 and HC-10, which had the lowest sample concentrations in 2013. High chlorophyll-a concentrations are a primarily a result of high nutrient inputs. None of the samples exceeded the BC water quality guideline for aquatic life in streams (10 µg/cm^2) or the lower guideline for recreation, set at 5 µg/cm^2.

Table 4.3.3 2011 -2013 Chlorophyll-a Sample Results

Site ID	Sample Size (n)	Sampling Dates			2011 Chlorophyll-a (μg/cm^2)	2012 Chlorophyll-a (μg/cm^2)	2013 Chlorophyll-a (μg/cm^2)
		2011	2012	2013	Mean ± S.E.	Mean ± S.E.	Mean ± S.E.
TMF-10	3	20-Sep-11	26-Sep-12	24-SEP-13	0.77 ± 0.09	0.23 ± 0.03	0.43 ± 0.31
TMF-20	3	23-Sep-11	25-Sep-12	25-SEP-13	0.78 ± 0.05	0.27 ± 0.15	0.18 ± 0.02
OP-10	3	21-Sep-11	27-Sep-12	26-Sep-13	0.31 ± 0.04	0.17 ± 0.05	0.92 ± 0.26
HC-10	3	21-Sep-11	26-Sep-12	26-Sep-13	1.47 ± 0.36	0.41 ± 0.06	0.21 ± 0.04
HC-20	5	21-Sep-11	26-Sep-12	26-Sep-13	1.04 ± 0.19	0.59 ± 0.09	1.78 ± 0.18
HC-30	5	20-Sep-11	27-Sep-12	26-Sep-13	0.35 ± 0.03	0.10 ± 0.04	0.25 ± 0.18
HC-40	3	21-Sep-11	27-Sep-12	24-SEP-13	0.56 ± 0.21	0.09 ± 0.01	0.44 ± 0.12
BR-10	3	21-Sep-11	26-Sep-12	24-Sep-13	1.27 ± 0.29	0.77 ± 0.15	0.93 ± 0.44
BR-20	3	21-Sep-11	26-Sep-12	25-SEP-13	0.69 ± 0.16	0.20 ± 0.02	0.21 ± 0.04
BC-10	3	22-Sep-11	25-Sep-12	24-Sep-13	1.69 ± 0.19	0.07 ± 0.03	0.28 ± 0.08

4.4 BENTHIC INVERTEBRATES

Data analyses were completed for all sampling in 2011, 2012, and 2013. Results are presented by each summary statistic or community metric for each year and all sites. Where applicable, results for sites are divided into four groups based on watershed; Baker Creek (one site), Barriere River (two sites), Harper Creek mainstem (four sites), and the tributaries to Harper Creek (P-Creek and T-Creek; three sites).

4.4.1 2011 Results

The benthic invertebrate descriptive statistics and community metrics for 2011 calculated for each site are summarized in Table 4.4.1. Means, standard deviations, standard errors, and maximum/minimum values for each descriptive statistic and community metric for the entire area in 2011 are presented in Table 4.4.2.

4.4.1.1 Taxonomic Summary Statistics

Raw data showing abundances at each site replicate for each family sampled in 2011 are presented in Appendix G. Appendix G also presents the calculated total mean densities and proportional abundances for each family in the study area in 2011. The families with the highest densities were Heptageniidae (1984 organisms/m^3; Ephemeroptera), Chloroperlidae (1791 organisms/m^3) and Nemouridae (1172 organisms/m^3; Plecoptera), and Chironomidae (977 organisms/m^3; Diptera).

A presence/absence matrix for all families in the study area in 2011 is presented in Appendix G. A total of 12 families were sampled in 30 or more of the 34 site replicates. The families with the highest presence count across all sites were Heptageniidae (Ephemeroptera; all 34 sites) Chloroperlidae (Plecoptera; 33 sites), Unidentified Trichoptera (33 sites), and Chironomidae (Diptera; 33 sites).

Table 4.4.1 2011 Benthic Invertebrate Summary Statistics and Community Indices

Site	Density (org/m^3)	Family Richness	EPT Index	Simpson's Diversity	Simpson's Evenness	Shannon-Wiener Diversity	Shannon-Wiener Evenness	Hilsenhoff FBI	Taxonomic Composition
BC-10	6,590	24	14	0.875	0.363	2.527	0.801	0.80	Ephemeroptera (40%); Plecoptera (33%); Diptera (7%); Trichoptera (6%)
BR-10	5,514	18	8	0.786	0.261	2.078	0.718	0.72	Coleoptera (34%); Plecoptera (20%); Ephemeroptera (17%); Diptera (12%)
BR-20	15,512	27	16	0.878	0.323	2.534	0.773	0.77	Ephemeroptera (39%); Plecoptera (33%); Trichoptera (13%); Coleoptera (7%)
HC-10	13,371	30	18	0.910	0.396	2.775	0.822	0.82	Ephemeroptera (35%); Plecoptera (26%); Diptera (12%); Tricoptera (10%)
HC-20	23,996	32	19	0.904	0.344	2.715	0.782	0.78	Plecoptera (38%); Ephemeroptera (24%); Diptera (19%); Trichoptera (15%)
HC-30	15,062	27	17	0.886	0.334	2.560	0.773	0.77	Plecoptera (41%); Ephemeroptera (25%); Tricoptera (18%); Diptera (13%)
HC-40	15,165	27	17	0.896	0.358	2.612	0.794	0.79	Plecoptera (50%); Ephemeroptera (22%); Trichoptera (12%); Diptera (6%);
OP-10	7,810	21	15	0.844	0.316	2.276	0.749	0.75	Plecoptera (46%); Ephemeroptera (25%); Trichoptera (21%); Diptera (5%)
TMF-10	17,043	34	20	0.930	0.428	2.977	0.845	0.84	Plecoptera (42%); Ephemeroptera (20%); Trichoptera (19%); Diptera (8%)
TMF-20	10,907	27	16	0.910	0.422	2.668	0.815	0.81	Plecoptera (39%); Ephemeroptera (17%); Coleoptera (14%); Ostracoda (11%)

Table 4.4.2 2011 Benthic Invertebrate Summary Statistics and Community Indices

Index	Mean	S.D.	S.E.	Max	Min
Density (org/m^3)	13,853.8	7,278.5	1,248.3	31,000.1	3,265.1
Family Richness	27	5	1	37	16
EPT Index	16	3	1	21	6
Simpson's Diversity	0.353	0.078	0.013	0.500	0.203
Simpson's Evenness	0.883	0.044	0.008	0.942	0.766
Shannon-Wiener Diversity	2.580	0.264	0.045	3.097	2.017
Shannon-Wiener Evenness	0.786	0.049	0.008	0.877	0.674
Hilsenhoff FBI	2.326	0.463	0.079	3.626	1.333

4.4.1.2 Site Summary Statistics

In Baker Creek, Ephemeroptera were the most abundant order present at site BC-10, followed by Plecoptera and, to a much smaller degree, Diptera and Trichoptera (Table 4.4.1). Within the Barriere River, there were quite different taxonomic compositions upstream and downstream. The Coleoptera, Plecoptera, and Ephemeroptera, and Diptera were the four most abundant orders downstream at site BR-10, while Ephemeroptera, Plecoptera, and Trichoptera dominated upstream at BR-20, with almost no Coleoptera or Diptera. In Harper Creek, Ephemeroptera and Plecoptera were the two most abundant orders at all four sites, followed by Trichoptera and Diptera. Moving downstream in Harper Creek, the Ephemeroptera consistently increased from HC-40 to HC-10, while Plecoptera decreased over the same sites. At the most downstream site only (HC-10), there was also a higher percentage of Coleoptera. Within the two Harper Creek tributaries (T-Creek and P-Creek), the most abundant order at all three sites was Plecoptera, followed by Ephemeroptera. Trichoptera and Diptera were the third and fourth most abundant orders at the downstream sites, TMF-10 and OP-10, while upstream at TMF-20 was quite different with Coleoptera and Ostracoda as the third and fourth most abundant orders.

For mean density, the Baker Creek site (BC-10) and the downstream Barriere River (BR-10) site had the lowest densities Table 4.4.1, Figure 4.4.1). The upstream Barriere River site (BR-20) had substantially higher densities that more resembled average densities for the study area (Table 4.4.2). Within the Harper Creek mainstem, HC-20 displayed the highest density of all sites in 2011, while all other sites in the Harper Creek mainstem displayed roughly average density (HC-10, HC-30, and HC-40). Within the Harper Creek tributaries, OP-10 in P-Creek showed one of the lowest densities in 2011, while the sites in T-Creek (TMF-10 and TMF-20) showed densities similar to the study area average. In general, sites downstream (ending in “-10”) had lower mean densities than those upstream, with the exception of TMF-10.

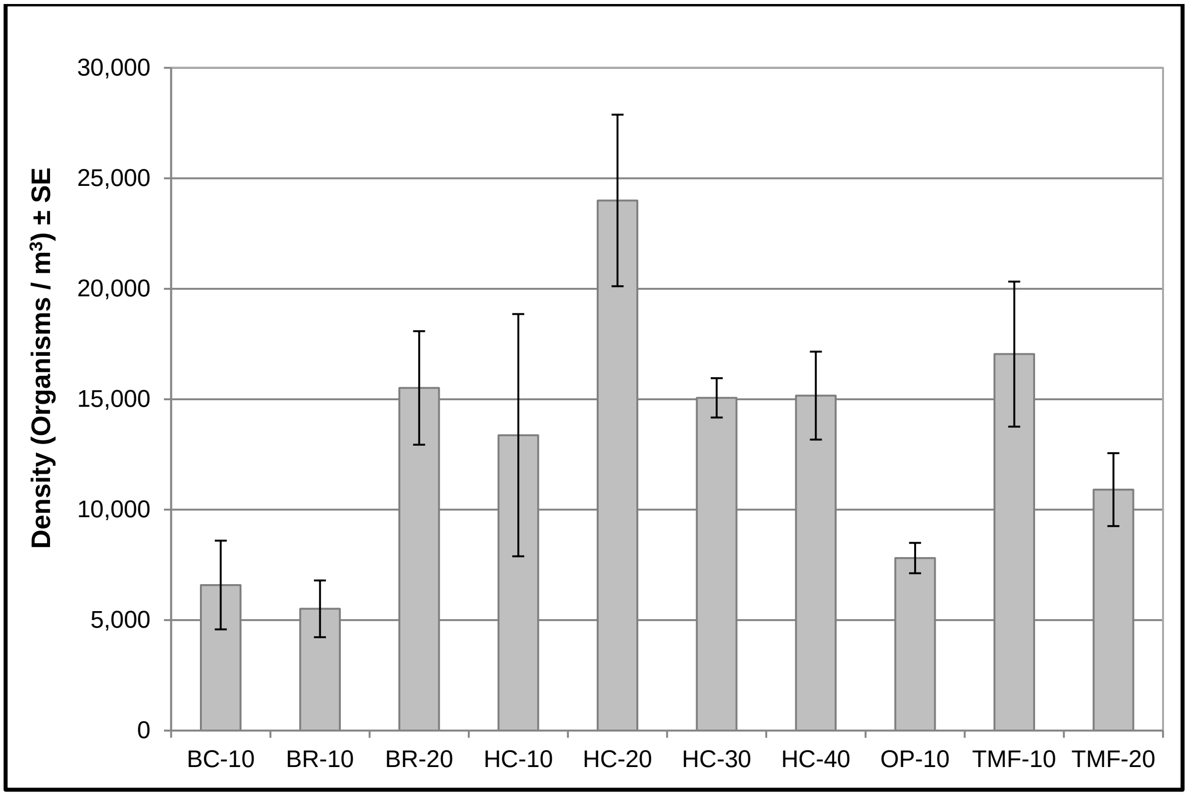


Figure 4.4.1 2011 Mean Benthic Invertebrate Densities (±S.E.)

The mean family richness in the Baker Creek site was average for the study area while, similar to mean density, the Barriere River downstream site (BR-10) had the lowest species richness and BR-20 displayed average richness for the study area (Table 4.4.1; Figure 4.4.2). The Harper Creek mainstem displayed some of the highest richness values downstream (HC-10 and HC-20), while upstream (HC-30 and HC-40) values were average. In the Harper Creek tributaries, OP-10 in P-Creek displayed one of the lowest family richness values, while downstream in T-Creek (TMF-10) the highest richness of 34 families was seen. Overall, the family richness was highest in the Harper Creek mainstem and T-Creek, but lowest downstream in Barriere River and in P-Creek.

The mean EPT Index for all sites was 8 or greater (Table 4.4.1; Figure 4.4.2), indicating good water quality for the entire study area (Table 3.4.1). Downstream in Barriere River (BR-10) the EPT Index of 8 was substantially lower than the other sites. Most other sites displayed an average value between 16 to 18. The highest EPT Index values were seen downstream in T-Creek (TMF-10) and downstream in Harper Creek (HC-10 and HC-20), which potentially indicates very clean water at those sites.

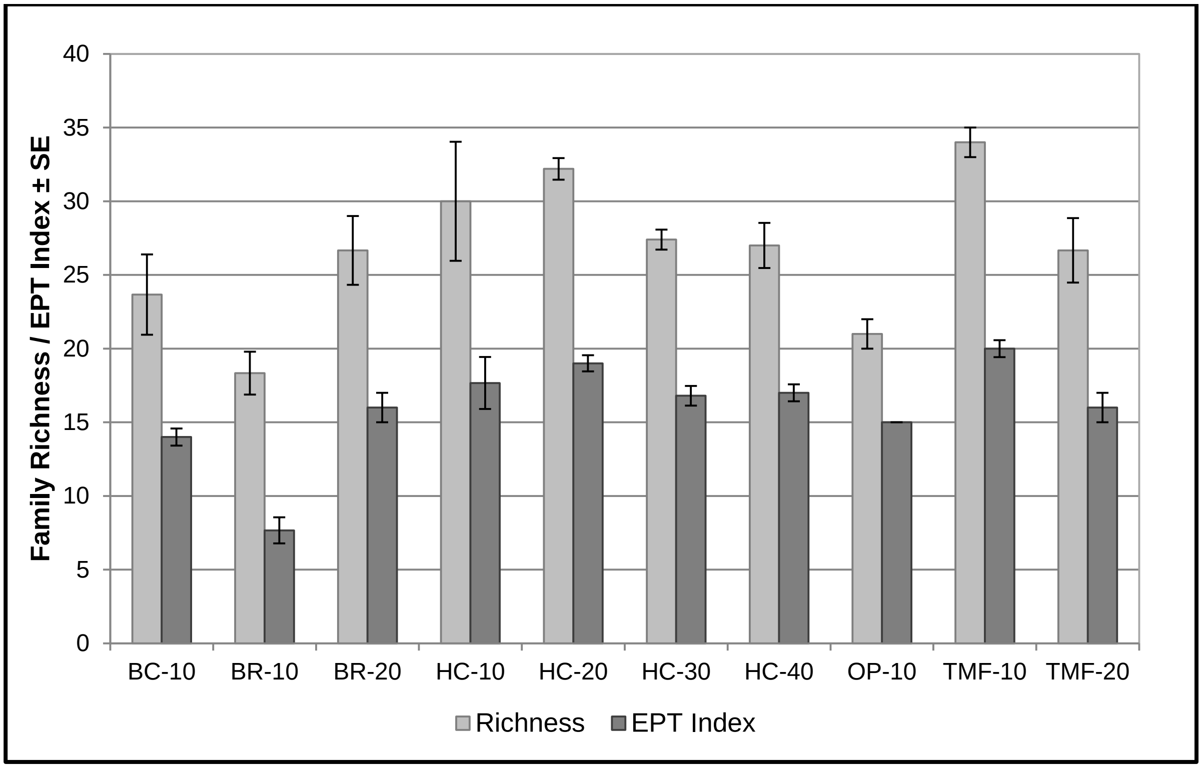


Figure 4.4.2 2011 Benthic Invertebrates Richness and EPT Index (±S.E.)

4.4.1.3 Community Metrics

Both the Simpson's and Shannon-Wiener Diversity and Evenness Indices were calculated for the study area. While the EC (2012) documentation requires only the Simpson's Index be calculated, diversity indices have strengths and weaknesses, so it is optimal to calculate more than one index for comparison.

Evenness indices portray the equitability with which individuals are distributed among the different families sampled. The Simpson's and Shannon-Wiener Evenness Indices both range from 0 - 1, with 1 indicating perfectly even dispersion. The sites with the highest evenness in 2011 were the T-Creek sites (TMF-10 and TMF-20) and the most downstream site on Harper Creek (HC-10; Table 4.4.1; Figure 4.4.3). The sites with the lowest evenness indices were found on P-Creek (OP-10) and downstream on Barriere River (BR-10) in 2011. The Shannon-Wiener Evenness Index values were considerably higher than those calculated with the Simpson's Evenness Index; using the Shannon-Wiener Evenness Index, with average values of 0.79 (Table 4.4.2), the study area would be considered to have quite high evenness.

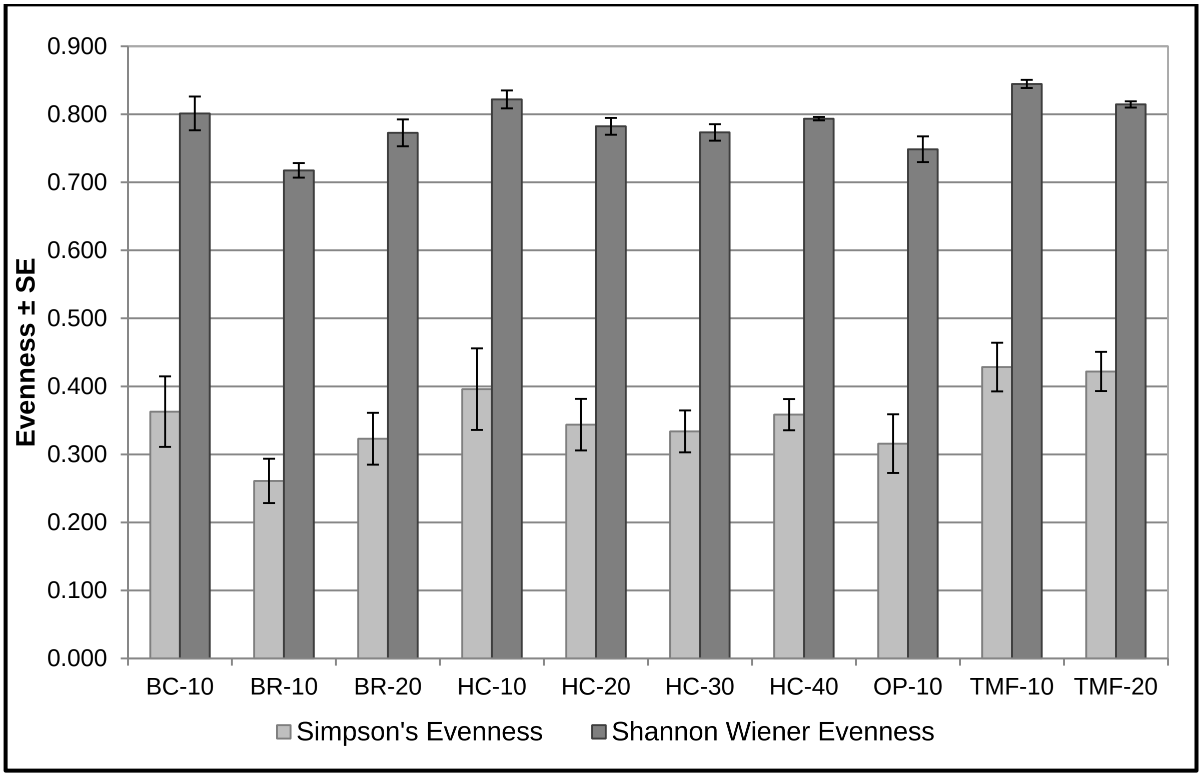


Figure 4.4.3 2011 Benthic Invertebrate Evenness Indices (±S.E.)

The diversity indices calculated in this study range from 0 upwards, with larger numbers indicating higher overall diversity. While the absolute values differ between the Simpson's and Shannon-Wiener Indices, general trends between sites were apparent in 2011. Diversity was highest in T-Creek (TMF-10 and TMF-20) and downstream in Harper Creek (HC-10 and HC-20; Table 4.4.1 and Figure 4.4.4). Values were lowest for P-Creek (OP-10) and downstream in Barriere River (BR-10). Although sites showed variable diversity index values, overall the range in diversity index values was low. The range of the Simpson's Diversity Index values varied between a mean minimum of 0.77 to a mean maximum of 0.94, while the Shannon-Wiener Diversity Index values varied between only 2.0 to 3.1 (Table 4.4.2). The Shannon-Wiener Diversity Index values also were consistently higher than the Simpson's Diversity Index values.

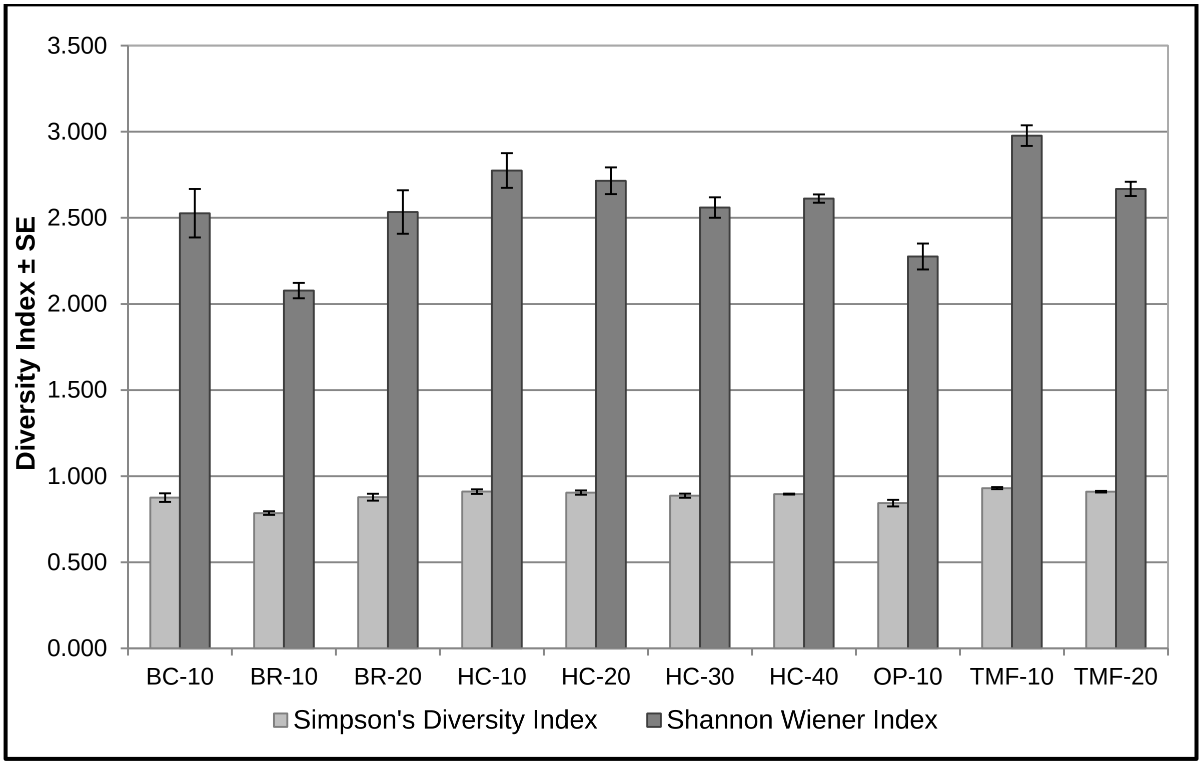


Figure 4.4.4 2011 Benthic Invertebrate Diversity Indices (±S.E.)

4.4.1.4 Biotic Index

Hilsenhoff Family Biotic Index (FBI) values from 0 – 3.75 are considered to have excellent water quality with organic pollution being unlikely; higher values indicate worsening water quality (Table 3.4.2). In 2011, all sites had excellent water quality with mean FBI values less than 3.75 (Table 4.4.1) and a mean FBI for the study area of 2.3 (Table 4.4.2). The sites with the lowest (better) FBI values in 2011 were upstream in Harper Creek (HC-30 and HC-40), while the highest (worst) value in the study area was downstream in Barriere River (BR-10); although it was still well within the excellent category.

4.4.1.5 2011 Results Summary

In 2011, most summary statistic values for abundance and richness and community metrics were lowest within the lower Barriere River (BR-10) and P-Creek (OP-10), but were highest at lower T-Creek (TMF-10) and lower Harper Creek (HC-10 and HC-20). All other sites displayed values for all statistics and indices that are similar to the study area average.

Mean invertebrate density ranged from 5,514 to 23,996, was lowest within the lower Barriere River (BR-10), and was highest at mid-Harper Creek (HC-20).

Taxonomic richness ranged from 18 to 34, was lowest within the lower Barriere River (BR-10), and was highest within lower T-Creek (TMF-10).

The EPT Index ranged from 8 to 20, which indicated Good water quality (Munro and Taccogna 1995). The lowest EPT Index value was in lower Barriere River (BR-10) and the highest value was in lower T-Creek (TMF-10).

Simpson's and Shannon-Wiener Diversity and Evenness Indices indicated that diversity and evenness were lower in lower Barriere River (BR-10) and P-Creek (OP-10), but were consistently higher in T-Creek (TMF-10 and TMF-20) and lower Harper Creek (HC-10 and HC-20).

The family level biotic index ranged from 1.74 to 3.07, which indicates that water quality within all baseline study area creeks and rivers in 2011 was excellent.

4.4.2 2012 Results

The benthic invertebrate descriptive statistics and community metrics for 2012 calculated for each site are summarized in Table 4.4.3. Means, standard deviations, standard errors, and maximum/minimum values for each descriptive statistic and community metric for the entire area in 2012 are presented in Table 4,4,4.

Table 4.4.3 2012 Benthic Invertebrate Summary Statistics and Community Indices By Site

Site	Density (org/m3)	Family Richness	EPT Index	Simpson's Diversity	Simpson's Evenness	Shannon-Wiener Diversity	Shannon-Wiener Evenness	Hilsenhoff FBI	Taxonomic Composition
BC-10	6,662	27	16	0.917	0.467	2.778	0.849	2.91	Plecoptera (46%); Ephemeroptera (24%); Diptera (13%); Trichoptera (10%)
BR-10	12,785	27	13	0.876	0.310	2.470	0.750	3.12	Ephemeroptera (29%); Trichoptera(20%) ; Coleoptera (18%); Diptera (14%)
BR-20	13,311	24	17	0.865	0.337	2.457	0.775	2.34	Ephemeroptera (46%); Plecoptera (33%); Trichoptera (14%); Diptera (4%)
HC-10	10,812	30	18	0.891	0.306	2.638	0.776	3.08	Ephemeroptera (43%); Diptera (19%); Plecoptera (13%); Coleoptera (13%)
HC-20	22,927	30	18	0.893	0.315	2.590	0.762	2.21	Plecoptera (43%); Ephemeroptera (28%); Trichoptera (15%); Diptera (11%)
HC-30	20,200	26	18	0.881	0.326	2.492	0.765	1.93	Plecoptera (43%); Ephemeroptera (33%); Tricoptera (19%); Diptera (4%)
HC-40	12,211	26	16	0.897	0.378	2.619	0.805	2.19	Plecoptera (44%); Ephemeroptera (27%); Trichoptera (11%); Diptera (7%)
OP-10	11,326	25	15	0.867	0.322	2.440	0.763	2.47	Ephemeroptera (52%); Plecoptera (27%); Trichoptera (12%); Diptera (6%)
TMF-10	8,025	28	18	0.905	0.388	2.707	0.817	1.75	Plecoptera (41%); Ephemeroptera (25%); Trichoptera (25%); Diptera (5%)
TMF-20	7,559	25	14	0.861	0.352	2.429	0.758	1.96	Plecoptera (36%); Ephemeroptera (17%); Ostracoda (21%); Coleoptera (11%)

Table 4.4.4 2012 Benthic Invertebrate Summary Statistics and Community Indices

Index	Mean	S.D.	S.E.	Max	Min
Density (org/m^3)	13,638.5	7,082.8	1,214.7	36,417.9	3,659.7
Family Richness	27	4	1	35	18
EPT Index	16	2	0	20	10
Simpson's Diversity	0.886	0.033	0.006	0.928	0.757
Simpson's Evenness	0.346	0.074	0.013	0.567	0.216
Shannon-Wiener Diversity	2.560	0.185	0.032	2.899	1.877
Shannon-Wiener Evenness	0.780	0.046	0.008	0.881	0.649
Hilsenhoff FBI	2.359	0.524	0.090	3.404	1.337

4.4.2.1 Taxonomic Summary Statistics

Raw data showing abundances at each site replicate for each family sampled in 2012 are presented in Appendix G3. Appendix G3 also presents the calculated total mean densities and proportional abundances for each family in the study area in 2012. The families with the highest densities were Ephemerellidae (1040 organisms/m^3) and Heptageniidae (2514 organisms/m^3; Ephemeroptera), Chloroperlidae (1187 organisms/m^3) and Nemouridae (1344 organisms/m^3; Plecoptera)

A presence/absence matrix for all families in the study area in 2011 is presented in Appendix G4. Nine families were sampled in 30 or more of the 34 site replicates. The families with the highest presence count across all sites were Heptageniidae (Ephemeroptera; all 34 sites), Chloroperlidae (Plecoptera; all 34 sites), and Unidentified Plecoptera (all 34 sites).

4.4.2.2 Site Summary Statistics

In Baker Creek, Plecoptera were the most abundant order present at site BC-10, followed by Ephemeroptera and, to a much smaller degree, Diptera and Trichoptera (Table 4.4.3). Within the Barriere River, there were quite different taxonomic compositions upstream and downstream. The Ephemeroptera, Trichoptera, Coleoptera, Plecoptera, and Diptera were the most abundant orders downstream at site BR-10, while Ephemeroptera, Plecoptera, and Trichoptera dominated upstream at BR-20, with almost no Coleoptera or Diptera. In Harper Creek, Ephemeroptera and Plecoptera were typically the most abundant orders at all four sites, followed by Trichoptera and Diptera. Moving downstream in Harper Creek, the Ephemeroptera increased from HC-40 to HC-10, while Plecoptera decreased over the same sites. At the most downstream site only (HC-10), there was also a higher percentage of Coleoptera. Within the two Harper Creek tributaries (T-Creek and P-Creek), the most abundant order at all three sites was Plecoptera, followed by Ephemeroptera. Trichoptera and Diptera were the third and fourth most abundant orders at the downstream sites, TMF-10 and OP-10, while upstream at TMF-20 was quite different with Coleoptera and Ostracoda as the third and fourth most abundant orders.

For mean density, the Baker Creek site (BC-10) had the lowest densities (Table 4.4.3 and Figure 4.4.5). The Barriere River sites (BR-10 and BR-20) had densities that more resembled average densities for the study area (Figure 4.4.8). Within the Harper Creek mainstem, HC-20 and HC-30 displayed the highest densities of all sites in 2012, while the most upstream (HC-10) and downstream (HC-40) sites in the Harper Creek mainstem displayed roughly average densities. Within the Harper Creek tributaries, OP-10 in P-Creek showed average densities in 2012, while the sites in T-Creek (TMF-10 and TMF-20) showed some of the lowest densities in the study area. In general for 2012, mid-stream on Harper Creek had the highest mean densities, while T-Creek and Baker Creek showed the lowest densities.

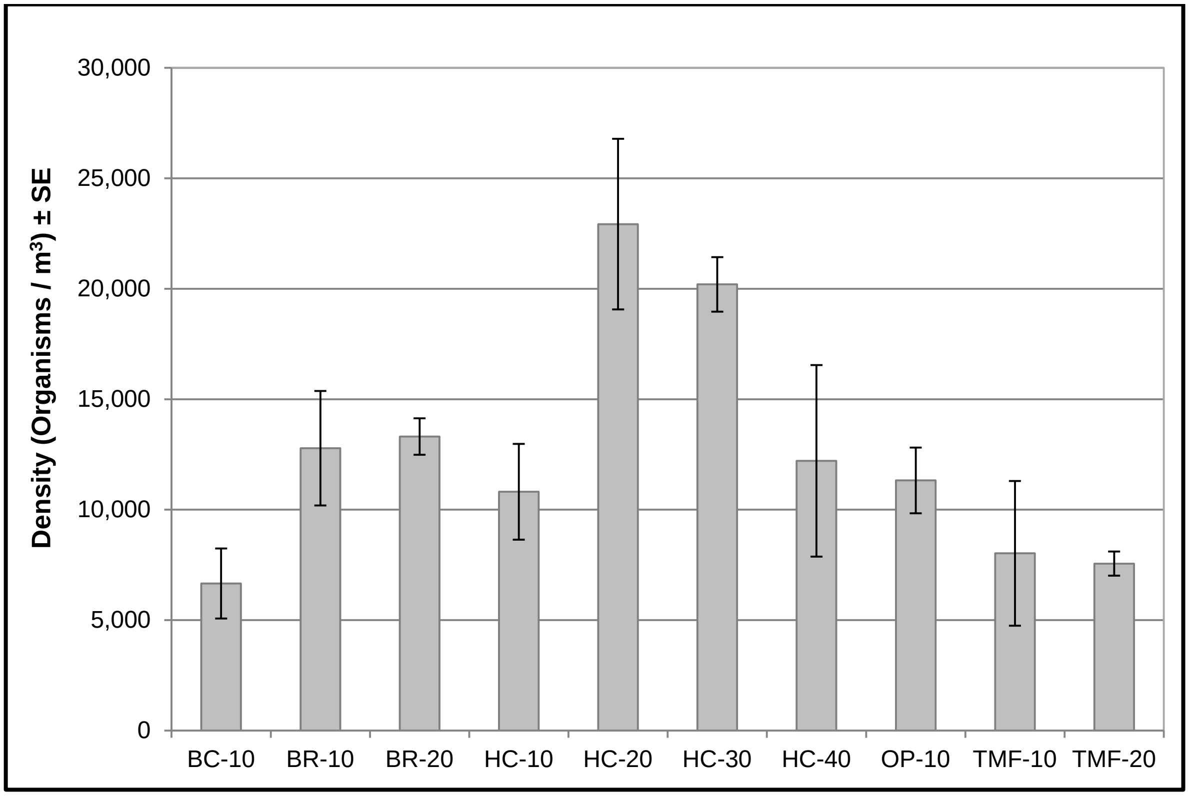


Figure 4.4.5 2012 Benthic Invertebrate Mean Densities (±S.E.)

The mean family richness in the Baker Creek site (BC-10) and the Barriere River downstream site (BR-10) were average for the study area while the Barriere River upstream site (BR-20) had the lowest species richness for the study area (Table 4.4.3 and Figure 4.4.6). The Harper Creek mainstem displayed the highest richness values for 2012 downstream (HC-10 and HC-20), while upstream (HC-30 and HC-40) values were average. In the Harper Creek tributaries, OP-10 in P-Creek and TMF-20 in T-Creek displayed two of the lowest family richness values, while downstream in T-Creek (TMF-10) showed average family richness for the study area. Overall, the family richness was highest downstream in the Harper Creek mainstem, but lowest in Baker Creek and T-Creek.

The mean EPT Index for all sites in 2012 was 13 or greater (Table 4.4.1; Figure 4.4.6), indicating good water quality for the entire study area (Table 3.4.1). Downstream in Barriere River (BR-10) the EPT Index of 13 was slightly lower than the other sites. Most other sites displayed an average index value between 15-17. The highest EPT Index values (18) were seen in Harper Creek (all sites except upstream at HC-40) and downstream in T-Creek (TMF-10), which potentially indicates very clean water at those sites.

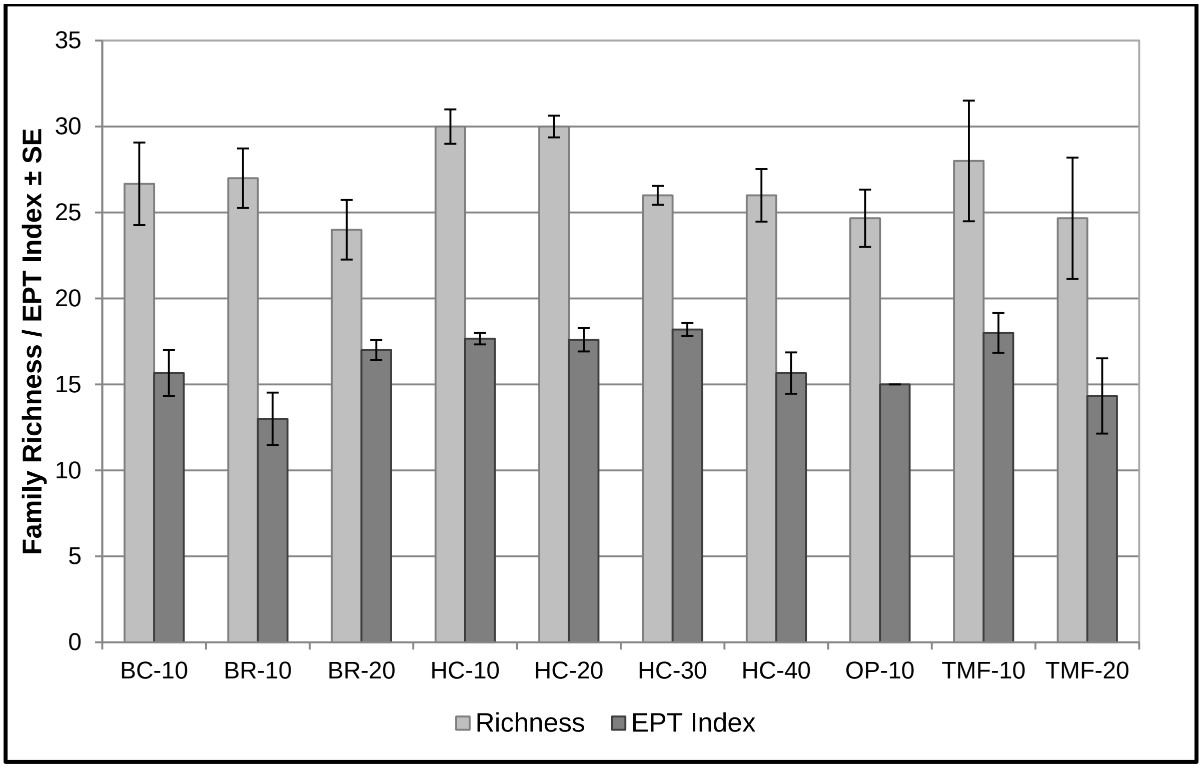


Figure 4.4.6 2012 Benthic Invertebrate Richness and EPT Index (±S.E.)

4.4.2.3 Community Metrics

Evenness indices portray the equitibility with which individuals are distributed among the different families sampled. The Simpson's and Shannon-Wiener Evenness Indices both range from 0 - 1, with 1 indicating perfectly even dispersion. The sites with the highest evenness in 2012 were Baker Creek (BC-10) and downstream in T-Creek (TMF-10; Table 4.4.1; Figure 4.4.7). The sites with the lowest evenness indices were found downstream on Barriere River (BR-10), downstream on Harper Creek (HC-10) according to Simpson's Evenness, and upstream in T-Creek (TMF-20) according to Shannon-Wiener Evenness. The Shannon-Wiener Evenness Index values were considerably higher than those calculated with the Simpson's Evenness Index; using the Shannon-Wiener Evenness Index, with average values of 0.78 (Table 4.4.4), the study area would be considered to have quite high evenness.

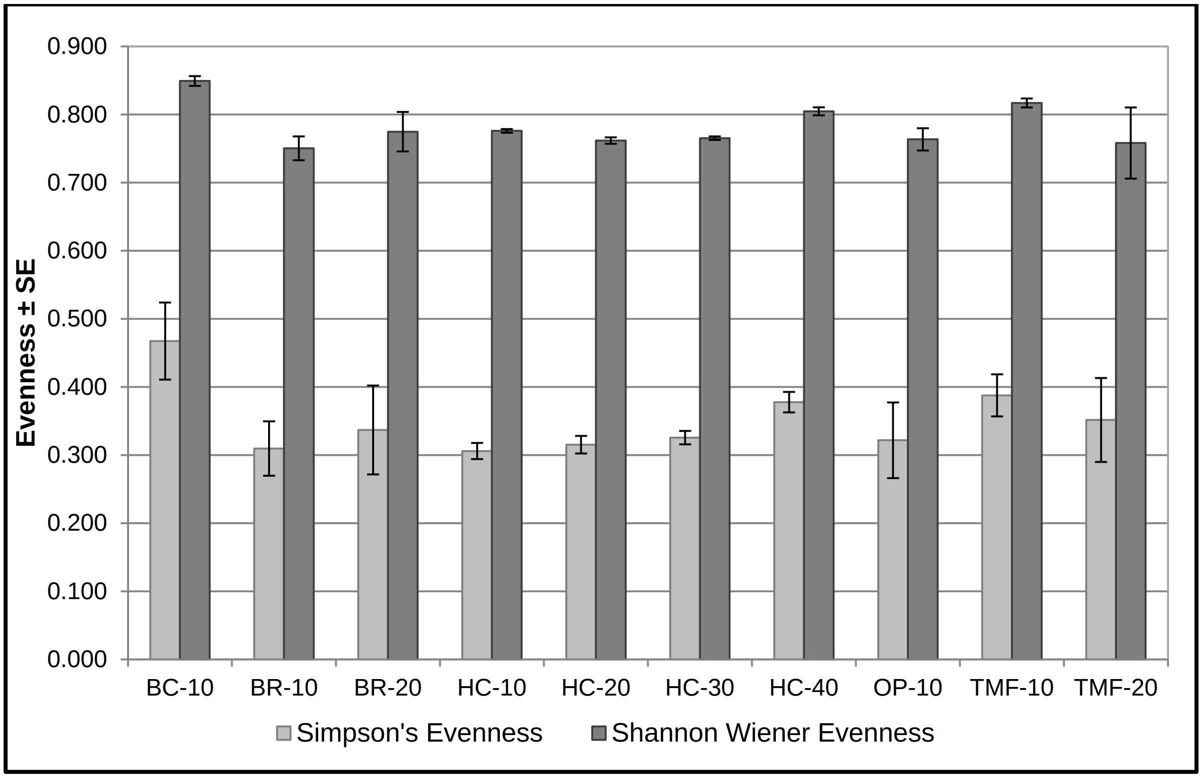


Figure 4.4.7 2012 Benthic Invertebrate Evenness Indices (±S.E.)

The diversity indices calculated in this study range from 0 upwards, with larger numbers indicating higher overall diversity. While the absolute values differ between the Simpson's and Shannon-Wiener Indices, general trends between sites were apparent in 2012. Diversity was highest in downstream T-Creek (TMF-10) and Baker Creek (BC-10; Table 4.4.1; Figure 4.4.8). Values were lowest for P-Creek (OP-10), downstream in Barriere River (BR-10), and downstream in T-Creek (TMF-20). Although sites showed variable diversity index values, overall the range in diversity index values was low. The range of the Simpson's Diversity Index values varied between a mean minimum of 0.76 to a mean maximum of 0.93, similar to 2011, while the Shannon-Wiener Diversity Index values varied between only 1.9 to 2.9 (Table 4.4.4, Table 4.4.2). The Shannon-Wiener Diversity Index values also were consistently higher than the Simpson's Diversity Index values.

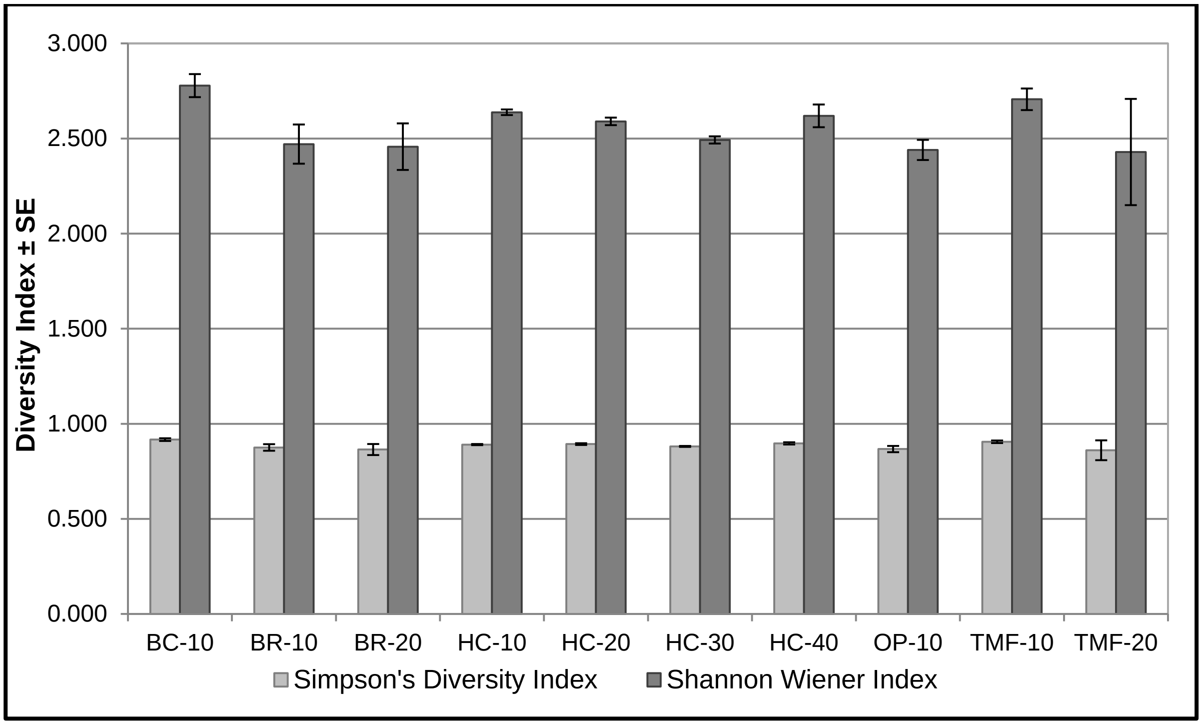


Figure 4.4.8 2012 Benthic Invertebrate Diversity Indices (±S.E.)

4.4.2.4 Biotic Index

Hilsenhoff Family Biotic Index (FBI) values from 0 – 3.75 are considered to have excellent water quality with organic pollution being unlikely; higher values indicate worsening water quality (Table 3.4.2). In 2012, all sites had excellent water quality with mean FBI values less than 3.75 (Table 4.4.1) and a mean FBI for the study area of 2.4 (Table 4.4.4). The sites with the lowest (better) FBI values in 2012 were in mid-Harper Creek (HC-30) and T-Creek (TMF-20), while the highest (worse) values in the study area were downstream in Barriere River (BR-10) and Harper Creek (HC-10); although they were still within the excellent category.

4.4.2.5 2012 Results Summary

In 2012, most summary statistic values for abundance and richness and community metrics were lowest within the Barriere River (BR-10 and BR-20) and upper T-Creek (TMF-20), but were highest at lower T-Creek (TMF-10) and lower Harper Creek (HC-10, HC-20, and HC-30). All other sites displayed values for all statistics and indices that are similar to the study area average.

Mean invertebrate density ranged from 6,662 to 22,927, was lowest within Baker Creek (BC-10), and was highest at mid-Harper Creek (HC-20).

Taxonomic richness ranged from 24 to 30, was lowest within the upper Barriere River (BR-20), and was highest within lower Harper Creek (HC-10 and HC-20).

The EPT Index ranged from 13 to 18, which indicated Good water quality (Munro and Taccogna 1995). The lowest EPT Index value was in lower Barriere River (BR-10) and the highest values were in lower T-Creek (TMF-10) and lower Harper Creek (HC-10, HC-20, and HC-30).

Simpson's and Shannon-Wiener Diversity and Evenness Indices indicated that diversity and evenness were generally lower in Barriere River (BR-10 and BR-20), P-Creek (OP-10), and upper T-Creek (TMF-20) but were consistently higher in lower T-Creek (TMF-10) and Baker Creek (BC-10).

The family level biotic index ranged from 1.75 to 3.08, which indicates that water quality within all baseline study area creeks and rivers in 2012 was excellent.

4.4.3 2013 Results

The benthic invertebrate descriptive statistics and community metrics for 2013 calculated for each site are summarized Table 4.4.5. Means, standard deviations, standard errors, and maximum/minimum values for each descriptive statistic and community metric for the entire area in 2013 are presented in Table 4.4.6).

Table 4.4.5 2013 Benthic Invertebrate Summary Statistics and Community Indices By Site

Site	Density (org/m3)	Family Richness	EPT Index	Simpson's Diversity	Simpson's Evenness	Shannon-Wiener Diversity	Shannon-Wiener Evenness	Hilsenhoff FBI	Taxonomic Composition
BC-10	10,764	24	14	0.862	0.319	2.424	0.767	2.68	Ephemeroptera (40%); Plecoptera (33%); Diptera (7%); Trichoptera (6%)
BR-10	10,872	26	14	0.889	0.374	2.527	0.783	3.17	Coleoptera (34%); Plecoptera (20%); Ephemeroptera (17%); Diptera (12%)
BR-20	10,776	28	18	0.918	0.433	2.817	0.843	2.24	Ephemeroptera (39%); Plecoptera (33%); Trichoptera (13%); Coleoptera (7%)
HC-10	8,444	26	16	0.909	0.430	2.704	0.832	2.60	Ephemeroptera (35%); Plecoptera (26%); Diptera (12%); Trichoptera (10%)
HC-20	22,324	28	18	0.880	0.308	2.513	0.753	2.75	Plecoptera (28%); Ephemeroptera (24%); Diptera (19%); Trichoptera (15%)
HC-30	14,359	26	17	0.895	0.373	2.557	0.784	2.24	Plecoptera (41%); Ephemeroptera (25%); Tricoptera (18%); Diptera (13%)
HC-40	9,460	26	18	0.888	0.343	2.611	0.799	2.16	Plecoptera (50%); Ephemeroptera (22%); Trichoptera (12%); Diptera (6%)
OP-10	8,922	23	16	0.861	0.327	2.418	0.772	2.57	Plecoptera (46%); Ephemeroptera (25%); Trichoptera (21%); Diptera (5%)
TMF-10	9,197	29	18	0.896	0.357	2.699	0.805	1.74	Plecoptera (42%); Ephemeroptera (20%); Trichoptera (19%); Diptera (8%)
TMF-20	12,594	25	15	0.880	0.348	2.429	0.760	2.21	Plecoptera (39%); Ephemeroptera (17%); Coleoptera (14%); Diptera (7%)

Table 4.4.6 2013 Benthic Invertebrate Summary Statistics and Community Indices for the Study Area

Index	Mean	S.D.	S.E.	Max	Min
Density (org/m^3)	12,544.2	6,390.5	1,096.0	34,623.9	3,839.1
Family Richness	26	4	1	32	19
EPT Index	16	2	0	21	11
Simpson's Diversity	0.888	0.026	0.004	0.930	0.814
Simpson's Evenness	0.359	0.077	0.013	0.528	0.218
Shannon-Wiener Diversity	2.566	0.184	0.031	2.971	2.188
Shannon-Wiener Evenness	0.787	0.047	0.008	0.870	0.703
Hilsenhoff FBI	2.443	0.452	0.078	3.361	1.407

4.4.3.1 Taxonomic Summary Statistics

Raw data showing abundances at each site replicate for each family sampled in 2013 are presented in Appendix G. Appendix G also presents the calculated total mean densities and proportional abundances for each family in the study area in 2013. The families with the highest densities were Baetidae (1180 organisms/m^3) and Heptageniidae (1822 organisms/m^3; Ephemeroptera), Chloroperlidae (1032 organisms/m^3) and Taeniopterygidae (1551 organisms/m^3; Plecoptera).

A presence/absence matrix for all families in the study area in 2012 is presented in Appendix G. Nine families were sampled in 30 or more of the 34 site replicates. The families with the highest presence count across all sites were Baetidae, Ephemerellidae, and Heptageniidae (Ephemeroptera; all 34 sites) Chloroperlidae (Plecoptera; all 34 sites), and Chironomidae (Diptera; all 34 sites).

4.4.3.2 Site Summary Statistics

In Baker Creek, Ephemeroptera were the most abundant order present at site BC-10, followed by Plecoptera and, to a much smaller degree, Diptera and Trichoptera (Table 4.4.5). Within the Barriere River, there were quite different taxonomic compositions upstream and downstream. Downstream at site BR-10, the Coleoptera, Plecoptera, Ephemeroptera, and Diptera were the most abundant orders, while Ephemeroptera, Plecoptera, and Trichoptera dominated upstream at BR-20, with very little Coleoptera or Diptera. In Harper Creek, Ephemeroptera and Plecoptera were typically the most abundant orders at all four sites, followed by Trichoptera and Diptera. Moving downstream in Harper Creek, the Ephemeroptera increased from HC-40 to HC-10, while Plecoptera decreased over the same sites. At the most downstream site only (HC-10), there was also a higher percentage of Coleoptera. Within the two Harper Creek tributaries (T-Creek and P-Creek), the most abundant order at all three sites was Plecoptera, followed by Ephemeroptera. Trichoptera and Diptera were the third and fourth most abundant orders at the downstream sites, TMF-10 and OP-10, while upstream at TMF-20 was quite different with Coleoptera and Ostracoda as the third and fourth most abundant orders.

For mean density, the Baker Creek site (BC-10) and the Barriere River sites (BR-10 and BR-20) had densities slightly below the study area average for 2013 (Table 4.4.5, Table 4.4.6, and Figure 4.4.9). Within the Harper Creek mainstem, HC-20 and HC-30 displayed the highest densities of all sites in

2032, while the most upstream (HC-40) and downstream (HC-10) sites in the Harper Creek mainstem displayed some of the lowest densities. Within the Harper Creek tributaries, OP-10 in P-Creek and TMF-10 in T-Creek showed low densities in 2013, while the TMF-20 showed average densities in the study area. In general for 2013, mid-stream on Harper Creek had the highest mean densities, while P-Creek and lower Harper Creek showed the lowest densities.

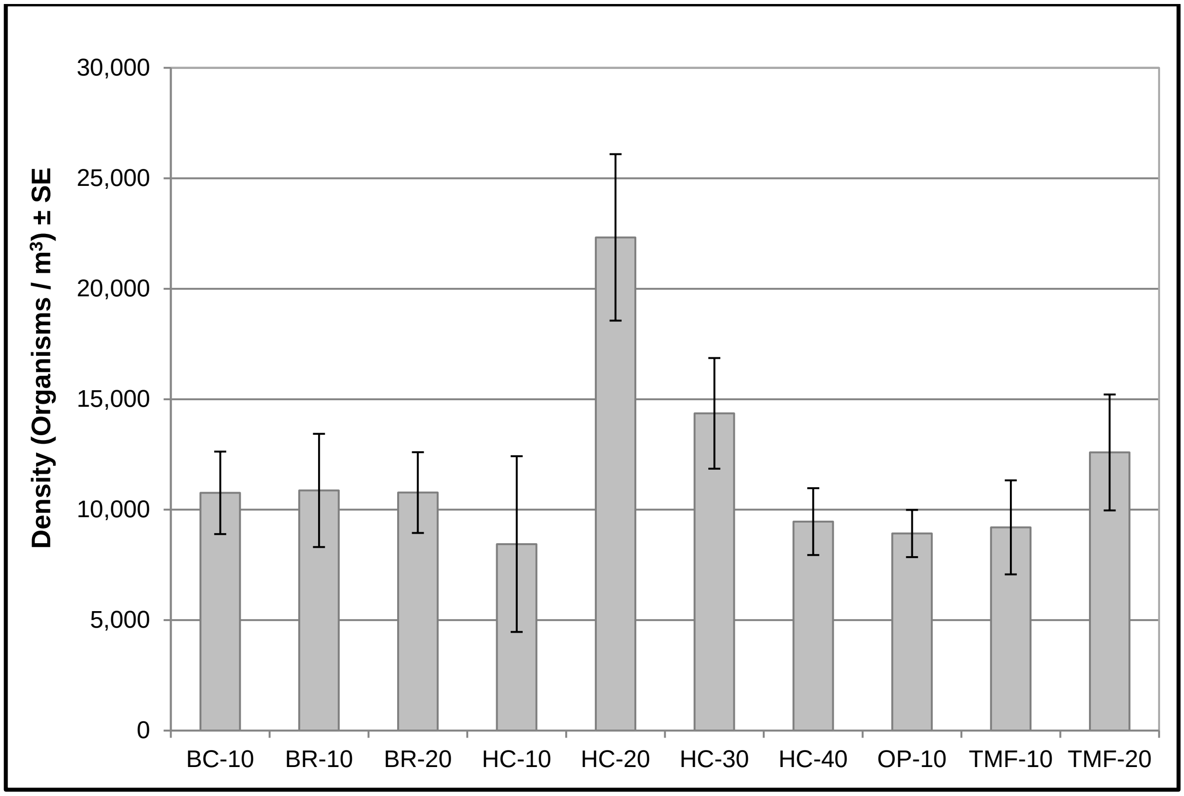


Figure 4.4.9 2013 Benthic Invertebrate mean densities (±S.E.)

The mean family richness in the Baker Creek site (BC-10) was low for the study area. The Barriere River downstream site (BR-10) was average for the 2013 study area while the upstream site (BR-20) had one of the highest species richness values (Table 4.4.5, Table 4.4.3 and Figure 4.4.10). The Harper Creek mainstem displayed average richness values for 2013, except mid-stream at HC-20, which has one of the highest richness values. In the Harper Creek tributaries, OP-10 in P-Creek displayed the lowest family richness value in 2013, while downstream in T-Creek (TMF-10) showed the highest family richness for the study area that year. Overall, the family richness was highest mid-stream in the Harper Creek mainstem, but lowest in Baker Creek and P-Creek.

The mean EPT Index for all sites in 2013 was 14 or greater (Table 4.4.5; Figure 4.4.10), indicating good water quality for the entire study area (Table 3.4.1). In Baker Creek (BC-10) and downstream in Barriere River (BR-10) the EPT Index of 14 was slightly lower than the other sites. Most other sites displayed an average value between 15 and 17. The highest EPT Index values (18) were seen in Harper Creek (HC-20 and HC-40) and downstream in T-Creek (TMF-10), which potentially indicates very clean water at those sites.

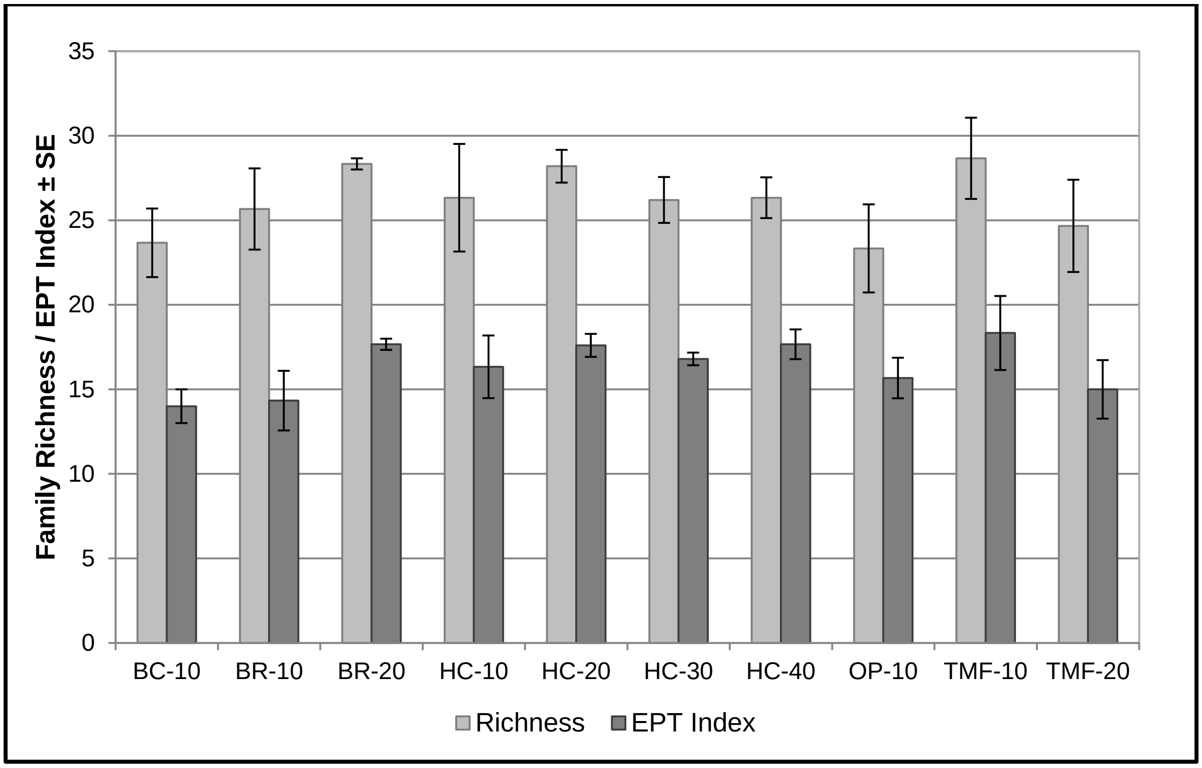


Figure 4.4.10 2013 Benthic Invertebrate Richness and EPT Index (±S.E.)

4.4.3.3 Community Metrics

Evenness indices portray the equitibility with which individuals are distributed among the different families sampled. The Simpson's and Shannon-Wiener Evenness Indices both range from 0 - 1, with 1 indicating perfectly even dispersion. The sites with the highest evenness in 2013 were upstream in Barriere River (BR-20) and downstream in Harper Creek (HC-10; Table 4.4.5; Figure 4.4.11). The sites with the lowest evenness indices were found mid-stream in Harper Creek (HC-20), in Baker Creek (BC-10) according to Simpson's Evenness, and upstream in T-Creek (TMF-20) according to Shannon-Wiener Evenness. The Shannon-Wiener Evenness Index values were considerably higher than those calculated with the Simpson's Evenness Index; using the Shannon-Wiener Evenness Index, with average values of 0.79 (Table 4.4.6), the study area would be considered to have quite high evenness.

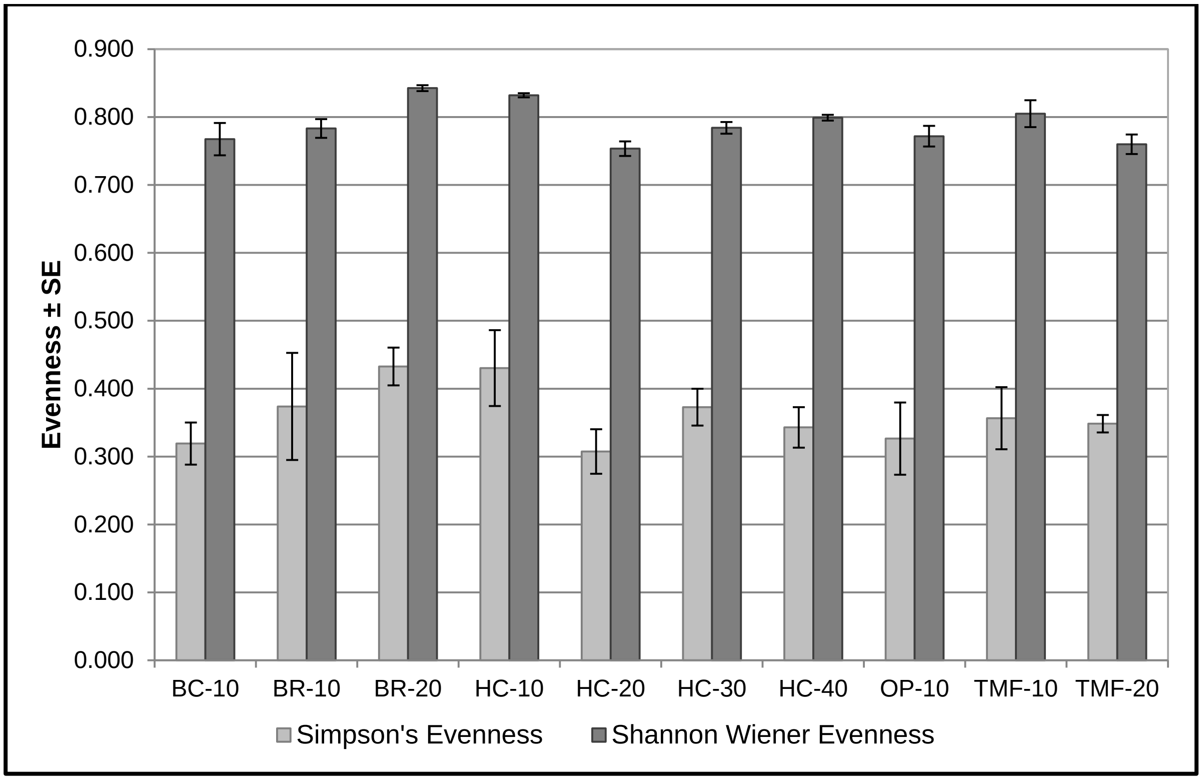


Figure 4.4.11 2013 Benthic Invertebrate Evenness Indices (±S.E.)

The diversity indices calculated in this study range from 0 upwards, with larger numbers indicating higher overall diversity. While the absolute values differ between the Simpson's and Shannon-Wiener Indices, general trends between sites were apparent in 2013. Diversity was highest in upper Barrier River (BR-20) and lower Harper Creek (HC-10) according to both indices (Table 4.4.5; Figure 4.4.12). Values were lowest for P-Creek (OP-10) and Baker Creek (BC-10). Although sites showed variable diversity index values, the overall range in diversity index values was low. The range of the Simpson's Diversity Index values varied between a mean minimum of 0.81 to a mean maximum of 0.93, similar to 2011 and 2012, while the Shannon-Wiener Diversity Index values varied between only 2.2 to 3.01 (Table 4.4.6). The Shannon-Wiener Diversity Index values also were consistently higher than the Simpson's Diversity Index values.

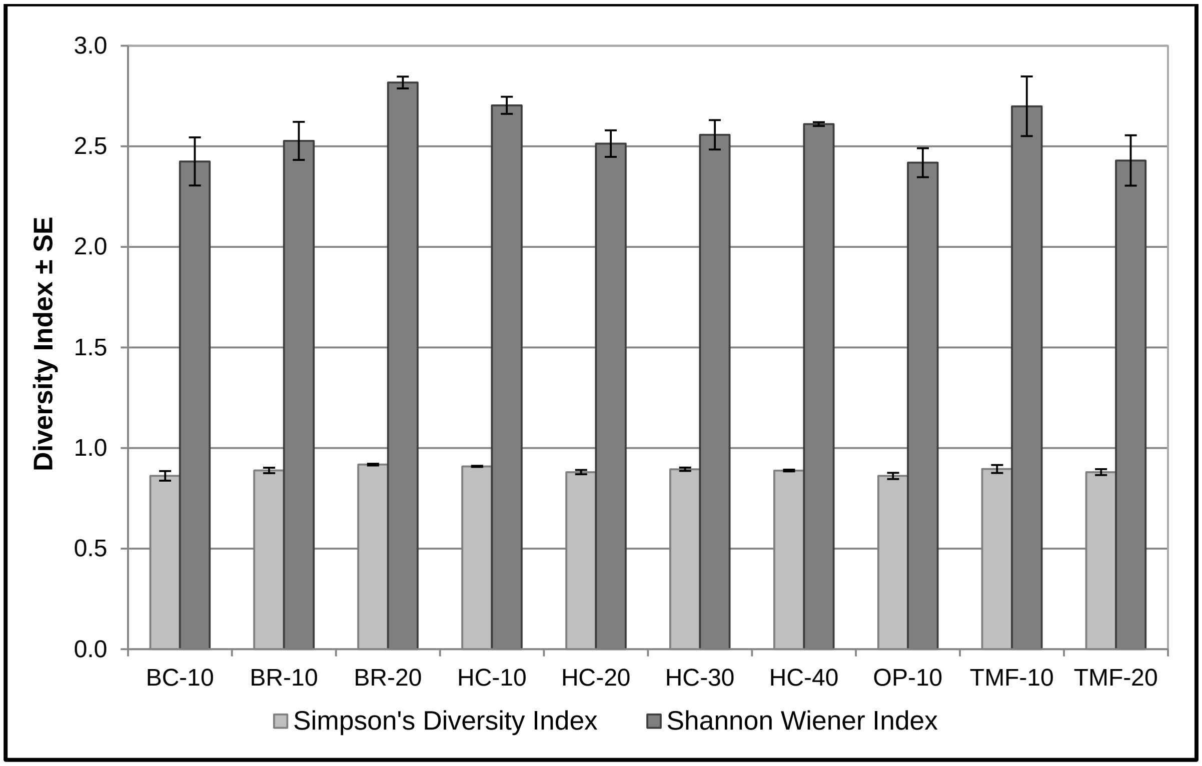


Figure 4.4.12 2013 Benthic Invertebrate Diversity Indices (±S.E.)

4.4.3.4 Biotic Index

Hilsenhoff Family Biotic Index (FBI) values from 0–3.75 are considered to have excellent water quality with organic pollution being unlikely; higher values indicate worsening water quality (Table 3.4.2). In 2013, all sites had excellent water quality with mean FBI values less than 3.75 (Table 4.4.5) and a mean FBI for the study area of 2.4 (Table 4.4.6). The sites with the lowest (better) FBI values in 2013 were in upper Harper Creek (HC-40) and lower T-Creek (TMF-20), while the highest (worse) values in the study area were downstream in Barriere River (BR-10) and mid Harper Creek (HC-20); although they were still within the excellent category.

4.4.3.5 2013 Results Summary

In 2013, many summary statistic values for abundance and richness and community metrics were consistently lowest within Baker Creek and P-Creek, but were highest at lower T-Creek (TMF-10), lower Harper Creek (HC-10 and HC-20),and upper Barriere River (BR-20). All other sites displayed values for all statistics and indices similar to the study area average.

