Page 001 to/à Page 009

Withheld pursuant to/removed as

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CONOCOPHILLIPS CANADA RESOURCES CORP.

INDIVIDUAL OWNERSHIP PLAN

SHOWING

WATER INTAKE LEASE AND ACCESS

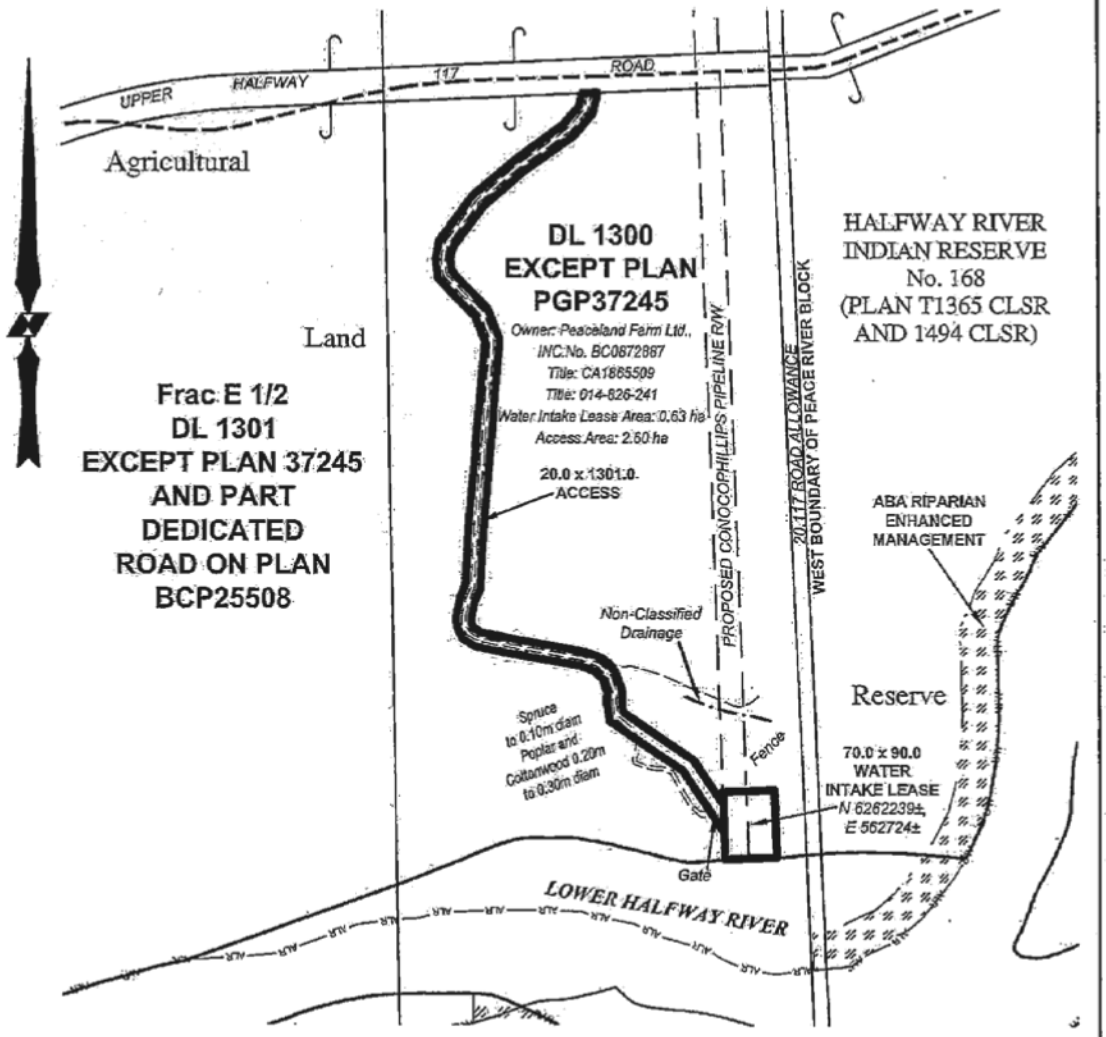
IN

DISTRICT LOT 1300

EXCEPT PLAN PGP37245

PEACE RIVER DISTRICT

NET:



OWNER(S): PEACELAND FARM LTD., INC.No. BC0872887

TITLE: CA1865509

PID: 014-826-241

WATER INTAKE LEASE	0.63	ha	1.56	Ac
ACCESS	2.60	ha	6.42	Ac

WS

BM.

McElhanney

McElhanney Geomatics
Professional Land Surveying Ltd.
8808 - 72 Street Fort St. John, BC
Phone: (250)787-0356, Fax: (250)787-0310

Distances are in metres.
Portions referred to are outlined in red.

REVISION: 0	DRAWN BY: KSP
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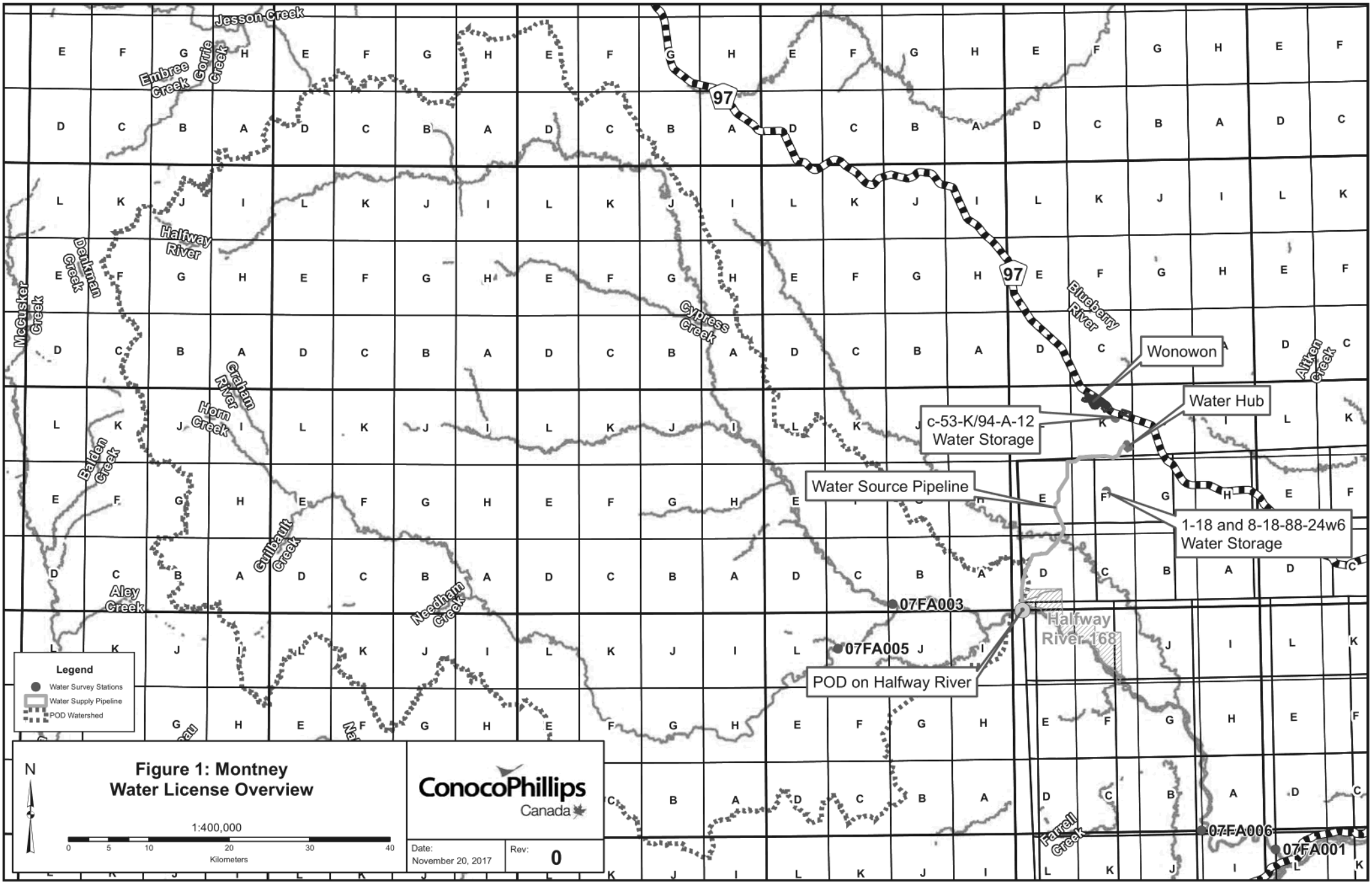
Jesson Creek
Embree Creek
Cottle Creek
97
Halfway River
Deakman Creek
McCusker Creek
Cypress Creek
Blueberry River
Wonowon
Water Hub
Aitken Creek
Graham River
Horn Creek
c-53-K/94-A-12
Water Storage
Baldon Creek
Water Source Pipeline
1-18 and 8-18-88-24w6
Water Storage
Grilbault Creek
Aley Creek
Needham Creek
07FA003
Halfway River 168
07FA005
POD on Halfway River
Legend
Water Survey Stations
Water Supply Pipeline
POD Watershed
N
Figure 1: Montney
Water License Overview
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Kilometers
ConocoPhillips
Canada
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November 20, 2017
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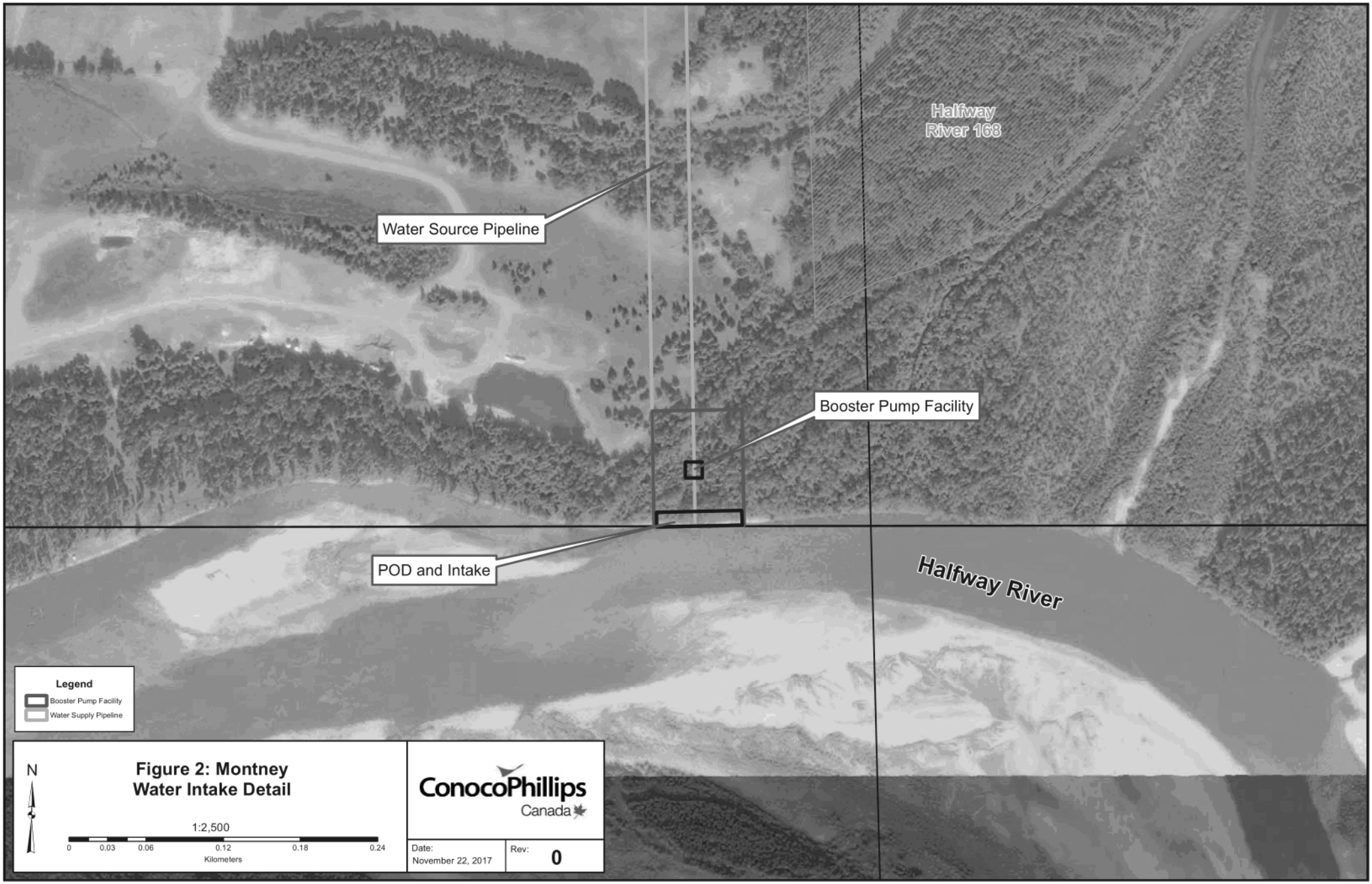
Farrell Creek
07FA006
07FA001


Halfway River 168
Water Source Pipeline
Booster Pump Facility
POD and Intake
Halfway River
Legend
Booster Pump Facility
Water Supply Pipeline
N
Figure 2: Montney
Water Intake Detail
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Kilometers
ConocoPhillips
Canada
Date:
November 22, 2017
Rev:
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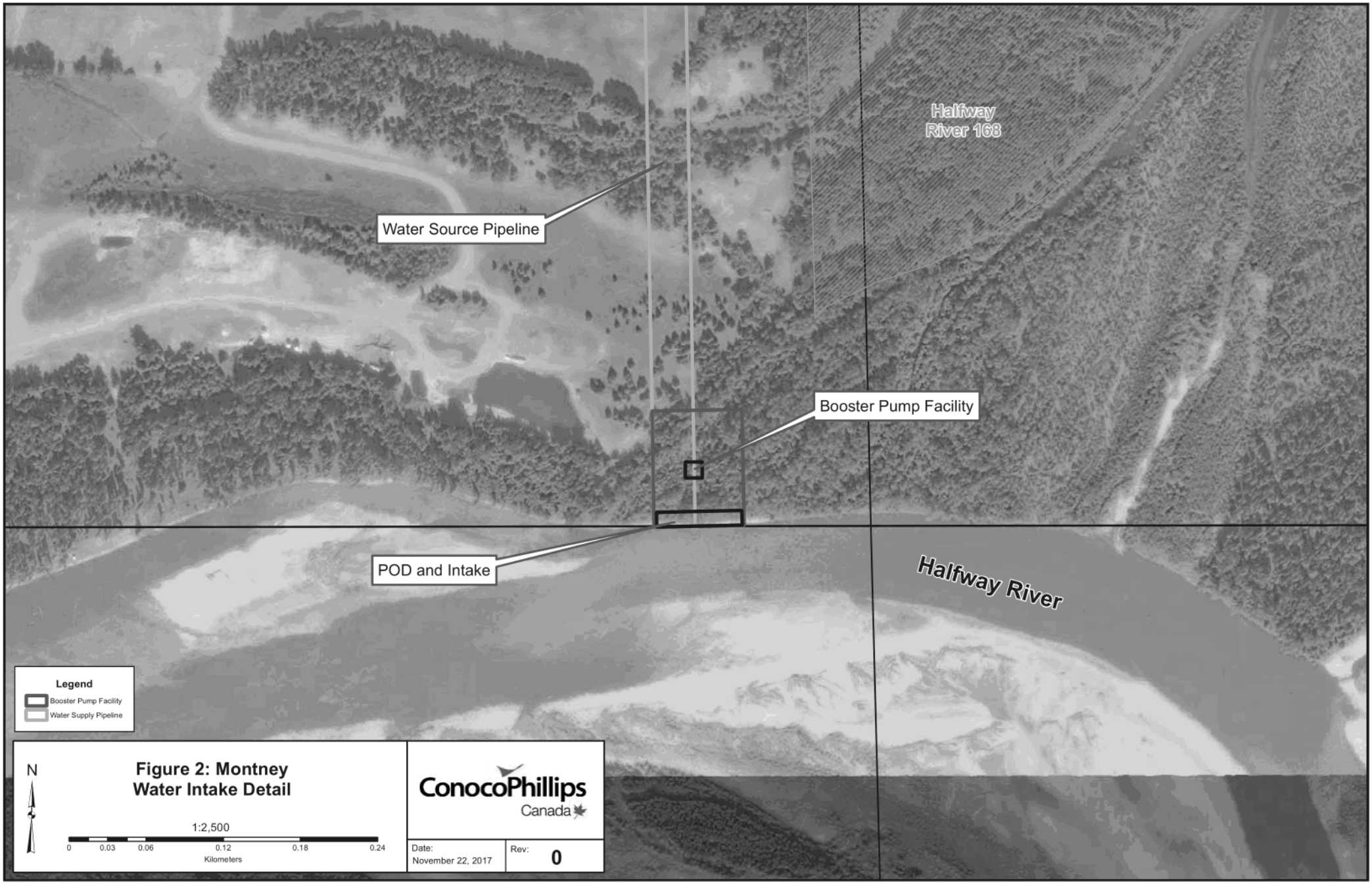
Halfway River 168
Water Source Pipeline
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Booster Pump Facility
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Figure 2: Montney
Water Intake Detail
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Kilometers
ConocoPhillips
Canada
Date:
November 22, 2017
Rev:
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Halfway River
Water Management Plan

Prepared by:

ConocoPhillips Canada Resources Corp.
401 9th Avenue SW
Calgary Alberta T2P 2H7

November 27, 2017

Contents

EXECUTIVE SUMMARY

ConocoPhillips Canada Resources Corp. (ConocoPhillips) is applying for a water licence with a 20-year term under Section 9 of the BC Water Sustainability Act to withdraw water from a Point of Diversion on the Halfway River at 56°30'00.00"N 121°58'51.63"W (UTM 6262196N 562728E Z10). The property is private tenure, owned by Peaceland Farm Ltd. ConocoPhillips has a long-term surface lease agreement with the property owner. The water licence application is to divert a maximum of 10,000 m^3 per day, to a maximum of 3,650,000 m^3 per year, for the purposes of Oil and Gas: Drilling, and Oil and Gas: Hydraulic Fracturing, and to store 200,000 m^3 in earthen excavations (three dugouts are constructed and approved for freshwater storage under OGC-issued permits - none are regulated dams under the Water Sustainability Act).

The water is required to enable ConocoPhillips to achieve its Late Appraisal and Initial Development well drilling and completions in it's Montney Asset, on a land base of 106,027 acres (42,908 hectares) in British Columbia, centred approximately on the community of Wonowon.

The works associated with this application include:

- **A water intake**. The water intake will be either an "In-Bank Infiltration Gallery" or an "In-Stream Screened Intake", located along the north side of the Halfway River at the proposed Point of Diversion (POD). The intake will be connected with a gravity feed to a below-ground caisson located approximately 10-20 m north of the edge of the river;
- **A below-ground caisson and pumping facility**. A pumphouse located above the caisson will serve to draw water from the bottom of the caisson to surface, where it will be transferred to an adjacent pump booster station. The pump booster station will contain pumps to mechanically lift the water through a 16" below-ground pipeline to well pads and to a Water Treatment/Recycling/Storage Facility (referred to as the Water Hub), located at c-11-K/94-A-12. The pumping facility will be sited and designed to be above the 200-year return period peak water level. A facility permit is being sought from the BC Oil and Gas Commission for the pumping facility, and detailed design and engineering review is anticipated through OGC Facilities in early 2018. A pipeline permit is being sought from the BC Oil and Gas Commission for the freshwater pipeline, and detailed design and engineering review is anticipated through OGC Pipelines.

The Halfway River is a tributary of the Peace River, and arises out of the northern Rocky Mountains. At the proposed POD, it has a drainage area of 6,610 km^2, with an elevation range of 680-2,395 m. There are four Water Survey of Canada (WSC) streamflow gauges (three active, one inactive) that provide up to 50 years of excellent discharge record for the river. These WSC data have been rigorously analyzed and reported in detail in this Water Management Plan. Mean annual runoff at the proposed POD is 2.13 billion m^3 per year, ranging from a low of 959 million m^3 to a high of 4.01 billion m^3 per year. Runoff is seasonally variable, with high flow during spring and summer resulting from the melt of the mountain snowpack, and low flow in late winter (Jan-Mar). During February, the month of lowest average runoff, discharge is 26.9 million m^3 (962,000 m^3 per day). During May, the month of highest average runoff, discharge is 625 million m^3 (20,800,000 m^3 per day).

The Halfway River is a high value fisheries river. Twenty species of fish are noted to occur in the Halfway River, including 8 sportfish, 2 suckers, 7 minnows, and 3 sculpin species. The sport fish are: Arctic Grayling, Bull Trout, Burbot, Kokanee, Mountain Whitefish, Northern Pike, Rainbow Trout and Walleye. In particular, tributaries of the Halfway River provide critical spawning and rearing area for the Peace River Bull Trout population. Bull Trout have been classified as a "blue listed" species by the British Columbia Conservation Data Centre, and require significant attention. Fish habitat at the proposed POD is primarily for fish migration, and potentially for winter rearing. There is no spawning habitat at or proximal to the proposed POD. Bull Trout migrate past the POD for spawning in the upper Halfway River and tributaries, including the Graham and Chowade river systems. Because of the high value fish habitat, this Water Management Plan has significant focus on managing water withdrawals to protect fish resources.

There is currently very low water demand on the Halfway River. For the Halfway River watershed upstream of the proposed POD, there is a current demand of 2.13 million m^3 per year (for 19 water licences, 5 water licence applications and 2 two short-term use approvals). Existing demand comprises 0.10% of mean annual discharge,

ranging from a low of 0.04% of June discharge to a high of 0.29% of February and March discharge. When combined with this water licence application, total cumulative demand will be 5.78 million m^3 per year. This is 0.27% of mean annual runoff, and 1.33% of mean winter runoff.

ConocoPhillips proposes to have as a condition of the water licence an Environmental Flow Needs "zero withdrawal threshold" of 7.04 m^3/s, corresponding to a 1-in-10 year low flow. Below this discharge no withdrawals would occur by ConocoPhillips, capping total current cumulative water withdrawals to no more than 2% of daily discharge in any season. Water withdrawals of 2% of discharge are well below the 10% maximum suggested by the BC Ministry of Environment's "Environmental Flow Needs" policy. The withdrawals are anticipated to have no effect of fish or aquatic resources, and are sufficiently small that they are within the range of "uncertainty" or "standard error" of hydrometric measurements, and so may not even be measurable. To verify the discharge, however, ConocoPhillips proposes to have as a condition of licence a requirement to monitor stream discharge at the proposed POD, using existing Water Survey of Canada "real-time" gauges, combined with manual discharge measurements during periods of low flow when ConocoPhillips is withdrawing water from the river.

ConocoPhillips has engaged with the Halfway River First Nation and the Blueberry River First Nation, as well as all Water Sustainability Act rights holders (Peaceland Farm Ltd. and Halfway River First Nation).

This Water Management Plan includes details on suggested conditions for the water licence.

To enable use of the water under this licence for January 1, 2019, it is necessary to complete the construction of the water intake during the "least risk" fisheries work window of July 15 – August 31, 2018. A decision by the Oil and Gas Commission on this application is requested before May 15, 2018.

1. INTRODUCTION

This water management plan was prepared to support an application from ConocoPhillips Canada Resources Corp. for a water licence with a 20-year term under the BC Water Sustainability Act, to divert up to 10,000 m^3per day and 3,650,000 m^3per year from the Halfway River, for the purposes of "Oil and Gas – hydraulic fracturing" and "Oil and Gas – drilling". In addition, we are also requesting a purpose of "Storage – non-power" of 200,000 m^3.

ConocoPhillips has PNG tenure, referred to as the ConocoPhillips' Montney Asset, on a land base of 106,027 acres (42,908 hectares) in British Columbia. The development area is approximately 45km long North-South, and 12km wide East-West, centred approximately on the community of Wonowon (Figure 1). Maturity across the tenure ranges from wet gas to volatile oil. Development to date (2009-2017) has consisted of six Exploration wells and twelve Early Appraisal wells, focused on improving the understanding of the subsurface, optimizing well design and completion, and detailing the opportunities for development. The water demand to date, to support this Exploration and Early Appraisal, has relied on short term water use approvals (s.10 of the Water Sustainability Act) from local small streams and dugouts, and the acquisition of water from private landowners. These water sources are not adequate to support increased development through Late Appraisal and Initial Development, creating the necessity to obtain a water licence, to provide an assured water supply.

ConocoPhillips has engaged in detailed assessment of a variety of potential water sources, including the Williston Reservoir, the Peace River, the Cameron River (and other small streams), deep aquifer saline groundwater (e.g., the Debolt formation) and shallow local groundwater. The local small streams were assessed to be unable to provide sufficient and reliable water quantity; the shallow and deep groundwater was similarly insufficient and unreliable; the Williston Reservoir and Peace River both have large quantities of water, but both require very extensive pipeline construction with large capital cost and large operating expense, and resulting in a greater overall environmental footprint . For the Williston Reservoir, the pipeline construction was assessed to have numerous technical challenges, including a 3-4km directionally-drilled bore under the Halfway River valley. For the Peace River, a geotechnical review of expected slope stability conditions along the Peace River post-Site C dam construction lead to a conclusion that construction of a water intake and associated facilities may not be feasible or advisable for a number of years following water impoundment. The Halfway River was selected as the best water source, for a number of primary reasons:

- It has very high rates of runoff (averaging 2.13 billion m^3 per year), allowing ConocoPhillips' water needs to be met with no effect on environmental flows for fish or aquatic resources;
- It is proximal to the ConocoPhillips' PNG tenure, minimizing the length of pipeline required to transport the fresh water;
- The fresh-water pipeline will be partially co-located with existing and anticipated rights-of-way for natural gas pipelines, reducing the cumulative footprint and disturbance;
- The river at the location of the proposed Point of Diversion is geotechnically well suited to construction of an intake and pumping facility.

Beginning with drilling a 14 well pad in 2018, ConocoPhillips will begin an accelerated Late Appraisal period (2018-2022), leading to Initial Development starting in 2023. At the present time, the 2018-2022 Late Appraisal Montney activity consists of:

- Construction of a Central Processing Facility and a co-located Water Treatment/Recycling/Storage Facility (Water Hub);
- Drilling and completion of approximately 75 Late Appraisal wells, and drilling (but no completion) of two Expiry wells to maintain land tenure.

Well drilling for the Late Appraisal wells will begin in 2018, but completions are scheduled to begin in early 2019.

Initial Development (2023-2028) and the early portion of the Manufacturing Phase are premised on a projection of 48 wells drilled and completed per year.

Current water demand projections for Late Appraisal well drilling and completions (2019-2022) is up to 3.4 million m^3 per year, of which approximately 30% is estimated to be acquired from the reuse of early flowback volumes by 2021. The initial years of Late Appraisal (2019-2020) will have increased requirements for fresh water, until such

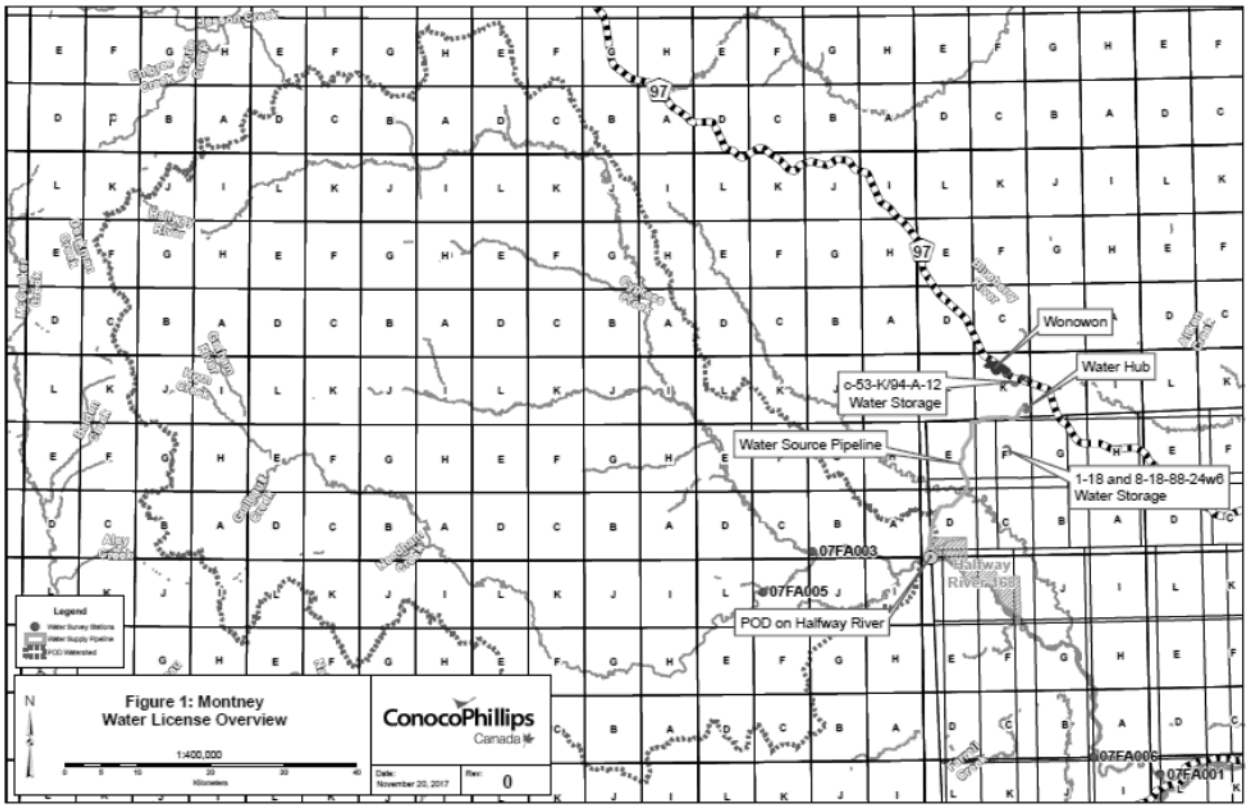

Figure 1. Location map of the Halfway River with the proposed Point of Diversion and pipeline to the Water Hub at c-11-K/94-A-12. The locations of the Water Survey of Canada gauges referenced in this report are also depicted.

time as more wells begin to flowback water to the Water Hub facility for treatment and re-use. The volume of treated water available for reuse is projected to increase by 2021 and beyond. Projections for freshwater demands from the Halfway River for 2019-2022 are 2.2-3.4 million m^3 per year. By 2023, with 48 wells completing per year, the yearly water demand projections will be up to 7.2 million m^3 per year, of which by then approximately 50% of the water is estimated to be acquired from the reuse of both early flowback volumes, and accumulating infield water production. The remaining ~3.6 million m^3 per year will be acquired from the Halfway River. The engineering design for well completions is premised on a sustained input of 10,000 m^3 of completion water per day, available on demand, 365 days per year, resulting in a need for a large and reliable year-round freshwater source.

The proposed Halfway River water intake is located on private land, at 56°30'00.00"N 121°58'51.63"W (UTM 6262196N 562728E Z10). ConocoPhillips has a long-term surface lease agreement with the landowner. The intake at the POD will be connected via gravity flow to a below-ground small volume caisson, with a pumping facility. The intake is being designed to provide the operational water requirements with minimal instream works that might affect fish or fish habitat, and minimal river bank and riparian disturbance. From the pumping facility the water will be moved through a 16" buried fresh water pipeline to various well pads and to a Water Treatment/Recycling/Storage Facility (referred to as the Water Hub), located at c-11-K/94-A-12.

The following sections of this Water Management Plan provide detail pertaining to the water licence application.

2. CONSTRUCTION AND OPERATIONAL ACTIVITIES

Description of Project Infrastructure

The infrastructure for this water diversion project consists of the following (Figure 2):

- Water intake;
- Gravity-flow buried pipeline from intake to a below-ground caisson;
- Pumping facility, powered by gas-electric generator;
- Buried 16” freshwater pipeline, transporting the water to various well pads and to a Water Treatment/Recycling/Storage Facility (referred to as the Water Hub), located at c-11-K/94-A-12, with the water then directed out for infield distribution, mainly via pipeline.

The pumping facility will be reviewed and approved as a facility under the Oil and Gas Activities Act (OGAA), and the pipeline will be reviewed and approved as a freshwater pipeline under OGAA.