Mean invertebrate density ranged from 8,444 to 22,324, was lowest within lower Harper Creek (HC-10), and was highest at mid-Harper Creek (HC-20).

Taxonomic richness ranged from 24 to 29, was lowest in P-Creek (OP-10), and was highest within lower T-Creek (TMF-10).

The EPT Index ranged from 14 to 18, which indicated good water quality (Munro and Taccogna 1995). The lowest EPT Index value was in lower Barriere River (BR-10) and Baker Creek (BC-10) and the highest values were in lower T-Creek (TMF-10) and Harper Creek (HC-20 and HC-40), and in upper Barriere River (BR-20).

Simpson's and Shannon-Wiener Diversity and Evenness Indices indicated that diversity and evenness were generally lower in Baker Creek (BC-10). Evenness was lowest in mid-Harper Creek (HC-20), while diversity was lowest in P-Creek (OP-10). Diversity and evenness indices were consistently higher in lower Harper Creek (HC-10) and upper Barriere River (BR-20).

The family level biotic index ranged from 1.74 to 3.17, which indicates that water quality within all baseline study area creeks and rivers in 2013 was excellent.

4.5 AQUATIC SEDIMENT

A table summarizing the number of sediment samples per parameter which surpassed the federal and provincial guidelines and grain size results for all three sampling events (2011, 2012 and 2013) are provided in Table 4.5.1 and Table 4.5.2. A complete set of data quality results for freshwater sediment is presented in Appendix H.

Table 4.5.1 Sediment Sampling Results (2011-2013)

Sediment Metals with Guideline Exceedances (mg/kg)	Guideline Limit CCME(ISQG - mg/kg)	Guideline Limit CCME (PEL - (mg/kg)	2011 Percent with values above guideline ISQG (n= 14 sites)	2011 Percent with values above guideline PEL (n= 14 sites)	2012 Percent with values above guideline ISQG (n= 10 sites)	2012 Percent with values above guideline PEL (n= 10 sites)	2013 Percent with values above guideline ISQG (n= 10 sites)	2013 Percent with values above guideline PEL (n= 10 sites)
Arsenic	5.9	17	100% (14)	50% (7)	100% (10)	50% (5)	100% (10)	50% (5)
Cadmium	0.6	3.5	43% (6)	0%	50% (5)	0%	40% (4)	0%
Chromium	37.3	90	50% (7)	0%	30% (3)	0%	30% (3)	20% (2)
Copper	35.7	197	100% (14)	7% (1)	80% (8)	10% (1)	90% (9)	10% (1)
Lead	35	91.3	43% (6)	0%	30% (3)	0%	40% (4)	10% (1)
Mercury	0.17	0.486	14% (2)	0%	0% (0)	0%	0%	0%
Zinc	123	315	71% (10)	7% (1)	60% (6)	0%	50% (5)	10% (1)

Sediment Metals with Guideline Exceedances (mg/kg)	Guideline Limit BCWQG (ISQG - mg/kg)	Guideline Limit BCWQG (PEL - (mg/kg)	2011 Percent with values above guideline ISQG (n= 14 sites)	2011 Percent with values above guideline PEL (n= 14 sites)	2012 Percent with values above guideline ISQG (n= 10 sites)	2012 Percent with values above guideline PEL (n= 10 sites)	2013 Percent with values above guideline ISQG (n= 10 sites)	2013 Percent with values above guideline PEL (n= 10 sites)
Arsenic	5.9	17	100% (14)	57% (8)	100% (10)	50% (5)	100% (10)	50% (5)
Cadmium	0.6	3.5	43% (6)	0%	50% (5)	0%	40% (4)	0%
Chromium	37.3	90	50% (7)	0%	50% (5)	0%	30% (3)	10% (1)
Copper	35.7	197	100% (14)	7% (1)	90% (9)	10% (1)	90% (9)	10% (1)
Iron	21200	43766	100% (14)	43% (6)	100% (10)	20% (2)	80% (8)	20% (2)
Lead	35	91.3	43% (6)	0%	20% (2)	0%	40% (4)	10% (1)
Manganese	460	1100	100% (14)	43% (6)	100% (10)	40% (4)	100% (10)	4% (4)
Mercury	0.17	0.486	14% (2)	0%	0% (0)	0%	0%	0%
Nickel	16	75	100% (14)	0%	70% (7)	0%	70% (7)	1% (1)
Zinc	123	315	71% (10)	7% (1)	70% (7)	10% (1)	50% (5)	10% (1)

Table 4.5.2 Sediment Grain Sizes (2011-2013)

Sediment Size Fractions (%)	Sample Year	T-Creek		P-Creek	Harper Creek				Barriere River		Baker Creek	Average	S.D.
		TMF-10	TMF-20	OP-10	HC-10	HC-20	HC-30	HC-40	BR-10	BR-20	BC-10	All sites	All sites
% Clay (<4um) %	2011	0.41	0.34	0.51	0.29	0.76	0.81	0.45	0.31	0.5	0.64	0.5	0.2
% Gravel (>2mm) %	2011	28	23.2	17.9	9.25	16.4	15.2	27.9	14.3	14	20.8	18.7	6.2
% Sand (0.09mm - 0.063mm) %	2011	1.01	0.16	0.54	1.21	3.4	3.13	0.26	0.83	3.56	2.17	1.6	1.3
% Sand (0.25mm - 0.125mm) %	2011	3.87	0.94	2.8	9.27	13.6	6.83	1.72	2.39	8.18	9.55	5.9	4.2
% Sand (0.5mm - 0.25mm) %	2011	7.2	6.84	9.19	23.9	23.6	11	7.34	12.3	15.1	15.9	13.2	6.4
% Sand (1mm - 0.5mm) %	2011	24.1	39	34.2	46.4	30.1	29.2	32	51.9	35.9	34.7	35.8	8.3
% Sand (2mm - 1mm) %	2011	34	28.1	33	8.14	7.68	28.3	28.7	16.6	17.2	14.2	21.6	10.0
% Silt (0.0312mm - 0.004mm) %	2011	0.68	0.75	1.07	0.7	2.08	2.91	0.99	0.66	2.58	0.9	1.3	0.9
% Silt (0.063mm - 0.0312mm) %	2011	0.76	0.66	0.74	0.9	2.39	2.61	0.62	0.72	3.05	1.11	1.4	0.9
% Clay (<4um) %	2012	0.53	0.34	0.78	0.24	0.49	0.38	0.52	0.32	0.28	0.62	0.5	0.2
% Gravel (>2mm) %	2012	34.3	23.2	19.2	20.6	20.9	21.7	24.1	0.39	33.1	11.2	20.9	9.8
% Sand (0.09mm - 0.063mm) %	2012	23.7	0.16	18.4	22.6	22.8	20.8	21	3.53	25.9	12	17.1	8.9
% Sand (0.25mm - 0.125mm) %	2012	26.8	0.94	35.3	36	32.6	34.1	33.1	58.1	24.2	30.9	31.2	14.0
% Sand (0.5mm - 0.25mm) %	2012	6.7	6.84	12.3	10.9	12.8	13.7	11.1	29.1	8.03	19.2	13.1	6.7
% Sand (1mm - 0.5mm) %	2012	4.58	39	5.95	6.3	5.58	6.08	3.89	6.39	5.01	15.7	9.8	10.8
% Sand (2mm - 1mm) %	2012	1.25	28.1	2.77	1.77	1.73	1.29	1.3	1.07	1.62	4.66	4.6	8.3
% Silt (0.0312mm - 0.004mm) %	2012	1.06	0.75	2.56	1	1.56	1.06	2.45	0.57	0.96	3.21	1.5	0.9
% Silt (0.063mm - 0.0312mm) %	2012	1.12	0.66	2.69	0.69	1.57	1.01	2.51	0.56	0.84	2.62	1.4	0.9
% Clay (<4um) %	2013	0.7	2.07	0.65	0.1	0	0.1	1.68	0.98	0.35	0.44	0.8	0.7
% Gravel (>2mm) %	2013	22	5.87	18.1	0.5	0	39.2	19.3	1.09	10.6	19.9	15.2	12.2
% Sand (0.09mm - 0.063mm) %	2013	3.8	8.49	2.24	1.59	0	0.23	4.99	8.18	3.04	3.48	4.0	2.8
% Sand (0.25mm - 0.125mm) %	2013	9.39	12.8	4.66	7.48	0	2.3	7.14	20.4	7.93	8.64	9.0	5.2
% Sand (0.5mm - 0.25mm) %	2013	14	15.9	15.4	34.2	0	11.1	9.29	34.1	30.4	18.9	20.4	9.9
% Sand (1mm - 0.5mm) %	2013	14.7	23.5	23.5	45.4	0	23.1	13.6	19.3	29.8	22.7	24.0	9.4
% Sand (2mm - 1mm) %	2013	28.2	9.04	29.4	9.36	0	23.3	21.1	4.25	13.7	21.6	17.8	9.0
% Silt (0.0312mm - 0.004mm) %	2013	3.66	11.6	3.29	0.54	0	0.41	12.2	5.64	2.07	2.07	4.6	4.4
% Silt (0.063mm - 0.0312mm) %	2013	3.56	10.8	2.8	0.86	0	0.36	10.8	6.04	2.18	2.2	4.4	4.0

4.5.1.1 2011 Aquatic Sediment

Total arsenic concentrations reported above the BC and CCME – ISQG or LEL guideline value of 5.9 mg/kg at all 14 (100%) of sites sampled (North Barriere Lake and all creeks or river locations). The concentrations ranged from 8.96 mg/kg (NBL-1) to 75.3 mg/kg (HC-30). Total copper concentrations reported above the ISQG or LEL value of 35.7 mg/kg at all 14 (100%) sites and the samples from P-Creek recorded maximum concentration of 417 mg/kg, which reports above the PEL or SEL (BC and CCME) value of 197 mg/kg in addition to the ISQG or LEL (BC and CCME). Total zinc levels were also elevated at a majority (71%) of sites sampled with concentrations ranging from 78.8 mg/kg (BR-20) and 376 mg/kg (OP-10). Zinc concentrations at 10 of the 14 sites sampled reported above the LEL and ISQG (BC and CCME) value (123 mg/kg) and one site reported above the SEL and PEL (BC and CCME) value (376 mg/kg).

Specifically, under the BC-ISQG working guidelines, iron, manganese, and nickel had concentrations above the guidelines for all 14 samples collected. Total manganese had six (43%) of samples that surpassed the BC-PEL (1100 mg/kg) guideline with the maximum recorded concentration of 12500 mg/kg (NBL-3). Total iron concentrations exceeded the BC-SEL at six sample sites with the maximum recorded value at NBL-4 (88000 mg/kg). Total nickel concentrations for all 14 sites were less than the BC-SEL guideline of 75 mg/kg but not the LEL of 16 mg/kg. The nickel concentrations ranged from 16.1 mg/kg (HC-20) to 59.5 mg/kg (BC-10).

Cadmium, chromium, lead, and mercury concentrations were slightly elevated at a portion of the sites sampled. Cadmium and lead concentrations report above the BC-LEL and CCEM-ISQG (0.6, 35 mg/kg respectively) at six of the 14 sites, while chromium concentrations reported above the ISQG (37.3 mg/kg) at seven of the 14 sites sampled. Mercury concentrations reported above the ISQG (0.17 mg/kg) at two sampling locations (NBL-3 and NBL-4) both of which are found in North Barriere Lake.

At all sample sites, concentrations of Polycyclic Aromatic Hydrocarbons reported below both federal and provincial guidelines at low to negligible values between <0.0010 mg/kg to <0.10 mg/kg). Total organic carbon (TOC) % values all reported above the method detection limit (MDL) of 0.05% with a value range of 0.1% to 0.35%. Highest values for TOC % were recorded in HC-40 and BR-20 (0.35% and 0.3% respectively).

Aquatic sediment grain sizes collected during 2011 among Project watersheds were dominated by sand with some small gravels and very little silt and clay. Approximately 78% of sediments size fractions were classified as sand between 0.063 mm to 2 mm and approximately 18.7 % was classified as small gravel (>2 mm). The remaining 3.2% of the grain size fractions were fine fractions classified as either silt (0.0312 – 0.063 mm) or clay (<4 µm).

4.5.1.2 2012 Aquatic Sediments

Total arsenic concentrations reported above BC-LEL and CCME-ISQG guidelines value of 5.9 mg/kg at all 10 sites (100%) and copper reported above the ISQG and LEL value of 35.7 mg/kg at eight of ten sites. The copper sediment sample from P-Creek recorded copper concentrations of 357 mg/kg, which report above the PEL or SEL value of 197 mg/kg in addition to the ISQG value. Total zinc concentrations were also elevated at a majority (70%) of sites with levels ranging from 76.2 mg/kg (BR-20) to 327 mg/kg (OP-10). The BC-SEL concentration guideline for zinc was surpassed once by P-Creek with a value of 327 mg/kg.

Under the BC-LEL working guideline, iron and manganese had concentrations above the guidelines for all ten samples collected. Total manganese had four (40%) samples that surpassed the BC-SEL (1100 mg/kg) guideline with the maximum recorded concentration of 1770 mg/kg at TMF-20. Total iron concentrations exceeded the BC-SEL at two (20%) sample sites with the maximum recorded value observed at OP-10 (50300 mg/kg). Total nickel concentrations were above the BC-LEL guideline (75 mg/kg) for seven of the ten sample sites. The nickel concentrations ranged from 11.10 mg/kg to 47.90 mg/kg with maximum observed concentration collected in Baker Creek. Total mercury concentrations never exceeded the BC or CCME guidelines.

Cadmium, chromium, lead and zinc concentrations were slightly elevated at a portion of the sites sampled. Chromium and lead concentrations reported above the BC-LEL and CCME-ISQG (37.3, 35 mg/kg, respectively) at five and three sites sampled, while cadmium concentrations reported above the BC-LEL and CCME-ISQG guideline (0.6 mg/kg) for five samples with values ranging between 0.23 mg/kg (BC-10) and 1.62 mg/kg (OP-10).

The 2012 sediment quality samples were not analyzed for Polycyclic Aromatic Hydrocarbons or Total Organic Carbon (%).

Aquatic sediment grain sizes collected during 2012 sampling among Project watersheds were, like those observed during 2011, dominated by sand with some small gravels and very little silt and clay. Approximately 76% of sediments size fractions were classified as sand between 0.063 mm to 2 mm and approximately 21% was classified as small gravel (>2 mm). The remaining 3.4% of the grain size fractions were fine fractions classified as either silt (0.0312-0.063 mm) or clay (<4 µm).

4.5.1.3 2013 Aquatic Sediments

Total arsenic concentrations reported above the LEL and ISQG (BC and CCME) guideline value of 5.9 mg/kg at all 10 sites sampled (rivers and tributaries). The concentrations ranged from 6.84 mg/kg (TMF-20) to 46.10 mg/kg (OP-10). Total copper concentrations reported above the LEL and ISQG (BC and CCME) guideline of 35.7 mg/kg at nine of the ten sample sites, with the exception of BR-20. In addition to the ISQG exceedances for copper, the BC-SEL and CCME-PEL guideline (197 mg/kg) was surpassed at the P-Creek sample site (469 mg/kg). Total zinc levels were also elevated at half of the sites sampled with concentrations ranging from 70.20 mg/kg (BR-20) to 424 mg/kg (OP-10). Zinc concentrations at five of the 10 sites sampled report above the LEL and ISQG (BC and CCME) value (123 mg/kg) and one site reported above the PEL (BC and CCME) guideline (315 mg/kg) with a value of 424 mg/kg in P-Creek.

Under the BC-MOE working guidelines, iron, manganese and nickel had concentrations above the guidelines for a majority of sites sampled. Total manganese had 10 (100%) of samples above the LEL guideline of 460 mg/kg and four samples above the BC-SEL guideline (11 mg/kg). The maximum concentration was observed at HC-30 (2160 mg/kg). Total iron concentration exceeded the BC-LEL (21200 mg/kg) in 10 (100%) of the samples collected and levels were above the BC-SEL guideline (43766 mg/kg) at OP-10 (57400 mg/kg) and HC-30 (44300 mg/kg). Total nickel concentrations were recorded above the BC-LEL (16 mg/kg) at seven sample locations with one sample above the BC-SEL (75 mg/kg). The nickel concentrations ranged from 9.79 mg/kg (TMF-20) to 83.10 mg/kg (HC-30).

Cadmium, chromium, and lead were slightly elevated at a portion of the sites sampled. Cadmium and lead concentrations reported above the LEL and ISQG (BC and CCME) (0.6, 0.35 mg/kg respectively) at four of the 10 sample sites, while chromium concentrations reported above the ISGQ (37.3 mg/kg) at three of the 10 sample sites. Total mercury concentrations never exceeded the BC or CCME guidelines.

The 2013 sediment quality samples were not analyzed for Polycyclic Aromatic Hydrocarbons or Total Organic Carbon (%).

Aquatic sediment grain seizes collected during 2013 among Project watersheds were dominated by sand with some small gravels and very little silt and clay. Approximately 75.4% of sediment size fractions were classified as sand between 0.063 mm to 2 mm and approximately 15.2% was classified as small gravel (>2 mm). The remaining 9.8% of the grain size fractions were fine fractions classified as either silt (0.004 – 0.063 mm) or clay (<4 µm).

5 – CONCLUSIONS

5.1 AQUATIC HABITAT

5.1.1 Lower Harper Creek

The highest fish species diversity and quality of aquatic habitat occurs in the lower 1.5 km of Harper Creek as it crosses an alluvial fan before discharging to the outlet of North Barriere Lake. The average channel slope of Reach 1 is 0.4% and consists primarily of riffle-pool habitat and cobble and gravel bed material. Reach 1 splits into a main western branch and an eastern distributary that was once a mainstem channel. Large woody debris is prevalent in the both the mainstem and the distributary channel where in the latter it has formed complex log jams. The fish fauna of North Barriere Lake and the first two reaches of Harper Creek are linked due to the largely unrestricted connection between lake and creek habitats.

Above the North Barriere Lake Forest Service Road bridge the channel slope of Harper Creek increases to between 3% and 5%. This increased slope in combination with the confined and relatively straight channel increases the water energy and turbulence which actively transports both sediment and woody debris. Habitat for fish is provided by roughened (i.e. boulder) channel elements in the main channel and along channel margins and intermittent widening of the active channel floodplain. Reach 5 is of note since it is lower gradient (1.7%), includes secondary channels and vegetated islands, and has noticeable patches of gravel relative to adjacent reaches. This section of Harper Creek is characterized by decreasing fish species diversity and a shift towards bull trout as lone fish species above river km 9.5. The species shift to bull trout is in part influenced by channel gradient, water energy, and increasing distance from North Barriere Lake.

Above Reach 5 Harper Creek reverts to slopes between 3% and 5% with some short stepped sections. Bull trout is the only fish species sampled to date in this section of Harper Creek. Other fish species appear to be excluded from Harper Creek above Reach 5 due to the increased gradient combined with obstacles to fish migration. Reach 10 is a 9.0% slope canyon section with a series of cascades bounded by a 2 m falls at its upper end. The falls are river km 18.5 from the mouth of Harper Creek. This section of Harper Creek acts to limit upstream migration or colonization by fish species other than bull trout.

5.1.2 Upper Harper Creek

Upper Harper Creek includes two low gradient reaches (Reach 12 and 14 slope <2%) upstream and downstream from its confluence with T-Creek at river km 20.3. Tree windfall has contributed relatively high amounts of large woody debris to the active floodplain of these reaches increasing sediment storage, secondary channel and deep pool development, and habitat complexity for fish. These reaches include patches of gravel, some of which are suitable for bull trout spawning. Summer rearing conditions are suitable for bull trout.

5.1.3 T-Creek

The lowermost 336 m of T-Creek (Reach 1) is fish bearing and has an average channel slope of 7.5% although its lower half is less steep at about 2% to 3%. Habitat conditions are suitable for rearing due to the prevalence of rough cobble and boulder channel elements combined with turbulent flow. T-Creek is warmer than the Harper Creek mainstem in summer and this temperature difference is thought to attract bull trout to these creeks for summer rearing.

Above Reach 1 on T-Creek the average channel slope of 23.8% and bull trout are unable to ascend this reach to the hanging valley above Reach 3. Field assessment confirmed multiple vertical drops in Reach 2 that are impassable to fish. Habitat conditions are suitable for rearing due to the prevalence of rough cobble and boulder channel elements combined with turbulent flow. Late summer and winter low flows may be limiting for bull trout in Reach 1 due to lack of flow and absence of deep pools.

5.1.4 P-Creek

The lowermost 469 m of P-Creek is fish bearing and has an average channel slope of 5.5% although discrete stepped sections are <2%. Habitat conditions below the waterfall barrier are suitable for rearing due to the prevalence of angular cobble and large woody debris elements combined with turbulent flow. Late summer and winter low flows may be limiting for bull trout due to lack of flow, unconfined channel sections, and relative absence of deep pools.

5.1.5 Baker Creek, Jones Creek, and Chuck Creek

Fish access to Baker Creek, Jones Creek, and Chuck Creek is restricted by existing poorly installed culverts at Birch Island-Lost-Creek Road. Increasing channel gradient with elevation limits resident rainbow trout distribution to the first <1.8 km of Baker Creek and Jones Creek. Late summer and winter flows may be limiting for rainbow trout due to low flows, water abstraction and lack of deep pool habitat. The upper limit of fish distribution on Chuck Creek was not confirmed although rainbow trout were detected just above the hanging culvert Birch Island-Lost-Creek Road.

5.2 FISH FAUNA

5.2.1 Lower Harper Creek

Lower Harper Creek contains the highest fish diversity of the Project watersheds surveyed. This diversity closely matches that observed in FISS databases and those observations made by Grinton (1994). The ranking of relative fish abundance (CPUE) suggests that bull trout were the most abundant, followed by coho, rainbow trout, mountain whitefish, torrent sculpin, and longnose dace. All fish species other that bull trout had disjunct or limited distributions within lower Harper Creek, while bull trout were observed throughout lower Harper Creek.

5.2.1.1 Longnose Dace and Torrent Sculpin

All life history phases of the most sessile species of fish including longnose dace and torrent sculpin were infrequently observed in the low gradient lower portion of Harper Creek, below river km 2.0, suggesting that these fish are spawning and rearing within Harper Creek. These fish utilize fast flowing water and were most commonly found in riffle environments within the main channel.

5.2.1.2 Rainbow Trout and Mountain Whitefish

The distribution of mountain whitefish and rainbow trout extended through to river km 9.5. These fish were usually observed within the main river channel associated with boulder clusters and within pools downstream of riffles. The absence of sub-adults or young-of-the-year suggests that mountain whitefish do not utilize lower sections of Harper Creek as a spawning or rearing location. The presence of rainbow trout sub-adults and age 1+ fish suggest that some rainbow trout may utilize portions of lower Harper Creek as a spawning location, however no adults in post-spawning condition were observed during surveys. Young-of-the-year rainbow trout were associated with slower edge waters with woody debris or boulder cover and were primarily observed in low gradient sections of lower Harper Creek.

5.2.1.3 Coho Salmon

Although juvenile coho juveniles were the second most abundant fish observed in lower Harper Creek the distribution was clumped and disjunct. Generally, fry were observed between river km 8.0 and 9.5 and associated with off channel habitat while older parr were most often observed associated with pools and woody debris in the lowest reaches of lower Harper below river km 2.0. The presence of two juvenile cohorts (fry and age 1+ parr) suggests that in recent years (2009 to 2012) some coho spawners have spawned in lower Harper Creek.

5.2.1.4 Bull Trout

Juvenile, sub-adult, and resident bull trout were the most frequently observed fish species in lower Harper Creek and they were the only species observed upstream of river km 9.5. All life history phases were observed within lower Harper Creek, although the relative abundances of fry, juveniles, and spawners was highest between river km 17.0 and the migratory obstacle located at river km 18.5. The distribution of the highest fry densities coincides with the observations of the greatest number of migratory bull trout sightings suggesting that these sections of river may be important spawning and rearing habitat.

McPhail (2007) and McPhail and Baxter (1996) suggest that adult bull trout cue to water temperature near 9.0° C for autumnal spawning migrations. Migratory bull trout spawners were first observed below river km 6.5 during July 27, 2011 when water temperatures were near 10°C and an increasing number of migratory spawners were observed during August and September when spot river temperatures throughout lower Harper Creek ranged between 7.5° C and 11° C. The highest number of adfluvial spawners were visually observed holding in pools in a section of river downstream of the migration obstacle located at river km 18.5 (Site HC-F280) on September 9, 2011. A number of adfluvial bull trout redds were observed in the 1 km reach downstream of the migration obstacle site during mid-September 2012 and 2013. No spawners were observed at the same location during the last week of September in 2011, 2012, and 2013 and this observation, coupled with the discovery of a male kelt mortality (450 mm fork length) during 2011, suggests that the majority of adfluvial spawners had out-migrated from the area. These observations are very similar to those made by Hagen and Baxter (1992) at the same river location who reported the presence ripe migratory bull trout on September 9, 1992 and at a later date (September 21), observed the presence of a post spawned male bull trout kelt that was subsequently aged to 15+ years.

5.2.2 Upper Harper Creek, T-Creek, and P-Creek

Bull trout were the only fish species observed in the mainstem portion of upper Harper Creek and the relative abundance was approximately three times that observed in lower Harper Creek. Bull trout were observed at mainstem locations between river km 19.0 (above the migratory obstacle) through to the upper portions of the watershed near river km 24.2. No fish were observed at sampling sites upstream of river km 24.2 (HC-F450 to HC-F470) and this portion of upper Harper Creek is considered fishless. These observations were similar to those made during late September 1994 by Grinton (1994) who observed young-of-the year, juvenile and sub-adult bull trout at two upper Harper sampling reaches located at road km 19.4 and 20.6, but did not observe any fish captures at the sampling site located at road km 23.1.

The presence of fry throughout the sampling season and the observation of bull trout redds (2011 and 2012) near river km 20.1 (Site HC-F330) during the third week of September, coupled with observations of adfluvial spawners and resident fish in spawning condition during late August and September when spot water temperatures ranged 6.5°C to 9.0°C, suggest that portions of upper Harper Creek are used for bull trout spawning. The majority of bull trout fry were observed downstream of the confluence of T-Creek among braided sections of river containing loose cobble and gravel that was associated with pools, woody debris and riparian cover. All of the redds observed were situated in shallow water (<0.3 m) over a substrate of gravel and small cobble. Redds were situated along the river banks in the tailout of pools upstream of riffles and were always associated with overhanging riparian cover.

T-Creek discharges down a high gradient portion of the eastern Harper Creek Valley and the distribution of fish is limited to the lower 336 m below a series of waterfalls. The lower 336 m of T-Creek below the fish barrier was sampled from late July through to late September 2011, during August and September 2012 and again during September 2013. The majority of bull trout observed in Lower T-Creek were parr and older juveniles (50 mm to 200 mm fork length), although some fry (<40 mm fork length) were observed near slower low gradient sections at the Harper Creek confluence. One male bull trout in spawning condition was observed in the tributary during the first week of September, 2011 at Site TC-F050. There is limited spawning habitat in the fish bearing portion of T-Creek and it is unclear whether this fish was using this area as a potential spawning location.

The relative abundance of bull trout juveniles observed within T-Creek varied by sampling date and suggests that abundance of bull trout were higher later in the sampling season (August – September). The seasonally averaged relative abundance of bull trout in T-Creek is very similar to those observed in the mainstem sampling locations in upper Harper Creek.

No fish were observed at any sampling locations in upper T-Creek upstream of the fish proof barrier during 2011, 2012 or 2013 efforts, and these areas are considered non-fish bearing. Sampling effort was distributed from locations just above the fish barrier on lower T-Creek through to the uppermost portion of the watershed within the project footprint (Sites TC-70 to TC 180). Portions of T-Creek between the fish barrier and the project site are largely comprised of large boulder field and the creek is high gradient (>20%).

P-Creek flows down a high gradient portion of the eastern Harper Creek Valley and the distribution of bull trout is limited to the relatively low gradient lower 469 m below a series of impassable debris fields and a 3.0 m high bedrock waterfall. The section of creek upstream of the bedrock waterfall (site PC-F060) has been determined to be non-fish bearing

Early in the 2011 sampling regime no bull trout were observed in P-Creek or near its confluence with upper Harper Creek, however, bull trout were later observed within P-Creek during August and September (2011 and 2012). The relative abundance of bull trout in P-Creek during late summer was slightly less than half the average values observed in T-Creek and upper Harper Creek during 2011 and 2012.

The densities of bull trout in both T-Creek and P-Creek averaged approximately 1.5 to 2 times those observed in three East Kootenay watersheds (Wigwam, Skookumchuck, and White rivers) located in eastern British Columbia and suggest that the habitat in upper Harper Creek are productive rearing environments for both juvenile and resident bull trout.

5.2.3 North Thompson Drainages

The portion of the Jones Creek downstream of the Birch Island Lost-Creek Road crossing is low gradient and flows through a section of private land before discharging into the North Thompson River. Coho (age 0+), rainbow trout (adults and juveniles), and torrent sculpin were observed in the lowest reaches of Jones Creek. Rainbow trout were the only fish species observed upstream of the road culvert and their distribution continued upstream until a series of waterfalls limited their distribution approximately 1.3 km upstream from the road crossing. The length distribution of Jones Creek rainbow trout was very similar to those observed in lower Harper Creek and the relative abundance was almost twice that observed in Harper Creek.

Lower Baker Creek downstream of the Birch Island Lost-Creek Road crossing is high gradient and flows through a section of private land before discharging into the North Thompson River. Juvenile coho, rainbow trout, and bull trout juveniles were observed in the lowest reaches of Baker Creek below an impassible hanging culvert. Only rainbow trout (fry, juveniles and adults) were observed upstream of the culvert crossing and their distribution continued upstream similar to that observed in Jones Creek until a series of high gradient cascades limited their distribution approximately 1.6 km upstream from the road crossing.

The relative abundance and size distribution of rainbow trout within Baker Creek were very similar to those observed in the fish bearing sections of Jones Creek, and again, like Jones Creek the abundance in Baker Creek was almost twice those observed within lower Harper Creek.

The lower portions of Chuck Creek, Lute Creek, and Foghorn Creek were each sampled on one occasion during the 2011 and Lute Creek resampled during 2012. Both juvenile coho and rainbow trout were observed in Foghorn Creek and Lute Creek while Chuck Creek only contained only rainbow trout. Avery Creek had very low discharges during late summer (September 2011, 2012, 2013) and no fish were observed during sampling at the Birch Island Lost-Creek Road crossing or higher in the watershed at the Mine Access Road crossing.

5.2.4 Non Fish-Bearing Stream Reaches

The upper portion of Harper Creek, T-Creek, P-Creek, Baker Creek, Jones Creek, and Avery Creek have barriers or habitat features that limit the upstream distribution of fish and these portions of the watersheds have been assessed as being non-fish bearing.

No fish were observed in the highest reaches of upper Harper Creek and these results were similar to those observed by Grinton (1994), who sampled upper Harper Creek near river km 25.5 during September 1994. This portion of upper Harper Creek exhibited water temperatures 2°C to 3°C cooler than those observed downstream of the P-Creek confluence and the bed materials were comprised of course angular cobble and bedrock.

T-Creek and P- Creek have fish proof waterfall barriers located 336 m and 469 m upstream from their respective confluences with Harper Creek. Repeated sampling during 2011-2013 higher in the watershed within the Project Site upstream of the fish barriers during confirmed these observations and the upper portions of these watersheds are considered fishless.

The limit of the rainbow trout distribution in upper Jones and Baker creeks is series of small waterfalls or cascades located approximately 1.7 km upstream from their confluences with the North Thompson River. Rainbow trout were observed below the barriers, however, their relative abundance gradually declined as the stream gradient increased and creek flows decreased.

Avery Creek was sampled at two different locations, and no fish were captured or observed at either location. The first site is located just upstream of the Birch Island Lost-Creek Road crossing and no creek flow was visible during late summer 2012 and 2013 to support fish or aquatic life. The second sampling location was located approximately 3.6 km upstream from the Birch Island Lost-Creek Road at the Avery-Jones Forest Service Road crossing which will form part of the Mine Access Road. This site was sampled during September 2012 and September 2013 and no fish were observed or captured.

5.3 PERIPHYTON

Periphyton biomass measured as chlorophyll-a directly relates to the productivity and trophic status of a body of water. Periphyton biomass is highly variable, both spatially and temporally, in the study area. There is no relationship between biomass at upstream and downstream sites within the same systems. The highest concentration at most sites was recorded in 2011, with the exception of sites OP-10 and HC-20, where values were highest in the 2013 samples. Similarly, the lowest concentrations were observed in the 2012 samples at all sites except for sites TMF-20 and HC-10, which had the lowest sample concentrations in 2013. High chlorophyll-a concentrations are a primarily a result of high nutrient inputs. None of the samples exceeded the BC water quality guideline for aquatic life in streams (10 $\mu g/cm^2$) or the lower guideline for recreation, set at 5 $\mu g/cm^2$.

Periphyton community composition is variable both spatially and temporally. Mean densities of periphyton are consistent with values seen during other studies throughout British Columbia. Bacillariophyceae, Chlorophyta, and Cyanophyta typically dominate periphyton communities in inland waters (Kalff 2001). The Bacillariophyceae and Cyanophyta were the two most abundant phyla at all sites, with Chlorophyta being the third most abundant phylum. Throughout the study area, the PTI values generally indicated good water quality conditions.

5.4 BENTHIC INVERTEBRATES

Throughout the baseline study area, with the exception of the lower Barriere River (BR-10) and upper T-Creek (TMF-20), benthic communities were dominated by invertebrates from the orders Ephemeroptera and Plecoptera in all years 2011 to 2013. The orders Diptera and Trichoptera were the third or fourth most abundant orders at most sample sites across all years. The order Plecoptera is considered to be the invertebrate order most sensitive to environmental stress, while the order Ephemeroptera is considered to be the second most sensitive invertebrate order (Timm 1997). Ephemeroptera, Plecoptera, and Trichoptera together are used in the EPT Index as they are sensitive to environmental stress. Diptera are potentially more resistant to environmental stress. Monitoring the relative abundances of these four orders over the life of the mine will give a good indication of environmental deterioration within the creeks and rivers.

The means and ranges of values for summary statistics and community indices in the study area were consistent across the three years of baseline sampling. In addition, the ranges of values across sites for many of the statistics and metrics were quite narrow. As a result, while it is possible to ascertain which sites had relatively lower or higher values each year, it is important to note that the values between sites were often quite similar.

In general, Baker Creek (BC-10), lower Barriere River (BR-10), and P-Creek (OP-10) had the least desirable overall values across all years. Baker Creek and lower Barriere River are downstream of human use activities, which may explain the general trend for lower densities, family richness, and EPT index values, and the higher FBI values. P-Creek displayed values for water quality similar to the study area average, but had generally lower density and family richness values. This site is not currently affected by human use activities, but is at a very high elevation and is subject to winter freezing, which appears to be affecting benthic invertebrate diversity. It is possible to see similar, although less obvious, trends in the other high elevation sites; e.g. TMF-20 in 2012 and HC-40 in 2013.

The most desirable summary statistics and community metrics were typically seen in upper Barriere River (BR-20), mid- to lower Harper Creek (HC-10, HC-20, and HC-30), and lower T-Creek (TMF-10) across all years. These sites are all upstream of human use activities and are at elevations that allow higher overall productivity.

The EPT Index and FBI values indicated that water quality for all sites in the study area was high (Good or Excellent, respectively) for all years. However, as noted previously, the relative change in water quality values through the study area indicated that the water quality deteriorated somewhat towards the most downstream sites (BR-10 and BC-10). It will be important to monitor changes in these values throughout the life of mine to determine if the benthic community is being affected by any potential changes to water quality.

5.5 AQUATIC SEDIMENT

Of the 30 elemental metals analyzed in the 2011, 2012, and 2013 sediment samples, seven metals reported above CCME ISQG and PEL guideline limits and ten sediment samples reported above the BC guideline limit. Arsenic reported above the ISQG guidelines in the vast majority of sample sites, and reports above PEL guideline limits in half the locales. Copper concentrations also reported above the ISQG guidelines in the vast majority of sample sites, and reports above PEL guideline limits only in sediments from the P-Creek watershed. Cadmium, chromium, lead, mercury, and zinc reported above ISQG guidelines in between 14%-71% of sample sites and zinc reports above PEL guideline limits only in samples from P-Creek. In 100% of all samples collected for Iron and Manganese the concentrations were above the BC-LEL guideline. For iron and manganese the concentrations surpassed the BC-SEL guideline between 4% and 43% of sample sites. The Nickel concentration report above the BC-LEL guideline in 70% to 100% of samples collected, while the BC-SEL guideline was only exceeded once in 2013. The highest loading of those metals that reported above both aquatic sediment CCME and BC guideline standards originated from P-Creek and these observations can be partially explained given the watersheds proximity to the proposed mine pit location.

Aquatic sediment grain sizes collected during the 2011, 2012, and 2013 sampling events were dominated by sand with some small gravels and very little silt and clay. At all sample sites, concentrations of Polycyclic Aromatic Hydrocarbons reported below both federal and provincial guidelines (ISQG and PEL or LEL and SEL) at low to negligible values. Total organic carbon (TOC) % values all reported above the method detection limit (MDL) of 0.05% with a value range of 0.1% to 0.35%. The majority of creeks in the baseline study area are swift moving mountainous drainages with high flushing rates and offer very little slow water side channel environments that could collect organic or inorganic fines.

6 – REFERENCES

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

CDC (BC Conservation Data Centre). 2012. BC Species and Ecosystems Explorer. BC Ministry of Environment. Victoria, BC.

CFIA (Canadian Food Inspection Agency). 2012. Fish Products Standards and Methods Manual. Available at: www.inspection.gc.ca/food/fish-and-seafood/manuals/standards-and-methods/eng/1348608971859/1348609209602

Clark, M.J.R. (editor). 1996. British Columbia Field Sampling Manual. Laboratory and Systems Management, Environmental Protection Department, Ministry of Environment, Lands and Parks, Victoria, BC, Canada. 312 pp.

Cope, R.S. 2007. Upper Kootenay Juvenile Bull Trout and Fish Habitat Monitoring Program: 2000-2005 Summary. Prepared for the Ministry of Environment, Cranbrook, B.C. Prepared by Westslope Fisheries Ltd., Cranbrook, B.C. 46 pp + 2 app.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2002. COSEWIC assessment and status report on the coho salmon (*Oncorhynchus kisutch*) (Interior Fraser population) in Canada. Ottawa. viii + 34 p.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2010. Assessment and Status Report on the Mountain Sucker *Catostomus platyrhynchus* (Saskatchewan Nelson River populations, Milk River populations, and Pacific populations) in Canada (2011). Ottawa. xvii+54 pp.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2012. COSEWIC assessment and status report on the Bull Trout *Salvelinus confluentus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. iv + 103 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

DFO (Fisheries and Oceans Canada). H. Olynyk pers comm. October 27, 2011

DFO (Fisheries and Oceans Canada).1995. Fraser River sockeye salmon. Prep. By Fraser River Action Plan, Fishery Management Group. Vancouver, B.C. 55 p.

Environment Canada. 2002. Metal Mining Guidance Document for Aquatic Environmental Effects Monitoring.

Environment Canada. 2010. Metal Mining Guidance Document for Aquatic Environmental Effects Monitoring.

Environment Canada. 2012. Metal Mining Technical Guidance for Environmental Effects Monitoring.

Ford, B.S., P.S. Higgins, A.F. Lewis, K.L. Cooper, T.A. Watson, C.M. Gee, G.L. Ennis, and R.L. Sweeting. 1995. Literature Reviews of the Life History, Habitat Requirements, and Mitigation/Compensation Strategies for selected Fish Species in the Peace, Liard, and

Columbia River Drainages of British Columbia. Prepared for the Department of Fisheries and Oceans, Eastern BC Unit of the Habitat Management Division, Pacific Region.

Fulton, T.W. 1902. The rate of growth of fishes. 20th Annual Report of the Fishery Board of Scotland 1902 (3):326-446.

Grinton, C. 1994. Barriere River Watershed fish Production and Habitat Assessment. Report for B.C. Min. Environ., Lands and Parks, Fish. Br. Kamloops, B.C. 181 p.

Hagen, J. and J.S. Baxter. 1992. Bull trout populations of the North Thompson River Basin, British Columbia: initial assessment of a biological wilderness. Report for B.C. Min. Environ., Lands and Parks, Fish. Br., Kamloops, BC. 37 p.

Harding and Offin. 1970. A partial survey of North Barriere Lake. Report for B.C. Min. Environ., Lands and Parks, Fish. Br., Kamloops, BC. 6 p.

Hatfield, T, A. Lewis, S. Babakaiff. 2007. Guidelines for the collection and analysis of fish and fish habitat data for the purpose of assessing impacts from small hydropower projects in British Columbia. British Columbia Ministry of Sustainable Resource Management, British Columbia.

Hilsenhoff, W.L. 1988. Rapid field assessment of organic pollution with a family-level biotic index. J. N. Am. Benthol. Soc. 7(1):65-68.

Hobbs, W.O. and A.P. Wolfe. 2008. Recent paleolimnology of three lakes in the Fraser River Basin (BC, Canada): no evidence for the collapse of sockeye salmon stocks following the Hells Gate landslides. J. Paleolimnol. 40: 295-308.

Irvine, J. R., R. E. Bailey, M. J. Bradford, R. K. Kadowaki, and W. S. Shaw. 1999. 1999 Assessment of Thomson River/Upper Fraser River Coho Salmon. Canadian Stock Assessment Secretariat Research Document 99/128.

Johnson, N.T. and P.A. Slaney. 1996. Watershed Restoration Program Fisheries Habitat Assessment Procedures (FHAP). Watershed Restoration Technical Circular No. 8 (BC Ministry of Environment, Lands and Parks, and Ministry of Forests, 1996).

Kalff, J. 2001. Limnology: Inland Water Ecosystems. Prentice-Hall, Inc. Upper Saddle River, NJ 07458.

Krebs CJ. 1985. Ecology: the experimental analysis of distribution and abundance. 3rd edition. New York (NY): Harper and Row.

Lange-Bertalot, H. 1979. Pollution tolerance as a criterion for water quality estimation. Nova Hedwigia 64:285-304.

McPhail J. D. and P. Troffe. 1998. The Mountain Whitefish (*Prosopium williamsoni*) a potential indicator species for the Fraser system. Fraser River Action Plan, Environmental Conservation Branch, Environment Canada, Vancouver, B.C.DOE FRAP 1988-16.

McPhail, J. D. 2007. The Freshwater Fish of British Columbia. University of Alberta Press, Edmonton. 620p.

McPhail, J.D. and J.S. Baxter. 1996. A Review of Bull Trout (*Salvelinus confluentus*) Life-history and Habitat Use in relation to Compensation and Improvement Opportunities. Fisheries Management Report No. 104. Province of BC.

McPhail, J.D. and R. Carveth 1994. Field Key to the Freshwater Fishes of British Columbia. Draft for 1994 Field Testing. Aquatic Inventory Task Force of the Resources Inventory Committee. 233 p.

Merit (Merit Consultants International Inc.). 2012. Technical Report and Feasibility Study for the Harper Creek Copper Project Near Vavenby, BC. March 29, 2012. Accessed from www.sedar.com

Ministry of Water, Land and Air Protection (MWLAP). 2003. British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples.. Part C Biological Testing.

MOE (Ministry of Environment) 2014. Companion Document to: Ambient Water Quality Guidelines for Selenium Update. Available at:http://www.env.gov.bc.ca/wat/wq/BCguidelines/selenium/pdfs/companion-document-2014.pdf

MOE (Ministry of Environment) 2012. Water and Baseline Monitoring Guidance Document for Mine Proponents and Operators. Version 1, August 2011. 168 p.

MOE (Ministry of Environment) 2006. A Compendium of Working Water Quality Guidelines for British Columbia. . Available at: http://www.env.gov.bc.ca/wat/wq/BCguidelines/working.html#table2. Updated August 2006

MOE (Ministry of Environment). 1997. Freshwater Biological Sampling Manual. Published by Resources Inventory Committee.

MOE (Ministry of Environment). 2001. Ambient Water Quality Guidelines for Selenium. Available at: www.env.gov.bc.ca/wat/wq/BCguidelines/selenium/selenium.html

MOF (Ministry of Forests) 1998. Fish-stream Identification Guidebook. Second edition. Version 2.1. Forest practices code of British Columbia. Victoria, BC.

Molles MC. 1999. Ecology: Concepts and Applications. 1st edition. Boston: WBC McGraw-Hill.

Muscio, C. No date. The Diatom Pollution Tolerance Index: Assigning Tolerance Values. City of Austin Watershed Protection Development Review.

Nielson, L.A., and D.L. Johnson. 1983. Fisheries Techniques. American Fisheries Society.

Nordin, R.N. 2001. Water Quality Criteria for Nutrients and Algae Overview Report. Ministry of Environment, Environmental Protection Division. Accessed May 2014. Available at: http://www.env.gov.bc.ca/wat/wq/BCguidelines/nutrients/nutrients.html

Raleigh, R.F., Hickman, T., Solomon, R.C., and P.C. Nelson. 1984. Habitat Suitability Information: Rainbow Trout. U.S. Fish and Wildlife Service. FWS/OBS-82/10.60. 64 pp.

RIC (Resources Inventory Committee). 1997a. Fish Collection Methods and Standards - Version 4.0. Province of British Columbia. January 1997.

RIC (Resources Inventory Committee). 1997b. Freshwater Biological Sampling Manual. BC Ministry of Environment, Lands and Parks, Wildlife Branch.

RIC (Resources Inventory Committee). 1998 Guidelines for Interpreting Water Quality Data. Resources Inventory Committee. 1998.

RIC (Resources Inventory Committee). 2001. Reconnaissance (1:20 000) Fish and Fish Habitat Inventory Standards and Procedures, April 2001, Version 2.0.

Sandercock, F.K. 1991. The History of Coho Salmon (*Oncorhynchus kisutch*). In Pacific Salmon Life History, edited by C. Groot and L. Margolis. Vancouver: University of British Columbia Press.

Scott, W.B., and E.J. Crossman. 1973. Freshwater fishes of Canada. Fish. Res. Bd. Can. Bulletin. 184: 996 pp.

Simonson, T.D., J. Lyons, and P.D. Kanehl. 1994. Quantifying Fish Habitat in Streams: Transect Spacing, Sample Size, and a Proposed Framework. North American Journal of Fisheries Management 14 (3): p. 607-615.

Smith B, Wilson JB. 1996. A consumer’s guide to evenness indices. Oikos 76:70-82.

Taccogna, G. and K. Munro (eds). 1995. The Streamkeepers Handbook: a Practical Guide to Stream and Wetland Care. Salmonid Enhancement Program, Dept. Fisheries and Oceans, Vancouver, BC.

Timm, H., 1997. Ephemeroptera and Plecoptera Larvae as Environmental Indicators in Running Waters of Estonia.

Westlake, D.F., M.S. Adams, M.E. Bindloss, G.G. Ganf, G.C. Gerloff, U.T. Hammer, P. Javornicky, J.F. Koonce and A.F. Marker. 1980. Primary production. In: E.D. LeCren and R.H. Lowe-McConnell. The functioning of freshwater ecosystems. Cambridge University Press. Cambridge. pp. 141-246.

Withler, R. E., K. D. Le, R. J. Nelson , K. M. Miller, and T. D. Beacham. 2000. Intact genetic structure and high levels of genetic diversity in bottlenecked sockeye salmon *Oncorhynchus nerka* , populations of the Fraser River, British Columbia, Canada. Canadian Journal of Fisheries and Aquatic Sciences 57, 1985-1998.

YMI (Yellowhead Mining Inc.). 2011. Application Information Requirements for the Harper Creek Copper-Gold-Silver Project. Revision 7. With Respect to an Application For an Environmental Assessment Certificate Pursuant to the BC Environmental Assessment Act. Submitted to: The British Columbia Environmental Assessment Office. October 19, 2011.

7 – CERTIFICATION

This report was prepared, reviewed and approved by the undersigned.

COLLEGE OF APPLIED BIOLOGY
Peter Troffe
PWT 08/22/14
R.P. Bio
2225
CAB

Prepared: ______________________________

Peter Troffe, M.Sc., R.P.Bio.
Senior Scientist

Reviewed: ______________________________

for. Oscar Gustafson, R.P.Bio.
Specialist Scientist/Project Manager

Approved: ______________________________

FOR Ken Brouwer, P.Eng.
President

APPENDIX A

SITE PHOTOS

(Pages A-1 to A-25)

PHOTO 1 – Looking south-southwest across the North Thompson River Valley at the abandoned Weyerhaeuser mill site near Vavenby, BC.

PHOTO 2 – Looking north across the North Thompson River Valley towards the abandoned Weyerhaeuser mill site near Vavenby, BC.

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 3 – Aerial view of the North Thompson River adjacent to the abandoned Weyerhaeuser mill site near Vavenby, BC.

PHOTO 4 – Mouth of Harper Creek where it discharges to North Barriere Lake looking west down the Barriere River valley.

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 5 – Looking upstream at the first reach of Harper Creek upstream of North Barriere Lake.

PHOTO 6 – Lower reaches of Harper Creek near river km 3.4 during high flows (May 21, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

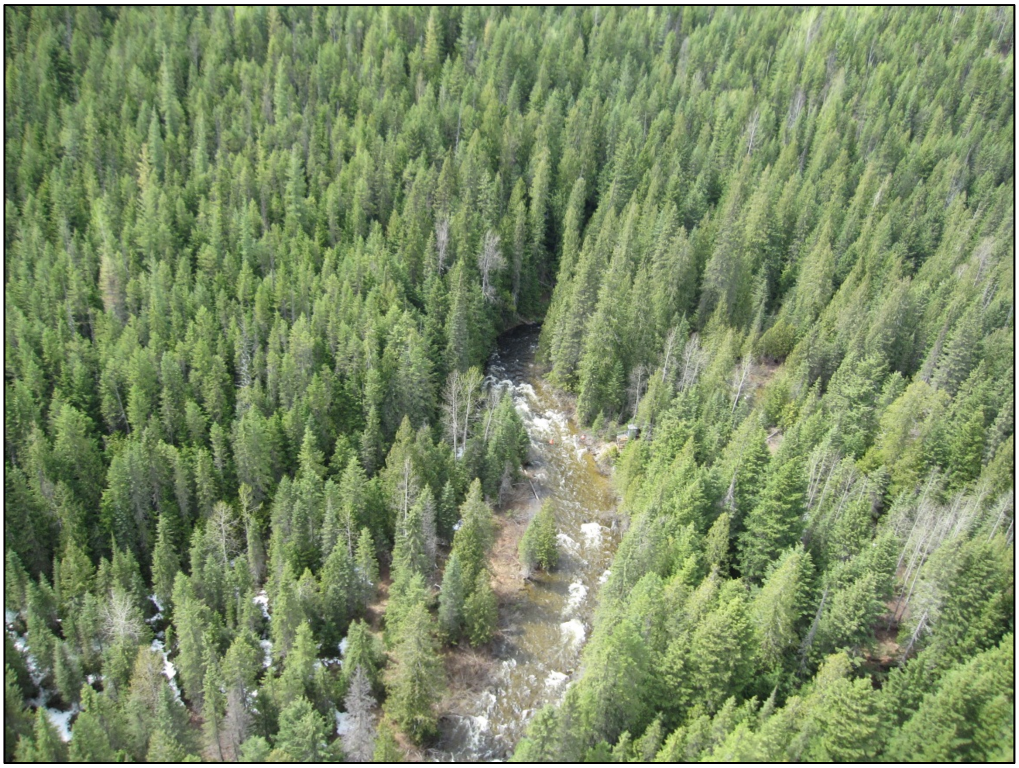


PHOTO 7 – WSC station on Harper Creek at river km 5.5 on May 21, 2011.

PHOTO 8 – Low gradient section of Harper Creek and secondary channel near river km 8.6 on May 21, 2011.

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 9 – Harper Creek just downstream of T-Creek near river km 20.2 on May 21, 2011.

PHOTO 10 – Aerial view of lower T-Creek at its confluence with upper Harper Creek on May 21, 2011.

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 11 – T-Creek at high flows approximately 200 m upstream of its confluence with Harper Creek on June 21, 2011.

PHOTO 12 – T-Creek at high flows approximately 340 m upstream of its confluence with Harper Creek (June 21, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 13 – Lower Harper Creek upstream of Water Survey Canada gauging station at river km 5.6 (July 27, 2011).

PHOTO 14 – Electrofishing below logjam on upper Harper Creek downstream of T-Creek near river km 20.3 (June 21, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 15 – Looking upstream on P-Creek towards the FSR bridge (June 22, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 16 – Lower Harper Creek approximately 600 m upstream of North Barriere Lake (June 22, 2011).

PHOTO 17 – Baker Creek just upstream of Lost Creek-Birch Island Road on June 23, 2011.

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 18 – Adult longnose dace (*Rhinichthys cataractae*) sampled from lower Harper Creek (June 22, 2011).

PHOTO 19 – T-Creek approximately 65 m upstream of the Harper Creek confluence (July 27, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 20 – T-Creek approximately 70 m upstream of the Harper Creek confluence (July 27, 2011).

PHOTO 21 – Pool habitat in T-Creek approximately 70 m upstream of the Harper Creek confluence (July 27, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 22 – T-Creek approximately 110 m upstream of the Harper Creek confluence (July 27, 2011).

PHOTO 23 – T-Creek approximately 120 m upstream of the Harper Creek confluence (July 27, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 24 – T-Creek approximately 160 m upstream of the Harper Creek confluence (July 27, 2011).

PHOTO 25 – T-Creek approximately 180 m upstream of the Upper Harper Creek confluence (July 27, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 26 – T-Creek approximately 190 m upstream of the Harper Creek confluence (July 27, 2011).

PHOTO 27 – T-Creek, approximately 210 m upstream of the Harper Creek confluence (July 27, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 28 – T-Creek approximately 260 m upstream of the Harper Creek confluence (July 27, 2011).

PHOTO 29 – 1.8 m high falls on T-Creek approximately 336 m upstream of the Harper Creek confluence (July 27, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 30 – High gradient potion of T-Creek above fish barrier approximately 400 m upstream of the Harper Creek confluence (July 26, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 31 – Juvenile bull trout (*Salvelinus confluentus*) sampled from T-Creek (July 27, 2011).

PHOTO 32 – Bull trout spawning habitat in lower Harper Creek near river km 17.9 just approximately 600m downstream of migratory bull trout obstacle at river km 18.5 (July 29, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 33 – Lower Jones Creek approximately 120 m upstream of the North Thompson River confluence (July 29, 2011) N.B. this portion of the creek was dry during late summer due to local water abstraction.

PHOTO 34 – Non fish bearing habitat in upper T-Creek approximately 2.6 km upstream of the Harper Creek confluence (August 16, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 35 – Non fish bearing habitat within the project site area in upper T-Creek approximately 3.3 km upstream of the Harper Creek confluence (August 16, 2011).

PHOTO 36 – Near the upper limit of rainbow trout and mountain whitefish habitat in lower Harper Creek near river km 8.7 (August 19, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 37 – lower Harper Creek near river km 8.6 (August 19, 2011).

PHOTO 38 – Pool habitat in lower Harper Creek near river km 17 (August 19, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 39 – Waterfall barrier that denotes the limit of fish distribution on P-Creek located approximately 469 m upstream of the Harper Creek confluence (September 9, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 40 – Lower Harper Creek near river km 17.3 (September 9, 2011).

PHOTO 41 – Headwaters of upper T-Creek within the project site are approximately 6.9 km upstream of the Harper Creek confluence (September 10, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 42 – Lower Harper Creek upstream of a series of large log jams at river km 1.4 (September 11, 2011).

PHOTO 43 – 2 m high falls situated upstream of a series of cascades that form a migration obstacle for adfluvial bull trout on Harper Creek at river km 18.5 (September 9, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 44 – Bull trout redd located in upper Harper Creek near river km 20.2 below its confluence with T-Creek (September 28, 2011).

PHOTO 45 – Lower Harper Creek off channel habitat located near river km 10.5 (October 19, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

PHOTO 46 – Fishless portion of upper Harper Creek near river km 25.6 (September 21, 2011).

PHOTO 47 – Series of cascades in the high gradient portion of Baker Creek approximately 1.4 km above Lost Creek-Birch Island Road (September 28, 2011).

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

APPENDIX B

FISH SAMPLING AND AQUATIC HABITAT CHARACTERIZATION SITES

(Pages B-1 to B-2)

Knight Piésold CONSULTING

APPENDIX B

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

FISH SAMPLING AND AQUATIC HABITAT CHARACTERIZATION SITES

Print Aug/22/14 10:15:57

No.	Watershed	Waterbody	Reach Number	Site Code	Mainstem km	UTM Zone	UTM Easting	UTM Northing
1	AVERY	Avery Creek	Reach 2	AC-F010	0.55	11U	309884	5717119
2	AVERY	Avery Creek	Reach 3	AC-F020	4.05	11U	311389	5714583
3	BAKER	Baker Creek	Reach 1	BC-F010	0.03	11U	305160	5717796
4	BAKER	Baker Creek	Reach 2	BC-F020	0.20	11U	305106	5717639
5	BAKER	Baker Creek	Reach 2	BC-F030	1.50	11U	305094	5716468
6	BAKER	Baker Creek	Reach 2	BC-F040	1.70	11U	305085	5716229
7	BAKER	Baker Creek	Reach 3	BC-F050	2.00	11U	305109	5715953
8	BAKER	Baker Creek	Reach 3	BC-F060	2.40	11U	305176	5715605
9	BAKER	Baker Creek	Reach 4	BC-F070	4.50	11U	305366	5713642
10	CHUCK	Chuck Creek	Reach 2	CC-F010	0.65	11U	313003	5718415
11	FOGHORN	Foghorn Creek	Reach 1	FC-F010	0.05	11U	297708	5720888
12	JONES	Jones Creek	Reach 1	JC-F010	0.15	11U	306785	5718217
13	JONES	Jones Creek	Reach 1	JC-F020	0.39	11U	306817	5717995
14	JONES	Jones Creek	Reach 1	JC-F030	0.62	11U	306737	5717783
15	JONES	Jones Creek	Reach 2	JC-F040	0.77	11U	306658	5717651
16	JONES	Jones Creek	Reach 2	JC-F050	1.30	11U	306412	5717233
17	JONES	Jones Creek	Reach 2	JC-F060	1.70	11U	306398	5716778
18	JONES	Jones Creek	Reach 2	JC-F065	1.95	11U	306500	5716594
19	JONES	Jones Creek	Reach 3	JC-F070	3.60	11U	307100	5715159
20	LOWER HARPER	Harper Creek	Reach 1	HC-F010	0.40	11U	299259	5689527
21	LOWER HARPER	Harper Creek	Reach 1	HC-F020	0.40	11U	299383	5689557
22	LOWER HARPER	Harper Creek	Reach 10	HC-F280	18.50	11U	301149	5704075
23	LOWER HARPER	Harper Creek	Reach 2	HC-F030	0.60	11U	299266	5689749
24	LOWER HARPER	Harper Creek	Reach 2	HC-F040	0.90	11U	299091	5689830
25	LOWER HARPER	Harper Creek	Reach 2	HC-F050	1.40	11U	298755	5689980
26	LOWER HARPER	Harper Creek	Reach 3	HC-F060	1.60	11U	298691	5690155
27	LOWER HARPER	Harper Creek	Reach 3	HC-F070	1.90	11U	298524	5690359
28	LOWER HARPER	Harper Creek	Reach 5	HC-F080	5.30	11U	299437	5693052
29	LOWER HARPER	Harper Creek	Reach 5	HC-F090	5.50	11U	299347	5693173
30	LOWER HARPER	Harper Creek	Reach 5	HC-F100	5.60	11U	299356	5693232
31	LOWER HARPER	Harper Creek	Reach 5	HC-F110	5.90	11U	299324	5693454
32	LOWER HARPER	Harper Creek	Reach 5	HC-F120	8.30	11U	299629	5695406
33	LOWER HARPER	Harper Creek	Reach 5	HC-F130	8.40	11U	299540	5695539
34	LOWER HARPER	Harper Creek	Reach 5	HC-F140	8.60	11U	299535	5695687
35	LOWER HARPER	Harper Creek	Reach 6	HC-F150	9.30	11U	299546	5696307
36	LOWER HARPER	Harper Creek	Reach 6	HC-F160	9.50	11U	299572	5696427
37	LOWER HARPER	Harper Creek	Reach 6	HC-F170	10.90	11U	299941	5697502
38	LOWER HARPER	Harper Creek	Reach 7	HC-F180	11.30	11U	299919	5697842
39	LOWER HARPER	Harper Creek	Reach 7	HC-F190	14.20	11U	300561	5700428
40	LOWER HARPER	Harper Creek	Reach 8	HC-F200	15.90	11U	300959	5701905
41	LOWER HARPER	Harper Creek	Reach 8	HC-F210	16.20	11U	300947	5702166
42	LOWER HARPER	Harper Creek	Reach 8	HC-F220	17.10	11U	301039	5702995
43	LOWER HARPER	Harper Creek	Reach 8	HC-F230	17.30	11U	300911	5703111
44	LOWER HARPER	Harper Creek	Reach 8	HC-F240	17.90	11U	300906	5703683
45	LOWER HARPER	Harper Creek	Reach 9	HC-F250	18.20	11U	300949	5703967
46	LOWER HARPER	Harper Creek	Reach 9	HC-F270	18.30	11U	301089	5703992
47	LOWER HARPER	Harper Creek	Reach 9	HC-F260	18.30	11U	301089	5703992
48	LOWER HARPER	Harper Creek	Reach 9	HC-F270	18.40	11U	301002	5704031
49	LUTE	Lute Creek	Reach 1	LC-F010	0.12	11U	302138	5718243

Knight Piésold CONSULTING

50	UPPER HARPER	D Creek	Reach 1	DF-F010	22.40	11U	301630	5707497
51	UPPER HARPER	Harper Creek	Reach 11	HC-F290	19.00	11U	301531	5704509
52	UPPER HARPER	Harper Creek	Reach 11	HC-F300	19.20	11U	301645	5704611
53	UPPER HARPER	Harper Creek	Reach 11	HC-F310	19.70	11U	301902	5704991
54	UPPER HARPER	Harper Creek	Reach 12	HC-F320	20.00	11U	302001	5705228
55	UPPER HARPER	Harper Creek	Reach 12	HC-F330	20.20	11U	301980	5705453
56	UPPER HARPER	Harper Creek	Reach 12	HC-F340	20.30	11U	301979	5705578
57	UPPER HARPER	Harper Creek	Reach 13	HC-F350	20.60	11U	302078	5705788
58	UPPER HARPER	Harper Creek	Reach 13	HC-F360	20.90	11U	302114	5706068
59	UPPER HARPER	Harper Creek	Reach 14	HC-F370	21.00	11U	301985	5706235
60	UPPER HARPER	Harper Creek	Reach 15	HC-F390	21.30	11U	301884	5706380
61	UPPER HARPER	Harper Creek	Reach 15	HC-F400	21.50	11U	301767	5706549
62	UPPER HARPER	Harper Creek	Reach 15	HC-F380	21.20	11U	301814	5706972
63	UPPER HARPER	Harper Creek	Reach 15	HC-F410	22.20	11U	301824	5707200
64	UPPER HARPER	Harper Creek	Reach 16	HC-F420	22.40	11U	301736	5707473
65	UPPER HARPER	Harper Creek	Reach 16	HC-F430	23.50	11U	301819	5708512
66	UPPER HARPER	Harper Creek	Reach 16	HC-F440	24.30	11U	301723	5709233
67	UPPER HARPER	Harper Creek	Reach 17	HC-F450	24.50	11U	301734	5709456
68	UPPER HARPER	Harper Creek	Reach 17	HC-F460	25.50	11U	302011	5710320
69	UPPER HARPER	Harper Creek	Reach 18	HC-F470	25.80	11U	302038	5710533
70	UPPER HARPER	P-Creek	Reach 1	PC-F010	0.04	11U	301796	5709375
71	UPPER HARPER	P-Creek	Reach 1	PC-F020	0.19	11U	301920	5709410
72	UPPER HARPER	P-Creek	Reach 1	PC-F030	0.28	11U	301989	5709461
73	UPPER HARPER	P-Creek	Reach 1	PC-F040	0.36	11U	302013	5709541
74	UPPER HARPER	P-Creek	Reach 2	PC-F050	0.42	11U	302043	5709587
75	UPPER HARPER	P-Creek	Reach 2	PC-F060	0.57	11U	302150	5709677
76	UPPER HARPER	P-Creek	Reach 2	PC-F070	0.95	11U	302419	5710006
77	UPPER HARPER	T-Creek	Reach 1	TC-F010	0.03	11U	302016	5705583
78	UPPER HARPER	T-Creek	Reach 1	TC-F020	0.08	11U	302069	5705572
79	UPPER HARPER	T-Creek	Reach 1	TC-F030	0.14	11U	302125	5705572
80	UPPER HARPER	T-Creek	Reach 1	TC-F040	0.18	11U	302162	5705586
81	UPPER HARPER	T-Creek	Reach 1	TC-F050	0.26	11U	302233	5705601
82	UPPER HARPER	T-Creek	Reach 2	TC-F060	0.30	11U	302269	5705604
83	UPPER HARPER	T-Creek	Reach 2	TC-F070	0.38	11U	302340	5705634
84	UPPER HARPER	T-Creek	Reach 2	TC-F080	0.62	11U	302569	5705608
85	UPPER HARPER	T-Creek	Reach 2	TC-F090	0.72	11U	302650	5705558
86	UPPER HARPER	T-Creek	Reach 2	TC-F105	8.00	11U	304182	5705919
87	UPPER HARPER	T-Creek	Reach 3	TC-F100	2.30	11U	304062	5705827
88	UPPER HARPER	T-Creek	Reach 3	TC-F110	2.60	11U	304288	5706068
89	UPPER HARPER	T-Creek	Reach 3	TC-F152	3.50	11U	304824	5706200
90	UPPER HARPER	T-Creek	Reach 4	TC-F120	3.00	11U	304427	5706343
91	UPPER HARPER	T-Creek	Reach 4	TC-F130	3.20	11U	304553	5706463
92	UPPER HARPER	T-Creek	Reach 4	TC-F140	3.50	11U	304738	5706581
93	UPPER HARPER	T-Creek	Reach 4	TC-F150	3.70	11U	304897	5706696
94	UPPER HARPER	T-Creek	Reach 4	TC-F156	4.50	11U	305858	5706708
95	UPPER HARPER	T-Creek	Reach 4	TC-F157	4.30	11U	305444	5706676
96	UPPER HARPER	T-Creek	Reach 5	TC-F155	5.17	11U	305628	5707920
97	UPPER HARPER	T-Creek	Reach 6	TC-F160	7.30	11U	306800	5709017
98	UPPER HARPER	T-Creek	Reach 6	TC-F170	7.60	11U	306920	5709159

ne\Tables\[2013 Tables All.xlsx]3.1.1 Fish and Habitat Sites

0	13MAY'14	ISSUED WITH REPORT VA101-458/15-1	AT	OG	CB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

APPENDIX C

LEVEL 1 HABITAT SURVEY

(Pages C-1 to C-3)

Knight Piésold CONSULTING

APPENDIX C

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

LEVEL 1 HABITAT SURVEY DATA (P-CREEK, T-CREEK)

Print Aug/22/14 10:21:03

Level 1 Habitat Survey Data Form

Watershed: Harper Creek — Sub-Basin: **T Creek**
Weather: sun with clouds — Date: Sept. 23/ 12
Survey Crew: PMT, KEF, NN

H.U. #	Reach Number	Distance (m)	Habitat Unit Type	Habitat Unit Cat	Length (m)	Gradient (%)	Mean Depth Bankfull (m)	Mean Depth Water (m)	Mean Width Bankfull (m)	Mean Width Wetted (m)	Pools Only Max Depth (m)	Pools Only Crest (m)	Pools Only Residual (m)	Pools Only Pool Type	Bed Material Dom.	Bed Material Sub-Dom.	Spawning Gravel? Type	Spawning Gravel? Amount	Functional LWD Tally Total	LWD 10 - 20 cm	LWD 20 - 50 cm	LWD > 50 cm	Cover Type	Cover %	Cover Type	Cover %	Riparian Vegetation Type	Riparian Vegetation Structure	Canopy Closure	Barriers	PHOTO #'S
1	1	21	R	1	21	2	0.48	0.06, 0.14, 0.12	6.4	4.3					C	B	R	L	1		1		OV	20	WD	5	D/C	MF	1		435-436
2	2	31	P	1	10	2	0.85	0.34, 0.47 , 0.32	7.3	6.1	0.47	0.28	0.19	S	B	C	N	N	2	2			B	15	OV	5	D/C	PS	1		437
3	3	40	G	1	9	1	0.9	0.15, 0.36, 0.20	6.2	3.4					B	C	N	N	0				B	15	B	50	D/C	PS	1		438
4	4	51	R	1	11	3	0.68	0.17, 0.15, 0.12	10.4	4.1					B	C	N	N	1		1		OV	30	B	20	D/C	MF	1		439
5	5	59	G	1	8	1	0.95	0.21, 0.28, 0.27	6.5	2.8					B	C	N	N	2		1	1	OV	20	B	20	D/C	MF	1		440
6	6	77	R	1	18	4	0.66	0.2, 0.11, 0.15	10.8	7.4					C	B	N	N	0				OV	30	B	20	D/C	MF	1		441
7	7	83	P	1	6	1	0.67	0.49, 0.85, 0.48	13.4	5.9	0.85	0.19	0.66	S	B	C	R	L	2			2	B	30	UC	20	D/C	MF	1		442
8	8	100	R	1	17	3	0.75	0.17, 0.27, 0.20	7.8	4.5					B	C	R	L	1	1			OV	20	B	30	D/C	MF	1		443
9	9	103	P	1	3	1	0.9	0.24, 0.39, 0.32	6.7	3.9	0.39	0.15	0.24	S	B	C	N	N	0				OV	50	B	50	D/C	MF	1		444
10	10	134	R	1	31	4	0.85	0.07, 0.13, 0.22	8.1	6.3					B	C	N	N	3			3	OV	25	B	25	D/C	MF	1		445
11	11	141	P	1	7	1	2.3	0.26, 0.48, 0.40	9.3	3.5	0.48	0.17	0.31		B	C	N	N	0				B	20	OV	20	D/C	MF	1		446
12	12	147	R	1	6	2	0.97	0.21, 0.24, 0.15	6.6	4.1					B	C	N	N	0				B	50	OV	60	D/C	MF	1		447
13	13	152	G	1	5	1	1.4	0.23, 0.43, 0.27	8.5	4					B	C	N	N	1		1		B	30	UC	25	D/C	MF	3		448
14	14	155	C	1	3	15	1.85	0.13, 0.17, 0.12	9	6.1					B	G	N	N	1		1		B	70	OV	20	D/C	MF	1		449-450
15	15	170	G	1	15	2	1.6	0.35, 0.30, 0.10	9.3	6					B	C	N	N	0				B	30	OV	60	D/C	MF	3		451-452
16	16	184	C	1	14	12	1.44	0.23, 0.25, 0.13	8.1	3.4					B	C	N	N	0				B	40	OV	20	D/C	MF	0		453-454
17	17	187	P	1	3	1	0.45	0.6, 0.68, 0.32	7.4	3.8	0.68	0.19	0.49		B		N	N	0				B	100			D/C	MF	1		455
18	18	188	C	1	1	25	0.45	0.13, 0.11, 0.09	5.1	3.2					B	G	N	N	0				B	50	OV	50	D/C	MF	1		456
19	19	195	SP	1	7	2	0.62	0.14, 0.28, 0.17	9.7	7.1					B	C	N	N	0				OV	70	B	40	D/C	MF	1		457
20	20	204	P	1	9	1	0.85	0.40, 0.53, 0.45	7.7	4.6	0.53	0.17	0.36		B		N	N	0				OV	50	B	50	D/C	MF	1		485
21	21	258	SP/C	1	54	27	1.5	0.27, 0.38, 0.27	11.8	6.7					B		N	N	10	4	4	2	OV	50	B	50	D/C	MF	1		459-460
22	22	265	P	1	7	1	2.2	0.48, 0.57, 0.63	9.3	5.6	0.63	0.22	0.41		B		N	N	0				B	90	OV	10	D/C	MF	1		461
23	23	336	C	1	71	22	0.45	0.14	0.25	0.42	12.7				B		N	N	1				B	80	OV	10	D/C	MF	1	FALLS	

Level 1 Habitat Survey Data Form

Watershed: Harper Creek — Sub-Basin: **P Creek**
Weather: sun with clouds — Date: Sept. 23/ 12
Survey Crew: PMT, KEF, NN

H.U. #	Reach Number	Distance (m)	Habitat Unit Type	Habitat Unit Cat	Length (m)	Gradient (%)	Mean Depth Bankfull (m)	Mean Depth Water (m)	Mean Width Bankfull (m)	Mean Width Wetted (m)	Pools Only Max Depth (m)	Pools Only Crest (m)	Pools Only Residual (m)	Pools Only Pool Type	Bed Material Dom.	Bed Material Sub-Dom.	Spawning Gravel? Type	Spawning Gravel? Amount	Functional LWD Tally Total	LWD 10 - 20 cm	LWD 20 - 50 cm	LWD > 50 cm	Cover Type	Cover %	Cover Type	Cover %	Riparian Vegetation Type	Riparian Vegetation Structure	Canopy Closure	Barriers	PHOTO #'S
1	1	19	R	1	19	2	0.52	0.06, 0.11, 0.03	5.1	4.6					C	G			3			3	LWD	25	OV	35	C/D	MF	1		404-405
2	2	25	P	1	6	1	0.43	0.22, 0.3, 0.2	4.9	2.2	0.39	0.07	0.32	D	C	G							OV	40			C/D	MF	1		406
3	3	87	R	1	62	2	0.47	0.04, 0.13, 0.05	7	3.8					C	G			5	2	2	1	LWD	15	OV	60	C/D	MF	1		407-408
4	4	104	SP	1	17	3	0.41	0.06, 0.23, 0.1	5.2	3.8					C	B			2		1	1	OV	30	B	15	C/D	MF	1		409-410
5	5	107	P	1	3	1	0.51	0.33, 0.62, 0.31	5.3	4	0.62	0.12	0.5	S	B	C			1			1	B	25	UC	20	C/D	MF	1	DROP POOL	411
6	6	175	SP	1	68	4	0.58	0.21, 0.14, 0.1	4.7	2.5					C	B			5	2	2	1	OV	40	B	15	C/D	MF	2		412-414
7	7	178	P	1	3	1	0.59	0.26, 0.34, 0.31	6	4.9	0.34	0.09	0.25	S	B	C			2			2	OV	40	B	10	C/D	MF	2		415
8	8	184	SP	1	6	5	0.56	0.12, 0.2, 0.1	5	4					C	C	R	L					B	15	OV	5	C/D	MF	1		416
9	9	186	P	1	2	1	0.79	0.26, 0.56, 0.41	4	3.1	0.56	0.17	0.39	S	B	C			2			2	B	25	OV	40	C/D	MF	2	DROP POOL	417
10	10	207	SP	1	21	10	0.5	0.04, 0.16, 0.25	4.8	2.8					C	G	R	L	10	4	3	3	OV	35	LWD	35	C/D	MF	1		418-419
11	11	212	P	1	5	1	0.35	0.23, 0.4, 0.21	9.1	7.1	0.4	0.11	0.29	J	F	C	R	L	3				LWD	30	OV	15	C/D	MF	1		420
12	12	231	SP	1	19	7	0.38	0.19, 0.3, 0.07	7.3	3.8	0.46	0.11	0.35	S	C	G	R	L	4				LWD	15	OV	20	C/D	MF	1	LOW FLOW	421-422
13	13	240	G	1	9	1	0.23	0.17, 0.23, 0.12	8	3.2					C	G	R	L	2	2			OV	25	LWD	10	C/D	MF	1		423
14	14	315	SP	1	75	11	0.35	0.08, 0.11, 0.23	7.4	6.1	0.32	0.14	0.26	J	C	B	R	L	10	4	3	3	OV	15	LWD	15	C/D	MF	1	LOW FLOW	424-425
15	15	338	R	1	23	4	0.62	0.05, 0.09, 0.09	4.8	3.6					C	B			2		1	1	OV	10	LWD	10	C/D	MF	1		426
16	16	352	C	1	14	14	0.43	0.09, 0.02, 0.11	13.4	12.3	0.25	0.09	0.37	S	C	B	R	L	5		3	2	OV	10	LWD	15	C/D	MF	0	DROP POOL	427-428
17	17	364	G	1	12	1	0.31	0.16, 0.12, 0.06	12.5	4.6					C	G	R	L	0				OV	5	LWD	5	C/D	MF	1		429
18	18	418	SP	1	54	16	0.36	0.12, 0.08, 0.25	5.7	4.2	0.21	0.07	0.19	S	B	C			10	4	3	3	OV	10	LWD	20	C/D	MF	1	DROP POOL	430-431
19	19	425	C	1	7	25	0.65	0.09, 0.29, 0.18	5	5					B	C			1	1			B	25	LWD	5	C/D	MF	1	LOW FLOW	432
20	20	429	P	1	4	1	0.72	0.45, 0.78, 0.56	5.1	4.2	0.78	0.28	0.5	S	B	BROCK			0				B	25			C/D	MF	1	FULL	433-434

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 1\Appendices\C - Level 1 Habitat Survey\[Appendix C level 1 habitat survey May 30.xlsx]APP C - Upper Harper Creek

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	30MAY'14	ISSUED WITH REPORT 101-458/15-1	PMT	PMT	WOG

Knight Piésold
CONSULTING

APPENDIX C

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

LEVEL 1 HABITAT SURVEY DATA (UPPER HARPER CREEK BELOW P-CREEK CONFLUENCE)

Print Aug/22/14 10:23:08

Level 1 Habitat Survey Data Form

Watershed: Harper Creek D/S of P Creek Confluence | Sub-Basin: **Harper Cr. Mainstem D/S P-Creek confluence (452m)**

Weather: sun | Flow: Very low flows | Date: Sept. 18/ 13

Survey Crew: PMT, Ryan Papp, Nick Sterling | Start : 11U, 301759 , 5709340 | End : 11U, 301735 , 5708982

H.U. #	Reach Number	Distance (m)	Habitat Unit Type	Cat	Length (m)	Gradient (%)	Mean Depth Bankfull (m)	Mean Depth Water (m)	Mean Width Bankfull (m)	Mean Width Wetted (m)	Max Depth (m)	Pools Only Crest (m)	Pools Only Residual (m)	Pool Type	Bed Material Type Dom.	Bed Material Type Sub-Dom.	Spawning Gravel? Type	Spawning Gravel? Amount	Total LWD Tally	Functional LWD Tally 10 - 20 cm	Functional LWD Tally 20 - 50 cm	Functional LWD Tally > 50 cm	Cover Type	Cover %	Cover Type	Cover %	Riparian Vegetation Type	Riparian Vegetation Structure	Riparian Vegetation Canopy Closure	Barriers	Comments PHOTO #'S
1		8	R	1	8	1.5	0.31	0.11,0.11,0.08	5.8	2.3					C	G	N		0				D	50	C	50	DEC	YF/PS	50		969
2		13	P	1	5		0.71	0.12,0.12,0.03	5.6	4.3	0.37	0.11			C	G	N		1	1			D	100	D		DEC	YF/PS	100		970
3		33	R	1	20	1.5	0.8	0.8,0.11,0.07	7.5	3.8					C	G	N		0				D	100	D	100	DEC	YF/PS	100		971
4		44	P	1	11		0.44	0.12,0.08,0.01	4.4		0.63	0.11			C	S	N		5			5	D	85	D		DEC	YF/PS		OLD BRIDGE	972
5		53	G	1	9	0.5	0.2	0.12,0.08,0.00	8	3.8					C	B	N		0				D	30	C	5	DEC	YF/PS	35		973
6		71	R	1	18	1.5	0.66	0.19,0.16,0.09	5.1	2.4					C	C	N		0				D	40	C	15	DEC	YF/PS	60		974
7		88	G	1	17	0.5	0.95	0.22.0.13, 0.2	5.1	5.5					C	B	N		5				C	10			DEC	YF/PS			975
8		97	P	1	9		0.71		6.7	3.8	0.49	0.16			C	C	N		4	2	2		LWD	10			DEC	YF/PS	60		976
9		104	R	1	7	1	0.65	0.13,0.03,0.04	6.7	3.3					G	G	N		1	1			UCB	10			DEC	YF/PS	40		977
10		115	P	1	11		1.6		7.6	3.7	0.48	0.1			C	G	N		4	2	1		D	75	LWD		DEC	YF/PS	75		978
11		131	R	1	16	1.5	0.6	0.11,0.11, 0.06	4	2.1					C	C	N		4	4			OV	50			DEC	YF/PS	30		979
12		160	G	1	29	1	0.69	0.21, 0.15, 0.09	6.5	2.6					C	G	N		0				OV	10			DEC	YF/PS	10		980
13		177	P	1	17		0.8		7.5	5.1	0.75	0.08			C	S	N		3	1			OV	15	LWD	20	DEC	YF/PS	30		981
14		193	R	1	23	1.6	0.46	0.09, 0.14, 0.03	6.1	2.9					G	C	N		1	1			D	15	UCB	15	DEC	YF/PS	10		982
15		224	G	1	31	1.6	0.36	0.09, 0.11, 0.1	6.3	4.1					C	B	N		2	2			OV	50	B	10	DEC	YF/PS	25		983
16		249	P	1	25		0.81		17.2	3.7	0.46	0.08			C	G	R		10	2	2	6	LWD	50	OV	10	DEC	YF/PS	15		984/85
17		292	RP	1	43	2	0.6	0.07, 0.08, 0.08	10.7	1.5	0.5	0.18			C	G	N		20	10	10	5	LWD	75			SRUB	YF/PS	15		986/87
18		313	R	1	21	0.5	0.77	0.06, 0.06, 0.04	7.7	2.8					G	S	R		1		1						DEC	YF/PS	5		988
19		322	P	1	9		0.61		9.4	3.4	0.66	0.09			G	S	N		10	5	2	3	LWD	80	UCB	15	DEC	YF/PS	10		989
20		353	R	1	31	0.5	0.3	0.01, 0.06, 0.08	4.9	1.5					C	G	N		15	5	5	5	LWD	30			DEC	YF/PS	10		990
21		366	P	1	13		0.82		7.1	3.6	0.57	0.06			G	S	R		2	1	1		LWD	10	UCB	20	DEC	YF/PS	10		991
22		392	RP	1	26	0.5	0.25	0.04, 0.07, 0.05	6.3	1.7	0.38	0.05			G	S	R		3	1	1	1	LWD	15			DEC	YF/PS	15		992
23		415	RP	1	23	0.5	0.42	0.05, 0.1, 0.1	7.4	3.2	0.43	0.07			C	G/S	N		20	5	15	7	UCB	5	LWD	70	DEC	YF/PS	25		993
24		452	R	1	37	0.5	0.49	0.01, 0.04, 0.09	8.7	4.3					C	G/S	N		20	5	10	5	LWD	30	OV	20	DEC	YF/PS	30		994

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 1\Appendices\C - Level 1 Habitat Survey\[Appendix C level 1 habitat survey May 30.xlsx]APP C - Upper Harper Creek

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	30MAY'14	ISSUED WITH 101-458/15 -1	PMT	PMT	WOG

Knight Piésold CONSULTING

APPENDIX C

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

LEVEL 1 HABITAT SURVEY DATA (BAKER CREEK)

Print Aug/22/14 10:21:03

Level 1 Habitat Survey Data Form

Watershed: Harper Creek D/S of P Creek Confluence — Sub-Basin: **Baker Creek**

Baker Creek — Flow: Very low flows — Date: Sept. 21/ 13

Survey Crew: PMT, Ryan Papp, Nick Sterling — Start : 11U, 305150, 5717718 — End: 11U, 305128, 5717096

H.U. #	Reach Number	Distance (m)	Habitat Unit Type	Cat	Length (m)	Gradient (%)	Mean Depth Bankfull (m)	Mean Depth Water (m)	Mean Width Bankfull (m)	Mean Width Wetted (m)	Pools Only Max Depth (m)	Pools Only Crest (m)	Pools Only Residual (m)	Pool Type	Bed Material Type Dom.	Bed Material Type Sub-Dom.	Spawning Gravel? Type	Spawning Gravel? Amount	Total LWD Tally	Functional LWD Tally 10 - 20 cm	Functional LWD Tally 20 - 50 cm	Functional LWD Tally > 50 cm	Cover Type	Cover %	Cover Type	Cover %	Riparian Vegetation Type	Riparian Vegetation Structure	Riparian Vegetation Canopy Closure	Barriers	PHOTO #'S	Comments
1		19	SP		19	25	1	0.2,0.21,0.0	6.3	2.3	0.28	0.09			B	C	R	PATCH	1	1			B	40	UCB	10	C	YF	50		75	OLD CAR PARTS
2		40	SP		21	25	0.9	0.08,0.07,0.04	16.5	2					B	C	R	PATCH	6	2	4		LWD				C	YF	50		76	OLD CAR PARTS
3		61	SP		21	25	0.7		6.9	2.1					B	C	N		10	4	2	4	LWD	40	D	20	D	YF	50		77	OLD CAR PARTS
4		68	P		7		0.55		6	2.1	0.16	0			C	G	N		0								D	YF	10		78	
5		107	SP		39	25	0.44		5.1	2.9					B	C	N		2	1	1		OV	15	B	10	D	SAP	5		79	
6		144	C		41	25	0.52	0.1,0.21,0.17	4.5	2.1					B	C	N		10	7	3		B	15	OV	10	D	SAP	10		80	CULVERT
7		ROAD																												CULVERT		ROAD
8		156	R		12	12	0.36	0.11,0.15, 0.12	4.2	2.1					C	B	N		2	2			OV	40	B	10	C/D	YF	100		81	CULVERT
9		162	P		6		0.81		4.5	3.1	0.3	0.15			C	B	N		2		1	1	OV	30	B	10	D	PS	50		82	
10		172	R		10	2	0.68	0.15,0.19,0.16	2.2	1.9					C	B	N		0				OV	50	UCB	10	D/C	PS	100		83	
11		175	P		3		0.42		2.6	2.1	0.3	0.14			C	B	N		0				OV	60	UCB	10	D	PS	45		85	OLD WOOD PILE
12		212	R		37	5	1.4	0.09,0.12,0.17	4.7	2.1					B	C	N		0				OV	70	UCB	20	D/C	YF	10		86	
13		216	P		4		0.93		4.3	3.8	0.42	0.14			G	B	N		0				OV	40	UCB	20	D/C	YF	100		87	
14		246	RP		30		0.6	0.04,0.07,0.1	5.1	1.9					B	C	N		4	4			OV	50	UCB	25	D/C	YF	100		87	
15		253	P		7		0.7		3.9	1.9	0.34	0.12			C	G	N		1			1	LWD	40	UCB	20	D/C	YF	60		88	
16		287	RP		34	5	0.87	0.19,0.18,0.1	4.8	1.7					B	C	N		5	5			OV	50	UCB	30	D	PS	70		89	
17		293	P		6		0.19		2.6	1.7	0.42	0.12			B	C	N		0						UCB		D	PS	75		90	
18		310	RP		17	5	0.63	0.11,0.06,0.14	2.8	2.9					B	C	N		5	3	2		OV	75	UCB		D	PS	80		91	
19		313	P		3		0.54		6.7	4	0.25	0.06			G	B	R		0				OV	10	POUROVER	20	D				92	
20		318	R		5	8	0.15	0.14,0.03,0.06	6.6	6.1					G	C	R		0						UCB		D	PS	5		93	WATER INTAKE
21		320	P		2		0.23		6	3.5	0.46	0.09			C	B	N		1			1	B	10	UCB	10	D	PS	5		93	
22		327	RP		7	3	0.31	0.1,0.23,0.04	2.9	2.2					B	C	N		2	1	1		OV	10	UCB	20	D	PS	30		94	
23		331	P		4		0.37		2.9	3	0.63	0.1			B	C	N		2		2		UCB	20	LWD	20	C/D	PS	80			
24		420	RP		89		0.45	0.05, 0.18, 0.18	5.3	4.8					B	C	N		15	5	5	5	UCB	30	LWD	20	C/D	YF	80		95	
25		430	SP		10	20	0.77		6.3	5.7	0.44	0.09			C	B	N		3	1		2	OV	50	UCB	20	VEG	MAT	30		96	
26		440	R		10	15	0.65	0.19,0.11,0.12	7.8	3					C	B	N		5	1	2	2	LWD	20	UCB	20	D	PS	80		97-98	
27		493	P		3		0.39		4.3	2.9	0.45	0.16			G	C	N		3	3			LWD	30	UCB	20	D/C	PS	85		99	
28		576	RP		94	7	0.2	0.05,0.05,0.3	3.4	4.1					C	B	N		20	10	10		UCB	30	LWD	25	D	PS	90		100	
29		581	P		5		0.44		3.2	2.7	0.34	0.13			C	B	N		0				UCB	30	UCB	25	VEG	MAT	50		101	
30		589	RP		7	10	0.59	0.07,0.11,0.1	3.9	2.9					B	C	N		3	2	1		OV	40	UCB	20	C/D	YF	60			
31		595	P		6		0.52		4.1	4.6	0.44	0.08			C	G	N		0				OV	50	UCB	30	C	YF	70			
32		623	RP		28	8	0.6	0.04,0.01,0.12	2.7	2					B	C	N		0				OV	60	UCB	20	D	YF	75			
33		630	P		7		0.56		4.9	2.9	0.62	0.09			C	B	N		0				OV	60	UCB	10	D/C	PS	60		102	
34		653	SP		23	10	0.46	0.14,0.17,0.09	4.2	2.3					C	B	N		5	2	3		OV	70	UCB	30	D/C	PS	80		103	
35		659	P		6		0.46		6.2	2.6	0.46	0.08			C	G	R		2		2		OV	80	UCB		VEG	MAT	30		104	
36		743	SP		89	10	0.51	0.18,0.12,0.09	3.4	1.8					B	C	N		10	2	2	6	OV	80	UCB	20	VEG	MAT	90			
37		746	P		3		0.59		5	4.7	0.4	0.09			C	G	R		1			1	OV	70	UCB	10	C	YF	70			
38		753	SP		7	12	0.89	0.22,0.16,0.09	3.1	1.9					B	G	N		5		3	2	OV	25	UCB	20	C	YF	80			
39		758	P		5		0.5		3.4	2.2	0.27	0.14			G	C	N		0				OV	30	UCB	20	C	MF	80			
40		782	SP		24	15	0.46	0.15,0.22,0.04	3	2.2					B	C	N		5	1	2	2	OV	40	UCB	20	C	MF	30		105	
41		790	P		8		0.6		4.4	4.1	0.43	0.09			C	G	N		1			1	UCB	20	UCB	20	C	MF	80		106	
42		804	SP		14	10	0.45	0.09,0.13,0.1	5.5	2.3					B	C	N		3	2	2		OV	20	UCB	20	C	MF	70			
43		808	P		4		0.38		4.9	4.1	0.55	0.09			C	G	N		1			1	OV	30	UCB	10	C	MF	70			
44		819	SP		11	11	0.35	0.09,0.19,0.1	3.7	2.2					B	C	N		3	2	1		OV	30	UCB	20	C	MF	35			
45		822	P		3		0.29		5.9	3.9	0.35	0.13			B	C	N		1		1		OV	80	UCB	10	C	MF	80		107	
46		849	SP		27	10	0.69	0.13,0.17,0.05	3.6	2.8					B	C	N		0				OV	10	UCB	10	C	MF	30		108	
47		854	P		5		0.44		3.6	4	0.46	0.12			C	G	R		2		1	1	OV	20	UCB	20	C	MF	20			
48		879	SP		25	15	0.7	0.09,0.2,0.09	4.8	2.4					B	C	N		10	2	2	6	UCB	30	OV	20	C	MF	30			
49		914	SP		35	10	0.8		4.8	3.3					B	C	N		4		2	2	OV	50	UCB	10	C	MF	50		109	
50		917	P		3		0.55		4.2	4.6	0.47	0.12			G	B	N		2	1	1		OV	50	UCB	10	C	MF	30		110	
51		953	SP		36	10	0.15	0.06,0.15,0.1	3.6	3.4					C	B	N		15	7	7	1	OV	80	UCB	10	C	MF	25		111	
52		958	P		5				4.3	3.6	0.65	0.15			B	G	R		3	1		2	UCB	40	OV	15	C	MF	30			
53		969	SP		9	15	0.53	0.09,0.08, 0.14	5.2	4.3					B	G	R		10	2	2	6	LWD	20	OV	20	VEG	PS	40		112	
54		975	P		6		0.53		6.2	5.1	0.56	0.08			C	G	R		0				OV	30	UCB	10			50		113	
55		978	SP		3	10	0.44	0.04,0.26,0.02	4.4	3.1					C	B	N		2		2		UCB	30			VEG	PS	50			
56		981	P		3		0.48		3.5	3.3	1.42	0.17			C	B	N		0				UCB	10			C	MF	30			
57		992	SP		11	15	0.35	0.14,0.14,0.04	2.9	1.7					C	G	N		3	1		2	UCB	30	LWD	20	C	MF	35		114	
58		995	P		3		0.41		4.8	3	0.48	0.08			G	C	N		4	1	2	1	LWD	20	UCB	20	C	MF	50		115	
59		1040	SP		45	15	0.56	0.21,0.05, 0.06	5.7	3.6					B	C	N		10	5	2	3	LWD	50	UCB	20	C	MF	80			
60		1046	P		6		0.5		5.4	3.6	0.51	0.15			C	G	N		0				UCB	30	OV	10	C	MF	20			
61		1190	SP		146	10	0.46	0.07,0.22,0.14	4.4	2.7					B	C	N		20	5	10	5	LWD	80	UCB	50	C	MF	70			
62		1195	P		5		0.42		3.9	3.7	0.42	0.14			B	C	N		0				UCB	10	OV	10	C	MF	60		116	
63		1220	SP		25	15	0.5	0.05,0.18,0.03	3.3	2.9					B	C	N		20	5	5	10	LWD	50	OV	10	C	MF	70			
64		1223	P		3		0.54		6.7	5.8	0.54	0.08			C	G	N		3	1		2	LWD	30	OV	20	C	MF	80			
65		1242	SP		19	15	0.53	0.12,0.16,0.1	7.2	1.9					C	G	R		10	4	2	6	LWD	40	OV	20	C	MF	70		117	
66		1250	P		8		0.74		4.1	3.7	0.57	0.17			C	G	R		4	2	2		LWD	30	UCB	20	C	MF	60		118	END

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 1\Appendices\C - Level 1 Habitat Survey\[Appendix C level 1 habitat survey May 30.xlsx]APP C - Upper Harper Creek

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	30MAY'14	ISSUED WITH 101-458/15 -1	PMT	PMT	WOG

APPENDIX D

FISH CAPTURE DATA

(Pages D-1 to D-27)

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
BARRIERE	BEAR CREEK	23/09/13	R1	BR-F10	0.1	11U	306137	5692294	CO	48	1.63	296		100
BARRIERE	BEAR CREEK	23/09/13	R1	BR-F10	0.1	11U	306137	5692294	CO	52	2.61	296		100
BARRIERE	BEAR CREEK	23/09/13	R1	BR-F10	0.1	11U	306137	5692294	CO	43	0.85	296		100
BARRIERE	BEAR CREEK	23/09/13	R1	BR-F10	0.1	11U	306137	5692294	CO	46	1.01	296		100
BARRIERE	BEAR CREEK	23/09/13	R1	BR-F10	0.1	11U	306137	5692294	CO	45	1.07	296		100
BARRIERE	BEAR CREEK	23/09/13	R1	BR-F10	0.1	11U	306137	5692294	CO	76	4.51	296		100
BARRIERE	BEAR CREEK	23/09/13	R1	BR-F10	0.1	11U	306137	5692294	CO	74	4.39	296		100
BARRIERE	BEAR CREEK	23/09/13	R1	BR-F10	0.1	11U	306137	5692294	CO	52	1.84	296		100
BARRIERE	BEAR CREEK	23/09/13	R1	BR-F10	0.1	11U	306137	5692294	CO	49	1.58	296		100
BARRIERE	BEAR CREEK	23/09/13	R1	BR-F10	0.1	11U	306137	5692294	RBT	49	1.54	296		100
BARRIERE	BEAR CREEK	23/09/13	R1	BR-F10	0.1	11U	306137	5692294	RBT	52	1.88	296		100
BARRIERE	BEAR CREEK	23/09/13	R1	BR-F10	0.1	11U	306137	5692294	RBT	42	0.99	296		100
BARRIERE	BEAR CREEK	23/09/13	R1	BR-F10	0.1	11U	306137	5692294	RBT	49	1.49	296		100
BARRIERE	BEAR CREEK	23/09/13	R1	BR-F10	0.1	11U	306137	5692294	RBT	63	2.65	296		100
BARRIERE	BEAR CREEK	23/09/13	R1	BR-F10	0.1	11U	306137	5692294	RBT	52	1.5	296		100
HARPER	LOWER HARPER	22/6/11	R8	HC-F240	17.90	11U	300906	5703683	BT	162	40.9	254		75
HARPER	LOWER HARPER	22/6/11	R1	HC-F010	0.40	11U	299259	5689527	CO	64	3.4	70		80
HARPER	LOWER HARPER	22/6/11	R1	HC-F020	0.40	11U	299383	5689557	CO	61	3.1	70		70
HARPER	LOWER HARPER	22/6/11	R2	HC-F030	0.60	11U	299266	5689749	LNC	93	8.0	70		60
HARPER	LOWER HARPER	28/7/11	R5	HC-F090	5.50	11U	299347	5693173	BT	120		401		100
HARPER	LOWER HARPER	28/7/11	R5	HC-F090	5.50	11U	299347	5693173	BT	125		401		100
HARPER	LOWER HARPER	28/7/11	R8	HC-F240	17.90	11U	300906	5703683	BT	30		186		125
HARPER	LOWER HARPER	28/7/11	R8	HC-F240	17.90	11U	300906	5703683	BT	34		186		125
HARPER	LOWER HARPER	28/7/11	R8	HC-F250	18.20	11U	300949	5703967	BT	63	2.9	266		100
HARPER	LOWER HARPER	28/7/11	R8	HC-F250	18.20	11U	300949	5703967	BT	65	2.7	266		100
HARPER	LOWER HARPER	28/7/11	R9	HC-F270	18.40	11U	301002	5704031	BT	70	3.8	434		275
HARPER	LOWER HARPER	28/7/11	R9	HC-F270	18.40	11U	301002	5704031	BT	75	4.4	434		275
HARPER	LOWER HARPER	28/7/11	R9	HC-F270	18.40	11U	301002	5704031	BT	105	15.5	434		275
HARPER	LOWER HARPER	28/7/11	R9	HC-F270	18.40	11U	301002	5704031	BT	126	22.2	434		275
HARPER	LOWER HARPER	28/7/11	R9	HC-F270	18.40	11U	301002	5704031	BT	160	37.4	434		275
HARPER	LOWER HARPER	18/8/11	R2	HC-F050	1.40	11U	298755	5689980	BT	128		857		350
HARPER	LOWER HARPER	18/8/11	R3	HC-F060	1.60	11U	298691	5690155	BT	81		532		75
HARPER	LOWER HARPER	18/8/11	R2	HC-F030	0.60	11U	299266	5689749	CO	48		240		140
HARPER	LOWER HARPER	18/8/11	R2	HC-F030	0.60	11U	299266	5689749	CO	52		240		140
HARPER	LOWER HARPER	18/8/11	R2	HC-F030	0.60	11U	299266	5689749	CO	57		240		140
HARPER	LOWER HARPER	18/8/11	R2	HC-F030	0.60	11U	299266	5689749	CO	64		240		140
HARPER	LOWER HARPER	18/8/11	R2	HC-F030	0.60	11U	299266	5689749	CO	80		240		140
HARPER	LOWER HARPER	18/8/11	R2	HC-F030	0.60	11U	299266	5689749	CO	84		240		140
HARPER	LOWER HARPER	18/8/11	R2	HC-F030	0.60	11U	299266	5689749	CO	85		240		140
HARPER	LOWER HARPER	18/8/11	R2	HC-F030	0.60	11U	299266	5689749	CO	91		240		140
HARPER	LOWER HARPER	18/8/11	R2	HC-F030	0.60	11U	299266	5689749	CO	96		240		140
HARPER	LOWER HARPER	18/8/11	R2	HC-F050	1.40	11U	298755	5689980	CO	38		857		350

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	LOWER HARPER	18/8/11	R2	HC-F050	1.40	11U	298755	5689980	CO	38		857		350
HARPER	LOWER HARPER	18/8/11	R2	HC-F050	1.40	11U	298755	5689980	CO	42		857		350
HARPER	LOWER HARPER	18/8/11	R2	HC-F050	1.40	11U	298755	5689980	CO	43		857		350
HARPER	LOWER HARPER	18/8/11	R2	HC-F050	1.40	11U	298755	5689980	CO	43		857		350
HARPER	LOWER HARPER	18/8/11	R2	HC-F050	1.40	11U	298755	5689980	CO	46		857		350
HARPER	LOWER HARPER	18/8/11	R2	HC-F050	1.40	11U	298755	5689980	CO	47		857		350
HARPER	LOWER HARPER	18/8/11	R2	HC-F050	1.40	11U	298755	5689980	CO	51		857		350
HARPER	LOWER HARPER	18/8/11	R3	HC-F070	1.90	11U	298524	5690359	CO	39		423		90
HARPER	LOWER HARPER	18/8/11	R3	HC-F070	1.90	11U	298524	5690359	CO	44		423		90
HARPER	LOWER HARPER	18/8/11	R2	HC-F040	0.90	11U	299091	5689830	CRH	35		440		160
HARPER	LOWER HARPER	18/8/11	R2	HC-F040	0.90	11U	299091	5689830	CRH	35		440		160
HARPER	LOWER HARPER	18/8/11	R2	HC-F040	0.90	11U	299091	5689830	CRH	54		440		160
HARPER	LOWER HARPER	18/8/11	R2	HC-F040	0.90	11U	299091	5689830	CRH	56		440		160
HARPER	LOWER HARPER	18/8/11	R2	HC-F040	0.90	11U	299091	5689830	CRH	61		440		160
HARPER	LOWER HARPER	18/8/11	R2	HC-F040	0.90	11U	299091	5689830	CRH	92		440		160
HARPER	LOWER HARPER	18/8/11	R2	HC-F040	0.90	11U	299091	5689830	CRH	94		440		160
HARPER	LOWER HARPER	18/8/11	R3	HC-F060	1.60	11U	298691	5690155	CRH	50		532		75
HARPER	LOWER HARPER	18/8/11	R2	HC-F030	0.60	11U	299266	5689749	LNC	101		240		140
HARPER	LOWER HARPER	18/8/11	R2	HC-F040	0.90	11U	299091	5689830	LNC	63		440		160
HARPER	LOWER HARPER	18/8/11	R2	HC-F040	0.90	11U	299091	5689830	LNC	74		440		160
HARPER	LOWER HARPER	18/8/11	R3	HC-F060	1.60	11U	298691	5690155	LNC	74		532		75
HARPER	LOWER HARPER	18/8/11	R3	HC-F060	1.60	11U	298691	5690155	LNC	96		532		75
HARPER	LOWER HARPER	18/8/11	R2	HC-F050	1.40	11U	298755	5689980	MW	235		857		120
HARPER	LOWER HARPER	18/8/11	R2	HC-F040	0.90	11U	299091	5689830	RBT	99		440		160
HARPER	LOWER HARPER	18/8/11	R3	HC-F060	1.60	11U	298691	5690155	RBT	117		532		75
HARPER	LOWER HARPER	18/8/11	R3	HC-F070	1.90	11U	298524	5690359	RBT	84		423		90
HARPER	LOWER HARPER	18/8/11	R3	HC-F070	1.90	11U	298524	5690359	RBT	139		423		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F080	5.30	11U	299437	5693052	BT	82	6.3	355		120
HARPER	LOWER HARPER	19/8/11	R5	HC-F080	5.30	11U	299437	5693052	BT	83	5.6	355		120
HARPER	LOWER HARPER	19/8/11	R5	HC-F080	5.30	11U	299437	5693052	BT	92	7.9	355		120
HARPER	LOWER HARPER	19/8/11	R5	HC-F090	5.50	11U	299347	5693173	BT	74	3.8	336		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F090	5.50	11U	299347	5693173	BT	132	25.0	336		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F090	5.50	11U	299347	5693173	BT	152	35.4	339		155
HARPER	LOWER HARPER	19/8/11	R5	HC-F100	5.60	11U	299356	5693232	BT	108	11.9	335		120
HARPER	LOWER HARPER	19/8/11	R5	HC-F100	5.60	11U	299356	5693232	BT	174	53.0	335		120
HARPER	LOWER HARPER	19/8/11	R5	HC-F110	5.90	11U	299324	5693454	BT	128	21.0	580		100
HARPER	LOWER HARPER	19/8/11	R5	HC-F120	8.30	11U	299629	5695406	BT	46		410		125
HARPER	LOWER HARPER	19/8/11	R5	HC-F120	8.30	11U	299629	5695406	BT	87		410		125
HARPER	LOWER HARPER	19/8/11	R5	HC-F120	8.30	11U	299629	5695406	BT	123		410		125
HARPER	LOWER HARPER	19/8/11	R5	HC-F130	8.40	11U	299540	5695539	BT	74		186		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F130	8.40	11U	299540	5695539	BT	87		186		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F130	8.40	11U	299540	5695539	BT	147		186		90

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	LOWER HARPER	19/8/11	R5	HC-F140	8.60	11U	299535	5695687	BT	84		220		85
HARPER	LOWER HARPER	19/8/11	R5	HC-F140	8.60	11U	299535	5695687	BT	103		220		85
HARPER	LOWER HARPER	19/8/11	R8	HC-F220	17.10	11U	301039	5702995	BT	37		423		125
HARPER	LOWER HARPER	19/8/11	R8	HC-F220	17.10	11U	301039	5702995	BT	62	3.4	423		125
HARPER	LOWER HARPER	19/8/11	R8	HC-F220	17.10	11U	301039	5702995	BT	72	3.8	423		125
HARPER	LOWER HARPER	19/8/11	R8	HC-F220	17.10	11U	301039	5702995	BT	110	12.8	423		125
HARPER	LOWER HARPER	19/8/11	R8	HC-F220	17.10	11U	301039	5702995	BT	137	23.4	423		125
HARPER	LOWER HARPER	19/8/11	R8	HC-F230	17.30	11U	300911	5703111	BT	42		336		125
HARPER	LOWER HARPER	19/8/11	R8	HC-F230	17.30	11U	300911	5703111	BT	64	3.2	336		125
HARPER	LOWER HARPER	19/8/11	R8	HC-F230	17.30	11U	300911	5703111	BT	78	5.1	336		125
HARPER	LOWER HARPER	19/8/11	R8	HC-F230	17.30	11U	300911	5703111	BT	121	18.4	336		125
HARPER	LOWER HARPER	19/8/11	R8	HC-F230	17.30	11U	300911	5703111	BT	142	29.5	336		125
HARPER	LOWER HARPER	19/8/11	R5	HC-F090	5.50	11U	299347	5693173	CO	84	8.9	336		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F090	5.50	11U	299347	5693173	CO	97	10.9	339		155
HARPER	LOWER HARPER	19/8/11	R5	HC-F100	5.60	11U	299356	5693232	CO	40		335		120
HARPER	LOWER HARPER	19/8/11	R5	HC-F110	5.90	11U	299324	5693454	CO	87	8.9	580		100
HARPER	LOWER HARPER	19/8/11	R5	HC-F120	8.30	11U	299629	5695406	CO	41		410		125
HARPER	LOWER HARPER	19/8/11	R5	HC-F120	8.30	11U	299629	5695406	CO	42		410		125
HARPER	LOWER HARPER	19/8/11	R5	HC-F120	8.30	11U	299629	5695406	CO	44		410		125
HARPER	LOWER HARPER	19/8/11	R5	HC-F120	8.30	11U	299629	5695406	CO	46		410		125
HARPER	LOWER HARPER	19/8/11	R5	HC-F120	8.30	11U	299629	5695406	CO	48		410		125
HARPER	LOWER HARPER	19/8/11	R5	HC-F120	8.30	11U	299629	5695406	CO	51		410		125
HARPER	LOWER HARPER	19/8/11	R5	HC-F130	8.40	11U	299540	5695539	CO	39		186		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F130	8.40	11U	299540	5695539	CO	41		186		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F130	8.40	11U	299540	5695539	CO	43		186		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F130	8.40	11U	299540	5695539	CO	44		186		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F130	8.40	11U	299540	5695539	CO	44		186		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F130	8.40	11U	299540	5695539	CO	50		186		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F140	8.60	11U	299535	5695687	CO	39		220		85
HARPER	LOWER HARPER	19/8/11	R5	HC-F140	8.60	11U	299535	5695687	CO	44		220		85
HARPER	LOWER HARPER	19/8/11	R5	HC-F140	8.60	11U	299535	5695687	CO	44		220		85
HARPER	LOWER HARPER	19/8/11	R5	HC-F140	8.60	11U	299535	5695687	CO	45		220		85
HARPER	LOWER HARPER	19/8/11	R5	HC-F140	8.60	11U	299535	5695687	CO	45		220		85
HARPER	LOWER HARPER	19/8/11	R5	HC-F140	8.60	11U	299535	5695687	CO	47		220		85
HARPER	LOWER HARPER	19/8/11	R5	HC-F140	8.60	11U	299535	5695687	CO	47		220		85
HARPER	LOWER HARPER	19/8/11	R5	HC-F090	5.50	11U	299347	5693173	MW	236		339		155
HARPER	LOWER HARPER	19/8/11	R5	HC-F090	5.50	11U	299347	5693173	MW	297		336		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F110	5.90	11U	299324	5693454	MW	264		580		100
HARPER	LOWER HARPER	19/8/11	R5	HC-F120	8.30	11U	299629	5695406	MW	295		410		125
HARPER	LOWER HARPER	19/8/11	R5	HC-F130	8.40	11U	299540	5695539	MW	293		186		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F130	8.40	11U	299540	5695539	MW	295		186		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F140	8.60	11U	299535	5695687	MW	265		220		85

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	LOWER HARPER	19/8/11	R5	HC-F090	5.50	11U	299347	5693173	RBT	219	106.0	336		90
HARPER	LOWER HARPER	19/8/11	R5	HC-F100	5.60	11U	299356	5693232	RBT	110	16.5	335		120
HARPER	LOWER HARPER	19/8/11	R5	HC-F100	5.60	11U	299356	5693232	RBT	176	71.2	335		120
HARPER	LOWER HARPER	19/8/11	R5	HC-F110	5.90	11U	299324	5693454	RBT	185	73.0	580		100
HARPER	LOWER HARPER	19/8/11	R5	HC-F140	8.60	11U	299535	5695687	RBT	59		220		85
HARPER	LOWER HARPER	19/8/11	R5	HC-F140	8.60	11U	299535	5695687	RBT	111		220		85
HARPER	LOWER HARPER	24/8/11	R6	HC-F150	9.30	11U	299546	5696307	BT	70		605		90
HARPER	LOWER HARPER	24/8/11	R6	HC-F150	9.30	11U	299546	5696307	BT	128		605		90
HARPER	LOWER HARPER	24/8/11	R6	HC-F160	9.50	11U	299572	5696427	BT	100		443		110
HARPER	LOWER HARPER	24/8/11	R9	HC-F250	18.20	11U	300949	5703967	BT	35		184		75
HARPER	LOWER HARPER	24/8/11	R9	HC-F250	18.20	11U	300949	5703967	BT	118		184		75
HARPER	LOWER HARPER	24/8/11	R9	HC-F250	18.20	11U	300949	5703967	BT	154		184		75
HARPER	LOWER HARPER	24/8/11	R9	HC-F260	18.30	11U	301089	5703992	BT	82		202		75
HARPER	LOWER HARPER	24/8/11	R9	HC-F260	18.30	11U	301089	5703992	BT	146		202		75
HARPER	LOWER HARPER	24/8/11	R9	HC-F260	18.30	11U	301089	5703992	BT	157		202		75
HARPER	LOWER HARPER	24/8/11	R9	HC-F270	18.40	11U	301002	5704031	BT	85		190		75
HARPER	LOWER HARPER	24/8/11	R9	HC-F270	18.40	11U	301002	5704031	BT	147		190		75
HARPER	LOWER HARPER	24/8/11	R9	HC-F270	18.40	11U	301002	5704031	BT	180		190		75
HARPER	LOWER HARPER	24/8/11	R9	HC-F280	18.50	11U	301149	5704075	BT	98		255		75
HARPER	LOWER HARPER	24/8/11	R9	HC-F280	18.50	11U	301149	5704075	BT	196		255		75
HARPER	LOWER HARPER	24/8/11	R6	HC-F160	9.50	11U	299572	5696427	CO	40		443		110
HARPER	LOWER HARPER	24/8/11	R6	HC-F150	9.30	11U	299546	5696307	MW	252		605		90
HARPER	LOWER HARPER	24/8/11	R6	HC-F160	9.50	11U	299572	5696427	RBT	171		443		110
HARPER	LOWER HARPER	25/8/11	R6	HC-F170	10.90	11U	299941	5697502	BT	38		466		210
HARPER	LOWER HARPER	25/8/11	R6	HC-F170	10.90	11U	299941	5697502	BT	70		466		210
HARPER	LOWER HARPER	25/8/11	R6	HC-F170	10.90	11U	299941	5697502	BT	125		466		210
HARPER	LOWER HARPER	25/8/11	R6	HC-F180	11.30	11U	299919	5697842	BT	68		410		170
HARPER	LOWER HARPER	25/8/11	R6	HC-F180	11.30	11U	299919	5697842	BT	81		410		170
HARPER	LOWER HARPER	25/8/11	R6	HC-F180	11.30	11U	299919	5697842	BT	133		410		170
HARPER	LOWER HARPER	25/8/11	R6	HC-F180	11.30	11U	299919	5697842	BT	140		410		170
HARPER	LOWER HARPER	25/8/11	R8	HC-F200	15.90	11U	300959	5701905	BT	45		406		160
HARPER	LOWER HARPER	25/8/11	R8	HC-F200	15.90	11U	300959	5701905	BT	71		406		160
HARPER	LOWER HARPER	25/8/11	R8	HC-F200	15.90	11U	300959	5701905	BT	132		406		160
HARPER	LOWER HARPER	25/8/11	R8	HC-F200	15.90	11U	300959	5701905	BT	145		406		160
HARPER	LOWER HARPER	25/8/11	R8	HC-F200	15.90	11U	300959	5701905	BT	162		406		160
HARPER	LOWER HARPER	25/8/11	R8	HC-F210	16.20	11U	300947	5702166	BT	44		417		110
HARPER	LOWER HARPER	25/8/11	R8	HC-F210	16.20	11U	300947	5702166	BT	45		417		110
HARPER	LOWER HARPER	25/8/11	R8	HC-F210	16.20	11U	300947	5702166	BT	81		417		110
HARPER	LOWER HARPER	25/8/11	R8	HC-F210	16.20	11U	300947	5702166	BT	136		417		110
HARPER	LOWER HARPER	25/8/11	R8	HC-F210	16.20	11U	300947	5702166	BT	164		417		110
HARPER	LOWER HARPER	25/8/11	R7	HC-F190	14.20	11U	300561	5700428	NFC	NFC				
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	BT	130		704		150

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	BT	137		704		150
HARPER	LOWER HARPER	11/9/11	R6	HC-F160	9.50	11U	299572	5696427	BT	47		625		130
HARPER	LOWER HARPER	11/9/11	R6	HC-F160	9.50	11U	299572	5696427	BT	80		625		130
HARPER	LOWER HARPER	11/9/11	R6	HC-F160	9.50	11U	299572	5696427	BT	96		625		130
HARPER	LOWER HARPER	11/9/11	R6	HC-F160	9.50	11U	299572	5696427	BT	117		625		130
HARPER	LOWER HARPER	11/9/11	R6	HC-F160	9.50	11U	299572	5696427	BT	122		625		130
HARPER	LOWER HARPER	11/9/11	R6	HC-F160	9.50	11U	299572	5696427	BT	157		625		130
HARPER	LOWER HARPER	11/9/11	R6	HC-F160	9.50	11U	299572	5696427	BT	163		625		130
HARPER	LOWER HARPER	11/9/11	R6	HC-F160	9.50	11U	299572	5696427	BT	176		625		130
HARPER	LOWER HARPER	11/9/11	R6	HC-F160	9.50	11U	299572	5696427	BT	185		625		130
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	CO	51		704		150
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	CO	51		704		150
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	CO	51		704		150
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	CO	52		704		150
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	CO	55		704		150
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	CO	57		704		150
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	CO	58		704		150
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	CO	87		704		150
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	CO	96		704		150
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	CRH	81		704		150
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	CRH	90		704		150
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	CRH	103		704		150
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	LNC	101		704		150
HARPER	LOWER HARPER	11/9/11	R6	HC-F160	9.50	11U	299572	5696427	MW	280		625		130
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	RBT	78		704		150
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	RBT	90		704		150
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	RBT	95		704		150
HARPER	LOWER HARPER	11/9/11	R2	HC-F050	1.40	11U	298755	5689980	RBT	173		704		150
HARPER	LOWER HARPER	2/8/12	R8	HC-F240	17.90	11U	300906	5703683	BT	165		1081		185
HARPER	LOWER HARPER	2/8/12	R8	HC-F240	17.90	11U	300906	5703683	BT	108		1081		185
HARPER	LOWER HARPER	2/8/12	R8	HC-F240	17.90	11U	300906	5703683	BT	68		1081		185
HARPER	LOWER HARPER	2/8/12	R8	HC-F240	17.90	11U	300906	5703683	BT	34		1081		185
HARPER	LOWER HARPER	2/8/12	R8	HC-F240	17.90	11U	300906	5703683	BT	68		1081		185
HARPER	LOWER HARPER	2/8/12	R8	HC-F240	17.90	11U	300906	5703683	BT	36		1081		185
HARPER	LOWER HARPER	2/8/12	R8	HC-F240	17.90	11U	300906	5703683	BT	36		1081		185
HARPER	LOWER HARPER	2/8/12	R8	HC-F240	17.90	11U	300906	5703683	BT	111		1081		185
HARPER	LOWER HARPER	2/8/12	R8	HC-F240	17.90	11U	300906	5703683	BT	72		1081		185
HARPER	LOWER HARPER	24/8/12	R2	HC-F050	1.40	11U	298755	5689980	BT	46	1.1	1124		165
HARPER	LOWER HARPER	24/8/12	R2	HC-F050	1.40	11U	298755	5689980	CO	68	4.6	1124		165
HARPER	LOWER HARPER	24/8/12	R2	HC-F050	1.40	11U	298755	5689980	CO	65	3.6	1124		165
HARPER	LOWER HARPER	24/8/12	R2	HC-F050	1.40	11U	298755	5689980	CO	71	4.2	1124		165
HARPER	LOWER HARPER	24/8/12	R2	HC-F050	1.40	11U	298755	5689980	CO	74	5.2	1124		165

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	LOWER HARPER	24/8/12	R2	HC-F050	1.40	11U	298755	5689980	CO	70	4.2	1124		165
HARPER	LOWER HARPER	24/8/12	R2	HC-F050	1.40	11U	298755	5689980	CO	25		1124		165
HARPER	LOWER HARPER	24/8/12	R2	HC-F050	1.40	11U	298755	5689980	CO	54	1.8	1124		165
HARPER	LOWER HARPER	24/8/12	R2	HC-F050	1.40	11U	298755	5689980	CRH	71	4.3	1124		165
HARPER	LOWER HARPER	24/8/12	R2	HC-F050	1.40	11U	298755	5689980	CRH	65	3.5	1124		165
HARPER	LOWER HARPER	24/8/12	R2	HC-F050	1.40	11U	298755	5689980	LNC	89	6.2	1124		165
HARPER	LOWER HARPER	24/8/12	R2	HC-F050	1.40	11U	298755	5689980	LNC	113	18.1	1124		165
HARPER	LOWER HARPER	24/8/12	R2	HC-F050	1.40	11U	298755	5689980	MWF	192	87.1	1124		165
HARPER	LOWER HARPER	24/8/12	R2	HC-F050	1.40	11U	298755	5689980	RBT	127	23.7	1124		165
HARPER	LOWER HARPER	19/09/13	R7	HC-F240	17.7	11U	300906	5703683	BT	87	9.7	486		125
HARPER	LOWER HARPER	19/09/13	R7	HC-F240	17.7	11U	300906	5703683	BT	95	7	486		125
HARPER	LOWER HARPER	19/09/13	R7	HC-F240	17.7	11U	300906	5703683	BT	134	21.52	486		125
HARPER	LOWER HARPER	19/09/13	R7	HC-F240	17.7	11U	300906	5703683	BT	134	21.82	486		125
HARPER	LOWER HARPER	19/09/13	R7	HC-F240	17.7	11U	300906	5703683	BT	121	16.258	486		125
HARPER	LOWER HARPER	19/09/13	R7	HC-F240	17.7	11U	300906	5703683	BT	94	7.58	486		125
HARPER	LOWER HARPER	19/09/13	R7	HC-F240	17.7	11U	300906	5703683	BT	86	5.85	486		125
HARPER	LOWER HARPER	19/09/13	R7	HC-F240	17.7	11U	300906	5703683	BT	56	1.62	486		125
HARPER	LOWER HARPER	19/09/13	R7	HC-F240	17.7	11U	300906	5703683	BT	54	1.53	486		125
HARPER	LOWER HARPER	19/09/13	R7	HC-F240	17.7	11U	300906	5703683	BT	53	1.47	486		125
HARPER	LOWER HARPER	19/09/13	R7	HC-F240	17.7	11U	300906	5703683	BT	54	1.98	486		125
HARPER	LOWER HARPER	19/09/13	R7	HC-F240	17.7	11U	300906	5703683	BT	48	1.26	486		125
HARPER	LOWER HARPER	19/09/13	R4	HC-F140	8.5	11U	299535	5695704	BT	95	11.08	389		150
HARPER	LOWER HARPER	19/09/13	R4	HC-F140	8.5	11U	299535	5695704	BT	88	6.62	389		150
HARPER	LOWER HARPER	19/09/13	R4	HC-F140	8.5	11U	299535	5695704	BT	87	9.29	389		150
HARPER	LOWER HARPER	19/09/13	R4	HC-F140	8.5	11U	299535	5695704	BT	77	5.57	389		150
HARPER	LOWER HARPER	19/09/13	R4	HC-F140	8.5	11U	299535	5695704	BT	53	2.16	389		150
HARPER	LOWER HARPER	19/09/13	R4	HC-F140	8.5	11U	299535	5695704	BT	62	2.16	389		150
HARPER	LOWER HARPER	19/09/13	R4	HC-F140	8.5	11U	299535	5695704	BT	60	3.04	389		150
HARPER	LOWER HARPER	19/09/13	R4	HC-F140	8.5	11U	299535	5695704	BT	48	1.28	389		150
HARPER	LOWER HARPER	19/09/13	R4	HC-F140	8.5	11U	299535	5695704	RBT	53	1.21	389		150
HARPER	LOWER HARPER	24/09/13	R4	HC-F090		11U	299347	5693173	BT	85	7.95	350		125
HARPER	LOWER HARPER	24/09/13	R4	HC-F090		11U	299347	5693173	BT	64	2.48	350		125
HARPER	LOWER HARPER	24/09/13	R4	HC-F090		11U	299347	5693173	BT	57	1.97	350		125
HARPER	LOWER HARPER	24/09/13	R4	HC-F090		11U	299347	5693173	BT	59	2.19	350		125
HARPER	LOWER HARPER	24/09/13	R4	HC-F090		11U	299347	5693173	BT	59	1.94	350		125
HARPER	LOWER HARPER	24/09/13	R4	HC-F090		11U	299347	5693173	CO	63	3.44	350		125
HARPER	LOWER HARPER	24/09/13	R4	HC-F090		11U	299347	5693173	CO	56	2.27	350		125
HARPER	LOWER HARPER	24/09/13	R4	HC-F090		11U	299347	5693173	CO	60	2.12	350		125
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CO	57	3.49	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CO	53	1.8	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CO	73	3.75	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CO	52	1.62	692		150

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CO	67	3.22	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CO	85	7.57	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CO	64	3.1	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CRH	31	0.4	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CRH	55	1.93	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CRH	75	5.55	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CRH	20	0.24	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CRH	27	0.5	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CRH	23	0.21	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CRH	25	0.4	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CRH	20	0.35	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CRH	27	0.29	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CRH	22	0.26	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CRH	24	0.21	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CRH	25	0.24	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CRH	24	0.26	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CRH	25	0.18	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	CRH	23	0.14	692		150
HARPER	LOWER HARPER	24/09/13	R1	HC-F30		11U	299197	5689865	LNC	88	9.27	692		150
HARPER	LOWER HARPER	24/09/13	R4	HC-F090		11U	299347	5693173	RBT	89	7.95	350		125
HARPER	LOWER HARPER	24/09/13	R4	HC-F090		11U	299347	5693173	RBT	60	2.07	350		125
HARPER	LOWER HARPER	24/09/13	R4	HC-F090		11U	299347	5693173	RBT	55	1.79	350		125
HARPER	LOWER HARPER	24/09/13	R4	HC-F090		11U	299347	5693173	RBT	40	0.79	350		125
HARPER	P-CREEK	22/8/11	R1	PC-F010	0.04	11U	301796	5709375	BT	133	20.5	203		90
HARPER	P-CREEK	22/8/11	R1	PC-F010	0.04	11U	301796	5709375	BT	165	48.0	203		90
HARPER	P-CREEK	22/8/11	R1	PC-F010	0.04	11U	301796	5709375	BT	186	60.3	203		90
HARPER	P-CREEK	22/8/11	R1	PC-F010	0.04	11U	301796	5709375	BT	196	66.5	203		90
HARPER	P-CREEK	22/8/11	R1	PC-F020	0.19	11U	301920	5709410	BT	85	7.5	224		75
HARPER	P-CREEK	22/8/11	R1	PC-F020	0.19	11U	301920	5709410	BT	126	22.1	224		75
HARPER	P-CREEK	22/8/11	R1	PC-F020	0.19	11U	301920	5709410	BT	156	40.5	224		75
HARPER	P-CREEK	22/8/11	R1	PC-F020	0.19	11U	301920	5709410	BT	168	54.8	224		75
HARPER	P-CREEK	22/8/11	R1	PC-F020	0.19	11U	301920	5709410	BT	207	86.3	224		75
HARPER	P-CREEK	8/9/11	R1	PC-F020	0.19	11U	301920	5709410	BT	182		227		50
HARPER	P-CREEK	8/9/11	R1	PC-F020	0.19	11U	301920	5709410	BT	213		227		50
HARPER	P-CREEK	8/9/11	R1	PC-F020	0.19	11U	301920	5709410	BT	233		227		50
HARPER	P-CREEK	8/9/11	R1	PC-F030	0.28	11U	301989	5709461	BT	145		152		60
HARPER	P-CREEK	8/9/11	R1	PC-F030	0.28	11U	301989	5709461	BT	176		152		60
HARPER	P-CREEK	8/9/11	R1	PC-F040	0.36	11U	302013	5709541	BT	183		226		70
HARPER	P-CREEK	8/9/11	R1	PC-F040	0.36	11U	302013	5709541	BT	193		226		70
HARPER	P-CREEK	8/9/11	R2	PC-F050	0.42	11U	302043	5709587	BT	185		303		50
HARPER	P-CREEK	8/9/11	R2	PC-F050	0.42	11U	302043	5709587	BT	220		303		50
HARPER	P-CREEK	12/9/11	R1	PC-F020	0.19	11U	301920	5709410	BT	149	31.0	70		30

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	P-CREEK	12/9/11	R1	PC-F030	0.28	11U	301989	5709461	BT	122	20.5	65		50
HARPER	P-CREEK	12/9/11	R1	PC-F030	0.28	11U	301989	5709461	BT	146	30.0	70		30
HARPER	P-CREEK	12/9/11	R1	PC-F040	0.36	11U	302013	5709541	BT	183	64.5	60		30
HARPER	P-CREEK	12/9/11	R2	PC-F050	0.42	11U	302043	5709587	BT	148	33.0	55		25
HARPER	P-CREEK	1/8/12	R1	PC-F010	0.04	11U	301835	5709316	BT	118		682		145
HARPER	P-CREEK	1/8/12	R1	PC-F010	0.04	11U	301835	5709316	BT	120		682		145
HARPER	P-CREEK	1/8/12	R1	PC-F010	0.04	11U	301835	5709316	BT	136		682		145
HARPER	P-CREEK	1/8/12	R1	PC-F010	0.04	11U	301835	5709316	BT	77		682		145
HARPER	P-CREEK	1/8/12	R1	PC-F020	0.19	11U	301920	5709410	BT	75		150		50
HARPER	P-CREEK	1/8/12	R1	PC-F030	0.28	11U	301989	5709461	BT	200		142		90
HARPER	P-CREEK	1/8/12	R1	PC-F030	0.28	11U	301989	5709461	BT	235		142		90
HARPER	P-CREEK	1/8/12	R1	PC-F040	0.36	11U	302013	5709541	BT	84		162		80
HARPER	P-CREEK	1/8/12	R1	PC-F040	0.36	11U	302013	5709541	BT	195		162		80
HARPER	P-CREEK	1/8/12	R1	PC-F050	0.42	11U	302043	5709587	BT	156		161		60
HARPER	P-CREEK	1/8/12	R1	PC-F060	0.57	11U	302150	5709677	BT	NFC	NFC	455		300
HARPER	P-CREEK	21/8/12	R1	PC-F010	0.04	11U	301835	5709316	BT	110	18.5	716		104
HARPER	P-CREEK	21/8/12	R1	PC-F010	0.04	11U	301835	5709316	BT	105	17.6	716		104
HARPER	P-CREEK	21/8/12	R1	PC-F010	0.04	11U	301835	5709316	BT	112	15.5	716		104
HARPER	P-CREEK	21/8/12	R1	PC-F010	0.04	11U	301835	5709316	BT	76	5.3	716		104
HARPER	P-CREEK	21/8/12	R1	PC-F010	0.04	11U	301835	5709316	BT	236	121.2	716		104
HARPER	P-CREEK	21/8/12	R1	PC-F020	0.19	11U	301920	5709410	BT	136	26.2	1025		190
HARPER	P-CREEK	21/8/12	R1	PC-F020	0.19	11U	301920	5709410	BT	73	4.8	1025		190
HARPER	P-CREEK	21/8/12	R1	PC-F020	0.19	11U	301920	5709410	BT	96	7.2	1025		190
HARPER	P-CREEK	21/8/12	R1	PC-F020	0.19	11U	301920	5709410	BT	208	96.7	1025		190
HARPER	P-CREEK	21/8/12	R1	PC-F020	0.19	11U	301920	5709410	BT	89	7.2	1025		190
HARPER	P-CREEK	21/8/12	R1	PC-F020	0.19	11U	301920	5709410	BT	37		1025		190
HARPER	P-CREEK	22/8/12	R1	PC-F020	0.19	11U	301920	5709410	BT	116	16.9	307		75
HARPER	P-CREEK	22/8/12	R1	PC-F020	0.19	11U	301920	5709410	BT	103	10.5	307		75
HARPER	P-CREEK	22/8/12	R1	PC-F020	0.19	11U	301920	5709410	BT	154	39.4	307		75
HARPER	P-CREEK	22/8/12	R1	PC-F030	0.28	11U	301989	5709461	BT	202	83.6	280		90
HARPER	P-CREEK	22/8/12	R1	PC-F030	0.28	11U	301989	5709461	BT	238	121.3	280		90
HARPER	P-CREEK	13/9/12	R1	PC-F060	0.57	11U	302150	5709677	BT	NFC	NFC	435		250
HARPER	P-CREEK	17/09/13	R1	PC-F10-50	0.0-0.46	11U	301959	5709410	BT	104	11.47	1651		469
HARPER	P-CREEK	17/09/13	R1	PC-F10-50	0.0-0.46	11U	301959	5709410	BT	190	74	1651		469
HARPER	P-CREEK	17/09/13	R1	PC-F10-50	0.0-0.46	11U	301959	5709410	BT	143	28.47	1651		469
HARPER	P-CREEK	17/09/13	R1	PC-F10-50	0.0-0.46	11U	301959	5709410	BT	104	14.96	1651		469
HARPER	P-CREEK	17/09/13	R1	PC-F10-50	0.0-0.46	11U	301959	5709410	BT	143	27.21	1651		469
HARPER	P-CREEK	17/09/13	R1	PC-F10-50	0.0-0.46	11U	301959	5709410	BT	99	10.86	1651		469
HARPER	P-CREEK	17/09/13	R1	PC-F10-50	0.0-0.46	11U	301959	5709410	BT	98	10.93	1651		469
HARPER	P-CREEK	17/09/13	R1	PC-F10-50	0.0-0.46	11U	301959	5709410	BT	107	11.67	1651		469
HARPER	P-CREEK	17/09/13	R1	PC-F10-50	0.0-0.46	11U	301959	5709410	BT	162	48	1651		469
HARPER	P-CREEK	17/09/13	R1	PC-F10-50	0.0-0.46	11U	301959	5709410	BT	155		1651		469

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	P-CREEK	17/09/13	R1	PC-F10-50	0.0-0.46	11U	301959	5709410	BT	174		1651		469
HARPER	T-CREEK	27/7/11	R1	TC-F010	0.03	11U	302016	5705583	BT	101	11.1	142		30
HARPER	T-CREEK	27/7/11	R1	TC-F010	0.03	11U	302016	5705583	BT	179	62.3	142		30
HARPER	T-CREEK	27/7/11	R1	TC-F020	0.08	11U	302069	5705572	BT	56	2.4	201		50
HARPER	T-CREEK	27/7/11	R1	TC-F020	0.08	11U	302069	5705572	BT	72	3.5	201		50
HARPER	T-CREEK	27/7/11	R1	TC-F020	0.08	11U	302069	5705572	BT	151	36.2	201		50
HARPER	T-CREEK	27/7/11	R1	TC-F030	0.14	11U	302125	5705572	BT	110	13.1	470		35
HARPER	T-CREEK	27/7/11	R1	TC-F030	0.14	11U	302125	5705572	BT	132	23.6	470		35
HARPER	T-CREEK	27/7/11	R1	TC-F030	0.14	11U	302125	5705572	BT	157	36.8	470		35
HARPER	T-CREEK	27/7/11	R1	TC-F040	0.18	11U	302162	5705586	BT	86	7.4	380		70
HARPER	T-CREEK	27/7/11	R1	TC-F040	0.18	11U	302162	5705586	BT	98	11.3	380		70
HARPER	T-CREEK	27/7/11	R1	TC-F040	0.18	11U	302162	5705586	BT	133	21.8	380		70
HARPER	T-CREEK	27/7/11	R1	TC-F040	0.18	11U	302162	5705586	BT	151	32.6	380		70
HARPER	T-CREEK	27/7/11	R1	TC-F040	0.18	11U	302162	5705586	BT	153	35.2	380		70
HARPER	T-CREEK	27/7/11	R1	TC-F040	0.18	11U	302162	5705586	BT	199	85.5	380		70
HARPER	T-CREEK	27/7/11	R1	TC-F050	0.26	11U	302233	5705601	BT	95	9.8	305		40
HARPER	T-CREEK	27/7/11	R1	TC-F050	0.26	11U	302233	5705601	BT	107	14.2	305		40
HARPER	T-CREEK	27/7/11	R1	TC-F050	0.26	11U	302233	5705601	BT	145	28.2	305		40
HARPER	T-CREEK	27/7/11	R1	TC-F050	0.26	11U	302233	5705601	BT	152	36.9	305		40
HARPER	T-CREEK	27/7/11	R1	TC-F050	0.26	11U	302233	5705601	BT	187	74.4	305		40
HARPER	T-CREEK	27/7/11	R1	TC-F050	0.26	11U	302233	5705601	BT	204	87.1	305		40
HARPER	T-CREEK	28/7/11	R1	TC-F040	0.18	11U	302162	5705586	BT	112	19.9	307		50
HARPER	T-CREEK	28/7/11	R1	TC-F040	0.18	11U	302162	5705586	BT	168	49.9	307		50
HARPER	T-CREEK	28/7/11	R1	TC-F050	0.26	11U	302233	5705601	BT	117	16.2	339		65
HARPER	T-CREEK	28/7/11	R1	TC-F050	0.26	11U	302233	5705601	BT	170	51.7	339		65
HARPER	T-CREEK	28/7/11	R1	TC-F050	0.26	11U	302233	5705601	BT	182	61.3	339		65
HARPER	T-CREEK	23/8/11	R1	TC-F020	0.08	11U	302069	5705572	BT	67		95		60
HARPER	T-CREEK	23/8/11	R1	TC-F020	0.08	11U	302069	5705572	BT	75		95		60
HARPER	T-CREEK	23/8/11	R1	TC-F020	0.08	11U	302069	5705572	BT	110		95		60
HARPER	T-CREEK	23/8/11	R1	TC-F020	0.08	11U	302069	5705572	BT	180		95		60
HARPER	T-CREEK	23/8/11	R1	TC-F030	0.14	11U	302125	5705572	BT	73		70		40
HARPER	T-CREEK	23/8/11	R1	TC-F030	0.14	11U	302125	5705572	BT	104		70		40
HARPER	T-CREEK	23/8/11	R1	TC-F030	0.14	11U	302125	5705572	BT	108		143		35
HARPER	T-CREEK	23/8/11	R1	TC-F030	0.14	11U	302125	5705572	BT	112		143		35
HARPER	T-CREEK	23/8/11	R1	TC-F030	0.14	11U	302125	5705572	BT	114		143		35
HARPER	T-CREEK	23/8/11	R1	TC-F030	0.14	11U	302125	5705572	BT	126		70		40
HARPER	T-CREEK	23/8/11	R1	TC-F030	0.14	11U	302125	5705572	BT	130		143		35
HARPER	T-CREEK	23/8/11	R1	TC-F030	0.14	11U	302125	5705572	BT	143		143		35
HARPER	T-CREEK	23/8/11	R1	TC-F030	0.14	11U	302125	5705572	BT	160		143		35
HARPER	T-CREEK	23/8/11	R1	TC-F030	0.14	11U	302125	5705572	BT	181		70		40
HARPER	T-CREEK	23/8/11	R1	TC-F030	0.14	11U	302125	5705572	BT	182		143		35
HARPER	T-CREEK	23/8/11	R1	TC-F030	0.14	11U	302125	5705572	BT	201		70		40