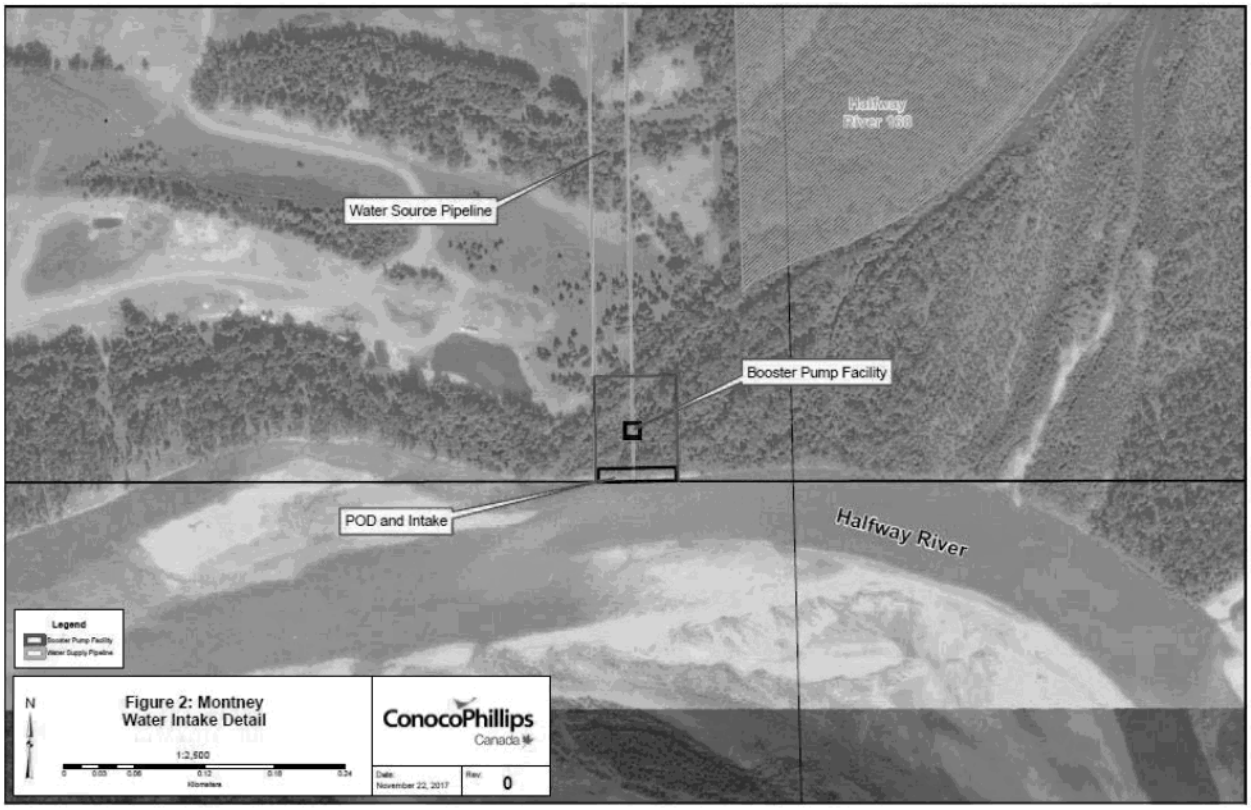

Figure 2. Details of the Proposed POD (UTM 6262196N 562728E Z10), Water Pumping Facility and freshwater pipeline right-of-way, along the Halfway River.

River Intake

The river intake is located on the north side of the Halfway River at 56°30’00.00”N 121°58’51.63”W (UTM 6262196N 562728E Z10), on private property owned by Peaceland Farm Ltd. A number of intake options were evaluated, including an in-stream screened intake to be located on the river bed, a well or trench situated near the river, and a river bank infiltration system. Primary considerations were: assurance of a reliable daily water supply volume, minimizing disturbance in the Halfway River, minimizing risk of infrastructure damage or loss resulting from flood flows or river scour or deposition, and ease of access for periodic maintenance or repairs. As of the date of water licence application, a final decision on the intake has not been made, and two options are being further evaluated. Geotechnical and engineering assessments and investigations are ongoing, and a decision on the water intake is anticipated in January 2018. The two options are:

- **An In-Bank Infiltration Gallery intake**. This option consists of an engineered infiltration system constructed under the river bank, at the POD location. The intake has the benefit of being mostly located outside of the river channel, with minimal direct effect on the Halfway River or its aquatic resources, during the lifespan of operation.
- **In-Stream Intake.** This option consists of an engineered intake structure installed on the bed of the river immediately off the north bank, at the POD location. This intake has the benefit of having a small installation footprint, but has different hydraulic risk factors due to being located on the bed of the river.

Both intake options are connected to an underground caisson via a trenched and buried gravity flow pipeline.

The intake construction will be done during the "least risk" fisheries work window, of July 15-Aug 31, 2018. The construction will be done "in the dry" behind an aquadam (or equivalent) placed along the river bank, to isolate the work area from fish and to prevent sediment input to the river. An authorization under Section 24 of the Water Sustainability Act, for a "permit over Crown land" is being sought as part of this water licence application, to provide authorization for the temporary use of an aquadam during the construction. Field work will have appropriate site and environmental control, including a sediment and erosion control plan and onsite environmental supervision.

A final decision on the water intake will be made in January 2018, and a submission of engineering designs will be forwarded to the Water Manager for approval and leave to commence construction, during the least risk fisheries work window in 2018.

Pumping Facility

The pumping facility will consist of a precast circular or rectangular concrete caisson, extending from the top of an elevated pad to bedrock (~ 6 metres) and a pumphouse founded on the caisson such that the floor slab is at least 0.6 m above the estimated 1-in-200 year flood level. The facility will have low head submersible pumps, each with a capacity of 7000 L/min. The pumphouse will serve to draw water from the bottom of the caisson to surface, where it will be transferred to an adjacent pump booster station. The pump booster station will contain high-head, pumps to mechanically lift the water the through the pipeline to the Water Hub, for distribution to well pads. Valves and piping will allow the pumps to backflush the infiltration gallery or in-stream intake, to clean sediment accumulations.

The pumping facility will be submitted as an OGAA "facility" application, and will be constructed concurrently with the approval of the water licence and the construction of the intake.

Lease Agreement and Site Access

The intake and pumping facility are located on Peaceland Farm Ltd. property, at District Lot 1300, Peace River District except Plan PGP37245. ConocoPhillips has entered into a long-term lease and access agreement with Peaceland Farm Ltd. Access to the site is from the Upper Halfway Road. A copy of the lease and access agreement will be submitted with the water licence application through Front Counter BC.

Pipeline

ConocoPhillips will construct a below-ground 16" pipeline to transport the water acquired under this licence from the pumping facility to the Water Hub located at c-11-K/94-A-12. The pipeline will be submitted as an OGAA application, and will be constructed concurrently with the approval of the water licence.

Water Storage

ConocoPhillips is applying for a purpose of "storage – non-power" in the amount of 200,000 m^3 for freshwater storage, to provide buffering capacity should there be a period of time when water diversions from the Halfway River are temporarily constrained. Three existing earthen dugouts, with total storage capacity of 115,870 m^3, all under Crown land approvals issued by the Oil and Gas Commission, will be attached to the water licence. None of the earthen dugouts are regulated dams under the Water Sustainability Act. They are:

- c-53-K/94-A-12 - 51,720 m^3
- 1-18-88-24w6 - 29,870 m^3

- 8-18-88-24w6 - 34,280 m^3

An additional freshwater storage dugout (non-dam) of approximately 84,000 m^3 is being planned in the vicinity of the Water Hub but is not yet at the design and engineering phase.

Schedule

ConocoPhillips requires the Halfway River water supply system to be fully constructed and operational by January 1, 2019, to provide water for the beginning of the Late Appraisal program, starting with the completion of a 14 well pad at 13-22-88-25W6. Construction of the water intake will begin on July 15, 2018, so as to be completed during the "least risk" fisheries work window. Construction of the freshwater pipeline and water pumping facility will be concurrent with the intake construction, to achieve the January 1, 2019, completion date.

Site Closure and Decommissioning Plan

ConocoPhillips is committed to environmental stewardship and will reclaim all components of this project (water intake, pumping facility, pipelines etc.) in accordance with OGC, WSA and DFO standards at time of decommissioning, and in accordance with the requirements of Peaceland Farm Ltd. under the lease agreement. This may include additional stream bank work to excavate the intake, but all necessary instream work approvals will be pursued at that time.

3. CLIMATE AND HYDROLOGY

Background

The Halfway River watershed (British Columbia watershed code 35) is remote, with minimal development and low human population. The headwaters arise out of Muskwa Range of the northern Rocky Mountains, at 2,395 m elevation. The river generally flows about 300 km in a south-easterly direction, to discharge into the Peace River approximately 40km downstream of the community of Hudson's Hope. At its confluence with the Peace River, the watershed encompasses a drainage area of 9,326 km^2, ranging in elevation from 588 m to 2,395 m, dominated by coniferous and mixed forest. At the proposed Point of Diversion (POD) on the Halfway River, the drainage area is 6,610 km^2, with an elevation range of 680 - 2,395 m, and a median elevation of 1,278 m (refer to Figure 1).

The climate is cold, continental, characterized by long cold winters and brief warm summers. From ClimateWNA[1], mean annual temperate is -1.0°C, ranging from an average of -12°C in December and January to +12°C in July and August. Average temperatures are generally below freezing from about mid-October to late-March. Mean annual precipitation is 660 mm, with about 38% occurring as snow during the mid-October to late-March winter period, and 62% occurring as rain during spring, summer and autumn. May, June and July are typically the wettest months, with rainfall resulting from frontal and convective storm systems. On occasions, very large rainstorms (e.g., 100 mm in 24-36 hours) blanket the region, resulting from frontal systems pushing into the Peace River region from Alberta.

Major sub-basins of the Halfway River are:

- The **Cameron River** (drainage area = 2,052 km^2), arising from the lower relief plains along the east side of the watershed. The Cameron River flows into the Halfway River downstream of the proposed POD, and does not contribute to runoff at the POD.
- The **Graham River** (drainage area = 2,314 km^2), **Chowade River** (drainage area = 1,006 km2) and **Cypress River** (drainage Area = 620 km^2), all arise from mid and high elevation terrain on the west side of the watershed, and all flow into the Halfway River upstream of the proposed POD.

[1] Wang, T. A. Hamann, D. Spittlehouse, T. Murdock. ClimateWNA—High-Resolution Spatial Climate Data for Western North America. Journal of the Amrican Meteorologicasl Society. http://journals.ametsoc.org/doi/full/10.1175/JAMC-D-11-043.1

Hydrology Data and Overview

There are three active Water Survey of Canada (WSC) streamflow gauges and one inactive gauge in the Halfway River system that provide excellent long-term flow measurements (refer to Figure 1 for locations):

- **Halfway River above Graham River** (**07FA003**, drainage area = 3,780 km^2, 20 years of record, 1977-1995, 2013-present) and **Graham River above Colt Creek** (**07FA005**, drainage area = 2,140 km^2, 32 years of record, 1981-1995, 1998-present). These two gauges have a combined drainage area of 5,920 km^2, representing about 90% of the drainage area of the proposed POD. In their combined record, data for years 1996-2012 are missing, and will be estimated from WSC gauges 07FA001 and 07FA006.
- **Halfway River near Farrell Creek** (**07FA006**, drainage area = 9,340 km^2, 33 years of record, 1984-present); and **Halfway River below Farrell Creek, Lower Station** (**07FA001**, drainage area = 9,400 km^2, 22 years of record, 1962-1983). These gauges are located downstream of the proposed POD. They provide 55 years of excellent data.

To estimate daily, monthly, seasonal and annual discharge at the proposed POD, the combined daily data record from gauges 07FA003 and 07FA005 is used, after the following adjustments, to produce a 34-year data record of 1981-2014 (data for 2015, 2016 and 2017 are not yet available from the Water Survey of Canada):

1. Data for the period of 1996-2012, which are missing from the record, are estimated using the Maintenance of Variance Extension, Type 1 Method (MOVE.1)[2], using 07FA01 and 07FA006 for years 1983, 1987, 1988, 1989, 1991, 1992 and 1995 as reference. The relationship is highly significant, with Pearson r = 0.979 (Figure 3).
2. The measured and estimated daily discharge values were adjusted upwards by a factor of 1.104, to account for the 10.4% increase in drainage area at the proposed POD (6,610 km^2) relative to that of the combined gauges (5,920 km^2).

The data from this 34-year data record for the proposed POD were analyzed to assess:

- Monthly and annual discharge, for average conditions and for the lowest flow month in the period of record;
- 7-day average daily discharge, for average conditions and for the lowest 7-day average discharge in the period of record;
- 7-day average low flows, calculated for 1-in-5 year, 1-in-10 year and 1-in-20 year return period frequencies;
- Peak discharge, of varying recurrence intervals;
- Calculation of a proposed Environmental Base Flow (EBF) threshold.

As a reference, although it was not used for the hydrology analysis contained in this report, the Northeast Water Tool (NEWT)[3] report for the Halfway River at the proposed POD is contained in Appendix A.

Monthly and Annual Discharge

The Halfway River has very high rates of discharge. It is worth noting that the Halfway River produces three times greater runoff per unit of land area than other rivers flowing into the north side of the Peace River[4]. This results from the mid- and high-elevation watershed area, draining out of the northern Rocky Mountains. The Halfway River upstream of its confluence with the Cameron River has an average annual unit runoff of 322 mm. Average unit runoff for other rivers to the east of the Halfway, situated on the low relief plateau, are substantially smaller: Cameron River – 108 mm; Blueberry River – 100 mm; Beatton River - 106 mm.

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[2] Hirsch 1982. A comparison of four stream record extension techniques. Water Resources Research, 18(4): 1081-1088. http://www.esf.edu/quest/documents/Hirsch.1982.WRR.pdf

[3] BCOGC 2017. North East Water Tool. https://water.bcogc.ca/newt

[4] BCOGC 2017. North East Water Tool. https://water.bcogc.ca/newt

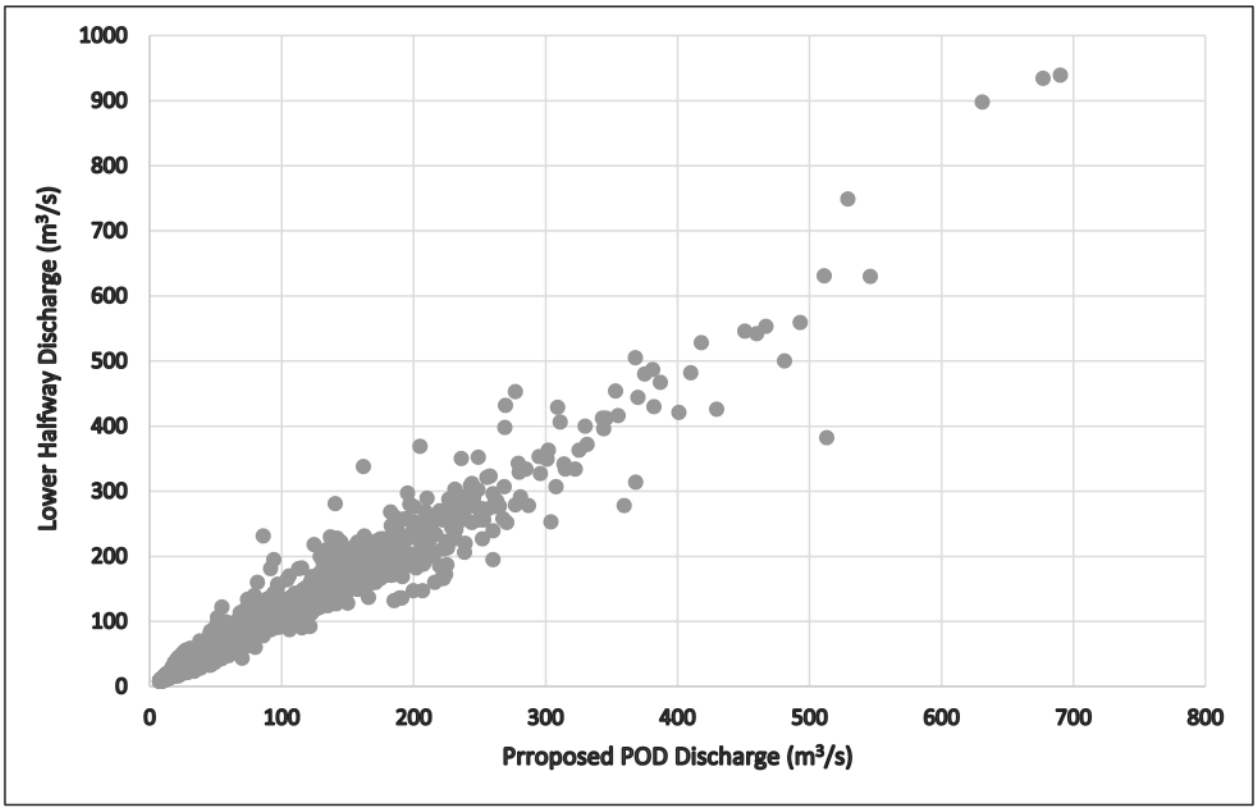

Figure 3. Relationship between daily discharge at the Lower Halfway River (07FA001 & 07FA006) and Halfway River at the Proposed POD (07FA003 & 07FA005), for MOVE.1 analysis

Monthly and annual discharge are presented in Table 1 and Figure 4. Average annual discharge for 1981-2014 is 2.13 billion cubic metres per year (5.83 million m^3per day), ranging from a low of 959 million m^3per year (2006) to a high of 4.01 billion m^3per year (1996). The 1-in-10 year return period low annual discharge is calculated to be 1.45 billion m^3per year (3.96 million m^3per day). The lowest annual discharge in the 34-year record is 959 million m^3per year (2.63 million m^3per day).

Monthly discharge varies from low runoff in winter (January-March) to high discharge in late spring and early summer, as the winter's accumulated snow melts (May-July). During February, the month of lowest average stream flow, discharge is 26.9 million m^3 (962,000 m^3 per day). During June, the month of highest average stream flow, discharge is 625 million m^3 (20.8 million m^3 per day). The 1-in-10 year return period low monthly discharge varies from a low of 22.9 million m^3 per month (745,000 m^3per day) in February to a high of 330 million m^3 per month (11 million m^3 per day) in June. For the 34-year period of data, the lowest monthly volume runoff recorded is 14.4 million m^3 in February 2011 (513,000 m^3 per day). This followed the significant summer drought of 2010.

Daily Discharge

As expected, daily discharge follows the same seasonal pattern described above for monthly discharge, with low runoff in late winter and high runoff in late spring and early summer (Figure 5). From the 34-year data set of daily discharge, average daily discharge is calculated to be 67.5 m^3/s (5.83 million m^3 per day), ranging from an average low of 10.8 m^3/s (933,000 m^3per day) on March 8 to an average high of 279 m^3/s (24.1 million m^3per day) on June 13. The 1-in-10 year daily low flow is 7.36 m^3/s (635,000 m^3per day), while the lowest daily flow ever recorded was 5.44 m^3/s (470,000 m^3per day), on January 17, 2011 (following the summer/autumn drought of 2010).

The highest daily discharge recorded was 2,410 m^3/s (208 million m^3per day) on June 12, 2001. This is the "flood of record" for the Halfway River.

Table 1. Monthly and annual discharge at the Halfway River Proposed POD, 1981-2014

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1981	36,839,763	23,610,105	24,028,453	43,221,264	591,571,430	653,000,021	334,446,694	153,697,077	150,576,373	92,944,800	60,186,106	46,780,606	2,210,902,691
1982	32,793,476	26,165,604	28,244,785	48,431,777	374,821,645	653,512,086	391,266,691	184,169,831	123,707,403	97,157,267	64,369,588	51,411,421	2,076,051,574
1983	32,500,729	26,147,247	26,635,158	49,563,153	209,821,437	521,621,290	657,521,659	197,386,930	104,142,619	76,674,629	43,848,304	29,951,027	1,975,814,182
1984	23,074,851	23,608,172	30,248,605	40,886,050	178,726,474	1,086,574,952	328,321,226	149,455,625	166,923,837	153,866,155	67,976,271	51,901,265	2,301,563,484
1985	37,057,150	23,549,237	26,753,030	55,859,632	185,517,628	445,284,817	302,399,095	85,297,626	266,159,319	127,494,759	48,385,401	46,642,445	1,650,400,138
1986	37,214,634	25,148,235	27,422,581	43,516,910	204,944,250	367,518,425	562,973,030	275,974,560	131,127,529	183,145,699	84,713,098	55,366,889	1,999,065,840
1987	40,293,793	30,253,436	28,198,409	56,714,685	313,944,733	577,851,928	562,915,061	784,900,479	229,772,685	137,272,320	71,882,465	51,125,437	2,885,125,430
1988	32,640,822	26,682,500	30,031,218	100,932,063	474,723,778	569,465,640	318,765,882	146,402,552	77,673,641	75,079,495	47,242,431	40,079,305	1,939,719,330
1989	28,640,911	23,743,435	28,413,863	71,287,309	443,584,372	511,901,698	425,584,771	332,301,814	185,155,317	158,141,423	56,564,930	54,256,769	2,319,576,611
1990	43,129,479	29,877,599	36,497,742	64,816,921	431,961,441	949,708,421	388,484,144	135,224,056	80,004,024	63,480,719	41,209,715	30,322,033	2,294,716,293
1991	27,977,158	25,610,060	25,206,205	61,796,698	335,306,578	428,067,808	275,887,605	103,968,710	106,587,010	94,136,078	56,604,543	41,983,611	1,583,132,063
1992	31,230,226	25,965,608	34,451,410	96,364,048	254,873,578	578,615,196	238,516,453	86,664,746	71,400,350	128,151,749	53,953,394	31,929,727	1,632,116,485
1993	24,329,896	24,447,767	25,804,259	54,591,061	312,737,030	630,478,781	767,557,868	626,710,748	256,351,806	104,674,009	58,355,228	44,028,010	2,930,066,463
1994	35,181,829	30,086,290	37,202,074	108,606,289	389,691,846	537,920,445	711,056,705	299,065,836	155,716,356	117,021,561	62,959,957	44,100,472	2,528,609,660
1995	33,763,503	27,124,037	31,334,571	46,289,795	268,573,758	614,759,322	784,852,171	322,128,126	199,135,683	107,119,365	68,562,732	61,942,589	2,565,585,652
1996	41,850,814	31,302,508	37,868,859	66,643,648	338,194,724	1,338,543,362	1,455,652,207	285,354,885	149,440,215	131,852,903	82,632,268	53,847,436	4,013,183,828
1997	44,416,388	32,138,189	29,535,940	74,043,556	565,244,827	703,241,577	482,378,810	231,883,210	299,869,473	272,020,280	86,659,506	40,464,568	2,861,896,322
1998	31,589,567	31,564,413	52,028,435	157,724,370	581,152,284	339,822,291	203,211,128	99,919,414	65,098,879	74,906,741	42,510,817	36,827,790	1,716,356,130
1999	32,210,914	28,241,846	32,390,540	103,575,545	197,370,282	589,414,514	289,968,140	108,751,717	55,665,920	41,993,225	31,491,637	27,037,572	1,538,111,853
2000	20,605,105	19,004,152	21,851,202	37,823,906	110,181,698	637,613,598	636,611,038	237,961,862	236,781,759	109,582,832	65,373,194	41,580,261	2,174,970,607
2001	40,636,305	32,066,607	31,392,438	40,692,720	232,699,560	1,573,351,684	663,819,003	237,334,631	114,137,235	74,185,266	38,801,828	31,859,626	3,110,976,903
2002	26,326,165	23,676,393	24,054,590	47,207,187	430,158,424	778,879,422	328,527,003	176,105,843	133,978,641	95,603,186	51,499,753	37,492,367	2,153,508,975
2003	30,500,279	25,631,098	24,221,052	45,829,231	248,761,172	404,602,069	601,543,986	175,408,285	86,149,006	78,905,088	61,841,247	48,504,711	1,831,897,224
2004	39,980,870	25,860,560	29,627,188	52,900,759	197,762,389	327,708,045	409,764,905	189,867,164	515,469,025	222,841,524	81,887,160	56,259,289	2,149,928,878
2005	39,890,466	32,721,880	34,099,701	125,487,092	387,147,224	536,265,542	274,674,953	233,994,910	145,673,864	93,484,768	52,651,063	36,272,315	1,992,363,778
2006	30,860,795	26,891,192	23,925,056	46,044,903	200,721,844	296,544,777	121,234,183	67,620,502	45,929,965	42,625,893	29,604,301	26,800,655	958,804,066
2007	22,923,504	19,580,673	19,365,530	63,148,751	336,973,007	850,369,995	300,558,864	189,138,716	149,675,224	96,158,433	56,796,745	43,470,487	2,148,159,929
2008	39,114,839	26,081,203	24,809,507	31,458,582	429,059,410	493,778,303	230,838,621	303,742,387	132,267,788	81,233,500	51,032,381	36,057,813	1,879,474,334
2009	27,731,814	20,419,540	18,743,839	31,950,432	235,580,254	387,491,518	303,114,541	155,902,667	97,018,432	67,910,368	44,364,633	33,459,336	1,423,687,374
2010	27,612,423	22,613,886	25,462,355	84,120,635	230,522,747	258,705,630	123,496,292	65,932,405	63,112,160	86,618,254	45,746,732	27,197,365	1,061,140,885
2011	15,750,511	14,372,007	18,267,149	34,486,563	584,711,812	836,489,911	884,478,324	189,898,568	98,008,180	90,450,349	44,051,699	35,310,998	2,846,276,073
2012										64,607,264	70,688,288	88,421,229	
2013	70,467,037	61,475,932	65,085,514	43,995,160	381,942,260	834,812,416	403,218,117	253,144,148	99,814,213	106,258,515	55,894,413	35,711,286	2,411,819,011
2014	29,716,250	23,080,648	27,857,354	52,227,828	266,852,057	298,399,184	130,943,958	57,169,747	44,986,443	70,324,045	47,771,888	38,706,389	1,088,035,790
Mean (m^3/month)	**33,601,584**	**26,931,577**	**29,729,049**	**63,098,137**	**331,085,938**	**624,615,596**	**451,351,004**	**216,438,781**	**146,591,223**	**106,409,484**	**56,709,227**	**42,855,973**	**2,128,879,935**
Mean (m^3/day)	**1,083,922**	**961,842**	**959,002**	**2,103,271**	**10,680,192**	**20,820,520**	**14,559,710**	**6,981,896**	**4,886,374**	**3,432,564**	**1,890,308**	**1,382,451**	**5,832,548**
Mean (m^3/s)	**12.5**	**11.1**	**11.1**	**24.3**	**123.6**	**241.0**	**168.5**	**80.8**	**56.6**	**39.7**	**21.9**	**16.0**	**67.5**
Standard Deviation (% of mean)	**28%**	**28%**	**31%**	**46%**	**40%**	**47%**	**60%**	**69%**	**64%**	**45%**	**26%**	**29%**	**636,048,171**
Minimum (m^3/month)	**15,750,511**	**14,372,007**	**18,267,149**	**31,458,582**	**110,181,698**	**258,705,630**	**121,234,183**	**57,169,747**	**44,986,443**	**41,993,225**	**29,604,301**	**26,800,655**	**958,804,066**
Minimum (m^3/day)	**508,081**	**513,286**	**589,263**	**1,048,619**	**3,554,248**	**8,623,521**	**3,910,780**	**1,844,185**	**1,499,548**	**1,354,620**	**986,810**	**864,537**	**2,626,860**
1-in-10 Year Low Flow (m^3/month)	**23,325,860**	**20,858,409**	**22,265,973**	**38,397,669**	**197,448,703**	**330,130,894**	**208,736,627**	**85,571,050**	**63,509,504**	**65,598,195**	**41,600,046**	**30,062,329**	**1,446,572,269**
1-in-10 Year Low Flow (m^3/day)	**752,447**	**744,943**	**718,257**	**1,279,922**	**6,369,313**	**11,004,363**	**6,733,440**	**2,760,356**	**2,116,983**	**2,116,071**	**1,386,668**	**969,753**	**3,963,212**
Effect of withdrawing 10,000 m^3/day													
- Effect on mean flow	**0.92%**	**1.04%**	**1.04%**	**0.48%**	**0.09%**	**0.05%**	**0.07%**	**0.14%**	**0.20%**	**0.29%**	**0.53%**	**0.72%**	**0.17%**
- Effect on 1-in-10 year low flow	**1.33%**	**1.34%**	**1.39%**	**0.78%**	**0.16%**	**0.09%**	**0.15%**	**0.36%**	**0.47%**	**0.47%**	**0.72%**	**1.03%**	**0.25%**
- Effect on lowest flow of record	**1.97%**	**1.95%**	**1.70%**	**0.95%**	**0.28%**	**0.12%**	**0.26%**	**0.54%**	**0.67%**	**0.74%**	**1.01%**	**1.16%**	**0.38%**

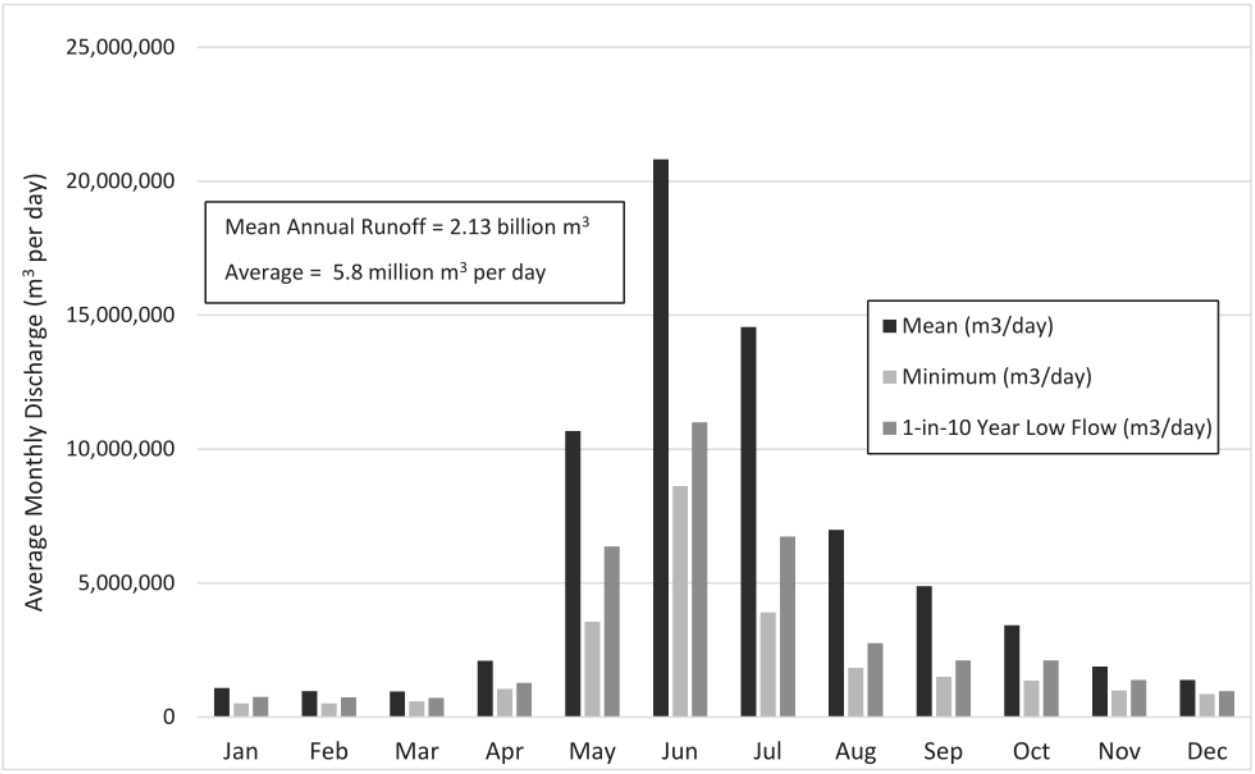

Figure 4. Monthly and annual discharge (1981-2014) at the Halfway River Proposed POD.

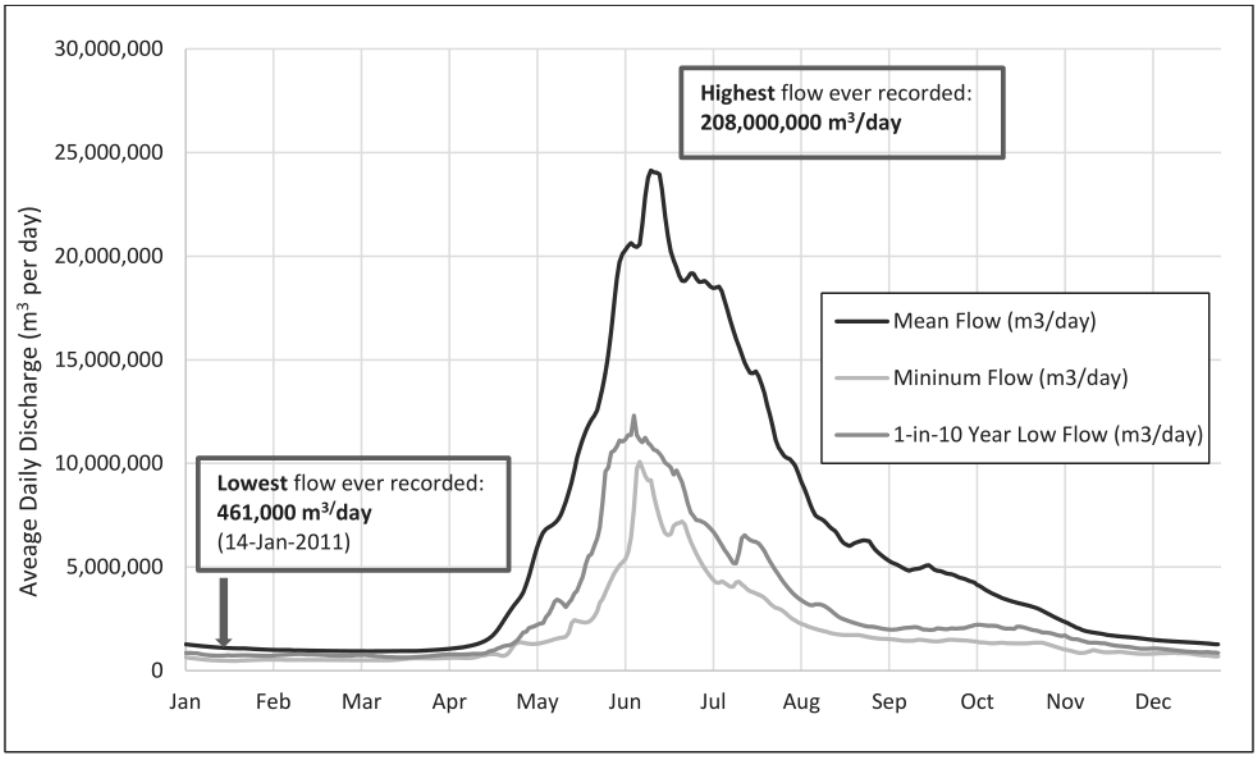

Figure 5. Daily average discharge (1981-2014) at the Halfway River Proposed POD.