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	T-CREEK	23/8/11	R1	TC-F040	0.18	11U	302162	5705586	BT	111		163		70
HARPER	T-CREEK	23/8/11	R1	TC-F040	0.18	11U	302162	5705586	BT	113		163		70
HARPER	T-CREEK	23/8/11	R1	TC-F040	0.18	11U	302162	5705586	BT	114		163		70
HARPER	T-CREEK	23/8/11	R1	TC-F040	0.18	11U	302162	5705586	BT	147		163		70
HARPER	T-CREEK	23/8/11	R1	TC-F040	0.18	11U	302162	5705586	BT	170		163		70
HARPER	T-CREEK	23/8/11	R1	TC-F040	0.18	11U	302162	5705586	BT	218		163		70
HARPER	T-CREEK	23/8/11	R1	TC-F050	0.26	11U	302233	5705601	BT	112		183		40
HARPER	T-CREEK	23/8/11	R1	TC-F050	0.26	11U	302233	5705601	BT	114		183		40
HARPER	T-CREEK	23/8/11	R1	TC-F050	0.26	11U	302233	5705601	BT	118		183		40
HARPER	T-CREEK	23/8/11	R1	TC-F050	0.26	11U	302233	5705601	BT	157		183		40
HARPER	T-CREEK	23/8/11	R1	TC-F050	0.26	11U	302233	5705601	BT	172		183		40
HARPER	T-CREEK	8/9/11	R1	TC-F010	0.03	11U	302016	5705583	BT	72	5.5	176		30
HARPER	T-CREEK	8/9/11	R1	TC-F010	0.03	11U	302016	5705583	BT	114	18.5	176		30
HARPER	T-CREEK	8/9/11	R1	TC-F010	0.03	11U	302016	5705583	BT	139	25.5	176		30
HARPER	T-CREEK	8/9/11	R1	TC-F010	0.03	11U	302016	5705583	BT	147	37.5	176		30
HARPER	T-CREEK	8/9/11	R1	TC-F010	0.03	11U	302016	5705583	BT	159	45.0	176		30
HARPER	T-CREEK	8/9/11	R1	TC-F010	0.03	11U	302016	5705583	BT	182	66.0	176		30
HARPER	T-CREEK	8/9/11	R1	TC-F010	0.03	11U	302016	5705583	BT	190	76.0	210		65
HARPER	T-CREEK	8/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	84	7.5	155		50
HARPER	T-CREEK	8/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	115	14.0	155		50
HARPER	T-CREEK	8/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	139	29.0	155		50
HARPER	T-CREEK	8/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	147	31.5	155		50
HARPER	T-CREEK	8/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	160	44.0	155		50
HARPER	T-CREEK	8/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	182	71.5	155		50
HARPER	T-CREEK	8/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	205	95.0	243		50
HARPER	T-CREEK	8/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	112	15.0	202		40
HARPER	T-CREEK	8/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	123	18.0	202		40
HARPER	T-CREEK	8/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	140	28.5	202		40
HARPER	T-CREEK	8/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	150	32.5	202		40
HARPER	T-CREEK	8/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	163	48.5	202		40
HARPER	T-CREEK	8/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	184	62.5	202		40
HARPER	T-CREEK	8/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	207	93.5	202		40
HARPER	T-CREEK	8/9/11	R1	TC-F040	0.18	11U	302162	5705586	BT	112	15.0	210		65
HARPER	T-CREEK	8/9/11	R1	TC-F040	0.18	11U	302162	5705586	BT	130	20.5	210		65
HARPER	T-CREEK	8/9/11	R1	TC-F040	0.18	11U	302162	5705586	BT	146	30.5	210		65
HARPER	T-CREEK	8/9/11	R1	TC-F040	0.18	11U	302162	5705586	BT	156	37.5	210		65
HARPER	T-CREEK	8/9/11	R1	TC-F040	0.18	11U	302162	5705586	BT	165	48.0	210		65
HARPER	T-CREEK	8/9/11	R1	TC-F040	0.18	11U	302162	5705586	BT	238	135.5	210		65
HARPER	T-CREEK	8/9/11	R1	TC-F050	0.26	11U	302233	5705601	BT	113	15.5	243		50
HARPER	T-CREEK	8/9/11	R1	TC-F050	0.26	11U	302233	5705601	BT	134	24.0	243		50
HARPER	T-CREEK	8/9/11	R1	TC-F050	0.26	11U	302233	5705601	BT	146	36.0	243		50
HARPER	T-CREEK	8/9/11	R1	TC-F050	0.26	11U	302233	5705601	BT	156	39.5	243		50

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	T-CREEK	8/9/11	R1	TC-F050	0.26	11U	302233	5705601	BT	179	58.5	243		50
HARPER	T-CREEK	12/9/11	R1	TC-F010	0.03	11U	302016	5705583	BT	132	22.0	250		75
HARPER	T-CREEK	12/9/11	R1	TC-F010	0.03	11U	302016	5705583	BT	139	26.5	250		75
HARPER	T-CREEK	12/9/11	R1	TC-F010	0.03	11U	302016	5705583	BT	139	25.0	250		75
HARPER	T-CREEK	12/9/11	R1	TC-F010	0.03	11U	302016	5705583	BT	170	50.5	250		75
HARPER	T-CREEK	12/9/11	R1	TC-F010	0.03	11U	302016	5705583	BT	200	85.0	250		75
HARPER	T-CREEK	27/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	44		237		50
HARPER	T-CREEK	27/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	47		237		50
HARPER	T-CREEK	27/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	70		237		50
HARPER	T-CREEK	27/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	74		237		50
HARPER	T-CREEK	27/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	96		237		50
HARPER	T-CREEK	27/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	102		237		50
HARPER	T-CREEK	27/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	111		237		50
HARPER	T-CREEK	27/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	122		237		50
HARPER	T-CREEK	27/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	132		237		50
HARPER	T-CREEK	27/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	146		237		50
HARPER	T-CREEK	27/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	152		237		50
HARPER	T-CREEK	27/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	158		237		50
HARPER	T-CREEK	27/9/11	R1	TC-F020	0.08	11U	302069	5705572	BT	183		237		50
HARPER	T-CREEK	27/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	44		333		45
HARPER	T-CREEK	27/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	48		333		45
HARPER	T-CREEK	27/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	72		333		45
HARPER	T-CREEK	27/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	90		333		45
HARPER	T-CREEK	27/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	99		333		45
HARPER	T-CREEK	27/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	105		333		45
HARPER	T-CREEK	27/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	118		333		45
HARPER	T-CREEK	27/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	125		333		45
HARPER	T-CREEK	27/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	140		333		45
HARPER	T-CREEK	27/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	152		333		45
HARPER	T-CREEK	27/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	154		333		45
HARPER	T-CREEK	27/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	162		333		45
HARPER	T-CREEK	27/9/11	R1	TC-F030	0.14	11U	302125	5705572	BT	206		333		45
HARPER	T-CREEK	2/8/12	R1	TC-F010	0.03	11U	302016	5705583	BT	147	5.5	115		30
HARPER	T-CREEK	2/8/12	R1	TC-F010	0.03	11U	302016	5705583	BT	111	18.5	115		30
HARPER	T-CREEK	2/8/12	R1	TC-F020	0.08	11U	302069	5705572	BT	135	25.5	176		50
HARPER	T-CREEK	2/8/12	R1	TC-F020	0.08	11U	302069	5705572	BT	120	37.5	176		50
HARPER	T-CREEK	2/8/12	R1	TC-F030	0.14	11U	302125	5705572	BT	114	45.0	176		60
HARPER	T-CREEK	2/8/12	R1	TC-F030	0.14	11U	302125	5705572	BT	152	66.0	176		60
HARPER	T-CREEK	2/8/12	R1	TC-F030	0.14	11U	302125	5705572	BT	133	76.0	115		60
HARPER	T-CREEK	2/8/12	R1	TC-F030	0.14	11U	302125	5705572	BT	139	22.0	115		60
HARPER	T-CREEK	2/8/12	R1	TC-F030	0.14	11U	302125	5705572	BT	150	26.5	115		60
HARPER	T-CREEK	2/8/12	R1	TC-F040	0.18	11U	302162	5705586	BT	138	25.0	95		40

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	T-CREEK	2/8/12	R1	TC-F040	0.18	11U	302162	5705586	BT	183	50.5	95		40
HARPER	T-CREEK	2/8/12	R1	TC-F040	0.18	11U	302162	5705586	BT	170	85.0	95		40
HARPER	T-CREEK	2/8/12	R1	TC-F050	0.26	11U	302233	5705601	BT	185	2.4	88		80
HARPER	T-CREEK	21/8/12	R1	TC-F010	0.03	11U	302016	5705583	BT	137	30.3	260		40
HARPER	T-CREEK	21/8/12	R1	TC-F010	0.03	11U	302016	5705583	BT	152	34.3	260		40
HARPER	T-CREEK	21/8/12	R1	TC-F010	0.03	11U	302016	5705583	BT	167	49.7	260		40
HARPER	T-CREEK	21/8/12	R1	TC-F010	0.03	11U	302016	5705583	BT	108	12.6	260		40
HARPER	T-CREEK	21/8/12	R1	TC-F010	0.03	11U	302016	5705583	BT	143	33.4	260		40
HARPER	T-CREEK	21/8/12	R1	TC-F010	0.03	11U	302016	5705583	BT	111	13.8	260		40
HARPER	T-CREEK	21/8/12	R1	TC-F020	0.08	11U	302069	5705572	BT	145	30.7	383		50
HARPER	T-CREEK	21/8/12	R1	TC-F020	0.08	11U	302069	5705572	BT	114	17.1	383		50
HARPER	T-CREEK	21/8/12	R1	TC-F020	0.08	11U	302069	5705572	BT	95	9.2	383		50
HARPER	T-CREEK	21/8/12	R1	TC-F020	0.08	11U	302069	5705572	BT	155	36.5	383		50
HARPER	T-CREEK	21/8/12	R1	TC-F020	0.08	11U	302069	5705572	BT	156	37.1	383		50
HARPER	T-CREEK	21/8/12	R1	TC-F020	0.08	11U	302069	5705572	BT	126	20.1	383		50
HARPER	T-CREEK	21/8/12	R1	TC-F020	0.08	11U	302069	5705572	BT	116	15.6	383		50
HARPER	T-CREEK	21/8/12	R1	TC-F020	0.08	11U	302069	5705572	BT	77	5.4	383		50
HARPER	T-CREEK	21/8/12	R1	TC-F030	0.14	11U	302125	5705572	BT	103	10.8	243		70
HARPER	T-CREEK	21/8/12	R1	TC-F030	0.14	11U	302125	5705572	BT	118	15.4	243		70
HARPER	T-CREEK	21/8/12	R1	TC-F030	0.14	11U	302125	5705572	BT	117	16.1	243		70
HARPER	T-CREEK	21/8/12	R1	TC-F030	0.14	11U	302125	5705572	BT	128	19.6	243		70
HARPER	T-CREEK	21/8/12	R1	TC-F030	0.14	11U	302125	5705572	BT	150	35.5	243		70
HARPER	T-CREEK	21/8/12	R1	TC-F030	0.14	11U	302125	5705572	BT	154	34.7	243		70
HARPER	T-CREEK	21/8/12	R1	TC-F030	0.14	11U	302125	5705572	BT	170	48.5	243		70
HARPER	T-CREEK	21/8/12	R1	TC-F030	0.14	11U	302125	5705572	BT	157	36.4	243		70
HARPER	T-CREEK	21/8/12	R1	TC-F030	0.14	11U	302125	5705572	BT	144	33.2	243		70
HARPER	T-CREEK	13/9/12	R1	TC-F060	0.33	11U	302269	5705604	BT	273		DIPNET	DIPNET	0
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	143	27.9	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	83	6.45	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	162	40.7	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	86	6.34	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	134	24.7	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	154	37.19	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	160	32.42	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	166	44.45	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	188	29	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	145	25.96	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	152	24.53	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	113	13.64	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	95	8.34	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	88	6.53	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	86	7.31	823		370

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	123	18.36	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	158	46.07	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	145	36.02	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	133	84.11	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	152	42.5	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	129	19.56	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	178	52.26	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	155	34.52	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	125	18.99	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	106	11.6	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	148	32.6	823		370
HARPER	T-CREEK	23/09/13	R1	TC-F10-60	0.03 - 0.33	11U	302069	5705572	BT	118	15.68	823		370
HARPER	UPPER HARPER	21/6/11	R12	HC-F330	20.20	11U	301980	5705453	BT	69	3.1	246		120
HARPER	UPPER HARPER	21/6/11	R12	HC-F330	20.20	11U	301980	5705453	BT	70	3.2	246		120
HARPER	UPPER HARPER	21/6/11	R12	HC-F330	20.20	11U	301980	5705453	BT	99	10.4	246		120
HARPER	UPPER HARPER	21/6/11	R12	HC-F330	20.20	11U	301980	5705453	BT	130	20.8	246		120
HARPER	UPPER HARPER	21/6/11	R12	HC-F330	20.20	11U	301980	5705453	BT	136	29.4	246		120
HARPER	UPPER HARPER	21/6/11	R12	HC-F330	20.20	11U	301980	5705453	BT	152	36.6	246		120
HARPER	UPPER HARPER	21/6/11	R12	HC-F340	20.30	11U	301979	5705578	BT	48	0.9	102		50
HARPER	UPPER HARPER	21/6/11	R12	HC-F340	20.30	11U	301979	5705578	BT	58	1.6	102		50
HARPER	UPPER HARPER	21/6/11	R15	HC-F390	21.30	11U	301884	5706380	BT	57	1.6	942		180
HARPER	UPPER HARPER	21/6/11	R15	HC-F390	21.30	11U	301884	5706380	BT	59	1.7	942		180
HARPER	UPPER HARPER	21/6/11	R15	HC-F390	21.30	11U	301884	5706380	BT	73	4.3	942		180
HARPER	UPPER HARPER	21/6/11	R15	HC-F390	21.30	11U	301884	5706380	BT	106	13.7	942		180
HARPER	UPPER HARPER	21/6/11	R15	HC-F390	21.30	11U	301884	5706380	BT	126	17.7	942		180
HARPER	UPPER HARPER	21/6/11	R15	HC-F390	21.30	11U	301884	5706380	BT	127	22.6	942		180
HARPER	UPPER HARPER	21/6/11	R15	HC-F390	21.30	11U	301884	5706380	BT	65	2.1		12hrs, 10 traps	
HARPER	UPPER HARPER	21/6/11	R15	HC-F390	21.30	11U	301884	5706380	BT	68	2.3		12hrs, 10 traps	
HARPER	UPPER HARPER	21/6/11	R15	HC-F390	21.30	11U	301884	5706380	BT	93			12hrs, 10 traps	
HARPER	UPPER HARPER	21/6/11	R15	HC-F400	21.50	11U	301767	5706549	BT	22	0.1	969		225
HARPER	UPPER HARPER	21/6/11	R15	HC-F400	21.50	11U	301767	5706549	BT	27	0.1	969		225
HARPER	UPPER HARPER	21/6/11	R15	HC-F400	21.50	11U	301767	5706549	BT	50	1.1	969		225
HARPER	UPPER HARPER	21/6/11	R15	HC-F400	21.50	11U	301767	5706549	BT	52	1.2	969		225
HARPER	UPPER HARPER	21/6/11	R15	HC-F400	21.50	11U	301767	5706549	BT	54	1.3	969		225
HARPER	UPPER HARPER	21/6/11	R15	HC-F400	21.50	11U	301767	5706549	BT	57	1.8	969		225
HARPER	UPPER HARPER	21/6/11	R15	HC-F400	21.50	11U	301767	5706549	BT	58	1.5	969		225
HARPER	UPPER HARPER	21/6/11	R15	HC-F400	21.50	11U	301767	5706549	BT	63	2.2	969		225
HARPER	UPPER HARPER	21/6/11	R15	HC-F400	21.50	11U	301767	5706549	BT	80	4.7	969		225
HARPER	UPPER HARPER	21/6/11	R15	HC-F400	21.50	11U	301767	5706549	BT	82	6.1	969		225
HARPER	UPPER HARPER	21/6/11	R15	HC-F400	21.50	11U	301767	5706549	BT	125	22.7	969		225
HARPER	UPPER HARPER	21/6/11	R15	HC-F400	21.50	11U	301767	5706549	BT	56	1.6	969		225
HARPER	UPPER HARPER	22/6/11	R16	HC-F440	24.20	11U	301833	5708959	NFC	NFC		1012		90

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	UPPER HARPER	22/8/11	R17	HC-F450	24.50	11U	301734	5709456	NFC	NFC		300		150
HARPER	UPPER HARPER	22/8/11	R17	HC-F470	25.80	11U	302038	5710533	NFC	NFC		160		50
HARPER	UPPER HARPER	23/8/11	R15	HC-F410	22.20	11U	301824	5707200	BT	99		630		260
HARPER	UPPER HARPER	23/8/11	R15	HC-F410	22.20	11U	301824	5707200	BT	106		630		260
HARPER	UPPER HARPER	23/8/11	R15	HC-F410	22.20	11U	301824	5707200	BT	109		630		260
HARPER	UPPER HARPER	23/8/11	R15	HC-F410	22.20	11U	301824	5707200	BT	115		630		260
HARPER	UPPER HARPER	23/8/11	R15	HC-F410	22.20	11U	301824	5707200	BT	115		630		260
HARPER	UPPER HARPER	23/8/11	R15	HC-F410	22.20	11U	301824	5707200	BT	131		630		260
HARPER	UPPER HARPER	23/8/11	R15	HC-F410	22.20	11U	301824	5707200	BT	131		630		260
HARPER	UPPER HARPER	23/8/11	R15	HC-F410	22.20	11U	301824	5707200	BT	150		630		260
HARPER	UPPER HARPER	23/8/11	R15	HC-F410	22.20	11U	301824	5707200	BT	151		630		260
HARPER	UPPER HARPER	23/8/11	R15	HC-F410	22.20	11U	301824	5707200	BT	167		630		260
HARPER	UPPER HARPER	23/8/11	R15	HC-F410	22.20	11U	301824	5707200	BT	171		630		260
HARPER	UPPER HARPER	23/8/11	R15	HC-F410	22.20	11U	301824	5707200	BT	35		630		260
HARPER	UPPER HARPER	23/8/11	R15	HC-F410	22.20	11U	301824	5707200	BT	66		630		260
HARPER	UPPER HARPER	23/8/11	R15	HC-F420	22.40	11U	301736	5707473	BT	119		104		50
HARPER	UPPER HARPER	23/8/11	R15	HC-F420	22.40	11U	301736	5707473	BT	150		104		50
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	42		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	42		628		80
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	48		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	68		628		80
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	70		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	72		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	73		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	81		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	85		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	92		628		80
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	99		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	102		628		80
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	103		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	103		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	107		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	109		628		80
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	109		628		80
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	110		628		80
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	111		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	112		628		80
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	112		628		80
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	130		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	138		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	160		628		80
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	162		628		80

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	164		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	164		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	184		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	186		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	245		628		80
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	254		628		80
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	38		386		90
HARPER	UPPER HARPER	23/8/11	R16	HC-F430	23.50	11U	301819	5708512	BT	39		386		90
HARPER	UPPER HARPER	25/8/11	R12	HC-F320	20.00	11U	302001	5705228	BT	73		444		275
HARPER	UPPER HARPER	25/8/11	R12	HC-F320	20.00	11U	302001	5705228	BT	77		444		275
HARPER	UPPER HARPER	25/8/11	R12	HC-F320	20.00	11U	302001	5705228	BT	78		444		275
HARPER	UPPER HARPER	25/8/11	R12	HC-F320	20.00	11U	302001	5705228	BT	107		444		275
HARPER	UPPER HARPER	25/8/11	R12	HC-F320	20.00	11U	302001	5705228	BT	115		444		275
HARPER	UPPER HARPER	25/8/11	R12	HC-F320	20.00	11U	302001	5705228	BT	115		444		275
HARPER	UPPER HARPER	25/8/11	R12	HC-F320	20.00	11U	302001	5705228	BT	120		444		275
HARPER	UPPER HARPER	25/8/11	R12	HC-F320	20.00	11U	302001	5705228	BT	129		444		275
HARPER	UPPER HARPER	25/8/11	R12	HC-F320	20.00	11U	302001	5705228	BT	132		444		275
HARPER	UPPER HARPER	25/8/11	R12	HC-F320	20.00	11U	302001	5705228	BT	138		444		275
HARPER	UPPER HARPER	25/8/11	R12	HC-F320	20.00	11U	302001	5705228	BT	193		444		275
HARPER	UPPER HARPER	25/8/11	R12	HC-F320	20.00	11U	302001	5705228	BT	199		444		275
HARPER	UPPER HARPER	25/8/11	R12	HC-F320	20.00	11U	302001	5705228	BT	56		444		275
HARPER	UPPER HARPER	25/8/11	R12	HC-F320	20.00	11U	302001	5705228	BT	68		444		275
HARPER	UPPER HARPER	26/8/11	R16	HC-F440	24.30	11U	301723	5709233	BT	90		595		125
HARPER	UPPER HARPER	26/8/11	R16	HC-F440	24.30	11U	301723	5709233	BT	170		595		125
HARPER	UPPER HARPER	26/8/11	R16	HC-F440	24.30	11U	301723	5709233	BT	179		595		125
HARPER	UPPER HARPER	26/8/11	R16	HC-F440	24.30	11U	301723	5709233	BT	205		595		125
HARPER	UPPER HARPER	26/8/11	R16	HC-F440	24.30	11U	301723	5709233	BT	86		595		125
HARPER	UPPER HARPER	26/8/11	R16	HC-F440	24.30	11U	301723	5709233	BT	86		595		125
HARPER	UPPER HARPER	8/9/11	R13	HC-F350	20.60	11U	302078	5705788	BT	110	13.5	90		80
HARPER	UPPER HARPER	8/9/11	R13	HC-F350	20.60	11U	302078	5705788	BT	121	18.5	90		80
HARPER	UPPER HARPER	8/9/11	R13	HC-F360	20.60	11U	302078	5705788	BT	132	24.0	101		70
HARPER	UPPER HARPER	8/9/11	R14	HC-F360	20.90	11U	302114	5706068	BT	123	21.0	101		70
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	36		303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	40		303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	44		303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	69	3.5	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	72	4.5	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	75	5.5	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	76	55.0	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	80	7.0	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	85	7.0	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	105	11.5	303		225

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	140	28.0	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	141	29.5	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	143	28.0	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	145	29.5	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	146	30.0	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	151	37.0	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	154	39.5	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	172	51.0	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	182	71.0	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	192	82.5	303		225
HARPER	UPPER HARPER	8/9/11	R14	HC-F370	21.00	11U	301985	5706235	BT	210	99.0	303		225
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	37		595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	42		595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	67	3.0	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	71	3.5	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	75	4.5	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	75	4.5	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	77	5.5	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	84	6.0	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	105	13.5	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	110	13.5	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	114	17.0	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	123	18.0	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	130	22.0	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	140	31.0	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	140	27.5	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	142	28.0	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	144	29.0	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	145	33.5	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	150	32.5	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	154	39.5	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	163	44.0	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	177	52.0	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	192	71.5	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F390	21.30	11U	301884	5706380	BT	200	78.0	595		289
HARPER	UPPER HARPER	8/9/11	R15	HC-F380	21.90	11U	301814	5706972	NFC	NFC				
HARPER	UPPER HARPER	9/9/11	R11	HC-F290	19.00	11U	301531	5704509	BT	90	7.5	699		160
HARPER	UPPER HARPER	9/9/11	R11	HC-F290	19.00	11U	301531	5704509	BT	107	12.5	699		160
HARPER	UPPER HARPER	9/9/11	R11	HC-F290	19.00	11U	301531	5704509	BT	117	16.0	699		160
HARPER	UPPER HARPER	9/9/11	R11	HC-F290	19.00	11U	301531	5704509	BT	130	21.0	699		160
HARPER	UPPER HARPER	9/9/11	R11	HC-F290	19.00	11U	301531	5704509	BT	143	27.5	699		160
HARPER	UPPER HARPER	9/9/11	R11	HC-F290	19.00	11U	301531	5704509	BT	146	33.0	699		160

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	UPPER HARPER	9/9/11	R11	HC-F290	19.00	11U	301531	5704509	BT	176	62.0	699		160
HARPER	UPPER HARPER	9/9/11	R11	HC-F290	19.00	11U	301531	5704509	BT	182	69.5	699		160
HARPER	UPPER HARPER	9/9/11	R11	HC-F290	19.00	11U	301531	5704509	BT	185	62.5	699		160
HARPER	UPPER HARPER	9/9/11	R11	HC-F290	19.00	11U	301531	5704509	BT	74	6.0	699		160
HARPER	UPPER HARPER	9/9/11	R11	HC-F290	19.00	11U	301531	5704509	BT	84	6.0	699		160
HARPER	UPPER HARPER	9/9/11	R11	HC-F300	19.20	11U	301645	5704611	BT	126	19.0	224		80
HARPER	UPPER HARPER	9/9/11	R11	HC-F300	19.20	11U	301645	5704611	BT	152	35.0	224		80
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	38		2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	39		2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	43		2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	45		2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	65	3.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	67		2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	68	3.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	70	7.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	70	4.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	72	4.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	73	5.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	75	4.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	75	4.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	75	4.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	77	4.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	80	5.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	81	5.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	83	5.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	92	9.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	102	11.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	103	11.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	103	11.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	104	11.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	106	11.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	106	12.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	107	14.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	107	12.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	108	12.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	108	13.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	109	12.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	109	11.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	113	14.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	122	17.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	122	18.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	122	18.0	2029		425

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	122	18.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	129	18.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	129	20.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	132	22.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	134	24.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	135	26.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	136	25.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	139	30.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	141	26.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	145	32.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	146	30.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	155	37.5	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	159	40.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	164	43.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	179	60.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	187	72.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	191	81.0	2029		425
HARPER	UPPER HARPER	9/9/11	R15	HC-F400	21.50	11U	301767	5706549	BT	200	98.0	2029		425
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	80		1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	111	14.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	114	14.5	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	115	15.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	116	10.5	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	117	13.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	122	18.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	123	18.5	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	125	19.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	126	22.5	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	130	22.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	131	23.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	132	21.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	136	28.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	139	139.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	141	31.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	143	29.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	146	30.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	147	37.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	149	32.5	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	149	31.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	150	32.5	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	152	38.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	153	34.5	1350		260

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	154	46.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	154	37.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	164	48.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	165	42.5	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	165	42.5	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	200	87.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	1914	76.0	1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	42		1350		260
HARPER	UPPER HARPER	11/9/11	R11	HC-F310	19.70	11U	301902	5704991	BT	46		1350		260
HARPER	UPPER HARPER	17/09/13	R16	HC-F440	25	11U	301770	5709338	BT	120	18.52	133		150
HARPER	UPPER HARPER	17/09/13	R16	HC-F440	25	11U	301770	5709338	BT	168	51.61	133		150
HARPER	UPPER HARPER	17/09/13	R16	HC-F440	25	11U	301770	5709338	BT	54	1.3	133		150
HARPER	UPPER HARPER	17/09/13	R16	HC-F440	25	11U	301770	5709338	BT	50	1.62	133		150
HARPER	UPPER HARPER	17/09/13	R16	HC-F440	25	11U	301770	5709338	BT	49	1.44	133		150
HARPER	UPPER HARPER	17/09/13	R16	HC-F440	25	11U	301770	5709338	BT	61	2.05	133		150
HARPER	UPPER HARPER	17/09/13	R16	HC-F450	25.5	11U	301744	5709502	BT	131	22.74	874		300
HARPER	UPPER HARPER	17/09/13	R16	HC-F450	25.5	11U	301744	5709502	BT	136	24.36	874		300
HARPER	UPPER HARPER	17/09/13	R16	HC-F450	25.5	11U	301744	5709502	BT	57	2.07	874		300
HARPER	UPPER HARPER	17/09/13	R16	HC-F450	25.5	11U	301744	5709502	BT	54	1.38	874		300
HARPER	UPPER HARPER	17/09/13	R16	HC-F450	25.5	11U	301744	5709502	BT	54	1.73	874		300
HARPER	UPPER HARPER	17/09/13	R16	HC-F450	25.5	11U	301744	5709502	BT	53	2.07	874		300
HARPER	UPPER HARPER	17/09/13	R16	HC-F450	25.5	11U	301744	5709502	BT	52	1.31	874		300
HARPER	UPPER HARPER	17/09/13	R16	HC-F450	25.5	11U	301744	5709502	BT	52	1.3	874		300
HARPER	UPPER HARPER	17/09/13	R16	HC-F450	25.5	11U	301744	5709502	BT	55	1.54	874		300
HARPER	UPPER HARPER	17/09/13	R16	HC-F450	25.5	11U	301744	5709502	BT	54	2.06	874		300
HARPER	UPPER HARPER	17/09/13	R16	HC-F450	25.5	11U	301744	5709502	BT	56	1.81	874		300
HARPER	UPPER HARPER	17/09/13	R16	HC-F450	25.5	11U	301744	5709502	BT	55	1.63	874		300
HARPER	UPPER HARPER	17/09/13	R16	HC-F450	25.5	11U	301744	5709502	BT	53	1.26	874		300
HARPER	UPPER HARPER	17/09/13	R16	HC-F450	25.5	11U	301744	5709502	BT	51	1.47	874		300
HARPER	UPPER HARPER	17/09/13	R17	HC-F470	27	11U	302032	5710556	NFC			500		200
HARPER	UPPER HARPER	17/09/13	R17	HC-F460	27	11U	302038	5710280	NFC			440		200
HARPER	UPPER HARPER	23/09/13	R15	HC- F400	21.50	11U	301766	5706578	BT	122	17.01	316		200
HARPER	UPPER HARPER	23/09/13	R15	HC- F400	21.50	11U	301766	5706578	BT	138	25.4	316		200
HARPER	UPPER HARPER	23/09/13	R15	HC- F400	21.50	11U	301766	5706578	BT	142	27.35	316		200
HARPER	UPPER HARPER	23/09/13	R15	HC- F400	21.50	11U	301766	5706578	BT	133	21.55	316		200
HARPER	UPPER HARPER	23/09/13	R15	HC- F400	21.50	11U	301766	5706578	BT	118	13.68	316		200
HARPER	UPPER HARPER	23/09/13	R15	HC- F400	21.50	11U	301766	5706578	BT	87	6.02	316		200
HARPER	UPPER HARPER	23/09/13	R15	HC- F400	21.50	11U	301766	5706578	BT	50	1	316		200
HARPER	UPPER HARPER	23/09/13	R15	HC- F400	21.50	11U	301766	5706578	BT	56	1.81	316		200
HARPER	UPPER HARPER	23/09/13	R15	HC- F400	21.50	11U	301766	5706578	BT	56	1.6	316		200
HARPER	UPPER HARPER	23/09/13	R15	HC- F400	21.50	11U	301766	5706578	BT	45	1.43	316		200
HARPER	UPPER HARPER	23/09/13	R15	HC- F400	21.50	11U	301766	5706578	BT	52	1.5	316		200

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	UPPER HARPER	23/09/13	R15	HC- F400	21.50	11U	301766	5706578	BT	53	1.47	316		200
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	155	38.85	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	118	15.05	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	114	13.36	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	90	6.93	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	54	1.62	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	50	1.23	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	47	0.97	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	50	1.96	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	81	5.02	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	48	1.23	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	57	1.91	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	52	1.64	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	50	1.53	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	55	1.82	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	51	1.69	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	55	1.95	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	44	1.2	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	48	1.42	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	50	1.53	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	57	1.86	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	47	1.94	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	50	2.1	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	51	1.73	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	47	1.74	923		225
HARPER	UPPER HARPER	23/09/13	R12	HC-F330	20.20	11U	301980	5705453	BT	48	1.32	923		225
HARPER	UPPER HARPER	27/7/11	R12	HC-F330	20.20	11U	301980	5705453	BT	55	1.6	551		125
HARPER	UPPER HARPER	27/7/11	R12	HC-F330	20.20	11U	301980	5705453	BT	64	2.7	551		125
HARPER	UPPER HARPER	27/7/11	R12	HC-F330	20.20	11U	301980	5705453	BT	67	3.0	551		125
HARPER	UPPER HARPER	27/7/11	R12	HC-F330	20.20	11U	301980	5705453	BT	189	64.9	551		125
HARPER	UPPER HARPER	27/7/11	R12	HC-F330	20.20	11U	301980	5705453	BT	62	2.7	551		125
HARPER	UPPER HARPER	27/7/11	R12	HC-F340	20.30	11U	301979	5705578	BT	109	14.3		19, 10 traps	
HARPER	UPPER HARPER	27/7/11	R12	HC-F340	20.30	11U	301979	5705578	BT	111	12.1		19, 10 traps	
HARPER	UPPER HARPER	27/7/11	R12	HC-F340	20.30	11U	301979	5705578	BT	146	30.6		19, 10 traps	
HARPER	UPPER HARPER	27/7/11	R12	HC-F340	20.30	11U	301979	5705578	BT	162	38.8		19, 10 traps	
HARPER	UPPER HARPER	27/7/11	R12	HC-F340	20.30	11U	301979	5705578	BT	206	78.4		19, 10 traps	
HARPER	UPPER P-CREEK	18/09/13	R2	PC-F70	0.7	11U	302419	5710006	NFC	NFC		569		200
HARPER	UPPER T-CREEK	16/8/11	R3	TC-F100	2.30	11U	304062	5705827	NFC	NFC		526		320
HARPER	UPPER T-CREEK	16/8/11	R3	TC-F110	2.60	11U	304288	5706068	NFC	NFC		489		290
HARPER	UPPER T-CREEK	16/8/11	R4	TC-F130	3.20	11U	304553	5706463	NFC	NFC		333		155
HARPER	UPPER T-CREEK	10/9/11	R2	TC-F070	0.38	11U	302340	5705634	NFC	NFC		223		80
HARPER	UPPER T-CREEK	10/9/11	R2	TC-F080	0.62	11U	302569	5705608	NFC	NFC		170		75

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
HARPER	UPPER T-CREEK	10/9/11	R2	TC-F090	0.72	11U	302650	5705558	NFC	NFC		175		90
HARPER	UPPER T-CREEK	10/9/11	R4	TC-F120	3.00	11U	304427	5706343	NFC	NFC		110		135
HARPER	UPPER T-CREEK	10/9/11	R6	TC-F160	7.30	11U	306800	5709017	NFC	NFC		127		110
HARPER	UPPER T-CREEK	10/9/11	R6	TC-F170	7.60	11U	306920	5709159	NFC	NFC		154		100
HARPER	UPPER T-CREEK	10/9/11	R6	TC-F180	8.00	11U	307272	5709220	NFC	NFC		135		90
HARPER	UPPER T-CREEK	31/7/12	R3	TC-F110	3.00	11U	304288	5706068	NFC	NFC		376		385
HARPER	UPPER T-CREEK	31/7/12	R4	TC-F140	3.40	11U	304738	5706581	NFC	NFC		539		350
HARPER	UPPER T-CREEK	31/7/12	R4	TC-F155	5.17	11U	305628	5707920	NFC	NFC		437		370
HARPER	UPPER T-CREEK	13/9/12	R2	TC-F070	0.38	11U	302340	5705634	NFC	NFC		423		130
HARPER	UPPER T-CREEK	20/09/13	R3	TC-F152	3.5	11U	304824	5706200	NFC	NFC		493		250
HARPER	UPPER T-CREEK	20/09/13	R4	TC-F156	4.5	11U	305858	5706708	NFC	NFC		189		130
HARPER	UPPER T-CREEK	20/09/13	R4	TC-F157	4.3	11U	305444	5706676	NFC	NFC		223		150
HARPER	UPPER T-CREEK	20/09/13	R2	TC-F105	2.5	11U	304182	5705919	NFC	NFC		537		300
NORTH THOMPSON	AVERY CREEK	30/9/11	R1	AC-F010	0.55	11U	309884	5717119	NFC	NFC		325		100
NORTH THOMPSON	AVERY CREEK	12/9/12	R1	AC-F020	4.05	11U	311389	5714583	NFC	NFC		329		125
NORTH THOMPSON	AVERY CREEK	12/9/12	R1	AC-F010	0.45	11U	309884	5717119	NFC (DRY BED)	NFC		0		0
NORTH THOMPSON	AVERY CREEK	20/09/13	R1	AC-F020	4.05	11U	311389	5714583	NFC	NFC		239		125
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	BT	135		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	CO	94		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	34		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	35		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	38		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	38		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	39		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	39		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	39		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	39		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	40		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	40		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	40		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	41		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	42		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	47		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	69		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	87		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	89		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	102		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	102		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	104		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	104		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	105		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	105		782		175

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	110		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	115		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	115		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	117		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	118		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	124		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	126		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	129		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	134		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	135		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	137		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	142		782		175
NORTH THOMPSON	BAKER CREEK	10/9/11	R1	BC-F010	0.03	11U	305160	5717796	RBT	147		782		175
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	33		281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	74	6.0	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	80	7.5	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	83	7.5	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	83	9.5	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	90	9.0	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	94	10.0	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	104	14.0	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	107	14.5	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	110	15.0	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	112	15.5	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	113	16.0	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	120	24.0	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	124	26.0	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	126	24.5	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	126	25.5	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	129	25.5	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	135	32.5	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	138	30.5	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	144	37.5	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F020	0.20	11U	305106	5717639	RBT	152	39.5	281		115
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F030	1.50	11U	305094	5716468	RBT	85		661		220
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F030	1.50	11U	305094	5716468	RBT	95		661		220
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F030	1.50	11U	305094	5716468	RBT	155		661		220
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F030	1.50	11U	305094	5716468	RBT	185		661		220
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F040	1.70	11U	305085	5716229	RBT	93		264		220
NORTH THOMPSON	BAKER CREEK	22/9/11	R2	BC-F040	1.70	11U	305085	5716229	RBT	185		264		220
NORTH THOMPSON	BAKER CREEK	28/9/11	R3	BC-F060	2.40	11U	305176	5715605	NFC	NFC		240		210
NORTH THOMPSON	BAKER CREEK	28/9/11	R4	BC-F070	4.5	11U	305375	5713599	NFC	NFC		470		85

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
NORTH THOMPSON	BAKER CREEK	28/9/11	R3	BC-F050	2.00	11U	305109	5715953	RBT	100		235		230
NORTH THOMPSON	BAKER CREEK	1/8/12	R3	BC-F060	2.40	11U	305176	5715605	NFC	NFC		376		190
NORTH THOMPSON	BAKER CREEK	1/8/12	R3	BC-F050	2.00	11U	305109	5715953	RBT	122		130		175
NORTH THOMPSON	BAKER CREEK	1/8/12	R3	BC-F050	2.00	11U	305109	5715953	RBT	154		130		175
NORTH THOMPSON	BAKER CREEK	1/8/12	R3	BC-F050	2.00	11U	305109	5715953	RBT	62		130		175
NORTH THOMPSON	BAKER CREEK	1/8/12	R3	BC-F050	2.00	11U	305109	5715953	RBT	187		130		175
NORTH THOMPSON	BAKER CREEK	12/9/12	R2	BC-F020	0.20	11U	305106	5717639	RBT	132	25.5	267		150
NORTH THOMPSON	BAKER CREEK	12/9/12	R2	BC-F020	0.20	11U	305106	5717639	RBT	133	25.7	267		150
NORTH THOMPSON	BAKER CREEK	12/9/12	R2	BC-F020	0.20	11U	305106	5717639	RBT	129	26.2	267		150
NORTH THOMPSON	BAKER CREEK	12/9/12	R2	BC-F020	0.20	11U	305106	5717639	RBT	153	45.5	267		150
NORTH THOMPSON	BAKER CREEK	12/9/12	R2	BC-F020	0.20	11U	305106	5717639	RBT	125	25.5	267		150
NORTH THOMPSON	CHUCK CREEK	23/6/11	R1	CC-F010	0.65	11U	313003	5718415	RBT	96	10.7	296		75
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	47		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	47		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	53		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	57		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	57		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	58		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	59		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	60		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	60		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	60		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	64		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	65		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	65		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	66		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	66		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	69		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	72		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	75		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	75		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	75		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	76		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	CO	97		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	RBT	67		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	RBT	77		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	RBT	92		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	RBT	98		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	RBT	102		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	RBT	103		725		70
NORTH THOMPSON	FOGHORN CREEK	28/9/11	R1	FC-F010	0.05	11U	297708	5720888	RBT	108		725		70
NORTH THOMPSON	JONES CREEK	23/6/11	R1	JC-F030	0.62	11U	306735	5717783	NFC	NFC		325		50

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
NORTH THOMPSON	JONES CREEK	23/6/11	R1	JC-F030	0.62	11U	306735	5717783	RBT	460		120		50
NORTH THOMPSON	JONES CREEK	29/7/11	R1	JC-F010	0.15	11U	306785	5718217	CRH	77		208		170
NORTH THOMPSON	JONES CREEK	29/7/11	R1	JC-F010	0.15	11U	306785	5718217	CRH	89		208		170
NORTH THOMPSON	JONES CREEK	29/7/11	R1	JC-F020	0.39	11U	306817	5717995	CRH	90		255		180
NORTH THOMPSON	JONES CREEK	29/7/11	R1	JC-F020	0.39	11U	306817	5717995	CRH	90		255		180
NORTH THOMPSON	JONES CREEK	29/7/11	R1	JC-F030	0.62	11U	306737	5717783	CRH	89		168		100
NORTH THOMPSON	JONES CREEK	29/7/11	R1	JC-F010	0.15	11U	306785	5718217	RBT	102		208		170
NORTH THOMPSON	JONES CREEK	29/7/11	R1	JC-F010	0.15	11U	306785	5718217	RBT	133		208		170
NORTH THOMPSON	JONES CREEK	29/7/11	R1	JC-F020	0.39	11U	306817	5717995	RBT	103		255		180
NORTH THOMPSON	JONES CREEK	29/7/11	R1	JC-F020	0.39	11U	306817	5717995	RBT	134		255		180
NORTH THOMPSON	JONES CREEK	29/7/11	R1	JC-F030	0.62	11U	306737	5717783	RBT	87		168		100
NORTH THOMPSON	JONES CREEK	29/7/11	R1	JC-F030	0.62	11U	306737	5717783	RBT	128		168		100
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	CO	72		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	CO	84		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	RBT	98		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	RBT	100		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	RBT	101		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	RBT	110		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	RBT	116		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	RBT	126		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	RBT	128		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	RBT	137		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	RBT	141		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	RBT	143		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	RBT	143		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	RBT	144		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	RBT	146		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	RBT	146		329		175
NORTH THOMPSON	JONES CREEK	10/9/11	R2	JC-F040	0.77	11U	306658	5717651	RBT	172		329		175
NORTH THOMPSON	JONES CREEK	29/9/11	R3	JC-F070	3.60	11U	307100	5715159	NFC	NFC		530		150
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	45		236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	67		236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	75		236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	85		236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	87		236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	89		236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	97		236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	105		236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	106		236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	110		236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	112	35.5	236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	115		236		210

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	115		236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	116		236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	134	32.5	214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	143		236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	152	35.5	214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	157	45.5	236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	168	63.5	236		210
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F050	1.30	11U	306412	5717233	RBT	172	62.0	214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F060	1.70	11U	306398	5716778	RBT	60		214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F060	1.70	11U	306398	5716778	RBT	68		214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F060	1.70	11U	306398	5716778	RBT	68		214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F060	1.70	11U	306398	5716778	RBT	69		214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F060	1.70	11U	306398	5716778	RBT	87		214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F060	1.70	11U	306398	5716778	RBT	95		214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F060	1.70	11U	306398	5716778	RBT	106		214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F060	1.70	11U	306398	5716778	RBT	108		214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F060	1.70	11U	306398	5716778	RBT	109		214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F060	1.70	11U	306398	5716778	RBT	110		214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F060	1.70	11U	306398	5716778	RBT	113		214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F060	1.70	11U	306398	5716778	RBT	115		214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F060	1.70	11U	306398	5716778	RBT	125		214		180
NORTH THOMPSON	JONES CREEK	29/9/11	R2	JC-F060	1.70	11U	306398	5716778	RBT	125		214		180
NORTH THOMPSON	JONES CREEK	12/9/12	R2	JC-F065	1.95	11U	306500	5716594	RBT	86		326		170
NORTH THOMPSON	JONES CREEK	12/9/12	R2	JC-F065	1.95	11U	306500	5716594	RBT	59		326		170

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
NORTH THOMPSON	JONES CREEK	12/9/12	R2	JC-F065	1.95	11U	306500	5716594	RBT	107		326		170
NORTH THOMPSON	JONES CREEK	12/9/12	R2	JC-F065	1.95	11U	306500	5716594	RBT	117		326		170
NORTH THOMPSON	JONES CREEK	12/9/12	R2	JC-F065	1.95	11U	306500	5716594	RBT	124	20.8	326		170
NORTH THOMPSON	JONES CREEK	12/9/12	R2	JC-F065	1.95	11U	306500	5716594	RBT	174	53.7	326		170
NORTH THOMPSON	JONES CREEK	12/9/12	R2	JC-F065	1.95	11U	306500	5716594	RBT	133	24.5	326		170
NORTH THOMPSON	JONES CREEK	12/9/12	R2	JC-F065	1.95	11U	306500	5716594	RBT	131	23.8	326		170
NORTH THOMPSON	JONES CREEK	12/9/12	R2	JC-F065	1.95	11U	306500	5716594	RBT	124	21.9	326		170
NORTH THOMPSON	LUTE CREEK	28/9/11	R1	LC-F010	0.05	11U	302117	5718238	RBT	109	109.0	725		75
NORTH THOMPSON	LUTE CREEK	28/9/11	R1	LC-F010	0.05	11U	302117	5718238	RBT	112	19.0	725		75
NORTH THOMPSON	LUTE CREEK	28/9/11	R1	LC-F010	0.05	11U	302117	5718238	RBT	115	18.0	725		75
NORTH THOMPSON	LUTE CREEK	28/9/11	R1	LC-F010	0.05	11U	302117	5718238	RBT	124	25.5	725		75
NORTH THOMPSON	LUTE CREEK	28/9/11	R1	LC-F010	0.05	11U	302138	5718243	RBT	147	35.0	725		75
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	CO	68		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	CO	59		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	CO	65		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	CO	72		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	CO	64		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	CO	59		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	CO	53		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	CO	64		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	CO	87		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	CO	72		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	73		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	91		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	105		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	103		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	87		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	104		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	96		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	94		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	89		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	95		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	109		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	97		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	102		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	99		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	85		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	93		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	97		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	79		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	89		327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	190	90.1	327		110

Knight Piésold CONSULTING

APPENDIX D

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011-2013 FISH CAPTURE DATA

Print Jun/12/14 10:51:29

Drainage	Watershed	Date	Reach	Site Codes	River KM	UTM Zone	UTM East	UTM North	Fish Species	Fork Length (mm)	Weight (g)	Electrofishing Seconds	Trap (Hours, # Traps)	Distance Sampled (m)
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	125	24.3	327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	116	18.6	327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	118	19.4	327		110
NORTH THOMPSON	LUTE CREEK	12/9/12	R1	LC-F010	0.12	11U	302117	5718238	RBT	99	12.6	327		110

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Appendices\D - Fish Capture Data\[Appendix D - Fish Capture Data.xlsx]Appendix X 2011-13

NOTES:

1. FISH SPECIES NAMES: BT=BULL TROUT, CO=COHO, LND=LONGNOSE DACE, MWF=MOUNTAIN WHITEFISH, RBT=RAINBOW TROUT, CRH=TORRENT SCULPIN, NFC=NO FISH CAPTURED

0	30MAY'14	ISSUED WITH REPORT VA101-458/15-1	PMT	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

APPENDIX E

FISH TISSUE DATA

(Pages E-1 to E-19)

Knight Piésold CONSULTING

APPENDIX E -1

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

SAMPLE KEY FOR FISH TISSUE SAMPLES

Print Aug/01/14 14:27:17

Sample	Sample Year	Species	Date Captured	Watershed	Location	ForkLength (mm)	Weight (g)	Age structure	Age Estimate	Tissues
2011-TMF#1	2011	BT	09/12/11	Harper Creek	T- Creek	132	22	otolith	3	ALS Lab disection of liver and somatic tissue
2011-TMF#2	2011	BT	09/12/11	Harper Creek	T- Creek	139	26.5	otolith	2	ALS Lab disection of liver and somatic tissue
2011-TMF#3	2011	BT	09/12/11	Harper Creek	T- Creek	139	25.8	otolith	2	ALS Lab disection of liver and somatic tissue
2011-TMF#4	2011	BT	09/12/11	Harper Creek	T- Creek	200	85.4	otolith	6	ALS Lab disection of liver and somatic tissue
2011-TMF#5	2011	BT	09/12/11	Harper Creek	T- Creek	170	50.5	otolith	4	ALS Lab disection of liver and somatic tissue
2011-OP#1	2011	BT	09/12/11	Harper Creek	P- Creek	149	31.2	otolith	3	ALS Lab disection of liver and somatic tissue
2011-OP#2	2011	BT	09/12/11	Harper Creek	P- Creek	122	20.5	otolith	2	ALS Lab disection of liver and somatic tissue
2011-OP#3	2011	BT	09/12/11	Harper Creek	P- Creek	183	64.4	otolith	4	ALS Lab disection of liver and somatic tissue
2011-OP#4	2011	BT	09/12/11	Harper Creek	P- Creek	148	33.2	otolith	3	ALS Lab disection of liver and somatic tissue
2011-OP#5	2011	BT	09/12/11	Harper Creek	P- Creek	146	30	otolith	3	ALS Lab disection of liver and somatic tissue
2012-TMF#1	2012	BT	09/21/12	Harper Creek	T- Creek	150	35.5	otolith	No Estimate	ALS Lab disection of liver and somatic tissue
2012-TMF#2	2012	BT	09/21/12	Harper Creek	T- Creek	154	34.7	otolith	No Estimate	ALS Lab disection of liver and somatic tissue
2012-TMF#3	2012	BT	09/21/12	Harper Creek	T- Creek	170	48.5	otolith	No Estimate	ALS Lab disection of liver and somatic tissue
2012-TMF#4	2012	BT	09/21/12	Harper Creek	T- Creek	157	36.4	otolith	No Estimate	ALS Lab disection of liver and somatic tissue
2012-TMF#5	2012	BT	09/21/12	Harper Creek	T- Creek	144	33.2	otolith	No Estimate	ALS Lab disection of liver and somatic tissue
2012-OP#1	2012	BT	09/22/12	Harper Creek	P- Creek	116	16.9	otolith	No Estimate	ALS Lab disection of liver and somatic tissue
2012-OP#2	2012	BT	09/22/12	Harper Creek	P- Creek	103	10.5	otolith	No Estimate	ALS Lab disection of liver and somatic tissue
2012-OP#3	2012	BT	09/22/12	Harper Creek	P- Creek	154	39.4	otolith	No Estimate	ALS Lab disection of liver and somatic tissue
2012-OP#4	2012	BT	09/22/12	Harper Creek	P- Creek	202	83.6	otolith	No Estimate	ALS Lab disection of liver and somatic tissue
2012-OP#5	2012	BT	09/22/12	Harper Creek	P- Creek	238	121.3	otolith	No Estimate	ALS Lab disection of liver and somatic tissue
2011-Baker Cr#1	2011	RBT	09/22/11	N. Thompson	Baker Creek	135	32.5	lateral scales	4+	ALS Lab disection of liver and somatic tissue
2011-Baker Cr#2	2011	RBT	09/22/11	N. Thompson	Baker Creek	112	15.8	lateral scales	3+	ALS Lab disection of liver and somatic tissue
2011-Baker Cr#3	2011	RBT	09/22/11	N. Thompson	Baker Creek	126	24.3	lateral scales	4+	ALS Lab disection of liver and somatic tissue
2011-Baker Cr#4	2011	RBT	09/22/11	N. Thompson	Baker Creek	152	39.2	lateral scales	5+	ALS Lab disection of liver and somatic tissue
2011-Baker Cr#5	2011	RBT	09/22/11	N. Thompson	Baker Creek	144	37.5	lateral scales	4+	ALS Lab disection of liver and somatic tissue
2011-Lute Cr#1	2011	RBT	09/28/11	N. Thompson	Lute Creek	147	35.2	lateral scales	4+	ALS Lab disection of liver and somatic tissue
2011-Lute Cr#2	2011	RBT	09/28/11	N. Thompson	Lute Creek	124	25.5	lateral scales	3+	ALS Lab disection of liver and somatic tissue
2011-Lute Cr#3	2011	RBT	09/28/11	N. Thompson	Lute Creek	112	19	lateral scales	3+	ALS Lab disection of liver and somatic tissue
2011-Lute Cr#4	2011	RBT	09/28/11	N. Thompson	Lute Creek	115	18	lateral scales	3+	ALS Lab disection of liver and somatic tissue
2011-Lute Cr#5	2011	RBT	09/28/11	N. Thompson	Lute Creek	109	16.3	lateral scales	2+	ALS Lab disection of liver and somatic tissue
2011-Jones Cr#1	2011	RBT	09/29/11	N. Thompson	Jones Creek	152	35.4	lateral scales	4+	ALS Lab disection of liver and somatic tissue
2011-Jones Cr#2	2011	RBT	09/29/11	N. Thompson	Jones Creek	168	63.8	lateral scales	4+	ALS Lab disection of liver and somatic tissue
2011-Jones Cr#3	2011	RBT	09/29/11	N. Thompson	Jones Creek	134	32.3	lateral scales	4+	ALS Lab disection of liver and somatic tissue
2011-Jones Cr#4	2011	RBT	09/29/11	N. Thompson	Jones Creek	157	45.1	lateral scales	3+	ALS Lab disection of liver and somatic tissue
2011-Jones Cr#5	2011	RBT	09/29/11	N. Thompson	Jones Creek	172	62	lateral scales	4+	ALS Lab disection of liver and somatic tissue
2012-Baker Cr#1	2012	RBT	09/12/12	N. Thompson	Baker Creek	132	25.5	lateral scales	No Estimate	ALS Lab disection of liver and somatic tissue
2012-Baker Cr#2	2012	RBT	09/12/12	N. Thompson	Baker Creek	133	25.7	lateral scales	No Estimate	ALS Lab disection of liver and somatic tissue
2012-Baker Cr#3	2012	RBT	09/12/12	N. Thompson	Baker Creek	129	26.2	lateral scales	No Estimate	ALS Lab disection of liver and somatic tissue
2012-Baker Cr#4	2012	RBT	09/12/12	N. Thompson	Baker Creek	153	45.5	lateral scales	No Estimate	ALS Lab disection of liver and somatic tissue
2012-Baker Cr#5	2012	RBT	09/12/12	N. Thompson	Baker Creek	125	25.5	lateral scales	No Estimate	ALS Lab disection of liver and somatic tissue
2012-Lute Cr#1	2012	RBT	09/12/12	N. Thompson	Lute Creek	190	90.1	lateral scales	No Estimate	ALS Lab disection of liver and somatic tissue
2012-Lute Cr#2	2012	RBT	09/12/12	N. Thompson	Lute Creek	125	24.3	lateral scales	No Estimate	ALS Lab disection of liver and somatic tissue
2012-Lute Cr#3	2012	RBT	09/12/12	N. Thompson	Lute Creek	116	18.6	lateral scales	No Estimate	ALS Lab disection of liver and somatic tissue
2012-Lute Cr#4	2012	RBT	09/12/12	N. Thompson	Lute Creek	118	19.4	lateral scales	No Estimate	ALS Lab disection of liver and somatic tissue
2012-Lute Cr#5	2012	RBT	09/12/12	N. Thompson	Lute Creek	99	12.6	lateral scales	No Estimate	ALS Lab disection of liver and somatic tissue
2012-Jones Cr#1	2012	RBT	09/12/12	N. Thompson	Jones Creek	124	20.8	lateral scales	No Estimate	ALS Lab disection of liver and somatic tissue
2012-Jones Cr#2	2012	RBT	09/12/12	N. Thompson	Jones Creek	174	53.7	lateral scales	No Estimate	ALS Lab disection of liver and somatic tissue
2012-Jones Cr#3	2012	RBT	09/12/12	N. Thompson	Jones Creek	133	24.5	lateral scales	No Estimate	ALS Lab disection of liver and somatic tissue
2012-Jones Cr#4	2012	RBT	09/12/12	N. Thompson	Jones Creek	131	23.8	lateral scales	No Estimate	ALS Lab disection of liver and somatic tissue
2012-Jones Cr#5	2012	RBT	09/12/12	N. Thompson	Jones Creek	124	27.9	lateral scales	No Estimate	ALS Lab disection of liver and somatic tissue

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]Sample Key

0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

APPENDIX E-2

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011 METALS IN TISSUE CONCENTRATIONS FROM BULL TROUT SAMPLED IN P CREEK

Print Aug/01/14 14:27:17

Sample ID Date Sampled	2011-OP#1 MUSCLE 12-SEP-11	2011-OP#1 LIVER 12-SEP-11	2011-OP#2 MUSCLE 12-SEP-11	2011-OP#2 LIVER 12-SEP-11	2011-OP#3 MUSCLE 12-SEP-11	2011-OP#3 LIVER 12-SEP-11	2011-OP#4 MUSCLE 12-SEP-11	2011-OP#4 LIVER 12-SEP-11	2011-OP#5 MUSCLE 12-SEP-11	2011-OP#5 LIVER 12-SEP-11
Physical Tests										
% Moisture	78.7	78.0	79.0	79.8	78.9	78.5	80.6	79.3	78.9	76.2
Metals										
Aluminum (Al)-Total	0.61	<0.80	<0.40	2.07	<0.40	1.98	<0.40	2.19	<0.40	1.31
Antimony (Sb)-Total	<0.0020	<0.0040	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020
Arsenic (As)-Total	0.0182	0.0178	0.0432	0.0476	0.0573	0.0373	0.0383	0.0396	0.0204	0.0333
Barium (Ba)-Total	0.018	<0.020	0.032	0.084	0.032	0.013	0.014	0.121	0.023	0.030
Beryllium (Be)-Total	<0.0020	<0.0040	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020
Bismuth (Bi)-Total	<0.0020	<0.0040	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020
Boron (B)-Total	<0.20	<0.40	0.30	1.94	0.31	<0.20	<0.20	<0.40	0.23	<0.20
Cadmium (Cd)-Total	0.0089	0.0166	0.0211	0.0783	0.0091	0.220	0.0108	0.183	0.0075	0.130
Calcium (Ca)-Total	209	172	513	731	500	115	173	1060	467	143
Cesium (Cs)-Total	0.0261	0.0265	0.0292	0.0263	0.0564	0.0413	0.0288	0.0280	0.0404	0.0442
Chromium (Cr)-Total	<0.010	0.022	0.011	0.034	0.015	0.080	0.013	0.025	0.016	0.010
Cobalt (Co)-Total	0.0174	0.0497	0.0345	0.0750	0.0161	0.0557	0.0108	0.0386	0.0196	0.0316
Copper (Cu)-Total	0.197	2.45	0.288	1.60	0.303	4.48	0.245	3.06	0.317	4.14
Gallium (Ga)-Total	<0.0040	<0.0080	<0.0040	<0.0080	<0.0040	<0.0040	<0.0040	<0.0080	<0.0040	<0.0040
Iron (Fe)-Total	3.29	170	4.44	79.0	4.33	188	3.06	179	3.82	110
Lead (Pb)-Total	<0.0040	<0.0080	<0.0040	0.0216	<0.0040	0.0045	<0.0040	<0.0080	<0.0040	<0.0040
Lithium (Li)-Total	<0.030	<0.040	<0.030	<0.040	<0.030	<0.020	<0.050	<0.040	<0.030	<0.020
Magnesium (Mg)-Total	212	196	247	246	280	206	235	252	310	248
Manganese (Mn)-Total	0.219	0.346	0.321	0.490	0.222	0.871	0.177	1.49	0.176	1.24
Mercury (Hg)-Total	0.0512	0.0490	0.0232	0.0356	0.0396	0.0638	0.0278	0.0525	0.0275	0.0496
Molybdenum (Mo)-Total	0.0052	0.0229	0.0051	0.0151	<0.0040	0.112	0.0059	0.132	0.0051	0.164
Nickel (Ni)-Total	<0.015	<0.020	<0.020	<0.060	<0.015	<0.020	<0.025	<0.040	<0.035	<0.025
Phosphorus (P)-Total	1890	2790	2290	3260	2500	2920	2030	3870	2700	3730
Potassium (K)-Total	3460	3000	3870	3700	4490	3250	3800	3300	4790	3680
Rhenium (Re)-Total	<0.0020	<0.0040	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020
Rubidium (Rb)-Total	4.25	4.66	4.23	4.37	7.91	6.35	4.30	4.61	6.56	7.18
Selenium (Se)-Total	0.167	0.435	0.374	0.670	0.281	0.748	0.270	0.730	0.222	0.717
Sodium (Na)-Total	580	<1700	750	1400	700	1160	620	<1200	870	1270
Strontium (Sr)-Total	0.101	0.142	0.268	0.436	0.303	0.091	0.097	0.751	0.223	0.138
Tellurium (Te)-Total	<0.0040	<0.0080	<0.0040	<0.0080	<0.0040	<0.0040	<0.0040	<0.0080	<0.0040	<0.0040
Thallium (Tl)-Total	0.00290	0.0113	0.00432	0.00997	0.00576	0.0131	0.00379	0.0160	0.00383	0.0157
Thorium (Th)-Total	<0.0020	<0.0040	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020
Tin (Sn)-Total	<0.0040	<0.0080	<0.0040	<0.0080	<0.0040	<0.0040	<0.0040	<0.0080	<0.0040	<0.0040
Titanium (Ti)-Total	0.017	<0.020	<0.010	0.058	<0.010	<0.010	<0.010	<0.020	<0.010	0.016
Uranium (U)-Total	0.00142	<0.00080	0.00079	0.00224	0.00052	0.00233	<0.00040	0.00428	<0.00040	0.00153
Vanadium (V)-Total	<0.0040	<0.0080	<0.0040	<0.0080	<0.0040	0.0043	<0.0040	<0.0080	<0.0040	<0.0040
Yttrium (Y)-Total	<0.0020	0.0041	<0.0020	0.0052	<0.0020	0.0025	<0.0020	0.0052	<0.0020	0.0040
Zinc (Zn)-Total	5.62	29.2	10.1	29.1	6.92	54.2	6.47	42.5	7.42	40.1
Zirconium (Zr)-Total	<0.040	<0.080	<0.040	<0.080	<0.040	<0.040	<0.040	<0.080	<0.040	<0.040
Aggregate Organics										
Lipid Content	1.2	-	0.9	-	1.0	-	0.8	-	1.2	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]P Tissue 2011

NOTE:

1. NONE OF THE RESULTS EXCEEDED GUIDELINE LIMITS FOR METALS IN TISSUE.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB

Knight Piésold CONSULTING

APPENDIX E-2

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2012 METALS IN TISSUE CONCENTRATIONS FROM BULL TROUT SAMPLED IN P CREEK

Print Aug/01/14 14:27:17

Sample ID	2012-OP#1 MUSCLE	2012-OP#1 LIVER	2012-OP#2 MUSCLE	2012-OP#2 LIVER	2012-OP#3 MUSCLE	2012-OP#3 LIVER	2012-OP#4 MUSCLE	2012-OP#4 LIVER	2012-OP#5 MUSCLE	2012-OP#5 LIVER
Date Sampled	22-Sep-12	22-Sep-12	22-Sep-12	22-Sep-12	22-Sep-12	22-Sep-12	22-Sep-12	22-Sep-12	22-Sep-12	22-Sep-12
Physical Tests										
% Moisture	79.7	77.4	78.8	79.6	79.0	75.9	75.8	77.5	76.9	78.5
Metals										
Aluminum (Al)-Total	0.92	1.08	1.03	1.93	1.04	2.32	<0.40	2.25	<0.40	2.05
Antimony (Sb)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total	0.0214	0.0313	0.0405	0.0578	0.0676	0.0387	0.0567	0.0335	0.0356	0.0291
Barium (Ba)-Total	0.014	<0.010	0.018	0.024	0.014	0.028	0.016	0.020	<0.010	<0.010
Beryllium (Be)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	<0.0040	<0.0020	<0.0040	<0.014	<0.0020	<0.044	<0.030	<0.0030	<0.0020	<0.0020
Boron (B)-Total	1.33	<0.20	<0.20	<0.40	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)-Total	0.0078	0.640	0.0145	0.457	0.0037	0.674	0.0108	0.941	0.0076	1.04
Calcium (Ca)-Total	170	128	224	210	163	133	205	84.4	139	82.3
Cesium (Cs)-Total	0.0392	0.0457	0.0270	0.0243	0.0319	0.0359	0.0331	0.0238	0.0342	0.0258
Chromium (Cr)-Total	<0.020	<0.030	<0.040	<0.050	<0.020	<0.050	<0.030	<0.050	<0.010	<0.030
Cobalt (Co)-Total	0.0403	0.161	0.0901	0.258	0.0105	0.0407	0.0249	0.0996	0.0221	0.0943
Copper (Cu)-Total	0.308	5.68	0.360	7.40	0.387	6.01	0.422	6.50	0.402	16.5
Gallium (Ga)-Total	<0.0040	<0.0040	<0.0040	<0.0080	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Iron (Fe)-Total	4.38	48.5	4.03	42.6	3.68	97.5	2.89	69.3	4.34	191
Lead (Pb)-Total	<0.0040	0.0083	0.0060	0.0169	0.0050	0.0127	0.0054	0.0048	<0.0040	0.0086
Lithium (Li)-Total	<0.020	<0.020	<0.020	<0.040	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Magnesium (Mg)-Total	259	246	269	255	258	252	299	212	273	214
Manganese (Mn)-Total	0.111	1.25	0.156	1.57	0.139	1.11	0.156	0.717	0.107	0.936
Mercury (Hg)-Total	0.0129	0.0059	0.0120	<0.0080	0.0220	0.0053	0.0313	0.0084	0.0235	0.0271
Molybdenum (Mo)-Total	<0.0040	0.183	0.0047	0.164	<0.0040	0.198	<0.0040	0.149	<0.0040	0.146
Nickel (Ni)-Total	<0.010	0.033	0.020	0.169	<0.010	0.086	0.016	0.028	<0.010	0.055
Phosphorus (P)-Total	2250	3590	2310	3460	2210	3890	2460	3030	2230	3150
Potassium (K)-Total	4210	4120	4020	3300	4020	4170	4930	3830	4320	3560
Rhenium (Re)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	5.01	6.40	5.54	5.11	4.66	5.27	4.82	4.06	3.97	4.12
Selenium (Se)-Total	0.472	1.51	0.635	1.52	0.433	1.12	0.511	1.19	0.429	1.35
Sodium (Na)-Total	760	1120	710	<1600	600	1390	750	1290	640	1250
Strontium (Sr)-Total	0.054	0.116	0.091	0.167	0.048	0.118	0.069	0.050	0.048	0.059
Tellurium (Te)-Total	<0.0040	<0.0040	<0.0040	<0.0080	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	0.00245	0.00939	0.00328	0.0129	0.00240	0.0109	0.00346	0.00897	0.00263	0.0120
Thorium (Th)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Tin (Sn)-Total	0.0165	0.188	0.0558	0.374	0.0175	0.173	0.0184	0.0506	0.0158	0.0830
Titanium (Ti)-Total	<0.10	<0.030	<0.040	<0.030	<0.040	<0.030	<0.010	<0.040	<0.010	<0.010
Uranium (U)-Total	<0.00040	<0.00040	<0.00040	<0.00080	<0.00040	0.00045	<0.00040	0.00057	<0.00040	<0.00040
Vanadium (V)-Total	<0.0040	0.0061	<0.0040	<0.0080	<0.0040	0.0042	<0.0040	0.0065	<0.0040	0.0046
Yttrium (Y)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Zinc (Zn)-Total	5.55	41.6	6.61	38.1	6.09	35.6	5.96	34.6	8.02	48.3
Zirconium (Zr)-Total	<0.040	<0.040	<0.040	<0.080	<0.040	<0.040	<0.040	0.102	<0.040	<0.040
Aggregate Organics										
Lipid Content	0.7	-	0.9	-	1.1	-	1.2	-	1.4	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]P Tissue 2012

NOTE:

1. EXCEEDS 1.0 mg/kg W.W. - BC MWLAP AMBIENT WATER QUALITY GUIDELINES FOR SELENIUM (2001)

0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold
CONSULTING

APPENDIX E-2

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011 METALS IN TISSUE CONCENTRATIONS FROM BULL TROUT SAMPLED IN T CREEK