The data set indicates that the Halfway River has high flow, and maintains substantial flow throughout the year. The late winter period of January-March experiences the lowest flows, comparably, and can be considered a critical time period where it is essential to maintain adequate flow for fish and other aquatic resources. However, average volume runoff during winter is not small, averaging slightly less than one million m^3per day. To assess discharge during this time period, statistical analysis of 7-day average discharge was done, using HEC-SSP v.2.1[5] (Table 2).

Return Period (years)	Probability of Exceedance	Summer Low Flow Discharge (m^3/s) Aug-Oct	Winter Low Flow Discharge (m^3/s) Dec-Apr
50	0.02	12.4	6.30
20	0.05	16.1	6.82
10	0.10	18.4	7.04
5	0.20	21.7	7.94
2	0.50	29.7	9.04

Table 2. Frequency analysis of summer and winter low flows.

Peak Discharge

From the daily discharge data set for the Halfway River at the proposed POD, the largest daily average discharge in every year was extracted and compiled (Table 3). This is referred to as the "annual flood series". These data were then analyzed using HEC-SSP. The probability and return period of extreme discharge values were calculated using the log-Pearson III distribution. The 200-year return period (p=0.005) daily average discharge was calculated to be 3,068 m^3/s (Figure 6). The dates of the annual floods range from May 15 to August 15, with an average date of June 23 (standard deviation = 21 days). To determine the instantaneous peak discharge, it was necessary to analyze the peak flow data from the two WSC gauges on the lower Halfway River (07FA001 and 07FA006). These gauges have records of both daily average peak flow and instantaneous peak flow dates and magnitudes. These data were compiled, and for years where the daily average peak discharge and the instantaneous peak discharge occurred on the same day or on adjacent days, the ratio of the instantaneous to daily peak discharge was calculated (Table 4). The average Instantaneous : Daily ratio was calculated to be 1.097. Using this ratio, the 200-year return period instantaneous peak discharge ($Q_{i,\,200}$) at the proposed POD location was calculated to be:

$$\mathbf{Q_{i,\,200} = 3{,}068 * 1.097 = 3{,}365\ m^3/s}$$

The return period peak flow estimates are reported in Table 5. The 200-year instantaneous peak flow will be used for the design of the intake system and pumping facility.

The flood of record on the Halfway River occurred on June 12, 2001. An instantaneous peak discharge of 3,020 m^3/s was recorded at WSC gauge 07FA006 (Halfway River near Farrell Creek). From the frequency analysis, this discharge is estimated to have an 80-year recurrence interval. At the proposed POD, the June 2001 flood is estimated to have a discharge of 2,410 m3/s. Through discussions with the Peaceland Farm Ltd. Director, the peak water level associated with the June 2001 flood is reasonably well known, and can be used as a field-based reference against the water level calculated from hydraulic modeling. Bill Stadler of Peaceland Farm Ltd. (personal communication, 26-Oct-2017) reports that in June 2001 the Halfway River flooded over its north bank and rose to a peak "*approximately mid-way between his shop and the horse corrals*".

[5] Statistical Software Package, U.S. Army Corp of Engineers, Institute for Water Resources, Hydrological Engineering Center, http://www.hec.usace.army.mil/software/hec-ssp/

Table 3. Annual series of "daily average" peak flows at the Proposed POD

Date	Year	Peak	Rank
29-Jun-65	1965	1,722	3
22-Jul-66	1966	266	43
3-Jun-67	1967	369	33
14-Jun-68	1968	606	21
28-Jun-69	1969	354	36
5-Jun-70	1970	264	44
12-Jul-71	1971	882	9
25-Jul-72	1972	572	24
19-Jun-73	1973	364	34
17-Jul-74	1974	1,132	7
29-Jun-75	1975	577	23
15-Aug-76	1976	1,722	2
10-Jun-77	1977	644	18
31-May-78	1978	352	37
4-Jul-79	1979	550	25
20-Jun-80	1980	602	22
27-May-81	1981	740	15
5-Jun-82	1982	350	38
3-Jul-83	1983	538	26
14-Jun-84	1984	741	14
24-Jun-85	1985	400	32
15-Jul-86	1986	708	16
2-Aug-87	1987	772	12
8-Jun-88	1988	426	30
9-Jul-89	1989	275	42
1-Jun-90	1990	1,398	4
15-May-91	1991	205	46
12-Jun-92	1992	310	41
29-Jun-93	1993	615	19
3-Jul-94	1994	698	17
5-Jul-95	1995	757	13
20-Jul-96	1996	1,261	6
29-Jun-97	1997	488	28
27-May-98	1998	316	40
17-Jun-99	1999	363	35
11-Jun-00	2000	876	10
12-Jun-01	**2001**	**2,410**	**1**
8-Jun-02	2002	495	27
2-Jul-03	2003	776	11
5-Jul-04	2004	432	29
12-Jun-05	2005	350	39
30-May-06	2006	196	47
7-Jun-07	2007	614	20
13-Aug-08	2008	402	31
8-Jul-09	2009	219	45
22-May-10	2010	181	48
26-Jun-11	2011	1,303	5
28-Jun-13	2013	966	8
25-May-14	2014	170	49

Table 4. Calculation of Instantaneous:Daily (I:D) ratio for peak flow at the Halfway River Proposed POD

WSC ID	Year	Instantaneous Peak Discharge (m^3/s)	Date Instantaneous	Daily Average Peak Discharge (m3/s)	Date Daily	I:D Ratio
07FA001	1964	708	3-Aug	682	3-Aug	1.038
07FA001	1965			1980	29-Jun	
07FA001	1966	306	22-Jul	294	22-Jul	1.041
07FA001	1967	422	3-Jun	411	3-Jun	1.027
07FA001	1968	833	13-Jun	682	13-Jun	1.221
07FA001	1969	408	28-Jun	394	28-Jun	1.036
07FA001	1970	294	5-Jun	292	5-Jun	1.007
07FA001	1971	1130	11-Jul	1000	12-Jul	1.13
07FA001	1972	833	24-Jul	643	24-Jul	1.295
07FA001	1973	501	18-Jun	405	19-Jun	1.237
07FA001	1974			1290	17-Jul	
07FA001	1975			648	29-Jun	
07FA001	1976			1980	14-Aug	
07FA001	1977	770	10-Jun	725	10-Jun	1.062
07FA001	1978	411	30-May	391	31-May	1.051
07FA001	1979	725	4-Jul	617	4-Jul	1.175
07FA001	1980	771	19-Jun	677	19-Jun	1.139
07FA001	1981	872	28-May	841	28-May	1.037
07FA001	1982	465	19-May	432	19-May	1.076
07FA001	1983	626	8-Jul	553	8-Jul	1.132
07FA006	1984	894	9-Jun	872	9-Jun	1.025
07FA006	1985	453	24-Jun	433	24-Jun	1.046
07FA006	1986	941	16-Jul	856	16-Jul	1.099
07FA006	1987	1050	2-Aug	939	2-Aug	1.118
07FA006	1988	575	7-Jun	505	8-Jun	1.139
07FA006	1989	314	11-May	308	2-Jun	
07FA006	1990			2000	2-Jun	
07FA006	1991	366	5-Jun	338	5-Jun	1.083
07FA006	1992	478	11-Jun	453	11-Jun	1.055
07FA006	1993	924	25-Aug	840	25-Aug	1.1
07FA006	1994			970	4-Jul	
07FA006	1995	984	5-Jul	934	5-Jul	1.054
07FA006	1996	1780	19-Jul	1440	19-Jul	1.236
07FA006	1997	577	28-Jun	546	28-Jun	1.057
07FA006	1998	363	16-May	351	27-May	
07FA006	1999	408	17-Jun	404	17-Jun	1.01
07FA006	2000	1070	10-Jun	993	10-Jun	1.078
07FA006	2001	3020	12-Jun	2790	12-Jun	1.082
07FA006	2002	615	7-Jun	555	8-Jun	1.108
07FA006	2003	945	2-Jul	877	2-Jul	1.078
07FA006	2004	529	4-Jul	482	4-Jul	1.098
07FA006	2005	416	12-Jun	389	12-Jun	1.069
07FA006	2006	235	31-May	215	30-May	1.093
07FA006	2007	726	7-Jun	691	7-Jun	1.051
07FA006	2008	541	11-Aug	448	12-Aug	1.208
07FA006	2009	264	8-Jul	241	8-Jul	1.095
07FA006	2010	208	21-May	199	22-May	1.045
07FA006	2011			1490	26-Jun	
07FA006	2013	1710	28-Jun	1430	28-Jun	1.196
07FA006	2014	170	2-May	165	2-May	1.03
					Average I:D ratio =	**1.097**

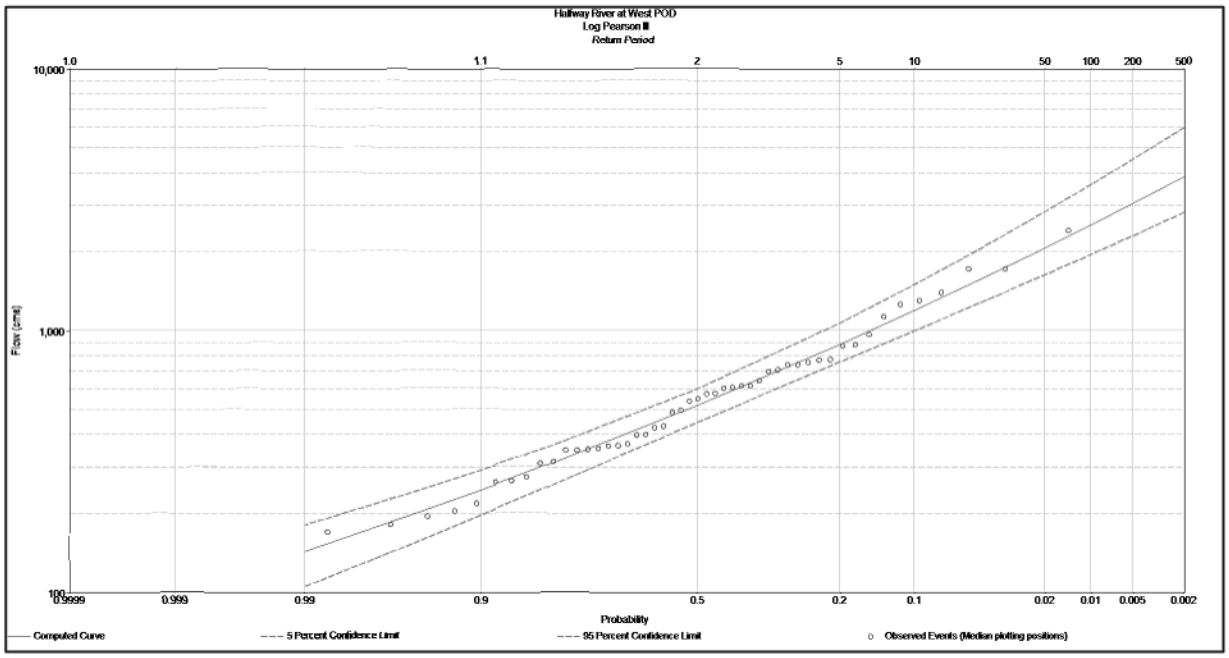

Figure 6. Flood frequency graph of daily average discharge (1981-2014) at the Halfway River West POD, based on the log-Pearson III extreme values distribution. To convert from daily average peak discharge to instantaneous peak discharge, increase the values noted in the graph by 1.097.

Return Period (years)	Probability of Exceedance	Daily Average Peak Discharge (m^3/s)	Instantaneous Peak Discharge (m^3/s)
500	0.002	3,880	4,256
200	0.005	3,068	3,366
100	0.01	2,538	2,784
50	0.02	2,073	2,274
20	0.05	1,542	1,692
10	0.1	1,196	1,312
5	0.2	888	974
2	0.5	518	568

Table 5. Return period flow estimates for the Halfway River at the Proposed POD

Trends in Stream Flow, and Future Climate

The stream flow record at the proposed POD was examined to see if there any trends over time that might be indicative of climate changes. The trend in annual runoff is shown in Figure 7. During the 1981-2014 period there is a slight downward trend in runoff, from about 2.3 billion m^3 per year in 1981 to about 2 billion m^3 per year in 2014. However, the trend is not statistically significant, and is well within the annual variability of the data (mean annual runoff = 2.13 billion m^3; standard deviation = 636 million m^3). All of the slight downward trend in annual runoff results from the three years of lowest stream flow – 2006, 2010 and 2014.

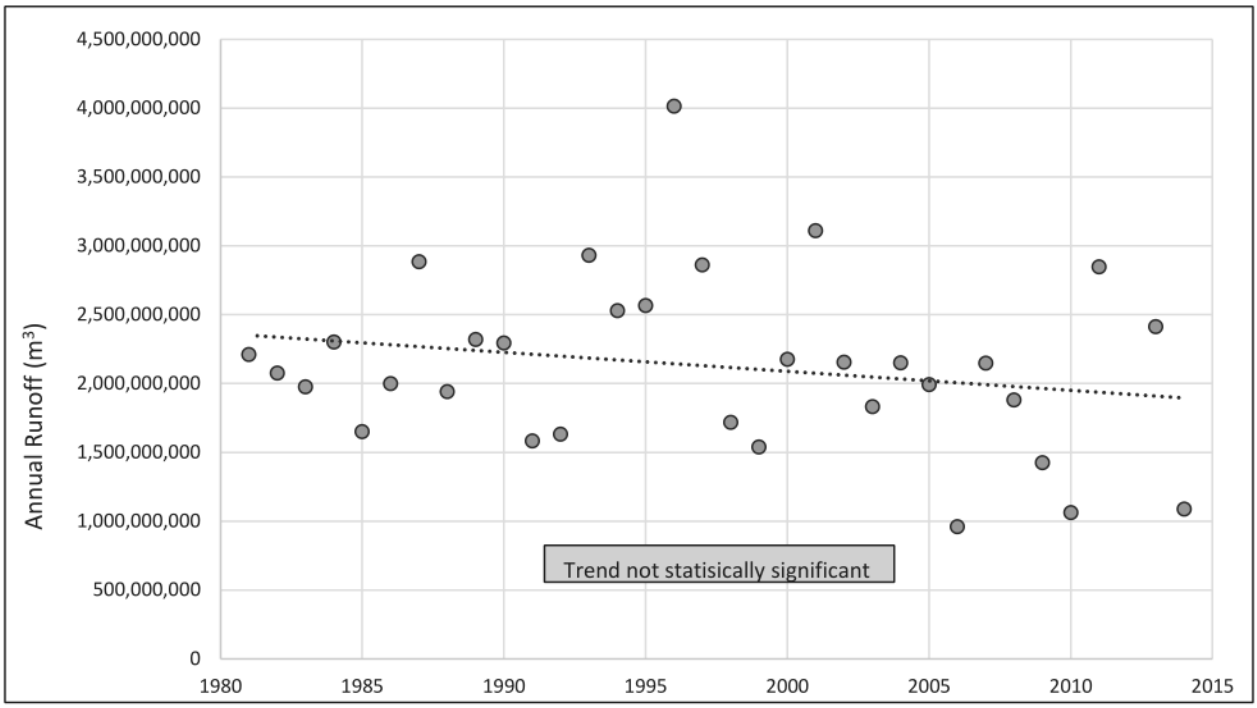

Figure 7. Trend in annual runoff for the Halfway River at the Proposed POD (1981-2014).

The annual runoff data were examined to see if there is any apparent relation with the El Niño–Southern Oscillation (ENSO) or the Pacific Decadal Oscillation (PDO). ENSO is an irregular periodic variation in winds and sea surface temperature over the tropical eastern Pacific Ocean, which results in a warm phase is known as El Niño and a cool phase as La Nina. ENSO is documented to affect weather across western North America, particularly in regions bordering the Pacific Ocean. PDO is a recurring pattern of ocean-atmosphere climate variability centered over the mid-latitude Pacific basin, with periodic warm and cool phases of a few years to multiple decades. PDO is documented to affect the North Pacific Ocean, and regions bordering the Pacific Ocean, affecting coastal sea and continental surface air temperatures. Average annual ENO and PDO values were calculated from data provided by the US National Oceanic and Atmospheric Administration (NOAA)[6] and regressed against mean annual runoff. The results indicate there is no statistically significant relationship between annual runoff on the Halfway River and the periodic ENSO and PDO patterns.

The Halfway River daily discharge data were also examined to see if there is any apparent change in the timing of runoff. In some rivers in British Columbia, there is evidence that the changing climate is resulting in earlier spring snowmelt, causing the date of snowmelt runoff to advance, resulting in an earlier beginning of summer low flows[7]. For the 1981-2014 period, the average date by which 50% of the annual runoff of the Halfway River at the proposed POD has occurred is June 27 (standard deviation = 15 days) (Figure 8). Over the 34-year period there is a slight trend towards advanced runoff, by a few days. However, the trend is very small and is not statistically significant. It is not possible to conclude that snowmelt is occurring earlier or that the timing of Halfway River runoff is shifting.

[6] US National Oceanic and Atmospheric Administration (NOAA). https://www.ncdc.noaa.gov/teleconnections/

[7] Indicators of Climate Change for BC, Ministry of Environment. https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/reporting/envreportbc/archived-reports/climate-change/climatechangeindicators-13sept2016_final.pdf

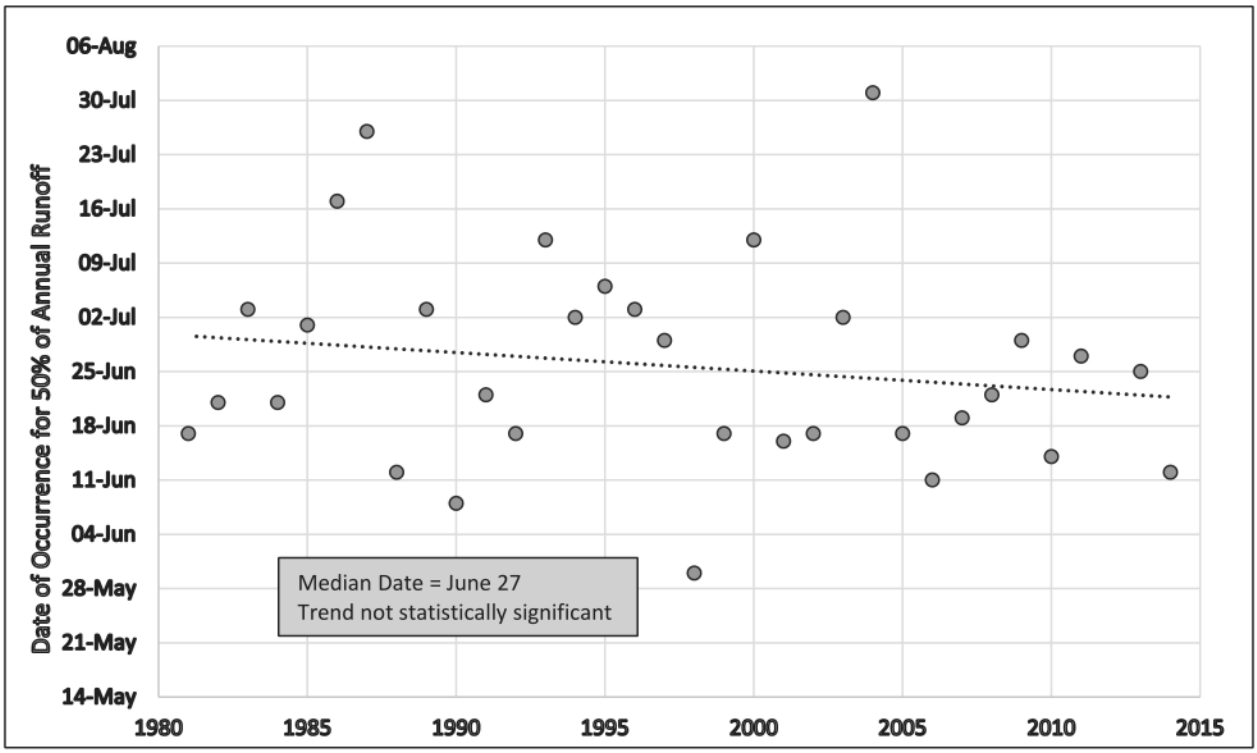

Figure 8. Date where 50% of the annual runoff of the Halfway River at the Proposed POD occurs

Climate studies in BC generally indicate a likely trend towards future climate (e.g., 2041-2070) being warmer across all seasons, with precipitation rates being variable by season and location[8]. To illustrate the possible range of effects, three climate change scenarios for 2041-2070[9] for the watershed area of the Halfway River upstream of the proposed POD were extracted from the North East Water Tool[10] and presented in Figure 9. Scenario A illustrates the UKMO HadGEM A1B run 1 global climate model (GCM), Scenario B shows the CGCM3 A2 run 4 GCM and Scenario C shows the UKMO HadCM3 B1 run 1 GCM. The combination of these three climate models and emissions scenarios provide a range of generally hot/dry, warm/very wet, and moderately warm/wet for Scenario A, B, and C respectively. All three models indicate a likelihood of reduced snowfall in the watershed during the winter period, which would be expected to result in reduced snowmelt runoff in the river during the May to August period. As well, all three models indicate a likelihood of warmer summer and autumn temperatures, which would be expected to result in increased rates of evaporation and evapotranspiration. At the same time, the models are not clear on whether spring, summer and fall rainfall is likely to increase, stay the same, or decrease. Should summer temperatures be warmer while rainfall stays unchanged, decreased summer runoff would be anticipated. These climate change scenarios cannot be considered as definitive or certain. However, they do suggest that the climate of the Halfway River by 2041-2070 is likely to have changed, and may change in ways that might result in a hydrologic effect. This recognition is reflected later in this Water Management Plan, with a

[8] Hydro-climatology and Future Climate Impacts in British Columbia, by: D, Rodenhuis, K. Bennett, A. Wernr, T. Murdock and D. Bronaugh. Pacific Climate Impacts Consortium, University of Victoria. https://www.pacificclimate.org/sites/default/files/publications/Rodenhuis.ClimateOverview.Mar2009.pdf

[9] Selecting and Using Climate Change Scenarios for British Columbia, by D. Murdock and D. Spittlehouse. Pacific Climate Impacts Consortium, University of Victoria, Victoria, BC. http://www.pacificclimate.org/sites/default/files/publications/Murdock.ScenariosGuidance.Dec2011.pdf

[10] BCOGC 2017. North East Water Tool. https://water.bcogc.ca/newt

recommendation for enhanced Environmental Flow Needs protection, to provide protection for fish and aquatic resources should future river flows be reduced or seasonally altered.

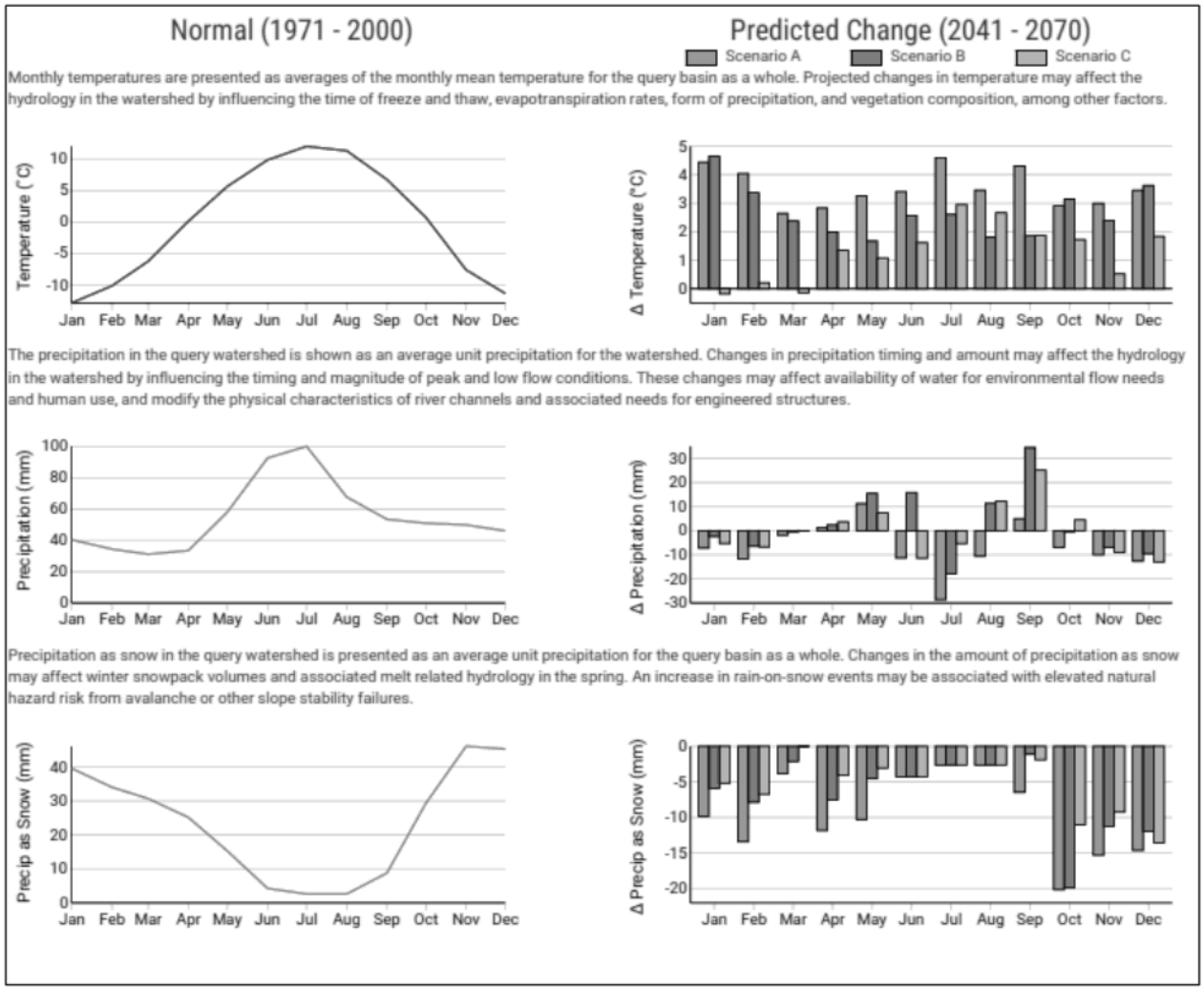

Figure 9. Climate Normal (1971-2000) and predicted future climate change (2041-2070) for the Halfway River at the Proposed POD. Scenario A illustrates the UKMO HadGEM A1B run 1 global climate model (GCM), Scenario B shows the CGCM3 A2 run 4 GCM and Scenario C shows the UKMO HadCM3 B1 run 1 GCM. From the North East Water Tool (BC Oil and Gas Commission 2017).

4. FISH RESOURCES AND FISH HABITAT

The Halfway River is a high value fisheries river. As part of this water licence application, detailed fisheries assessment was done by Eco-Web Ecological Consulting Ltd.[11] In addition, reports by Mainstream Aquatics Ltd.[12],[13]

[11] Aquatic Effects Assessment of the Proposed Halfway River Water Withdrawal Bank Infiltration System, Eco-Web Ecological Consulting Ltd, October 6, 2017.

[12] Halfway River and Moberly River summer fish survey – 2009, Mainstream Aquatics Ltd. 2010, Prepared for BC Hydro Engineering Services. Report No. 09008BF.

[13] Site C Clean Energy Project – Fish and Fish Habitat Technical Data Report. Mainstream Aquatics Ltd. 2012 Prepared for BC Hydro Site C Project, Corporate Affairs Report No. 12002F.

provide detailed data and information on fish utilization of the Halfway River and the specific reach associated with the proposed POD.

Sampling by Mainstream Aquatics Ltd. found 20 species of fish in the Halfway River, including 8 sportfish, 2 suckers, 7 minnows, and 3 sculpin species. The sport fish are: Arctic Grayling, Bull Trout, Burbot, Kokanee, Mountain Whitefish, Northern Pike, Rainbow Trout and Walleye.

In particular, the Halfway River watershed is a critical spawning and rearing area for the Peace River Bull Trout population. Bull Trout have been classified as a "blue listed" species by the British Columbia Conservation Data Centre, and require significant attention. In the Halfway River, monitoring of Bull Trout spawner and redd numbers since 2002 have documented a large increase in adult Bull Trout abundance and expansion of Bull Trout spawning reas[14]. Tributaries to the upper Halfway River system are important spawning and early rearing areas for Bull Trout. Data suggest that movements of Bull Trout into the Halfway River from the Peace River occur as early as May and that the fish complete extensive upstream migrations into the upper Halfway River and tributaries, including the Graham and Chowade river system, presumably to spawn.

Fish habitat in the Halfway River in the vicinity of the proposed POD is described as "Important" – referring to habitat that would be used by fish for feeding, growth, and migration but not critical due to limited spawning potential[15]. This reach, between the Graham River to the north and the Cameron River to the south, contains an abundance of rearing, feeding, and overwintering habitats for fish species potentially found in the Halfway River. Immediately proximal to the proposed POD there is no known spawning habitat, and fish utilization appears to be primarily for migration and overwintering. Fish sampling has indicated that "age 0" Bull Trout, Rainbow Trout, and Arctic Grayling were scarce or absent along the mainstem Halfway River[16], suggesting that the Halfway River itself is not significant spawning and early rearing habitat for these sport fish species; instead, most spawning and rearing occurs in headwater and upper tributaries, such as the Graham and Chowade rivers.

Managing water withdrawals in relation to the Environmental Flow Needs of the river to protect the valuable fisheries resources is critical, and is a key part of this application.

5. WATER DEMAND

Existing Licenced Water Demand

For the Halfway River watershed upstream of the proposed POD, there are currently 19 water licences with a total approved volume of 1,371,031 m^3 per year (excluding storage); two short-term use approvals with a total approved volume of 478,473 m^3 per year; and five water licence applications totalling 284,041 m^3 per year (Table 6). In total, the existing water licences, water licence applications and short term use approvals have a volume of 2,130,545 m^3 per year. The various licences, applications and use approvals comprise a number of water use purposes, as defined in the Water Sustainability Act. The three largest are: Irrigation – 1,121,233 m^3 (52.6% of total demand); oil and gas – 664,184 m^3 (31.2% of total) and dust control – 169,367 m^3 (8.0% of total) (Table 7).

The existing licences, applications and use approvals comprise a negligible portion of average streamflow. In total, they represent 0.10% of mean annual discharge, ranging from a low of 0.04% of June discharge to a high of 0.29% of February and March discharge (Table 8).

ConocoPhillips' Water Demand (this application)

ConocoPhillips has PNG tenure, referred to as the ConocoPhillips' Montney Asset, on a land base of 106,027 acres (42,908 hectares) in British Columbia. The development area is approximately 45km long North-South, and 12km wide East-West, centred approximately on the community of Wonowon. Maturity across the tenure ranges from wet gas to volatile oil. Development to date (2009-2017) has consisted of six Exploration wells and twelve Early

[14] Eco-Web Ecological Consulting Ltd., October 7, 2017. Ibid.

[15] Eco-Web Ecological Consulting Ltd., October 7, 2017. Ibid.

[16] Eco-Web Ecological Consulting Ltd., October 7, 2017. Ibid.