Print Aug/01/14 14:27:17

Sample ID Date Sampled	2011-TMF#1 MUSCLE 12-SEP-11	2011-TMF#1 LIVER 12-SEP-11	2011-TMF#2 MUSCLE 12-SEP-11	2011-TMF#2 LIVER 12-SEP-11	2011-TMF#3 MUSCLE 12-SEP-11	2011-TMF#3 LIVER 12-SEP-11	2011-TMF#4 MUSCLE 12-SEP-11	2011-TMF#4 LIVER 12-SEP-11	2011-TMF#5 MUSCLE 12-SEP-11	2011-TMF#5 LIVER 12-SEP-11
Physical Tests										
% Moisture	78.1	78.6	78.6	76.8	78.1	75.0	78.6	77.2	78.6	75.6
Metals										
Aluminum (Al)-Total	0.46	0.83	<0.40	1.26	<0.40	0.98	<0.40	1.02	<0.40	1.64
Antimony (Sb)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total	0.0587	0.0566	0.0454	0.0568	0.0479	0.0970	0.0312	0.0375	0.0427	0.0372
Barium (Ba)-Total	0.100	0.246	0.018	0.075	0.019	0.030	<0.010	0.011	0.011	0.012
Beryllium (Be)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total	0.30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.90	<0.20	<0.20
Cadmium (Cd)-Total	0.0251	0.474	0.0239	0.554	0.0594	0.565	0.0083	0.653	0.0271	0.847
Calcium (Ca)-Total	1530	143	179	954	301	205	126	96.8	211	140
Cesium (Cs)-Total	0.0427	0.0461	0.0346	0.0417	0.0381	0.0434	0.0240	0.0310	0.0390	0.0401
Chromium (Cr)-Total	0.019	<0.010	<0.010	0.026	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cobalt (Co)-Total	0.0613	0.177	0.0646	0.170	0.117	0.371	0.0182	0.118	0.0488	0.152
Copper (Cu)-Total	0.471	6.06	0.308	6.69	0.503	8.15	0.213	6.97	0.339	11.6
Gallium (Ga)-Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Iron (Fe)-Total	4.42	121	2.48	125	4.31	152	2.25	166	3.71	160
Lead (Pb)-Total	<0.0040	0.0096	<0.0040	0.0058	<0.0040	0.0072	<0.0040	0.0046	<0.0040	0.0076
Lithium (Li)-Total	<0.020	<0.020	<0.030	<0.020	<0.020	<0.020	<0.030	<0.020	<0.030	<0.020
Magnesium (Mg)-Total	324	251	235	259	225	271	215	246	261	235
Manganese (Mn)-Total	0.582	7.26	0.257	1.48	0.354	2.56	0.136	0.910	0.136	0.933
Mercury (Hg)-Total	0.0203	0.0314	0.0169	0.0266	0.0164	0.0345	0.0204	0.0299	0.0189	0.0358
Molybdenum (Mo)-Total	0.0057	0.157	0.0046	0.146	0.0050	0.160	<0.0040	0.119	0.0047	0.152
Nickel (Ni)-Total	<0.020	<0.050	<0.020	<0.025	<0.025	<0.065	<0.010	<0.010	<0.025	<0.020
Phosphorus (P)-Total	3270	3710	2120	4220	2210	3680	1880	3780	2360	3710
Potassium (K)-Total	4920	3840	3790	3910	3860	3860	3440	4080	4380	3760
Rhenium (Re)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	5.38	5.85	4.41	5.90	4.65	5.24	3.56	4.66	5.85	5.05
Selenium (Se)-Total	0.484	1.43	0.442	1.39	0.530	1.44	0.365	1.33	0.450	1.45
Sodium (Na)-Total	770	1260	730	1320	670	1230	600	1380	780	1210
Strontium (Sr)-Total	0.638	0.137	0.084	0.502	0.165	0.182	0.056	0.089	0.106	0.143
Tellurium (Te)-Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	0.00402	0.0147	0.00317	0.0118	0.00356	0.0142	0.00210	0.0145	0.00393	0.0173
Thorium (Th)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Tin (Sn)-Total	<0.0040	<0.0040	<0.0040	0.0216	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Titanium (Ti)-Total	0.014	0.013	<0.010	0.023	0.024	0.011	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	<0.00040	0.00057	<0.00040	0.00056	<0.00040	0.00087	<0.00040	<0.00040	<0.00040	<0.00040
Vanadium (V)-Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Yttrium (Y)-Total	<0.0020	0.0032	<0.0020	0.0021	<0.0020	0.0021	<0.0020	<0.0020	<0.0020	<0.0020
Zinc (Zn)-Total	8.72	46.7	7.11	43.1	8.11	52.4	4.57	40.5	7.35	43.5
Zirconium (Zr)-Total	<0.040	<0.040	<0.040	<0.040	<0.040	0.099	<0.040	<0.040	<0.040	<0.040
Aggregate Organics										
Lipid Content	1.3	-	1.1	-	1.1	-	1.0	-	1.2	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]T Tissue 2011

NOTE:

1. Exceeds 1.0 mg/kg W.W. - BC MWLAP Ambient Water Quality Guidelines for Selemium (2001)

0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold
CONSULTING

APPENDIX E-2

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2012 METALS IN TISSUE CONCENTRATIONS FROM BULL TROUT SAMPLED IN T CREEK

Print Aug/01/14 14:27:17

Sample ID Date Sampled	2012-TMF#1 MUSCLE 21-Sep-12	2012-TMF#1 LIVER 21-Sep-12	2012-TMF#2 MUSCLE 21-Sep-12	2012-TMF#2 LIVER 21-Sep-12	2012-TMF#3 MUSCLE 21-Sep-12	2012-TMF#3 LIVER 21-Sep-12	2012-TMF#4 MUSCLE 21-Sep-12	2012-TMF#4 LIVER 21-Sep-12	2012-TMF#5 MUSCLE 21-Sep-12	2012-TMF#5 LIVER 21-Sep-12
Physical Tests										
% Moisture	79.2	78.6	78.7	76.9	78.6	78.1	78.2	77.6	78.7	76.6
Metals										
Aluminum (Al)-Total	<0.40	2.26	0.43	2.55	<0.40	2.43	<0.40	2.12	<0.40	1.33
Antimony (Sb)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total	0.0287	0.0226	0.0926	0.0610	0.0287	0.0361	0.0221	0.0258	0.0155	0.0276
Barium (Ba)-Total	0.016	0.027	0.011	0.037	0.021	0.045	0.135	0.015	0.019	0.032
Beryllium (Be)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	<0.0050	0.304	<0.0030	<0.0050	<0.0020	<0.0030	<0.036	<0.0020	<0.0020	<0.0020
Boron (B)-Total	<0.20	1.34	0.84	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)-Total	0.0044	0.135	0.0225	0.743	0.0033	0.178	<0.0020	0.119	<0.0020	0.111
Calcium (Ca)-Total	194	112	173	96	181	109	188	117	159	121
Cesium (Cs)-Total	0.0415	0.0347	0.0350	0.0362	0.0425	0.0424	0.0436	0.0301	0.0532	0.0514
Chromium (Cr)-Total	<0.010	<0.040	<0.020	<0.090	<0.020	<0.030	<0.020	<0.030	<0.050	<0.060
Cobalt (Co)-Total	0.0088	0.0359	0.0085	0.0301	0.0055	0.0357	0.0072	0.0298	0.0056	0.0365
Copper (Cu)-Total	0.285	4.37	0.270	5.11	0.220	6.01	0.256	3.22	0.237	6.75
Gallium (Ga)-Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Iron (Fe)-Total	2.72	105	2.36	210	4.53	191	2.76	143	2.34	118
Lead (Pb)-Total	0.0044	0.0092	<0.0040	0.0106	<0.0040	0.0080	<0.0040	0.0107	<0.0040	0.0079
Lithium (Li)-Total	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Magnesium (Mg)-Total	268	221	257	214	260	216	258	220	295	231
Manganese (Mn)-Total	0.118	0.909	0.223	1.32	0.116	1.31	0.110	0.872	0.143	1.17
Mercury (Hg)-Total	0.0337	0.0300	0.0434	0.0307	0.0346	0.0117	0.0365	0.0147	0.0296	0.0317
Molybdenum (Mo)-Total	<0.0040	0.143	<0.0040	0.214	<0.0040	0.161	<0.0040	0.135	0.0045	0.187
Nickel (Ni)-Total	<0.010	0.037	<0.010	0.052	<0.010	0.050	<0.010	0.019	0.049	0.046
Phosphorus (P)-Total	2180	3170	2080	3360	2100	3200	2210	3320	2290	3380
Potassium (K)-Total	4090	3100	3870	3300	4000	3090	4280	3100	4340	3300
Rhenium (Re)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	6.30	4.76	5.90	5.85	6.59	6.42	6.93	4.69	7.75	7.06
Selenium (Se)-Total	0.233	0.533	0.413	1.00	0.192	0.705	0.242	0.625	0.211	0.705
Sodium (Na)-Total	690	980	730	1140	600	1070	690	1040	630	1130
Strontium (Sr)-Total	0.082	0.087	0.078	0.107	0.100	0.156	0.077	0.085	0.054	0.119
Tellurium (Te)-Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	0.00361	0.0138	0.00329	0.0139	0.00313	0.0117	0.00391	0.0156	0.00371	0.0145
Thorium (Th)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Tin (Sn)-Total	0.0125	0.0790	0.0275	0.156	0.0157	0.137	0.0233	0.0958	0.0312	0.118
Titanium (Ti)-Total	<0.020	<0.020	<0.020	<0.010	<0.010	<0.020	<0.020	<0.010	<0.020	<0.020
Uranium (U)-Total	<0.00040	0.00162	<0.00040	0.00125	<0.00040	0.00237	<0.00040	0.00163	<0.00040	0.00129
Vanadium (V)-Total	<0.0040	<0.0040	<0.0040	0.0067	<0.0040	0.0051	<0.0040	<0.0040	<0.0040	<0.0040
Yttrium (Y)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Zinc (Zn)-Total	6.52	35.1	6.10	38.5	5.48	46.9	6.17	27.7	5.76	36.3
Zirconium (Zr)-Total	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Aggregate Organics										
Lipid Content	0.6	-	0.6	-	0.5	-	1.1	-	0.7	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]T Tissue 2012

NOTE:

1. Exceeds 1.0 mg/kg W.W. - BC MWLAP Ambient Water Quality Guidelines for Selemium (2001)

0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

APPENDIX E-2

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011 METALS IN TISSUE CONCENTRATIONS FROM RAINBOW TROUT SAMPLED IN BAKER CREEK

Print Aug/01/14 14:27:17

Sample ID	2011-BAKER CR#1 MUSCLE	2011-BAKER CR#1 LIVER	2011-BAKER CR#2 MUSCLE	2011-BAKER CR#2 LIVER	2011-BAKER CR#3 MUSCLE	2011-BAKER CR#3 LIVER	2011-BAKER CR#4 MUSCLE	2011-BAKER CR#4 LIVER	2011-BAKER CR#5 MUSCLE	2011-BAKER CR#5 LIVER
Date Sampled	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11
Physical Tests										
% Moisture	78.0	72.4	76.8	70.4	94.4	70.2	78.3	73.8	78.0	71.4
Metals										
Aluminum (Al)-Total	0.95	227	<0.40	6.4	<0.40	4.89	<0.40	1.21	1.19	20.3
Antimony (Sb)-Total	<0.0020	0.0025	<0.0020	<0.0060	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total	0.136	0.240	0.0344	0.107	0.0546	0.0902	0.121	0.0765	0.0282	0.259
Barium (Ba)-Total	0.030	1.15	0.090	0.157	0.040	0.267	0.015	0.019	0.030	0.155
Beryllium (Be)-Total	<0.0020	0.0059	<0.0020	<0.0060	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	<0.0020	0.0024	<0.0020	<0.0060	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total	0.21	<0.20	<0.20	0.86	<0.20	<0.40	<0.20	0.73	<0.20	0.49
Cadmium (Cd)-Total	0.0178	0.132	0.0094	0.0876	0.0041	0.0575	0.0034	0.0808	<0.0020	0.153
Calcium (Ca)-Total	288	1870	845	643	533	3050	223	153	191	542
Cesium (Cs)-Total	0.0379	0.0426	0.0426	0.0470	0.0386	0.0453	0.0478	0.0383	0.0232	0.0390
Chromium (Cr)-Total	0.012	0.483	0.013	0.034	0.011	0.064	0.013	0.010	<0.010	0.056
Cobalt (Co)-Total	0.0911	0.392	0.204	0.534	0.0651	0.163	0.0634	0.288	0.0137	0.139
Copper (Cu)-Total	0.460	8.28	0.706	11.0	0.388	7.20	0.365	20.6	0.242	3.19
Gallium (Ga)-Total	<0.0040	0.0574	<0.0040	<0.012	<0.0040	<0.0080	<0.0040	<0.0040	<0.0040	0.0061
Iron (Fe)-Total	7.42	620	8.99	89.4	4.06	63.4	5.10	120	3.90	204
Lead (Pb)-Total	<0.0040	0.356	0.0117	0.047	<0.0040	0.0189	<0.0040	0.0094	<0.0040	0.0284
Lithium (Li)-Total	<0.030	<0.25	<0.030	<0.060	<0.030	<0.040	<0.020	<0.030	<0.040	<0.040
Magnesium (Mg)-Total	241	467	236	237	294	312	284	214	162	246
Manganese (Mn)-Total	0.161	11.5	0.870	3.85	0.192	1.33	0.226	1.09	0.0827	1.66
Mercury (Hg)-Total	0.0187	0.0272	0.0131	0.0443	0.0157	0.0515	0.0237	0.0251	0.0134	0.0395
Molybdenum (Mo)-Total	0.0074	0.130	0.0094	0.129	0.0045	0.0976	0.0044	0.194	<0.0040	0.229
Nickel (Ni)-Total	<0.055	0.711	<0.060	<0.20	<0.020	<0.070	<0.020	<0.040	<0.010	<0.075
Phosphorus (P)-Total	2150	3770	2490	3460	2600	4480	2400	3710	1540	3280
Potassium (K)-Total	3900	3430	3890	3700	4550	4300	4540	3190	2710	3780
Rhenium (Re)-Total	<0.0020	<0.0020	<0.0020	<0.0060	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	2.49	2.29	3.03	2.97	2.36	2.92	5.17	4.12	1.40	2.36
Selenium (Se)-Total	0.508	1.74	0.741	2.52	0.508	1.73	0.493	2.63	0.229	2.21
Sodium (Na)-Total	690	1000	690	<1800	760	<1600	830	1250	410	1390
Strontium (Sr)-Total	0.372	6.75	0.766	0.667	0.433	2.99	0.179	0.178	0.152	0.837
Tellurium (Te)-Total	<0.0040	<0.0040	<0.0040	<0.012	<0.0040	<0.0080	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	0.00257	0.0109	0.00431	0.0133	0.00251	0.00988	0.00586	0.0333	0.00181	0.00963
Thorium (Th)-Total	<0.0020	0.0555	0.0021	<0.0060	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	0.0077
Tin (Sn)-Total	0.0049	<0.0040	<0.0040	0.090	<0.0040	0.0110	<0.0040	0.0125	<0.0040	0.0123
Titanium (Ti)-Total	0.134	11.1	0.027	0.528	<0.010	0.113	<0.010	0.013	0.034	0.656
Uranium (U)-Total	<0.00040	0.0156	<0.00040	0.0012	<0.00040	<0.00080	<0.00040	0.00198	<0.00040	0.00219
Vanadium (V)-Total	<0.0040	0.373	<0.0040	0.019	<0.0040	<0.0080	<0.0040	<0.0040	<0.0040	0.0460
Yttrium (Y)-Total	<0.0020	0.0753	<0.0020	0.0090	<0.0020	0.0063	<0.0020	0.0032	<0.0020	0.0144
Zinc (Zn)-Total	9.53	39.3	11.4	41.0	6.21	28.0	10.8	56.7	3.22	48.7
Zirconium (Zr)-Total	<0.040	0.137	<0.040	<0.12	<0.040	<0.080	<0.040	<0.040	<0.040	<0.040
Aggregate Organics										
Lipid Content	2.0	-	1.8	-	1.6	-	0.9	-	1.5	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]Baker Tissue 2011

NOTE:

1. Exceeds 1.0 mg/kg W.W. - BC MWLAP Ambient Water Quality Guidelines for Selemium (2001)

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB

Knight Piésold CONSULTING

APPENDIX E-2

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2012 METALS IN TISSUE CONCENTRATIONS FROM RAINBOW TROUT SAMPLED IN BAKER CREEK

Print Aug/01/14 14:27:17

Sample ID Date Sampled	2012-BAKER CR#1 MUSCLE 12-Sep-12	2012-BAKER CR#1 LIVER 12-Sep-12	2012-BAKER CR#2 MUSCLE 12-Sep-12	2012-BAKER CR#2 LIVER 12-Sep-12	2012-BAKER CR#3 MUSCLE 12-Sep-12	2012-BAKER CR#3 LIVER 12-Sep-12	2012-BAKER CR#4 MUSCLE 12-Sep-12	2012-BAKER CR#4 LIVER 12-Sep-12	2012-BAKER CR#5 MUSCLE 12-Sep-12	2012-BAKER CR#5 LIVER 12-Sep-12
Physical Tests										
% Moisture	78.4	80.3	78.2	78.8	78.0	80.4	77.8	76.9	78.1	74.3
Metals										
Aluminum (Al)-Total	<0.40	002	<0.40	13.7	0.69	2.10	0.95	1.28	0.69	03.1
Antimony (Sb)-Total	<0.0020	<0.0020	<0.0020	0.0059	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total	0.056	0.045	0.0879	0.069	0.0821	0.0659	0.374	0.1080	0.1600	0.143
Barium (Ba)-Total	<0.010	0.02	0.018	0.124	<0.010	0.022	<0.010	<0.010	0.014	0.032
Beryllium (Be)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total	<0.20	6.19	0.21	<0.40	1.78	<0.40	3.25	2.24	<0.20	9.84
Cadmium (Cd)-Total	<0.0020	0.125	<0.0020	0.2300	0.0040	0.1260	0.0023	0.1130	0.0057	0.207
Calcium (Ca)-Total	171	0165	346	173	210	0139	154	091	210	188
Cesium (Cs)-Total	0.0281	0.0216	0.0290	0.0261	0.0620	0.0757	0.0295	0.0175	0.0291	0.0238
Chromium (Cr)-Total	<0.010	<0.030	<0.010	2.720	<0.010	<0.030	<0.010	<0.030	<0.020	<0.060
Cobalt (Co)-Total	0.0222	0.140	0.018	0.136	0.0354	0.121	0.0222	0.129	0.0460	0.191
Copper (Cu)-Total	0.389	12.80	0.315	30.0	0.482	4.62	0.432	14.7	0.357	24.70
Gallium (Ga)-Total	<0.0040	<0.0040	<0.0040	<0.0080	<0.0040	<0.0080	<0.0040	<0.0040	<0.0040	<0.0040
Iron (Fe)-Total	2.97	073	2.32	116.0	4.43	87.5	3.17	136	3.38	127
Lead (Pb)-Total	<0.0040	0.012	0.0052	0.047	<0.0040	0.0433	<0.0040	0.0068	0.0738	0.4140
Lithium (Li)-Total	<0.020	<0.020	<0.020	<0.040	<0.020	<0.040	<0.020	<0.020	<0.020	<0.020
Magnesium (Mg)-Total	269	174	282	213	276	211	335	162	278	234
Manganese (Mn)-Total	0.078	00.9	0.125	1.67	0.118	1.05	0.106	1.02	0.1270	1.47
Mercury (Hg)-Total	0.0138	<0.0030	0.0156	<0.0050	0.0138	<0.0050	0.0134	0.0147	0.0202	<0.0040
Molybdenum (Mo)-Total	<0.0040	0.211	<0.0040	0.399	<0.0040	0.1790	<0.0040	0.132	0.0194	0.238
Nickel (Ni)-Total	<0.010	0.034	<0.010	0.629	0.015	0.03	<0.010	0.023	<0.010	0.096
Phosphorus (P)-Total	2140	2560	2300	3120	2280	3280	2520	2620	2220	3230
Potassium (K)-Total	4090	2740	4230	3200	4300	3100	4800	2670	4070	3210
Rhenium (Re)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	2.69	2.28	2.60	2.45	2.83	2.35	2.80	2.02	2.63	2.32
Selenium (Se)-Total	0.481	2.48	0.378	3.87	0.444	1.45	0.505	3.54	0.490	3.41
Sodium (Na)-Total	570	0980	540	1100	640	1000	650	1150	630	1160
Strontium (Sr)-Total	0.105	0.15	0.269	0.255	0.146	0.29	0.147	0.150	0.171	0.216
Tellurium (Te)-Total	<0.0040	<0.0040	<0.0040	<0.0080	<0.0040	<0.0080	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	0.00127	0.0080	0.00123	0.0090	0.00239	0.00582	0.00248	0.0079	0.00179	0.00992
Thorium (Th)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0020
Tin (Sn)-Total	0.0285	0.256	0.0198	0.598	0.0251	0.1100	0.0165	0.0941	0.0171	0.1300
Titanium (Ti)-Total	<0.060	<0.020	<0.010	<0.16	<0.010	<0.040	<0.010	<0.020	<0.030	<0.040
Uranium (U)-Total	<0.00040	<0.00040	<0.00040	0.0022	<0.00040	<0.00080	<0.00040	<0.00040	<0.00040	0.00055
Vanadium (V)-Total	<0.0040	<0.0040	<0.0040	0.048	<0.0040	<0.0080	<0.0040	<0.0040	0.0077	<0.0040
Yttrium (Y)-Total	<0.0020	<0.0020	<0.0020	0.0112	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0020
Zinc (Zn)-Total	6.32	24.6	07.5	53.5	7.05	24.0	05.7	26.0	7.19	32.4
Zirconium (Zr)-Total	<0.040	<0.040	<0.040	0.663	<0.040	<0.080	<0.040	<0.040	<0.040	<0.040
Aggregate Organics										
Lipid Content	1.3	-	1.0	-	1.7	-	1.3	-	1.1	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]Baker Tissue 2012

NOTE:

1. Exceeds 1.0 mg/kg W.W. - BC MWLAP Ambient Water Quality Guidelines for Selemium (2001)

0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

APPENDIX E-2

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011 METALS IN TISSUE CONCENTRATIONS FROM RAINBOW TROUT SAMPLED IN LUTE CREEK

Print Aug/01/14 14:27:17

Sample ID / Date Sampled	2011-LUTE CR#1 MUSCLE	2011-LUTE CR#1 LIVER	2011-LUTE CR#2 MUSCLE	2011-LUTE CR#2 LIVER	2011-LUTE CR#3 MUSCLE	2011-LUTE CR#3 LIVER	2011-LUTE CR#4 MUSCLE	2011-LUTE CR#4 LIVER	2011-LUTE CR#5 MUSCLE	2011-LUTE CR#5 LIVER
Date Sampled	28-SEP-11	28-SEP-11	28-SEP-11	28-SEP-11	28-SEP-11	28-SEP-11	28-SEP-11	28-SEP-11	28-SEP-11	28-SEP-11
Physical Tests										
% Moisture	78.8	72.6	75.6	67.3	76.6	70.8	76.6	64.0	75.3	70.2
Metals										
Aluminum (Al)-Total	1.23	2.06	<0.40	2.59	<0.40	<1.2	0.75	767	1.15	3.65
Antimony (Sb)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0060	<0.0020	0.0079	<0.0020	<0.0020
Arsenic (As)-Total	0.0281	0.0296	0.301	0.202	0.0977	0.111	0.0377	0.704	0.110	0.160
Barium (Ba)-Total	0.363	0.139	0.163	1.18	0.039	<0.030	0.058	11.7	0.101	0.107
Beryllium (Be)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0060	<0.0020	0.0342	<0.0020	<0.0020
Bismuth (Bi)-Total	<0.0020	<0.0020	<0.0020	0.0054	<0.0020	<0.0060	<0.0020	0.0612	<0.0020	<0.0020
Boron (B)-Total	0.68	<0.20	0.67	<0.40	<0.20	<1.4	<0.50	<2.0	<0.80	<1.5
Cadmium (Cd)-Total	0.0139	0.0804	0.0309	0.397	0.0202	0.159	0.0173	0.0772	0.0144	0.163
Calcium (Ca)-Total	2720	381	1060	7460	476	571	393	411	858	473
Cesium (Cs)-Total	0.0264	0.0225	0.0184	0.0149	0.0142	0.0129	0.0401	0.131	0.0166	0.0148
Chromium (Cr)-Total	0.016	0.034	0.014	0.045	<0.010	<0.030	0.024	1.32	0.014	0.019
Cobalt (Co)-Total	0.0435	0.0926	0.113	0.135	0.0286	0.075	0.0671	0.346	0.0461	0.138
Copper (Cu)-Total	0.331	5.18	0.734	52.8	0.640	13.6	0.719	4.80	0.575	28.6
Gallium (Ga)-Total	<0.0040	<0.0040	<0.0040	<0.0080	<0.0040	<0.012	<0.0040	0.192	<0.0040	<0.0040
Iron (Fe)-Total	5.76	163	4.79	91.8	5.32	98.0	6.40	1350	7.82	113
Lead (Pb)-Total	0.0076	0.0105	0.0191	0.140	0.0041	0.016	0.0265	4.68	0.0142	0.0438
Lithium (Li)-Total	<0.040	<0.020	<0.020	<0.040	<0.020	<0.060	0.093	1.03	0.056	<0.020
Magnesium (Mg)-Total	274	298	285	410	273	310	217	581	315	264
Manganese (Mn)-Total	2.55	8.86	1.44	9.04	0.199	0.946	0.804	16.0	0.333	1.17
Mercury (Hg)-Total	0.0345	0.0404	0.0287	0.0350	0.0429	0.0739	0.0191	0.0111	0.0162	0.0177
Molybdenum (Mo)-Total	0.0069	0.237	0.0124	0.194	0.0066	0.176	0.0088	0.219	0.0077	0.139
Nickel (Ni)-Total	<0.025	<0.050	<0.035	<0.070	<0.050	<0.11	<0.12	0.672	<0.050	<0.050
Phosphorus (P)-Total	3390	4250	2730	7970	2520	5110	1990	2950	3030	3840
Potassium (K)-Total	4060	3840	4170	3300	4420	3800	3290	3400	4910	3960
Rhenium (Re)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0060	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	3.42	3.23	3.35	2.78	2.71	2.56	6.00	6.51	2.52	2.60
Selenium (Se)-Total	0.261	0.995	0.786	5.32	0.374	2.06	0.504	0.929	0.544	3.02
Sodium (Na)-Total	730	1360	790	1100	700	<2000	550	<1200	810	1330
Strontium (Sr)-Total	4.25	1.03	4.83	33.0	1.17	2.65	0.802	2.56	2.56	1.85
Tellurium (Te)-Total	<0.0040	<0.0040	<0.0040	<0.0080	<0.0040	<0.012	<0.0040	0.0196	<0.0040	<0.0040
Thallium (Tl)-Total	0.00594	0.0277	0.00323	0.0190	0.00459	0.0262	0.00343	0.0173	0.00225	0.0114
Thorium (Th)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0060	<0.0020	2.57	0.0278	0.0355
Tin (Sn)-Total	<0.0040	0.0219	<0.0040	<0.0080	<0.0040	<0.012	<0.0060	<0.020	<0.0050	<0.0040
Titanium (Ti)-Total	0.019	0.017	0.011	0.074	0.016	0.032	0.017	2.54	0.220	0.026
Uranium (U)-Total	0.00284	0.00453	0.00080	0.00687	0.00054	0.0048	<0.00040	0.458	0.00076	0.00493
Vanadium (V)-Total	<0.0040	0.0075	<0.0040	<0.0080	<0.0040	<0.012	0.0155	1.83	0.0128	0.0067
Yttrium (Y)-Total	<0.0020	0.0055	<0.0020	<0.0040	<0.0020	<0.0060	<0.0020	0.727	0.0023	0.0187
Zinc (Zn)-Total	11.6	72.4	13.4	79.5	10.3	59.9	9.80	68.5	8.65	68.9
Zirconium (Zr)-Total	<0.040	<0.040	<0.040	<0.080	<0.040	<0.12	<0.040	1.81	<0.040	0.146
Aggregate Organics										
Lipid Content	1.3	-	2.6	-	2.0	-	2.1	-	2.1	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]Lute Tissue 2011

NOTE:

1. Exceeds 1.0 mg/kg W.W. - BC MWLAP Ambient Water Quality Guidelines for Selemium (2001)
2. EXCEEDS 0.8 mg/kg CFIA GUIDELINES FOR LEAD;

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB

Knight Piésold CONSULTING

APPENDIX E-2

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2012 METALS IN TISSUE CONCENTRATIONS FROM RAINBOW TROUT SAMPLED IN LUTE CREEK

Print Aug/01/14 14:27:17

Sample ID	2012-LUTE CR#1 MUSCLE	2012-LUTE CR#1 LIVER	2012-LUTE CR#2 MUSCLE	2012-LUTE CR#2 LIVER	2012-LUTE CR#3 MUSCLE	2012-LUTE CR#3 LIVER	2012-LUTE CR#4 MUSCLE	2012-LUTE CR#4 LIVER	2012-LUTE CR#5 MUSCLE	2012-LUTE CR#5 LIVER
Date Sampled	12-Sep-12	12-Sep-12	12-Sep-12	12-Sep-12	12-Sep-12	12-Sep-12	12-Sep-12	12-Sep-12	12-Sep-12	12-Sep-12
Physical Tests										
% Moisture	74.7	75.5	77.8	77.1	77.1	70.3	77.4	78.3	77.5	72.6
Metals										
Aluminum (Al)-Total	0.40	0.77	<0.40	1.54	<0.40	1.73	0.50	001	0.55	2.00
Antimony (Sb)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0060
Arsenic (As)-Total	0.1100	0.0462	0.049	0.063	0.0521	0.098	0.0819	0.188	0.072	0.109
Barium (Ba)-Total	0.014	0.020	<0.010	0.04	0.015	0.058	0.024	00.1	0.023	0.087
Beryllium (Be)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0060
Bismuth (Bi)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0060
Boron (B)-Total	0.22	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.60
Cadmium (Cd)-Total	0.0030	0.2820	0.0076	0.189	0.0091	0.340	0.0042	0.3330	0.0142	0.445
Calcium (Ca)-Total	0160	073	0179	0176	296	210	311	239	250	368
Cesium (Cs)-Total	0.0172	0.0100	0.0144	0.0106	0.0179	0.0175	0.0153	0.012	0.0167	0.0190
Chromium (Cr)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.020	<0.010	<0.030	<0.020	<0.060
Cobalt (Co)-Total	0.0248	0.0975	0.049	0.191	0.0596	0.324	0.0352	0.273	0.0453	0.247
Copper (Cu)-Total	0.815	30.60	0.491	29.3	0.525	25.7	0.329	27.50	0.389	31.2
Gallium (Ga)-Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.012
Iron (Fe)-Total	6.54	151	3.10	89.3	3.84	82.1	2.66	0069	3.44	117
Lead (Pb)-Total	0.0046	0.0115	<0.0040	0.025	0.0069	0.039	0.0042	0.02	0.0066	0.0580
Lithium (Li)-Total	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.060
Magnesium (Mg)-Total	286	157	255	184	267	278	272	228	283	250
Manganese (Mn)-Total	0.13	0.78	0.23	2.11	0.157	2.620	0.185	03.8	0.133	2.41
Mercury (Hg)-Total	0.0244	0.0258	0.0161	0.0043	0.0175	<0.0040	0.0160	<0.0040	0.0214	<0.010
Molybdenum (Mo)-Total	<0.0040	0.160	<0.0040	0.135	<0.0040	0.255	0.0044	0.201	<0.0040	0.364
Nickel (Ni)-Total	<0.010	0.025	<0.010	0.035	<0.010	0.047	<0.010	0.060	<0.010	0.174
Phosphorus (P)-Total	2440	2790	2230	2730	2290	4140	2420	3170	2190	4000
Potassium (K)-Total	4190	2920	4040	2660	4220	3990	4220	2940	4590	3800
Rhenium (Re)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0060
Rubidium (Rb)-Total	2.75	2.42	3.20	2.63	4.13	4.62	3.82	3.19	3.66	4.25
Selenium (Se)-Total	0.843	5.920	0.668	3.17	0.788	4.09	0.771	3.580	0.862	5.09
Sodium (Na)-Total	650	1150	740	1100	720	1650	600	1110	670	<2000
Strontium (Sr)-Total	0.20	0.22	0.19	00.5	0.39	0.71	0.464	0.71	0.30	0.95
Tellurium (Te)-Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.012
Thallium (Tl)-Total	0.00264	0.0119	0.00205	0.0077	0.00201	0.0112	0.00289	0.0151	0.00209	0.0174
Thorium (Th)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0060
Tin (Sn)-Total	<0.0040	0.1210	0.0189	0.0709	0.0203	0.128	0.0225	0.272	0.0245	0.215
Titanium (Ti)-Total	<0.040	<0.030	<0.010	<0.010	<0.020	<0.030	<0.020	<0.020	<0.020	<0.040
Uranium (U)-Total	<0.00040	<0.00040	<0.00040	0.00205	<0.00040	0.0014	<0.00040	0.001	<0.00040	<0.0012
Vanadium (V)-Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.012
Yttrium (Y)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0022	<0.0020	<0.0020	<0.0020	<0.0060
Zinc (Zn)-Total	07.2	26.4	07.9	26.8	07.3	39.0	7.27	32.2	7.63	38.4
Zirconium (Zr)-Total	<0.040	<0.040	<0.040	<0.040	<0.040	0.052	<0.040	<0.040	<0.040	<0.12
Aggregate Organics										
Lipid Content	1.7	-	1.5	-	-	-	-	-	-	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]Lute Tissue 2012

NOTE:

1. EXCEEDS 0.8 mg/kg CFIA GUIDELINES FOR LEAD;
2. EXCEEDS 1.0 mg/kg W.W. - BC MWLAP AMBIENT WATER QUALITY GUIDELINES FOR SELENIUM (2001)

0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

APPENDIX E-2

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011 METALS IN TISSUE CONCENTRATIONS FROM RAINBOW TROUT SAMPLED IN JONES CREEK

Print Aug/01/14 14:27:17

Sample ID / Date Sampled	2011-JONES CR#1 MUSCLE 29-SEP-11	2011-JONES CR#1 LIVER 29-SEP-11	2011-JONES CR#2 MUSCLE 29-SEP-11	2011-JONES CR#2 LIVER 29-SEP-11	2011-JONES CR#3 MUSCLE 29-SEP-11	2011-JONES CR#3 LIVER 29-SEP-11	2011-JONES CR#4 MUSCLE 29-SEP-11	2011-JONES CR#4 LIVER 29-SEP-11	2011-JONES CR#5 MUSCLE 29-SEP-11	2011-JONES CR#5 LIVER 29-SEP-11
Physical Tests										
% Moisture	78.7	74.8	80.2	74.6	77.6	73.9	80.3	73.4	77.7	72.1
Metals										
Aluminum (Al)-Total	<0.40	1.99	0.70	4.21	0.50	1.63	<0.40	3.60	<0.40	2.92
Antimony (Sb)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total	0.0542	0.239	0.129	0.154	0.0687	0.0851	0.0821	0.140	0.0461	0.0633
Barium (Ba)-Total	0.022	0.045	0.034	0.029	0.045	0.055	0.021	0.071	0.054	0.019
Beryllium (Be)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total	<0.40	<0.20	<0.20	<0.20	<0.70	<0.90	<0.20	<0.20	<0.20	<0.60
Cadmium (Cd)-Total	0.0069	0.193	0.0148	0.433	0.0099	0.201	<0.0020	0.161	<0.0020	0.345
Calcium (Ca)-Total	208	654	242	228	278	530	274	270	1100	241
Cesium (Cs)-Total	0.0120	0.0084	0.0100	0.0071	0.0088	0.0082	0.0107	0.0087	0.0151	0.0141
Chromium (Cr)-Total	<0.010	0.013	<0.010	0.018	0.012	0.011	<0.010	<0.010	<0.010	<0.010
Cobalt (Co)-Total	0.0215	0.112	0.0190	0.124	0.0246	0.109	0.0320	0.169	0.0587	0.119
Copper (Cu)-Total	0.377	14.0	0.322	11.0	0.434	61.6	0.342	3.42	0.499	69.2
Gallium (Ga)-Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Iron (Fe)-Total	4.90	130	4.96	222	3.86	157	6.17	138	6.11	123
Lead (Pb)-Total	<0.0040	0.0414	0.0090	0.0162	0.0105	0.0115	<0.0040	0.0256	0.0051	0.0167
Lithium (Li)-Total	0.045	<0.020	0.040	<0.020	0.042	0.033	<0.020	<0.020	<0.020	<0.020
Magnesium (Mg)-Total	223	208	218	204	172	197	245	225	288	260
Manganese (Mn)-Total	0.0708	0.868	0.127	1.14	0.142	0.679	0.117	0.985	0.239	1.62
Mercury (Hg)-Total	0.0330	0.0343	0.0467	0.0476	0.0432	0.0258	0.0345	0.0405	0.0404	0.0321
Molybdenum (Mo)-Total	0.0048	0.161	<0.0040	0.328	0.0054	0.197	0.0048	0.167	0.0077	0.228
Nickel (Ni)-Total	<0.020	<0.080	<0.040	<0.080	<0.040	<0.040	<0.080	<0.080	<0.060	<0.070
Phosphorus (P)-Total	1960	3540	1950	3490	1480	3470	2230	3600	2830	4000
Potassium (K)-Total	3550	3440	3420	3300	2540	3100	4060	3550	4380	3400
Rhenium (Re)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	1.48	1.29	1.24	1.10	1.28	1.28	1.30	1.15	1.72	1.70
Selenium (Se)-Total	0.381	2.03	0.391	3.02	0.413	2.72	0.424	1.73	0.400	2.66
Sodium (Na)-Total	590	1390	540	1410	<500	<1200	740	1410	800	1260
Strontium (Sr)-Total	0.266	1.02	0.264	0.469	0.514	1.17	0.271	0.402	0.799	0.420
Tellurium (Te)-Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	0.00178	0.00720	0.00142	0.0109	0.00138	0.00676	0.00206	0.00935	0.00244	0.00898
Thorium (Th)-Total	0.0084	0.0074	0.0043	0.0023	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Tin (Sn)-Total	<0.0040	<0.0040	<0.0050	<0.0040	<0.0060	<0.0040	<0.0090	<0.0040	<0.0040	<0.0040
Titanium (Ti)-Total	<0.010	0.027	0.016	0.014	0.018	0.023	<0.010	0.011	<0.010	<0.010
Uranium (U)-Total	<0.00040	0.00211	<0.00040	0.00106	<0.00040	0.00048	<0.00040	0.00079	<0.00040	0.00109
Vanadium (V)-Total	<0.0040	0.0054	0.0061	0.0074	0.0099	<0.0040	<0.0040	0.0058	<0.0040	0.0053
Yttrium (Y)-Total	<0.0020	<0.0020	<0.0020	0.0423	<0.0020	<0.0020	<0.0020	0.0045	<0.0020	0.0034
Zinc (Zn)-Total	8.13	42.0	4.33	59.9	8.22	32.0	7.22	42.7	8.14	52.1
Zirconium (Zr)-Total	<0.040	<0.040	<0.040	0.305	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Aggregate Organics										
Lipid Content	2.0	-	1.1	-	2.3	-	1.0	-	1.8	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]Jones Tissue 2011

NOTE:

1. EXCEEDS 1.0 mg/kg W.W. - BC MWLAP AMBIENT WATER QUALITY GUIDELINES FOR SELENIUM (2001)

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB

Knight Piésold CONSULTING

APPENDIX E-2

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2012 METALS IN TISSUE CONCENTRATIONS FROM RAINBOW TROUT SAMPLED IN JONES CREEK

Print Aug/01/14 14:27:17

Sample ID / Date Sampled	2012-JONES CR#1 MUSCLE	2012-JONES CR#1 LIVER	2012-JONES CR#2 MUSCLE	2012-JONES CR#2 LIVER	2012-JONES CR#3 MUSCLE	2012-JONES CR#3 LIVER	2012-JONES CR#4 MUSCLE	2012-JONES CR#4 LIVER	2012-JONES CR#5 MUSCLE	2012-JONES CR#5 LIVER
	12-Sep-12	12-Sep-12	12-Sep-12	12-Sep-12	12-Sep-12	12-Sep-12	12-Sep-12	12-Sep-12	12-Sep-12	12-Sep-12
Physical Tests										
% Moisture	79.7	89.4	80.5	79.0	78.0	82.2	80.6	76.7	79.2	81.9
Metals										
Aluminum (Al)-Total	<0.40	6.40	<0.40	9.76	<0.40	2.86	<0.40	5.22	<0.40	2.35
Antimony (Sb)-Total	<0.0020	<0.0060	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0040
Arsenic (As)-Total	0.1910	0.073	0.130	0.217	0.1320	0.1230	0.1240	0.112	0.0830	0.1650
Barium (Ba)-Total	0.049	<0.030	0.027	0.030	0.012	<0.020	0.015	0.032	<0.010	<0.020
Beryllium (Be)-Total	<0.0020	<0.0060	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0040
Bismuth (Bi)-Total	<0.0020	<0.0060	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0040
Boron (B)-Total	<0.20	15.9	<0.20	<0.20	<0.20	<0.40	<0.20	<0.20	<0.20	<0.40
Cadmium (Cd)-Total	0.0020	0.030	0.0023	0.359	0.0056	0.174	<0.0020	0.141	<0.0020	0.137
Calcium (Ca)-Total	378	174	288	133	285	185	323	145	0223	219
Cesium (Cs)-Total	0.0265	0.0128	0.0144	0.0099	0.0193	0.0134	0.0167	0.0142	0.0181	0.0155
Chromium (Cr)-Total	<0.040	<0.24	<0.010	<0.040	<0.010	<0.050	<0.020	<0.070	<0.010	<0.040
Cobalt (Co)-Total	0.0572	0.377	0.0284	0.192	0.0398	0.171	0.0192	0.126	0.0376	0.170
Copper (Cu)-Total	0.350	02.5	0.304	06.1	0.371	30.9	0.288	4.64	0.347	24.2
Gallium (Ga)-Total	<0.0040	<0.012	<0.0040	<0.0040	<0.0040	<0.0080	<0.0040	<0.0040	<0.0040	<0.0080
Iron (Fe)-Total	4.29	115	6.31	334	8.81	098	3.62	142	2.69	113
Lead (Pb)-Total	0.0145	0.0330	0.0131	0.0464	0.1980	0.0833	0.0064	0.0283	0.0360	0.0216
Lithium (Li)-Total	<0.020	<0.060	<0.020	<0.020	<0.020	<0.040	<0.020	<0.020	<0.020	<0.040
Magnesium (Mg)-Total	289	134	249	167	276	193	266	181	247	183
Manganese (Mn)-Total	0.1850	0.668	0.166	1.16	0.100	0.937	0.114	1.100	0.094	1.06
Mercury (Hg)-Total	0.0345	<0.0090	0.0496	0.0457	0.0285	<0.0070	0.0261	0.0064	0.0255	<0.0040
Molybdenum (Mo)-Total	<0.0040	0.067	<0.0040	0.265	<0.0040	0.307	<0.0040	0.295	<0.0040	0.264
Nickel (Ni)-Total	0.016	0.156	<0.010	0.09	0.389	0.053	<0.010	0.05	<0.010	0.148
Phosphorus (P)-Total	2350	1990	2280	2840	2370	3140	2190	3140	2070	3140
Potassium (K)-Total	4520	2100	4440	2970	4340	2600	3960	3180	3980	3050
Rhenium (Re)-Total	<0.0020	<0.0060	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0040
Rubidium (Rb)-Total	2.62	1.41	1.52	1.22	2.43	1.71	1.88	2.02	2.55	2.46
Selenium (Se)-Total	0.463	1.10	0.483	1.78	0.499	4.19	0.481	1.93	0.452	2.90
Sodium (Na)-Total	740	<1800	780	1320	680	<1400	650	1370	600	1180
Strontium (Sr)-Total	0.328	0.25	0.234	0.298	0.236	0.33	0.262	0.316	0.182	0.289
Tellurium (Te)-Total	<0.0040	<0.012	<0.0040	<0.0040	<0.0040	<0.0080	<0.0040	<0.0040	<0.0040	<0.0080
Thallium (Tl)-Total	0.00259	0.00560	0.00277	0.0134	0.00171	0.00926	0.00161	0.00809	0.00146	0.00859
Thorium (Th)-Total	<0.0020	<0.0060	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	<0.0040
Tin (Sn)-Total	0.0231	0.225	0.015	0.153	0.0141	0.13	0.0138	0.425	0.048	0.103
Titanium (Ti)-Total	<0.010	<0.030	<0.070	<0.020	<0.020	<0.060	<0.010	<0.040	<0.010	<0.020
Uranium (U)-Total	<0.00040	<0.0012	<0.00040	0.00129	<0.00040	<0.00080	<0.00040	0.00115	<0.00040	<0.00080
Vanadium (V)-Total	<0.0040	<0.012	<0.0040	0.0261	<0.0040	<0.0080	<0.0040	0.0050	<0.0040	<0.0080
Yttrium (Y)-Total	<0.0020	<0.0060	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	0.0047	<0.0020	<0.0040
Zinc (Zn)-Total	9.43	29.3	7.03	34.0	7.93	24.4	6.62	35.6	6.30	30.9
Zirconium (Zr)-Total	<0.040	<0.12	<0.040	<0.040	<0.040	0.195	<0.040	0.181	<0.040	<0.080
Aggregate Organics										
Lipid Content	<0.5	-	<0.5	-	0.9	-	0.5	-	0.8	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]Jones tissue 2012

NOTE:

1. EXCEEDS 1.0 mg/kg W.W. - BC MWLAP AMBIENT WATER QUALITY GUIDELINES FOR SELENIUM (2001)

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB

Knight Piésold CONSULTING

APPENDIX E-3 (DETECTION LIMITS)

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011 BULLTROUT TISSUE ANALYSIS DETECTION LIMITS

Print Aug/01/14 14:27:17

	DETECTION LIMITS																			
Sample ID	2011-OP#1 MUSCLE	2011-OP#1 LIVER	2011-OP#2 MUSCLE	2011-OP#2 LIVER	2011-OP#3 MUSCLE	2011-OP#3 LIVER	2011-OP#4 MUSCLE	2011-OP#4 LIVER	2011-OP#5 MUSCLE	2011-OP#5 LIVER	2011-TMF#1 MUSCLE	2011-TMF#1 LIVER	2011-TMF#2 MUSCLE	2011-TMF#2 LIVER	2011-TMF#3 MUSCLE	2011-TMF#3 LIVER	2011-TMF#4 MUSCLE	2011-TMF#4 LIVER	2011-TMF#5 MUSCLE	2011-TMF#5 LIVER
Date Sampled	12-SEP-11	12-SEP-11	12-SEP-11	12-SEP-11	12-SEP-11	12-SEP-11	12-SEP-11	12-SEP-11	12-SEP-11	12-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11
Time Sampled	09:30	09:30	09:30	09:30	09:30	09:30	09:30	09:30	09:30	09:30	10:30	10:30	10:30	10:30	10:30	10:30	10:30	10:30	10:30	10:30
ALS Sample ID	L1068772-1	L1068772-2	L1068772-3	L1068772-4	L1068772-5	L1068772-6	L1068772-7	L1068772-8	L1068772-9	L1068772-10	L1068772-11	L1068772-12	L1068772-13	L1068772-14	L1068772-15	L1068772-16	L1068772-17	L1068772-18	L1068772-19	L1068772-20
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests																				
% Moisture	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Metals																				
Aluminum (Al)-Total	0.40	0.80	0.40	0.80	0.40	0.40	0.40	0.80	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Antimony (Sb)-Total	0.0020	0.0040	0.0020	0.0040	0.0020	0.0020	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Arsenic (As)-Total	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Barium (Ba)-Total	0.010	0.020	0.010	0.020	0.010	0.010	0.010	0.020	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Beryllium (Be)-Total	0.0020	0.0040	0.0020	0.0040	0.0020	0.0020	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Bismuth (Bi)-Total	0.0020	0.0040	0.0020	0.0040	0.0020	0.0020	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Boron (B)-Total	0.20	0.40	0.20	0.40	0.20	0.20	0.20	0.40	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Cadmium (Cd)-Total	0.0020	0.0040	0.0020	0.0040	0.0020	0.0020	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Calcium (Ca)-Total	5.0	42	5.0	27	5.0	11	5.0	30	5.0	11	5.0	15	5.0	8.0	5.0	11	5.0	5.0	5.0	5.0
Cesium (Cs)-Total	0.0010	0.0020	0.0010	0.0020	0.0010	0.0010	0.0010	0.0020	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Chromium (Cr)-Total	0.010	0.020	0.010	0.020	0.010	0.010	0.010	0.020	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Cobalt (Co)-Total	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Copper (Cu)-Total	0.010	0.020	0.010	0.020	0.010	0.010	0.010	0.020	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Gallium (Ga)-Total	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Iron (Fe)-Total	0.20	0.40	0.20	0.40	0.20	0.20	0.20	0.40	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Lead (Pb)-Total	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Lithium (Li)-Total	0.030	0.040	0.030	0.040	0.030	0.020	0.050	0.040	0.030	0.020	0.020	0.020	0.030	0.020	0.020	0.020	0.030	0.020	0.030	0.020
Magnesium (Mg)-Total	10	84	10	54	10	22	10	60	10	22	10	30	10	16	10	22	10	10	10	10
Manganese (Mn)-Total	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Mercury (Hg)-Total	0.0010	0.0080	0.0010	0.0050	0.0010	0.0020	0.0010	0.0060	0.0010	0.0020	0.0010	0.0030	0.0010	0.0020	0.0010	0.0020	0.0010	0.0010	0.0010	0.0010
Molybdenum (Mo)-Total	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Nickel (Ni)-Total	0.015	0.020	0.020	0.060	0.015	0.020	0.025	0.040	0.035	0.025	0.020	0.050	0.020	0.025	0.025	0.065	0.010	0.010	0.025	0.020
Phosphorus (P)-Total	50	420	50	270	50	110	50	300	50	110	50	150	50	80	50	110	50	50	50	50
Potassium (K)-Total	200	1680	200	1080	200	440	200	1200	200	440	200	600	200	320	200	440	200	200	200	200
Rhenium (Re)-Total	0.0020	0.0040	0.0020	0.0040	0.0020	0.0020	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Rubidium (Rb)-Total	0.010	0.020	0.010	0.020	0.010	0.010	0.010	0.020	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Selenium (Se)-Total	0.020	0.040	0.020	0.040	0.020	0.020	0.020	0.040	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Sodium (Na)-Total	200	1680	200	1080	200	440	200	1200	200	440	200	600	200	320	200	440	200	200	200	200
Strontium (Sr)-Total	0.010	0.020	0.010	0.020	0.010	0.010	0.010	0.020	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Tellurium (Te)-Total	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Thallium (Tl)-Total	0.00040	0.00080	0.00040	0.00080	0.00040	0.00040	0.00040	0.00080	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040
Thorium (Th)-Total	0.0020	0.0040	0.0020	0.0040	0.0020	0.0020	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Tin (Sn)-Total	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Titanium (Ti)-Total	0.010	0.020	0.010	0.020	0.010	0.010	0.010	0.020	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Uranium (U)-Total	0.00040	0.00080	0.00040	0.00080	0.00040	0.00040	0.00040	0.00080	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040
Vanadium (V)-Total	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Yttrium (Y)-Total	0.0020	0.0040	0.0020	0.0040	0.0020	0.0020	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Zinc (Zn)-Total	0.10	0.20	0.10	0.20	0.10	0.10	0.10	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Zirconium (Zr)-Total	0.040	0.080	0.040	0.080	0.040	0.040	0.040	0.080	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Aggregate Organics																				
Lipid Content	0.5	-	0.5	-	0.5	-	0.5	-	0.5	-	0.5	-	0.5	-	0.5	-	0.5	-	0.5	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]BT Detection Limits 2011

0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold
CONSULTING

APPENDIX E-3 (DETECTION LIMITS)

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2012 BULLTROUT TISSUE ANALYSIS DETECTION LIMITS

Print Aug/01/14 14:27:17

DETECTION LIMITS

Sample ID	2012-TMF#1 MUSCLE	2012-TMF#1 LIVER	2012-TMF#2 MUSCLE	2012-TMF#2 LIVER	2012-TMF#3 MUSCLE	2012-TMF#3 LIVER	2012-TMF#4 MUSCLE	2012-TMF#4 LIVER	2012-TMF#5 MUSCLE	2012-TMF#5 LIVER	2012-OP#1 MUSCLE	2012-OP#1 LIVER	2012-OP#2 MUSCLE	2012-OP#2 LIVER	2012-OP#3 MUSCLE	2012-OP#3 LIVER	2012-OP#4 MUSCLE	2012-OP#4 LIVER	2012-OP#5 MUSCLE	2012-OP#5 LIVER
Date Sampled	21-Sep-12	21-Sep-12	21-Sep-12	21-Sep-12	21-Sep-12	21-Sep-12	21-Sep-12	21-Sep-12	21-Sep-12	21-Sep-12	22-Sep-12	22-Sep-12	22-Sep-12	22-Sep-12	22-Sep-12	22-Sep-12	22-Sep-12	22-Sep-12	22-Sep-12	22-Sep-12
Time Sampled	13:00	13:00	13:00	13:00	13:00	13:00	13:00	13:00	13:00	13:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00	16:00
ALS Sample ID	L1206758-1	L1206758-2	L1206758-3	L1206758-4	L1206758-5	L1206758-6	L1206758-7	L1206758-8	L1206758-9	L1206758-10	L1206758-11	L1206758-12	L1206758-13	L1206758-14	L1206758-15	L1206758-16	L1206758-17	L1206758-18	L1206758-19	L1206758-20
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests																				
% Moisture	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Metals																				
Aluminum (Al)-Total	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.80	0.40	0.40	0.40	0.40	0.40	0.40
Antimony (Sb)-Total	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Arsenic (As)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Barium (Ba)-Total	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	0.020	0.010	0.010	0.010	0.010	0.010	0.010
Beryllium (Be)-Total	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Bismuth (Bi)-Total	0.0050	0.0020	0.0030	0.0050	0.0020	0.0030	0.036	0.0020	0.0020	0.0020	0.0040	0.0020	0.0040	0.014	0.0020	0.044	0.030	0.0030	0.0020	0.0020
Boron (B)-Total	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.40	0.20	0.20	0.20	0.20	0.20	0.20
Cadmium (Cd)-Total	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Calcium (Ca)-Total	5.0	10	5.0	10	5.0	5.0	5.0	10	5.0	10	5.0	20	5.0	40	5.0	10	5.0	5.0	5.0	5.0
Cesium (Cs)-Total	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0020	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Chromium (Cr)-Total	0.010	0.040	0.020	0.090	0.020	0.030	0.020	0.030	0.050	0.060	0.020	0.030	0.040	0.050	0.020	0.050	0.030	0.050	0.010	0.030
Cobalt (Co)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Copper (Cu)-Total	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	0.020	0.010	0.010	0.010	0.010	0.010	0.010
Gallium (Ga)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Iron (Fe)-Total	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.40	0.20	0.20	0.20	0.20	0.20	0.20
Lead (Pb)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Lithium (Li)-Total	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	0.040	0.020	0.020	0.020	0.020	0.020	0.020
Magnesium (Mg)-Total	10	20	10	20	10	10	10	20	10	20	10	40	10	80	10	20	10	10	10	10
Manganese (Mn)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Mercury (Hg)-Total	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0020	0.0010	0.0040	0.0010	0.0080	0.0010	0.0020	0.0010	0.0010	0.0010	0.0010
Molybdenum (Mo)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Nickel (Ni)-Total	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	0.020	0.010	0.010	0.010	0.010	0.010	0.010
Phosphorus (P)-Total	50	100	50	100	50	50	50	100	50	100	50	200	50	400	50	100	50	50	50	50
Potassium (K)-Total	200	400	200	400	200	200	200	400	200	400	200	800	200	1600	200	400	200	200	200	200
Rhenium (Re)-Total	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Rubidium (Rb)-Total	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	0.020	0.010	0.010	0.010	0.010	0.010	0.010
Selenium (Se)-Total	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	0.040	0.020	0.020	0.020	0.020	0.020	0.020
Sodium (Na)-Total	200	400	200	400	200	200	200	400	200	400	200	800	200	1600	200	400	200	200	200	200
Strontium (Sr)-Total	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	0.020	0.010	0.010	0.010	0.010	0.010	0.010
Tellurium (Te)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Thallium (Tl)-Total	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00080	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040
Thorium (Th)-Total	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Tin (Sn)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Titanium (Ti)-Total	0.020	0.020	0.020	0.010	0.010	0.020	0.020	0.010	0.020	0.020	0.10	0.030	0.040	0.030	0.040	0.030	0.010	0.040	0.010	0.010
Uranium (U)-Total	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00080	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040
Vanadium (V)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
Yttrium (Y)-Total	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Zinc (Zn)-Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.20	0.10	0.10	0.10	0.10	0.10	0.10
Zirconium (Zr)-Total	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.080	0.040	0.040	0.040	0.040	0.040	0.040
Aggregate Organics																				
Lipid Content	0.5	-	0.5	-	0.5	-	0.5	-	0.5	-	0.5	-	0.5	-	0.5	-	0.5	-	0.5	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]BT Detection Limits 2012

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB

Knight Piésold CONSULTING

APPENDIX E-3 (DETECTION LIMITS)

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011 BAKER CREEK RAINBOW TROUT TISSUE ANALYSIS DETECTION LIMITS

Print Aug/01/14 14:27:17

	DETECTION LIMITS									
Sample ID	**2011-BAKER CR#1 MUSCLE**	**2011-BAKER CR#1 LIVER**	**2011-BAKER CR#2 MUSCLE**	**2011-BAKER CR#2 LIVER**	**2011-BAKER CR#3 MUSCLE**	**2011-BAKER CR#3 LIVER**	**2011-BAKER CR#4 MUSCLE**	**2011-BAKER CR#4 LIVER**	**2011-BAKER CR#5 MUSCLE**	**2011-BAKER CR#5 LIVER**
Date Sampled	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11
Time Sampled	15:30	15:30	15:30	15:30	15:30	15:30	15:30	15:30	15:30	15:30
ALS Sample ID	L1068772-21	L1068772-22	L1068772-23	L1068772-24	L1068772-25	L1068772-26	L1068772-27	L1068772-28	L1068772-29	L1068772-30
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests										
% Moisture	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Metals										
Aluminum (Al)-Total	0.40	0.40	0.40	1.2	0.40	0.80	0.40	0.40	0.40	0.40
Antimony (Sb)-Total	0.0020	0.0020	0.0020	0.0060	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020
Arsenic (As)-Total	0.0040	0.0040	0.0040	0.012	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Barium (Ba)-Total	0.010	0.010	0.010	0.030	0.010	0.020	0.010	0.010	0.010	0.010
Beryllium (Be)-Total	0.0020	0.0020	0.0020	0.0060	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020
Bismuth (Bi)-Total	0.0020	0.0020	0.0020	0.0060	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020
Boron (B)-Total	0.20	0.20	0.20	0.60	0.20	0.40	0.20	0.20	0.20	0.20
Cadmium (Cd)-Total	0.0020	0.0020	0.0020	0.0060	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020
Calcium (Ca)-Total	5.0	9.0	5.0	45	5.0	40	5.0	9.0	5.0	12
Cesium (Cs)-Total	0.0010	0.0010	0.0010	0.0030	0.0010	0.0020	0.0010	0.0010	0.0010	0.0010
Chromium (Cr)-Total	0.010	0.010	0.010	0.030	0.010	0.020	0.010	0.010	0.010	0.010
Cobalt (Co)-Total	0.0040	0.0040	0.0040	0.012	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Copper (Cu)-Total	0.010	0.010	0.010	0.030	0.010	0.020	0.010	0.010	0.010	0.010
Gallium (Ga)-Total	0.0040	0.0040	0.0040	0.012	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Iron (Fe)-Total	0.20	0.20	0.20	0.60	0.20	0.40	0.20	0.20	0.20	0.20
Lead (Pb)-Total	0.0040	0.0040	0.0040	0.012	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Lithium (Li)-Total	0.030	0.25	0.030	0.060	0.030	0.040	0.020	0.030	0.040	0.040
Magnesium (Mg)-Total	10	18	10	90	10	80	10	18	10	24
Manganese (Mn)-Total	0.0040	0.0040	0.0040	0.012	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Mercury (Hg)-Total	0.0010	0.0020	0.0010	0.0090	0.0010	0.0080	0.0010	0.0020	0.0010	0.0020
Molybdenum (Mo)-Total	0.0040	0.0040	0.0040	0.012	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Nickel (Ni)-Total	0.055	0.010	0.060	0.20	0.020	0.070	0.020	0.040	0.010	0.075
Phosphorus (P)-Total	50	90	50	450	50	400	50	90	50	120
Potassium (K)-Total	200	360	200	1800	200	1600	200	360	200	480
Rhenium (Re)-Total	0.0020	0.0020	0.0020	0.0060	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020
Rubidium (Rb)-Total	0.010	0.010	0.010	0.030	0.010	0.020	0.010	0.010	0.010	0.010
Selenium (Se)-Total	0.020	0.020	0.020	0.060	0.020	0.040	0.020	0.020	0.020	0.020
Sodium (Na)-Total	200	360	200	1800	200	1600	200	360	200	480
Strontium (Sr)-Total	0.010	0.010	0.010	0.030	0.010	0.020	0.010	0.010	0.010	0.010
Tellurium (Te)-Total	0.0040	0.0040	0.0040	0.012	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Thallium (Tl)-Total	0.00040	0.00040	0.00040	0.0012	0.00040	0.00080	0.00040	0.00040	0.00040	0.00040
Thorium (Th)-Total	0.0020	0.0020	0.0020	0.0060	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020
Tin (Sn)-Total	0.0040	0.0040	0.0040	0.012	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Titanium (Ti)-Total	0.010	0.010	0.010	0.030	0.010	0.020	0.010	0.010	0.010	0.010
Uranium (U)-Total	0.00040	0.00040	0.00040	0.0012	0.00040	0.00080	0.00040	0.00040	0.00040	0.00040
Vanadium (V)-Total	0.0040	0.0040	0.0040	0.012	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Yttrium (Y)-Total	0.0020	0.0020	0.0020	0.0060	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020
Zinc (Zn)-Total	0.10	0.10	0.10	0.30	0.10	0.20	0.10	0.10	0.10	0.10
Zirconium (Zr)-Total	0.040	0.040	0.040	0.12	0.040	0.080	0.040	0.040	0.040	0.040
Aggregate Organics										
Lipid Content	0.5	-	0.5	-	0.5	-	0.5	-	0.5	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]RBT BAKER 2011 DL

0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

APPENDIX E-3 (DETECTION LIMITS)

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2012 BAKER CREEK RAINBOW TROUT TISSUE ANALYSIS DETECTION LIMITS

Print Aug/01/14 14:27:17

	DETECTION LIMITS									
Sample ID	**2012-BAKER CR#1 MUSCLE**	**2012-BAKER CR#1 LIVER**	**2012-BAKER CR#2 MUSCLE**	**2012-BAKER CR#2 LIVER**	**2012-BAKER CR#3 MUSCLE**	**2012-BAKER CR#3 LIVER**	**2012-BAKER CR#4 MUSCLE**	**2012-BAKER CR#4 LIVER**	**2012-BAKER CR#5 MUSCLE**	**2012-BAKER CR#5 LIVER**
Date Sampled	12-SEP-12	12-SEP-12	12-SEP-12	12-SEP-12	12-SEP-12	12-SEP-12	12-SEP-12	12-SEP-12	12-SEP-12	12-SEP-12
Time Sampled	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	L1209651-11	L1209651-12	L1209651-13	L1209651-14	L1209651-15	L1209651-16	L1209651-17	L1209651-18	L1209651-19	L1209651-20
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests										
% Moisture	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Metals										
Aluminum (Al)-Total	0.40	0.40	0.40	0.80	0.40	0.80	0.40	0.40	0.40	0.40
Antimony (Sb)-Total	0.0020	0.0020	0.0020	0.0040	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020
Arsenic (As)-Total	0.0040	0.0040	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Barium (Ba)-Total	0.010	0.010	0.010	0.020	0.010	0.020	0.010	0.010	0.010	0.010
Beryllium (Be)-Total	0.0020	0.0020	0.0020	0.0040	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020
Bismuth (Bi)-Total	0.0020	0.0020	0.0020	0.0040	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020
Boron (B)-Total	0.20	0.20	0.20	0.40	0.20	0.40	0.20	0.20	0.20	0.20
Cadmium (Cd)-Total	0.0020	0.0020	0.0020	0.0040	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020
Calcium (Ca)-Total	5.0	15	5.0	25	5.0	25	5.0	10	5.0	20
Cesium (Cs)-Total	0.0010	0.0010	0.0010	0.0020	0.0010	0.0020	0.0010	0.0010	0.0010	0.0010
Chromium (Cr)-Total	0.010	0.030	0.010	0.020	0.010	0.030	0.010	0.030	0.020	0.060
Cobalt (Co)-Total	0.0040	0.0040	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Copper (Cu)-Total	0.010	0.010	0.010	0.020	0.010	0.020	0.010	0.010	0.010	0.010
Gallium (Ga)-Total	0.0040	0.0040	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Iron (Fe)-Total	0.20	0.20	0.20	0.40	0.20	0.40	0.20	0.20	0.20	0.20
Lead (Pb)-Total	0.0040	0.0040	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Lithium (Li)-Total	0.020	0.020	0.020	0.040	0.020	0.040	0.020	0.020	0.020	0.020
Magnesium (Mg)-Total	10	30	10	50	10	50	10	20	10	40
Manganese (Mn)-Total	0.0040	0.0040	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Mercury (Hg)-Total	0.0010	0.0030	0.0010	0.0050	0.0010	0.0050	0.0010	0.0010	0.0010	0.0040
Molybdenum (Mo)-Total	0.0040	0.0040	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Nickel (Ni)-Total	0.010	0.010	0.010	0.020	0.010	0.020	0.010	0.010	0.010	0.010
Phosphorus (P)-Total	50	150	50	250	50	250	50	100	50	200
Potassium (K)-Total	200	600	200	1000	200	1000	200	400	200	800
Rhenium (Re)-Total	0.0020	0.0020	0.0020	0.0040	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020
Rubidium (Rb)-Total	0.010	0.010	0.010	0.020	0.010	0.020	0.010	0.010	0.010	0.010
Selenium (Se)-Total	0.020	0.020	0.020	0.040	0.020	0.040	0.020	0.020	0.020	0.020
Sodium (Na)-Total	200	600	200	1000	200	1000	200	400	200	800
Strontium (Sr)-Total	0.010	0.010	0.010	0.020	0.010	0.020	0.010	0.010	0.010	0.010
Tellurium (Te)-Total	0.0040	0.0040	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Thallium (Tl)-Total	0.00040	0.00040	0.00040	0.00080	0.00040	0.00080	0.00040	0.00040	0.00040	0.00040
Thorium (Th)-Total	0.0020	0.0020	0.0020	0.0040	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020
Tin (Sn)-Total	0.0040	0.0040	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Titanium (Ti)-Total	0.060	0.020	0.010	0.16	0.010	0.040	0.010	0.020	0.030	0.040
Uranium (U)-Total	0.00040	0.00040	0.00040	0.00080	0.00040	0.00080	0.00040	0.00040	0.00040	0.00040
Vanadium (V)-Total	0.0040	0.0040	0.0040	0.0080	0.0040	0.0080	0.0040	0.0040	0.0040	0.0040
Yttrium (Y)-Total	0.0020	0.0020	0.0020	0.0040	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020
Zinc (Zn)-Total	0.10	0.10	0.10	0.20	0.10	0.20	0.10	0.10	0.10	0.10
Zirconium (Zr)-Total	0.040	0.040	0.040	0.080	0.040	0.080	0.040	0.040	0.040	0.040
Aggregate Organics										
Lipid Content	0.5	-	0.5	-	0.5	-	0.5	-	0.5	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]RBT BAKER 2012 DL

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB

Knight Piésold
CONSULTING

APPENDIX E-3 (DETECTION LIMITS)

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011 LUTE CREEK RAINBOW TROUT TISSUE ANALYSIS DETECTION LIMITS

Print Aug/01/14 14:27:17

	DETECTION LIMITS									
Sample ID	2011-LUTE CR#1 MUSCLE	2011-LUTE CR#1 LIVER	2011-LUTE CR#2 MUSCLE	2011-LUTE CR#2 LIVER	2011-LUTE CR#3 MUSCLE	2011-LUTE CR#3 LIVER	2011-LUTE CR#4 MUSCLE	2011-LUTE CR#4 LIVER	2011-LUTE CR#5 MUSCLE	2011-LUTE CR#5 LIVER
Date Sampled	28-SEP-11	28-SEP-11	28-SEP-11	28-SEP-11	28-SEP-11	28-SEP-11	28-SEP-11	28-SEP-11	28-SEP-11	28-SEP-11
Time Sampled	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00
ALS Sample ID	L1068772-31	32	L1068772-33	L1068772-34	L1068772-35	L1068772-36	L1068772-37	38	L1068772-39	L1068772-40
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests										
% Moisture	78.8	72.6	75.6	67.3	76.6	70.8	76.6	64.0	75.3	70.2
Metals										
Aluminum (Al)-Total	1.23	2.06	<0.40	2.59	<0.40	<1.2	0.75	767	1.15	3.65
Antimony (Sb)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0060	<0.0020	0.0079	<0.0020	<0.0020
Arsenic (As)-Total	0.0281	0.0296	0.301	0.202	0.0977	0.111	0.0377	0.704	0.110	0.160
Barium (Ba)-Total	0.363	0.139	0.163	1.18	0.039	<0.030	0.058	11.7	0.101	0.107
Beryllium (Be)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0060	<0.0020	0.0342	<0.0020	<0.0020
Bismuth (Bi)-Total	<0.0020	<0.0020	<0.0020	0.0054	<0.0020	<0.0060	<0.0020	0.0612	<0.0020	<0.0020
Boron (B)-Total	0.68	<0.20	0.67	<0.40	<0.20	<1.4	<0.50	<2.0	<0.80	<1.5
Cadmium (Cd)-Total	0.0139	0.0804	0.0309	0.397	0.0202	0.159	0.0173	0.0772	0.0144	0.163
Calcium (Ca)-Total	2720	381	1060	7460	476	571	393	411	858	473
Cesium (Cs)-Total	0.0264	0.0225	0.0184	0.0149	0.0142	0.0129	0.0401	0.131	0.0166	0.0148
Chromium (Cr)-Total	0.016	0.034	0.014	0.045	<0.010	<0.030	0.024	1.32	0.014	0.019
Cobalt (Co)-Total	0.0435	0.0926	0.113	0.135	0.0286	0.075	0.0671	0.346	0.0461	0.138
Copper (Cu)-Total	0.331	5.18	0.734	52.8	0.640	13.6	0.719	4.80	0.575	28.6
Gallium (Ga)-Total	<0.0040	<0.0040	<0.0040	<0.0080	<0.0040	<0.012	<0.0040	0.192	<0.0040	<0.0040
Iron (Fe)-Total	5.76	163	4.79	91.8	5.32	98.0	6.40	1350	7.82	113
Lead (Pb)-Total	0.0076	0.0105	0.0191	0.140	0.0041	0.016	0.0265	4.68	0.0142	0.0438
Lithium (Li)-Total	<0.040	<0.020	<0.020	<0.040	<0.020	<0.060	0.093	1.03	0.056	<0.020
Magnesium (Mg)-Total	274	298	285	410	273	310	217	581	315	264
Manganese (Mn)-Total	2.55	8.86	1.44	9.04	0.199	0.946	0.804	16.0	0.333	1.17
Mercury (Hg)-Total	0.0345	0.0404	0.0287	0.0350	0.0429	0.0739	0.0191	0.0111	0.0162	0.0177
Molybdenum (Mo)-Total	0.0069	0.237	0.0124	0.194	0.0066	0.176	0.0088	0.219	0.0077	0.139
Nickel (Ni)-Total	<0.025	<0.050	<0.035	<0.070	<0.050	<0.11	<0.12	0.672	<0.050	<0.050
Phosphorus (P)-Total	3390	4250	2730	7970	2520	5110	1990	2950	3030	3840
Potassium (K)-Total	4060	3840	4170	3300	4420	3800	3290	3400	4910	3960
Rhenium (Re)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0060	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	3.42	3.23	3.35	2.78	2.71	2.56	6.00	6.51	2.52	2.60
Selenium (Se)-Total	0.261	0.995	0.786	5.32	0.374	2.06	0.504	0.929	0.544	3.02
Sodium (Na)-Total	730	1360	790	1100	700	<2000	550	<1200	810	1330
Strontium (Sr)-Total	4.25	1.03	4.83	33.0	1.17	2.65	0.802	2.56	2.56	1.85
Tellurium (Te)-Total	<0.0040	<0.0040	<0.0040	<0.0080	<0.0040	<0.012	<0.0040	0.0196	<0.0040	<0.0040
Thallium (Tl)-Total	0.00594	0.0277	0.00323	0.0190	0.00459	0.0262	0.00343	0.0173	0.00225	0.0114
Thorium (Th)-Total	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0060	<0.0020	2.57	0.0278	0.0355
Tin (Sn)-Total	<0.0040	0.0219	<0.0040	<0.0080	<0.0040	<0.012	<0.0060	<0.020	<0.0050	<0.0040
Titanium (Ti)-Total	0.019	0.017	0.011	0.074	0.016	0.032	0.017	2.54	0.220	0.026
Uranium (U)-Total	0.00284	0.00453	0.00080	0.00687	0.00054	0.0048	<0.00040	0.458	0.00076	0.00493
Vanadium (V)-Total	<0.0040	0.0075	<0.0040	<0.0080	<0.0040	<0.012	0.0155	1.83	0.0128	0.0067
Yttrium (Y)-Total	<0.0020	0.0055	<0.0020	<0.0040	<0.0020	<0.0060	<0.0020	0.727	0.0023	0.0187
Zinc (Zn)-Total	11.6	72.4	13.4	79.5	10.3	59.9	9.80	68.5	8.65	68.9
Zirconium (Zr)-Total	<0.040	<0.040	<0.040	<0.080	<0.040	<0.12	<0.040	1.81	<0.040	0.146
Aggregate Organics										
Lipid Content	1.3	-	2.6	-	2.0	-	2.1	-	2.1	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]RBT LUTE 2011 DL

0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

APPENDIX E-3 (DETECTION LIMITS)

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2012 LUTE CREEK RAINBOW TROUT TISSUE ANALYSIS DETECTION LIMITS

Print Aug/01/14 14:27:17

	DETECTION LIMITS									
Sample ID	2012-LUTE CR#1 MUSCLE	2012-LUTE CR#1 LIVER	2012-LUTE CR#2 MUSCLE	2012-LUTE CR#2 LIVER	2012-LUTE CR#3 MUSCLE	2012-LUTE CR#3 LIVER	2012-LUTE CR#4 MUSCLE	2012-LUTE CR#4 LIVER	2012-LUTE CR#5 MUSCLE	2012-LUTE CR#5 LIVER
Date Sampled	12-SEP-12	12-SEP-12	12-SEP-12	12-SEP-12	12-SEP-12	12-SEP-12	12-SEP-12	12-SEP-12	12-SEP-12	12-SEP-12
Time Sampled	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	L1209651-21	22	L1209651-23	L1209651-24	L1209651-25	L1209651-26	L1209651-27	28	L1209651-29	L1209651-30
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests										
% Moisture	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Metals										
Aluminum (Al)-Total	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	1.2
Antimony (Sb)-Total	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0060
Arsenic (As)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.012
Barium (Ba)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.030
Beryllium (Be)-Total	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0060
Bismuth (Bi)-Total	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0060
Boron (B)-Total	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.60
Cadmium (Cd)-Total	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0060
Calcium (Ca)-Total	5.0	5.0	5.0	10	5.0	20	5.0	20	5.0	50
Cesium (Cs)-Total	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0030
Chromium (Cr)-Total	0.010	0.010	0.010	0.010	0.010	0.020	0.010	0.030	0.020	0.060
Cobalt (Co)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.012
Copper (Cu)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.030
Gallium (Ga)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.012
Iron (Fe)-Total	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.60
Lead (Pb)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.012
Lithium (Li)-Total	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.060
Magnesium (Mg)-Total	10	10	10	20	10	40	10	40	10	100
Manganese (Mn)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.012
Mercury (Hg)-Total	0.0010	0.0010	0.0010	0.0010	0.0010	0.0040	0.0010	0.0040	0.0010	0.010
Molybdenum (Mo)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.012
Nickel (Ni)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.030
Phosphorus (P)-Total	50	50	50	100	50	200	50	200	50	500
Potassium (K)-Total	200	200	200	400	200	800	200	800	200	2000
Rhenium (Re)-Total	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0060
Rubidium (Rb)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.030
Selenium (Se)-Total	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.060
Sodium (Na)-Total	200	200	200	400	200	800	200	800	200	2000
Strontium (Sr)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.030
Tellurium (Te)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.012
Thallium (Tl)-Total	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.0012
Thorium (Th)-Total	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0060
Tin (Sn)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.012
Titanium (Ti)-Total	0.040	0.030	0.010	0.010	0.020	0.030	0.020	0.020	0.020	0.040
Uranium (U)-Total	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.0012
Vanadium (V)-Total	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040	0.012
Yttrium (Y)-Total	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0060
Zinc (Zn)-Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.30
Zirconium (Zr)-Total	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.12
Aggregate Organics										
Lipid Content	0.5	-	0.5	-	-	-	-	-	-	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]RBT LUTE 2012 DL

0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold
CONSULTING

APPENDIX E-3 (DETECTION LIMITS)

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011 JONES CREEK RAINBOW TROUT TISSUE ANALYSIS DETECTION LIMITS

Print Aug/01/14 14:27:17

	DETECTION LIMITS									
Sample ID	2011-JONES CR#1 MUSCLE	2011-JONES CR#1 LIVER	2011-JONES CR#2 MUSCLE	2011-JONES CR#2 LIVER	2011-JONES CR#3 MUSCLE	2011-JONES CR#3 LIVER	2011-JONES CR#4 MUSCLE	2011-JONES CR#4 LIVER	2011-JONES CR#5 MUSCLE	2011-JONES CR#5 LIVER
Date Sampled	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11
Time Sampled	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00
ALS Sample ID	L1068772-41	L1068772-42	L1068772-43	L1068772-44	L1068772-45	L1068772-46	L1068772-47	L1068772-48	L1068772-49	L1068772-50
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests										
% Moisture	78.7	74.8	80.2	74.6	77.6	73.9	80.3	73.4	77.7	72.1
Metals										
Aluminum (Al)-Total	<0.40	1.99	0.70	4.21	0.50	1.63	<0.40	3.60	<0.40	2.92
Antimony (Sb)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total	0.0542	0.239	0.129	0.154	0.0687	0.0851	0.0821	0.140	0.0461	0.0633
Barium (Ba)-Total	0.022	0.045	0.034	0.029	0.045	0.055	0.021	0.071	0.054	0.019
Beryllium (Be)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total	<0.40	<0.20	<0.20	<0.20	<0.70	<0.90	<0.20	<0.20	<0.20	<0.60
Cadmium (Cd)-Total	0.0069	0.193	0.0148	0.433	0.0099	0.201	<0.0020	0.161	<0.0020	0.345
Calcium (Ca)-Total	208	654	242	228	278	530	274	270	1100	241
Cesium (Cs)-Total	0.0120	0.0084	0.0100	0.0071	0.0088	0.0082	0.0107	0.0087	0.0151	0.0141
Chromium (Cr)-Total	<0.010	0.013	<0.010	0.018	0.012	0.011	<0.010	<0.010	<0.010	<0.010
Cobalt (Co)-Total	0.0215	0.112	0.0190	0.124	0.0246	0.109	0.0320	0.169	0.0587	0.119
Copper (Cu)-Total	0.377	14.0	0.322	11.0	0.434	61.6	0.342	3.42	0.499	69.2
Gallium (Ga)-Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Iron (Fe)-Total	4.90	130	4.96	222	3.86	157	6.17	138	6.11	123
Lead (Pb)-Total	<0.0040	0.0414	0.0090	0.0162	0.0105	0.0115	<0.0040	0.0256	0.0051	0.0167
Lithium (Li)-Total	0.045	<0.020	0.040	<0.020	0.042	0.033	<0.020	<0.020	<0.020	<0.020
Magnesium (Mg)-Total	223	208	218	204	172	197	245	225	288	260
Manganese (Mn)-Total	0.0708	0.868	0.127	1.14	0.142	0.679	0.117	0.985	0.239	1.62
Mercury (Hg)-Total	0.0330	0.0343	0.0467	0.0476	0.0432	0.0258	0.0345	0.0405	0.0404	0.0321
Molybdenum (Mo)-Total	0.0048	0.161	<0.0040	0.328	0.0054	0.197	0.0048	0.167	0.0077	0.228
Nickel (Ni)-Total	<0.020	<0.080	<0.040	<0.080	<0.040	<0.040	<0.080	<0.080	<0.060	<0.070
Phosphorus (P)-Total	1960	3540	1950	3490	1480	3470	2230	3600	2830	4000
Potassium (K)-Total	3550	3440	3420	3300	2540	3100	4060	3550	4380	3400
Rhenium (Re)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	1.48	1.29	1.24	1.10	1.28	1.28	1.30	1.15	1.72	1.70
Selenium (Se)-Total	0.381	2.03	0.391	3.02	0.413	2.72	0.424	1.73	0.400	2.66
Sodium (Na)-Total	590	1390	540	1410	<500	<1200	740	1410	800	1260
Strontium (Sr)-Total	0.266	1.02	0.264	0.469	0.514	1.17	0.271	0.402	0.799	0.420
Tellurium (Te)-Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	0.00178	0.00720	0.00142	0.0109	0.00138	0.00676	0.00206	0.00935	0.00244	0.00898
Thorium (Th)-Total	0.0084	0.0074	0.0043	0.0023	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Tin (Sn)-Total	<0.0040	<0.0040	<0.0050	<0.0040	<0.0060	<0.0040	<0.0090	<0.0040	<0.0040	<0.0040
Titanium (Ti)-Total	<0.010	0.027	0.016	0.014	0.018	0.023	<0.010	0.011	<0.010	<0.010
Uranium (U)-Total	<0.00040	0.00211	<0.00040	0.00106	<0.00040	0.00048	<0.00040	0.00079	<0.00040	0.00109
Vanadium (V)-Total	<0.0040	0.0054	0.0061	0.0074	0.0099	<0.0040	<0.0040	0.0058	<0.0040	0.0053
Yttrium (Y)-Total	<0.0020	<0.0020	<0.0020	0.0423	<0.0020	<0.0020	<0.0020	0.0045	<0.0020	0.0034
Zinc (Zn)-Total	8.13	42.0	4.33	59.9	8.22	32.0	7.22	42.7	8.14	52.1
Zirconium (Zr)-Total	<0.040	<0.040	<0.040	0.305	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Aggregate Organics										
Lipid Content	2.0	-	1.1	-	2.3	-	1.0	-	1.8	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]RBT JONES 2011 DL

0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

APPENDIX E-3 (DETECTION LIMITS)

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2012 JONES CREEK RAINBOW TROUT TISSUE ANALYSIS DETECTION LIMITS

Print Aug/01/14 14:27:17

	DETECTION LIMITS									
Sample ID	2012-JONES CR#1 MUSCLE	2012-JONES CR#1 LIVER	2012-JONES CR#2 MUSCLE	2012-JONES CR#2 LIVER	2012-JONES CR#3 MUSCLE	2012-JONES CR#3 LIVER	2012-JONES CR#4 MUSCLE	2012-JONES CR#4 LIVER	2012-JONES CR#5 MUSCLE	2012-JONES CR#5 LIVER
Date Sampled	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11	29-SEP-11
Time Sampled	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00
ALS Sample ID	L1068772-41	L1068772-42	L1068772-43	L1068772-44	L1068772-45	L1068772-46	L1068772-47	L1068772-48	L1068772-49	L1068772-50
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests										
% Moisture	78.7	74.8	80.2	74.6	77.6	73.9	80.3	73.4	77.7	72.1
Metals										
Aluminum (Al)-Total	<0.40	1.99	0.70	4.21	0.50	1.63	<0.40	3.60	<0.40	2.92
Antimony (Sb)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total	0.0542	0.239	0.129	0.154	0.0687	0.0851	0.0821	0.140	0.0461	0.0633
Barium (Ba)-Total	0.022	0.045	0.034	0.029	0.045	0.055	0.021	0.071	0.054	0.019
Beryllium (Be)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total	<0.40	<0.20	<0.20	<0.20	<0.70	<0.90	<0.20	<0.20	<0.20	<0.60
Cadmium (Cd)-Total	0.0069	0.193	0.0148	0.433	0.0099	0.201	<0.0020	0.161	<0.0020	0.345
Calcium (Ca)-Total	208	654	242	228	278	530	274	270	1100	241
Cesium (Cs)-Total	0.0120	0.0084	0.0100	0.0071	0.0088	0.0082	0.0107	0.0087	0.0151	0.0141
Chromium (Cr)-Total	<0.010	0.013	<0.010	0.018	0.012	0.011	<0.010	<0.010	<0.010	<0.010
Cobalt (Co)-Total	0.0215	0.112	0.0190	0.124	0.0246	0.109	0.0320	0.169	0.0587	0.119
Copper (Cu)-Total	0.377	14.0	0.322	11.0	0.434	61.6	0.342	3.42	0.499	69.2
Gallium (Ga)-Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Iron (Fe)-Total	4.90	130	4.96	222	3.86	157	6.17	138	6.11	123
Lead (Pb)-Total	<0.0040	0.0414	0.0090	0.0162	0.0105	0.0115	<0.0040	0.0256	0.0051	0.0167
Lithium (Li)-Total	0.045	<0.020	0.040	<0.020	0.042	0.033	<0.020	<0.020	<0.020	<0.020
Magnesium (Mg)-Total	223	208	218	204	172	197	245	225	288	260
Manganese (Mn)-Total	0.0708	0.868	0.127	1.14	0.142	0.679	0.117	0.985	0.239	1.62
Mercury (Hg)-Total	0.0330	0.0343	0.0467	0.0476	0.0432	0.0258	0.0345	0.0405	0.0404	0.0321
Molybdenum (Mo)-Total	0.0048	0.161	<0.0040	0.328	0.0054	0.197	0.0048	0.167	0.0077	0.228
Nickel (Ni)-Total	<0.020	<0.080	<0.040	<0.080	<0.040	<0.040	<0.080	<0.080	<0.060	<0.070
Phosphorus (P)-Total	1960	3540	1950	3490	1480	3470	2230	3600	2830	4000
Potassium (K)-Total	3550	3440	3420	3300	2540	3100	4060	3550	4380	3400
Rhenium (Re)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	1.48	1.29	1.24	1.10	1.28	1.28	1.30	1.15	1.72	1.70
Selenium (Se)-Total	0.381	2.03	0.391	3.02	0.413	2.72	0.424	1.73	0.400	2.66
Sodium (Na)-Total	590	1390	540	1410	<500	<1200	740	1410	800	1260
Strontium (Sr)-Total	0.266	1.02	0.264	0.469	0.514	1.17	0.271	0.402	0.799	0.420
Tellurium (Te)-Total	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	0.00178	0.00720	0.00142	0.0109	0.00138	0.00676	0.00206	0.00935	0.00244	0.00898
Thorium (Th)-Total	0.0084	0.0074	0.0043	0.0023	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Tin (Sn)-Total	<0.0040	<0.0040	<0.0050	<0.0040	<0.0060	<0.0040	<0.0090	<0.0040	<0.0040	<0.0040
Titanium (Ti)-Total	<0.010	0.027	0.016	0.014	0.018	0.023	<0.010	0.011	<0.010	<0.010
Uranium (U)-Total	<0.00040	0.00211	<0.00040	0.00106	<0.00040	0.00048	<0.00040	0.00079	<0.00040	0.00109
Vanadium (V)-Total	<0.0040	0.0054	0.0061	0.0074	0.0099	<0.0040	<0.0040	0.0058	<0.0040	0.0053
Yttrium (Y)-Total	<0.0020	<0.0020	<0.0020	0.0423	<0.0020	<0.0020	<0.0020	0.0045	<0.0020	0.0034
Zinc (Zn)-Total	8.13	42.0	4.33	59.9	8.22	32.0	7.22	42.7	8.14	52.1
Zirconium (Zr)-Total	<0.040	<0.040	<0.040	0.305	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Aggregate Organics										
Lipid Content	2.0	-	1.1	-	2.3	-	1.0	-	1.8	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 0\Appendices\E - Fish Tissues\[Appendix E - Fish Tissues July30 2014.xlsx]RBT JONES 2012 DL

0	30MAY'14	ISSUED WITH VA101-458/15-1	PMT	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

APPENDIX F

PERIPHYTON AND CHLOROPHYL-A

(Pages F-1 to F-3)

APPENDIX F

HARPER CREEK MINING INC.

HARPER CREEK PROJECT

2013 PERIPHYTON TAXA

22/08/2014 10:54

FES Sample Number			130470	130471	130472	130473	130474	130475	130476	130477	130478	130479	130480	130481	130482	130483	130484	130485	130486	130487	130488	130489	130490	130491	130492	130493	130494	130495	130496	130497	130498	130499	130500	130501	130502	130503
Sampling Station			BR-10 A	BR-10 B	BR-10 C	HC-40 A	HC-40 B	HC-40 C	OP-10 A	OP-10 B	OP-10 C	TMF-10 A	TMF-10 B	TMF-10 C	BC-10 A	BC-10 B	BC-10 C	BR-20 A	BR-20 B	BR-20 C	TMF-20 A	TMF-20 B	TMF-20 C	HC-10 A	HC-10 B	HC-10 C	HC-20 A	HC-20 B	HC-20 C	HC-20 D	HC-20 E	HC-30 A	HC-30 B	HC-30 C	HC-30 D	HC-30 E
Sampling Date			23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12
Area Sampled (cm^2)			24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55
Units = cells/cm^2																																				
Phylum	Order	Genus and Species																																		
Bacillariophycae	Centrales	*Cyclotella spp.*	38.5	50.2	55.3									<33.2					<28.2																	
		Melosira spp.	154.0	502.0	331.8		<37.9	<39.2			<22.9	39.6		<33.2							56.8	61.9	144.6		81.9		<182.1		<132.1	<147.1	100.8	<26.5	<50.5		<31.2	
		Orthoseira roeseana																									<182.1		<132.1							
	Pennales	*Achnanthes flexella*	770.0	1,558.4	2,574.6	<44.2	<37.9	<39.2	<33.4													<61.9		46.8	109.2	40.3	2549.4	95.2	792.6	882.6	201.6					<24.0
		Achnanthes laevis	2,385.6	779.2	858.2	44.2			<33.4	26.4								67.4	56.4	641.6				187.2	163.8	241.8	18,352.1	368.8	5,119.5	5,701.0	12,510.4	53.0		215.2	62.4	24.0
		Achnanthes lanceolata	77.0		110.6		<37.9			<26.4	<22.9				68.2	72.4	152.4		<28.2	<40.1				46.8			364.2	95.2	<132.1	294.2	605.7	<26.5	50.5	<26.9		
		Achnanthes minutissima	136,564.0	170,897.4	156,883.0	112,946.4	72,409.8	645,018.6	117,260.4	99,234.8	77,924.0	6,717.7	166,643.2	78,709.4	92,285.6	88,108.7	15,262.0	33,174.4	65,092.5	193,800.8	134,588.3	339,018.8	56,430.0	72,040.0	87,308.0	157,683.2	461,754.0	47,536.5	598,880.0	548,462.5	117,339.3	848.0	135,612.0	69,109.6	74,392.0	24,327.0
		Achnanthes minutissima var. gracillima [1]																						374.4	654.6	322.6	3,455,006.4	13,480.5	843,160.0	930,190.4	252,730.8	265.0	1,506.8	417.6	187.2	<24.0
		Achnanthes spp.	22,952.0	23,985.6	28,073.8	14,968.8	4,671.6	9,663.2	7,200.2	4,067.0	9,209.2	634.8	18,226.6	4,088.8	11,535.7	8,922.4	2,348.0	4,146.8	6,075.3	22,219.2	5,243.7	17,141.4	4,455.0	14,408.0	12,592.5	9,932.8	81,486.0	5,676.0	31,520.0	39,489.3	15,043.5	159.0	16,574.8	5,625.2	9,299.0	2,862.0
		Amphipleura pellucida	77.0	100.4	110.6																	<61.9					<182.1	<23.8		<147.1						
		Amphora spp.	<38.5	<50.2		88.4	<37.9	39.2		<26.4					<34.1	144.8	38.1	67.4		80.2							364.2	23.8	264.2	294.2	201.6		<50.5	<26.9		
		Anomoeoneis spp.	4,174.8	8,960.8	19,816.8	132.6	<37.9		33.4	<26.4	22.9	19.8		33.2										187.2	27.3	80.6					<100.8	<26.5				
		Caloneis spp.	154.0	100.4	110.6	<44.2									<34.1	<36.2		<33.7	<28.2	<40.1	<56.8	<61.9	96.4	46.8	109.2		182.1		<132.1		<100.8		<50.5			
		Cavinula pseudoscutiformis		<50.2																																
		Ceratoneis arcus	77.0	200.8	331.8	88.4	<37.9		<33.4	26.4	<22.9	59.4	5,074.5	232.4				<33.7	<28.2	40.1	56.8	61.9	48.2	936.0	218.4	161.2	1,456.8	1,290.8	1,585.2	1,471.0	1,211.4	<26.5	707.0	80.7	62.4	<24.0
		Cocconeis placentula	77.0	<50.2		2,475.2	606.4	313.9	33.4	26.4	114.5	<19.8	507.6	265.6	4,360.0	2,318.4	5,186.7	269.6	338.4	561.4	<56.8		24.1	<46.8	54.6	<40.3	2,185.2	142.8	1,056.8	1,176.8	807.6	159.0	202.0	107.6	187.2	96.0
		Cymbella affinis	5,738.0	26,938.8	67,707.4	132.6	37.9	39.2	133.6	<26.4		19.8	42.3	99.6			<38.1																			
		Cymbella caespitosa	<38.5	<50.2	55.3									<33.2													?									
		Cymbella cf. cesatii	770.0	702.8	1,716.4	<44.2	<37.9		<33.4	<26.4		<19.8		<33.2				<33.7			<56.8	123.8		<46.8	27.3		1,092.6	<23.8	132.1		201.6	<26.5			<31.2	
		Cymbella cistula	1,789.2	1,168.8	663.6	<44.2	<37.9	<39.2	<33.4				<42.3	33.2				<33.7	<28.2		<56.8	123.8	24.1		<27.3	<40.3	2,549.4	23.8	528.4	588.4	201.6					
		Cymbella lanceolata / aspera																			<56.8					<40.3				<147.1						
		Cymbella mesiana																									1,821.0	95.2	1,056.8	588.4	403.8		<50.5			
		Cymbella cf. microcephala	2,683.8	3,506.4	6,436.5	<44.2	<37.9																		27.3	80.6										
		Cymbella minuta [2]	1,192.8	779.2	1,287.3					26.4	22.9		169.2	<33.2				<33.7		<40.1		247.6	48.2	468.0	218.4	322.4	59,756.4	6,385.2	21,501.9	21,663.8	9,382.8	79.5	50.5	26.9	<31.2	24.0
		Cymbella sinuata	77.0	301.2	221.2	1,149.2	454.8	3,766.8	3,207.6	1,268.4	1,647.0	277.2	4,397.9	1,859.2	1,635.0	1,449.0	3,661.2	1,885.8	1,578.5	3,528.8	13,983.2	742.8	337.4	655.2	2,400.2	241.8	11,293.6	1,844.0	8,191.2	9,121.6	6,255.2	424.0	4,699.2	2,923.2	1,208.0	929.5
		Cymbella spp.	12,623.6	10,493.7	19,816.8	44.2	37.9	78.4	100.2	<26.4	22.9	19.8	169.2	33.2				<33.7	<28.2	40.1		<61.9	96.4	280.8	163.8	161.2	2,823.2	47.6	264.2		403.8					
		Denticula sp.	77.0	200.8	221.2	<44.2		<39.2																						<147.1				<26.9	31.2	
		Diatoma anceps		<50.2				<39.2						<33.2				<33.7		<40.1					<27.3				<132.1		<100.8					
		Diatoma elongatum	4,473.0	2,337.6	4,720.1																															
		Diatoma hiemale				<44.2	<37.9	78.4	<33.4	26.4	<22.9				102.3	<36.2		<33.7	<28.2	120.3					<27.3		15,528.7	1,475.2	6,143.4	7,981.4	5,473.3	79.5	606.0	161.4	249.6	240.0
		Diatoma mesodom		<50.2	<55.3	176.8	113.7	<39.2	<33.4	26.4	<22.9	19.8	126.9		<34.1	<36.2	<38.1	101.1	56.4	80.2					54.6	40.3	16,940.4	553.2	11,262.9	5,701.0	4,691.4	53.0	505.0	215.2	124.8	144.0
		Diatomella sp.																	<28.2											<147.1						
		Didymosphenia geminata	<38.5	50.2	<55.3	<44.2							169.2	33.2										46.8	54.6	40.3	5,463.0	238.0	1,849.4	1,471.0	605.7		202.0	<26.9	31.2	
		Diploneis oblongella				88.4	<37.9	<39.2																												
		Diploneis spp.	<38.5	<50.2	<55.3			<39.2					<42.3				<38.1						<24.1			<40.3	182.1	<23.8	<132.1	<147.1	<100.8					
		Epithemia turgida													<34.1	<36.2	<38.1						<24.1				<182.1		<132.1	<147.1	<100.8					
		Epithemia sp.													<34.1	<36.2	<38.1					<61.9	<24.1						<132.1							
		Eunotia spp.	154.0	401.6	331.8	44.2	<37.9	<39.2				39.6	84.6	66.4				33.7	28.2	<40.1	113.6	1,361.8	674.8	280.8	382.2	161.2	1,456.8		264.2	588.4	201.6	<26.5	<50.5	<26.9	31.2	<24.0
		Fragilaria construens	385.0	2,337.6	3,432.8																		48.2	748.8			1,821.0	238.0	132.1		100.8					
		Fragilaria crotonensis	2,385.6	2,727.2	2,145.5																															
		Fragilaria leptostauron	<38.5	200.8	<55.3	44.2	<37.9																<24.1				1,456.8		<132.1	147.1						
		Fragilaria pinnata	<38.5	301.2	110.6																		24.1				364.2		132.1				<50.5		<31.2	<24.0
		Fragilaria vaucheriae	596.4	3,506.4	858.2	44.2	37.9		<33.4		22.9	217.8	507.6	199.2	<34.1	72.4		101.1	56.4	<40.1	340.8	247.6	289.2	4,492.8	109.2	483.6	15,528.7	2,028.4	4,095.6	6,841.2	6,255.2	106.0	783.2	26.9	374.4	
		Fragilaria spp.	894.6	2,337.6	2,574.6	44.2	<37.9					59.4	253.8					<33.7			227.2	123.8	144.6	2,620.8	273.0	564.2	1,411.7	553.2	792.6	588.4	2,345.7		202.0			
		Frustulia rhomboides	<38.5	<50.2	<55.3	<44.2				<26.4										<40.1		<61.9	<24.1	<46.8			<182.1	<23.8	<132.1	<147.1	<100.8		<50.5	<26.9	<31.2	<24.0
		Gomphonema acuminatum		<50.2	<55.3																	<61.9														
		Gomphonema angustatum/parvulum	308.0	1,558.4	1,716.4	1,060.8	2,731.5	1,489.6	5,613.3	5,496.4	7,137.0	59.4	4,397.9	132.8	409.2	362.0	152.4	337.0	394.8	1,443.6	3,633.6	990.4	433.8	140.4	491.4	161.2	5,646.8	1,106.4	7,167.3	2,280.4	403.8	371.0	7,048.8	4,802.4	1,691.2	1,301.3
		Gonphonema brebisonii												<33.2													<182.1									
		Gomphonema gracile	38.5											<33.2					<28.2			<61.9	<24.1								<100.8					
		Gomphonema subclavatum											42.3	<33.2							56.8	61.9	24.1													
		Gomphonema truncatum	<38.5	<50.2	<55.3																															
		Gomphonema spp.	4,174.8	17,989.2	23,119.6	1,768.0	1,517.5	6,278.0	2,673.0	3,171.0	7,320.0	277.2	29,943.7	5,843.2	477.4	868.8	457.2	674.0	2,480.5	6,095.2	157,311.0	302,831.4	54,945.0	655.2	4,582.2	1,209.0	7,058.5	1,659.6	5,119.5	5,701.0	3,127.6	265.0	1,566.4	2,505.6	312.0	371.8
		Hantzschia sp.																									<182.1									
		Luticola cf. geoppertiana																												<147.1						
		Meridion circulare				<44.2	<37.9			<26.4	<22.9	39.6			<34.1									<46.8	<27.3	<40.3	364.2	23.8	132.1		100.8		<50.5	<26.9	<31.2	
		Navicula radiosa	<38.5	<50.2	110.6	<44.2	<37.9							<33.2								<61.9	<24.1	<46.8	<27.3		<182.1	<23.8	<132.1	<147.1	<100.8				<31.2	
		Navicula spp.	894.6	779.2	1,287.3	132.6	75.8		<33.4		22.9	19.8	<42.3	<33.2	68.2	36.2	76.2	67.4	<28.2	160.4	56.8	371.4	48.2	187.2	163.8	161.2	8,470.2	142.8	3,071.7	3,420.6	2,345.7		50.5	80.7	62.4	<24.0
		Neidium sp.		<50.2	<55.3																		<24.1	<46.8			<182.1									
		Nitzschia angustata	308.0	301.2	221.2						<22.9		<42.3											<46.8	27.3	<40.3										
		Nitzschia spp.	1,491.0	2,337.6	1,716.4	<44.2	37.9	<39.2	66.8	52.8	<22.9	<19.8			102.3	144.8	<38.1	33.7	28.2	40.1		61.9	48.2	748.8	491.4	886.6	38,115.9	1,475.2	16,382.4	33,065.8	33,095.7	<26.5	<50.5	<26.9	93.6	<24.0
		Pinnularia spp.	<38.5	100.4	55.3				<33.4	<26.4							<38.1	<33.7	<28.2			<61.9	<24.1	<46.8	27.3	<40.3	364.2		132.1	<147.1	<100.8					
		Rhopalodia gibba	<38.5	<50.2											<34.1			<33.7									182.1		<132.1	<147.1	<100.8					
		Stauroneis spp.		<50.2	<55.3																						<182.1	<23.8	<132.1		<100.8					
		Surirella spp.		<50.2	<55.3		<37.9						<42.3						<28.2				<24.1	<46.8	<27.3		182.1		<132.1	<147.1	100.8					<24.0
		Synedra ulna	847.0	803.2	995.4	<44.2						59.4	6,089.4	166.0		<36.2	<38.1	<33.7	<28.2	<40.1	1,289.2	619.0	2,316.0	1,591.2	655.2	806.0	12,705.3	2,397.2	18,430.2	13,682.4	4,691.4	<26.5	<50.5	<26.9	<31.2	<24.0
		Synedra spp.	4,771.2	3,506.4	21,468.2	<44.2			<33.4		<22.9	<19.8	338.4								568.0	114.2	771.2	93.6	436.8	241.8	14,117.0	553.2	4,095.6	9,121.6	7,037.1	26.5	808.0		62.4	
		Tabellaria flocculosa	14,313.6	8,181.6	17,593.1		<37.9				<22.9	<19.8	<42.3	<33.2									<24.1	<46.8	<27.3	<40.3	<182.1		<132.1		<100.8					
		Tetracyclus sp.										<19.8	<42.3	<33.2																						
		UID girdle view		<50.2				<39.2														<61.9	<24.1		273.0							<26.5				
		Deformed diatoms		200.8	110.6						<22.9																									
Chlorophyta	Chaetophorales	*Chaetosphaeridinium sp.*	231.0	401.6																																
		Stigeoclonium sp.?	1,694.0	502.0	1,548.4	2,006.4	<37.9	<39.2	<33.4												2,385.6	742.8		374.4				<23.8	<132.1	<147.1					343.2	<24.0
		UID basal cells						<39.2		<26.4			126.9	7,436.8		217.2		168.5			1,704.0	495.2	626.6		218.4	725.4					<100.8			188.3	187.2	72.0
		UID Chaetophorales										<19.8																								
	Chlorococcales	*Ankistrodesmus falcatus*		<50.2																									<132.1							
		Ankistrodesmus spiralis		<50.2	<55.3																															
		Ankistrodesmus spp.	154.0	<50.2	331.8																		21.4													
		Oocystis sp.	77.0	<50.2	110.6			<39.2																												
		Pediastrum boryanum		<50.2																																
		Pediastrum sp.		<50.2	<55.3																															
		Scenedesmus spp.	308.0	1,004.0	1,769.6																								<132.1							
		Tetradesmus sp.		<50.2																																
	Oedogoniales	*Bulbochaete spp.*	385.0	803.2	2,322.6																	<61.9	<21.4													
		Oedogonium spp.	<38.5	150.6	<55.3							<19.8		<33.2								309.5	72.3		<27.3			<23.8			<100.8				<31.2	
	Ulothricales	*Microspora sp.*		<50.2																							<182.1		396.3	<147.1	<100.8					
		Ulothrix zonata	<38.5	<50.2								<19.8																								
	Zygnematales	*Actinotaenium sp.*										<19.8																								
		Closterium spp.	38.5	50.2	55.3				<33.4			<19.8	<42.3	<33.2			<38.1	<33.7			<56.8	<61.9	<21.4	<46.8	<27.3		<182.1	23.8	132.1	<147.1	<100.8	<26.5		<26.9	31.2	<24.0
		Cosmarium spp.	231.0	401.6	663.6			<39.2	<33.4			<19.8	<42.3	<33.2								<61.9	<24.1	<46.8	<27.3		182.1				<100.8				<31.2	
		Mougeotia spp.	5,069.4	4,675.2	1,716.4							<19.8					<38.1				<56.8						<182.1		<132.1		<100.8					
		Penium sp.		<50.2																																
		Spirogyra sp.										<19.8	6,206.2	298.8													<182.1	<23.8	<132.1		504.0					
		Staurastrum spp.	<38.5	50.2	55.3																						<182.1	<23.8	<132.1	<147.1	<100.8					
		Teilingia granulata			442.4																															
Chlorophyta		UID Chlorophyta colonial	<38.5	7,792.0	4,291.0																					<40.3		<23.8			<100.8					
		UID Chlorophyta filamentous										<19.8		<33.2						<40.1								<23.8								
		UID Chlorophyta unicellular	894.6	3,116.8	1,287.3					<26.4		<19.8								<40.1				93.6	<27.3		364.2		264.2		<100.8					
Chrysophyta	Chromulinales	*Hydrurus foetidus ?*				<44.2	<37.9	<39.2	<33.4	105.6	137.4		<42.3					33.7										<23.8	<132.1							
		UID Chromulinales flagellate											338.3										386.0			161.2		737.6	1,023.9			159.0	783.2			24.0
	Mischococcales	*Characiopsis sp.*			<55.3																															
		Isthmochloron trispinatum			<55.3																															
		Ophiocytium sp.		<50.2																																
	Ochromonadales	*Pseudokephyrion sp.*			<55.3																															
Chrysophyta		UID Chrysophyta colonial	616.0	803.2	884.8	9,900.8	95,767.8	103,879.4	26,743.6	34,976.2	26,210.8	79.2	84.6	2,656.0	3,270.0	3,477.6	76.2	40,431.3	48,602.4	28,391.2	2,725.2	4,949.0	579.0	1,123.2	1,745.6	8,065.0	2,823.4	20,575.5	145,780.0	131,631.0	20,329.4	5,924.8	232,047.2	53,841.2	45,565.1	120,919.5
		UID Chrysophyta cyst	298.2	779.2	1,287.3	44.2	227.4	13,286.9		54.5		19.8	<42.3			<36.2	76.2		56.4	<40.1	227.2	123.8	48.2	374.4		80.6	4,235.1	184.4	3,071.7	4,560.4	781.9	53.0				
		UID Chrysophyta flagellate																																		
		UID Chrysophyta unicellular	2,683.8	1,168.8	2,145.5	88.4						<19.8		66.4	34.1					40.1		61.9		468.0	436.4	2,258.2	5,646.8		3,071.7		201.6			208.8		
Cryptophyta	Cryptomonadales	*Cryptomonas sp.*		<50.2																						<40.3		<23.8	<132.1							
		UID Cryptomonadales		<50.2										<33.2				<33.7						46.8		<40.3										
Cyanophyta	Chamaesiphonales	*Chamaesiphon spp.*	96,398.4	65,960.4	19,816.8	254,469.6	995,050.8	661,929.2	3,024,084.0	1,493,402.4	460,460.0	188,095.6	494,722.0	492,700.4	375,434.6	1,173,295.6	936,852.0	47,688.2	381,876.0	864,080.0	284,907.7	1,237,990.0	682,482.3	276,633.6	226,665.0	566,531.0	12,705.3	208,593.0	149,720.0	105,304.8	776,244.6	25,243.3	739,332.0	331,083.2	961,516.6	1,501,743.6
		Clastidium spp.	18,361.6	1,168.8		62,596.8	5,839.5	14,494.8	48,344.2	48,804.0	23,377.2	19,542.4	106,755.8	77,887.2				5,183.5	31,244.4	24,688.0	38,453.8	87,611.6	15,592.5	12,967.2	436.4	7,449.6	364.2	1,290.8	4,095.6	2,280.4	2,345.7		45,204.0	11,250.4	72,532.2	30,786.5
	Chroococcales	*Aphanocapsa spp.*	1,232.0	15,584.0	<55.3																															
		Aphanothece sp.		<50.2	<55.3																															
		Chroococcus spp.	<38.5	803.2	1,990.8																															
		Merismopedia spp.	<38.5	<50.2	1,769.6																						1,456.8	95.2	<132.1	<147.1	<100.8					
		UID Chroococcales	<38.5		<55.3		<37.9					39.6											<21.4													
	Nostocales	*Anabaena sp.*	192.5	<50.2																																
		Calothrix sp.	1,694.0	4,417.6	2,322.6																															
		Calothrix / Rivularia spp.	2,233.0	4,518.0	18,880.4				<33.4				338.4		<34.1	<36.2					<56.8	247.6	1,397.8	468.0		<40.3		<23.8			<100.8					
		Nostoc sp.										495.0	<42.3																							
		Stigonema sp.		<50.2																																
		Tolypothrix sp.										<19.8	<42.3	232.4		<36.2	<38.1	<33.7	<28.2											<147.1	<100.8					
		UID Nostocales												<33.2							<56.8															
	Oscillatoriales	*Homoeothrix varians*	20,874.0	202,378.5	21,455.0	277,603.2	1,060,453.2	572,544.6	1,880,280.8	937,036.8	249,356.8	41,527.6	1,406,052.0	168,663.0	434,161.8	1,206,754.6	380,376.0	42,504.7	560,663.4	918,393.6	562,823.8	1,127,523.2	559,940.0	129,672.0	81,431.5	285,568.0		43,989.0	279,440.0	27364,8	15,638.0	2,120.0	675,046.4	310,189.6	541,201.8	3,120,082.2
		Lyngbya spp.	2,002.0	4,016.0	4,424.0	<44.2	<37.9		<33.4	316.8		<19.8	<42.3					<33.7	<28.2	240.6		<61.9	<21.4	561.6	<27.3		<182.1									<24.0
		Oscillatoria spp.	23,259.6	12,467.2	22,742.3	4,154.8		<39.2	1,791.4	6,976.0	1,982.4	178.2	6,547.5	863.2	613.8	1,448.0		606.6	<28.2	1,483.7		1,980.8	<21.4	32,947.2	3,549.0	5,319.6	2,913.6	428.4	924.7					807.0	624.0	528.0
		Phormidium sp.																								<40.3				<147.1			<50.5			
		Pseudoanabaena spp.	847.0	401.6	2,543.8	<44.2						79.2	169.2						<28.2			433.3		608.4		120.9	200,461.4		35,836.5	12,542.2	72,716.7			295.9	374.4	144.0
		Spirulina sp.																								<40.3										
		UID Oscillatoriales <2µ	11,629.8	86,947.8	16,305.8							<19.8		<33.2										<46.8	<27.3	<40.3	91,760.5	714.0			3,230.4	<26.5				
		UID Oscillatoriales				442.0			<33.4	654.0		396.0	211.5		272.8	<36.2		303.3		280.7	340.8			1,310.4	<27.3	2,982.2	<182.1	666.4				<26.5	959.5			
Euglenophyta	Euglenales	*Trachelomonas sp.*			<55.3		<37.9																					<23.8								
Pyrrhophyta	Dinokontae	UID Dinoflagellate		<50.2																																
Rhodophyta	Nemalionales	*Audouinella spp.* [3]	<38.5	<50.2	<55.3	12,022.4	909.6	4,939.2	482.3	272.5			2,495.7	232.4	2,725.0	5,216.4	1,447.8	404.4	564.0	3,368.4	4,203.2	2,228.4	915.8	2,527.2	2,184.0	80.6	<182.1	<23.8	<132.1	<147.1	<100.8		1,174.8	134.5	312.0	240.0
		Batrachospermum sp.																<33.7			<56.8	<61.9														<24.0
Unidentified		UID colonial		<50.2	<55.3						<22.9																									
		UID filamentous																<33.7																		
		UID flagellate		779.2																		<61.9								2280.4			<50.5			
		UID unicellular	596.4	3,506.4	3,432.8	88.4	75.8			<26.4		79.2		531.2		72.4	<38.1	67.4	56.4	80.2		123.8	96.4		218.2		1,411.7		1,023.9	1,140.2	781.9	106.0				48.0
UID = unidentified				25.1	27.7	22.1																														

cf. = (confertim = close together) = possibly for species

? = possibly for genus

1 = *Achnanthes minutissima var. gracillima* = *Achnanthidium gracillimum*

2= *Cymbella minuta* includes *Cymbella minuta var. silesiaca* which is now called *Encyonema silesiaca*

3 = Morphologically the Chantransia stage (juvenile) of *Batrachospermum* is identical to *Audouinella.*
Since *Batrachospermum* is present in this data set, the *Audouinella* observed could actually be juvenile *Batrachospermum*

Synonyms:(Newer name underlined)

Melosira sp.= *Aulacoseira sp*. (for this data)

Achnanthes flexella = *Eucocconeis flexella*

Achnanthes laevis = *Eucocconeis laevis*

Achanthes lanceolata = *Planothidium lanceolatum*

Achnanthes minutissima = *Achnanthidium minutissimum*

Achnanthes minutissima var. gracillima = *Achnanthidium gracillimum*

Cavinula pseudoscutiformis = *Navicula pseudoscutiformis*

Cymbella caepitosa = *Encyonema caespitosum*

Cymbella cesatii = *Encyonopsis cesatii*

Cymbella mesiana = *Encyonema mesianum*

Cymbella microcephala = *Encyonopsis microcephala*

Cymbella minuta = *Encyonema minutum*

Cymbella sinuata = *Reimeria sinuata*

Diatoma mesodon = *Diatoma hiemale var. mesodon*

Diatoma elongatum = *Diatoma tenue var. elongatum* = *Diatoma tenuis*

Didymosphenia geminata = *Gomphonema geminata*

Gomphonema truncatum = *Gomphonema constrictum*

Luticola cf. geoppertiana = *Navicula cf. geoppertiana*

Nitzschia angustata = *Tryblionella angustata*

22/08/2014 10:54

APPENDIX F
HARPER CREEK MINING INC.
HARPER CREEK PROJECT
2013 PERIPHYTON TAXA

Phylum	Order	Genus and Species	130470	130471	130472	130473	130474	130475	130476	130477	130478	130479	130480	130481	130482	130483	130484	130485	130486	130487	130488	130489	130490	130491	130492	130493	130494	130495	130496	130497	130498	130499	130500	130501	130502	130503
FES Sample Number			130470	130471	130472	130473	130474	130475	130476	130477	130478	130479	130480	130481	130482	130483	130484	130485	130486	130487	130488	130489	130490	130491	130492	130493	130494	130495	130496	130497	130498	130499	130500	130501	130502	130503
Sampling Station			BR-10 A	BR-10 B	BR-10 C	HC-40 A	HC-40 B	HC-40 C	OP-10 A	OP-10 B	OP-10 C	TMF-10 A	TMF-10 B	TMF-10 C	BC-10 A	BC-10 B	BC-10 C	BR-20 A	BR-20 B	BR-20 C	TMF-20 A	TMF-20 B	TMF-20 C	HC-10 A	HC-10 B	HC-10 C	HC-20 A	HC-20 B	HC-20 C	HC-20 D	HC-20 E	HC-30 A	HC-30 B	HC-30 C	HC-30 D	HC-30 E
Sampling Date			23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12	23-Sep-12
Area Sampled (cm^2)			24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55	24.55
Units = cells/cm^2																																				
Phylum	Order	Genus and Species																																		
Bacillariophycae	Centrales	*Cyclotella spp.*	38.5	50.2	55.3									<33.2					<28.2																	
		Melosira spp.	154.0	502.0	331.8		<37.9	<39.2			<22.9	39.6		<33.2							56.8	61.9	144.6		81.9		<182.1		<132.1	<147.1	100.8	<26.5	<50.5		<31.2	
		Orthoseira roeseana																									<182.1		<132.1							
	Pennales	*Achnanthes flexella*	770.0	1,558.4	2,574.6	<44.2	<37.9	<39.2	<33.4													<61.9		46.8	109.2	40.3	2549.4	95.2	792.6	882.6	201.6					<24.0
		Achnanthes laevis	2,385.6	779.2	858.2	44.2			<33.4	26.4								67.4	56.4	641.6				187.2	163.8	241.8	18,352.1	368,8	5,119.5	5,701.0	12,510.4	53.0		215.2	62.4	24.0
		Achnanthes lanceolata	77.0		110.6		<37.9			<26.4	<22.9				68.2	72.4	152.4		<28.2	<40.1				46.8			364.2	95.2	<132.1	294.2	605.7	<26.5	50.5	<26.9		
		Achnanthes minutissima	136,564.0	170,897.4	156,883.0	112,946.4	72,409.8	645,018.6	117,260.4	99,234.8	77,924.0	6,717.7	166,643.2	78,709.4	92,285.6	88,108.7	15,262.0	33,174.4	65,092.5	193,800.8	134,588.3	339,018.8	56,430.0	72,040.0	87,308.0	157,683.2	461,754.0	47,536.5	598,880.0	548,462.5	117,339.3	848.0	135,612.0	69,109.6	74,392.0	24,327.0
		Achnanthes minutissima var. gracillima [1]																						374.4	654.6	322.6	3,455,006.4	13,480.5	843,160.0	930,190.4	252,730.8	265.0	1,506.8	417.6	187.2	<24.0
		Achnanthes spp.	22,952.0	23,985.6	28,073.8	14,968.8	4,671.6	9,663.2	7,200.2	4,067.0	9,209.2	634.8	18,226.6	4,088.8	11,535.7	8,922.4	2,348.0	4,146.8	6,075.3	22,219.2	5,243.7	17,141.4	4,455.0	14,408.0	12,592.5	9,932.8	81,486.0	5,676.0	31,520.0	39,489.3	15,043.5	159.0	16,574.8	5,625.2	9,299.0	2,862.0
		Amphipleura pellucida	77.0	100.4	110.6																	<61.9					<182.1	<23.8		<147.1						
		Amphora spp.	<38.5	<50.2		88.4	<37.9	39.2		<26.4					<34.1	144.8	38.1	67.4		80.2							364.2	23.8	264.2	294.2	201.6		<50.5	<26.9		
		Anomoeoneis spp.	4,174.8	8,960.8	19,816.8	132.6	<37.9		33.4	<26.4	22.9	19.8		33.2										187.2	27.3	80.6					<100.8	<26.5				
		Caloneis spp.	154.0	100.4	110.6	<44.2									<34.1	<36.2		<33.7	<28.2	<40.1	<56.8	<61.9	96.4	46.8	109.2		182.1		<132.1		<100.8		<50.5			
		Cavinula pseudoscutiformis		<50.2																																
		Ceratoneis arcus	77.0	200.8	331.8	88.4	<37.9		<33.4	26.4	<22.9	59.4	5,074.5	232.4				<33.7	<28.2	40.1	56.8	61.9	48.2	936.0	218.4	161.2	1,456.8	1,290.8	1,585.2	1,471.0	1,211.4	<26.5	707.0	80.7	62.4	<24.0
		Cocconeis placentula	77.0	<50.2		2,475.2	606.4	313.9	33.4	26.4	114.5	<19.8	507.6	265.6	4,360.0	2,318.4	5,186.7	269.6	338.4	561.4	<56.8		24.1	<46.8	54.6	<40.3	2,185.2	142.8	1,056.8	1,176.8	807.6	159.0	202.0	107.6	187.2	96.0
		Cymbella affinis	5,738.0	26,938.8	67,707.4	132.6	37.9	39.2	133.6	<26.4		19.8	42.3	99.6			<38.1																			
		Cymbella caespitosa	<38.5	<50.2	55.3									<33.2													?									
		Cymbella cf. cesatii	770.0	702.8	1,716.4	<44.2	<37.9		<33.4	<26.4		<19.8		<33.2				<33.7			<56.8	123.8		<46.8	27.3		1,092.6	<23.8	132.1		201.6	<26.5			<31.2	
		Cymbella cistula	1,789.2	1,168.8	663.6	<44.2	<37.9	<39.2	<33.4				<42.3	33.2				<33.7	<28.2		<56.8	123.8	24.1		<27.3	<40.3	2,549.4	23.8	528.4	588.4	201.6					
		Cymbella lanceolata / aspera																			<56.8					<40.3				<147.1						
		Cymbella mesiana																									1,821.0	95.2	1,056.8	588.4	403.8		<50.5			
		Cymbella cf. microcephala	2,683.8	3,506.4	6,436.5	<44.2	<37.9																		27.3	80.6										
		Cymbella minuta [2]	1,192.8	779.2	1,287.3					26.4	22.9		169.2	<33.2				<33.7		<40.1		247.6	48.2	468.0	218.4	322.4	59,756.4	6,385.2	21,501.9	21,663.8	9,382.8	79.5	50.5	26.9	<31.2	24.0
		Cymbella sinuata	77.0	301.2	221.2	1,149.2	454.8	3,766.8	3,207.6	1,268.4	1,647.0	277.2	4,397.9	1,859.2	1,635.0	1,449.0	3,661.2	1,885.8	1,578.5	3,528.8	13,983.2	742.8	337.4	655.2	2,400.2	241.8	11,293.6	1,844.0	8,191.2	9,121.6	6,255.2	424.0	4,699.2	2,923.2	1,208.0	929.5
		Cymbella spp.	12,623.6	10,493.7	19,816.8	44.2	37.9	78.4	100.2	<26.4	22.9	19.8	169.2	33.2				<33.7	<28.2	40.1		<61.9	96.4	280.8	163.8	161.2	2,823.2	47.6	264.2		403.8					
		Denticula sp.	77.0	200.8	221.2	<44.2		<39.2																						<147.1				<26.9	31.2	
		Diatoma anceps		<50.2				<39.2						<33.2				<33.7		<40.1					<27.3				<132.1		<100.8					
		Diatoma elongatum	4,473.0	2,337.6	4,720.1																															
		Diatoma hiemale				<44.2	<37.9	78.4	<33.4	26.4	<22.9				102.3	<36.2		<33.7	<28.2	120.3					<27.3		15,528.7	1,475.2	6,143.4	7,981.4	5,473.3	79.5	606.0	161.4	249.6	240.0
		Diatoma mesodom		<50.2	<55.3	176.8	113.7	<39.2	<33.4	26.4	<22.9	19.8	126.9		<34.1	<36.2	<38.1	101.1	56.4	80.2					54.6	40.3	16,940.4	553.2	11,262.9	5,701.0	4,691.4	53.0	505.0	215.2	124.8	144.0
		Diatomella sp.																	<28.2											<147.1						
		Didymosphenia geminata	<38.5	50.2	<55.3	<44.2							169.2	33.2										46.8	54.6	40.3	5,463.0	238.0	1,849.4	1,471.0	605.7		202.0	<26.9	31.2	
		Diploneis oblongella				88.4	<37.9	<39.2																												
		Diploneis spp.	<38.5	<50.2	<55.3			<39.2					<42.3				<38.1						<24.1			<40.3	182.1	<23.8	<132.1	<147.1	<100.8					
		Epithemia turgida													<34.1	<36.2	<38.1						<24.1				<182.1		<132.1	<147.1	<100.8					
		Epithemia sp.													<34.1	<36.2	<38.1					<61.9	<24.1						<132.1							
		Eunotia spp.	154.0	401.6	331.8	44.2	<37.9	<39.2				39.6	84.6	66.4				33.7	28.2	<40.1	113.6	1,361.8	674.8	280.8	382.2	161.2	1,456.8		264.2	588.4	201.6	<26.5	<50.5	<26.9	31.2	<24.0
		Fragilaria construens	385.0	2,337.6	3,432.8																		48.2	748.8			1,821.0	238.0	132.1		100.8					
		Fragilaria crotonensis	2,385.6	2,727.2	2,145.5																															
		Fragilaria leptostauron	<38.5	200.8	<55.3	44.2	<37.9																<24.1				1,456.8		<132.1	147.1						
		Fragilaria pinnata	<38.5	301.2	110.6																		24.1				364.2		132.1				<50.5		<31.2	<24.0
		Fragilaria vaucheriae	596.4	3,506.4	858.2	44.2	37.9		<33.4		22.9	217.8	507.6	199.2	<34.1	72.4		101.1	56.4	<40.1	340.8	247.6	289.2	4,492.8	109.2	483.6	15,528.7	2,028.4	4,095.6	6,841.2	6,255.2	106.0	783.2	26.9	374.4	
		Fragilaria spp.	894.6	2,337.6	2,574.6	44.2	<37.9					59.4	253.8					<33.7			227.2	123.8	144.6	2,620.8	273.0	564.2	1,411.7	553.2	792.6	588.4	2,345.7		202.0			
		Frustulia rhomboides	<38.5	<50.2	<55.3	<44.2				<26.4										<40.1		<61.9	<24.1	<46.8			<182.1	<23.8	<132.1	<147.1	<100.8		<50.5	<26.9	<31.2	<24.0
		Gomphonema acuminatum		<50.2	<55.3																	<61.9														
		Gomphonema angustatum/parvulum	308.0	1,558.4	1,716.4	1,060.8	2,731.5	1,489.6	5,613.3	5,496.4	7,137.0	59.4	4,397.9	132.8	409.2	362.0	152.4	337.0	394.8	1,443.6	3,633.6	990.4	433.8	140.4	491.4	161.2	5,646.8	1,106.4	7,167.3	2,280.4	403.8	371.0	7,048.8	4,802.4	1,691.2	1,301.3
		Gonphonema brebisonii												<33.2													<182.1									
		Gomphonema gracile	38.5											<33.2					<28.2			<61.9	<24.1								<100.8					
		Gomphonema subclavatum											42.3	<33.2							56.8	61.9	24.1													
		Gomphonema truncatum	<38.5	<50.2	<55.3																															
		Gomphonema spp.	4,174.8	17,989.2	23,119.6	1,768.0	1,517.5	6,278.0	2,673.0	3,171.0	7,320.0	277.2	29,943.7	5,843.2	477.4	868.8	457.2	674.0	2,480.5	6,095.2	157,311.0	302,831.4	54,945.0	655.2	4,582.2	1,209.0	7,058.5	1,659.6	5,119.5	5,701.0	3,127.6	265.0	1,566.4	2,505.6	312.0	371.8
		Hantzschia sp.																									<182.1									
		Luticola cf. geoppertiana																												<147.1						
		Meridion circulare				<44.2	<37.9			<26.4	<22.9	39.6			<34.1									<46.8	<27.3	<40.3	364.2	23.8	132.1		100.8		<50.5	<26.9	<31.2	
		Navicula radiosa	<38.5	<50.2	110.6	<44.2	<37.9							<33.2								<61.9	<24.1	<46.8	<27.3		<182.1	<23.8	<132.1	<147.1	<100.8				<31.2	
		Navicula spp.	894.6	779.2	1,287.3	132.6	75.8		<33.4		22.9	19.8	<42.3	<33.2	68.2	36.2	76.2	67.4	<28.2	160.4	56.8	371.4	48.2	187.2	163.8	161.2	8,470.2	142.8	3,071.7	3,420.6	2,345.7		50.5	80.7	62.4	<24.0
		Neidium sp.		<50.2	<55.3																		<24.1	<46.8			<182.1									
		Nitzschia angustata	308.0	301.2	221.2						<22.9		<42.3											<46.8	27.3	<40.3										
		Nitzschia spp.	1,491.0	2,337.6	1,716.4	<44.2	37.9	<39.2	66.8	52.8	<22.9	<19.8			102.3	144.8	<38.1	33.7	28.2	40.1		61.9	48.2	748.8	491.4	886.6	38,115.9	1,475.2	16,382.4	33,065.8	33,095.7	<26.5	<50.5	<26.9	93.6	<24.0
		Pinnularia spp.	<38.5	100.4	55.3				<33.4	<26.4							<38.1	<33.7	<28.2			<61.9	<24.1	<46.8	27.3	<40.3	364.2		132.1	<147.1	<100.8					
		Rhopalodia gibba	<38.5	<50.2											<34.1			<33.7									182.1		<132.1	<147.1	<100.8					
		Stauroneis spp.		<50.2	<55.3																						<182.1	<23.8	<132.1		<100.8					
		Surirella spp.		<50.2	<55.3		<37.9						<42.3						<28.2				<24.1	<46.8	<27.3		182.1		<132.1	<147.1	100.8					<24.0
		Synedra ulna	847.0	803.2	995.4	<44.2						59.4	6,089.4	166.0		<36.2	<38.1	<33.7	<28.2	<40.1	1,289.2	619.0	2,316.0	1,591.2	655.2	806.0	12,705.3	2,397.2	18,430.2	13,682.4	4,691.4	<26.5	<50.5	<26.9	<31.2	<24.0
		Synedra spp.	4,771.2	3,506.4	21,468.2	<44.2			<33.4		<22.9	<19.8	338.4								568.0	114.2	771.2	93.6	436.8	241.8	14,117.0	553.2	4,095.6	9,121.6	7,037.1	26.5	808.0		62.4	
		Tabellaria flocculosa	14,313.6	8,181.6	17,593.1		<37.9				<22.9	<19.8	<42.3	<33.2									<24.1	<46.8	<27.3	<40.3	<182.1		<132.1		<100.8					
		Tetracyclus sp.										<19.8	<42.3	<33.2																						
		UID girdle view		<50.2				<39.2														<61.9	<24.1		273.0							<26.5				
		Deformed diatoms		200.8	110.6						<22.9																									
Chlorophyta	Chaetophorales	*Chaetoshaeridinium sp.*	231.0	401.6																																
		Stigeoclonium sp.?	1,694.0	502.0	1,548.4	2,006.4	<37.9	<39.2	<33.4												2,385.6	742.8		374.4				<23.8	<132.1	<147.1					343.2	<24.0
		UID basal cells						<39.2		<26.4			126.9	7,436.8		217.2		168.5			1,704.0	495.2	626.6		218.4	725.4					<100.8			188.3	187.2	72.0
		UID Chaetophorales										<19.8																								
	Chlorococcales	*Ankistrodesmus falcatus*		<50.2																									<132.1							
		Ankistrodesmus spiralis		<50.2	<55.3																															
		Ankistrodesmus spp.	154.0	<50.2	331.8																		21.4													
		Oocystis sp.	77.0	<50.2	110.6			<39.2																												
		Pediastrum boryanum		<50.2																																
		Pediastrum sp.		<50.2	<55.3																															
		Scenedesmus spp.	308.0	1,004.0	1,769.6																								<132.1							
		Tetradesmus sp.		<50.2																																
	Oedogoniales	*Bulbochaete spp.*	385.0	803.2	2,322.6																	<61.9	<21.4													
		Oedogonium spp.	<38.5	150.6	<55.3							<19.8		<33.2								309.5	72.3		<27.3			<23.8			<100.8				<31.2	
	Ulothricales	*Microspora sp.*		<50.2																							<182.1		396.3	<147.1	<100.8					
		Ulothrix zonata	<38.5	<50.2								<19.8																								
	Zygnematales	*Actinotaenium sp.*										<19.8																								
		Closterium spp.	38.5	50.2	55.3				<33.4			<19.8	<42.3				<38.1	<33.7			<56.8	<61.9	<21.4	<46.8	<27.3		<182.1	23.8	132.1	<147.1	<100.8	<26.5		<26.9	31.2	<24.0
		Cosmarium spp.	231.0	401.6	663.6			<39.2	<33.4			<19.8	<42.3	<33.2								<61.9			<27.3		182.1				<100.8				<31.2	
		Mougeotia spp.	5,069.4	4,675.2	1,716.4							<19.8					<38.1				<56.8						<182.1		<132.1		<100.8					
		Penium sp.		<50.2																																
		Spirogyra sp.										<19.8	8,206.2	298.8													<182.1	<23.8	<132.1		504.0					
		Staurastrum spp.	<38.5	50.2	55.3																						<182.1		<132.1	<147.1	<100.8					
		Teilingia granulata			442.4																															
Chlorophyta		UID Chlorophyta colonial	<38.5	7,792.0	4,291.0																					<40.3		<23.8			<100.8					
		UID Chlorophyta filamentous										<19.8		<33.2						<40.1								<23.8								
		UID Chlorophyta unicellular	894.6	3,116.8	1,287.3					<26.4		<19.8								<40.1				93.6	<27.3		364.2		264.2		<100.8					
Chrysophyta	Chromulinales	*Hydrurus foetidus ?*				<44.2	<37.9	<39.2	<33.4	105.6	137.4		<42.3					33.7										<23.8	<132.1							
		UID Chromulinales flagellate											338.3										386.0			161.2		737.6	1,023.9			159.0	783.2			24.0
	Mischococcales	*Characiopsis spp.*			<55.3																															
		Isthmochloron trispinatum			<55.3																															
		Ophiocytium sp.		<50.2																																
	Ochromonadales	*Pseudokephyrion sp.*			<55.3																															
Chrysophyta		UID Chrysophyta colonial	616.0	803.2	884.8	9,900.8	95,767.8	103,879.4	26,743.6	34,976.2	26,210.8	79.2	84.6	2,656.0	3,270.0	3,477.6	76.2	40,431.3	48,602.4	28,391.2	2,725.2	4,949.0	579.0	1,123.2	1,745.6	8,065.0	2,823.4	20,575.5	145,780.0	131,631.0	20,329.4	5,924.8	232,047.2	53,841.2	45,565.1	120,919.5
		UID Chrysophyta cyst	298.2	779.2	1,287.3	44.2	227.4	13,286.9		54.5		19.8	<42.3			<36.2	76.2		56.4	<40.1	227.2	123.8	48.2	374.4		80.6	4,235.1	184.4	3,071.7	4,560.4	781.9	53.0				
		UID Chrysophyta flagellate																																		
		UID Chrysophyta unicellular	2,683.8	1,168.8	2,145.5	88.4						<19.8		66.4	34.1					40.1		61.9		468.0	436.4	2,258.2	5,646.8		3,071.7		201.6			208.8		
Cryptophyta	Cryptomonadales	*Cryptomonas sp.*		<50.2																						<40.3		<23.8	<132.1							
		UID Cryptomonadales		<50.2										<33.2				<33.7						46.8		<40.3					<100.8					
Cyanophyta	Chamaesiphonales	*Chamaesiphon spp.*	96,398.4	65,960.4	19,816.8	254,469.6	995,050.8	661,929.2	3,024,084.0	1,493,402.4	460,460.0	188,095.6	494,722.0	492,700.4	375,434.6	1,173,295.6	936,852.0	47,688.2	381,876.0	864,080.0	284,907.7	1,237,990.0	682,482.3	276,633.6	226,665.0	566,531.0	12,705.3	208,593.0	149,720.0	105,304.8	776,244.6	25,243.3	738,332.0	331,083.2	961,516.6	1,501,743.6
		Clastidium spp.	18,361.6	1,168.8		62,596.8	5,839.5	14,494.8	48,344.2	48,804.0	23,377.2	19,542.4	106,755.8	77,687.2				5,183.5	31,244.4	24,688.0	38,453.8	87,611.6	15,592.5	12,967.2	436.4	7,449.6	364.2	1,290.8	4,095.6	2,280.4	2,345.7		45,204.0	11,250.4	72,532.2	30,766.5
	Chroococcales	*Aphanocapsa spp.*	1,232.0	15,584.0	<55.3																															
		Aphanothece sp.		<50.2	<55.3																															
		Chroococcus spp.	<38.5	803.2	1,990.8																															
		Merismopedia spp.	<38.5	<50.2	1,769.6																						1,456.8	95.2	<132.1	<147.1	<100.8					
		UID Chroococcales	<38.5		<55.3		<37.9					39.6											<21.4													
	Nostocales	*Anabaena sp.*	192.5	<50.2																																
		Calothrix sp.	1,694.0	4,417.6	2,322.6																															
		Calothrix / Rivularia spp.	2,233.0	4,518.0	18,880.4				<33.4				338.4		<34.1	<36.2					<56.8	247.6	1,397.8	468.0		<40.3		<23.8			<100.8					
		Nostoc sp.										495.0	<42.3																							
		Stigonema sp.		<50.2																																
		Tolypothrix sp.										<19.8	<42.3	232.4		<36.2	<38.1	<33.7	<28.2											<147.1	<100.8					
		UID Nostocales												<33.2							<56.8															
	Oscillatoriales	*Homoeothrix varians*	20,874.0	202,378.5	21,455.0	277,603.2	1,060,453.2	572,544.6	1,880,280.8	937,036.8	249,356.8	41,527.6	1,406,052.0	168,663.0	434,161.8	1,206,754.6	380,376.0	42,504.7	560,663.4	918,393.6	562,823.8	1,127,523.2	559,940.0	129,672.0	81,431.5	285,568.0		43,989.0	279,440.0	27364,8	15,638.0	2,120.0	675,046.4	310,189.6	541,201.8	3,120,082.2
		Lyngbya spp.	2,002.0	4,016.0	4,424.0	<44.2	<37.9		<33.4	316.8		<19.8	<42.3					<33.7	<28.2	240.6		<61.9	<21.4	561.6	<27.3		<182.1									<24.0
		Oscillatoria spp.	23,259.6	12,467.2	22,742.3	4,154.8		<39.2	1,791.4	6,976.0	1,982.4	178.2	6,547.5	863.2	613.8	1,448.0		606.6	<28.2	1,483.7		1,980.8	<21.4	32,947.2	3,549.0	5,319.6	2,913.6	428.4	924.7					807.0	624.0	528.0
		Phormidium sp.																								<40.3				<147.1			<50.5			
		Pseudoanabaena spp.	847.0	401.6	2,543.8	<44.2						79.2	169.2						<28.2			433.3		608.4		120.9	200,461.4		35,836.5	12,542.2	72,716.7			295.9	374.4	144.0
		Spirulina sp.																								<40.3										
		UID Oscillatoriales <2µ	11,629.8	86,947.8	16,305.8							<19.8		<33.2										<46.8	<27.3	<40.3	91,760.5	714.0			3,230.4	<26.5				
		UID Oscillatoriales				442.0			<33.4	654.0		396.0	211.5		272.8	<36.2		303.3		280.7	340.8			1,310.4	<27.3	2,982.2	<182.1	666.4				<26.5	959.5			
Euglenophyta	Euglenales	*Trachelomonas sp.*			<55.3		<37.9																					<23.8								
Pyrrhophyta	Dinokontae	UID Dinoflagellate		<50.2																																
Rhodophyta	Nemalionales	*Audouinella spp.* [3]	<38.5	<50.2	<55.3	12,022.4	909.6	4,939.2	482.3	272.5			2,495.7	232.4	2,725.0	5,216.4	1,447.8	404.4	564.0	3,368.4	4,203.2	2,228.4	915.8	2,527.2	2,184.0	80.6	<182.1	<23.8	<132.1	<147.1	<100.8		1,174.8	134.5	312.0	240.0
		Batrachospermum sp.																<33.7			<56.8	<61.9														<24.0
Unidentified		UID colonial		<50.2	<55.3						<22.9																									
		UID filamentous																<33.7																		
		UID flagellate		779.2																		<61.9								2280.4			<50.5			
		UID unicellular	596.4	3,506.4	3,432.8	88.4	75.8			<26.4		79.2		531.2		72.4	<38.1	67.4	56.4	80.2		123.8	96.4		218.2		1,411.7		1,023.9	1,140.2	781.9	106.0				48.0
UID = unidentified				25.1	27.7	22.1																														

cf. = (confertim = close together) = possibly for species

? = possibly for genus

1 = *Achnanthes minutissima var. gracillima* = *Achnanthidium gracillimum*

2= *Cymbella minuta* includes *Cymbella minuta var. silesiaca* which is now called *Encyonema silesiaca*

3 = Morphologically the Chantransia stage (juvenile) of *Batrachospermum* is identical to *Audouinella.*
Since *Batrachospermum* is present in this data set, the *Audouinella* observed could actually be juvenile *Batrachospermum*

Synonyms:(Newer name underlined)
Melosira sp.= *Aulacoseira sp*. (for this data)
Achnanthes flexella = *Eucocconeis flexella*
Achnanthes laevis = *Eucocconeis laevis*
Achanthes lanceolata = *Planothidium lanceolatum*
Achnanthes minutissima = *Achnanthidium minutissimum*
Achnanthes minutissima var. gracillima = *Achnanthidium gracillimum*
Cavinula pseudoscutiformis = *Navicula pseudoscutiformis*
Cymbella caepitosa = *Encyonema caespitosum*
Cymbella cesatii = *Encyonopsis cesatii*
Cymbella mesiana = *Encyonema mesianum*
Cymbella microcephala = *Encyonopsis microcephala*
Cymbella minuta = *Encyonema minutum*
Cymbella sinuata = *Reimeria sinuata*
Diatoma mesodon = *Diatoma hiemale var. mesodon*
Diatoma elongatum = *Diatoma tenue var. elongatum* = *Diatoma tenuis*
Didymosphenia geminata = *Gomphonema geminata*
Gomphonema truncatum = *Gomphonema constrictum*
Luticola cf. geoppertiana = *Navicula cf. geoppertiana*
Nitzschia angustata = *Tryblionella angustata*

Knight Piésold CONSULTING

APPENDIX F
HARPER CREEK MINING INC.
HARPER CREEK PROJECT
2011-2013 PERIPHYTON BIOMASS

22/08/2014 10:57

RESULTS OF 2011 ANALYSIS

Sample ID	HC-30-1	HC-30-2	HC-30-3	HC-30-4	HC-30-5	HC-20-1	HC-20-2	HC-20-3	HC-20-4	HC-20-5	TMF-10-1	TMF-10-2	TMF-10-3	HC-40-1	HC-40-2	HC-40-3	OP-10-1
Date Sampled	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	21-SEP-11	21-SEP-11	21-SEP-11	21-SEP-11
Time Sampled	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	L1062941-1	L1062941-2	L1062941-3	L1062941-4	L1062941-5	L1062941-6	L1062941-7	L1062941-8	L1062941-9	L1062941-10	L1062941-11	L1062941-12	L1062941-13	L1062941-14	L1062941-15	L1062941-16	L1062941-17
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Plant Pigments																	
Chlorophyll a (ug/cm²)	9.85	18.6	5.61	6.15	2.64	17.3	20.2	37.2	18.1	34.3	22.0	19.6	14.8	17.2	3.78	20.2	5.65

Sample ID	OP-10-2	OP-10-3	HC-10-1	HC-10-2	HC-10-3	BR-20-1	BR-20-2	BR-20-3	BR-10-1	BR-10-2	BR-10-3	BC-10-1	BC-10-2	BC-10-3	TMF-20-1	TMF-20-2	TMF-20-3
Date Sampled	21-SEP-11	21-SEP-11	21-SEP-11	21-SEP-11	21-SEP-11	21-SEP-11	21-SEP-11	21-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	22-SEP-11	23-SEP-11	23-SEP-11	23-SEP-11
Time Sampled	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	L1062941-18	L1062941-19	L1062941-20	L1062941-21	L1062941-22	L1062941-23	L1062941-24	L1062941-25	L1062941-26	L1062941-27	L1062941-28	L1062941-29	L1062941-30	L1062941-31	L1062941-32	L1062941-33	L1062941-34
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Plant Pigments																	
Chlorophyll a (ug/cm²)	8.92	8.41	31.3	52.9	23.7	13.9	24.7	11.8	49.7	23.9	20.1	48.0	44.1	32.6	16.5	19.8	21.0

RESULTS OF 2012 ANALYSIS

Sample ID	BR-10 1	BR-10 2	BR-10 3	BR-20 1	BR-20 2	BR-20 3	HC-10 1	HC-10 2	HC-10 3	HC-20 1	HC-20 2	HC-20 3	HC-20 4	HC-20 5	HC-30 1	HC-30 2	HC-30 3
Date Sampled	25-SEP-12	25-SEP-12	25-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	27-SEP-12	27-SEP-12	27-SEP-12
Time Sampled	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:00	00:00	00:00	00:00
ALS Sample ID	L1216435-1	L1216435-2	L1216435-3	L1216435-4	L1216435-5	L1216435-6	L1216435-7	L1216435-8	L1216435-9	L1216435-10	L1216435-11	L1216435-12	L1216435-13	L1216435-14	L1216435-15	L1216435-16	L1216435-17
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Plant Pigments																	
Chlorophyll a (ug/cm²)	27.4	10.8	18.6	4.00	5.03	5.31	7.00	11.1	12.1	17.9	7.21	18.7	18.1	10.0	1.66	3.10	0.848

Sample ID	HC-30 4	HC-30 5	HC-40 1	HC-40 2	HC-40 3	OP-10 1	OP-10 2	OP-10 3	TMF-10 1	TMF-10 2	TMF-10 3	TMF-20 1	TMF-20 2	TMF-20 3	BC-10 1	BC-10 2	BC-10 3
Date Sampled	27-SEP-12	27-SEP-12	27-SEP-12	27-SEP-12	27-SEP-12	27-SEP-12	27-SEP-12	27-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	25-SEP-12	25-SEP-12	25-SEP-12	25-SEP-12	25-SEP-12	25-SEP-12
Time Sampled	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	L1216435-18	L1216435-19	L1216435-20	L1216435-21	L1216435-22	L1216435-23	L1216435-24	L1216435-25	L1216435-26	L1216435-27	L1216435-28	L1216435-29	L1216435-30	L1216435-31	L1216435-32	L1216435-33	L1216435-34
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Plant Pigments																	
Chlorophyll a (ug/cm²)	4.86	1.25	1.58	2.30	2.74	2.65	3.25	6.31	4.50	5.43	7.33	13.1	6.47	0.329	3.00	1.09	0.895

RESULTS OF 2013 ANALYSIS

Sample ID	BR-10 A=3	BR-10 B=3	BR-10 C=3	HC-40 A=3	HC-40 B=2	HC-40 C=3	OP-10 A=2	OP-10 B=2	OP-10 C=2	TMF-10 A=1	TMF-10 B=1	TMF-10 C=1	TMF-20 A=3	TMF-20 B=2	TMF-20 C=3	BC-10 A=2	BC-10 B=2
Date Sampled	24-SEP-13	24-SEP-13	24-SEP-13	24-SEP-13	24-SEP-13	24-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	24-SEP-13	24-SEP-13	24-SEP-13	25-SEP-13	25-SEP-13	25-SEP-13	25-SEP-13	25-SEP-13
Time Sampled	08:00	08:00	08:00	11:00	11:00	11:00	17:00	17:00	17:00	14:30	14:30	14:30	09:30	09:30	09:30	13:00	13:00
ALS Sample ID	L1370086-1	L1370086-2	L1370086-3	L1370086-4	L1370086-5	L1370086-6	L1370086-7	L1370086-8	L1370086-9	L1370086-10	L1370086-11	L1370086-12	L1370086-13	L1370086-14	L1370086-15	L1370086-16	L1370086-17
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Plant Pigments																	
Chlorophyll a (ug/cm²)	50.4	5.06	13.3	15.1	11.9	5.20	12.1	21.7	34.1	4.62	25.6	1.53	3.20	4.87	5.07	10.4	3.35

Sample ID	BC-10 C=2	BR-20 A=3	BR-20 B=3	BR-20 C=4	HC-10 A=3	HC-10 B=4	HC-10 C=3	HC-20 A=5	HC-20 B=2	HC-20 C=8	HC-20 D=4	HC-20 E=8	HC-30 A=2	HC-30 B=4	HC-30 C=3	HC-30 D=4	HC-30 E=8
Date Sampled	25-SEP-13	25-SEP-13	25-SEP-13	25-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13
Time Sampled	13:00	16:30	16:30	16:30	08:15	08:15	08:15	12:30	12:30	12:30	12:30	12:30	14:30	14:30	14:30	14:30	14:30
ALS Sample ID	L1370086-18	L1370086-19	L1370086-20	L1370086-21	L1370086-22	L1370086-23	L1370086-24	L1370086-25	L1370086-26	L1370086-27	L1370086-28	L1370086-29	L1370086-30	L1370086-31	L1370086-32	L1370086-33	L1370086-34
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Plant Pigments																	
Chlorophyll a (ug/cm²)	6.70	3.92	4.00	7.24	5.43	6.65	3.44	4.51	3.22	64.2	81.8	64.9	3.24	2.30	1.57	3.44	19.8

APPENDIX G

BENTHIC INVERTEBRATES

(Pages G-1 to G-9)

Sandpiper Biological Consulting

Sample Processing Methodology
Fresh water samples.