Table 6. Water licences, water licence applications, and short term use approvals on the Halfway River upstream of the Proposed POD

Licence No.	Licensee	Stream Name	Purpose	Quantity (m^3/year)	Licence Status	Priority	Issued
C054704	DONIS DAWN E ET AL	Fremont Spring	Domestic	830	Current	19781004	
C054705	DONIS DAWN E ET AL	French Spring	Domestic	830	Current	19781004	
"	DONIS DAWN E ET AL	French Spring	Irrigation: Private	11,101	Current	19781004	
C102506	STEWART LOIS ELAINE	Boreal Spring	Domestic	830	Current	19910311	19931213
C103500	WEITZEL UDO & MARGRIT	Crystal Spring	Domestic	830	Current	19910617	19940217
"	WEITZEL UDO & MARGRIT	Crystal Spring	Livestock & Animal: Stock	4,981	Current	19910617	19940217
C103512	MACCABEE FARMS LTD	MacCabee Spring	Livestock & Animal: Stock	830	Current	19910711	19941110
"	MACCABEE FARMS LTD	Allen Creek	Livestock & Animal: Stock	415	Current	19910711	19941110
"	MACCABEE FARMS LTD	Allen Creek	Livestock & Animal: Stock	415	Current	19910711	19941110
"	MACCABEE FARMS LTD	Cromie Creek	Livestock & Animal: Stock	830	Current	19910711	19941110
"	MACCABEE FARMS LTD	Cromie Creek	Livestock & Animal: Stock	830	Current	19910711	19941110
C103517	MACCABEE FARMS LTD	Cab Creek	Livestock & Animal: Stock	830	Current	19930320	19950106
C103645	CIMARRON CAMP SERVICES	Graham River	Livestock & Animal: Stock	830	Current	19911015	19950321
"	CIMARRON CAMP SERVICES	Graham River	Livestock & Animal: Stock	830	Current	19911015	19950321
"	CIMARRON CAMP SERVICES	Beattie Spring	Livestock & Animal: Stock	830	Current	19911015	19950321
"	CIMARRON CAMP SERVICES	Federal Slough	Livestock & Animal: Stock	830	Current	19911015	19950321
C109319	BLUEBERRY FIRST NATIONS HOLDINGS LTD	Two Bit Creek	Domestic	830	Current	19941206	19980225
C110878	AL CLARKE SCOBIE	Scobie Four Spring	Livestock & Animal: Stock	830	Current	19960409	19990714
"	AL CLARKE SCOBIE	Scobie Three Spring	Livestock & Animal: Stock	830	Current	19960409	19990714
"	AL CLARKE SCOBIE	Halfway River	Irrigation: Private	41,198	Current	19960409	19990714
"	AL CLARKE SCOBIE	Scobie One Spring	Livestock & Animal: Stock	830	Current	19960409	19990714
"	AL CLARKE SCOBIE	Scobie Two Spring	Livestock & Animal: Stock	830	Current	19960409	19990714
"	AL CLARKE SCOBIE	Halfway River	Irrigation: Private	41,075	Current	19960409	19990714
"	AL CLARKE SCOBIE	Halfway River	Irrigation: Private	41,075	Current	19960409	19990714
"	AL CLARKE SCOBIE	Halfway River	Livestock & Animal: Stock	830	Current	19960409	19990714
C113654	WARD NORMAN JACK & DONNA MAY	Montego Creek	Livestock & Animal: Stock	830	Current	19930318	19990224
"	WARD NORMAN JACK & DONNA MAY	Monterey Creek	Livestock & Animal: Stock	830	Current	19930318	19990224
C116364	Halfway River	Halfway River	Transport Mgmt: Dust Cont	56,456	Current	19930325	20010625
"	TRANSPORTATION & INFRASTRUCTURE MIN OF	Halfway River	Transport Mgmt: Dust Cont	56,456	Current	19930325	20010625
"	TRANSPORTATION & INFRASTRUCTURE MIN OF	Halfway River	Transport Mgmt: Dust Cont	56,456	Current	19930325	20010625
C117571	HAMPEL BRIAN DOUGLAS & CRYSTAL MARY	Simpson Spring	Domestic	1,660	Current	20020909	20020913
C118017	THE BOARD OF SCHOOL TRUSTEES OF SCHOOL D	Upper Halfway School	Camps & Pub Facil: Instit	1,660	Current	19770922	20030211
C125089	BELL JAMES A ET AL	Shiloh Spring	Domestic	1,660	Current	19910503	20100422
C125905	WARD NORMAN JACK & DONNA MAY	Halfway River	Irrigation: Private	986,784	Current	20020306	20101209
C126336	SIMPSON JAMES & DERYL	Simpson Spring	Domestic	830	Current	20100827	20110411
C131510	WARD NORMAN JACK & DONNA MAY	Grayling Creek	Domestic	1,660	Current	19910123	20140520
"	WARD NORMAN JACK & DONNA MAY	Grayling Creek	Livestock & Animal: Stock	4,981	Current	19910123	20140520
"	WARD NORMAN JACK & DONNA MAY	McLean Spring	Domestic	1,660	Current	19910123	20140520
"	WARD NORMAN JACK & DONNA MAY	McLean Spring	Livestock & Animal: Stock	4,981	Current	19910123	20140520
"	WARD NORMAN JACK & DONNA MAY	Gieni Spring	Domestic	1,660	Current	19910123	20140520
"	WARD NORMAN JACK & DONNA MAY	Gieni Spring	Livestock & Animal: Stock	4,981	Current	19910123	20140520
C132993	WARD NORMAN JACK & DONNA MAY	Miesau Spring	Livestock & Animal	4,981	Current	19930318	20160405
"	WARD NORMAN JACK & DONNA MAY	Cab Creek	Livestock & Animal	4,981	Current	19930318	20160405
"	WARD NORMAN JACK & DONNA MAY	Monteith Creek	Livestock & Animal	4,981	Current	19930318	20160405
"	WARD NORMAN JACK & DONNA MAY	Monteith Creek	Livestock & Animal	4,981	Current	19930318	20160405
"	WARD NORMAN JACK & DONNA MAY	Cab Creek	Livestock & Animal	4,981	Current	19930318	20160405
C133847	PROGRESS ENERGY CANADA LTD.	unnamed	O & G: Drilling	3,686	Current	20161223	20170619
"	PROGRESS ENERGY CANADA LTD.	unnamed	O & G: Hydrlc Frctrg	3,686	Current	20161223	20170619
"	PROGRESS ENERGY CANADA LTD.	unnamed	Stream Storage: Non-Power	9,943	Current	20161223	20170619
	Sub-Total - Active Licences (except Storage)			**1,371,031**	**m^3 per year**		

Application No.	Licensee	Stream Name	Purpose	Quantity (m^3/year)	Licence Status	Date of Application	
9000014	NORTH RIDGE VENTURES LTD.	unnamed	Land Improve: General	0	Active Application	20131119	
9000019	WILDFIRE LAND & CATTLE CO. LTD.	unnamed	Livestock & Animal: Stock	2	Active Application	20140326	
"	WILDFIRE LAND & CATTLE CO. LTD.	unnamed	Stream Storage: Non-Power	138,000	Active Application	20140326	
"	WILDFIRE LAND & CATTLE CO. LTD.	unnamed	Waterworks: Water Delivery	4,000	Active Application	20140326	
9000213	CONOCOPHILLIPS CANADA RESOURCES CORP.	unnamed	O & G: Hydrlc Frctrg	84,315	Active Application	20170127	
"	CONOCOPHILLIPS CANADA RESOURCES CORP.	unnamed	Stream Storage: Non-Power	84,220	Active Application	20170127	
9000281	734554 ALBERTA LTD.	Townsend Creek	Stream Storage: Non-Power	235,871	Active Application	20170608	
"	734554 ALBERTA LTD.	Townsend Creek	Waterworks: Water Sales	98,700	Active Application	20170608	
9000316	PROGRESS ENERGY CANADA LTD.	unnamed	O & G: Drilling	47,012	Active Application	20170918	
"	PROGRESS ENERGY CANADA LTD.	unnamed	O & G: Hydrlc Frctrg	47,012	Active Application	20170918	
"	PROGRESS ENERGY CANADA LTD.	unnamed	Stream Storage: Non-Power	189,516	Active Application	20170918	
	Sub-Total - Licence Applications (except Storage)			**281,041**	**m^3 per year**		

OGC Short Term Use No. (s.10)	Permit Holder	Stream Name	Purpose	Quantity (m^3/year)	Licence Status	Date of Issue	
0004497	Progress Energy	dugouts/dams	O & G: Hydrlc Frctrg	465,182	S.10 Use Approval	20170123	
0004743	Progress Energy	dugouts/dams	O & G: Hydrlc Frctrg	13,291	S.10 Use Approval	20170504	
	Sub-Total - S.10 Use Approvals			**478,473**	**m^3 per year**		

Total - Active Water Licences, Licence Applications and Use Approvals	**2,130,545**	**m^3 per year**

Water Use Purpose	Demand (m^3per year)	% of Total
Domestic	13,283	0.62
Irrigation	1,121,233	52.63
Livestock & Animal: Stock	58,117	2.73
Transport Management: Dust Control	169,367	7.95
Camps & Public Facility: Institutions	1,660	0.08
Oil and Gas	664,184	31.17
Stream Storage: Non-Power	519,550	24.39
Waterworks: Water Delivery	4,000	0.19
Waterworks: Water Sales	98,700	4.63
Total (except Storage)	**2,130,545**	

Table 7. Current water licences, water licence applications, and short-term use approvals, by WSA purpose.

Month	Demand (licences, approvals, applications)			Mean Discharge m^3/s	% of Discharge
	m^3/month	m^3per day	m^3/s		
Jan	85,722	2,765	0.032	12.5	0.26
Feb	77,427	2,765	0.032	11.1	0.29
Mar	85,722	2,765	0.032	11.1	0.29
Apr	82,957	2,765	0.032	24.3	0.13
May	197,846	6,382	0.074	123.6	0.06
Jun	251,142	8,371	0.097	241.0	0.04
Jul	422,092	13,616	0.158	168.5	0.09
Aug	422,092	13,616	0.158	80.8	0.20
Sep	251,142	8,371	0.097	56.6	0.17
Oct	85,722	2,765	0.032	39.7	0.08
Nov	82,957	2,765	0.032	21.9	0.15
Dec	85,722	2,765	0.032	16.0	0.20
Annual	**2,130,545**	**5,837**	**0.068**	**67.5**	**0.10**

Table 8. Existing water demand at the Halfway River Proposed POD, as a percentage of monthly discharge.

Appraisal wells, focused on improving the understanding of the subsurface, optimizing well design and completion, and detailing the opportunities for development. The water demand to date, to support this exploration and Early Appraisal, has relied on short term water use approvals (s.10 of the Water Sustainability Act) from local small streams and dugouts, and the acquisition of water from private landowners. These water sources are not adequate to support increased development through Late Appraisal and Initial Development, creating the necessity to obtain a water licence on the Halfway River, to provide assured water supply.

Projected Water Demand

Beginning in in 2018, ConocoPhillips has an accelerated Late Appraisal period (2018-2022), leading to Initial Development beginning in 2023. At the present time, the 2018-2022 development activity consists of:

- Construction of a Central Processing Facility and a co-located Water Treatment/Recycling/Storage Facility (Water Hub);
- Drilling and completion of approximately 75 Late Appraisal wells, and drilling (but no completion) of two Expiry wells;

Well drilling for the Late Appraisal wells will begin in 2018, with completion operations starting in early 2019.

Initial Development (2023-2028) and the early portion of the Manufacturing Phase are premised on a projection of 48 wells drilled and completed per year.

Current well design is for horizontal well legs of 2,400-3,000 metres, cluster spacing of ~10 metres, 240-300 fracture stages per well, and 475-600 m^3 of water per stage. Currently, projected water demands for well completions are (additional water volume is required for well drilling):

- 2019 - 2022: 114,000-180,000 m^3 per well, 75 wells = up to 3.4 million m^3 per year;
- 2023 – 2028+: average of 150,000 m^3 per well, 48 wells per year = 7.2 million m^3 per year. ConocoPhillips expects to make a larger off-take commitment by 2021, with facility expansions completed by 2023.

The amount of water produced and returned to surface after each well completion varies across the tenure. For modelling purposes and based on Early Appraisal data, ConocoPhillips estimates that an average of 30% of water used for well completions will return as produced flowback water in the first year after completion. By 2023, it is estimated that 50% of the water volume required for well completions will be treated produced water, from both early flowback volumes and accumulating infield water production. Produced flowback water will be transported with hydrocarbons in an effluent pipeline to the Central Processing Facility for separation, with the water continuing to the Water Hub. The Water Hub will consist of a treatment plant and saline water storage facility. The Water Treatment Plant is being designed to remove solids, iron, and H_2S, and have microbial inactivation. Once processed through treatment, the treated saline water will be stored in engineered water storage ponds, constructed and approved through the water hub facility.

Following treatment and release into storage, it is expected that all produced flowback water will be reused for on-going well completions. The timing of well completion activity will be optimized to maximize the reuse of flowback water volumes for subsequent well pads. However, if there is water production in excess of immediate needs for well completions, the produced water will be offered to other industry players for hydraulic fracturing use, with disposal being the last option.

The completions engineering design requires 10,000 m^3 of completion water per day to keep a completion frac crew optimized over a 24 hour period. This 10,000 m^3 per day volume must be available on demand, 365 days per year, for the life of the development. Over the period of Late Appraisal and Initial Development, the amount of fresh water required on a daily and annual basis will be variable, depending on the amount of treated saline water in storage and available for use. For the first pad, all completion water will be fresh water, and will need to be available at a rate of 10,000 m^3 per day. By Initial Development, the amount of fresh water required is estimated to be 50% of 7.2 million m^3 per year ≈ 3.6 million m^3 per year.

6. ENVIRONMENTAL FLOW NEEDS, AND RECOMMENDED EFN THRESHOLD

Effect of Proposed Water Withdrawal

ConocoPhillips is applying to withdraw 10,000 m^3per day (3.65 million m^3per year) from the Halfway River at the proposed POD. As summarized in Table 1 and Figures 10 and 11, this rate of withdrawal represents a small portion of discharge or runoff at the POD. It represents:

- 0.17% of average annual discharge, and 0.38% of annual discharge in the driest year of record (1996).
- About 1% of average January-March runoff, and 0.07-0.20% of average July-September runoff.

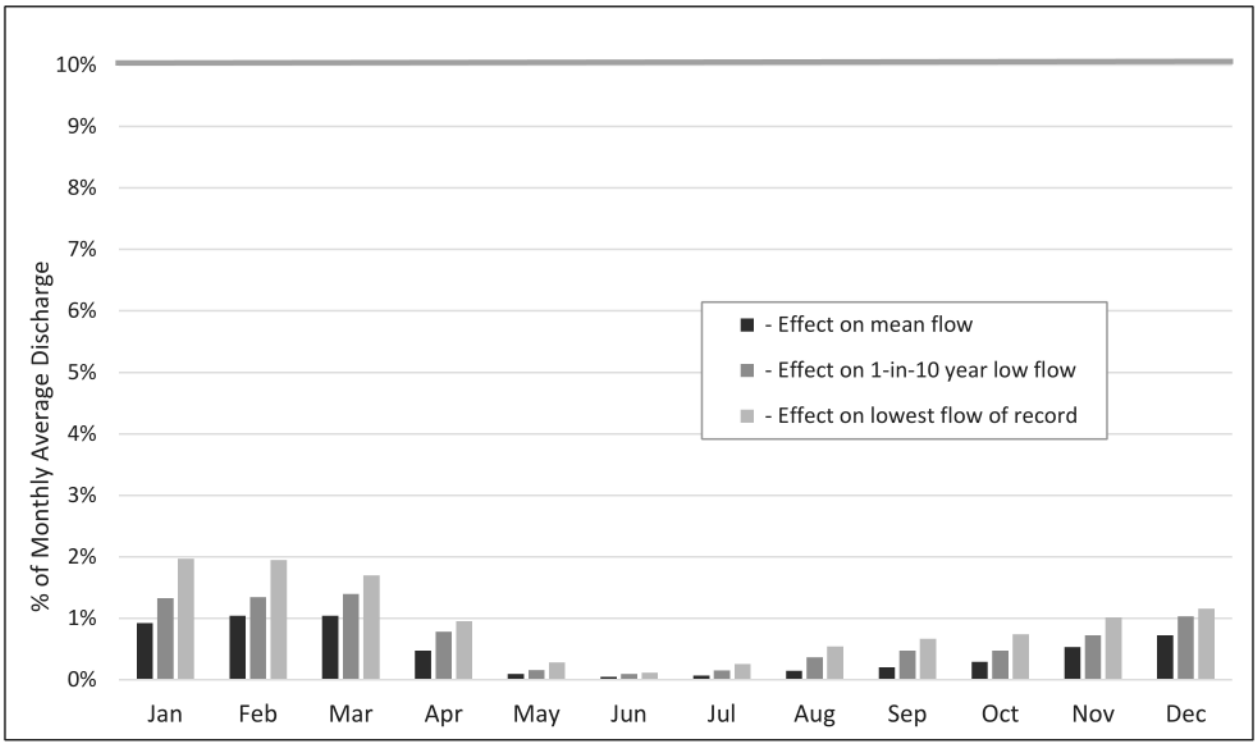

Figure 10. Halfway River Proposed POD (1981-2014), showing effect on monthly average flow from withdrawing 10,000 m^3 per day.

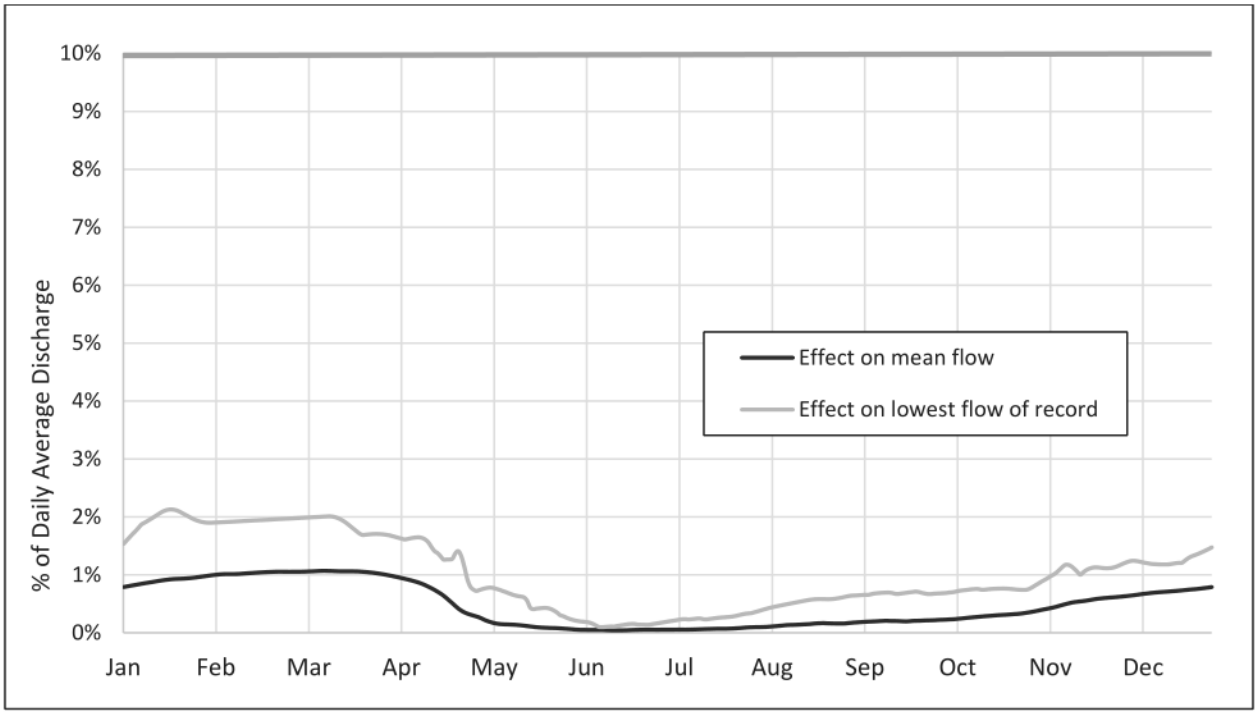

Figure 11. Halfway River Proposed POD (1981-2014), showing effect on daily average flow from withdrawing 10,000 m^3per day.

- For the months of lowest runoff in the 34-year record, the withdrawals amount to less than 2% of winter runoff in January-March 2011 (the months of lowest winter runoff in the period of record) and less than 0.67% of summer runoff in July-September 2014 (the months of lowest summer runoff in the period of record).

In relation to 34 years of daily discharge, the effect of withdrawing 10,000 m^3per day remains a small percentage of daily flows, ranging from a maximum of about 1.1% of average daily runoff in winter (January-March), to 0.05-0.20% of average daily runoff in summer (July-September). For the 1-in-10 year low flow, the proposed withdrawal comprises less than 1.5% of winter discharge and less than 0.5% of summer discharge. The lowest daily flow ever recorded in the 34 years was 5.44 m^3/s on January 17, 2011. The proposed withdrawal would have comprised less than 2.1% of the discharge on that day. The lowest summer flows in the 34-year record occurred in July-September period of 2014. The proposed rate of withdrawal would have comprised 0.19 – 0.71% of discharge during that summer period.

The 10,000 m^3per day proposed withdrawal is a very small portion of flows, even in periods of summer and winter low flow. The application of an Environmental Flow Needs threshold to be applied as a condition of the water licence will ensure there is no impact of water withdrawals on environmental needs or fish and aquatic resources.

Environmental Flow Needs

It is a requirement of the Water Sustainability Act (s.15) that the environmental flow needs of a stream be taken into consideration in making a determination on a water licence application. Environmental Flow Needs (EFN) of streams are assessed using the framework of the BC Environmental Flow Needs Policy[17] (Ministry of Environment and Ministry of Forests, Lands and Natural Resource Operations). Under the EFN Policy, the Halfway River is classified as:

- **Moderate Sensitivity** - because the lowest mean monthly discharge values are 10-20% of Mean Annual Discharge);
- **Medium – Large in Size** - because Mean Annual Discharge is >10 m^3/s (the Halfway River at the proposed POD has a Mean Annual Discharge of 67.5 m^3/s);
- **Fish-bearing**.

With this classification, the EFN Policy states that cumulative water withdrawals of ≤10% of discharge are within "Risk Level 1", indicating there "is sufficient natural water availability for the proposed withdrawal period and that cumulative water withdrawals are below the specified threshold" that might result in an impact on environmental flows. Given the status of the Halfway River as a high value fisheries stream for a number of sport and non-sport species, including the "blue-listed" Bull Trout, this Water Management Plan has significant focus on managing water withdrawals to provide for enhanced protection of the fish resources (Table 9).

Table 9 depicts the cumulative water demand for the Halfway River at the proposed POD in relation to monthly and annual runoff calculated from the 34-year WSC record. Should the water licence to ConocoPhillips be issued, the total cumulative water demand is 0.27% of mean annual runoff. On a monthly time scale, the total cumulative water demand is <1% of mean flow in every month except January, February and March. February and March have the highest water demand as a percentage of mean monthly runoff, at 1.33%.

At a monthly time scale, the total cumulative water demand is very small in every month, is well below a level that might result in fisheries or environmental concerns, and is likely below a level that could even be detected by hydrometric monitoring.

Cumulative water demand for the Halfway River at the proposed POD in relation to the low daily flow of record (1981-2014) and the 1-in-10 year low flow are shown in Table 10. Should the water licence to ConocoPhillips be issued, the total cumulative water demand is 0.60% of the lowest annual runoff of record, and 2.72% of the lowest daily flow in the 34 year data record. If a "zero withdrawal threshold corresponding to the 1-in-10 year low flow

[17] BC Environmental Flow Needs Policy (BC MOE and FLNRO), February 29, 2016. http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-rights/efn_policy_mar-2016_signed.pdf

Table 9. Total water demand (including the ConocoPhillips application) on the Halfway River at the Proposed POD, based on a total maximum water allocation of 10% of discharge.

Month	Mean Runoff (mm)	Mean Discharge (m^3/s)	Mean Runoff (m^3)	% of Mean Annual Discharge	Sensitivity	Environmental Flow Needs (m^3)	Potential Maximum Allocation (m^3)	Existing Allocation (m^3)	Remaining Potential Allocation (m^3)	This Application (m^3)	This Application as % of Mean Runoff	Total Allocation (m3)	Total Allocation as % of Mean Runoff
Jan	5.1	12.5	33,601,584	18.6%	Mod	30,241,425	3,360,158	85,722	3,274,436	310,000	0.92%	395,722	1.18%
Feb	4.1	11.1	26,931,577	16.5%	Mod	24,238,420	2,693,158	77,427	2,615,731	280,000	1.04%	357,427	1.33%
Mar	4.5	11.1	29,729,049	16.4%	Mod	26,756,144	2,972,905	85,722	2,887,183	310,000	1.04%	395,722	1.33%
Apr	9.5	24.3	63,098,137	36.1%	Low	56,788,323	6,309,814	82,957	6,226,857	300,000	0.48%	382,957	0.61%
May	50.1	123.6	331,085,938	183.1%	Low	297,977,344	33,108,594	197,846	32,910,748	310,000	0.09%	507,846	0.15%
Jun	94.5	241.0	624,615,596	357.0%	Low	562,154,036	62,461,560	251,142	62,210,417	300,000	0.05%	551,142	0.09%
Jul	68.3	168.5	451,351,004	249.6%	Low	406,215,904	45,135,100	422,092	44,713,008	310,000	0.07%	732,092	0.16%
Aug	32.7	80.8	216,438,781	119.7%	Low	194,794,903	21,643,878	422,092	21,221,786	310,000	0.14%	732,092	0.34%
Sep	22.2	56.6	146,591,223	83.8%	Low	131,932,101	14,659,122	251,142	14,407,980	300,000	0.20%	551,142	0.38%
Oct	16.1	39.7	106,409,484	58.9%	Low	95,768,536	10,640,948	85,722	10,555,226	310,000	0.29%	395,722	0.37%
Nov	8.6	21.9	56,709,227	32.4%	Low	51,038,304	5,670,923	82,957	5,587,966	300,000	0.53%	382,957	0.68%
Dec	6.5	16.0	42,855,973	23.7%	Low	38,570,376	4,285,597	85,722	4,199,875	310,000	0.72%	395,722	0.92%
Annual	**322.1**	**67.5**	**2,128,879,935**	-	-	**2,022,435,938**	**106,443,997**	**2,130,545**	**104,313,452**	**3,650,000**	**0.17%**	**5,780,545**	**0.27%**

Notes: **Mean Runoff (mm)**, **Mean Discharge (m^3/s)** and **Mean Runoff (m^3)** are all calculated from WSC data from gauges 07FA001, 07FA003, 07FA005 and 07FA006
Sensitivity is calculated as per the BC MOE/FLNRO *Environmental Flow Needs* Policy
Environmental Flow Needs (m^3) is calculated as 90% of Mean Monthly Runoff
Potential Maximum Allocation (m^3) is calculated as 10% of Mean Runoff (monthly)
Existing Allocation (m^3) is derived from MOE/FLNRO E-Licence and OGC data, as presented in Table 8
Remaining Potential Allocation (m^3) is calculated as **Potential Maximum Allocation** - **Existing Allocation**
This Application (m^3) is based on a withdrawal of up to 10,000 m^3/day and 3,650,000 m^3/year, for this application
This Application as % of Mean Runoff refers to the requested withdrawal from **This Application** as a percentage of **Mean Runoff**
Total Application (m^3) is the sum of the existing water licences, water licence applications and use approvals, and this application
Total Allocation as % of Mean Runoff refers to the sum of the **Existing Allocation** and **This Application** as a percentage of **Mean Runoff**

Table 10. Total water demand (including the ConocoPhillips application) on the Halfway River at the Propsoed POD, in relation to daily low flows

Month	Low Daily Flow of Record		1-in-10 Year Daily Low Flow		This Application			Total Allocation		
	m^3/s	m^3/day	m^3/s	m^3/day	m^3	% of Low Flow of Record	% of 1-in-10 Year Low Flow	m^3	% of Low Flow of Record	% of 1-in-10 Year Low Flow
Jan	5.4	14,568,633	8.1	21,617,659	310,000	2.13%	1.43%	395,722	2.72%	1.83%
Feb	5.9	14,154,770	8.0	19,298,961	280,000	1.98%	1.45%	357,427	2.53%	1.85%
Mar	5.8	15,428,906	7.0	18,855,936	310,000	2.01%	1.64%	395,722	2.56%	2.10%
Apr	6.9	17,989,846	8.3	21,554,520	300,000	1.67%	1.39%	382,957	2.13%	1.78%
May	14.9	39,783,521	21.8	58,284,780	310,000	0.78%	0.53%	507,846	1.28%	0.87%
Jun	54.1	140,324,563	79.0	204,755,528	300,000	0.21%	0.15%	551,142	0.39%	0.27%
Jul	32.6	87,243,063	48.8	130,612,299	310,000	0.36%	0.24%	732,092	0.84%	0.56%
Aug	18.4	47,671,821	24.4	63,234,209	310,000	0.65%	0.49%	732,092	1.54%	1.16%
Sep	16.3	43,595,859	22.1	59,134,678	300,000	0.69%	0.51%	551,142	1.26%	0.93%
Oct	15.2	40,616,809	18.5	49,609,004	310,000	0.76%	0.62%	395,722	0.97%	0.80%
Nov	9.9	25,589,916	13.0	33,824,036	300,000	1.17%	0.89%	382,957	1.50%	1.13%
Dec	7.8	21,019,368	9.6	25,751,037	310,000	1.47%	1.20%	395,722	1.88%	1.54%
Annual	**30.4**	**958,804,066**	**45.9**	**1,446,572,269**	**3,650,000**	**0.38%**	**0.25%**	**5,780,545**	**0.60%**	**0.40%**

discharge was applied to ConocoPhillips' water withdrawals, Table 10 indicates the cumulative water demand would be a maximum of 2.1% of the 1-in-10 year daily low flow discharge.

At a daily time scale, the total cumulative water demand is very small, is well below a level that might result in fisheries or environmental concerns, and is likely below a level that could even be detected by hydrometric monitoring.

Figure 12 shows the effect of the total, cumulative water demand (all existing water licences, water licence applications and short term water use approvals, and the ConocoPhillips licence application), in relation to the daily discharge at the POD from the 34-year record. The figure depicts the relationship of withdrawal to average daily discharge, the 1-in-10 year low flow daily discharge, and the lowest daily flow ever recorded in the 34 years:

- In an average year, withdrawals are 0.08-1.37% of daily discharge, with the largest percentage withdrawal occurring in January-March;
- In a dry year (the 1-in-10 year daily low flows), withdrawals are 0.15-2.1% of daily discharge;
- In relation to the lowest daily flows of record, withdrawals would be 0.18-2.72% of daily discharge.

This analysis indicates that given the high flow of the Halfway River the cumulative water demand is low (as a percentage of flow), and is below a level that would be anticipated to result in concerns for environmental flows.

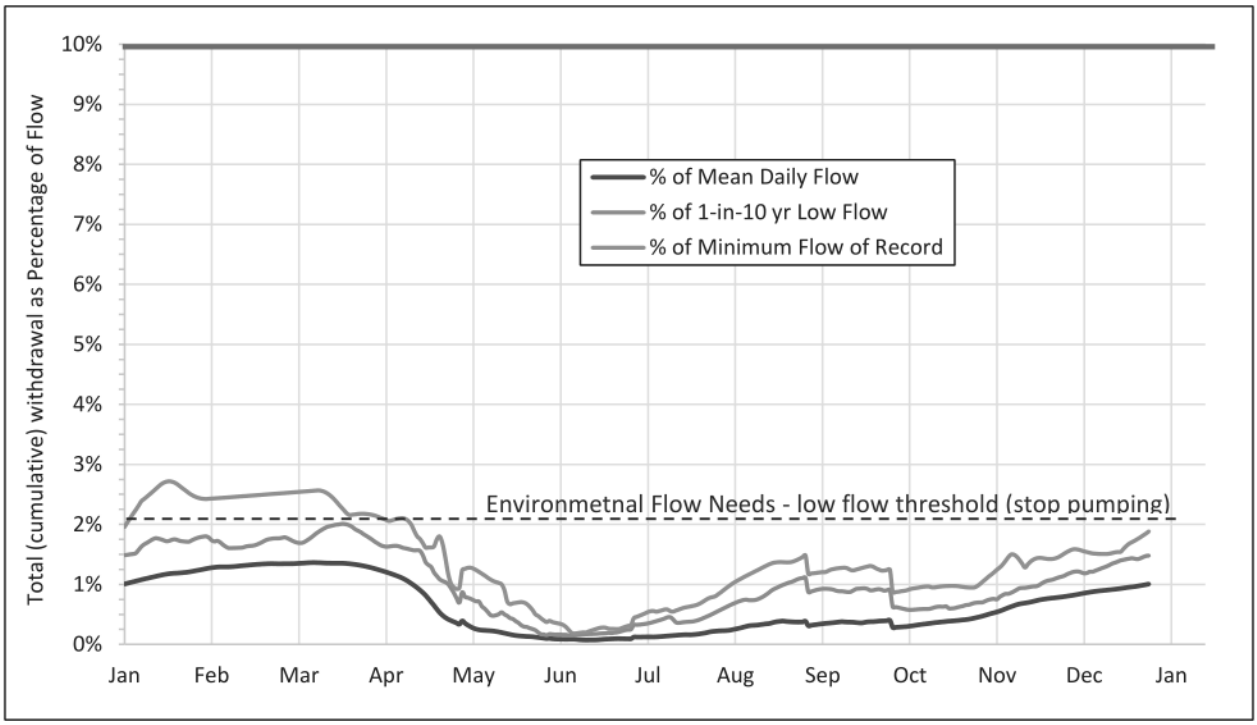

Figure 12. Halfway River Proposed POD (1981-2014), showing total cumulative water demand from all current water licence, water licence applications (including this ConocoPhillips application) and OGC short term use approvals in relation to daily stream flow. Also shown is the maximum withdrawal that would occur with an EFN "stop pumping" threshold of 7.04 m^3/s.

Recommended EFN Threshold

To provide for a high level of protection for the fish resources of the Halfway River, ConocoPhillips recommends that a "zero withdrawal threshold" of 7.04 m^3/s be applied as a condition of the water licence. This corresponds to the 1-in-10 year (p = 0.10) low flow discharge for the winter period of January to March. When applied, this EFN

threshold would limit current cumulative water withdrawals (including this ConocoPhillips application) to a maximum of ≤2.1% of discharge at all time, with zero withdrawal during times of winter drought.

In summary, ConocoPhillips' recommended EFN approach is:

- Recognize the Halfway River as a high value fisheries river, and set the "Risk Level 1", as described in the BC Environmental Flow Needs Policy;
- Apply a zero withdrawal threshold of 7.04 m^3/s, to provide for an escalated level of fish flow protection during times of low flow.

7. FIRST NATIONS

Historically, the Halfway River watershed has accommodated a variety of uses by both First Nations and settler communities, such as fishing, hunting, trapping and agriculture. The Halfway River First Nation (HRFN) reserve is located along the river, immediately east of the proposed POD.

First Nations Engagement

ConocoPhillips actively engages and consults with both Halfway River and Blueberry River First Nation regarding proposed activities within the ConocoPhillips Montney asset area, providing an avenue for concerns to be communicated and where possible, mitigated within the project planning process. ConocoPhillips strives to maintain good relationships that are supportive of both communities.

Given the proximity of the proposed POD, immediately west of the HRFN Reserve, ConocoPhillips has engaged extensively with HRFN on the specifics of ConocoPhillips' water acquisition plans and the details of this application. Meetings with the Lands Department staff began in the spring of 2017 and with HRFN Chief and Council in the autumn of 2017.

HRFN has communicated that their primary interests include:

- Ensuring that any water withdrawals do not impact the fish and aquatic resources of the Halfway River;
- Ensuring that any water withdrawals do not impact the HRFN community water supply.

It is ConocoPhillips' view that the water withdrawals associated with this water licence application will have no effect on fish or aquatic resources of the Halfway River, because of: the high flows of the river, and that withdrawals would be very small in relation to river flows; the implementation of strict Environmental Flow Needs considerations in the water licence; and, monitoring to verify river discharge during periods of low flow, in addition to the three operating Water Survey of Canada gauges.

It is ConocoPhillips' view that the water withdrawals associated with this water licence application will have no effect on the HRFN community water supply. The HRFN community water supply consists of two shallow water wells located on a terrace slope approximately 330 m north of the active river channel. The wells intercept shallow groundwater from the large alluvial aquifer along the north side of the Halfway River, and appear to not be directly connected to the Halfway River itself. These water wells are not currently licenced under the Water Sustainability Act. HRFN has a water licence (C033693, priority date 25-Oct-1967) for two spring water sources. One of these, referred to as "School Spring", is located approximately 100m west of one of the HRFN water wells. It is our understanding that this spring is not currently used as a community water source.

Archaeological Assessment

The project area for the intake and pumping facility is located on private land that has a large extent of historical disturbance. An archaeological assessment of the surface lease area was undertaken by Heritage North on November 14th, 2017, under HCA Permit 2017-0230. No areas of archaeological potential were observed within the proposed project area. Subsurface testing was not required and there are no further archaeological concerns. The archaeological report and Archaeological Assessment Information Form will be submitted to the OGC as part of the required OGAA application for the lease site.

8. WSA RIGHTS HOLDER ENGAGEMENT

There are no water licenses and no water licence applications on the Halfway River between the proposed POD and the Peace River. There are two parties who are considered to have WSA rights, as riparian landowners proximal to the proposed POD. These are Peaceland Farm Ltd., and the Halfway River First Nation.

As noted above, the Halfway River First Nation, located immediately downstream of the POD, has a water licence (C033693) for two springs that arise from the alluvial aquifer located along the north side of the river. The recharge areas for these springs, however, are not hydraulically connected to the Halfway River, and water withdrawal from the Halfway River will not affect the water availability from the springs. The Halfway River First Nation currently uses two water wells as their community water supply. Both wells are shallow (approximately 9m deep), drilled into the alluvial aquifer on the north side of the river, and are located approximately 330 m of the Halfway River. These wells do not currently have a water licence under the WSA, but we understand that they wish to obtain a water licence. It is likely that the wells will have minimal, if any, hydraulic connectivity to the Halfway River, due to their distance from the active channel and the low rate of pumping of the wells. It is ConocoPhillips' view that the water withdrawals associated with this water licence application will have no effect on the HRFN community water supply wells. The Halfway River First Nation, as landowners proximal to the proposed water intake, have WSA rights as riparian land owners.

Peaceland Farm Ltd. is the landowner of the property on which the proposed intake and pumping facility are located. ConocoPhillips has a long-term surface lease agreement with Peaceland Farm Ltd. Peaceland Farm Ltd. operates a water sales and trucking business, diverting groundwater from an excavated dugout on the property. Diversion of water from the Halfway River associated with the ConocoPhillips application is anticipated to have no effect on the groundwater input to the dugout.

Both Peaceland Farm Ltd. and Halfway River First Nation were provided notification of this water licence application in November 2017. A Rights Holder Engagement line-list was attached as part of the water licence application submission.

9. MONITORING

Water Quality

Historic water quality monitoring data for the Halfway River are available through the BC government's Water Portal[18]. In addition, ConocoPhillips has had the water quality of the river at the proposed POD sampled and tested for a full range of water quality parameters. The results are summarized in Table 11. There were no exceedances of Canadian drinking water guidelines or Maximum Allowable Concentrations for any water chemistry parameters. The water quality is characterized as "very hard", with high $CaCO_3$ (260 mg/L) and Total Dissolved Solids of 278 mg/L. Dissolved calcium (71 mg/L), magnesium (19 mg/L) and iron (0.049 mg/L) are all high, indicating a high degree of mineral contact with the groundwater and surface water within the Halfway River system. Total coliform and E.coli bacteria are found in the water, indicating contact with animal fecal material. The water requires disinfection to be safe for drinking.

Water Quantity

As described earlier in this document, three active Water Survey of Canada (WSC) gauges provide both historic stream flow data and current "real-time" data. The historic and real-time data are publicly available from Environment Canada[19]. Two gauges are located upstream of the POD, comprising 89.4% of the drainage area of the river at the POD. They are:

- Halfway River above Graham River (07FA003), drainage area = 3,780 km^2;
- Graham River above Colt Creek (07FA005), drainage area = 2,140 km^2.

[18] Government of British Columbia, Water Portal: http://waterportal.geoweb.bcogc.ca

[19] Environment Canada, Water Survey of Canada, Real-Time data website: https://wateroffice.ec.gc.ca/google_map/google_map_e.html?searchBy=p&province=BC&doSearch=Go

Table 11. Water quality results for the Halfway River at the Proposed POD, 6-Oct-2017

Report Results Group	Parameter Name	Unit	Results
Metals Extractable	Aluminum	mg/L	0.027
Metals Extractable	Antimony	mg/L	0.00171
Metals Extractable	Arsenic	mg/L	0.0002
Metals Extractable	Barium	mg/L	0.0939
Metals Extractable	Boron	mg/L	0.012
Metals Extractable	Cadmium	mg/L	0.00002
Metals Extractable	Chromium	mg/L	<0.00005
Metals Extractable	Copper	mg/L	<0.0005
Metals Extractable	Lead	mg/L	0.00001
Metals Extractable	Selenium	mg/L	0.0016
Metals Extractable	Uranium	mg/L	0.00084
Metals Extractable	Vanadium	mg/L	0.00025
Metals Extractable	Zinc	mg/L	0.0025
Microbiological Analysis	Total Coliforms	MPN/100 mL	129.8
Microbiological Analysis	Escherichia coli	MPN/100 mL	5.3
Physical and Aggregate Properties	Colour	Colour units	<5
Physical and Aggregate Properties	Turbidity	NTU	1.7
Polycyclic Aromatic Hydrocarbons - Water	Acenaphthene	µg/L	<0.1
Polycyclic Aromatic Hydrocarbons - Water	Acenaphthylene	µg/L	<0.1
Polycyclic Aromatic Hydrocarbons - Water	Acridine	µg/L	<0.05
Polycyclic Aromatic Hydrocarbons - Water	Anthracene	µg/L	<0.1
Polycyclic Aromatic Hydrocarbons - Water	Benzo(a)anthracene	µg/L	<0.01
Polycyclic Aromatic Hydrocarbons - Water	Benzo(a)pyrene	µg/L	<0.01
Polycyclic Aromatic Hydrocarbons - Water	Benzo(b)fluoranthene	µg/L	<0.01
Polycyclic Aromatic Hydrocarbons - Water	Benzo(g,h,i)perylene	µg/L	<0.1
Polycyclic Aromatic Hydrocarbons - Water	Benzo(k)fluoranthene	µg/L	<0.02
Polycyclic Aromatic Hydrocarbons - Water	Chrysene	µg/L	<0.1
Polycyclic Aromatic Hydrocarbons - Water	Dibenzo(a,h)anthracene	µg/L	<0.01
Polycyclic Aromatic Hydrocarbons - Water	Fluoranthene	µg/L	<0.1
Polycyclic Aromatic Hydrocarbons - Water	Fluorene	µg/L	<0.1
Polycyclic Aromatic Hydrocarbons - Water	Indeno(1,2,3-c,d)pyrene	µg/L	<0.1
Polycyclic Aromatic Hydrocarbons - Water	Naphthalene	µg/L	<0.1
Polycyclic Aromatic Hydrocarbons - Water	Phenanthrene	µg/L	<0.1
Polycyclic Aromatic Hydrocarbons - Water	Pyrene	µg/L	<0.02
Polycyclic Aromatic Hydrocarbons - Water	Quinoline	µg/L	<0.34
Routine Water	pH		8.31
Routine Water	Electrical Conductivity	µS/cm at 25 °C	450
Routine Water	Calcium	mg/L	71
Routine Water	Iron	mg/L	0.049
Routine Water	Magnesium	mg/L	19
Routine Water	Manganese	mg/L	0.003
Routine Water	Potassium	mg/L	0.62
Routine Water	Silicon	mg/L	1.7
Routine Water	Sodium	mg/L	2.1
Routine Water	T-Alkalinity	mg/L	204
Routine Water	Chloride	mg/L	0.55
Routine Water	Fluoride	mg/L	0.09
Routine Water	Nitrate - N	mg/L	0.05
Routine Water	Nitrite - N	mg/L	<0.01
Routine Water	Sulfate (SO4)	mg/L	56.7
Routine Water	Hardness	mg/L	260
Routine Water	Total Dissolved Solids	mg/L	278
Extractable Petroleum Hydrocarbons - Water	EPHw10-19	µg/L	<200
Extractable Petroleum Hydrocarbons - Water	LEPHw	µg/L	<200
Extractable Petroleum Hydrocarbons - Water	EPHw19-32	µg/L	<200
Extractable Petroleum Hydrocarbons - Water	HEPHw	µg/L	<200
Mono-Aromatic Hydrocarbons - Water	Benzene	µg/L	<0.5
Mono-Aromatic Hydrocarbons - Water	Ethylbenzene	µg/L	<0.5
Mono-Aromatic Hydrocarbons - Water	Methyl t-Butyl Ether	µg/L	<0.5
Mono-Aromatic Hydrocarbons - Water	Styrene	µg/L	<0.5
Mono-Aromatic Hydrocarbons - Water	Toluene	µg/L	<0.5
Mono-Aromatic Hydrocarbons - Water	Total Xylenes (m,p,o)	µg/L	<0.5
Mono-Aromatic Hydrocarbons - Water	Dibromofluoromethane	%	94.58
Mono-Aromatic Hydrocarbons - Water	Toluene-d8	%	116.62
Mono-Aromatic Hydrocarbons - Water	4-Bromofluorobenzene	%	108.3
Volatile Petroleum Hydrocarbons - Water	VPHw (VHw6-10 minus BTEX)	µg/L	<50
Volatile Petroleum Hydrocarbons - Water	VHw6-10	µg/L	<50

These two gauges have a combined drainage area of 5,920 km, in relation to a drainage area of 6,620 km^2 at the POD. From the historic data, flows at the proposed POD are calculated as:

$$Flow_{POD} = (Flow_{07FA003} + Flow_{07FA005}) * 1.118$$

This same approach is used to calculate flows at the POD in "real-time", using the current discharge measurements available from the WSC. However, it is recognized that the WSC real-time flow data have some uncertainty, resulting largely from rating curve shifts[20]. The real-time data can be adjusted in real-time, using available information on rating curve deviations.

Monitoring Plan

As a condition of a water licence, ConocoPhillips proposes to do the following:

1. Produce estimated instantaneous discharge values at the proposed POD from the combined and adjusted WSC data, with a correction for known rating curve shifts;
2. Undertake field-based measurements of discharge when necessary, during periods of low flow, and when ConocoPhillips is actively pumping water from the Halfway River. These data will be used to determine when the 7.04 m^3/s zero withdrawal threshold is being approached, and when withdrawals need to cease.
3. Make the discharge estimates publicly available in near-real-time, and make the field-based discharge measurements available within 48 hours of measurement, through the BC Government's Water Portal.

10. SUGGESTED CONDITIONS FOR WATER LICENCE

The following are suggested conditions for a water licence issued to ConocoPhillips Canada Resources Corp., as per this application.

1. The stream on which the rights are granted is the Halfway River and storage is in dugouts.
2. The point of diversion is located at District Lot 1300, Peace River District except Plan PGP37245 (56°30'00.00"N 121°58'51.63"W), and storage sites are located as shown on the attached plan.
3. The date from which this licence shall have precedence is December 1, 2017.
4. The purposes for which this licence is issued are: Oil and Gas – hydraulic fracturing; Oil and Gas – drilling; and Storage - non-power.
5. The maximum quantity of water which may be diverted for Oil and Gas – hydraulic fracturing is 3,550,000 cubic metres per year, and the maximum quantity of water which may be diverted for Oil and gas - drilling is 100,000 cubic metres per year, with the following conditions:
    a. Daily diversions will not exceed a rate of 10,000 cubic metres per day;
    b. Instantaneous diversions will not exceed a rate of 0.1157 cubic metres per second;
    c. Water diversions from the Halfway River will cease when the discharge of the Halfway River at the point of diversion is at or below 7.04 cubic metres per second;
6. The maximum quantity which may be held in storage is 200,000 cubic metres.
7. The period of the year during which water may be diverted into storage is January 1 to December 31, and the stored water may be used for the whole year.
8. The undertaking upon which the water is to be used and to which this licence is appurtenant are oil and gas activities associated with various Petroleum and Natural Gas leases held by the licence holder under the Petroleum and Natural Gas Lease System for lands within, between and proximal to the Blueberry,

[20] Note: The WSC's "real-time" data are considered to be preliminary until such time as the WSC has completed QA/QC adjustments and corrections, and has produced the final data set for archiving.

Blueberry East, Blueberry West, Inga, Inga North, Bernadet, Halfway and Gundy Creek fields, all within the North Montney Regional Field, in the Peace River District.

9. The authorized permanent works are water intake, pipeline and pumping facility, which shall be located approximately as shown on the attached plan.
10. The licensee must monitor river discharge at or near the point of diversion for as long as this water licence is active in the following manner:
    a. The stream flow monitoring can be based on existing Water Survey of Canada gauges (07FA003, 07FA005, 07FA006), adjusted to the point of diversion location;
    b. The licensee will undertake field-based measurements of discharge when necessary to verify the zero withdrawal threshold and the licensee is withdrawing water from the river under this licence. The measurements must be consistent with the "Manual of British Columbia Hydrometric Standards";
    c. Discharge data from the point of diversion must be submitted to the Regional Water Manager on a quarter-annual basis, on or before January 25, April 25, July 25 and October 25, for the preceding 3-month period, or made available to the Regional Water Manager upon request;
    d. The requirement for water use reporting may be amended from time to time, as directed by the Regional Water Manager.
11. The licensee shall keep records on actual daily water withdrawals in units of cubic metres. This information will be submitted to the Regional Water Manager on a quarter-annual basis, on or before January 25, April 25, July 25 and October 25, for the preceding 3-month period. The requirement for water use reporting may be amended from time to time, as directed by the Regional Water Manager.
12. The construction of the permanent works shall be completed and the water shall be beneficially used prior to August 31, 2019. Until such time as the permanent works are completed, the licensee is authorized to use temporary works. Thereafter, the licensee shall continue to make regular beneficial use of the water in the manner authorized herein.
13. Design plans for the works authorized by this licence must be prepared by a professional engineer registered in the Province of British Columbia and submitted to the Regional Water Manager. The licensee must obtain leave to commence construction from the Regional Water Manager before proceeding with construction.
14. This licence terminates on December 31, 2037. Prior to the termination date, the licensee may apply to the Comptroller of Water Rights or the Regional Water Manager in accordance with the provisions of the Water Sustainability Act to amend this licence to extend its term.

11. SUMMARY AND CONCLUSIONS

ConocoPhillips Canada Resources Corp. is applying for a water licence with a 20-year term under Section 9 of the BC Water Sustainability Act to withdraw water from a Point of Diversion on the Halfway River at 56°30'00.00"N 121°58'51.63"W (UTM 6262196N 562728E Z10). The property is private tenure, owned by Peaceland Farm Ltd. ConocoPhillips has a long-term surface lease agreement with the property owner. The water licence applications is to divert a maximum of 10,000 m^3 per day, to a maximum of 3,650,000 m^3 per year, for the purposes of Oil and Gas: Drilling and Oil and Gas: Hydraulic Fracturing, and to store 200,000 m^3 in earthen excavations (which are not dams under the Water Sustainability Act).

The water is required to enable ConocoPhillips to achieve its Late Appraisal and Initial Development well drilling completions in its Montney Asset, on a land base of 106,027 acres in British Columbia centred approximately on the community of Wonowon.

The works associated with this application include:

- **A water intake**. The water intake will be either an "In-Bank Infiltration Gallery" or an "In-Stream Intake", located along the north side of the Halfway River at the proposed Point of Diversion (POD). The intake will be connected with a gravity feed to a below-ground caisson located approximately 10-20 m north of the edge of the river;
- **A below-ground caisson and pumping facility**. A pumphouse located above the caisson will serve to draw water from the bottom of the caisson to surface, where it will be transferred to an adjacent pump booster station. The pump booster station will contain pumps to mechanically lift the water through a 16" below-ground pipeline to well pads and to a Water Treatment/Recycling/Storage Facility (referred to as the Water Hub), located at c-11-K/94-A-12. The pumping facility will be sited and designed to be above the 200-year return period peak water level. A facility permit is being sought from the BC Oil and Gas Commission for the pumping facility, and detailed design and engineering review is anticipated through OGC Facilities in early 2018. A pipeline permit is being sought from the BC Oil and Gas Commission for the freshwater pipeline, and detailed design and engineering review is anticipated through OGC Pipelines.

The Halfway River is a tributary of the Peace River, and arises out of the northern Rocky Mountains. At the proposed POD, it has a drainage area of 6,610 km^2, with an elevation range of 680-2,395 m. There are four Water Survey of Canada (WSC) streamflow gauges (three active, one inactive) that provide up to 50 years of excellent discharge record for the river. These WSC data have been rigorously analyzed and reported in detail in this Water Management Plan. Mean annual runoff at the proposed POD is 2.13 billion m^3, ranging from a low of 959 million m^3per year to a high of 4.01 billion m^3per year. Runoff is seasonally variable, with high flow during spring and summer resulting from the melt of the mountain snowpack, and low flows in late winter (Jan-Mar). During February, the month of lowest average runoff, discharge is 26.9 million m^3 (962,000 m^3 per day). During May, the month of highest average runoff, discharge is 625 million m^3 (20.8 million m^3 per day).

The Halfway River is a high value fisheries river. Twenty species of fish are noted to occur in the Halfway River, including 8 sportfish, 2 suckers, 7 minnows, and 3 sculpin species. The sport fish are: Arctic Grayling, Bull Trout, Burbot, Kokanee, Mountain Whitefish, Northern Pike, Rainbow Trout and Walleye. In particular, tributaries of the Halfway River provide critical spawning and rearing area for the Peace River Bull Trout population. Bull Trout have been classified as a "blue listed" species by the British Columbia Conservation Data Centre, and require significant attention. Fish habitat at the proposed POD is primarily for fish passage to, and potentially for winter rearing. There is no spawning habitat at or proximal to the proposed POD. Bull Trout migrate past the POD for spawning in the upper Halfway River and tributaries, including the Graham and Chowade river systems. Because of the high value fish habitat, this Water Management Plan focuses on careful management of water withdrawal under the guidance of the BC Environmental Flow Needs Policy.

There is currently very low water demand on the Halfway River. For the Halfway River watershed upstream of the proposed POD, there is a current demand of 2.13 million m^3 per year (for 19 water licences, 5 water licence applications and 2 two short-term use approvals. Existing demand comprises 0.10% of mean annual discharge, ranging from a low of 0.04% of June discharge to a high of 0.29% of February and March discharge. When combined with this water licence application, total cumulative demand will be 5.78 million m^3 per year. This is 0.27% of mean annual runoff, and 1.33% of mean winter runoff.

ConocoPhillips proposes to have as a condition of the water licence an Environmental Flow Needs "zero withdrawal threshold" of 7.04 m^3/s, corresponding to a 1-in-10 year low flow. Below this discharge no withdrawals would occur, capping total cumulative water withdrawals to no more than 2% of daily discharge in any season. Water withdrawals of 2% of discharge will have no effect on fish or aquatic resources, and are sufficiently small that they are within the range of "uncertainty" or "standard error" of hydrometric measurements, and so may not even be measurable. To verify the discharge, however, ConocoPhillips proposes to have as a condition of licence a requirement to monitor stream discharge at the proposed POD.

ConocoPhillips has engaged with the Halfway River First Nation and the Blueberry River First Nation, as well as all Water Sustainability Act rights holders (Peaceland Farm Ltd. and Halfway River First Nation).

This Water Management Plan includes details on suggested conditions for the water licence.

To enable use of the water under this licence for January 1, 2019, it is necessary to complete the construction of the water intake during the "least risk" fisheries work window of July 15 – August 31, 2018. A decision by the Oil and Gas Commission on this application is requested before May 15, 2018.

12. CONTACTS

For further information, primary contacts are:

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Appendix A: North East Water Tool (NEWT) Report (as of November 26, 2017)

North East Water Tool Report

Nov 26 2017

Halfway River

Peace River

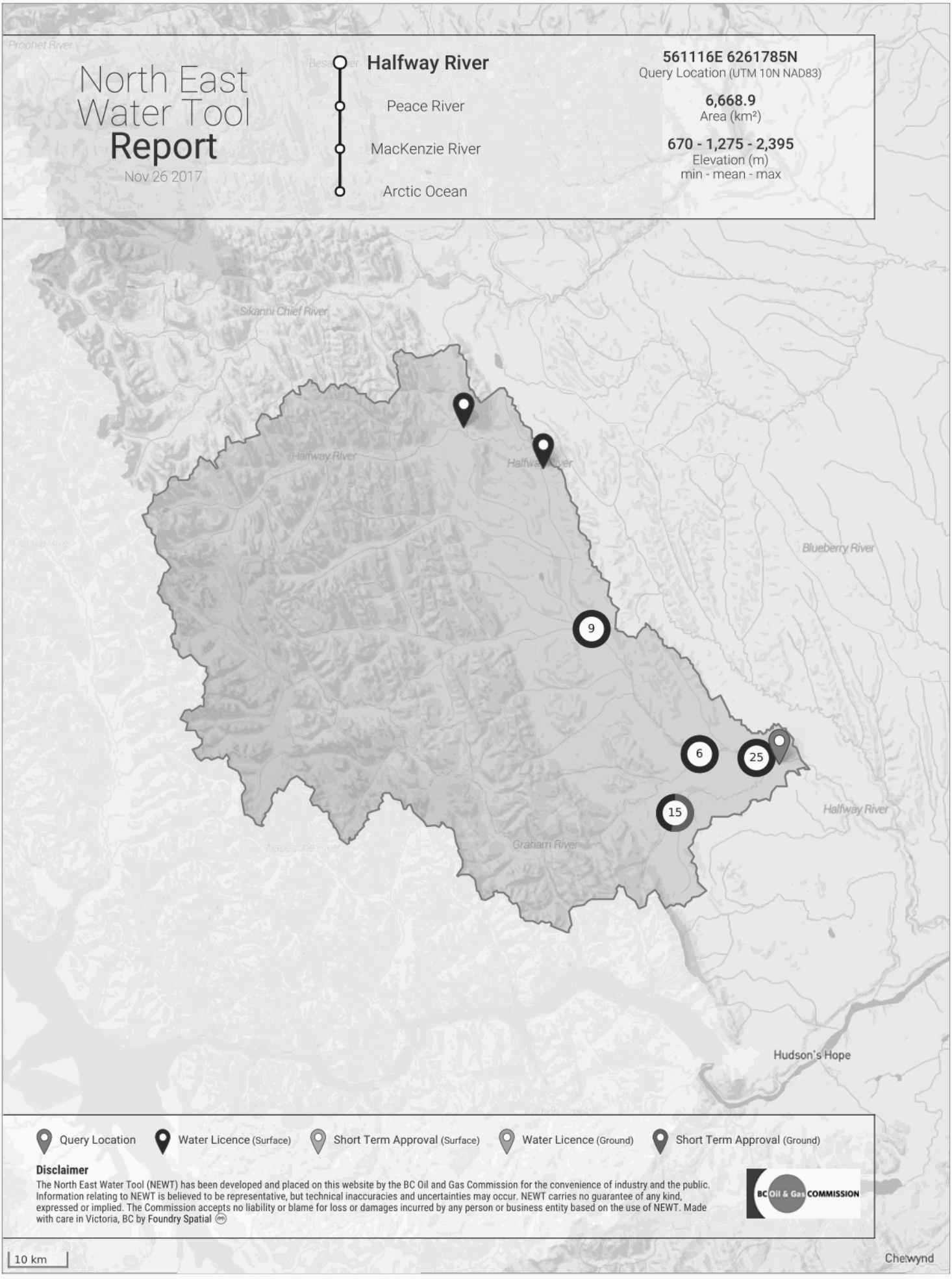
MacKenzie River

Arctic Ocean

561116E 6261785N
Query Location (UTM 10N NAD83)

6,668.9
Area (km²)

670 - 1,275 - 2,395
Elevation (m)
min - mean - max



Query Location | Water Licence (Surface) | Short Term Approval (Surface) | Water Licence (Ground) | Short Term Approval (Ground)

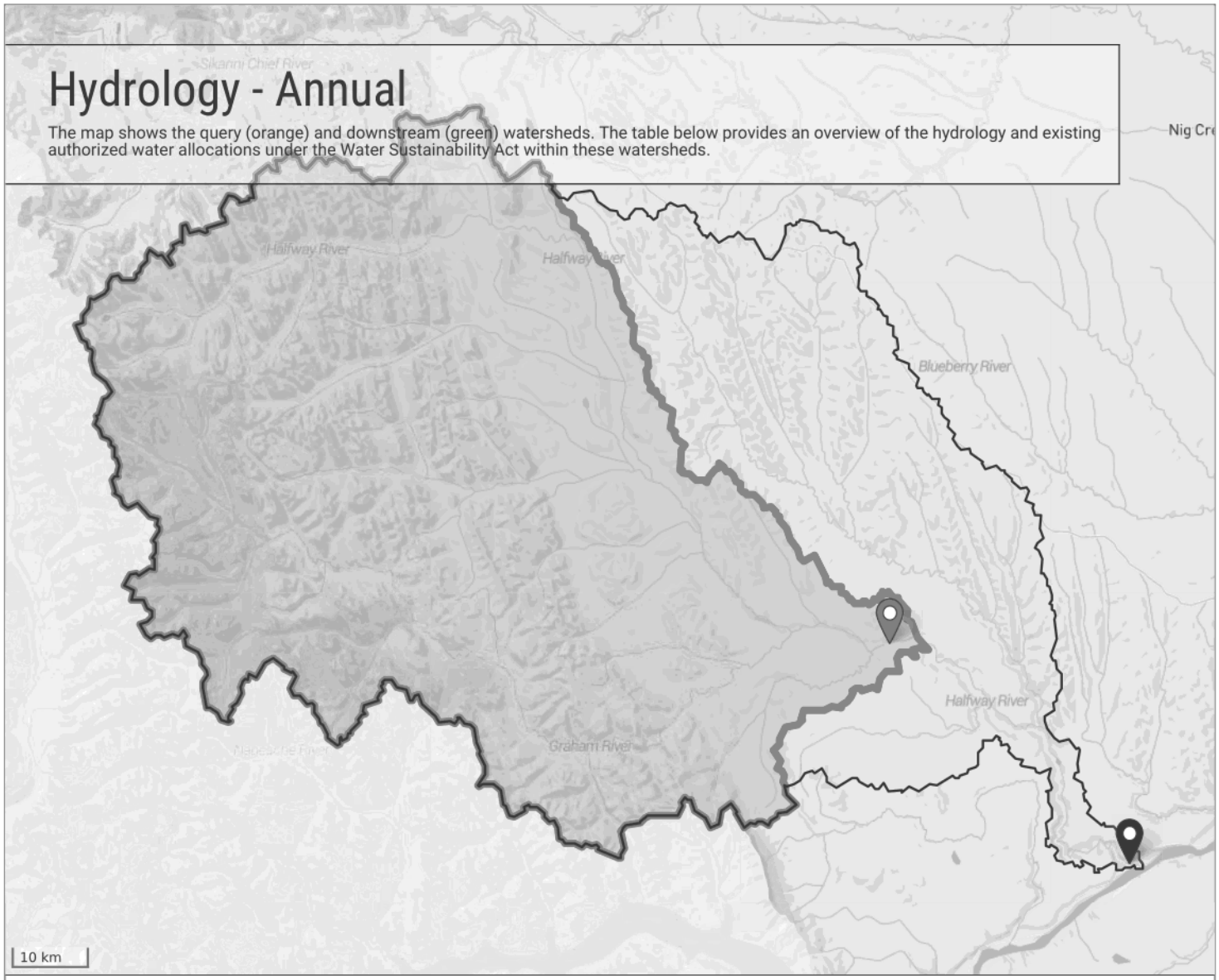
Disclaimer

The North East Water Tool (NEWT) has been developed and placed on this website by the BC Oil and Gas Commission for the convenience of industry and the public. Information relating to NEWT is believed to be representative, but technical inaccuracies and uncertainties may occur. NEWT carries no guarantee of any kind, expressed or implied. The Commission accepts no liability or blame for loss or damages incurred by any person or business entity based on the use of NEWT. Made with care in Victoria, BC by Foundry Spatial

BC Oil & Gas COMMISSION

Hydrology - Annual

The map shows the query (orange) and downstream (green) watersheds. The table below provides an overview of the hydrology and existing authorized water allocations under the Water Sustainability Act within these watersheds.



Query Watershed		Downstream Watershed
6,668.9	Area (km²)	9,350.6
65.207	Mean Annual Discharge (m³/s)	74.747
0.054	Allocations (m³/s)	0.084
0.1	Allocations (%)	0.1
None	Reserves & Restrictions	None
2,057,773,812	Annual Runoff (m³/yr)	2,358,823,666
1,697,685	Current Total Allocations (m³/yr) (Water licence & Short Term Use Approvals)	2,635,882

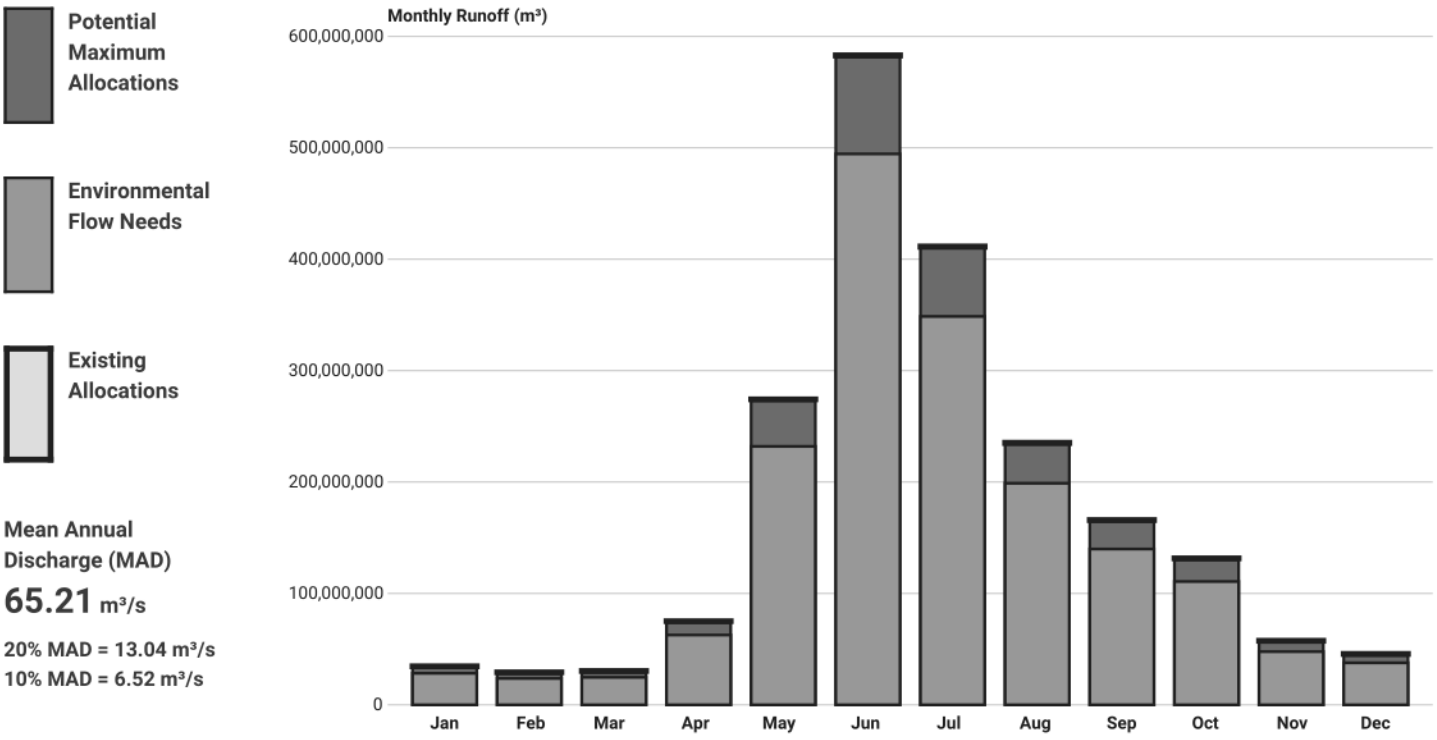
The downstream watershed is defined at the location where the queried drainage meets with another drainage of comparable size. For information further downstream, please generate an additional report at a location of interest.