Sample sorting

Preparation of the sample:

Excess formalin is poured off of the sample (over screens appropriate to the client's needs) and collected for appropriate disposal.

Samples are washed through these screens. This removes any residual formalin and separates the sample into more easily handled size fractions. Typically we use a series of screens to separate a coarse and fine fraction. This allows us to maximize our ability to identify the rare organisms and subsample a minimal amount of the complete sample.

When the 2 fractions are clear of mud and silt, so the water runs clean, they are placed in separate containers. If processing is going to be delayed, a small amount of formalin or alcohol is added to each fraction.

Samples are sorted into vials as follows. Each vial is clearly labeled with the company, date, job number, sample number and if it is coarse, fine or a sub-sample fraction with both an external and internal label. Vials are filled with alcohol to preserve the collection.

Sorting

For the coarse fraction, a small amount of water and material is poured into a petri dish. The material is sorted by moving the material away from the near edge of the petri dish, then pulling the material into the clear space, working it so that all the organisms are visible. This clear space is worked across the petri dish until all the material has been sorted.

Then the dish is swirled, so that the material is disturbed and evenly distributed. It is then scanned systematically over the surface of the debris, removing any organisms that have appeared. The swirl and scan procedure is repeated until no more organisms are found.

Small amounts of water and material are sorted until all the material has been processed.

Sub-sampling

Sub-sampling is a common practice in order to make it time effective to deal with samples with high numbers of organisms or very high volume of organic matter and debris.

Several methods of sub-sampling are utilized depending on the nature of the sample and the needs of the client. Methods include a Folsom plankton splitter (only for very fine materials), Motodo plankton splitter, Caton trays, Marchant box, weight and volume.

The subsampled fraction is sorted into a fresh vial using the same methodology as stated earlier. The unsorted portion is stored with a bit of formalin or alcohol in a closed container until we are satisfied it will not be required for further analysis. Should it be necessary, the other portion would be processed as well. The criteria for the minimum number of organisms collected for sub-sampling is dictated by the procedure the client requires. It is typically a minimum of 300 organisms.

If there are few enough organisms and volume that sub-sampling is not required, then all material are sorted into a single vial.

Sample Identification procedures

Samples are examined under a dissecting microscope at sufficient magnification to ensure clear recognition of diagnostic parts. Where a dissecting microscope does not provide sufficient magnification, such as is required for the identification of chironomids where examination of mouth parts is required, a compound microscope is used with magnifications available up to 2500x.

Identifications are done using standard texts (list available if required). An effort is made to ensure the latest versions of texts are utilized and the taxonomist makes every effort to remain current by attending workshops and conferences.

Where subsampling has taken place, the numbers from the subsample are extrapolated to have the number reported reflect what would have been present in the entire sample.

QA/QC

QA/QC for sorting and subsampling: A sorter with a reliable 95% efficiency will resort the whole sample after it has been processed. The usual EEM criterion is that the resort should be less than 10% of what was found in the original sort. I require my sorters to achieve at least a 95% removal level, and with our methodology, this is routinely achieved.

For subsampling, a second subsample is counted for comparison.

Internal QA/QC includes 10% sort checks and sub-sampling confirmations. If a sorter does not achieve the required level of sorting efficiency, all their work on that job is resorted. If sub-sampling confirmation shows the sub-sampling to be more than 5% different, the entire sample (or a greater portions until the results are comparable) will be processed and all subsampling for that job will be confirmed.

Confirmations by an independent taxonomist are performed at the client's request and expense. The results of the independent taxonomist are compared to our results and a data set that both taxonomist agree upon is submitted to the client (in addition to the independent results).

Reporting

All data is reported on an Excell spread sheet. The QA/QC is reported on Sheet 2

Document last modified August 2012

Knight Piésold CONSULTING

APPENDIX G

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011 BENTHIC INVERTEBRATES - RAW DATA

Order	Family	BR-10-1	BR-10-2	BR-10-3	BR-20-1	BR-20-2	BR-20-3	TMF-10-1	TMF-10-2	TMF-10-3	TMF-20-1	TMF-20-2	TMF-20-3	OP-10-1	OP-10-2	OP-10-3	BC-10-1	BC-10-2	BC-10-3	HC-10-1	HC-10-2	HC-10-3	HC-20-1	HC-20-2	HC-20-3	HC-20-4	HC-20-5	HC-30-1	HC-30-2	HC-30-3	HC-30-4	HC-30-5	HC-40-1	HC-40-2	HC-40-3	Density (Mean)	Density (SE)	Proportion (Mean)	Proportion (SE)
Insecta	Unidentified							1																												35.9	0.0	0.002	0.0000
Ephemeroptera	Unidentified	3		5	1				2		1						1	4	1	2		1	6	4	26	6	5	7	8	10	1		2	5	2	168.0	41.5	0.013	0.0027
	Ameletidae				11				5	1	3	6		1	4					1	7	1	2	5	4	3				2			2	9	1	135.5	24.9	0.011	0.0024
	Baetidae		1		29	43	50	40	26	18	10	2	24	1	4	4	23	65	54	18	11	8	36	12	70	25	28	11	5	19	18	12	2	4	2	756.8	120.5	0.062	0.0135
	Caenidae																																						
	Ephemerellidae	6	7	1	28	20	46	13	6	11			1	1	3	4	5	7	7	50	12	14	22	20	16	40	57	16	25	12	15	13	56	23	29	657.0	101.2	0.044	0.0052
	Heptageniidae	7	7	37	75	141	62	80	30	38	36	29	41	33	60	49	7	21	26	97	38	47	27	70	27	147	154	59	33	54	86	120	30	36	76	1,983.9	238.8	0.151	0.0146
	Leptophlebiidae			4	2			6	11	1	2		2							57	13	14	1	1			1									317.4	151.6	0.024	0.0080
Plecoptera	Unidentified	2	2		6	4	8	18	11	16	2	1	1	3	4	2	5	7	3	6	4		25	14	129	66	68	18	19	17	15	23	52	9	14	643.6	168.4	0.035	0.0056
	Capniidae	1			2	3	1	60	43	13	14	7	26	11	8	5		2		12	5	2	27	7	67	51	64	8	23	40	15	19	9	8	26	692.5	129.5	0.042	0.0059
	Chloroperlidae	38	43		92	21	9	62	31	18	46	34	41	76	58	37	11	19	8	48	22	46	23	30	32	107	84	135	80	38	90	85	35	69	52	1,761.4	190.7	0.136	0.0138
	Leuctridae				35	12	7	32	7	11	15	8	17	1	3	3		28	3	6	5	3	17	10	9	5	18	46	33	18	17	17	4	10	14	495.1	73.0	0.034	0.0044
	Nemouridae				19	13	8	110	35	71	47	16	29	30	19	21	13	42	15	59	9	3	37	30	66	83	116	4	9	7	14	8	46	12	22	1,172.5	192.3	0.078	0.0087
	Peltoperlidae				3	6	3	2		1		1	1	1	5	4							1	4		3	13	4	5	2	17	2	126	38	79	523.5	233.2	0.033	0.0137
	Perlidae	1			4	4	2	11	8	27	26	12	13	2			1	12	4	41	8	2	5	1	3	7	8		1	4	1		1	3		281.7	65.9	0.021	0.0042
	Perlodidae			3	6	12	3	1	1							1	3		1				1	3		2	1	3	2	1	1	5	4		4	104.1	21.0	0.009	0.0021
	Pteronarcyidae																																						
	Taeniopterygidae				39	51	56	5	1	1	1				3	1		4	1	7		8	2	1	1	13	11	5	1		2	2				352.3	125.3	0.024	0.0094
Trichoptera	Unidentified	17	12		44	11	6	24	19	20	1	3	2	9	25	19	5	8	4	29	5	2	41	27	21	47	40	64	46	10	42	39	21	22	14	760.0	101.7	0.053	0.0060
	Apataniidae																			5					1	1										83.7	47.8	0.003	0.0021
	Brachycentridae		2						1	1	4		2							3													11		1	112.1	42.6	0.007	0.0023
	Glossosomatidae							3	2	1							1	2								1	4	1	1		1	5		1		68.8	14.3	0.005	0.0010
	Hydropsychidae		8		18	23	14	26	2	12	4	1	9	13	19	16	3	5	2	39	3	1	2	14		22	31	2	2		3	5	3	2	2	366.0	66.3	0.026	0.0041
	Hydroptilidae		1					12	21	8			1																							308.6	134.5	0.020	0.0095
	Lepidostomatidaae																																						
	Leptoceridae																																						
	Limnephilidae																			2	4	2							1							80.7	22.6	0.008	0.0039
	Philopotamidae																			2		1	2		1											53.8	10.4	0.003	0.0008
	Polycentropodidae																																						
	Rhyacophilidae				12	22	19	16	9	10	4	4	6	5	10	4	2	2	1	9	3	3	61	43	31	43	54	40	49	23	32	16	28	18	27	701.4	110.6	0.044	0.0061
	Uenoidae			1				34	13	35	7	2	1	3	6	9				1			1	1	1	1	6	1	1			2	1		1	218.7	78.3	0.016	0.0050
Coleoptera	Unidentified		2	5	2		1	6	5	6	2							1		2	2			1			1					2				97.4	18.2	0.010	0.0036
	Carabidae																																						
	Curculionidae																																						
	Dytiscidae																																						
	Elmidae	56	92	2	73	8	8	12	10	5	45	34	44				6	8		48	14	26	3	1	9	11	6		2		1					783.4	184.1	0.077	0.0224
	Georissidae																																						
	Haliplidae																																						
	Hydrophilidae														1																					35.9	0.0	0.004	0.0000
	Scotylidae																																						
	Staphylinidae																																						
Megaloptera	Sialidae																																						
Diptera	Unidentified		1	4	2	1		3	2					1		1	1	2	5			2	11	8	8	4		3	1	1	5	4	1			115.8	21.1	0.010	0.0023
	Athericidae	1	2	2																																59.8	12.0	0.013	0.0048
	Blephariceridae																																						
	Ceratopogonidae	3	8	5	8	3	3	3		5		2		1	1		6	5		2		2	9	5	23	13	13	16	18	25	10	8				282.7	48.1	0.022	0.0037
	Chaoboridae																																						
	Chironomidae	5	8	9	11	4	4	19	23	18	22	12	17	5	16		1	5	7	50	30	19	31	37	260	90	43	18	35	29	37	11	10	4	9	977.5	283.7	0.060	0.0096
	Deuterophlebiidae																																						
	Dixidae																1																			35.9	0.0	0.010	0.0000
	Ephydridae																																						
	Empididae				11	8	1	20	13	12	2	3	4	4	1	2		1		3	2		14	9	14	12	20	7	16	10	12	2	32	2	9	315.2	50.2	0.019	0.0025
	Muscidae																																						
	Pelecrohynchidae																			1																35.9	0.0	0.001	0.0000
	Psychodidae																	1		8		3	1		4	1							1			97.4	35.6	0.005	0.0018
	Sciomyzidae																	1																		35.9	0.0	0.003	0.0000
	Simuliidae																									1								1		35.9	0.0	0.002	0.0009
	Stratiomyidae																																						
	Thaumaleidae																																						
	Tipulidae		2	5					2	1	1									2	3	2				2							2	3		81.5	11.9	0.011	0.0046
Collembola	Unidentified																																						
	Hypogastruridae																																						
	Isotomidae								2																											71.8	0.0	0.005	0.0000
	Sminthuridae																																						
Hemiptera	Unidentified																													1						35.9	0.0	0.003	0.0000
	Gerridae																																						
	Corixidae																																						
Homoptera	Unidentified													1																						35.9	0.0	0.005	0.0000
	Aphididae																		2																	71.8	0.0	0.013	0.0000
	Cicadellidae																																						
Hymenoptera	Unidentified					2		3	3			1		1	1					1			1	1	1		3	4	3	1	3	10				87.5	20.4	0.006	0.0013
	Formicidae																																						
Lepidoptera	Unidentified																																						
Psocoptera	Unidentified				1		1	1												1					1											35.9	0.0	0.002	0.0003
Thysanoptera	Unidentified																																						
Araneae	Unidentified																							2												71.8	0.0	0.005	0.0000
Hydracarina	Unidentified	1	2		2	2	3	15	7	11	6		5			1		1	1	11		1	4	3	1	1	2	2	1	1	3		7	1	4	131.6	25.4	0.009	0.0013
	Arrenuridae																																						
	Hygrobatidae																																						
	Lebertiidae	3	6		3			2		2	3							2		7		1		1	2		1							1	2	92.3	17.5	0.007	0.0020
	Unionicolidae																																						
	Oripodidae																																						
	Sperchontidae	2	3		6	1		3	9	2	2	2	2					2		4		2		3		1	1						1		2	95.7	16.9	0.007	0.0013
	Torrenticolidae	6	3		3															8		1				1										131.6	41.1	0.013	0.0056
	Oribatidae																																						
	Oxidae																																						
	Hydryphantidae			1							1				1									1		1				1	2	1	2	1		43.1	4.8	0.004	0.0008
Amphipoda	Unidentified																																						
	Gammaridae																																						
	Hyalellidae																																						
Cladocera	Unidentified																																						
	Bosminidae																																						
	Chydoridae																																						
	Daphnidae																																						
	Eurycercinae																																						
	Polyphemidae																																						
	Sididae																																						
Copepoda	Calanoida																																						
	Cyclopoida																																						
	Harpacticoida																																						
Ostracoda	Candonidae	2			10	1	1		3	1	44	24	30				2	17	1	18	5	3	6	2	15	3	2	1	3	1	1	1	6	36	13	322.9	79.4	0.026	0.0069
	Cyprididae																																						
	Unidentified																																						
Hirudinea	Unidentified																																						
	Glossiphoniidae																																						
Oligochaeta	Unidentified																																						
	Enchytraidae			6				1	1		1	1					1	1			2	7						2	2	1	1	1	12		2	94.2	27.8	0.011	0.0042
	Lumbriculidae																																						
	Lumbricidae (Terr.)					1																														35.9	0.0	0.002	0.0000
	Tubificidae																																						
	Naididae							2	1																1											47.8	12.0	0.002	0.0006
Mollusca	Acroloxidae																																						
Bivalva	Unidentified										2																									71.8	0.0	0.005	0.0000
	Pisidiinae		3	1																																71.8	35.9	0.012	0.0015
	Sphaeriidae																																						
Gastropoda	Unidentified																																						
	Lymnaeidae																																						
	Physidae																																						
	Planorbidae																																						
	Valvatidae																																						
	Ancylidae																																						
Platyhelminthes	Planariidae							10	12	12	9	8	13	3	3	9	6	17	8	18	3	3	8	7	6	5	6			2	2		14	10	9	291.3	32.0	0.025	0.0032
	Unidentified																																						
Hydra	Unidentified																																						
Nematoda	Unidentified	1			5	1		2		1	2	1	1				1						4	1	1		3	2	1	1	2	1	1	2		61.0	9.1	0.004	0.0006
Odonata	Anisoptera																																						
	Coengrionidae																																						
	Gomphidae																																						
	Corduliidae																																						
Chilopoda	Unidentified																																						
Diplopoda	Unidentified																																						
Salmoniformes	Salmonidae																																						
TOTALS	13128 (AREA TOTAL)	155	215	91	563	418	316	658	377	390	365	214	333	206	255	192	105	292	154	678	210	230	431	379	851	819	864	479	426	331	449	414	522	330	416	295.4	58.2	0.022	0.0040

0	30MAY'14	ISSUED WITH VA101-458/15-1	CAC	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

APPENDIX G

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2011 BENTHIC INVERTEBRATES - PRESENCE/ABSENCE

Order	Family	BR-10-1	BR-10-2	BR-10-3	BR-20-1	BR-20-2	BR-20-3	TMF-10-1	TMF-10-2	TMF-10-3	TMF-20-1	TMF-20-2	TMF-20-3	OP-10-1	OP-10-2	OP-10-3	BC-10-1	BC-10-2	BC-10-3	HC-10-1	HC-10-2	HC-10-3	HC-20-1	HC-20-2	HC-20-3	HC-20-4	HC-20-5	HC-30-1	HC-30-2	HC-30-3	HC-30-4	HC-30-5	HC-40-1	HC-40-2	HC-40-3	Total
Insecta	Unidentified	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ephemeroptera	Unidentified	1	0	1	1	0	0	0	1	0	1	0	0	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	22
	Ameletidae	0	0	0	1	0	0	0	1	1	1	1	0	1	1	0	0	0	0	1	1	1	1	1	1	1	0	0	0	1	0	0	1	1	1	18
	Baetidae	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	32
	Caenidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemerellidae	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	32
	Heptageniidae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	34
	Leptophlebiidae	0	0	1	1	0	0	1	1	1	1	0	1	0	0	0	0	0	0	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	13
Plecoptera	Unidentified	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	32
	Capniidae	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	30
	Chloroperlidae	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	33
	Leuctridae	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	30
	Nemouridae	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31
	Peltoperlidae	0	0	0	1	1	1	1	0	1	0	1	1	1	1	1	0	0	0	0	0	0	1	1	0	1	1	1	1	1	1	1	1	1	1	22
	Perlidae	1	0	0	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	0	27
	Perlodidae	0	0	1	1	1	1	1	1	0	0	0	0	0	0	1	1	0	1	0	0	0	1	1	0	1	1	1	1	1	1	1	1	0	1	20
	Pteronarcyidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Taeniopterygidae	0	0	0	1	1	1	1	1	1	1	0	0	0	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	0	0	0	22
Trichoptera	Unidentified	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	33
	Apataniidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	3
	Brachycentridae	0	1	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	8
	Glossosomatidae	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	1	1	0	1	1	0	1	0	12
	Hydropsychidae	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	30
	Hydroptilidae	0	1	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
	Lepidostomatidaae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Leptoceridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Limnephilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	4
	Philopotamidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	4
	Polycentropodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhyacophilidae	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31
	Uenoidae	0	0	1	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	1	0	0	1	1	1	1	1	1	1	0	0	1	1	0	1	21
Coleoptera	Unidentified	0	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0	1	0	1	1	0	0	1	0	0	1	0	0	0	0	1	0	0	0	14
	Carabidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Curculionidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Dytiscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Elmidae	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	0	1	1	1	1	1	1	1	1	0	1	0	1	0	0	0	0	24
	Georissidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Haliplidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hydrophilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Scotylidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Staphylinidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Megaloptera	Sialidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diptera	Unidentified	0	1	1	1	1	0	1	1	0	0	0	0	1	0	1	1	1	1	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0	0	22
	Athericidae	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	Blephariceridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ceratopogonidae	1	1	1	1	1	1	1	0	1	0	1	0	1	1	0	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	25
	Chaoboridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chironomidae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	33
	Deuterophlebiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Dixidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Ephydridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Empididae	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	28
	Muscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pelecrohynchidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Psychodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	1	1	0	0	0	0	0	0	1	0	0	7
	Sciomyzidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Simuliidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	2
	Stratiomyidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Thaumaleidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tipulidae	0	1	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	1	1	0	11
Collembola	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hypogastruridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Isotomidae	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Sminthuridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemiptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
	Gerridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Corixidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Homoptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Aphididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Cicadellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hymenoptera	Unidentified	0	0	0	0	1	0	1	1	0	0	1	0	1	1	0	0	0	0	1	0	0	1	1	1	0	1	1	1	1	1	1	0	0	0	16
	Formicidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidoptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psocoptera	Unidentified	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5
Thysanoptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Araneae	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Hydracarina	Unidentified	1	1	0	1	1	1	1	1	1	1	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	27
	Arrenuridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hygrobatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lebertiidae	1	1	0	1	0	0	1	0	1	1	0	0	0	0	0	0	1	0	1	0	1	0	1	1	0	1	0	0	0	0	0	0	1	1	14
	Unionicolidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Oripodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperchontidae	1	1	0	1	1	0	1	1	1	1	1	1	0	0	0	0	1	0	1	0	1	0	1	0	1	1	0	0	0	0	0	1	0	1	18
	Torrenticolidae	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	6
	Oribatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Oxidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hydryphantidae	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1	1	1	1	0	10
Amphipoda	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gammaridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hyalellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cladocera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bosminidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chydoridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Daphnidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Eurycercinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Polyphemidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copepoda	Calanoida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cyclopoida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Harpacticoida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ostracoda	Candonidae	1	0	0	1	1	1	0	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	28
	Cyprididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hirudinea	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glossiphonidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaeta	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Enchytraidae	0	0	1	0	0	0	1	1	0	1	1	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	1	1	1	1	1	1	0	1	16
	Lumbriculidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lumbricidae (Terr.)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Tubificidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Naididae	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3
Mollusca	Acroloxidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalva	Unidentified	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Pisidiinae	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	Sphaeriidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lymnaeidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Physidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Planorbidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Valvatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ancylidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Platyhelminthes	Planariidae	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	1	1	1	25
	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydra	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda	Unidentified	1	0	0	1	1	0	1	0	1	1	1	1	0	0	0	1	0	0	0	0	0	1	1	1	0	1	1	1	1	1	1	1	1	0	20
Odonata	Anisoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coengrionidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gomphidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Corduliidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chilopoda	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diplopoda	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salmoniformes	Salmonidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS		18	21	16	31	26	23	35	35	32	31	24	25	22	22	19	22	29	20	37	23	30	31	34	31	34	31	26	29	27	29	26	30	26	25	

0	30MAY14	ISSUED WITH VA101-458/15-1	CAC	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

APPENDIX G

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2012 BENTHIC INVERTEBRATES - RAW DATA

Order	Family	BR-10-1	BR-10-2	BR-10-3	BR-20-1	BR-20-2	BR-20-3	HC-10-1	HC-10-2	HC-10-3	HC-20-1	HC-20-2	HC-20-3	HC-20-4	HC-20-5	HC-30-1	HC-30-2	HC-30-3	HC-30-4	HC-30-5	HC-40-1	HC-40-2	HC-40-3	OP-10-1	OP-10-2	OP-10-3	BC-10-1	BC-10-2	BC-10-3	TMF-10-1	TMF-10-2	TMF-10-3	TMF-20-1	TMF-20-2	TMF-20-3	Density (Mean)	Density (SE)	Proportion (Mean)	Proportion (SE)
Insecta	Unidentified																																						
Ephemeroptera	Unidentified	4	3	9	22	4	4		3		9		4	3	14	3	2	5	6	4	8	8	1		3	7		1				2	1	1		188.0	33.7	0.013	0.0025
	Ameletidae	1		1	5	2	3	3	3	1	10	5	3			1			2		5	4	13	21	26	77	1			3	6	6	3	2	4	291.2	107.7	0.027	0.0086
	Baetidae	1	4	1	29	16	26	14	3	16	38	5	7	5	35	4	4	4	4	7		2		57	78	15	28	12	12	3	7	6	15	8	2	524.7	109.9	0.046	0.0104
	Caenidae																																						
	Ephemerellidae	21	26	3	39	17	33	53	40	56	82	66	65	67	43	54	40	51	39	25	14	43	13	2	6	5	11	8	1	3	11	16	1	3		1040.5	146.4	0.070	0.0088
	Heptageniidae	90	71	48	96	155	63	47	40	91	164	77	70	85	30	141	131	165	140	87	44	90	27	69	73	58	24	20	13	16	28	61	29	29	10	2513.7	277.4	0.180	0.0116
	Leptophlebiidae	10	10	4				11	6	1																										251.2	58.6	0.023	0.0050
Plecoptera	Unidentified	3	4	1	28	7	7	2	4	2	44	11	33	31	107	25	79	57	70	105	1	20	1	4	12	21	2	2	2	9	1	13	6	1	2	756.6	181.5	0.044	0.0087
	Capniidae				5	5	4			1	18			2	5	6	15	23	6	19	9	7	3	5	15	27	6	8	5	18	36	46	13	10	3	425.2	75.0	0.042	0.0098
	Chloroperlidae	55	40	30	25	56	12	5	7	37	105	29	10	11	14	71	45	71	64	21	52	64	30	14	25	37	25	17	7	14	11	22	31	27	41	1187.2	142.1	0.093	0.0086
	Leuctridae				1	6	1	1	1	1	16	13	7	4	4	23	13	34	26	7	4	4	1				8	5		4	3	12	10	3	2	284.4	58.0	0.019	0.0029
	Nemouridae		1		14	15	40	3	1	13	147	140	69	68	101	36	108	28	46	43	29	28	15	11	21	41	55	21	12	5	8	37	19	15	9	1344.4	243.3	0.089	0.0105
	Peltoperlidae				7	2	9				12	5	1	3	5	15	10	14	6	9	55	109	9	3	4		1	1	6		1	2	1			433.5	170.9	0.030	0.0105
	Perlidae	2	1		2			3	1	13	1	5	7	3	2												11	9	6	1	10	19	18	15		243.6	49.4	0.027	0.0060
	Perlodidae				9	2	3	2		1	3		1	1	1	1	2	3	2	3	3	5	2	2	1			1		1		1				81.5	14.0	0.006	0.0011
	Pteronarcyidae																																						
	Taeniopterygidae				27	32	52	6	3	7	180	3	17	25	109	10	28	25	17	27				6	6	2	16	18	11		1	2				941.8	291.9	0.054	0.0103
Trichoptera	Unidentified	23	18	11	11	19	11	4	4	9	19	28	13	16	13	17	62	48	32	31	6	24	9	10	20	18	5	7	4	6	12	7	2			581.9	82.7	0.041	0.0037
	Apataniidae							5	3	14						1	2	3																		167.4	69.7	0.013	0.0050
	Brachycentridae	3	25																			8					1						2	2		245.2	135.3	0.017	0.0081
	Glossosomatidae	1	1		2	1		1		1	6	2	1	27	11	2	3	6	1	2		1					3	4	7	3	9	40	1			203.3	67.4	0.017	0.0053
	Hydropsychidae	21	35		3	13	16	1	3	13	6	8	1	13	14	29	33	14	31	30	3	7	1	10	7	7	6	6			1	9	1	1		410.2	69.1	0.026	0.0038
	Hydroptilidae	1																													5	6		1	1	100.5	40.0	0.012	0.0052
	Lepidostomatidaae	8	68	4																																956.8	742.7	0.064	0.0448
	Leptoceridae																																						
	Limnephilidae							1	1							1		3			1					8				1					1	76.2	31.4	0.007	0.0022
	Philopotamidae																																						
	Polycentropodidae																																						
	Rhyacophilidae				33	24	23	2	4	7	57	64	45	41	73	55	42	43	29	12	13	31	9	2	9	15	7	6	2	2	2	8		5		822.8	142.0	0.049	0.0060
	Uenoidae										4		1	6	1		3	1	2	1		1		1		2				3	2	53	3	3		195.1	114.4	0.015	0.0080
Coleoptera	Unidentified	4	6	2	1		1		2			1															1						1	3	1	75.0	17.7	0.007	0.0014
	Carabidae																																						
	Curculionidae																																						
	Dytiscidae																																						
	Elmidae	72	56	56	5	4	13	43	31	37	1	5		5	4	2											8	1		1	1	2	16	27	22	671.9	164.7	0.065	0.0159
	Georissidae																											1								35.9	0.0	0.005	0.0000
	Haliplidae																																						
	Hydrophilidae																																						
	Scotylidae																																						
	Staphylinidae																						1	2												53.8	17.9	0.007	0.0011
Megaloptera	Sialidae																																						
Diptera	Unidentified			2								1								1				2		2						1	1			51.3	7.2	0.005	0.0012
	Athericidae	2	5																																	125.6	53.8	0.008	0.0032
	Blephariceridae																																						
	Ceratopogonidae	7	6	5	7	3	1	7	2	2	31	24	11	5	9	7	2	5	2	1		1		2	2		3	4	1			2	1			203.3	47.8	0.013	0.0019
	Chaoboridae																																						
	Chironomidae	53	32	20	9	6		28	25	50	22	12	31	33	95	11	12	12	9	16	2	5	6	2	14	24	4	10	2	3	1	15	23	17	5	662.1	118.4	0.049	0.0069
	Deuterophlebiidae																																						
	Dixidae																							1												35.9	0.0	0.004	0.0000
	Ephydridae																																						
	Empididae			1	7	1	1	6	1	10	14	12	8	14	22	10	8	2		4	13	32	6		2					1	4	3		1		273.6	55.5	0.018	0.0029
	Muscidae																																						
	Pelecrohynchidae				1			1																												35.9	0.0	0.003	0.0005
	Psychodidae							5		14	1	3	5		2								1				16	29	5	1		1				248.2	88.9	0.029	0.0119
	Sciomyzidae																																						
	Simuliidae											1					1																			35.9	0.0	0.002	0.0001
	Stratiomyidae																																						
	Thaumaleidae																																						
	Tipulidae	8	6	2	2	4	2	6	4	7			2								1	5	2	1	1	3	1			3		1			1	111.2	17.8	0.010	0.0016
Collembola	Unidentified																																						
	Hypogastruridae																																						
	Isotomidae																		1					1						1		1				35.9	0.0	0.005	0.0018
	Sminthuridae																			1																35.9	0.0	0.002	0.0000
Hemiptera	Unidentified																																						
	Gerridae																																						
	Corixidae																																						
Homoptera	Unidentified																																						
	Aphididae		1											1																		1	3			53.8	17.9	0.005	0.0026
	Cicadellidae																																						
Hymenoptera	Unidentified													1												2		1				1		1		43.1	7.2	0.004	0.0007
	Formicidae																											1								35.9	0.0	0.005	0.0000
Lepidoptera	Unidentified																																						
Psocoptera	Unidentified																							1												35.9	0.0	0.004	0.0000
Thysanoptera	Unidentified																																						
Araneae	Unidentified	1																						1					1					1		35.9	0.0	0.005	0.0016
Hydracarina	Unidentified	2	5	2				2	2	4	1	8	2		3		4	1	1	1		1				1					1	3	3			88.8	14.9	0.006	0.0009
	Arrenuridae																																						
	Hygrobatidae										2		2	3	1						2	7	1	3	3									1		89.7	20.2	0.007	0.0012
	Lebertiidae	2	7	3				3	3	1	4	2	1		3		1	1	2				1		1		1	1	1		1	1	2		1	70.1	11.2	0.006	0.0009
	Unionicolidae																																						
	Oripodidae																																						
	Sperchontidae	1	5	1					4			1	2	1	2	1		1	1	1	1	6	1	2		1	1	1					1	2		63.2	11.3	0.005	0.0009
	Torrenticolidae	2	2	3				2	7	2																										107.6	29.3	0.011	0.0046
	Oribatidae																								1	4										89.7	53.8	0.007	0.0038
	Oxidae																																						
	Hydryphantidae			1	1			1				4			4			1		1								2	1							63.8	15.6	0.005	0.0010
Amphipoda	Unidentified																																						
	Gammaridae																																						
	Hyalellidae																																						
Cladocera	Unidentified																																						
	Bosminidae																																						
	Chydoridae																																						
	Daphnidae																																						
	Eurycercinae																																						
	Polyphemidae																																						
	Sididae																																						
Copepoda	Calanoida																																						
	Cyclopoida																																						
	Harpacticoida																																						
Ostracoda	Candonidae					1		7	2		4				1	3		3			8	13	6				1	1	1		1		27	26	78	386.2	166.8	0.048	0.0247
	Cyprididae																																						
	Unidentified																																						
Hirudinea	Unidentified																																						
	Glossiphoniidae																																						
Oligochaeta	Unidentified																																						
	Enchytraidae	2	1	2							3			2							1	27		1				1		1		1	1			128.6	76.7	0.008	0.0036
	Lumbriculidae																																						
	Lumbricidae (Terr.)																																						
	Tubificidae																												1							35.9	0.0	0.010	0.0000
	Naididae	1									1																									35.9	0.0	0.002	0.0007
Mollusca	Acroloxidae																																						
Bivalva	Unidentified	6	4	1																																131.6	52.1	0.009	0.0028
	Pisidiinae																																						
	Sphaeriidae																																						
Gastropoda	Unidentified																																						
	Lymnaeidae																																						
	Physidae																																						
	Planorbidae																																						
	Valvatidae																																						
	Ancylidae																																						
Platyhelminthes	Planariidae					1		1	1	4	7	9	2	1	3	5	2	3	1	3	11	11	2		2	1	5	4	1			1	2		3	123.4	21.8	0.009	0.0017
	Unidentified																																						
Hydra	Unidentified																																						
Nematoda	Unidentified	6			1			1		1	3	3	1	1	2						2	7	1	1						1	1	1	2	1	1	69.9	14.4	0.006	0.0008
Odonata	Anisoptera																																						
	Coengrionidae																																						
	Gomphidae																																						
	Corduliidae																																						
Chilopoda	Unidentified																																						
Diplopoda	Unidentified																										1									35.9	0.0	0.004	0.0000
Salmoniformes	Salmonidae																																						
TOTALS	**12924 (AREA TOTAL)**	**413**	**443**	**213**	**392**	**396**	**325**	**277**	**211**	**416**	**1015**	**547**	**422**	**478**	**733**	**534**	**652**	**627**	**540**	**462**	**288**	**571**	**162**	**237**	**332**	**378**	**252**	**203**	**102**	**104**	**164**	**403**	**239**	**206**	**187**	**306.3**	**74.7**	**0.023**	**0.0051**

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	30MAY'14	ISSUED WITH VA101-458/15-1	CAC	WOG	KJB

APPENDIX G

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2012 BENTHIC INVERTEBRATES - PRESENCE/ABSENCE

Order	Family	BR-10-1	BR-10-2	BR-10-3	BR-20-1	BR-20-2	BR-20-3	HC-10-1	HC-10-2	HC-10-3	HC-20-1	HC-20-2	HC-20-3	HC-20-4	HC-20-5	HC-30-1	HC-30-2	HC-30-3	HC-30-4	HC-30-5	HC-40-1	HC-40-2	HC-40-3	OP-10-1	OP-10-2	OP-10-3	BC-10-1	BC-10-2	BC-10-3	TMF-10-1	TMF-10-2	TMF-10-3	TMF-20-1	TMF-20-2	TMF-20-3	Total
Insecta	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemeroptera	Unidentified	1	1	1	1	1	1	0	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	0	0	0	1	1	1	0	25
	Ameletidae	1	0	1	1	1	1	1	1	1	1	1	1	0	0	1	0	0	1	0	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	26
	Baetidae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	32
	Caenidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemerellidae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	33
	Heptageniidae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	34
	Leptophlebiidae	1	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Plecoptera	Unidentified	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	34
	Capniidae	0	0	0	1	1	1	0	0	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	27
	Chloroperlidae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	34
	Leuctridae	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	0	1	1	1	1	1	1	27
	Nemouridae	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	32
	Peltoperlidae	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	0	0	24
	Perlidae	1	1	0	1	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	19
	Perlodidae	0	0	0	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1	0	1	0	0	0	22
	Pteronarcyidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Taeniopterygidae	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	1	1	0	0	0	24
Trichoptera	Unidentified	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	32
	Apataniidae	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
	Brachycentridae	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	1	0	6
	Glossosomatidae	1	1	0	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	1	1	1	1	1	1	1	0	0	24
	Hydropsychidae	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	0	30
	Hydroptilidae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	5
	Lepidostomatidae	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	Leptoceridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Limnephilidae	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	1	8
	Philopotamidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Polycentropodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhyacophilidae	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	29
	Uenoidae	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	1	1	1	1	0	1	0	1	0	1	0	0	0	1	1	1	1	1	0	16
Coleoptera	Unidentified	1	1	1	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	11
	Carabidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Curculionidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Dytiscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Elmidae	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	1	1	1	1	22
	Georissidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
	Haliplidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hydrophilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Scotylidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Staphylinidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2
Megaloptera	Sialidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diptera	Unidentified	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	1	1	0	0	7
	Athericidae	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	Blephariceridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ceratopogonidae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0	1	1	1	0	0	1	1	0	0	27
	Chaoboridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chironomidae	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	33
	Deuterophlebiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Dixidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
	Ephydridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Empididae	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	0	0	0	0	1	1	1	0	1	0	24
	Muscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pelecrohynchidae	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	Psychodidae	0	0	0	0	0	0	1	0	1	1	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1	1	1	0	1	0	0	0	12
	Sciomyzidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Simuliidae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	Stratiomyidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Thaumaleidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tipulidae	1	1	1	1	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	1	0	1	0	0	1	20
Collembola	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hypogastruridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Isotomidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	4
	Sminthuridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hemiptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gerridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Corixidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Homoptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Aphididae	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	4
	Cicadellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hymenoptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0	5
	Formicidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Lepidoptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psocoptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Thysanoptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Araneae	Unidentified	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	4
Hydracarina	Unidentified	1	1	1	0	0	0	1	1	1	1	1	1	0	1	0	1	1	1	1	0	1	0	0	0	1	0	0	0	0	1	1	1	0	0	19
	Arrenuridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hygrobatidae	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	10
	Lebertiidae	1	1	1	0	0	0	1	1	1	1	1	1	0	1	0	1	1	1	0	0	0	1	0	1	0	1	1	1	0	1	1	1	0	1	22
	Unionicolidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Oripodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperchontidae	1	1	1	0	0	0	0	1	0	0	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	0	0	0	0	1	1	0	21
	Torrenticolidae	1	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
	Oribatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2
	Oxidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hydryphantidae	0	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	9
Amphipoda	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gammaridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hyalellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cladocera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bosminidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chydoridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Daphnidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Eurycercinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Polyphemidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copepoda	Calanoida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cyclopoida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Harpacticoida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ostracoda	Candonidae	0	0	0	0	1	0	1	1	0	1	0	0	0	1	1	0	1	0	0	1	1	1	0	0	0	1	1	1	0	1	0	1	1	1	17
	Cyprididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hirudinea	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glossiphoniidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaeta	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Enchytraidae	1	1	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	1	0	0	0	1	0	1	0	1	1	0	0	12
	Lumbriculidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lumbricidae (Terr.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tubificidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
	Naididae	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Mollusca	Acroloxidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalva	Unidentified	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	Pisidiinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sphaeriidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lymnaeidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Physidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Planorbidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Valvatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ancylidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Platyhelminthes	Planariidae	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0	1	1	0	1	25
	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydra	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda	Unidentified	1	0	0	1	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	1	1	1	1	19
Odonata	Anisoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coengrionidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gomphidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Corduliidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chilopoda	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diplopoda	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Salmoniformes	Salmonidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS		30	27	24	27	24	21	32	29	29	32	29	29	29	31	26	25	28	25	26	24	29	25	28	23	23	28	30	22	24	25	35	30	26	18	

0	30MAY14	ISSUED WITH VA101-458/15-1	CAC	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

APPENDIX G

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2013 BENTHIC INVERTEBRATES - RAW DATA

Order	Family	BR-10-1	BR-10-2	BR-10-3	BR-20-1	BR-20-2	BR-20-3	HC-10-1	HC-10-2	HC-10-3	HC-20-1	HC-20-2	HC-20-3	HC-20-4	HC-20-5	HC-30-1	HC-30-2	HC-30-3	HC-30-4	HC-30-5	HC-40-1	HC-40-2	HC-40-3	OP-10-1	OP-10-2	OP-10-3	BC-10-1	BC-10-2	BC-10-3	TMF-10-1	TMF-10-2	TMF-10-3	TMF-20-1	TMF-20-2	TMF-20-3	Density (Mean)	Density (SE)	Proportion (Mean)	Proportion (SE)
Insecta	Unidentified																																					
Ephemeroptera	Unidentified	2	4		6	14	16	1		1	5	15	4	21	1	5	5		16	27	3		18	8	1	7			3	3	6	6	2	6	1	265.3	47.1	0.022	0.0035
	Ameletidae	1	2		12	6	21	2	3	13	1			7					4		18	4	7	14	33	5				81	43	1	22	3	5	480.5	137.0	0.056	0.0155
	Baetidae	2	4	11	25	65	20	14	6	2	117	96	75	97	28	26	52	22	40	74	7	11	5	29	11	27	43	34	11	10	2	3	11	61	77	1,179.8	195.8	0.082	0.0096
	Caenidae																																					
	Ephemerellidae	55	15	35	32	25	50	52	17	16	34	24	29	31	22	49	32	47	27	54	15	15	9	5	1	2	7	7	10	8	1	5	1	2	5	779.9	107.0	0.066	0.0090
	Heptageniidae	32	17	70	25	63	34	87	24	7	37	78	100	26	57	51	57	71	33	139	77	43	71	103	78	42	68	39	21	35	10	32	18	38	44	1,822.5	182.5	0.151	0.0121
	Leptophlebiidae	1	9	1			2	49	20	13																				1						430.6	209.3	0.054	0.0211
Plecoptera	Unidentified	3		1	6	17	8	1			5	4	1	10	4	3	3	3	2	7	1	4	4	3	3		1		1	4		5		1	1	140.9	24.1	0.011	0.0019
	Capniidae	1			1	2	2	3	1	2	2	1	4	3	2	2	2		3	8	6	1	13	11	6	2	2		9	37	14	7	5	24	14	227.2	51.6	0.021	0.0047
	Chloroperlidae	16	24	51	15	5	9	16	10	5	19	67	63	16	20	31	14	34	17	42	60	20	40	25	40	22	10	14	19	33	27	19	52	73	50	1,032.1	115.0	0.090	0.0094
	Leuctridae				5	16	8		2		10	18	10	2	16	8	9	24	16	11	6	1	5	1	1	3	4	2	3	8	9	16	2	2	5	275.9	40.8	0.023	0.0034
	Nemouridae	1		1	2	10	12	5	3	2	77	40	14	14	15	32	2	16		22	14	17	8	11	22	17	93	16	9	38	5	33	1	3	22	647.0	131.3	0.049	0.0083
	Peltoperlidae						2				6	4	7	1	6	14	8	5	2	16	35	16	35	1								3				361.0	97.8	0.031	0.0098
	Perlidae			3		1	2	5	2	2	7	21	9	7	2												5	3	5	13	4	13	3	22	32	288.8	66.5	0.022	0.0042
	Perlodidae	1			2	2					2	4	2				1	2	3	1	5	1		2	1	1	1					2			1	67.8	9.6	0.006	0.0009
	Pteronarcyidae			2																																71.8	0.0	0.005	0.0000
	Taeniopterygidae				14	51	31	9	2		310	165	99	121	65	31	65	44	21	117	2	2	2	12	16	6	13	4	1	1		4		1	1	1,550.5	462.2	0.085	0.0168
Trichoptera	Unidentified	13	6	2	4	11	5	41	10	4	5	10	1		4	5	2	4	1	13	5	7	13	4	10	3	17	1	5	4		5			8	266.7	49.5	0.024	0.0037
	Apataniidae				3	1		18	1	3						1	2	4		1		1								2		2				116.6	49.2	0.011	0.0033
	Brachycentridae	6		9			1															3													170.4	62.8	0.013	0.0044
	Glossosomatidae	5	3	4	7	31	5	1	1		17	15	5		3	5	12	7		9		1	4	1			37	102	52	2		5		1	2	465.1	154.8	0.041	0.0161
	Hydropsychidae	7	10	108		14		3			21	32	12	2	25	19	2	18	1	1	1	10		2		1	10	8		1	1	6			28	492.3	155.9	0.035	0.0101
	Hydroptilidae	1										1																		16	2	31				366.0	212.7	0.036	0.0218
	Lepidostomatidae	2	6	6																																167.4	47.8	0.018	0.0082
	Leptoceridae							3																												107.6	0.0	0.007	0.0000
	Limnephilidae				1		1	2		1		1		1					2	1	2	2			1					2	1					49.7	5.0	0.005	0.0008
	Philopotamidae																												2							71.8	0.0	0.009	0.0000
	Polycentropodidae																																					
	Rhyacophilidae			1	20	11	9	6	4	4	67	66	48	56	34	40	44	79	16	62	16	7	14	22	14	18	10	10	16	21	4	22	3	2	8	845.4	140.5	0.062	0.0075
	Uenoidae											1			1			3	1		1	2		1								8	1	1	10	97.9	34.6	0.009	0.0029
Coleoptera	Unidentified		1	3				1					1											1											50.2	14.4	0.004	0.0010
	Carabidae																																					
	Curculionidae																																					
	Dytiscidae																																		1	35.9	0.0	0.002	0.0000
	Elmidae	47	31	46	8	7	11	60	10	11	7	3	2	1							1					1			1	4	2	3	28	40	34	583.9	141.2	0.055	0.0123
	Georissidae																																					
	Haliplidae																																					
	Hydrophilidae																																					
	Scotylidae																																					
	Staphylinidae						1																													35.9	0.0	0.004	0.0000
Megaloptera	Sialidae																																					
Diptera	Unidentified															1					1											1				35.9	0.0	0.003	0.0003
	Athericidae			3																															107.6	0.0	0.007	0.0000
	Blephariceridae																																					
	Ceratopogonidae	9	7	8	10	6	6	2	1		22	7	1	18	12	4	1	6	10	4				5			4	2	8	5	5	6	5			240.1	34.4	0.020	0.0025
	Chaoboridae																																					
	Chironomidae	28	17	42	1	7	7	20	6	14	130	34	4	21	14	7	9	1	4	19	7	2	4	13	14	12	24	4	3	10	3	4	15	28	20	578.3	138.3	0.043	0.0059
	Deuterophlebiidae																																					
	Dixidae																																					
	Ephydridae																																					
	Empididae				9	11	1	6	1	2	21	11	3	5	12	2	3	3		7	11	2	1	5	4	7		2		7	3	9	1	3	1	196.1	31.7	0.016	0.0021
	Muscidae																																					
	Pelecrohynchidae				1			1																											35.9	0.0	0.003	0.0011
	Psychodidae				3	1		10	5	2	24	8	3	62	3	1	1	2	11	5							31	12	36							438.5	137.7	0.033	0.0102
	Sciomyzidae																																					
	Simuliidae			1								4			2				1																	71.8	25.4	0.004	0.0007
	Stratiomyidae																																					
	Thaumaleidae						1																			2					1				47.8	12.0	0.004	0.0004
	Tipulidae	48	10	7	5	8	8	11	3		3			2	4	14		2	9	9	7	7	5	4	7	8	3	1	2	3		1	2	3	5	248.7	57.0	0.023	0.0054
Collembola	Unidentified																																					
	Hypogastruridae																																					
	Isotomidae																										1				3					71.8	35.9	0.011	0.0088
	Sminthuridae																																					
Hemiptera	Unidentified																																					
	Gerridae																																					
	Corixidae																																					
Homoptera	Unidentified																							1		1						2				47.8	12.0	0.005	0.0012
	Aphididae												1										1														35.9	0.0	0.003	0.0008
	Cicadellidae																																					
Hymenoptera	Unidentified																	1																		35.9	0.0	0.002	0.0000
	Formicidae					1																														35.9	0.0	0.003	0.0000
Lepidoptera	Unidentified																											1								35.9	0.0	0.004	0.0000
Psocoptera	Unidentified																																					
Thysanoptera	Unidentified																																					
Araneae	Unidentified				1				1														1				1								1	35.9	0.0	0.004	0.0009
Hydracarina	Unidentified		1					4			1		1	1		1				1			1							1	1				1	45.7	9.8	0.004	0.0007
	Arrenuridae																																					
	Hygrobatidae	3																		2		2	1							1	1					59.8	12.0	0.006	0.0015
	Lebertiidae	1	5	1						1				1					1													1				1	53.8	17.9	0.007	0.0031
	Unionicolidae																																					
	Oripodidae																																					
	Sperchontidae		2									2			1			1	1	1										1						46.1	6.6	0.004	0.0013
	Torrenticolidae	1	1			1			2																											44.8	9.0	0.006	0.0026
	Oribatidae																																					
	Oxidae																				1															35.9	0.0	0.003	0.0000
	Hydryphantidae			2							2								1								1						1			50.2	8.8	0.004	0.0006
Amphipoda	Unidentified																																					
	Gammaridae																																					
	Hyalellidae																																					
Cladocera	Unidentified																																					
	Bosminidae																																					
	Chydoridae																																					
	Daphnidae																																					
	Eurycercinae																																					
	Polyphemidae																																					
	Sididae																																					
Copepoda	Calanoida																																					
	Cyclopoida																																					
	Harpacticoida																																					
Ostracoda	Candonidae				3	4	3	18	4		2	2		3	1	2			4	4	14		8	3		3	3	4	3	1	1	1	30	96	47	378.9	148.5	0.031	0.0107
	Cyprididae																																					
	Unidentified																																					
Hirudinea	Unidentified																																					
	Glossiphoniidae																																					
Oligochaeta	Unidentified																																					
	Enchytraidae	5	2	3	2	3	3	1	3	1	3	4						1		2	4		1	1		1	1		2			1		1	1	75.0	9.4	0.007	0.0011
	Lumbriculidae																																					
	Lumbricidae (Terr.)				1		2																				1		1							44.8	9.0	0.005	0.0010
	Tubificidae																																					
	Naididae	4																																		143.5	0.0	0.013	0.0000
Mollusca	Acroloxidae																																					
Bivalva	Unidentified																																					
	Pisidiinae	7		1																															143.5	107.6	0.013	0.0102
	Sphaeriidae																																					
Gastropoda	Unidentified																																					
	Lymnaeidae																																					
	Physidae																																					
	Planorbidae	1																																		35.9	0.0	0.003	0.0000
	Valvatidae																																					
	Ancylidae																																					
Platyhelminthes	Planariidae										6	5	5	2	10	6		2	2	1	3	5	8	1		1	7	9	2	2	1	7	1	2	5	145.1	21.2	0.012	0.0020
	Unidentified							3	1	1																									59.8	23.9	0.008	0.0009
Hydra	Unidentified																																					
Nematoda	Unidentified	5		2		3					2	1	2	1		1	1			1	2		1	1	2	1							1	3	1	61.8	9.1	0.005	0.0008
Odonata	Anisoptera																																					
	Coengrionidae																																					
	Gomphidae																																					
	Corduliidae																																					
Chilopoda	Unidentified																																					
Diplopoda	Unidentified																																					
Salmoniformes	Salmonidae																		1																		35.9	0.0	0.004	0.0000
TOTALS	11887 (AREA TOTAL)	308	177	424	224	397	280	456	143	107	965	744	506	532	364	361	327	402	250	661	325	183	283	290	265	191	400	275	225	355	150	264	205	416	432	262.2	57.9	0.022	0.0045

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	30MAY14	ISSUED WITH VA101-458/15-1	CAC	WOG	KJB

APPENDIX G

HARPER CREEK MINING CORP.
HARPER CREEK PROJECT

2013 BENTHIC INVERTEBRATES - PRESENCE/ABSENCE

Order	Family	BR-10-1	BR-10-2	BR-10-3	BR-20-1	BR-20-2	BR-20-3	HC-10-1	HC-10-2	HC-10-3	HC-20-1	HC-20-2	HC-20-3	HC-20-4	HC-20-5	HC-30-1	HC-30-2	HC-30-3	HC-30-4	HC-30-5	HC-40-1	HC-40-2	HC-40-3	OP-10-1	OP-10-2	OP-10-3	BC-10-1	BC-10-2	BC-10-3	TMF-10-1	TMF-10-2	TMF-10-3	TMF-20-1	TMF-20-2	TMF-20-3	Total
Insecta	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemeroptera	Unidentified	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	0	0	1	1	1	1	1	1	1	28
	Ameletidae	1	1	0	1	1	1	1	1	1	1	0	0	1	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	23
	Baetidae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	34
	Caenidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemerellidae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	34
	Heptageniidae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	34
	Leptophlebiidae	1	1	1	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	8
Plecoptera	Unidentified	1	0	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0	1	0	1	1	27
	Capniidae	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	30
	Chloroperlidae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	34
	Leuctridae	0	0	0	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	29
	Nemouridae	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	32
	Peltoperlidae	0	0	0	0	0	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	16
	Perlidae	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	20
	Perlodidae	1	0	0	1	1	0	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0	1	0	0	1	18
	Pteronarcyidae	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Taeniopterygidae	0	0	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	28
Trichoptera	Unidentified	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	1	30
	Apataniidae	0	0	0	1	1	0	1	1	1	0	0	0	0	0	1	1	1	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	12
	Brachycentridae	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	4
	Glossosomatidae	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	0	1	0	1	1	1	0	0	1	1	1	1	0	1	0	1	1	26
	Hydropsychidae	1	1	1	0	1	0	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	0	0	1	25
	Hydroptilidae	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	5
	Lepidostomatidaae	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	Leptoceridae	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Limnephilidae	0	0	0	1	0	1	1	0	1	0	1	0	1	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	1	1	0	0	0	0	13
	Philopotamidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
	Polycentropodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rhyacophilidae	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	32
	Uenoidae	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	1	0	1	1	0	1	0	0	0	0	0	0	0	1	1	1	1	11
Coleoptera	Unidentified	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5
	Carabidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Curculionidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Dytiscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
	Elmidae	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	1	1	1	1	1	1	22
	Georissidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Haliplidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hydrophilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Scotylidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Staphylinidae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Megaloptera	Sialidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3
	Athericidae	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blephariceridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ceratopogonidae	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	0	1	0	0	1	1	1	1	1	1	1	0	0	26
	Chaoboridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chironomidae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	34
	Deuterophlebiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Dixidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephydridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Empididae	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	28
	Muscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pelecorhynchidae	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	Psychodidae	0	0	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	18
	Sciomyzidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Simuliidae	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
	Stratiomyidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Thaumaleidae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	3
	Tipulidae	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	29
Collembola	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hypogastruridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Isotomidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	2
	Sminthuridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemiptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gerridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Corixidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Homoptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	3
	Aphididae	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
	Cicadellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hymenoptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Formicidae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lepidoptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Psocoptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thysanoptera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Araneae	Unidentified	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	5
Hydracarina	Unidentified	0	1	0	0	0	0	1	0	0	1	0	1	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0	1	11
	Arrenuridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hygrobatidae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	6
	Lebertiidae	1	1	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	8
	Unionicolidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Oripodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sperchontidae	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	7
	Torrenticolidae	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
	Oribatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Oxidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Hydryphantidae	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	5
Amphipoda	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gammaridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hyalellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cladocera	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bosminidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chydoridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Daphnidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Eurycercinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Polyphemidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copepoda	Calanoida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cyclopoida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Harpacticoida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ostracoda	Candonidae	0	0	0	1	1	1	1	1	0	1	1	0	1	1	1	0	0	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	25
	Cyprididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hirudinea	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glossiphoniidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaeta	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Enchytraeidae	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	1	1	0	1	1	0	1	1	0	1	0	0	1	0	1	1	22
	Lumbriculidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lumbricidae (Terr.)	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	4
	Tubificidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Naididae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Mollusca	Acroloxidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalva	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pisidiinae	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	Sphaeriidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lymnaeidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Physidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Planorbidae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Valvatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ancylidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Platyhelminthes	Planariidae	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	23
	Unidentified	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Hydra	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda	Unidentified	1	0	1	0	1	0	0	0	0	1	1	1	1	0	1	1	0	0	1	1	0	1	1	1	1	0	0	0	0	0	0	1	1	1	18
Odonata	Anisoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coengrionidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gomphidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Corduliidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chilopoda	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diplopoda	Unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salmoniformes	Salmonidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTALS		29	21	27	28	29	28	32	26	21	30	31	27	27	26	26	22	25	28	30	28	24	27	28	19	23	27	20	24	30	24	32	21	23	30	

0	30MAY14	ISSUED WITH VA101-458/15-1	CAC	WOG	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

APPENDIX H

AQUATIC SEDIMENTS

(Pages H-1 to H-8)