* For more information on water reserves or restrictions present in the watershed, please contact FrontCounter BC.

FrontCounter BC: www.frontcounterbc.ca **Email:** FrontCounterBC@gov.bc.ca **Toll Free:** 1-877-855-3222 **Outside North America:** ++1-778-372-0729

Hydrology - Monthly Halfway River

The chart and table show information on modeled hydrology and existing allocations in the **query watershed**. This location is shown with an orange marker and watershed outline in the map on page 2.



Mean Annual Discharge (MAD)

65.21 m³/s

20% MAD = 13.04 m³/s
10% MAD = 6.52 m³/s

Month	Mean Runoff (mm)	Mean Discharge (m³/s)	Mean Runoff (m³)	% of MAD	Flow Sensitivity	Environmental Flow Needs (m³)	Potential Max Allocation (m³)	Existing Allocations (m³)	Remaining Potential Allocation (m³)	Notes
Jan	5.0	12.42	33,278,492	19.1%	Mod	28,286,718	4,991,774	8,316	4,983,458	
Feb	4.2	11.41	27,856,218	17.5%	Mod	23,677,785	4,178,433	7,578	4,170,855	
Mar	4.4	10.85	29,049,616	16.6%	Mod	24,692,174	4,357,442	8,316	4,349,126	
Apr	11.1	28.45	73,730,042	43.6%	Low	62,670,535	11,059,506	8,048	11,051,459	
May	40.9	101.88	272,875,152	156.2%	Low	231,943,879	40,931,273	8,766	40,922,507	
Jun	87.2	224.43	581,714,625	344.2%	Low	494,457,431	87,257,194	344,418	86,912,776	
Jul	61.5	153.12	410,115,763	234.8%	Low	348,598,398	61,517,364	344,686	61,172,679	
Aug	35.1	87.35	233,958,981	134.0%	Low	198,865,134	35,093,847	344,686	34,749,161	
Sep	24.7	63.47	164,524,905	97.3%	Low	139,846,169	24,678,736	120,171	24,558,565	
Oct	19.5	48.60	130,162,718	74.5%	Low	110,638,310	19,524,408	8,316	19,516,092	
Nov	8.4	21.66	56,147,448	33.2%	Low	47,725,331	8,422,117	8,048	8,414,070	
Dec	6.7	16.56	44,359,919	25.4%	Low	37,705,931	6,653,988	8,316	6,645,672	
Annual	**308.6**	**65.21**	**2,057,773,812**	-	-	**1,749,107,797**	**308,666,082**	**1,697,685**	**306,968,397**	

Notes

W - Winter flows may be limited.

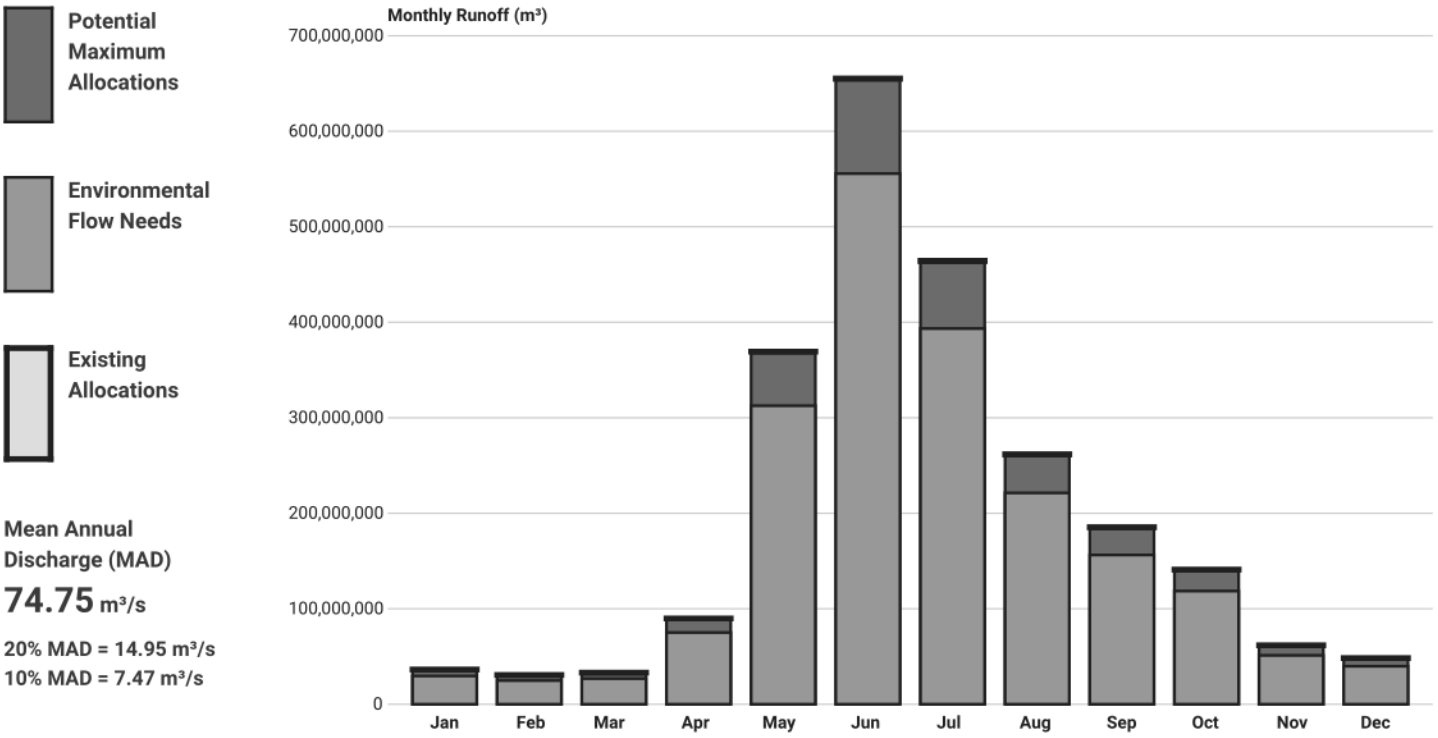
L - Winter lake withdrawal limits apply. Water withdrawal limits are based on lake surface area and cumulative maximum drawdown of 10 cm for December 1 - March 31.

Environmental Flow Needs Determination
The Commission manages oil- and gas-related water use authorizations to protect fisheries or aquatic resources, and to protect drinking water supply, consistent with the requirements of the Water Sustainability Act (http://www.bclaws.ca/civix/document/id/complete/statreg/14015). The calculations of water availability in the North East Water Tool (NEWT) reflect the Commission's approach to maintaining environmental flows. Please refer to the NEWT application for details.

Model Performance
Mean error: 5.5%, Median error: 3.7%, Mean absolute error: 16.1%, Within ±20%: 77.8%
The hydrology estimates are produced from a hydrology model which included 45 long term hydrometric stations in northeast BC, NWT, and AB.

Hydrology - Monthly Halfway River

The chart and table show information on modeled hydrology and existing allocations in the **downstream watershed**, where the subject drainage meets with another drainage of comparable size. This location is shown with a green marker and watershed outline in the map on page 2.



Mean Annual Discharge (MAD)

74.75 m³/s

20% MAD = 14.95 m³/s
10% MAD = 7.47 m³/s

Month	Mean Runoff (mm)	Mean Discharge (m³/s)	Mean Runoff (m³)	% of MAD	Flow Sensitivity	Environmental Flow Needs (m³)	Potential Max Allocation (m³)	Existing Allocations (m³)	Remaining Potential Allocation (m³)	Notes
Jan	3.7	13.00	34,815,992	17.4%	Mod	29,593,593	5,222,399	52,976	5,169,422	
Feb	3.1	11.94	29,135,990	16.0%	Mod	24,765,592	4,370,399	45,127	4,325,272	
Mar	3.4	11.79	31,566,483	15.8%	Mod	26,831,510	4,734,972	9,576	4,725,396	
Apr	9.4	34.07	88,304,316	45.6%	Low	75,058,669	13,245,647	9,267	13,236,380	
May	39.3	137.30	367,742,246	183.7%	Low	312,580,909	55,161,337	26,073	55,135,264	
Jun	69.9	252.21	653,730,435	337.4%	Low	555,670,870	98,059,565	361,589	97,697,977	
Jul	49.5	172.81	462,847,136	231.2%	Low	393,420,065	69,427,070	352,223	69,074,848	
Aug	27.8	97.19	260,312,656	130.0%	Low	221,265,758	39,046,898	352,223	38,694,676	
Sep	19.7	70.95	183,907,684	94.9%	Low	156,321,531	27,586,153	121,391	27,464,762	
Oct	14.9	52.07	139,452,474	69.7%	Low	118,534,603	20,917,871	9,576	20,908,295	
Nov	6.4	23.23	60,223,350	31.1%	Low	51,189,848	9,033,503	16,267	9,017,235	
Dec	5.0	17.47	46,784,903	23.4%	Low	39,767,168	7,017,736	52,976	6,964,759	
Annual	**252.3**	**74.75**	**2,358,823,666**	**-**	**-**	**2,005,000,116**	**353,823,550**	**2,635,882**	**351,187,668**	

Notes

W - Winter flows may be limited.

L - Winter lake withdrawal limits apply. Water withdrawal limits are based on lake surface area and cumulative maximum drawdown of 10 cm for December 1 - March 31.

Environmental Flow Needs Determination

The Commission manages oil- and gas-related water use authorizations to protect fisheries or aquatic resources, and to protect drinking water supply, consistent with the requirements of the Water Sustainability Act (http://www.bclaws.ca/civix/document/id/complete/statreg/14015) . The calculations of water availability in the North East Water Tool (NEWT) reflect the Commission's approach to maintaining environmental flows. Please refer to the NEWT application for details.

Model Performance

Mean error: 5.5%, Median error: 3.7%, Mean absolute error: 16.1%, Within ±20%: 77.8%
The hydrology estimates are produced from a hydrology model which included 45 long term hydrometric stations in northeast BC, NWT, and AB.

Existing Allocations Water Licences

Current approved water licences.

BC Water Sustainability Act - Water Licences - 18 Licences, 1,219,213.58 m³ Total Annual Volume

Licensee	Number	POD	Priority Date	Expiry Date	Quantity (m³/year)	Flag
Halfway River First Nation Domestic from School Spring 565074E 6262163N	C033693 File # 0277260	PD36657	1967-10-25		8,302.13	D
Donis Dawn E Et Al Domestic from Fremont Spring 555302E 6262899N	C054704 File # 0364753	PD36601	1978-10-04		830.21	T
Donis Dawn E Et Al Irrigation: Private from French Spring 555392E 6262656N	C054705 File # 0366176	PD36602	1978-10-04		11,101.32	T
Donis Dawn E Et Al Domestic from French Spring 555392E 6262656N	C054705 File # 0366176	PD36602	1978-10-04		830.21	T
Stewart Lois Elaine Domestic from Boreal Spring 521352E 6291520N	C102506 File # 7000852	PD63860	1991-03-11		830.21	T
Weitzel Udo & Margrit Livestock & Animal: Stockwatering from Crystal Spring 548102E 6263370N	C103500 File # 7000880	PD64549	1991-06-17		4,981.28	T
Weitzel Udo & Margrit Domestic from Crystal Spring 548102E 6263370N	C103500 File # 7000880	PD64549	1991-06-17		830.21	T
Maccabee Farms Ltd Livestock & Animal: Stockwatering from Cromie Creek 561305E 6262429N	C103512 File # 7000888	PD64584	1991-07-11		830.21	D
Maccabee Farms Ltd Livestock & Animal: Stockwatering from Cromie Creek 560104E 6264577N	C103512 File # 7000888	PD69420	1991-07-11		830.21	D
Maccabee Farms Ltd Livestock & Animal: Stockwatering from Maccabee Spring 561872E 6262143N	C103512 File # 7000888	PD70299	1991-07-11		830.21	D
Maccabee Farms Ltd Livestock & Animal: Stockwatering from Allen Creek 562392E 6263161N	C103512 File # 7000888	PD64226	1991-07-11		415.29	D
Maccabee Farms Ltd Livestock & Animal: Stockwatering from Allen Creek 561559E 6264074N	C103512 File # 7000888	PD69419	1991-07-11		415.29	D
Maccabee Farms Ltd Livestock & Animal: Stockwatering from Cab Creek 558198E 6263753N	C103517 File # 7000889	PD64588	1993-03-20		830.21	T
Cimarron Camp Services Livestock & Animal: Stockwatering from Beattie Spring 537236E 6254821N	C103645 File # 7000967	PD64768	1991-10-15		830.21	D
Cimarron Camp Services Livestock & Animal: Stockwatering from Federal Slough 537270E 6255223N	C103645 File # 7000967	PD64770	1991-10-15		830.21	D
Cimarron Camp Services Livestock & Animal: Stockwatering from Graham River 535615E 6254637N	C103645 File # 7000967	PD64774	1991-10-15		830.21	D
Cimarron Camp Services Livestock & Animal: Stockwatering from Graham River 536489E 6254960N	C103645 File # 7000967	PD70369	1991-10-15		830.21	D

Water Licence Flag Description
D : Multiple PODs for PUC/qty at each are known/PODs on different sources
M : Max licenced demand for purpose/multiple PODs/qty at each POD unknown
P : Multiple PODs for PUC/qty at each are known/PODs on same source
T : Total demand one POD

Other
N : Licence volumes not used in calculations
R : Rediversion

For more information on water licences:
Water Licence Query Tool: http://a100.gov.bc.ca/pub/wtrwhse/water_licences.input
Scanned Water Licence Directory: http://www.env.gov.bc.ca/wsd/water_rights/scanned_lic_dir/
BC OGC Water Information page: http://www.bcogc.ca/public-zone/water-information

Existing Allocations Water Licences

Current approved water licences.

BC Water Sustainability Act - Water Licences - 18 Licences, 1,219,213.58 m³ Total Annual Volume

Licensee	Number	POD	Priority Date	Expiry Date	Quantity (m³/year)	Flag
Blueberry First Nations Holdings Ltd. Domestic from Two Bit Creek 504900E 6320836N	C109319 File # 7001184	PD70610	1994-12-06		830.21	T
Al Clarke Scobie Irrigation: Private from Halfway River 527360E 6285430N	C110878 File # 7001254	PD74287	1996-04-09		41,198.23	P
Al Clarke Scobie Irrigation: Private from Halfway River 527639E 6284763N	C110878 File # 7001254	PD74288	1996-04-09		41,074.88	P
Al Clarke Scobie Irrigation: Private from Halfway River 529324E 6283252N	C110878 File # 7001254	PD74292	1996-04-09		41,074.88	P
Al Clarke Scobie Livestock & Animal: Stockwatering from Scobie One Spring 527135E 6286429N	C110878 File # 7001254	PD72045	1996-04-09		830.21	D
Al Clarke Scobie Livestock & Animal: Stockwatering from Scobie Two Spring 527383E 6286426N	C110878 File # 7001254	PD72047	1996-04-09		830.21	D
Al Clarke Scobie Livestock & Animal: Stockwatering from Scobie Four Spring 530155E 6282697N	C110878 File # 7001254	PD72051	1996-04-09		830.21	D
Al Clarke Scobie Livestock & Animal: Stockwatering from Halfway River 527667E 6284654N	C110878 File # 7001254	PD74289	1996-04-09		830.21	D
Al Clarke Scobie Livestock & Animal: Stockwatering from Scobie Three Spring 529339E 6283449N	C110878 File # 7001254	PD74291	1996-04-09		830.21	D
Ward Norman Jack & Donna May Livestock & Animal: Stockwatering from Montego Creek 555007E 6260603N	C113654 File # 7001386	PD69929	1993-03-18		830.21	D
Ward Norman Jack & Donna May Livestock & Animal: Stockwatering from Monterey Creek 555520E 6261371N	C113654 File # 7001386	PD69931	1993-03-18		830.21	D
Transportation & Infrastructure Min Of Transport Mgmt: Dust Control from Halfway River 554817E 6262903N	C116364 File # 7001118	PD65843	1993-03-25		56,455.60	M
Transportation & Infrastructure Min Of Transport Mgmt: Dust Control from Halfway River 546525E 6262996N	C116364 File # 7001118	PD65844	1993-03-25		56,455.60	M, N
Transportation & Infrastructure Min Of Transport Mgmt: Dust Control from Halfway River 518895E 6313630N	C116364 File # 7001118	PD65848	1993-03-25		56,455.60	M, N
Hampel Brian Douglas & Crystal Mary Domestic from Simpson Spring 545949E 6263390N	C117571 File # 7001615	PD77239	2002-09-09		1,660.43	T
The Board Of School Trustees Of School D Camps & Pub Facil: Institutions from Upper Halfway School Spring 546802E 6263661N	C118017 File # 7001659	PD36600	1977-09-22		1,660.43	T
Ward Norman Jack & Donna May Irrigation: Private from Halfway River 558711E 6260476N	C125905 File # 7001603	PD76766	2002-03-06		986,784.00	T

Water Licence Flag Description
D : Multiple PODs for PUC/qty at each are known/PODs on different sources
M : Max licenced demand for purpose/multiple PODs/qty at each POD unknown
P : Multiple PODs for PUC/qty at each are known/PODs on same source
T : Total demand one POD

Other
N : Licence volumes not used in calculations
R : Rediversion

For more information on water licences:
Water Licence Query Tool: http://a100.gov.bc.ca/pub/wtrwhse/water_licences.input
Scanned Water Licence Directory: http://www.env.gov.bc.ca/wsd/water_rights/scanned_lic_dir/
BC OGC Water Information page: http://www.bcogc.ca/public-zone/water-information

Existing Allocations Water Licences

Current approved water licences.

BC Water Sustainability Act - Water Licences - 18 Licences, 1,219,213.58 m³ Total Annual Volume

Licensee	Number	POD	Priority Date	Expiry Date	Quantity (m³/year)	Flag
Simpson James & Deryl Domestic from Simpson Spring 545949E 6263390N	C126336 File # 7002116	PD77239	2010-08-27		830.21	T
Ward Norman Jack & Donna May Livestock & Animal: Stockwatering from Grayling Creek 553128E 6263896N	C131510 File # 7000808	PD63600	1991-01-23		4,981.28	M
Ward Norman Jack & Donna May Livestock & Animal: Stockwatering from Mclean Spring 552667E 6263782N	C131510 File # 7000808	PD63654	1991-01-23		4,981.28	M, N
Ward Norman Jack & Donna May Livestock & Animal: Stockwatering from Gieni Spring 552328E 6263951N	C131510 File # 7000808	PD63655	1991-01-23		4,981.28	M, N
Ward Norman Jack & Donna May Domestic from Grayling Creek 553128E 6263896N	C131510 File # 7000808	PD63600	1991-01-23		1,660.43	M
Ward Norman Jack & Donna May Domestic from Mclean Spring 552667E 6263782N	C131510 File # 7000808	PD63654	1991-01-23		1,660.43	M, N
Ward Norman Jack & Donna May Domestic from Gieni Spring 552328E 6263951N	C131510 File # 7000808	PD63655	1991-01-23		1,660.43	M, N
Ward Norman Jack & Donna May Livestock & Animal from Miesau Spring 557249E 6261818N	C132993 File # 7001063	PD63634	1993-03-18		13.64	M
Ward Norman Jack & Donna May Livestock & Animal from Monteith Creek 557829E 6262921N	C132993 File # 7001063	PD63637	1993-03-18		13.64	M, N
Ward Norman Jack & Donna May Livestock & Animal from Cab Creek 560065E 6261501N	C132993 File # 7001063	PD63638	1993-03-18		13.64	M, N
Ward Norman Jack & Donna May Livestock & Animal from Monteith Creek 558954E 6261019N	C132993 File # 7001063	PD70417	1993-03-18		13.64	M, N
Ward Norman Jack & Donna May Livestock & Animal from Cab Creek 558857E 6263029N	C132993 File # 7001063	PD74089	1993-03-18		13.64	M, N

Water Licence Flag Description
D : Multiple PODs for PUC/qty at each are known/PODs on different sources
M : Max licenced demand for purpose/multiple PODs/qty at each POD unknown
P : Multiple PODs for PUC/qty at each are known/PODs on same source
T : Total demand one POD

Other
N : Licence volumes not used in calculations
R : Rediversion

For more information on water licences:
Water Licence Query Tool: http://a100.gov.bc.ca/pub/wtrwhse/water_licences.input
Scanned Water Licence Directory: http://www.env.gov.bc.ca/wsd/water_rights/scanned_lic_dir/
BC OGC Water Information page: http://www.bcogc.ca/public-zone/water-information

Active Applications Water Licences

Active applications for water licences.

BC Water Sustainability Act - Water Interests - 1 Active Application, 173,639.85 m³ Total Annual Volume

Licensee	Number	POD	Priority Date	Expiry Date	Quantity (m³/year)	Flag
Progress Energy Canada Ltd. Oil & Gas: Drilling from Unnamed River 547171E 6250592N	9000216 File # 9000216	PD190632	2016-12-23		86,819.93	T
Progress Energy Canada Ltd. Oil & Gas: Hydraulic Fracturing (non-deep GW) from Unnamed River 547171E 6250592N	9000216 File # 9000216	PD190632	2016-12-23		86,819.93	T
Progress Energy Canada Ltd. Stream Storage: Non-Power from Unnamed River 547171E 6250592N	9000216 File # 9000216	PD190632	2016-12-23		84,673.00	N, T

Water Licence Flag Description
D : Multiple PODs for PUC/qty at each are known/PODs on different sources
M : Max licenced demand for purpose/multiple PODs/qty at each POD unknown
P : Multiple PODs for PUC/qty at each are known/PODs on same source
T : Total demand one POD

Other
N : Licence volumes not used in calculations
R : Rediversion

For more information on water licences:
Water Licence Query Tool: http://a100.gov.bc.ca/pub/wtrwhse/water_licences.input
Scanned Water Licence Directory: http://www.env.gov.bc.ca/wsd/water_rights/scanned_lic_dir/
BC OGC Water Information page: http://www.bcogc.ca/public-zone/water-information

Existing Allocations Short Term Approvals (Section 10)

Current approved applications for temporary use of water, with a maximum term of 24 months.

BC Water Sustainability Act - Short Term Approvals (Section 10) - 2 Approvals, 478,471.00 m³ Total Volume

Authorization Holder	Number	POD	Start Date	End Date	Approved Volume (m³)
Progress Energy Canada Ltd. Oil Field Injection (Includes Hydraulic Fracturing) from D-94-F/94-B-8 (Water S 543761E 6252398N	0004497 **	2	2016-01-23	2018-01-22	4,400 (total)
Progress Energy Canada Ltd. Oil Field Injection (Includes Hydraulic Fracturing) from B-24-K/94-B-8 (Water S 543165E 6254802N	0004497 **	1	2016-01-23	2018-01-22	131,600 (total)
Progress Energy Canada Ltd. Oil Field Injection (Includes Hydraulic Fracturing) from C-79-G/94-B-8 (Water S 547140E 6250591N	0004497 **	3	2016-01-23	2018-01-22	143,400 (total)
Progress Energy Canada Ltd. Oil Field Injection (Includes Hydraulic Fracturing) from D-8-J/94-B-8 (Water Sc 548402E 6253235N	0004497 **	4	2016-01-23	2018-01-22	38,000 (total)
Progress Energy Canada Ltd. Oil Field Injection (Includes Hydraulic Fracturing) from D-97-G/94-B-8 (Water S 548944E 6252772N	0004497 **	5	2016-01-23	2018-01-22	131,000 (total)
Progress Energy Canada Ltd. Oil Field Injection (Includes Hydraulic Fracturing) from C-98-F/94-B-8 (Water S 540170E 6252380N	0004497 **	7	2016-01-23	2018-01-22	11,980 (total)
Progress Energy Canada Ltd. Oil Field Injection (Includes Hydraulic Fracturing) from A-8-K/94-B-8 (Water Sc 540554E 6252961N	0004497 **	9	2016-01-23	2018-01-22	4,800 (total)
Progress Energy Canada Ltd. Road Maintenance from (Water Source Dugout) 540906E 6251622N	0004734 **	001	2017-05-04	2018-05-03	13,291 (total)

For more information on water licences:
BC OGC Water Information page: http://www.bcogc.ca/public-zone/water-information
*BC Ministry of Forests, Lands and Natural Resource Operations is statutory decision maker.
**BC Oil and Gas Commission is statutory decision maker.

Downstream Water Rights Interests

Current licences, active applications, and short term use approvals on or near the main stem of the waterbody, downstream within the water management basin.

BC Water Sustainability Act - Water Interests - 1 Authorization, 4,981.28 m³ Total Volume

Licensee	Number	POD	Priority Date	Expiry Date	Quantity (m³/year)	Flag
Halfway River First Nation Domestic from Band Spring 569870E 6258394N	C033693 File # 0277260	PD36658	1967-10-25		4,981.28	D

Water Licence Flag Description
D : Multiple PODs for PUC/qty at each are known/PODs on different sources
M : Max licenced demand for purpose/multiple PODs/qty at each POD unknown
P : Multiple PODs for PUC/qty at each are known/PODs on same source
T : Total demand one POD

Other
N : Licence volumes not used in calculations
R : Rediversion

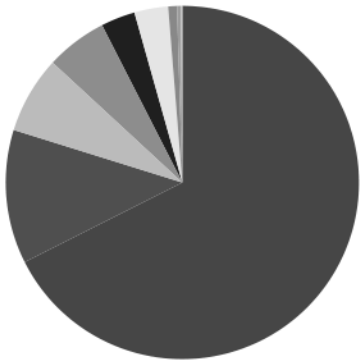
For more information on water licences:
Water Licence Query Tool: http://a100.gov.bc.ca/pub/wtrwhse/water_licences.input
Scanned Water Licence Directory: http://www.env.gov.bc.ca/wsd/water_rights/scanned_lic_dir/
BC OGC Water Information page: http://www.bcogc.ca/public-zone/water-information

Land Cover and Topography

Characteristics of the query watershed. For more information on watershed characterization in British Columbia please refer to Pike and Wilford (2013).

Land Cover

The land cover characteristics chart illustrates the composition of vegetation and land cover types in the query watershed. These land cover components are incorporated in the hydrologic model, to represent the variations in evapotranspiration rates amongst the classes.

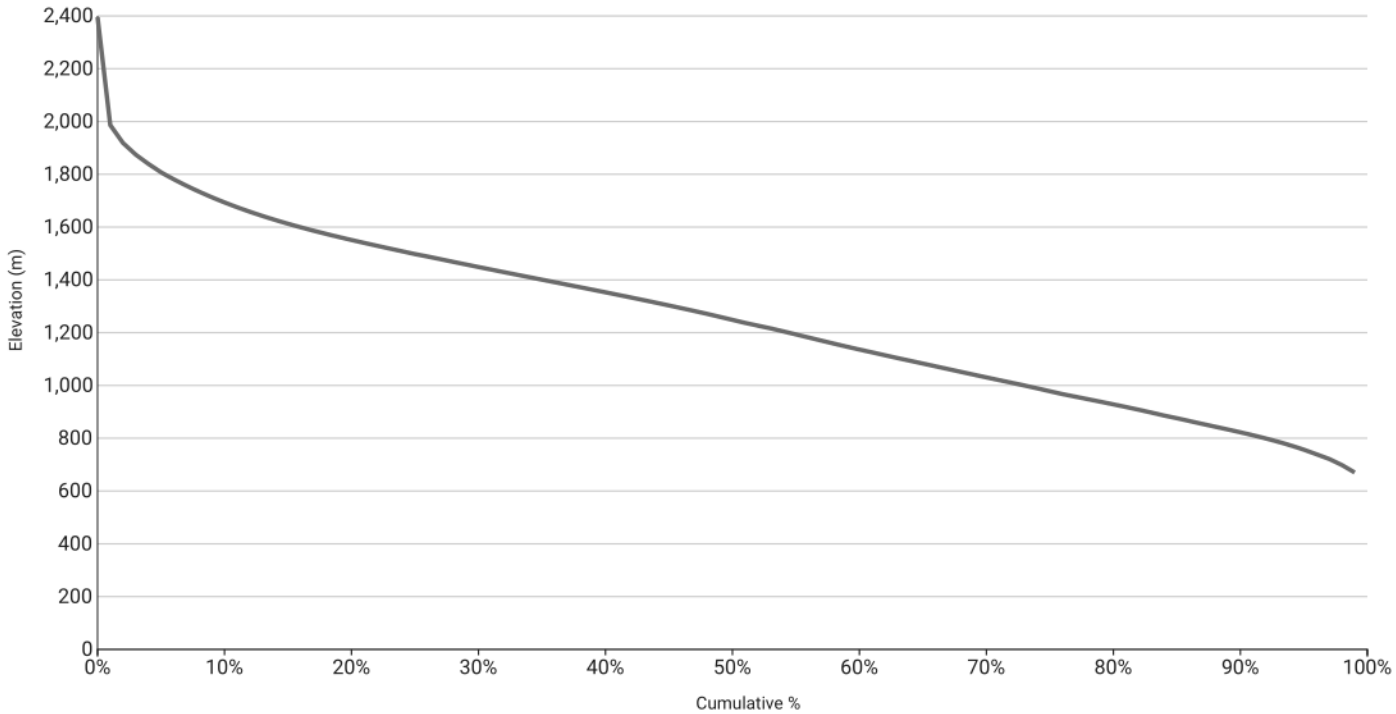


Type	Area (km²)	% of Query Watershed (%)
Barren	207.8	3.1
Coniferous	4,464.7	66.9
Deciduous	370.6	5.6
Developed	0.0	0.0
Grassland	204.2	3.1
Herb	53.1	0.8
Mixed	809.4	12.1
Shrub	466.8	7.0
Snow / Glacier	10.1	0.2
Water	0.0	0.0
Wetland	21.7	0.3

The land cover characteristics chart illustrates the composition of vegetation and land cover types in the query watershed. These land cover components are incorporated in the hydrologic model, to represent the variations in evapotranspiration rates amongst the classes.

Topography

Elevation of the query watershed influences hydrology in a number of ways. The amount, and state of precipitation (as rain or snow) is influenced by elevation substantially. Likewise, temperatures will vary by elevation in value and also direction of temperature gradient throughout the course of the year.



The elevation characteristics of the query watershed are shown using a hypsometric curve, which shows the cumulative distribution of elevation by area in the watershed. Percent values can be used to identify the percentage of the watershed above a given elevation value.

Reference:
Pike, R.G. and D.J. Wilford. 2013. Desktop watershed characterization methods for British Columbia. Prov. B.C., Victoria, B.C. Tech. Rep. 079. www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr079.htm.

Climate

Historic normal conditions and predicted future change.

The climate of the query watershed has been characterized using ClimateWNA (Wang 2012). In the left hand column, charts are presented for the reference time period 1971-2000. In the right hand column, three illustrative climate change scenarios have been selected to estimate a wide range of potential future change in the query watershed (Murdock and Spittlehouse 2011).

Scenario A illustrates the UKMO HadGEM A1B run 1 global climate model (GCM), Scenario B shows the CGCM3 A2 run 4 GCM and Scenario C shows the UKMO HadCM3 B1 run 1 GCM. The combination of these three climate models and emissions scenarios were chosen because, over most of British Columbia, they provide a range of generally hot/dry, warm/very wet, and moderately warm/wet for Scenario A, B, and C respectively.

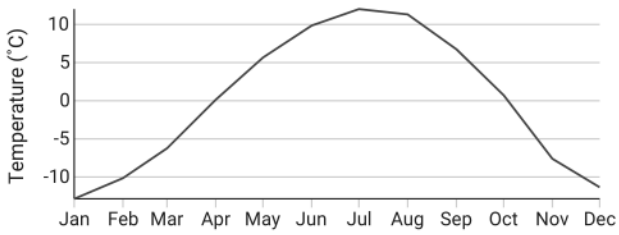
Historic and future climate change information has been provided to assist in understanding potential changes in the basin as temperature and precipitation are intricately related to stream flow. For example, snowpack levels affect many aspects of water resources, from instream flows for fish to community water supplies to soil moisture, groundwater, and aquifer recharge. Climate studies generally indicate a trend of rising air temperatures for all seasons across BC while precipitation trends vary by season and region (Pike *et al.* 2008, Rodenhuis *et al.* 2007). Local responses to changing precipitation and temperature will differ due to BC's inherent hydrological diversity as well as varying climate trends. These charts are intended as a quick glance starting point to basin climate change assessment.

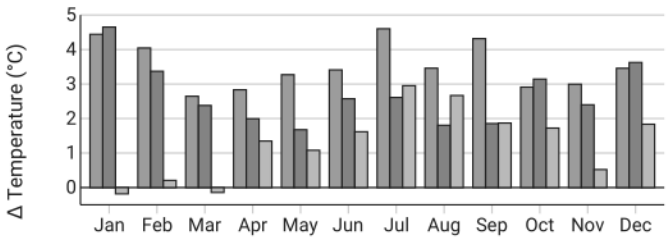
Normal (1971 - 2000)

Predicted Change (2041 - 2070)

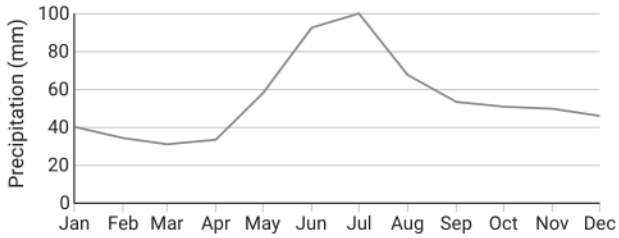
Scenario A Scenario B Scenario C

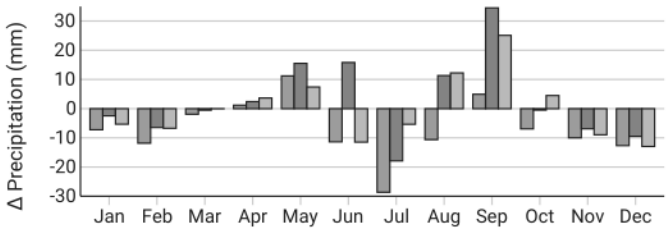
Monthly temperatures are presented as averages of the monthly mean temperature for the query basin as a whole. Projected changes in temperature may affect the hydrology in the watershed by influencing the time of freeze and thaw, evapotranspiration rates, form of precipitation, and vegetation composition, among other factors.



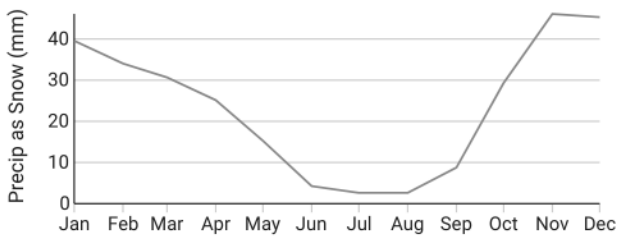


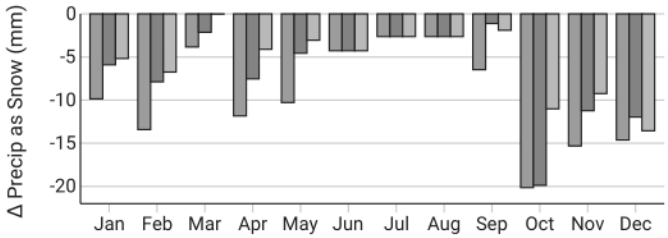
The precipitation in the query watershed is shown as an average unit precipitation for the watershed. Changes in precipitation timing and amount may affect the hydrology in the watershed by influencing the timing and magnitude of peak and low flow conditions. These changes may affect availability of water for environmental flow needs and human use, and modify the physical characteristics of river channels and associated needs for engineered structures.





Precipitation as snow in the query watershed is presented as an average unit precipitation for the query basin as a whole. Changes in the amount of precipitation as snow may affect winter snowpack volumes and associated melt related hydrology in the spring. An increase in rain-on-snow events may be associated with elevated natural hazard risk from avalanche or other slope stability failures.





References

Murdock, T.Q., Spittlehouse, D.L. 2011. Selecting and Using Climate Change Scenarios for British Columbia. Pacific Climate Impacts Consortium, University of Victoria, Victoria, BC. http://www.pacificclimate.org/sites/default/files/publications/Murdock.ScenariosGuidance.Dec2011.pdf

Pike, R.G., D.L. Spittlehouse, K.E. Bennett, V.N. Egginton, P.J. Tschaplinski, T.Q. Murdock, and A.T. Werner. 2008. Climate Change and Watershed Hydrology: Part I - Recent and Projected Changes in British Columbia. Streamline, Watershed Management Bulletin 11-2 8-13. http://www.pacificclimate.org/sites/default/files/publications/Pike.StreamlineHydrologyPartI.Apr2008.pdf

Rodenhuis, D., K.E. Bennett, A. Werner, T.Q. Murdock, and D. Bronaugh. 2007. Hydro-climatology and future climate impacts in British Columbia. Pacific Climate Impacts Consortium. http://www.pacificclimate.org/sites/default/files/publications/Rodenhuis.ClimateOverview.Mar2009.pdf

Wang, T., Hamann, A., Spittlehouse, D., and Murdock, T. N. 2012. ClimateWNA – High-resolution spatial climate data for western North America. Journal of Applied Meteorology and Climatology 61: 16-29.

Application

Tracking Number: 100238527

Applicant Information

If approved, will the authorization be issued to an Individual or Company/Organization?	Company/Organization
What is your relationship to the company/organization?	Employee

APPLICANT COMPANY / ORGANIZATION CONTACT INFORMATION

You have indicated in Step 2 - Setup that you are applying on behalf of the applicant. Please provide us with your name, address, and contact information.

Name:	ConocoPhillips Canada Resources Corp.
Doing Business As:	
Phone:	250-785-4887 ext. 35
Fax:	
Email:	lynda.m.neufeld@cop.com
BC Incorporation Number:	
Extra Provincial Inc. No:	
Society Number:	
GST Registration Number:	
Contact Name:	Administrator Surface
Mailing Address:	9619 112 Street Fort St. John BC V1J 7C7

CORRESPONDENCE E-MAIL ADDRESS

Email:	lynda.m.neufeld@conocophillips.com
Contact Name:	Lynda Neufeld

TECHNICAL INFORMATION

APPLICATION

Please provide us with as much detail as possible about the application you would like to amend so that we are able to locate it.

Type of Application:	Water Licence Application
Approximate date that the application was submitted:	Nov 29, 2017
Reference Number (tracking number, file number, etc.):	9000333

REASON FOR AMENDMENT

Please provide us with the reason why you would like to amend the application (please select all that apply):

Reason for amendment: Submit a report or other document

SUBMIT A REPORT OR OTHER DOCUMENT

You have indicated that you would like to submit a report or other document. Please upload those documents at the next step (Step 4).

ATTACHED DOCUMENTS

Document Type	Description	Filename
Report	FFHA and Works Plan for intake construction	OGC FFHA and Works Plan Fin...

PRIVACY DECLARATION

PRIVACY NOTE FOR THE COLLECTION, USE AND DISCLOSURE OF PERSONAL INFORMATION

Personal information is collected by FrontCounter BC under the legal authority of section 26 (c) and 27 (1) of the Freedom of Information and Protection of Privacy Act (the Act).

The collection, use, and disclosure of personal information is subject to the provisions of the Act. The personal information collected by FrontCounter BC will be used to process your inquiry or application(s). It may also be shared when strictly necessary with partner agencies that are also subject to the provisions of the Act. The personal information supplied in the application package may be used for referrals or notifications as required. Personal information may be used by FrontCounter BC for survey purposes.For more information regarding the collection, use, and/or disclosure of your personal information by FrontCounter BC, please contact FrontCounter BC at 1-877-855-3222 or at:

FrontCounter BC Program Director
FrontCounter BC, Provincial Operation
441 Columbia Street
Kamloops, BC V2C 2T3

☑ Check here to indicate that you have read and agree to the privacy declaration stated above.

IMPORTANT NOTICES

DECLARATION

☑ By submitting this application form, I, declare that the information contained on this form is complete and accurate.

OFFICE

Office to submit application to: Fort St. John

PROJECT INFORMATION

Is this application for an activity or project which requires more than one natural resource authorization from the Province of BC? No

OFFICE USE ONLY		
Office Fort St. John	**File Number**	**Project Number**
	Disposition ID	**Client Number**

BRITISH COLUMBIA

Ministry of Forests, Lands, Natural Resource Operations and Rural Development
Receipt

RETAIN THIS COPY FOR YOUR RECORDS

November 29, 2017

Received on behalf of:

ConocoPhillips Canada Resources Corp.

Receipt Number:	R641318
Received Date:	November 29, 2017
Payment Amount:	$11,500.00
Reference Number:	1000002

Description	Invoice	Authorization #	Tracking #	Tax Paid	Amount Paid
08A-APP 200000 m3/y - Stream Storage: Non-Power			100231934	N/A **	$500.00
05E-APP 3613500 m3/y - O & G: Hydrlc Frctrg (non-deep GW)			100231934	N/A **	$10,000.00
05H-APP 36500 m3/y - O & G: Drilling			100231934	N/A **	$1,000.00
				Total:	**$11,500.00**

GST/HST Registration #: R107864738

Cash Handling Area/ Receipting Office:
FrontCounter BC Fort St. John
FrontCounter BC Fort St. John
100-10003 110 Avenue
Fort St John, BC
V1J 6M7

(250) 787-3415

Payment Method: eGARMS Payment

Eco-Web Ecological Consulting Ltd.
Reducing the Consequences of Man's Influence on Nature
www.eco-web.ca

FISH AND FISH HABITAT ASSESSMENT AND WORKS PLAN

Proposed Halfway River Water Withdrawal Bank Infiltration System

REPORT PREPARED FOR:

CONOCOPHILLIPS CANADA RESOURCES CORP.
401 9 AVE SW,
CALGARY, AB
T2P 2H7
ATTENTION: LYNDA NEUFELD

ECO-WEB PROJECT #: E2-2024

Report Date: February 1, 2018
Field Assessment Dates: October 6, 2017

8211 93rd Street, Fort St. John. BC V1J6X1 (o)250-787-1110 (f) 250-787-1175

EXECUTIVE SUMMARY

ConocoPhillips Canada Resources Corp (CPC) has applied to the British Columbia Oil and Gas Commission (OGC) for a water licence under the Water Sustainability Act, to withdraw water (10,000 m^3/day and up to 3,650,000 m^3/year) from a Point of Diversion (POD) on the Halfway River in northeastern British Columbia. The purpose of the water licence is to support CPC's natural gas development in their Montney lease. Associated with the water licence, CPC is proposing to construct a river bed/bank infiltration gallery intake, with a gravity flow to a below-ground caisson located approximately 25 m north of the river bank. A pumping facility at the caisson will transport the water via a 400 mm below-ground freshwater pipeline to various well pads and a Water Treatment/Recycling/Storage Facility (referred to as the Water Hub), located at c-11-K/94-A-12.

CPC contracted an engineering company for the infiltration gallery engineering designs and plans, and further contracted with Eco-Web Ecological Consulting Ltd. (Eco-Web) to complete the Aquatic Effects Assessment, to support a review by the Department of Fisheries and Oceans under the Fisheries Act and this Fish and Fish Habitat Assessment (FFHA) and Works Plan to submit to the OGC. This FFHA has been prepared to provide information on the fish and fish habitat values at the proposed water intake, and provides recommendations on the installation, operation, and maintenance of the water intake site and system. This report also provides the necessary mitigation measures, compensation measures and monitoring plan, directed towards ensuring the construction and operation of the water intake does not result in serious harm to fish or harmful alteration, disruption or destruction of fish habitat.

The Halfway River (B.C. Watershed Code 235) is part of the Peace River Watershed in the Mackenzie drainage basin. The Halfway River originates in the northern Rocky Mountains. From its headwaters, the river flows south for approximately 300 km to the confluence with the Peace River, approximately 40 km downstream of the town of Hudson's Hope. The Halfway River POD is located on private land at UTM E562722 / N6262165, approximately 100 m upstream of the western boundary of the Halfway River Indian Reserve. The watershed area at the POD is 6,610 km^2, with an elevation range of 680-2,395 m. The river proximal to the POD is 150+ m in width, with a gradient of 0.5%, with a riffle-pool morphology and bed material dominated by cobble- and gravel-sized particles. The riparian area adjacent to the river at the POD is immature mixed forest of approximately <40 years age. The riparian area within the POD construction site does not provide any Large Woody Debris (LWD) within 1 m of the water edge, or feature any riparian vegetation that overhangs the channel providing shade or organic material to the edge of the water, or providing notable fish habitat value.

The Halfway River is a high value fisheries river. Twenty species of fish are noted to occur in the Halfway River, including 8 sportfish, 2 suckers, 7 minnows, and 3 sculpin species. The sport fish include: Arctic grayling, bull trout, burbot, kokanee, mountain whitefish, northern pike, rainbow trout and walleye. In particular, tributaries of the Halfway River well upstream of the POD provide critical spawning and rearing area for the Peace River Bull Trout population. Bull trout have been classified as a "blue listed" species by the British Columbia Conservation Data Centre. Fish habitat at the POD is primarily for fish migration and rearing. Based on the river substrate there is no suitable bull trout spawning habitat at or proximal to the POD location. Bull trout migrate past the POD for spawning in the upper Halfway River and tributaries, including the Graham and Chowade river systems.

There are four Water Survey of Canada (WSC) streamflow gauges that provide 30+ years of excellent discharge record for the river. These WSC data have been rigorously analyzed and reported in detail in the

Water Management Plan submitted to the OGC with the water licence application[1]. Mean annual runoff at the proposed POD is 2.13 billion m^3 per year (67.5 m^3/s), ranging from a low of 959 million m^3 to a high of 4.01 billion m^3 per year. Runoff is seasonally variable, with high flow during spring and summer resulting from the melt of the mountain snowpack, and low flow in late winter (Jan-Mar). During February, the month of lowest average runoff, discharge is 26.9 million m^3 (962,000 m^3 per day). During June, the month of highest average runoff, discharge is 625 million m^3 (20,800,000 m^3 per day). Because of its high elevation snowmelt source area, the Halfway River typically experiences its freshet peak in late June, with high flows continuing through July.

The proposed CPC water diversion comprises 0.17% of mean annual runoff, 1% of mean winter runoff (January-March, the months of lowest runoff), and <2% of runoff in the month of lowest runoff in the 30+ years of hydrologic record. Existing water demand from the Halfway River is low, and the CPC water licence in combination with all existing water licences will produce a maximum cumulative water demand of about 1.3% of mean daily winter discharge, and <2.1% of the lowest daily winter discharge in the 30+ year period of record[1]. Using the framework of the BC Environmental Flow Needs Policy[2], the proposed water withdrawal by CPC as assessed as "Risk Level 1", indicating there "*is sufficient natural water availability for the proposed withdrawal period and that cumulative water withdrawals are below the specified threshold that might result in an impact on environmental flows*".

The river bed/bank water intake is designed to be constructed along a 55 m length of the north bank of the channel, extending about 10 m into the river from the north bank (the river is 150+ m in width). The intake is an in-bed/bank infiltration gallery, consisting of 400 mm slotted intake pipe within a sand-sized filter pack, installed under the stream bed and bank. The infiltration gallery is protected with competent rock, and then surfaced with the natural cobble particles of the size being transported by the river. Once constructed, the infiltration gallery will not be visible. Construction of the in-stream components will begin on or about July 15, at the start of the July 15-August 15 the "least risk fisheries timing window", and is estimated to require 8 weeks to complete. Because discharge and river velocities are high in July from the late snowmelt, CPC is proposing to isolate the infiltration gallery construction area behind a temporary steel sheet pile barrier, with a silt curtain barrier to control sediment. Although the construction will extend outside the least risk fisheries timing window, it is our assessment that there will be no harmful alteration, disruption or destruction of fish habitat:

- Installation of sheet piling will occur while spawning bull trout are typically not within the reach of the river near the POD location. Based on the historical data and movements of radio tagged bull trout it is evident that bull trout use the reach associated at the POD location primarily as a migratory corridor, as well as possible overwintering, but not for spawning;
- The critical bull trout spawning grounds are over 70 km upstream of the POD location, within the Chowade, Graham and Upper Halfway tributaries;
- Most bull trout will have already passed the POD location during their upstream migration to reach the identified spawning grounds;
- The peak spawning activity of both whitefish species is within October;

[1] Halfway River Water Management Plan. ConocoPhillips Canada Resources Corp., 401 9th Avenue SW, Calgary Alberta, 27-November-2017.

[2] BC Environmental Flow Needs Policy (BC MOE and FLNRO), February 29, 2016. http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-rights/efn_policy_mar-2016_signed.pdf

- The removal of the sheet piling is not anticipated to create onsite noise or sediment disturbance, and will occur starting November 1, when most of the bull trout will have already past the POD location returning to their overwintering areas;
- The peak of the whitefish spawning will be over;
- The installation of the Silt Curtain mitigative measure is anticipated to minimize the release of suspended sediment or other materials that may be harmful to any resident or migratory fish near the POD construction area;
- The isolation area will encroach up to 10 m into the wetted width of the river. Based on a late summer/fall wetted width of 55-100 m, approximately 45-90 m of the wetted channel width will still be available for use by fish for migration or rearing.

Once the sheet pilling is installed and mitigated by placement of a surrounding Silt Curtain, it is our view that the standing sheet piling will have little impact on any migrating or resident bull trout or to the abundant population of mountain whitefish in the Halfway River.

This document provides detail on the proposed water withdrawals and intake construction in relation to the Halfway River fish resources, and includes many details related to environmental protection and mitigation associated with the installation, operation and maintenance of the intake and associated water pumping facility. Monitoring will occur throughout construction with a Qualified Environmental Professional on-site for all aspects of construction regarding the installation of the river bed/bank infiltration system at the POD.

It is our assessment that there will be no serious harm to fish or harmful alteration, disruption or destruction of fish habitat.

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INTRODUCTION

ConocoPhillips Canada Resources Corp. (CPC) retained an engineering company to develop engineering designs and plans for a proposed river bed/bank Infiltration water intake on the Halfway River. Eco-Web Ecological Consulting Ltd. (Eco-Web) was further retained to assess and provide mitigative compensation measures to address construction of the proposed river bed/bank infiltration system at the Point of Diversion (POD) location in northeastern British Columbia.

At the request of CPC, Eco-Web completed a Fish and Fish Habitat Assessment (FFHA) on the proposed river bed/bank infiltration system to facilitate water withdrawal from the Halfway River POD located at UTM E562722/ N6262165 (water withdrawal site). This report provides an assessment of the site-specific fisheries habitat and possible effects anticipated by the proposed water intake and a works plan outlining the corresponding mitigative measures to ensure protection of fish and fish habitat.

LOCATION

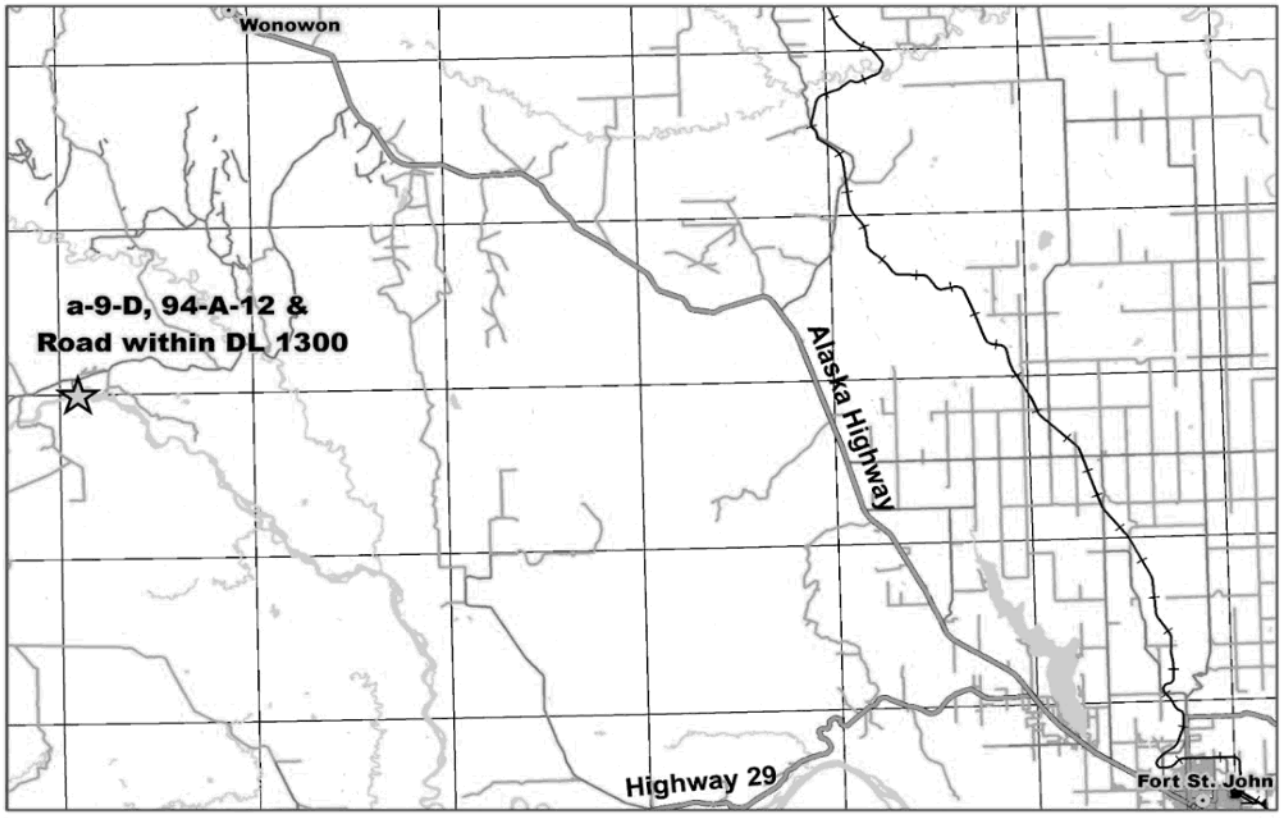
CPC is proposing to construct the Water Intake Facility Site at a-9-D, 94-A-12 and the associated access road within District Lot 1300 Except Plan PGP37245. The development is located within the Agricultural Land Reserve (ALR) on private land owned by Peaceland Farm Ltd. The site is located off of the Upper Halfway road which is accessed off of the Alaska Highway (Highway 97) approximately 76.5km Northwest of Fort St John, in northeastern BC. The proposed development includes an access road and a water intake facility and requires 3.23 hectares (ha) for the development (access road 2.6 ha and facility 0.63 ha). A pipeline right-of-way is planned to run north from this withdrawal site.

PURPOSE

The purpose of this FFHA is to provide an assessment of the fish and fish habitat values based upon site-specific information and historical data and provide recommendations on the water withdrawal, installation and operation of a water intake structure at the proposed POD site. As proposed, construction operations will occur in-stream and fall outside of the Least Risk Timing Windows as identified by the OGC. As such this report will provide recommendations on site-specific mitigation measures and Best Management Practices (BMPs) to ensure that no serious harm to fish occurs and that no harmful alteration, disruption or destruction of fish or fish habitat occurs during the construction and operation of the proposed water withdrawal system.

In summary, the purpose of this assessment is to:

- Provide a detailed description and timeline of the proposed work;
- Complete a detailed assessment of the proposed location and area of potential impact;
- Complete a fish and fish habitat assessment of the biological and physical characteristics of the development site;
- Identify and assess the potential impacts of the proposed development;
- Identify suitable rationale and mitigation for working outside of the Least Risk Timing Window; and
- Develop a Works Plan identifying BMPs and mitigation measures to reduce the potential environmental impacts of the development.



Eco-Web Ecological Consulting 8211 93rd Street, Fort St. John, BC V1J 6X1 Tel. 250-787-1110 Fax: 250-787-1175	ConocoPhillips Canada a-9-D, 94-A-12 & Road within DL 1300	Date: January 4, 2018 Map Datum/Source: NAD 83 Zone 10 Eco-Web Job# R1-2050 Scale: 1:500,000 Drawn by: Lee Waddell	Title Overview Map Figure # 1

FIGURE 1 – OVERVIEW MAP

REGULATORY FRAMEWORK

A fish and fish habitat assessment is required to classify a stream and assess the fish habitat contained within the stream. This information is required to ensure compliance with the federal *Fisheries Act* which has general prohibitions regarding the addition of deleterious substances to fish habitat and activities which result in serious harm to fish. Additional provisions regarding fish habitat and stream crossings are made in BC OGC Environmental Protection and Management Regulation (EPMR) and EPMG.

The Fisheries Act defines fish as:

"*Parts of fish, shellfish, crustaceans, marine animals and any part of shellfish, crustaceans or marine animals, and the eggs, sperm, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals.*"

Under the *Fisheries Act* fish habitat includes:

"*Spawning grounds and any other areas, including nursery, rearing, food supply and migration area, on which fish depend directly or indirectly in order to carry out their life processes*."

The EPMR provides the following definition for a stream:

"*A watercourse, including a watercourse that is obscured by overhanging or bridging vegetation or soil mats, that contains water on a perennial or seasonal basis, is scoured by water or contains observable deposits of mineral alluvium, and that*

(a) has a continuous channel bed that is 100 m or more in length, or
(b) flows directly into
(i) a fish stream or a fish-bearing lake or wetland, or
(ii) a waterworks"

Under the EPMR a fish stream is:

"*A stream that*

(a) is frequented by any of the following species of fish:
(i) anadromous salmonids;
(ii) rainbow trout, cutthroat trout, brown trout, bull trout, dolly varden char, lake trout, brook trout, kokanee, largemouth bass, smallmouth bass, mountain whitefish, lake whitefish, arctic grayling, burbot, white sturgeon, black crappie, yellow perch, walleye or northern pike;
(iii) a species identified as a species at risk by an order under section 29 (a);
(iv) a species identified as regionally important wildlife by an order under section 29 (b), or
(b) has a slope gradient of less than 20%, unless the watercourse
(i) does not contain any of the species of fish referred to in paragraph (a),
(ii) is located upstream of a natural barrier to fish passage and all reaches upstream of the barrier are simultaneously dry at any time during the year, or
(iii) is located upstream of a natural barrier to fish passage and no perennial fish habitat exists upstream of the barrier."

The new *Water Sustainability Act* (WSA) came into force in March of 2016 and includes a broader definition of a stream:

"*a natural watercourse, including a natural glacier course, or a natural body of water, whether or not the stream channel of the stream has been modified; or, a natural source of water supply; including, without limitation, a lake, pond, river, creek, spring, ravine, gulch, wetland or glacier, whether or not usually containing water, including ice, but does not include an aquifer*."

A stream channel is defined as:

"*…the bed of the stream and the banks of the stream, both above and below the natural boundary and whether or not the channel has been modified, and includes side channels of the stream*."

A change approval, issued under Part 2 (Section 11) of the WSA, is required for a change in and about a stream. Changes in and about a stream is defined as:

"*Any modification to the nature of a stream, including any modification to the land, vegetation and natural environment of a stream or the flow of water in a stream; or, any activity or construction within a stream channel that has or may have an impact on a stream or a stream channel*."

Chapter 4.8 of the Oil and g issued under OGAA in accordance with the EPMR covers off the requirements, and a separate WSA Section 11 application for changes in and about stream is not required.

DESCRIPTION OF PROPOSED WORK

An engineering company has designed a river bed/bank infiltration system (Figure 2) that will allow water withdrawal through an infiltration gallery. The system involves installing approximately 55 m of slotted 400mm PVC pipe within the river bed and below the bank of the Halfway River. River water will flow through a granular infiltration bed construction below the river and enter the slotted pipe, flow via gravitational feed to the north for approximately 25 m through two underground 400mm PVC pipes to a small volume caisson with a pumping facility. From the pumping facility the water will be moved through a 400 mm buried fresh water pipeline to various well pads and to a Water Treatment/Recycling/Storage Facility (referred to as the Water Hub), located at c-11-K/94-A-12.

This system has been designed to draw 10,000 m^3/day for a total of 3.65 million m^3/year. This is about 1.7% of the potential allocation for the Halfway River at this location based on application of the BC Ministry of Environment's Environmental Flow Needs policy.

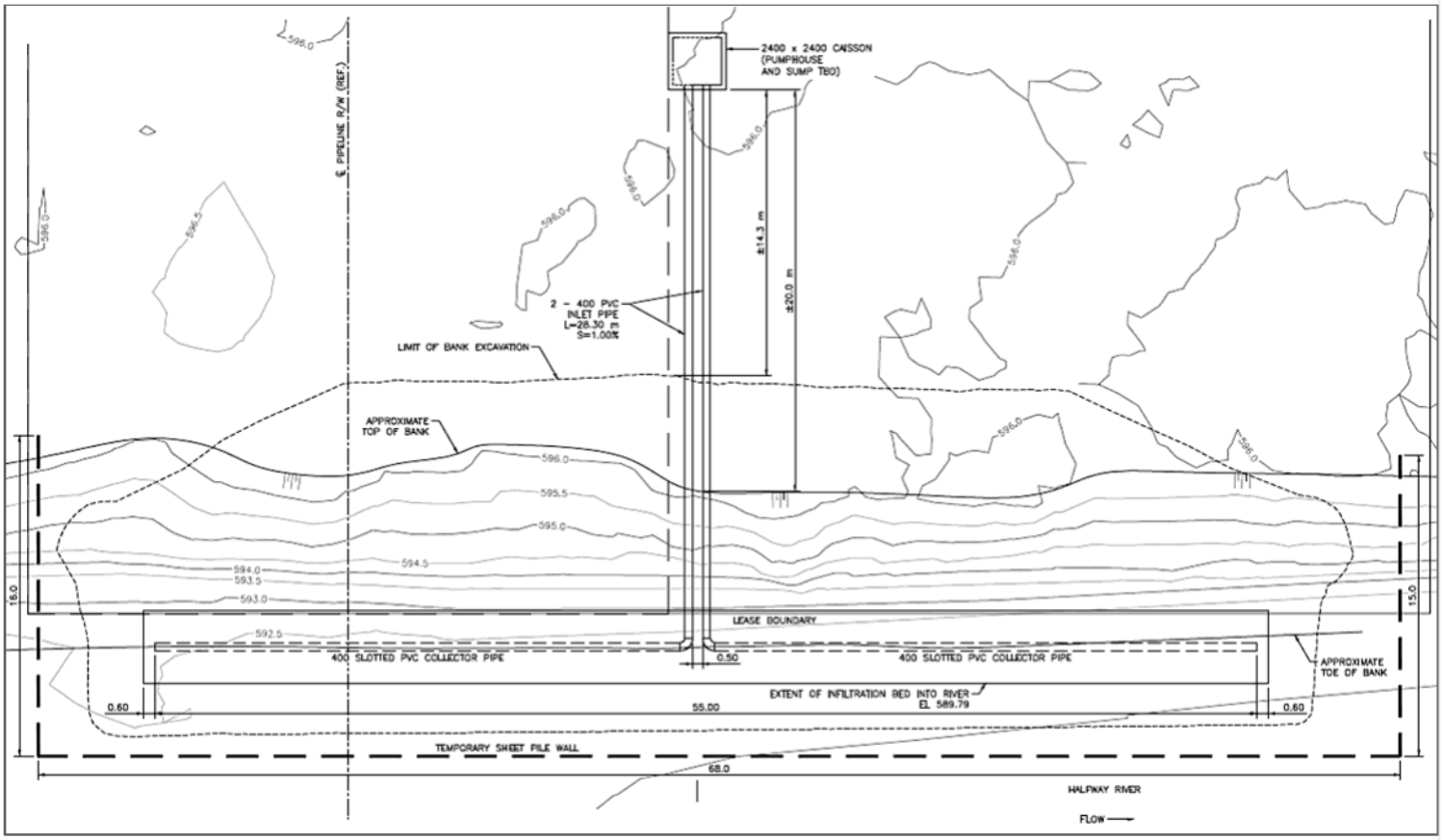


FIGURE 2– PROPOSED RIVER BED/BANK INFILTRATION SYSTEM INSTALLATION LAYOUT

Methodology

The proposed water intake at the POD will feature a river bed/bank infiltration system. The infiltration system has been designed and engineered to be constructed into the existing northern river bank and below the river substrate at the POD location. As such, a 69 m section of river along the northern river bank (approximately 10 m x 69 m) will be isolated by way of installing metal sheet piling. Once the isolated area is dewatered and all fish salvage has been completed, the installation of the filtration system will commence following the engineered drawings (Appendix I). To summarize the installation:

- Slotted pipe will be installed parallel to the river and connected to a pipe with gravity flow to a subground caisson;
- the excavation will be filled with a filter pack underneath coarse rock and sand, and covered with river-bed substrate of competent size in relation to channel hydraulics;
- Once the system has been installed bank armouring and reclamation will occur at the site to an extent to where the sheet piling can be removed;
- Once the sheet piling is removed final reclamation activities along the top of bank and adjacent riparian area can occur.

Permanent Structures

The proposed development includes an access road and a water intake facility and requires 3.23 hectares (ha) for the development (access road 2.6 ha and facility 0.63 ha). This water intake withdrawal facility is expected to be a permanent structure for the lifetime of the permit. The actual dimensions of the water intake infiltration system measurements can be viewed in Appendix I and will include a caisson, pumping facility, two generators, electrical building, communications tower and pipeline exiting the facility to the north (see survey plans in Appendix I). Channel migration issues have been addressed in the design by ensuring that river banks and the intake structure are armoured and will be monitored to minimize/ensure no damage occurs.

Construction Methodologies

A detailed Schedule A Pre-Construction Site Assessment[3] has been completed for the associated Facility Site (0.63 ha) and Access Road (2.6 ha). CPC has committed to following all construction methodologies and BMPs outlined in the above-mentioned report. This report will focus on the construction of the withdrawal system related to the lower part of the riparian area, the river bank and the river bed.