APPENDIX H

HARPER CREEK MINING INC.
HARPER CREEK PROJECT

2011 AQUATIC SEDIMENT DATA - BC GUIDELINES

Print Aug/22/14 11:05:18

Site Name	MDL (a)	North Barriere Lake				T Creek		P Creek	Harper Creek				Barriere River		Baker Creek	Samples Collected	Min	Max	BCWQG - ISQG	BCWQG - PEL
Site ID (sample size)		NBL-1 (n=1)	NBL-2 (n=1)	NBL-3 (n=1)	NBL-4 (n=1)	TMF-10 (n=3)	TMF-20 (n=3)	OP-10 (n=3)	HC-10 (n=3)	HC-20 (n=5)	HC-30 (n=5)	HC-40 (n=3)	BR-10 (n=3)	BR-20 (n=3)	BC-10 (n=3)					
Date/Time Sampled		19-Oct-11	19-Oct-11	19-Oct-11	19-Oct-11	20-Sep-11	23-Sep-11	21-Sep-11	21-Sep-11	24-Sep-11	20-Sep-11	21-Sep-11	22-Sep-11	21-Sep-11	22-Sep-11					
Physical Tests																				
Alkalinity (Total as CaCO3) %						0.7	0.91	0.7	0.7	0.88	0.74	0.79	0.7	0.7	1.22	24	0.7	1.22		
Carbon (Total) %						0.1	0.2	0.2	0.1	0.3	0.2	0.4	0.2	0.3	0.2	24	0.1	0.4		
Carbon Inorganic (Total) %						0.1	0.11	0.1	0.1	0.11	0.1	0.1	0.1	0.1	0.15	24	0.1	0.15		
Moisture %						20	19.5	25.6	22.3	24.1	26.4	16.6	22.6	19.7	17.8	24	16.6	26.4		
pH		6.62	6.29	6.66	5.94	7.52	7.53	7.66	7.22	7.54	7.18	7.61	7.39	7.56	8.5	24	5.94	8.5		
Total Metals																				
Sulphur (Total) mg/kg						600	500	500	500	500	500	500	500	500	500	34	500	600		
Sediment Metals																				
Aluminum (Sediment) mg/kg		24200	27000	32400	27400	26500	29400	25200	14500	19100	24500	19100	10700	21200	12200	24	10700	32400		
Antimony (Sediment) mg/kg		0.2	0.2	0.38	0.54	0.38	0.16	0.53	0.35	0.47	0.54	0.49	0.37	0.2	0.48	24	0.16	0.54		
Arsenic (Sediment) mg/kg		8.96	10.5	25.3	35.1	14.7	12.5	44.1	19.5	21.4	75.3	53.9	12.3	12.5	24.9	24	8.96	75.3	5.9	17
Barium (Sediment) mg/kg		141	176	465	382	179	167	123	84.1	132	132	96.8	72	126	71.9	24	71.9	465		
Beryllium (Sediment) mg/kg		1.56	1.94	2.43	2.27	0.78	0.59	0.47	0.67	0.54	0.68	0.43	0.45	0.53	0.28	24	0.28	2.43		
Bismuth (Sediment) mg/kg		0.6	0.63	0.93	0.98	0.44	0.37	1.25	1.05	0.53	0.84	0.76	0.41	0.3	0.28	24	0.28	1.25		
Boron (Sediment) mg/kg		5	5	5	5											4	5	5		
Cadmium (Sediment) mg/kg		0.457	0.538	0.872	0.906	0.491	0.405	1.91	0.715	0.527	0.808	1.35	0.354	0.309	0.251	24	0.251	1.91	0.6	3.5
Calcium (Sediment) mg/kg		5780	6050	5950	4120											24	4120	6050		
Chromium (Sediment) mg/kg		35.5	33.1	32.3	35.4	38.1	31.6	68.3	36.2	26.8	37.5	52.5	54.5	48.7	72.1	24	26.8	72.1	37.3	90
Cobalt (Sediment) mg/kg		17.5	13.2	17.9	17.2	15.3	15.5	24.1	12.6	14.8	23	24.3	10.8	17	21.2	24	10.8	24.3		
Copper (Sediment) mg/kg		50.5	44	55.3	54	53.4	60.3	417	88.2	80.7	172	131	49.7	36.4	41.9	24	36.4	417	35.7	197
Iron (Sediment) mg/kg		32800	37300	71100	88000	39700	36600	57400	32500	35700	61000	50200	43100	39000	47700	24	32500	88000	21200	43766
Lead (Sediment) mg/kg		16.9	22	35.6	47	19.3	13.7	43.2	53.9	20.2	31.2	57.7	39.9	12.3	27.6	24	12.3	57.7	35	91.3
Magnesium (Sediment) mg/kg		8720	6970	6700	5060	10900	10200	14900	7570	9630	12700	11000	6000	10800	8720	24	5060	14900	460	1100
Manganese (Sediment) mg/kg		808	1940	12500	7200	1420	1450	1080	647	943	1040	1610	483	988	838	24	483	12500		
Mercury (Sediment) mg/kg		0.0693	0.14	0.25	0.19	0.032	0.0328	0.0328	0.0256	0.024	0.0397	0.0593	0.021	0.0288	0.0131	24	0.0131	0.25	0.17	0.486
Molybdenum (Sediment) mg/kg		7.45	12.4	20.8	18.3	3.53	1.95	1.94	3.99	1.64	7.57	2.19	1.88	4.33	1.58	24	1.58	20.8		
Nickel (Sediment) mg/kg		23.1	22.4	24.4	27.7	17.2	16.4	53.2	16.3	16.1	25.2	42.7	26.8	28.2	59.5	24	16.1	59.5	16	75
Phosphorus (Sediment) mg/kg		1350	1600	1920	1950	1600	682	1020	1270	2200	1160	1090	1060	998	1270	24	682	2200		
Potassium (Sediment) mg/kg		2150	2360	3150	2420	3390	2350	1840	1580	2390	2060	870	1220	1660	850	24	850	3390		
Selenium (Sediment) mg/kg		0.81	1.03	1.56	1.93	0.36	0.58	1.31	1.05	0.52	0.97	1.55	0.61	0.55	0.46	24	0.36	1.93		
Silver (Sediment) mg/kg		0.273	0.293	0.576	0.624	0.157	0.242	0.439	0.31	0.152	0.246	0.349	0.149	0.169	0.121	24	0.121	0.624		
Sodium (Sediment) mg/kg		310	300	330	270	690	1100	350	320	390	490	120	230	380	150	24	120	1100		
Strontium (Sediment) mg/kg		36.3	43.8	50.4	31.8	32.3	33.8	26.2	27.5	32.2	38.7	34.1	24.2	41.1	50.2	24	24.2	50.4		
Thallium (Sediment) mg/kg		0.41	0.393	0.489	0.388	0.276	0.178	0.144	0.161	0.201	0.176	0.098	0.124	0.107	0.062	24	0.062	0.489		
Tin (Sediment) mg/kg		2.09	2.52	2.46	2.43	1.63	1.29	1.24	1.82	0.92	1.47	1.03	2.21	1.46	1.19	24	0.92	2.52		
Titanium (Sediment) mg/kg		698	677	809	606	1190	831	554	717	740	735	311	739	802	459	24	311	1190		
Uranium (Sediment) mg/kg		64.6	84.3	119	114	11.4	3.3	1.45	26.1	6.56	10.8	2.87	13.3	38.3	3.32	24	1.45	119		
Vanadium (Sediment) mg/kg		50.3	52.5	66.6	65.1	80.6	70.2	55	54.7	62.3	83.2	44.5	76.1	67.9	44.7	24	44.5	83.2		
Zinc (Sediment) mg/kg		146	145	151	145	130	120	376	150	128	192	223	97.1	78.8	97.3	24	78.8	376	123	315
Organics																				
Carbon Organic (Total) %						0.14	0.11	0.18	0.11	0.16	0.23	0.35	0.16	0.3	0.1	10	0.1	0.35		
Polycyclic Aromatic Hydrocarbons (PAHs)																				
2-Methylnaphthalene mg/kg						0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	10	0.01	0.01	0.0202	0.201
Acenaphthene mg/kg						0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	10	0.005	0.005	0.00671	0.0889
Acenaphthene-d10 (SS) %						86	87	77	88	89	83	85	85	82	87	10	77	89		
Acenaphthylene mg/kg						0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	10	0.005	0.005	0.00587	0.128
Anthracene mg/kg						0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	10	0.004	0.004	0.0469	0.245
Benzo (a) anthracene mg/kg						0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	10	0.01	0.01	0.0317	0.385
						0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	10	0.01	0.01	0.0319	0.782
						0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	10	0.02	0.02		
						0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	10	0.01	0.01		
						0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	10	0.015	0.015		
						0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	10	0.01	0.01		
						0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	10	0.01	0.01		
						0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	10	0.01	0.01	0.0571	0.862
						87	80	75	80	88	79	85	80	75	82	10	75	88		
Dibenzo (a/h) anthracene mg/kg									0.005	0.005	0.005	0.005	0.005	0.005	0.005	10	0.005	0.005	0.00622	0.135
Fluoranthene mg/kg									0.01	0.01	0.01	0.01	0.01	0.01	0.01	10	0.01	0.01	0.111	2.355
Fluorene mg/kg									0.01	0.01	0.01	0.01	0.01	0.01	0.01	10	0.01	0.01	0.0212	0.144
High Molecular Weight PAHs mg/kg									0.15	0.15	0.15	0.15	0.15	0.15	0.15	10	0.15	0.15		
Indeno(1/2/3-cd)pyrene mg/kg									0.01	0.01	0.01	0.01	0.01	0.01	0.01	10	0.01	0.01		
Naphthalene mg/kg									0.01	0.01	0.01	0.01	0.01	0.01	0.01	10	0.01	0.01	0.0346	0.391
Naphthalene-d8 (SS) %									86	88	83	84	83	81	86	10	81	88		
Phenanthrene mg/kg									0.01	0.01	0.01	0.01	0.01	0.01	0.01	10	0.01	0.01	0.0419	0.515
Phenanthrene-d10 (SS) %									81	85	79	82	80	78	82	10	78	85		
Pyrene mg/kg						0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	10	0.01	0.01	0.053	0.875
Particle Size																				
% Clay (<4um) %						0.41	0.34	0.51	0.29	0.76	0.81	0.45	0.31	0.5	0.64	10	0.29	0.81		
% Gravel (>2mm) %						28	23.2	17.9	9.25	16.4	15.2	27.9	14.3	14	20.8	10	9.25	28		
% Sand (0.09mm - 0.063mm) %						1.01	0.16	0.54	1.21	3.4	3.13	0.26	0.83	3.56	2.17	10	0.16	3.56		
% Sand (0.25mm - 0.125mm) %						3.87	0.94	2.8	9.27	13.6	6.83	1.72	2.39	8.18	9.55	10	0.94	13.6		
% Sand (0.5mm - 0.25mm) %						7.2	6.84	9.19	23.9	23.6	11	7.34	12.3	15.1	15.9	10	6.84	23.9		
% Sand (1mm - 0.5mm) %						24.1	39	34.2	46.4	30.1	29.2	32	51.9	35.9	34.7	10	24.1	51.9		
% Sand (2mm - 1mm) %						34	28.1	33	8.14	7.68	28.3	28.7	16.6	17.2	14.2	10	7.68	34		
% Silt (0.0312mm - 0.004mm) %						0.68	0.75	1.07	0.7	2.08	2.91	0.99	0.66	2.58	0.9	10	0.66	2.91		
% Silt (0.063mm - 0.0312mm) %						0.76	0.66	0.74	0.9	2.39	2.61	0.62	0.72	3.05	1.11	10	0.62	3.05		

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 1\Appendices\H - Sediment\[H -1 2011-2013 BC Guidelines.xlsx]H-1 2011 BC Final

NOTES:
(a) Units are mg/kg/ unless otherwise stated
(b) BCWQG - BCWQG: Sediment - LEL - British Columbia Water Quality Guideline for Sediment - Interim Sediment Quality Guideline (.).
(c) BCWQG - BCWQG: Sediment - SEL - British Columbia Water Quality Guideline for Sediment - Potable Effect Level (.).
(d) indicates the value exceeds the limits of BCWQG: Sediment - LEL
(e) indicates the value exceeds the limits of BCWQG: Sediment - ISQG BCWQG: Sediment - SEL
(f) Detection limit values displayed with less than symbol (<); statistics calculated using the detection limit value.
(g) VALUES HAVE BEEN AVERAGED AMOUNG SITE REPLICATES

APPENDIX H

HARPER CREEK MINING INC.
HARPER CREEK PROJECT

2012 AQUATIC SEDIMENT DATA - BC GUIDELINE

Print Aug/22/14 11:05:18

Site Name	MDL (a)	T Creek		P Creek	Harper Creek				Barriere River		Baker Creek	Samples Collected	Min	Max	BCWQG - ISQG	BCWQG - PEL
Site ID (sample size)		TMF-10 (n=3)	TMF-20 (n=3)	OP-10 (n=3)	HC-10 (n=3)	HC-20 (n=5)	HC-30 (n=5)	HC-40 (n=3)	BR-10 (n=3)	BR-20 (n=3)	BC-10 (n=3)					
Date/Time Sampled		26-Sep-12	25-Sep-12	27-Sep-12	26-Sep-12	26-Sep-12	27-Sep-12	27-Sep-12	25-Sep-12	26-Sep-12	25-Sep-12					
Physical Tests																
pH	0.1	7.56	7.18	7.58	7.29	7.49	7.44	7.91	7.43	7.46	8.41	34	7.18	8.5		
Total Metals																
Sediment Metals																
Aluminum (Sediment) mg/kg	50	24900	23600	21200	13700	22000	20100	20800	16500	21600	11400	34	11400.00	24900.00		
Antimony (Sediment) mg/kg	0.1	0.37	0.17	0.46	0.3	0.46	0.4	0.48	0.52	0.2	0.34	34	0.17	0.52		
Arsenic (Sediment) mg/kg	0.05	14.5	9.68	42.5	14.2	28.3	32.5	45.6	16.7	14.1	19.5	34	9.68	45.60	5.9	17
Barium (Sediment) mg/kg	0.5	169	158	108	78.8	130	110	88.9	111	132	58.8	34	58.80	169.00		
Beryllium (Sediment) mg/kg	0.1	0.82	0.5	0.44	0.68	0.66	0.55	0.43	0.75	0.63	0.3	34	0.30	0.82		
Bismuth (Sediment) mg/kg	0.1	0.48	0.36	1.25	0.68	0.71	0.76	0.65	0.77	0.23	0.25	34	0.23	1.25		
Boron (Sediment) mg/kg	5	<5	<5	<5	<5	<5	<5	<5		<5	<5	34	<5.0	<5.0		
Cadmium (Sediment) mg/kg	0.05	0.544	1.18	1.62	0.471	0.68	0.996	1.59	0.494	0.338	0.23	34	0.23	1.62	0.6	3.5
Calcium (Sediment) mg/kg	50	8890	6090	4760	5920	8250	6870	8240	6450	7520	7870	34	4760.00	8890.00		
Chromium (Sediment) mg/kg	0.5	28.1	22.5	36.3	19.6	49.8	37.8	47.5	37.3	51.8	45.1	34	19.60	51.80	37.3	90
Cobalt (Sediment) mg/kg	0.1	13.7	15.2	21.5	9.42	16.8	17.5	21.6	15.1	16.5	17.4	34	9.42	21.60		
Copper (Sediment) mg/kg	0.5	49.9	58.1	356	73.5	102	140	136	59.8	37	35.3	34	35.30	356.00	35.7	197
Iron (Sediment) mg/kg	50	37600	30200	50300	28200	39900	42100	45100	35500	37000	37500	34	28200.00	50300.00	21200	43766
Lead (Sediment) mg/kg	0.1	27.6	12.9	34.4	31.2	25.4	26.3	43.2	39.3	12.7	23.5	34	12.70	43.20	35	91.3
Lithum (Sediment) mg/kg		28	15.2	14.6	20.3	27	22	17.4	25.3	24	13.5	34	13.50	28.00		
Magnesium (Sediment) mg/kg	10	10700	8110	12100	6930	11500	11200	12100	8760	10300	7990	34	6930.00	12100.00	460	1100
Manganese (Sediment) mg/kg	0.2	1410	1770	961	570	1110	952	1360	801	1090	684	34	570.00	1770.00		
Mercury (Sediment) mg/kg	0.005 - 0.01	0.0352	0.0527	0.0329	0.0264	0.0324	0.0381	0.0728	0.029	0.0421	0.0211	34	0.02	0.07	0.17	0.486
Molybdenum (Sediment) mg/kg	0.1	2.66	1.54	1.2	3.51	3.09	2.13	1.54	2.23	4.58	0.98	34	0.98	4.58		
Nickel (Sediment) mg/kg	0.5	14.6	13.3	37.3	11.1	30.6	25.1	39	30.7	32.3	47.9	34	11.10	47.90	16	75
Phosphorus (Sediment) mg/kg	10	1600	652	934	1120	1390	1050	1210	1090	833	1060	34	652.00	1600.00		
Potassium (Sediment) mg/kg	100	3310	2210	1610	1500	2540	1850	930	1920	1730	780	34	780.00	3310.00		
Selenium (Sediment) mg/kg	0.1	0.4	0.61	1.19	0.62	0.71	1.01	2.29	0.67	0.66	0.57	34	0.40	2.29		
Silver (Sediment) mg/kg	0.05	0.188	0.24	0.415	0.183	0.174	0.283	0.41	0.207	0.186	0.136	34	0.14	0.42		
Sodium (Sediment) mg/kg	100	560	520	240	250	370	390	<100	340	350	<100	34	240.00	560.00		
Strontium (Sediment) mg/kg	0.1	29.3	23.6	20.5	25.6	37	32.3	37	30.6	41	38.1	34	20.50	41.00		
Thallium (Sediment) mg/kg	0.05	0.256	0.195	0.113	0.126	0.213	0.149	0.08	0.18	0.121	0.055	34	0.06	0.26		
Tin (Sediment) mg/kg	0.2	2.14	0.79	1.07	1.21	1.47	2.18	1.17	1.61	1.21	0.47	34	0.47	2.18		
Titanium (Sediment) mg/kg	1	1190	618	386	595	862	667	319	750	745	274	34	274.00	1190.00		
Uranium (Sediment) mg/kg	0.05	9.93	3.07	1.33	19.3	10.6	7.48	2.36	14.5	35.2	0.876	34	0.88	35.20		
Vanadium (Sediment) mg/kg	0.2	69.5	46.6	42.2	44.4	62.6	61.3	42.2	48.9	61.4	31.8	34	31.80	69.50		
Zinc (Sediment) mg/kg	1	124	136	327	120	159	182	232	138	82.1	81.6	34	81.60	327.00	123	315
Particle Size																
% Clay (<4um) %	0.1	0.1	0.53	0.34	0.78	0.24	0.49	0.38	0.52	0.32	0.28	34	0.10	0.78		
% Gravel (>2mm) %	0.1	0.1	34.3	34.2	19.2	20.6	20.9	21.7	24.1	0.39	33.1	34	0.10	34.30		
% Sand (0.09mm - 0.063mm) %	0.1	0.1	1.25	0.94	2.77	1.77	1.73	1.29	1.3	1.07	1.62	34	0.10	2.77		
% Sand (0.25mm - 0.125mm) %	0.1	0.1	4.58	2.06	5.95	6.3	5.58	6.08	3.89	6.39	5.01	34	0.10	6.39		
% Sand (0.5mm - 0.25mm) %	0.1	0.1	6.7	7.59	12.3	10.9	12.8	13.7	11.1	29.1	8.03	34	0.10	29.10		
% Sand (1mm - 0.5mm) %	0.1	0.1	26.8	26.2	35.3	36	32.6	34.1	33.1	58.1	24.2	34	0.10	58.10		
% Sand (2mm - 1mm) %	0.1	0.1	23.7	25.3	18.4	22.6	22.8	20.8	21	3.53	25.9	34	0.10	25.90		
% Silt (0.0312mm - 0.004mm) %	0.1	0.1	1.12	1.66	2.69	0.69	1.57	1.01	2.51	0.56	0.84	34	0.10	2.69		
% Silt (0.063mm - 0.0312mm) %	0.1	0.1	1.06	1.63	2.56	1	1.56	1.06	2.45	0.57	0.96	34	0.10	2.56		

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 1\Appendices\H - Sediment\[H -1 2011-2013 BC Guidelines.xlsx]H-2 2012 BC Final

NOTES:
(a) Units are mg/kg/ unless otherwise stated
(b) BCWQG - BCWQG: Sediment - LEL - British Columbia Water Quality Guideline for Sediment - Interim Sediment Quality Guideline (.).
(c) BCWQG - BCWQG: Sediment - SEL - British Columbia Water Quality Guideline for Sediment - Potable Effect Level (.).
(d) indicates the value exceeds the limits of BCWQG: Sediment - LEL
(e) indicates the value exceeds the limits of BCWQG: Sediment - ISQG BCWQG: Sediment - SEL
(f) Detection limit values displayed with less than symbol (<); statistics calculated using the detection limit value.
(g) VALUES HAVE BEEN AVERAGED AMOUNG SITE REPLICATES

Knight Piésold CONSULTING

APPENDIX H

HARPER CREEK MINING INC.
HARPER CREEK PROJECT

2013 AQUATIC SEDIMENT DATA - BC GUIDELINES

Print Aug/22/14 11:05:18

Site Name	MDL (a)	T Creek		P Creek	Harper Creek				Barriere River		Baker Creek	Samples Collected	Min	Max	BCWQG - ISQG	BCWQG - PEL
Site ID (sample size)		TMF-10	TMF-20	OP-10	HC-10	HC-20	HC-30	HC-40	BR-10	BR-20	BC-10					
Date/Time Sampled		24-Sep-13	25-Sep-13	24-Sep-13	25-Sep-13	25-Sep-13	26-Sep-13	24-Sep-13	24-Sep-13	25-Sep-13	25-Sep-13					
Physical Tests																
pH	0.1	7.04	6.34	7.28	6.9	7.32	7.1	7.35	7.14	7.63	8.33	34	6.34	8.5		
Total Metals																
Sediment Metals																
Aluminum (Sediment) mg/kg	50	22000	21000	29000	13400	23200	24500	18500	15400	20800	9960	34	9960.00	29000.00		
Antimony (Sediment) mg/kg	0.1	0.34	0.15	0.49	0.44	0.49	0.44	0.43	0.39	0.17	0.56	34	0.15	0.56		
Arsenic (Sediment) mg/kg	0.05	13.1	6.84	46.1	13.5	31.6	33.1	31.1	13.9	9.09	18	34	6.84	46.10	5.9	17
Barium (Sediment) mg/kg	0.5	137	129	136	71	135	138	74.8	96.9	108	57.9	34	57.90	138.00		
Beryllium (Sediment) mg/kg	0.1	0.66	0.41	0.51	0.58	0.67	0.66	0.36	0.75	0.54	0.25	34	0.25	0.75		
Bismuth (Sediment) mg/kg	0.1	0.43	0.32	1.3	0.76	0.73	0.7	0.54	0.55	0.19	0.3	34	0.19	1.30		
Boron (Sediment) mg/kg	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	34	<5.0	<5.0		
Cadmium (Sediment) mg/kg	0.05	0.505	0.512	2.22	0.51	0.755	0.973	0.926	0.424	0.243	0.335	34	0.24	2.22	0.6	3.5
Calcium (Sediment) mg/kg	50	7580	4730	5950	5980	7400	7380	8840	5780	6060	8080	34	4730.00	8840.00		
Chromium (Sediment) mg/kg	0.5	26.4	14	68.1	25.3	34.9	121	31	28.6	41	36.7	34	14.00	121.00	37.3	90
Cobalt (Sediment) mg/kg	0.1	12.1	11.6	26	9.89	18.7	19.9	16	12.2	14.1	16.6	34	9.89	26.00		
Copper (Sediment) mg/kg	0.5	48.7	48	469	69.9	110	131	108	50.9	27.2	36.3	34	27.20	469.00	35.7	197
Iron (Sediment) mg/kg	50	31600	24600	57400	30900	42900	44300	34800	30900	32600	36000	34	24600.00	57400.00	21200	43766
Lead (Sediment) mg/kg	0.1	15.4	10.7	43.6	39.4	25.5	158	35.6	33.7	9.83	24.4	34	9.83	158.00	35	91.3
Lithium (Sediment) mg/kg		21.7	13.2	19	20.3	26.4	25.7	14.2	22.4	23.9	10.1	34	10.10	26.40		
Magnesium (Sediment) mg/kg	10	8010	7050	15500	7020	11400	12500	9380	6480	10600	6240	34	6240.00	15500.00	460	1100
Manganese (Sediment) mg/kg	0.2	1260	985	1180	545	1290	2160	762	631	839	640	34	545.00	2160.00		
Mercury (Sediment) mg/kg	0.005 - 0.01	0.0499	0.0455	0.0479	0.0154	0.032	0.0283	0.0775	0.042	0.0268	0.0256	34	0.02	0.08	0.17	0.486
Molybdenum (Sediment) mg/kg	0.1	2.38	1.04	1.47	3.19	2.75	3.75	1.1	2.52	3	0.91	34	0.91	3.75		
Nickel (Sediment) mg/kg	0.5	14.6	9.79	61.7	12.5	23.4	83.1	30	24.6	25.2	44	34	9.79	83.10	16	75
Phosphorus (Sediment) mg/kg	10	1270	709	1090	1410	1360	1110	1140	1180	860	1150	34	709.00	1410.00		
Potassium (Sediment) mg/kg	100	2350	1910	2070	1500	2470	2380	890	1420	1620	700	34	700.00	2470.00		
Selenium (Sediment) mg/kg	0.1	0.43	0.5	1.44	0.76	0.79	0.77	2.11	0.81	0.47	0.65	34	0.43	2.11		
Silver (Sediment) mg/kg	0.05	0.174	0.221	0.428	0.249	0.195	0.403	0.364	0.235	0.121	0.149	34	0.12	0.43		
Sodium (Sediment) mg/kg	100	420	370	390	300	400	570	<100	230	360	<100	34	230.00	570.00		
Strontium (Sediment) mg/kg	0.1	27.4	18.2	24.8	23.7	33.8	35.6	38	31.4	32.7	39.8	34	18.20	39.80		
Thallium (Sediment) mg/kg	0.05	0.209	0.155	0.151	0.122	0.209	0.187	0.073	0.144	0.09	<0.05	34	0.07	0.21		
Tin (Sediment) mg/kg	0.2	1.09	0.6	1.25	1.31	2.47	1.52	0.42	0.95	1.02	0.71	34	0.42	2.47		
Titanium (Sediment) mg/kg	1	759	431	514	766	849	984	282	595	686	298	34	282.00	984.00		
Uranium (Sediment) mg/kg	0.05	10.5	2.57	1.62	18.9	10.9	8.23	3.4	25.7	22.1	0.908	34	0.91	25.70		
Vanadium (Sediment) mg/kg	0.2	54.5	36.9	54.4	53.6	66.4	68.3	32	43.2	57.1	31.6	34	31.60	68.30		
Zinc (Sediment) mg/kg	1	114	101	424	130	172	226	164	115	70.2	81.7	34	70.20	424.00	123	315
Particle Size																
% Clay (<4um) %	0.1	0.7	2.07	0.65	<0.1		<0.1	1.68	0.98	0.35	0.44	10	0.35	2.07		
% Gravel (>2mm) %	0.1	22	5.87	18.1	0.5		39.2	19.3	1.09	10.6	19.9	10	0.50	39.20		
% Sand (0.09mm - 0.063mm) %	0.1	3.8	8.49	2.24	1.59		0.23	4.99	8.18	3.04	3.48	10	0.23	8.49		
% Sand (0.25mm - 0.125mm) %	0.1	9.39	12.8	4.66	7.48		2.3	7.14	20.4	7.93	8.64	10	2.30	20.40		
% Sand (0.5mm - 0.25mm) %	0.1	14	15.9	15.4	34.2		11.1	9.29	34.1	30.4	18.9	10	9.29	34.20		
% Sand (1mm - 0.5mm) %	0.1	14.7	23.5	23.5	45.4		23.1	13.6	19.3	29.8	22.7	10	13.60	45.40		
% Sand (2mm - 1mm) %	0.1	28.2	9.04	29.4	9.36		23.3	21.1	4.25	13.7	21.6	10	4.25	29.40		
% Silt (0.0312mm - 0.004mm) %	0.1	3.66	11.6	3.29	0.54		0.41	12.2	5.64	2.07	2.07	10	0.41	12.20		
% Silt (0.063mm - 0.0312mm) %	0.1	3.56	10.8	2.8	0.86		0.36	10.8	6.04	2.18	2.2	10	0.36	10.80		

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 1\Appendices\H - Sediment\[H -1 2011-2013 BC Guidelines.xlsx]H-3 2013 BC Final

NOTES:

(a) Units are mg/kg/ unless otherwise stated
(b) BCWQG - BCWQG: Sediment - LEL - British Columbia Water Quality Guideline for Sediment - Interim Sediment Quality Guideline (.).
(c) BCWQG - BCWQG: Sediment - SEL - British Columbia Water Quality Guideline for Sediment - Potable Effect Level (.).
(d) indicates the value exceeds the limits of BCWQG: Sediment - LEL
(e) indicates the value exceeds the limits of BCWQG: Sediment - ISQG BCWQG: Sediment - SEL
(f) Detection limit values displayed with less than symbol (<); statistics calculated using the detection limit value.
(g) VALUES HAVE BEEN AVERAGED AMOUNG SITE REPLICATES

APPENDIX H
HARPER CREEK MINING INC.
HARPER CREEK PROJECT
2011 AQUATIC SEDIMENT DATA (STREAM SITES)

Print Aug/22/14 13:02:02

RESULTS OF ANALYSIS										
Sample ID	HC-30	HC-20	TMF-10	HC-40	OP-10	HC-10	BR-20	BR-10	BC-10	TMF-20
Date Sampled	20-SEP-11	20-SEP-11	20-SEP-11	21-SEP-11	21-SEP-11	21-SEP-11	21-SEP-11	22-SEP-11	22-SEP-11	23-SEP-11
Time Sampled	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	L1062942-1	L1062942-2	L1062942-3	L1062942-4	L1062942-5	L1062942-6	L1062942-7	L1062942-8	L1062942-9	L1062942-10
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests										
Moisture	26.4	24.1	20.0	16.6	25.6	22.3	19.7	22.6	17.8	19.5
pH (1:2 soil:water)	7.18	7.54	7.52	7.61	7.66	7.22	7.56	7.39	8.50	7.53
Particle Size										
% Gravel (>2mm)	15.2	16.4	28.0	27.9	17.9	9.25	14.0	14.3	20.8	23.2
% Sand (2.00mm - 1.00mm)	28.3	7.68	34.0	28.7	33.0	8.14	17.2	16.6	14.2	28.1
% Sand (1.00mm - 0.50mm)	29.2	30.1	24.1	32.0	34.2	46.4	35.9	51.9	34.7	39.0
% Sand (0.50mm - 0.25mm)	11.0	23.6	7.20	7.34	9.19	23.9	15.1	12.3	15.9	6.84
% Sand (0.25mm - 0.125mm)	6.83	13.6	3.87	1.72	2.80	9.27	8.18	2.39	9.55	0.94
% Sand (0.125mm - 0.063mm)	3.13	3.40	1.01	0.26	0.54	1.21	3.56	0.83	2.17	0.16
% Silt (0.063mm - 0.0312mm)	2.61	2.39	0.76	0.62	0.74	0.90	3.05	0.72	1.11	0.66
% Silt (0.0312mm - 0.004mm)	2.91	2.08	0.68	0.99	1.07	0.70	2.58	0.66	0.90	0.75
% Clay (<4um)	0.81	0.76	0.41	0.45	0.51	0.29	0.50	0.31	0.64	0.34
Organic / Inorganic Carbon										
CaCO3 Equivalent	0.74	0.88	<0.70	0.79	<0.70	<0.70	0.70	<0.70	1.22	0.91
Inorganic Carbon	<0.10	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.15	0.11
Total Carbon by Combustion	0.2	0.3	0.1	0.4	0.2	0.1	0.3	0.2	0.2	0.2
Total Organic Carbon	0.23	0.16	0.14	0.35	0.18	0.11	0.30	0.16	<0.10	0.11
Metals										
Aluminum (Al)	24500	19100	26500	19100	25200	14500	21200	10700	12200	29400
Antimony (Sb)	0.54	0.47	0.38	0.49	0.53	0.35	0.20	0.37	0.48	0.16
Arsenic (As)	75.3	21.4	14.7	53.9	44.1	19.5	12.5	12.3	24.9	12.5
Barium (Ba)	132	132	179	96.8	123	84.1	126	72.0	71.9	167
Beryllium (Be)	0.68	0.54	0.78	0.43	0.47	0.67	0.53	0.45	0.28	0.59
Bismuth (Bi)	0.84	0.53	0.44	0.76	1.25	1.05	0.30	0.41	0.28	0.37
Boron (B)	-	-	-	-	-	-	-	-	-	-
Cadmium (Cd)	0.808	0.527	0.491	1.35	1.91	0.715	0.309	0.354	0.251	0.405
Calcium (Ca)	7440	8550	8960	7290	5990	6160	6770	5200	9850	7930
Chromium (Cr)	37.5	26.8	38.1	52.5	68.3	36.2	48.7	54.5	72.1	31.6
Cobalt (Co)	23.0	14.8	15.3	24.3	24.1	12.6	17.0	10.8	21.2	15.5
Copper (Cu)	172	80.7	53.4	131	417	88.2	36.4	49.7	41.9	60.3
Iron (Fe)	61000	35700	39700	50200	57400	32500	39000	43100	47700	36600

RESULTS OF ANALYSIS										
Sample ID	HC-30-1 A/B	HC-30-2 A/B	HC-30-3 A/B	HC-30-4 A/B	HC-30-5 A/B	HC-20-1 A/B	HC-20-2 A/B	HC-20-3 A/B	HC-20-4 A/B	HC-20-5 A/B
Date Sampled	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11	20-SEP-11
Time Sampled	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	L1062942-11	L1062942-12	L1062942-13	L1062942-14	L1062942-15	L1062942-16	L1062942-17	L1062942-18	L1062942-19	L1062942-20
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests										
Moisture	-	-	-	-	-	-	-	-	-	-
pH (1:2 soil:water)	7.42	7.46	7.24	7.61	7.46	7.16	7.20	7.46	7.49	7.47
Particle Size										
% Gravel (>2mm)	-	-	-	-	-	-	-	-	-	-
% Sand (2.00mm - 1.00mm)	-	-	-	-	-	-	-	-	-	-
% Sand (1.00mm - 0.50mm)	-	-	-	-	-	-	-	-	-	-
% Sand (0.50mm - 0.25mm)	-	-	-	-	-	-	-	-	-	-
% Sand (0.25mm - 0.125mm)	-	-	-	-	-	-	-	-	-	-
% Sand (0.125mm - 0.063mm)	-	-	-	-	-	-	-	-	-	-
% Silt (0.063mm - 0.0312mm)	-	-	-	-	-	-	-	-	-	-
% Silt (0.0312mm - 0.004mm)	-	-	-	-	-	-	-	-	-	-
% Clay (<4um)	-	-	-	-	-	-	-	-	-	-
Organic / Inorganic Carbon										
CaCO3 Equivalent	-	-	-	-	-	-	-	-	-	-
Inorganic Carbon	-	-	-	-	-	-	-	-	-	-
Total Carbon by Combustion	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon	-	-	-	-	-	-	-	-	-	-
Metals										
Aluminum (Al)	19900	17900	20900	19600	18700	17200	17100	15300	16800	13900
Antimony (Sb)	0.50	0.42	0.46	0.44	0.40	0.46	0.36	0.41	0.45	0.39
Arsenic (As)	37.2	29.0	59.9	33.4	29.3	24.8	21.7	18.0	23.9	16.9
Barium (Ba)	126	98.9	112	121	109	103	108	106	122	93.7
Beryllium (Be)	0.55	0.47	0.60	0.54	0.49	0.49	0.51	0.45	0.51	0.43
Bismuth (Bi)	1.48	0.86	0.71	0.75	0.60	0.57	0.50	0.44	0.55	0.40
Boron (B)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd)	1.52	0.822	0.661	1.39	1.05	0.484	0.535	0.531	0.623	0.378
Calcium (Ca)	6800	6310	6790	6840	6080	6270	6870	7210	7420	7930
Chromium (Cr)	42.3	59.3	68.3	59.5	32.4	39.4	51.4	82.5	34.7	34.1
Cobalt (Co)	20.3	16.7	19.4	20.2	17.2	15.8	14.1	14.1	15.2	12.1
Copper (Cu)	171	147	151	158	129	97.6	86.1	80.8	89.1	59.6
Iron (Fe)	44600	36900	52300	40300	39500	36600	34800	32400	35200	30300

Lead (Pb)	31.2	20.2	19.3	57.7	43.2	53.9	12.3	39.9	27.6	13.7	32.7	24.0	25.9	28.9	22.8	23.2	19.4	16.7	20.3	15.1
Magnesium (Mg)	12700	9630	10900	11000	14900	7570	10800	6000	8720	10200	11400	9780	11300	10700	11100	9840	9270	8730	9100	7460
Manganese (Mn)	1040	943	1420	1610	1080	647	988	483	838	1450	1290	873	852	1230	1020	907	847	836	980	725
Mercury (Hg)	0.0397	0.0240	0.032	0.0593	0.0328	0.0256	0.0288	0.0210	0.0131	0.0328	0.0577	0.0328	0.0310	0.0410	0.0236	0.0186	0.0263	0.0171	0.0231	0.0135
Molybdenum (Mo)	7.57	1.64	3.53	2.19	1.94	3.99	4.33	1.88	1.58	1.95	2.95	2.50	6.69	2.63	2.14	2.22	2.29	2.16	1.88	1.72
Nickel (Ni)	25.2	16.1	17.2	42.7	53.2	16.3	28.2	26.8	59.5	16.4	34.9	43.2	48.2	46.4	26.5	27.1	32.2	51.3	23.6	19.7
Phosphorus (P)	1160	2200	1600	1090	1020	1270	998	1060	1270	682	1030	1050	1180	1110	1110	1560	1620	1930	1900	2430
Potassium (K)	2060	2390	3390	870	1840	1580	1660	1220	850	2350	2070	1690	1890	1820	2110	2280	2180	2230	2340	2030
Selenium (Se)	0.97	0.52	0.36	1.55	1.31	1.05	0.55	0.61	0.46	0.58	1.12	0.75	0.84	0.91	0.75	0.48	0.53	0.41	0.49	0.35
Silver (Ag)	0.246	0.152	0.157	0.349	0.439	0.310	0.169	0.149	0.121	0.242	0.301	0.216	0.209	0.228	0.209	0.181	0.135	0.106	0.123	0.099
Sodium (Na)	490	390	690	120	350	320	380	230	150	1100	430	380	460	410	430	400	370	340	360	310
Strontium (Sr)	38.7	32.2	32.3	34.1	26.2	27.5	41.1	24.2	50.2	33.8	34.8	30.8	33.4	34.1	31.3	26.9	27.1	26.5	29.4	24.7
Sulfur (S)-Total	<500	<500	600	<500	<500	<500	<500	<500	<500	<500	-	-	-	-	-	-	-	-	-	-
Thallium (Tl)	0.176	0.201	0.276	0.098	0.144	0.161	0.107	0.124	0.062	0.178	0.173	0.132	0.149	0.158	0.161	0.171	0.166	0.169	0.199	0.151
Tin (Sn)	1.47	0.92	1.63	1.03	1.24	1.82	1.46	2.21	1.19	1.29	2.43	2.55	2.37	1.94	2.44	1.58	1.47	2.23	1.55	1.62
Titanium (Ti)	735	740	1190	311	554	717	802	739	459	831	682	675	692	624	794	760	689	741	753	669
Uranium (U)	10.8	6.56	11.4	2.87	1.45	26.1	38.3	13.3	3.32	3.30	6.65	5.94	8.49	6.50	5.74	5.50	7.12	4.74	5.91	4.56
Vanadium (V)	83.2	62.3	80.6	44.5	55.0	54.7	67.9	76.1	44.7	70.2	62.1	52.0	71.4	57.2	59.5	60.9	58.7	57.0	57.8	53.5
Zinc (Zn)	192	128	130	223	376	150	78.8	97.1	97.3	120	207	164	172	194	176	141	130	119	134	96.0
Polycyclic Aromatic Hydrocarbons																				
Acenaphthene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-	-	-	-	-	-	-
Anthracene	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-
Benzo(b+j+k)fluoranthene	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-
Chrysene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-	-	-	-	-	-	-
Fluoranthene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-
Fluorene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-c,d)pyrene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-
Naphthalene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-
Phenanthrene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-
Pyrene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-
Surrogate: Acenaphthene d10	83	89	86	85	77	88	82	85	87	87	-	-	-	-	-	-	-	-	-	-
Surrogate: Chrysene d12	79	88	87	85	75	80	75	80	82	80	-	-	-	-	-	-	-	-	-	-
Surrogate: Naphthalene d8	83	88	85	84	77	86	81	83	86	85	-	-	-	-	-	-	-	-	-	-
Surrogate: Phenanthrene d10	79	85	81	82	72	81	78	80	82	82	-	-	-	-	-	-	-	-	-	-
B(a)P Total Potency Equivalent	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	-	-	-	-	-	-	-	-	-	-
IACR (CCME)	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	-	-	-	-	-	-	-	-	-	-

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 1\Appendices\H - Sediment\[H-3 2011-2013 Sediment.xls]2011

Knight Piésold
CONSULTING

APPENDIX H

HARPER CREEK MINING INC.
HARPER CREEK PROJECT

2011 AQUATIC SEDIMENT DATA (LAKE SITES)

Print Aug/22/14 13:03:38

RESULTS OF ANALYSIS				
Sample ID	NBL-1A	NBL-2A	NBL-3A	NBL-4A
Date Sampled	19-OCT-11	19-OCT-11	19-OCT-11	19-OCT-11
Time Sampled	09:00	09:30	09:45	10:00
ALS Sample ID	L1074749-1	L1074749-3	L1074749-5	L1074749-7
Matrix	Soil	Soil	Soil	Soil
Physical Tests				
pH (1:2 soil:water)	6.62	6.29	6.66	5.94
Metals				
Aluminum (Al)	24200	27000	32400	27400
Antimony (Sb)	0.20	0.20	0.38	0.54
Arsenic (As)	8.96	10.5	25.3	35.1
Barium (Ba)	141	176	465	382
Beryllium (Be)	1.56	1.94	2.43	2.27
Bismuth (Bi)	0.60	0.63	0.93	0.98
Boron (B)	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd)	0.457	0.538	0.872	0.906
Calcium (Ca)	5780	6050	5950	4120
Chromium (Cr)	35.5	33.1	32.3	35.4
Cobalt (Co)	17.5	13.2	17.9	17.2
Copper (Cu)	50.5	44.0	55.3	54.0
Iron (Fe)	32800	37300	71100	88000
Lead (Pb)	16.9	22.0	35.6	47.0
Magnesium (Mg)	8720	6970	6700	5060
Manganese (Mn)	808	1940	12500	7200
Mercury (Hg)	0.0693	0.140	0.250	0.190
Molybdenum (Mo)	7.45	12.4	20.8	18.3
Nickel (Ni)	23.1	22.4	24.4	27.7
Phosphorus (P)	1350	1600	1920	1950
Potassium (K)	2150	2360	3150	2420
Selenium (Se)	0.81	1.03	1.56	1.93
Silver (Ag)	0.273	0.293	0.576	0.624
Sodium (Na)	310	300	330	270
Strontium (Sr)	36.3	43.8	50.4	31.8
Thallium (Tl)	0.410	0.393	0.489	0.388
Tin (Sn)	2.09	2.52	2.46	2.43
Titanium (Ti)	698	677	809	606
Uranium (U)	64.6	84.3	119	114
Vanadium (V)	50.3	52.5	66.6	65.1
Zinc (Zn)	146	145	151	145

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 1\Appendices\H - Sediment\[H-3 2011-2013 Sediment.xls]2011 Lake

Knight Piésold CONSULTING

APPENDIX H

HARPER CREEK MINING INC.
HARPER CREEK PROJECT

2012 AQUATIC SEDIMENT DATA

Print Aug/22/14 13:18:47

RESULTS OF ANALYSIS																	
Sample ID	BR-10A-1	BR-10A-2	BR-10A-3	BR-20A-1	BR-20A-2	BR-20A-3	HC-10A-1	HC-10A-2	HC-10A-3	HC-20A-1	HC-20A-2	HC-20A-3	HC-20A-4	HC-20A-5	HC-30A-1	HC-30A-2	HC-30A-3
Date Sampled	25-SEP-12	25-SEP-12	25-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	27-SEP-12	27-SEP-12	27-SEP-12
Time Sampled	12:00	12:00	12:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	L1216405-1	L1216405-2	L1216405-3	L1216405-7	L1216405-8	L1216405-9	L1216405-13	L1216405-14	L1216405-15	L1216405-19	L1216405-20	L1216405-21	L1216405-22	L1216405-23	L1216405-29	L1216405-30	L1216405-31
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests																	
pH (1:2 soil:water)	7.43	7.43	7.40	7.46	7.47	7.21	7.29	7.26	6.94	7.49	7.47	7.40	7.39	7.24	7.44	7.47	7.43
Particle Size																	
% Gravel (>2mm)	0.39	-	-	33.1	-	-	20.6	-	-	20.9	-	-	-	-	21.7	-	-
% Sand (2.00mm - 1.00mm)	3.53	-	-	25.9	-	-	22.6	-	-	22.8	-	-	-	-	20.8	-	-
% Sand (1.00mm - 0.50mm)	58.1	-	-	24.2	-	-	36.0	-	-	32.6	-	-	-	-	34.1	-	-
% Sand (0.50mm - 0.25mm)	29.1	-	-	8.03	-	-	10.9	-	-	12.8	-	-	-	-	13.7	-	-
% Sand (0.25mm - 0.125mm)	6.39	-	-	5.01	-	-	6.30	-	-	5.58	-	-	-	-	6.08	-	-
% Sand (0.125mm - 0.063mm)	1.07	-	-	1.62	-	-	1.77	-	-	1.73	-	-	-	-	1.29	-	-
% Silt (0.063mm - 0.0312mm)	0.57	-	-	0.96	-	-	1.00	-	-	1.56	-	-	-	-	1.06	-	-
% Silt (0.0312mm - 0.004mm)	0.56	-	-	0.84	-	-	0.69	-	-	1.57	-	-	-	-	1.01	-	-
% Clay (<4um)	0.32	-	-	0.28	-	-	0.24	-	-	0.49	-	-	-	-	0.38	-	-
Texture	Sand	-	-	Sand	-	-	Sand	-	-	Sand	-	-	-	-	Sand	-	-
Metals																	
Aluminum (Al)	16500	15900	15500	21600	20300	19300	13700	14100	10800	22000	21200	20300	18600	20400	20100	19700	18700
Antimony (Sb)	0.52	0.45	0.44	0.20	0.21	0.18	0.30	0.36	0.33	0.46	0.39	0.46	0.48	0.44	0.40	0.46	0.44
Arsenic (As)	16.7	13.7	14.8	14.1	11.9	11.2	14.2	17.0	14.7	28.3	25.1	23.6	22.0	17.0	32.5	36.3	31.1
Barium (Ba)	111	106	106	132	120	106	78.8	89.4	71.6	130	123	120	114	130	110	113	122
Beryllium (Be)	0.75	0.74	0.72	0.63	0.57	0.52	0.68	0.74	0.44	0.66	0.59	0.62	0.57	0.64	0.55	0.59	0.55
Bismuth (Bi)	0.77	0.50	0.46	0.23	0.37	0.27	0.68	0.84	0.56	0.71	0.63	0.59	0.61	0.49	0.76	0.86	0.72
Boron (B)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd)	0.494	0.472	0.588	0.338	0.259	0.223	0.471	0.659	0.331	0.680	0.647	0.651	0.588	0.500	0.996	0.984	1.01
Calcium (Ca)	6450	6520	6010	7520	7560	5810	5920	6500	5130	8250	7170	8090	6890	7380	6870	6920	7270
Chromium (Cr)	37.3	41.7	33.4	51.8	38.9	37.1	19.6	30.9	27.0	49.8	31.1	31.7	23.6	26.6	37.8	32.9	35.4
Cobalt (Co)	15.1	12.8	13.0	16.5	15.0	14.6	9.42	11.3	10.9	16.8	15.7	15.1	13.3	12.9	17.5	17.6	16.0
Copper (Cu)	59.8	56.8	55.7	37.0	32.3	31.1	73.5	93.8	58.0	102	107	89.9	95.1	64.8	140	151	132
Iron (Fe)	35500	32500	30200	37000	35900	34300	28200	32000	30200	39900	37400	36700	32900	32700	42100	39800	37200
Lead (Pb)	39.3	35.4	32.6	12.7	11.2	10.9	31.2	49.7	27.2	25.4	21.9	21.2	19.6	18.0	26.3	28.1	24.6
Lithium (Li)	25.3	23.9	22.4	24.0	22.5	20.4	20.3	22.5	15.1	27.0	22.9	22.9	19.4	21.9	22.0	21.1	21.5
Magnesium (Mg)	8760	8730	7910	10300	9920	9420	6930	7740	6030	11500	10800	10300	9150	8770	11200	10800	10100
Manganese (Mn)	801	663	755	1090	866	806	570	712	551	1110	992	1100	831	1100	952	1010	1090
Mercury (Hg)	0.0290	0.0321	0.0306	0.0421	0.0317	0.0311	0.0264	0.029	0.0212	0.0324	0.0363	0.0329	0.0340	0.0374	0.0381	0.0409	0.038
Molybdenum (Mo)	2.23	2.19	2.12	4.58	3.36	3.36	3.51	3.97	2.59	3.09	1.87	2.11	1.55	2.48	2.13	2.56	2.70
Nickel (Ni)	30.7	28.1	25.7	32.3	25.9	24.0	11.1	15.0	16.0	30.6	20.4	19.7	16.3	14.6	25.1	24.6	23.1
Phosphorus (P)	1090	1100	1060	833	917	937	1120	1290	1230	1390	1230	1740	1410	1510	1050	991	1080
Potassium (K)	1920	1810	1710	1730	1660	1550	1500	1770	1450	2540	2210	2290	2230	2510	1850	1700	2110
Selenium (Se)	0.67	0.65	0.66	0.66	0.55	0.43	0.62	0.94	0.44	0.71	0.67	0.64	0.66	0.54	1.01	1.01	1.05
Silver (Ag)	0.207	0.195	0.191	0.186	0.160	0.159	0.183	0.250	0.159	0.174	0.208	0.164	0.207	0.165	0.283	0.270	0.254
Sodium (Na)	340	330	280	350	340	310	250	270	230	370	360	350	280	370	390	320	380
Strontium (Sr)	30.6	31.1	28.9	41.0	36.8	34.4	25.6	29.9	21.1	37.0	31.8	32.4	29.4	27.1	32.3	31.7	32.5
Thallium (Tl)	0.180	0.163	0.158	0.121	0.100	0.093	0.126	0.160	0.132	0.213	0.179	0.198	0.183	0.203	0.149	0.150	0.184
Tin (Sn)	1.61	1.52	1.66	1.21	0.95	1.01	1.21	2.29	1.45	1.47	1.29	1.48	1.05	1.53	2.18	1.35	2.13
Titanium (Ti)	750	703	751	745	769	732	595	675	586	862	712	845	628	749	667	526	810
Uranium (U)	14.5	15.6	16.4	35.2	23.3	32.0	19.3	27.8	12.0	10.6	7.87	9.78	7.69	10.6	7.48	8.55	8.03
Vanadium (V)	48.9	45.6	44.1	61.4	59.8	56.9	44.4	50.6	47.7	62.6	58.9	59.3	48.6	55.0	61.3	53.2	54.8
Zinc (Zn)	138	131	126	82.1	76.5	70.0	120	141	99.8	159	160	141	136	118	182	185	169

RESULTS OF ANALYSIS																	
Sample ID	HC-30A-4	HC-30A-5	HC-40A-1	HC-40A-2	HC-40A-3	OP-10A-1	OP-10A-2	OP-10A-3	TMF-10A-1	TMF-10A-2	TMF-10A-3	TMF-20A-1	TMF-20A-2	TMF-20A-3	BC-10A-1	BC-10A-2	BC-10A-3
Date Sampled	27-SEP-12	27-SEP-12	27-SEP-12	27-SEP-12	27-SEP-12	27-SEP-12	27-SEP-12	27-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	25-SEP-12	25-SEP-12	25-SEP-12	25-SEP-12	25-SEP-12	25-SEP-12
Time Sampled	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	L1216405-32	L1216405-33	L1216405-39	L1216405-40	L1216405-41	L1216405-45	L1216405-46	L1216405-47	L1216405-51	L1216405-52	L1216405-53	L1216405-57	L1216405-58	L1216405-59	L1216405-63	L1216405-64	L1216405-65
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests																	
pH (1:2 soil:water)	7.28	7.38	7.91	7.68	7.75	7.58	7.57	7.66	7.56	7.41	7.54	7.18	7.49	7.30	8.41	8.45	8.18
Particle Size																	
% Gravel (>2mm)	-	-	24.1	-	-	19.2	-	-	34.3	-	-	34.2	-	-	11.2	-	-
% Sand (2.00mm - 1.00mm)	-	-	21.0	-	-	18.4	-	-	23.7	-	-	25.3	-	-	12.0	-	-
% Sand (1.00mm - 0.50mm)	-	-	33.1	-	-	35.3	-	-	26.8	-	-	26.2	-	-	30.9	-	-
% Sand (0.50mm - 0.25mm)	-	-	11.1	-	-	12.3	-	-	6.70	-	-	7.59	-	-	19.2	-	-
% Sand (0.25mm - 0.125mm)	-	-	3.89	-	-	5.95	-	-	4.58	-	-	2.06	-	-	15.7	-	-
% Sand (0.125mm - 0.063mm)	-	-	1.30	-	-	2.77	-	-	1.25	-	-	0.94	-	-	4.66	-	-
% Silt (0.063mm - 0.0312mm)	-	-	2.45	-	-	2.56	-	-	1.06	-	-	1.63	-	-	3.21	-	-
% Silt (0.0312mm - 0.004mm)	-	-	2.51	-	-	2.69	-	-	1.12	-	-	1.66	-	-	2.62	-	-
% Clay (<4um)	-	-	0.52	-	-	0.78	-	-	0.53	-	-	0.34	-	-	0.62	-	-
Texture	-	-	Sand	-	-	Sand	-	-	Sand	-	-	Sand	-	-	Sand	-	-
Metals																	
Aluminum (Al)	22900	22400	20800	21300	19100	21200	18900	21200	24900	26300	22600	23600	28200	28900	11400	11100	10000
Antimony (Sb)	0.47	0.44	0.48	0.45	0.40	0.46	0.50	0.49	0.37	0.56	0.33	0.17	0.20	0.20	0.34	0.37	0.32
Arsenic (As)	34.6	34.4	45.6	41.8	40.6	42.5	48.4	41.0	14.5	17.7	12.5	9.68	13.9	17.3	19.5	19.4	16.8
Barium (Ba)	127	115	88.9	88.1	89.3	108	99.3	112	169	184	146	158	172	183	58.8	59.3	55.1
Beryllium (Be)	0.64	0.59	0.43	0.42	0.44	0.44	0.43	0.47	0.82	0.81	0.70	0.50	0.58	0.69	0.30	0.28	0.26
Bismuth (Bi)	0.75	0.81	0.65	0.64	0.59	1.25	1.33	1.17	0.48	0.51	0.37	0.36	0.40	0.44	0.25	0.25	0.23
Boron (B)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd)	1.46	1.18	1.59	1.18	1.43	1.62	1.50	1.75	0.544	0.469	0.473	1.18	0.640	0.873	0.230	0.233	0.194
Calcium (Ca)	6990	6800	8240	7400	8830	4760	4290	5010	8890	8210	8280	6090	7290	6810	7870	7800	6620
Chromium (Cr)	37.9	34.0	47.5	41.7	39.3	36.3	35.9	40.2	28.1	25.6	37.3	22.5	24.7	27.7	45.1	43.1	37.4
Cobalt (Co)	19.3	18.4	21.6	20.6	19.7	21.5	21.5	20.9	13.7	13.9	12.3	15.2	16.4	18.5	17.4	17.2	15.5
Copper (Cu)	156	158	136	123	127	356	341	375	49.9	56.9	46.8	58.1	67.3	68.7	35.3	36.0	30.1
Iron (Fe)	43300	42600	45100	44500	40700	50300	49100	49800	37600	37700	33700	30200	37900	40600	37500	38000	33200
Lead (Pb)	28.6	28.2	43.2	41.9	42.1	34.4	35.2	34.9	27.6	19.3	14.2	12.9	14.4	16.3	23.5	23.0	20.9
Lithium (Li)	25.0	23.3	17.4	17.8	15.5	14.6	13.4	15.1	28.0	28.3	23.5	15.2	18.5	19.3	13.5	12.9	11.0
Magnesium (Mg)	12900	12100	12100	11600	10300	12100	10500	12300	10700	9070	9400	8110	9750	9870	7990	7340	6390
Manganese (Mn)	1290	1090	1360	1300	1360	961	1060	978	1410	1330	1140	1770	1960	2850	684	656	549
Mercury (Hg)	0.0384	0.0415	0.0728	0.0621	0.0764	0.0329	0.0276	0.0379	0.0352	0.0623	0.0393	0.0527	0.0523	0.0493	0.0211	0.0224	0.0185
Molybdenum (Mo)	2.95	2.55	1.54	1.59	1.57	1.20	1.43	1.23	2.66	2.73	2.56	1.54	1.91	2.82	0.98	0.96	0.88
Nickel (Ni)	27.9	26.1	39.0	39.8	35.1	37.3	35.8	38.5	14.6	12.3	18.5	13.3	13.1	15.2	47.9	48.3	40.9
Phosphorus (P)	1080	1020	1210	1230	1180	934	886	881	1600	1290	1460	652	678	645	1060	1110	1220
Potassium (K)	2130	1940	930	1090	880	1610	1450	1600	3310	3030	2870	2210	2560	2460	780	810	840
Selenium (Se)	1.01	1.00	2.29	1.66	2.09	1.19	1.16	1.20	0.40	0.57	0.37	0.61	0.65	0.71	0.57	0.60	0.46
Silver (Ag)	0.272	0.384	0.410	0.378	0.412	0.415	0.381	0.380	0.188	0.311	0.171	0.240	0.245	0.223	0.136	0.117	0.112
Sodium (Na)	440	420	<100	140	110	240	210	240	560	460	510	520	640	670	<100	<100	<100
Strontium (Sr)	34.9	32.8	37.0	32.2	38.0	20.5	18.2	21.2	29.3	31.3	27.9	23.6	27.5	26.3	38.1	39.3	33.7
Thallium (Tl)	0.182	0.159	0.080	0.090	0.081	0.113	0.106	0.114	0.256	0.265	0.214	0.195	0.200	0.229	0.055	0.055	0.050
Tin (Sn)	1.53	1.45	1.17	1.22	1.01	1.07	1.05	1.32	2.14	1.44	1.96	0.79	1.18	1.25	0.47	0.57	0.48
Titanium (Ti)	774	686	319	348	289	386	309	354	1190	833	990	618	751	817	274	281	291
Uranium (U)	7.43	7.47	2.36	2.86	2.95	1.33	1.36	1.34	9.93	14.1	10.2	3.07	3.10	3.16	0.876	0.930	0.906
Vanadium (V)	63.2	59.1	42.2	41.7	37.3	42.2	37.9	42.5	69.5	61.8	63.8	46.6	58.0	64.9	31.8	31.8	29.7
Zinc (Zn)	209	202	232	209	210	327	296	338	124	137	114	136	127	132	81.6	80.2	71.1

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 1\Appendices\H - Sediment\[H-3 2011-2013 Sediment.xls]2012 stream

APPENDIX H
HARPER CREEK MINING INC.
HARPER CREEK PROJECT
2013 AQUATIC SEDIMENT DATA

Print Aug/22/14 13:21:06

RESULTS OF ANALYSIS																																		
Sample ID	BR-10A	BR-10B	BR-10C	HC-40A	HC-40B	HC-40C	OP-10A	OP-10B	OP-10C	TMF-10A	TMF-10B	TMF-10C	TMF-20A	TMF-20B	TMF-20C	BC-10A	BC-10B	BC-10C	BR-20A	BR-20B	BR-20C	HC-10A	HC-10B	HC-10C	HC-20A	HC-20B	HC-20C	HC-20D	HC-20E	HC-30A	HC-30B	HC-30C	HC-30D	HC-30E
Date Sampled	24-SEP-13	24-SEP-13	24-SEP-13	24-SEP-13	24-SEP-13	24-SEP-13	24-SEP-13	24-SEP-13	24-SEP-13	24-SEP-13	24-SEP-13	24-SEP-13	25-SEP-13	25-SEP-13	25-SEP-13	25-SEP-13	25-SEP-13	25-SEP-13	25-SEP-13	25-SEP-13	25-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13	26-SEP-13
Time Sampled	08:00	08:00	08:00	11:00	11:00	11:00	13:00	13:00	13:00	14:30	14:30	14:30	09:30	09:30	09:30	13:00	13:00	13:00	16:30	16:30	16:30	08:15	08:15	08:15	12:30	12:30	12:30	12:30	12:30	14:30	14:30	14:30	14:30	14:30
ALS Sample ID	L1370078-1	L1370078-2	L1370078-3	L1370078-4	L1370078-5	L1370078-6	L1370078-7	L1370078-8	L1370078-9	L1370078-10	L1370078-11	L1370078-12	L1370078-13	L1370078-14	L1370078-15	L1370078-16	L1370078-17	L1370078-18	L1370078-19	L1370078-20	L1370078-21	L1370078-22	L1370078-23	L1370078-24	L1370078-25	L1370078-26	L1370078-27	L1370078-28	L1370078-29	L1370078-30	L1370078-31	L1370078-32	L1370078-33	L1370078-34
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests																																		
pH (1:2 soil:water)	7.14	7.10	7.24	7.35	7.64	7.34	7.28	7.31	7.24	7.04	7.03	7.09	6.34	7.22	7.21	8.33	8.33	8.41	7.63	7.27	7.15	6.90	6.92	6.85	7.33	7.32	7.27	7.19	6.78	7.10	7.28	7.00	7.00	7.24
Particle Size																																		
% Gravel (>2mm)	1.09	-	-	19.3	-	-	18.1	-	-	22.0	-	-	5.87	-	-	19.9	-	-	10.6	-	-	0.50	-	-	6.45	-	-	-	-	39.2	-	-	-	-
% Sand (2.00mm - 1.00mm)	4.25	-	-	21.1	-	-	29.4	-	-	28.2	-	-	9.04	-	-	21.6	-	-	13.7	-	-	9.36	-	-	10.3	-	-	-	-	23.3	-	-	-	-
% Sand (1.00mm - 0.50mm)	19.3	-	-	13.6	-	-	23.5	-	-	14.7	-	-	23.5	-	-	22.7	-	-	29.8	-	-	45.4	-	-	50.6	-	-	-	-	23.1	-	-	-	-
% Sand (0.50mm - 0.25mm)	34.1	-	-	9.29	-	-	15.4	-	-	14.0	-	-	15.9	-	-	18.9	-	-	30.4	-	-	34.2	-	-	23.9	-	-	-	-	11.1	-	-	-	-
% Sand (0.25mm - 0.125mm)	20.4	-	-	7.14	-	-	4.66	-	-	9.39	-	-	12.8	-	-	8.64	-	-	7.93	-	-	7.48	-	-	4.04	-	-	-	-	2.30	-	-	-	-
% Sand (0.125mm - 0.063mm)	8.18	-	-	4.99	-	-	2.24	-	-	3.80	-	-	8.49	-	-	3.48	-	-	3.04	-	-	1.59	-	-	1.13	-	-	-	-	0.23	-	-	-	-
% Silt (0.063mm - 0.0312mm)	6.04	-	-	10.8	-	-	2.80	-	-	3.56	-	-	10.8	-	-	2.20	-	-	2.18	-	-	0.86	-	-	1.30	-	-	-	-	0.36	-	-	-	-
% Silt (0.0312mm - 0.004mm)	5.64	-	-	12.2	-	-	3.29	-	-	3.66	-	-	11.6	-	-	2.07	-	-	2.07	-	-	0.54	-	-	1.63	-	-	-	-	0.41	-	-	-	-
% Clay (<4um)	0.98	-	-	1.68	-	-	0.65	-	-	0.70	-	-	2.07	-	-	0.44	-	-	0.35	-	-	<0.10	-	-	0.63	-	-	-	-	<0.10	-	-	-	-
Texture	Sand	-	-	Sandy loam	-	-	Sand	-	-	Sand	-	-	Loamy sand	-	-	Sand	-	-	Sand	-	-	Sand	-	-	Sand	-	-	-	-	Sand	-	-	-	-
Metals																																		
Aluminum (Al)	15400	16600	17400	18500	20200	19900	29000	22800	19400	22000	25600	24100	21000	31600	29600	9960	12500	11900	20800	19800	19300	13400	14500	13900	20100	23200	21100	22200	21900	24500	21000	23800	23800	19100
Antimony (Sb)	0.39	0.47	0.44	0.43	0.43	0.41	0.49	0.59	0.46	0.34	0.31	0.48	0.15	0.17	0.25	0.56	0.43	0.38	0.17	0.19	0.18	0.44	0.31	0.29	0.43	0.49	0.44	0.46	0.43	0.44	0.45	0.43	0.41	0.36
Arsenic (As)	13.9	15.0	14.5	31.1	40.3	39.8	46.1	44.9	39.1	13.1	16.1	14.4	6.84	13.6	14.7	18.0	19.5	17.7	9.09	9.94	9.90	13.5	15.6	14.0	18.3	31.6	26.7	24.8	24.0	33.1	33.7	34.0	36.4	27.1
Barium (Ba)	96.9	97.6	112	74.8	92.6	84.0	136	110	107	137	124	171	129	188	176	57.9	68.4	65.9	108	105	101	71.0	66.7	82.5	139	135	122	128	114	138	120	118	126	102
Beryllium (Be)	0.75	0.73	0.72	0.36	0.41	0.35	0.51	0.46	0.37	0.66	0.81	0.64	0.41	0.62	0.56	0.25	0.28	0.27	0.54	0.53	0.53	0.58	0.66	0.64	0.61	0.67	0.57	0.62	0.58	0.66	0.55	0.58	0.62	0.47
Bismuth (Bi)	0.55	0.56	0.56	0.54	0.63	0.60	1.30	1.31	1.18	0.43	0.56	0.45	0.32	0.39	0.42	0.30	0.61	0.26	0.19	0.20	0.20	0.76	0.65	0.67	0.48	0.73	0.66	0.60	0.59	0.70	0.86	0.77	0.78	0.60
Boron (B)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd)	0.424	0.405	0.565	0.926	1.46	1.78	2.22	1.80	1.58	0.505	0.284	0.518	0.512	0.691	0.684	0.335	0.300	0.279	0.243	0.269	0.268	0.510	0.426	0.574	0.677	0.755	0.594	0.621	0.614	0.973	1.11	0.668	0.957	0.773
Calcium (Ca)	5780	5680	6580	8840	10500	7610	5950	5220	4490	7580	5310	7420	4730	7060	7090	8080	10300	8900	6060	6110	5990	5980	6050	5630	7290	7400	6940	7580	6940	7380	7450	7440	7360	6050
Chromium (Cr)	28.6	34.2	43.0	31.0	38.8	46.1	68.1	44.3	31.5	26.4	21.8	29.1	14.0	27.9	24.8	36.7	49.3	38.5	41.0	35.7	36.1	25.3	21.4	22.4	22.9	34.9	37.4	28.4	28.0	121	46.2	56.2	50.9	37.4
Cobalt (Co)	12.2	13.5	17.7	16.0	20.3	22.8	26.0	22.0	19.2	12.1	12.0	12.3	11.6	17.3	16.7	16.6	19.0	17.5	14.1	13.8	13.8	9.89	10.0	10.1	12.4	18.7	16.0	15.3	15.1	19.9	17.0	19.8	19.9	15.1
Copper (Cu)	50.9	57.1	63.7	108	119	129	469	395	320	48.7	54.6	49.2	48.0	65.7	63.4	36.3	41.4	39.4	27.2	29.7	29.5	69.9	72.4	68.0	76.2	110	102	96.9	100	131	141	123	148	118
Iron (Fe)	30900	34500	35900	34800	40300	40300	57400	51600	46400	31600	29600	36300	24600	39700	37400	36000	41800	36000	32600	32400	32100	30900	30100	29900	32700	42900	39000	38600	38600	44300	39400	44400	45400	35600
Lead (Pb)	33.7	36.0	39.7	35.6	41.9	41.1	43.6	38.9	33.9	15.4	17.8	16.1	10.7	15.8	15.2	24.4	28.4	27.6	9.83	10.5	10.4	39.4	31.1	35.7	19.3	25.5	23.8	23.1	22.5	158	28.1	26.9	30.3	22.8
Lithium (Li)	22.4	21.8	23.7	14.2	16.3	14.5	19.0	15.7	13.0	21.7	26.9	22.8	13.2	22.8	18.8	10.1	12.7	11.5	23.9	21.6	21.2	20.3	22.3	19.8	21.6	26.4	22.8	24.1	23.0	25.7	20.2	26.1	25.0	20.1
Magnesium (Mg)	6480	7870	9060	9380	10500	10600	15500	11400	9980	8010	8250	8360	7050	11400	10200	6240	7770	7130	10600	9250	9290	7020	6970	6760	8820	11400	10300	10600	10300	12500	9960	12200	12200	10200
Manganese (Mn)	631	619	729	762	1490	1560	1180	1040	1180	1260	895	1240	985	1690	2060	640	801	771	839	816	779	545	539	616	1000	1290	936	981	968	2160	1040	894	1290	855
Mercury (Hg)	0.0420	0.0277	0.0311	0.0775	0.0890	0.0672	0.0479	0.0373	0.0335	0.0499	0.0500	0.0543	0.0455	0.0446	0.0492	0.0256	0.0303	0.0302	0.0268	0.0346	0.0305	0.0154	0.0237	0.0272	0.0445	0.0320	0.0322	0.0331	0.0352	0.0283	0.0509	0.0250	0.0410	0.0378
Molybdenum (Mo)	2.52	2.30	2.06	1.10	1.47	1.41	1.47	1.38	1.11	2.38	3.97	2.24	1.04	1.67	1.64	0.91	1.16	0.94	3.00	3.55	3.34	3.19	3.70	3.33	1.70	2.75	1.92	1.79	2.15	3.75	2.55	2.62	2.50	1.91
Nickel (Ni)	24.6	27.3	32.5	30.0	36.5	44.1	61.7	45.0	35.0	14.6	12.2	14.9	9.79	15.3	14.3	44.0	52.2	45.7	25.2	24.0	23.5	12.5	11.5	11.4	15.0	23.4	24.5	18.8	18.0	83.1	32.5	36.1	37.4	27.6
Phosphorus (P)	1180	1140	1160	1140	1210	1180	1090	963	850	1270	958	1290	709	598	687	1150	1110	995	860	870	879	1410	1320	1280	1310	1360	1250	1440	1380	1110	1070	1270	1160	969
Potassium (K)	1420	1610	1900	890	820	800	2070	1550	1450	2350	1870	2670	1910	2870	2530	700	770	710	1620	1450	1490	1500	1450	1530	2530	2470	2190	2470	2330	2380	1790	2180	2160	1750
Selenium (Se)	0.81	0.70	0.67	2.11	2.11	1.88	1.44	1.23	1.09	0.43	0.40	0.45	0.50	0.58	0.65	0.65	0.80	0.73	0.47	0.49	0.48	0.76	0.60	0.68	0.87	0.79	0.70	0.74	0.68	0.77	1.27	0.72	1.01	0.88
Silver (Ag)	0.235	0.225	0.248	0.364	0.365	0.336	0.428	0.425	0.426	0.174	0.176	0.240	0.221	0.207	0.233	0.149	0.166	0.203	0.121	0.169	0.168	0.249	0.200	0.216	0.169	0.195	0.176	0.165	0.176	0.403	0.293	0.202	0.250	0.217
Sodium (Na)	230	300	320	<100	110	<100	390	230	230	420	340	410	370	850	730	<100	<100	<100	360	340	340	300	290	290	340	400	380	390	400	570	410	570	520	350
Strontium (Sr)	31.4	29.5	31.2	38.0	44.8	30.5	24.8	22.4	19.8	27.4	22.5	27.5	18.2	29.4	28.3	39.8	51.0	45.3	32.7	33.9	33.7	23.7	23.3	24.8	31.2	33.8	32.5	34.2	30.6	35.6	37.1	34.6	35.8	29.6
Thallium (Tl)	0.144	0.139	0.164	0.073	0.082	0.080	0.151	0.117	0.108	0.209	0.176	0.226	0.155	0.198	0.192	<0.050	0.056	0.059	0.090	0.101	0.094	0.122	0.132	0.145	0.223	0.209	0.188	0.202	0.190	0.187	0.158	0.173	0.162	0.145
Tin (Sn)	0.95	0.88	1.36	0.42	0.89	0.55	1.25	1.07	0.70	1.09	0.97	1.12	0.60	1.06	1.31	0.71	0.73	0.57	1.02	0.98	0.99	1.31	1.17	1.26	1.07	2.47	1.21	1.17	1.25	1.52	1.59	1.43	1.08	1.03
Titanium (Ti)	595	743	759	282	269	258	514	369	329	759	662	760	431	910	800	298	309	279	686	705	694	766	637	609	678	849	696	791	765	984	671	871	752	583
Uranium (U)	25.7	16.7	13.7	3.40	3.28	2.89	1.62	1.56	1.44	10.5	12.6	12.3	2.57	2.49	2.88	0.908	1.16	1.04	22.1	32.7	37.3	18.9	19.3	21.9	11.5	10.9	9.07	8.89	12.3	8.23	12.7	8.22	8.66	9.21
Vanadium (V)	43.2	47.2	51.1	32.0	37.0	36.6	54.4	41.3	35.3	54.5	54.0	65.9	36.9	70.0	61.3	31.6	36.1	30.0	57.1	54.0	54.2	53.6	49.7	51.2	52.4	66.4	59.1	59.6	61.3	68.3	54.1	72.3	64.9	51.8
Zinc (Zn)	115	133	138	164	221	192	424	329	266	114	88.0	119	101	154	135	81.7	91.7	85.5	70.2	67.9	68.1	130	119	122	138	172	151	149	143	226	181	180	204	163

M:\1\01\00458\15\A\Report\1- Aquatic Baseline\Rev 1\Appendices\H - Sediment\[H-3 2011-2013 Sediment.xls]2013 stream