During construction of the bank, the surface soil and organics, which are very limited in this area, will be stripped and stockpiled along the edge of the construction area away from the river. These areas will have sediment control structures such as silt fence installed to reduce unwanted sediment transfer off site or into the river.

Once erosion and siltation control measures have been installed and surface soils have been stripped, material will be pulled back from the bank and stockpiled in bermed temporary workspaces. The portion extending approximately 10 m out into the river and 69 m long of the Halfway River, along the north bank will be isolated utilizing steel sheet piling. Once Isolation is achieved and the work site dewatered, the bank will be dug down to the specified depth and the bank infiltration system will be installed as per the engineered drawings.

Once the system is installed suitable rock armouring will be installed in layers, with brush layering and/or willow staking interspersed as per the engineered design and reconstruction of the bank will match the contours of the original bank to the point practicable. The upper bank materials will be brought back to the original grade and contoured in to match the natural topography. The salvaged, topsoil and organics will be placed along the top of bank to promote restoration. Live staking of any erodible portions of the bank at the water layer will be done to enhance the stability of the bank and to provide shade cover to the edge of the river.

[3] Eco-Web Ecological Consulting Ltd. 2018. Schedule A Pre-Construction Site Assessment - Water Intake Facility Site a-9-D, 94-A-12 and Road within District Lot 1300 Except Plan PGP37245. Prepared for ConocoPhillips, Calgary, AB. 49 pgs.

Project Operations

The proposed river bed/bank infiltration system is designed to run 365 days per year and withdraw 10,000 m^3/day and total 3.65 million m^3/year. This correspond to 0.17% of mean annual runoff, 1.04% of mean monthly runoff in the low flow winter period, and 2% of the lowest monthly discharge according to Water Survey Canada (WSC)[4] data records. This is about 1.7% of the potential allocation for the Halfway River at this location based on application of the BC Ministry of Environment's Environmental Flow Needs policy.

Timeline

The approximate construction timeline is estimated at 8 weeks. The following is an estimated timeline for the associated construction activities:

- Clearing/Stripping: 3 days
- Silt curtain installation: 4.5 days
- Sheet Pile Installation: 7 days
- Fish Salvage: 7 days
- Excavation: 7 days
- Infiltration Gallery Install, river bank restoration: 18 days
- Remaining Backfill: 5 days
- Removal of Sheet Pile: 4 days

The proposed instream construction is scheduled to start July 15 if feasible. Construction start will be dictated by water levels, which if high, could delay the start of construction. For this reason a wide window of July 15 to November 9, 2018 has been provided to cover all foreseeable conditions. CPC was aiming to align construction within the Northeast Region Least Risk Timing Window[5] (Table 1) for both Spring and Fall Spawners (July 15 to August 15) however the duration of the construction will take longer than the allotted 30 days and the possibility of the hydrological characteristics of the Halfway River and feasibility of isolating a section of River needs to be factored into this timing.

TABLE 1 – NORTHEAST LEAST RISK TIMING WINDOW

Fish/Wildlife Presence	Window of Least Risk
Both spring and fall spawners*; or unknown	July 15 – August 15
Fall spawners* (eg bull trout, kokanee)	June 15 – August 15
Spring spawners (eg rainbow trout, walleye)	July 15 – March 31
Anadromous salmon (eg chum)	Please contact Fisheries and Oceans Canada (DFO) for site-specific timing
Beavers	July 15 – September 14

* Includes winter spawning burbot (*Lota lota*).

It is necessary for CPC's instream work to extend outside of the least risk timing window, as river conditions vary from year to year. At the POD location, water levels approximately 10m off the bank near the thalweg in July and August are from 3.7 m to 3 m deep historically, while into September and October they come

[4] Water Survey Canada. 2017. Available at https://www.ec.gc.ca/rhc-wsc/.
[5] Ministry of Forest, Lands, and Natural Resource Operations. 2016. Habitat Officer Terms and Conditions Ministry of Forests, Lands and Natural Resource Operations Northeast Region. Accessed at https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-licensing-rights/working-around-water/regional-terms-conditions-timing-windows

down from 2.5 m to 2 m (Figure 3). Attempting bank isolation during the higher flow periods could result in a greater impact as the river's velocity levels would not allow one of the key mitigative measures of a Silt Curtain to be used. The Silt Curtain would surround the construction site, outside of the sheet piling, to help reduce the migration of suspended sediment downstream as well as keep fish away from the construction activities. However, commercially available Silt Curtains can only be properly installed and withstand the lower river velocities which may occur outside of the least risk timing windows. As well, to try and isolate during the higher velocities would also decrease crew safety. Commercially available Silt Curtains have a limited structural integrity and can only be installed in water with flows up to 1.5 m/s. Water velocity at the time of construction will be monitored to ensure that silt curtains can be installed and will operate effectively.

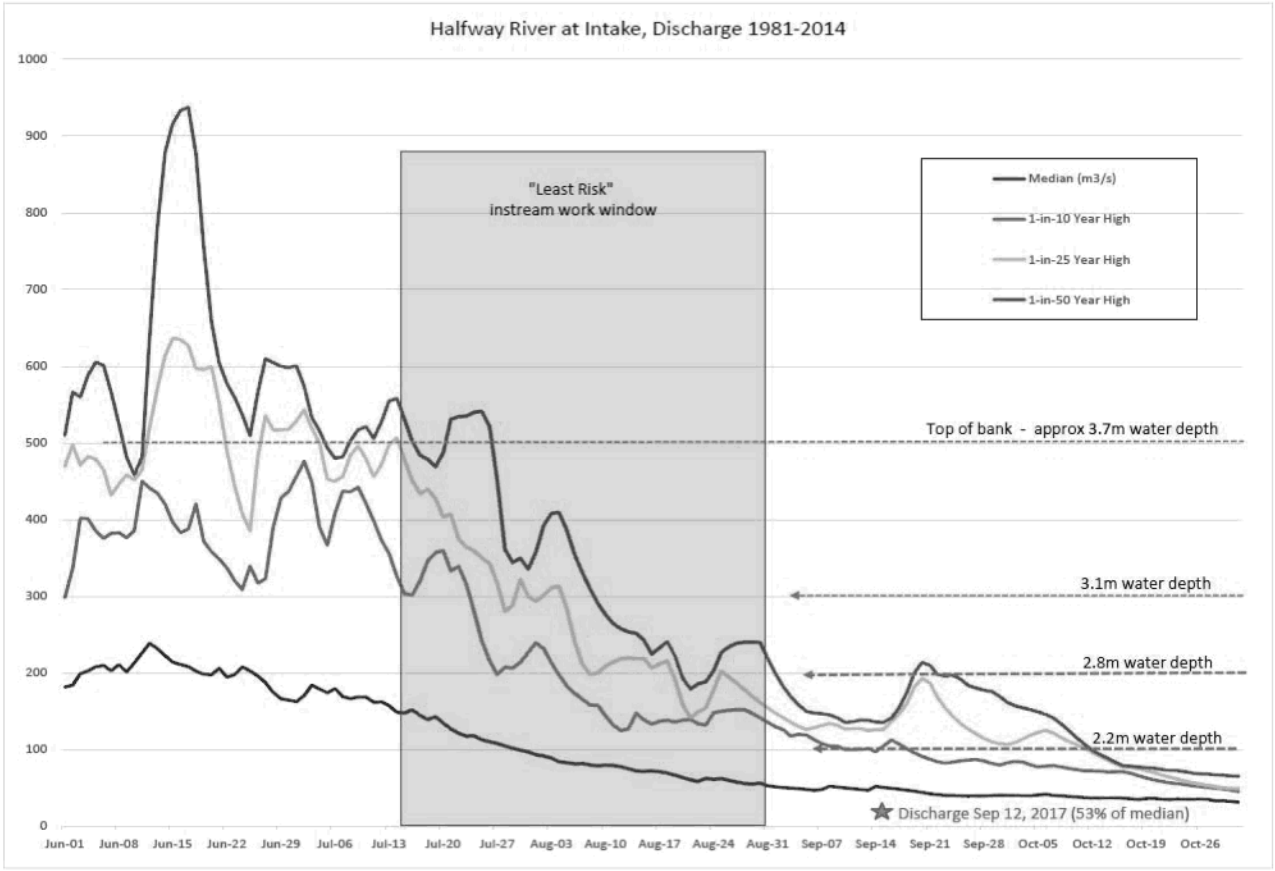


FIGURE 3 - WSC GAUGES ON THE HALFWAY UPSTREAM OF THE INTAKE, ADJUSTED TO THE INTAKE LOCATION, 1981-2014

In summary, CPC is proposing to start construction on July 15, but the hydrological characteristics need to be assessed at that time. Ideally, CPC will have the sheet piling installed before August 15 but the remainder of the construction will be proceeding outside of the least risk window. If project delays and/or water levels do not allow the sheet piling installation to be completed by August 15, the next suitable least risk window based on fish species is suggested to occur between September 5 and 12 (this rationale is explained in more detail within the Operational Activities section below). To support this, enhanced mitigation efforts have been identified within this document to rationalize the deviation from working within the normal least risk fisheries timing window.

CPC has prepared the sheet piling installation engineered design in order to withstand and work within the unfavorable high flows that may be present within the least risk timing window. It will be difficult to work

within the least risk period if water levels are high but CPC will endeavor to conduct work in the safest manner possible and include the mitigation measures that are feasible.

ENVIRONMENTAL SETTING

The site is located on terraced land, with development on nearly level to gently sloping topography with a south facing aspect. Slopes ranges from 1 - 10%. The access road, which may be upgraded, passes through and borders pasture and mixed wood forested land, while the facility is located on the river's edge in an immature mixed wood forest (<40 years). Based on soil and vegetation type, the site is well-drained, with a small area of poor drainage along the access. The access road is currently a high-grade road which may be further upgraded, and the facility site area is located in an undisturbed forested area (see the Schedule A PCSA Eco-Web Project R1-2050 for further details regarding the Access road and Facility).

The proposed POD is found in the Boreal White and Black Spruce moist warm (BWBSmw) Biogeoclimatic zone, which covers the lowlands from the Halfway River up to the Northwest Territories, with elevations ranging from 300 to 1050 m above sea level. The area has numerous wetlands and bogs throughout, and few rivers with steep-sided canyons that have cut through upland surface. The western portion of the BWBS contains large wetlands of black spruce and open scrub birch/sedges, and the eastern zone is dominated by upland forests of trembling aspen and white spruce[6]. Tree species within forested sections of the BWBS include white spruce, trembling aspen, lodgepole pine, black spruce, balsam polar, tamarack, subalpine fir, common paper birch and Alaska paper birch while the subzone is dominated by white spruce and trembling aspen. Fire is a common natural disturbance, with seral forests, dominated by trembling aspen and willow, found within the area.

The climate within the BWBSmw2 is northern continental, with short warm and moist growing seasons with localized rain showers and cumulus clouds caused by the heating of regional water bodies throughout the summer. Winters have short daylight hours, and are typically cold, with uninterrupted Arctic air currents coming through the area[3]. The ground is deeply frozen for most of the year, although it has the least snowfall of all the northern zones[7].

The POD location is on the Halfway River which is the defining border between the Ministry of Environment Wildlife Management Unit 7-44 to the north and 7-35 to the south[8]. Moose, elk, mule deer and white-tailed deer are common and widespread ungulate species within the area. Populations of large carnivores, including grey wolf, black bear, grizzly bear and lynx are also widespread and common[9].

Type of water body

The focal reach of the Halfway River at the POD is classified as an S1 river due to the average channel width being greater than 20 m. A river with an S1 Riparian Classification has a 50m Riparian Reserve Zone and a 50m Riparian Management Zone totaling a 100m Riparian Management Area (RMA). However, this

[6] DeLong, C., A. Banner, W. H. MacKenzie, B. J. Rogers, and B. Kaytor. 2011. *A field guide to ecosystem identification for the Boreal White and Black Spruce Zone of British Columbia.* B.C. Min. For. Range, For. Sci. Prog., Victoria, B.C. Land Manag. Handb. No. 65. www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh65.htm

[7] DeLong, C., Annas, R.M. & Stewart, A.C. 1991. *Chapter 16: Boreal White and Black Spruce Zone*. In: Meidinger, D.V. & Pojar, J. *Ecosystems of Britich Columbia*. Special Report Series 6. BC Ministry of Forests. ISSN 0843-6452: no 6. Victoria, BC.

[8] Province of British Columbia, 2013. *iMap BC Wildlife Management Units*. Accessed on November 3, 2014. Available at: http://maps.gov.bc.ca/ess/sv/imapbc/

[9] British Columbia Ministry of Forests, 2014. *The Ecology of the Boreal White and Black Spruce Zone.* 6p. Victoria, B.C. Available at: http://www.for.gov.bc.ca/hfd/pubs/docs/Bro/bro49.pdf

water withdrawal system will be entirely located within private land so the same RMA measurements do not apply.

Watersheds, Water Sources, Waterbodies Likely to be Affected

The Halfway River (Watershed Code 235) is within the Peace River Watershed and the POD location is at a-9-D/94-A-12 (UTM 10 E562722 / N6262165) which has an overall drainage basin of 6610 km^2. There are four Water Survey of Canada (WSC) streamflow gauges that provide 30+ years of excellent discharge records for the river. These WSC data have been rigorously analyzed and reported in detail in the Water Management Plan submitted to the OGC with the water licence application[10]. Based on the WSC records, the mean annual runoff at the proposed POD is 2.13 billion m^3 per year (67.5 m^3/s), ranging from a low of 959 million m^3 to a high of 4.01 billion m^3 per year. Runoff is seasonally variable, with high flow during spring and summer resulting from the melt of the mountain snowpack, and low flow in late winter (Jan-Mar). During February, the month of lowest average runoff, discharge is 26.9 million m^3 (962,000 m^3 per day). During June, the month of highest average runoff, discharge is 625 million m^3 (20,800,000 m^3 per day). Because of its high elevation snowmelt source area, the Halfway River typically experiences its freshet peak in late June, with high flows continuing through July.

A total of 19 water licenses and 2 short term use approvals are currently active within the catchment basin with a total current allocation (Water Licence and Short Term Use Approvals) of 1,697,685 m^3/yr upstream and 2,629,882 m^3/yr downstream of the POD location (NEWT)[11].

The Halfway River is part of the Peace River Watershed in the Mackenzie drainage basin. The Halfway River originates at Robb Lake between Mount Robb and Mount Kenny in the Muskwa Range of the Rocky Mountains. From its headwaters, the river flows south for approximately 300 km to the confluence with the Peace River approximately 40 km downstream of the town of Hudson's Hope and is fed by substantial snowpack within a large drainage area. The river flows in a general south-east direction gaining in size within the withdrawal catchment basin by its major tributaries the Chowadee River and Graham River River (along with a large number of major creeks including locally: Cypress Creek, Aikmen Creek, Headstone Creek, Fiddes Creek, Horsehoe Creek to list a few) before flowing into the Peace River. .

ABA Analysis

Area-based Analysis (ABA) framework was developed by the BC OGC to assist with making decisions on oil and gas applications by looking at the cumulative effects of the proposed oil and gas activities on ecological, cultural and social values in the context of all other development activities across the landscape. However, current riparian reserve regulations do not apply to private land, and the condition of riparian habitat on private land is not assessed within OGC's Area Based Analysis and therefore is not applicable for this project.

DESCRIPTION OF FISH AND FISH HABITAT

The proposed intake location has not been previously disturbed by any major developments, with only trails leading down to this portion of the river, accessed from private land on the north side.

An area of 100 m upstream and 100m downstream of the proposed water withdrawal location was the focal segment during the field assessment which occurred on October 6, 2017 and only accessed from the northern

[10] Halfway River Water Management Plan. ConocoPhillips Canada Resources Corp., 401 9th Avenue SW, Calgary Alberta, 27-November-2017.

[11] British Columbia Oil and Gas Commission. 2017. *NorthEast Water Tool.* UTM coordinates 562722/6262165. Accessed on Oct 16, 2017. Available at: http://geoweb.bcogc.ca/apps/newt/newt.html

shore. The immediate riparian vegetation on the northern shore consisted of an immature mixed wood forest overstory containing; cottonwood, white spruce, aspen with an understory featuring; prickly rose, willow species, grass species, and moss species. The late season assessment did not allow for a thorough vegetation composition due to plant desiccation. An Unmanned Aerial Vehicle (UAV) was utilized to help explore the assessment area and to provide current photographs of the site as well as assess the general habitat from a bird's eye view. Figures 5 and 6 below illustrates the current conditions (October 6, 2017) of the Halfway River and location of the bank infiltration system from an aerial UAV picture. More UAV photographs of the withdrawal location are in Appendix III.

The average channel width of the of the Halfway River based on an approximate 1 km section centered at the POD location is 215 m (Ranging from 140 m to 285 m) with the actual channel width at the POD location sprawling to 247 m. The current residual pool depth was measured at 1.3 5m approximately 3 m out from shore (maximum safe wading distance from shore) but the depth on the actual thalwag was estimated to be closer to 3 m. The bankfull depth was measured at an average of 4.4 m. The bed material substrate is dominated by small and large cobble, with a good amount of gravels and fines interspersed with some large rock present with a D95 of 0.41 m. Table 2 provides ground estimates of the bed material abundance found within the assessed area. Further information and pictures obtained during the field investigation can be found in the Fish and Fish Habitat Field Report in Appendix II.

TABLE 2 – COMPOSITION OF BED MATERIAL AT PROPOSED WATER WITHDRAWAL LOCATION

Bed Material	Range (cm)	Estimated cover
Fines	< 0.2	20%
Gravel	0.2-6	20%
Cobble	>6-25	50%
Rock	>25	10%

There is no crown closure and no overhanging vegetation and no functioning small or large woody debris at the immediate POD location. Fish cover features deep pools and boulders. Fish habitat at the proposed POD location is described as Important – referring to habitat that would be used by fish for feeding, growth, and migration but not critical due to limited spawning potential based on bed material. For most species of salmonids (rainbow trout, bull trout, arctic grayling), the general bed material composition guideline for spawning habitat features approximately 80% of 1 to 5 cm gravel with the remaining 20% made up of 10 cm gravel and a small portion of coarse sand (0.2 to 0.05 cm)[12].

This evaluation is similar with that of Mainstream Aquatics Ltd.[13] (Mainstream) who describe this reach of the Halfway River (POD location) from the confluence of the Graham River down to the confluence of the Cameron River (Figure 4) as containing an abundance of rearing, feeding, and overwintering habitats for fish species potentially found in the Halfway River (arctic grayling, bull trout, mountain whitefish, and rainbow trout). Mainstream further describes this reach of the river as consisting of an occasionally

[12] Whyte et al. 1997. Chapter 5: Restoring Fish Access and Rehabilitation of Spawning sites. Fish Habitat Rehabilitation Procedures. Watershed Restoration Technical Circular No. 9. Ministry of Environment Lands Parks. ISBN 0-7726-3320-7.
[13] Mainstream Aquatics Ltd. 2010. Halfway River and Moberly River summer fish survey – 2009. Prepared for BC Hydro Engineering Services. Report No. 09008BF: 61 p. + plates and appendices.

confined, wide channel with short braided sections or riffle/rapid sections with several small named and unnamed tributaries entering the river. Numerous side channels containing physical features that provided good quality fish habitat are present. It was also noted by Mainstream that there was a short (approximately 10 km) section immediately downstream of the Graham River confluence that contained numerous outcrops and a series of bedrock sills.

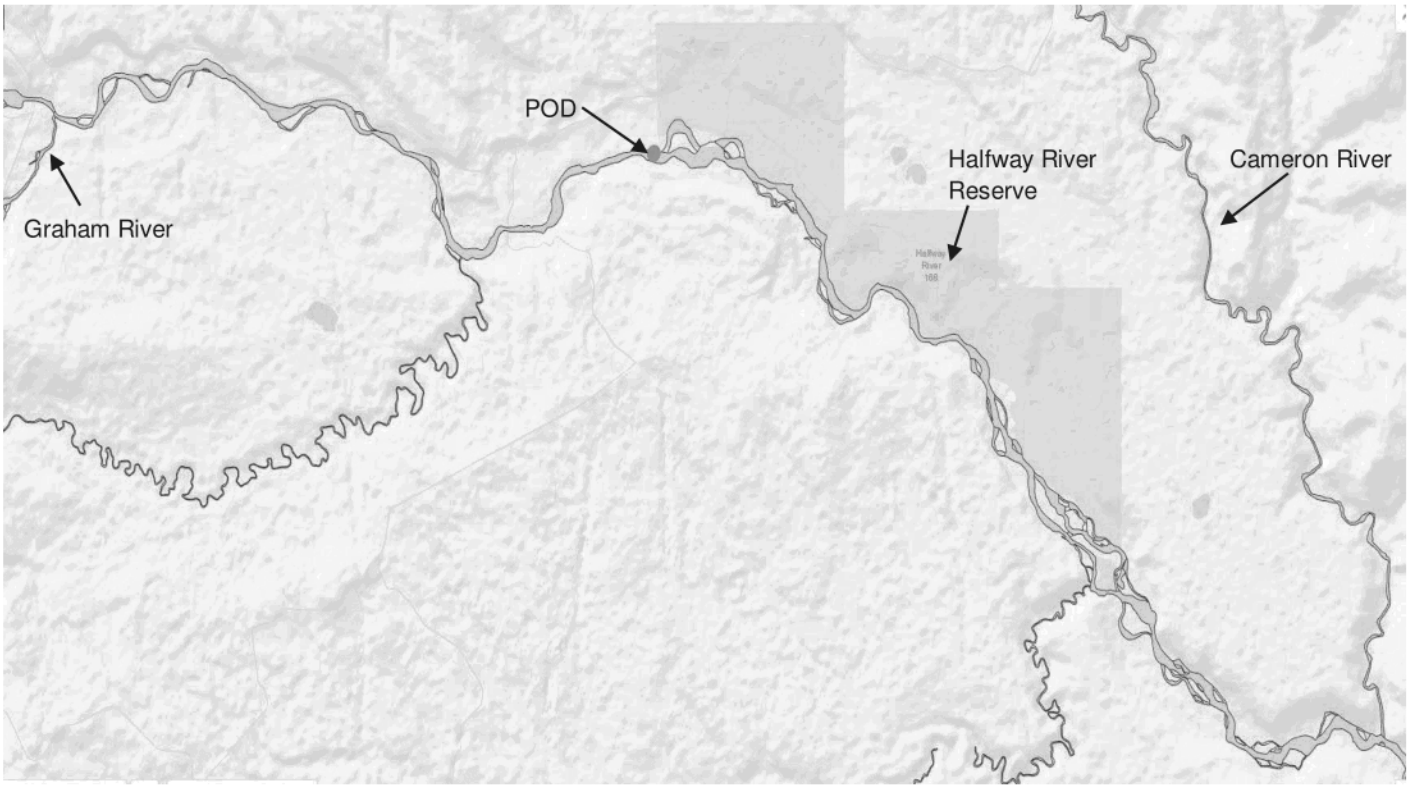


FIGURE 4 – REACH OF THE HALFWAY RIVER BETWEEN THE CONFLUENCES OF THE GRAHAM RIVER AND CAMERON RIVER

FIGURE 5 - UAV PHOTOGRAPH LOOKING UPSTREAM AT THE POTENTIAL WATER INFILTRATION GALLERY

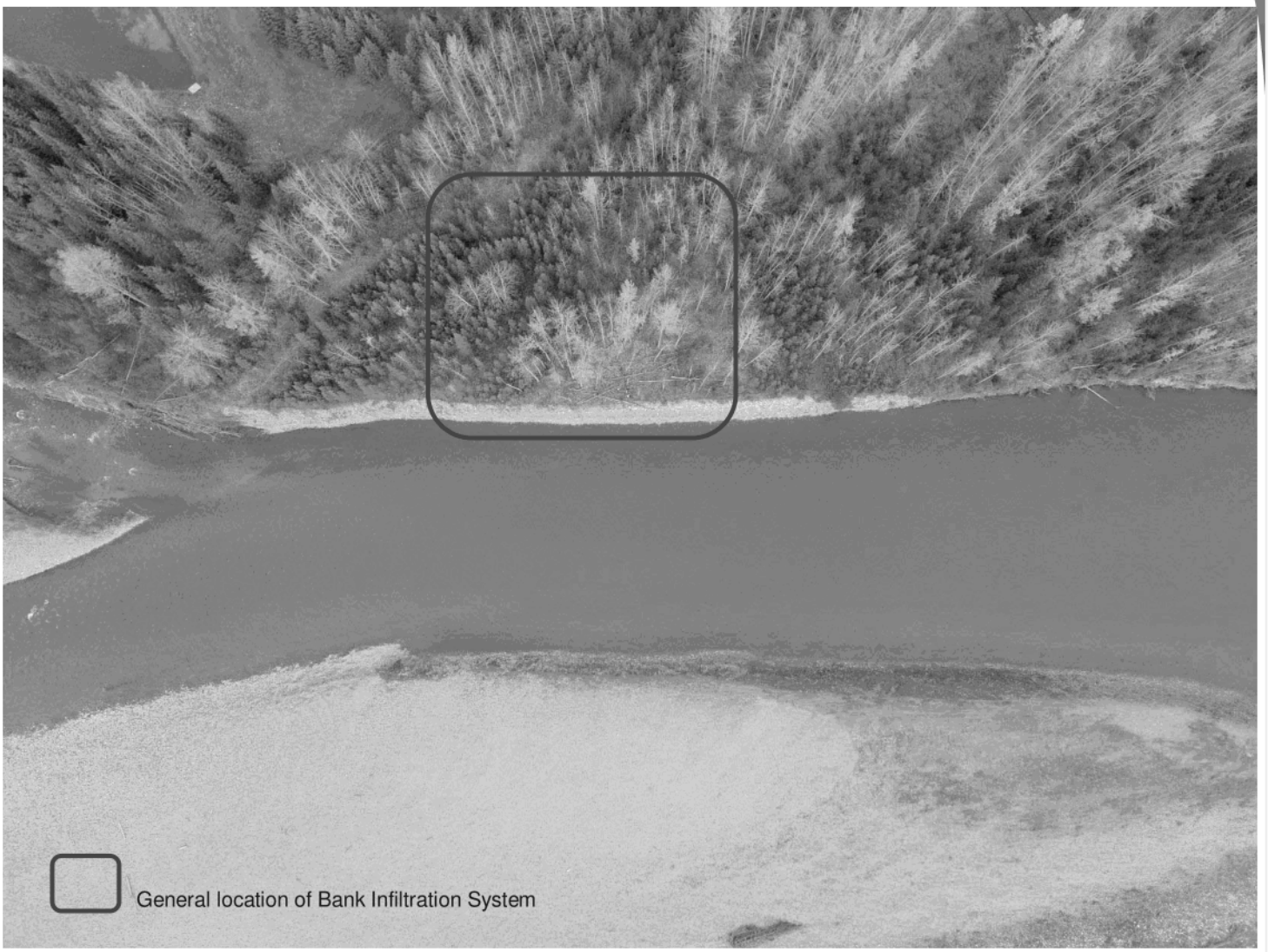


FIGURE 6– UAV OVERVIEW OF BANK INFILTRATION LOCATION

Fish species present and estimate of abundance

Eco-Web performed a literature review of the subject watercourse to gather historical data to verify potential fish species present in the Halfway River. Due to the extensive amount of data on this river, field sampling was not deemed necessary for this report. Several web-based databases were reviewed to obtain the necessary information (iMap GeoBC website[14] and the Fisheries Inventory Summary System (FISS)[15], as well as several fish and fish habitat based technical reports such as Mainstream 2012[16].

Historically, numerous fisheries inventories have been completed on the Halfway River, but the Mainstream (2012) report was selected as a main reference due to: its relatively recent data collection, fish sampling

[14] Integrated Land Management Bureau. GeoBC Gateway. iMapBC website: https://webmaps.gov.bc.ca/imfz/imf.jsp?site=imapbc accessed October 20, 2014
[15] Ministry of Environment. Fisheries Information Summary System website: http://www.env.gov.bc.ca/fish/fiss/index.html accessed October 20, 2014
[16] Mainstream Aquatics Ltd. 2012. Mainstream Aquatics Ltd. 2012. Site C Clean Energy Project – Fish and Fish Habitat Technical Data Report. Prepared for BC Hydro Site C Project, Corporate Affairs Report No. 12002F: 239 p.

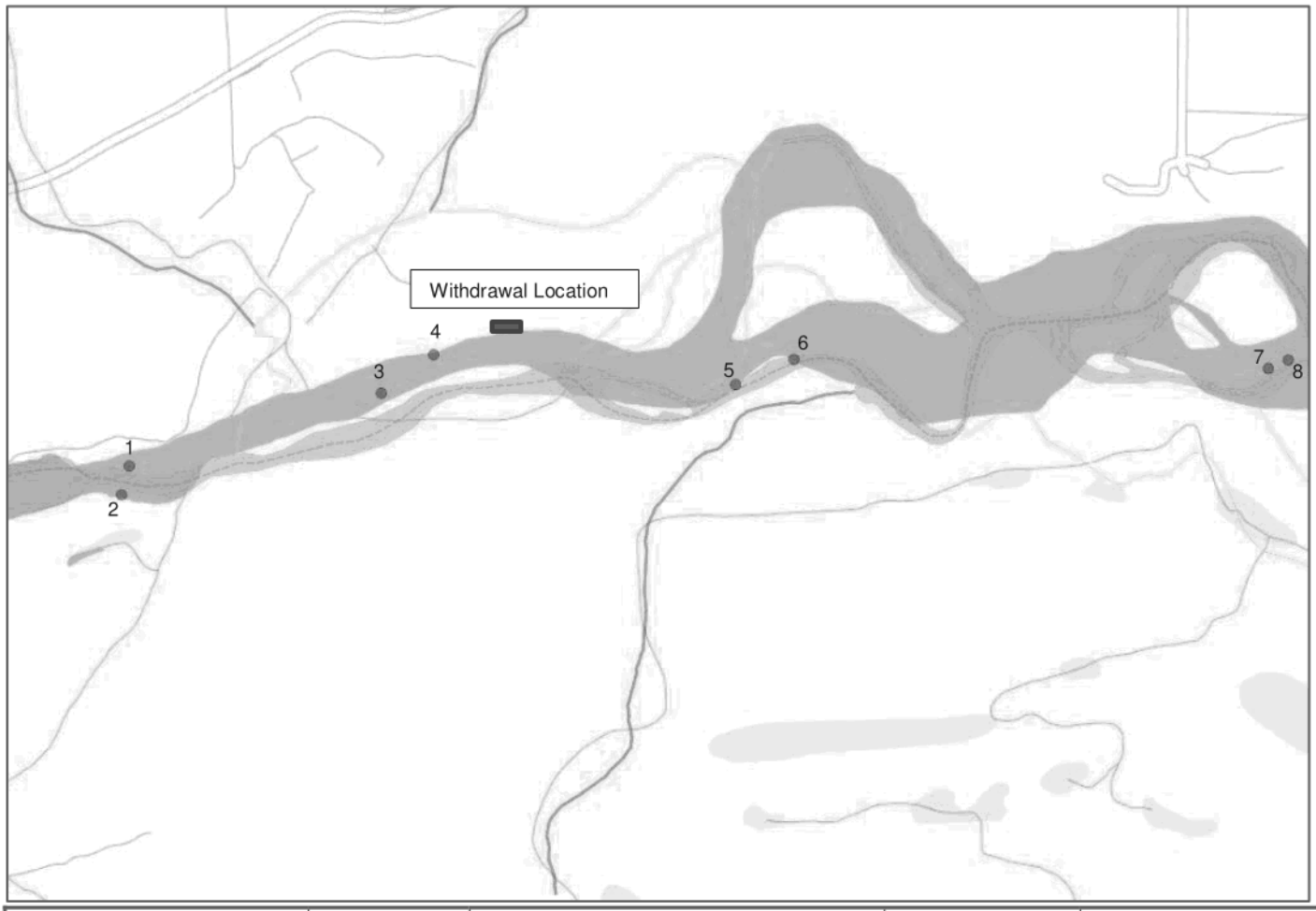
conditions on the Halfway River were favorable at the time of their assessment and a variety of sampling methods were employed. The following presents pertinent results identified by Mainstream (2012).

Mainstream reported that 8,481 fish were recorded during the fish survey on the Halfway River (Table 3). A sample consisting of 20 species, which included 8 sportfish, 2 suckers, 7 minnows, and 3 sculpin species was used to generate a breakdown of species composition. Sportfish accounted for 22.9% of the total sample. The sportfish group was dominated by mountain whitefish, which accounted for 19.5% of the total sample. Arctic grayling (1.2%), bull trout (1.2%), and rainbow trout (0.9%), also were represented. The remaining sportfish, including 1 kokanee, 6 burbot, 3 northern pike, and 1 walleye, were scarce. Suckers were the dominant group and accounted for 37.1% of the total. Longnose sucker numerically dominated with 28.7% of the total. Largescale suckers accounted for 8.3% of the total sample. Minnows were the second most numerically dominant group (35.8%) in the total sample. Longnose dace (17.9%), redside shiner (10.5%), lake chub (4.9%), and northern pikeminnow (2.4%) were numerically dominant. The remaining minnow species, flathead chub, northern redbelly dace, and trout-perch, each accounted for < 0.1% of the total sample. The sculpin group accounted for 4.2% of the total sample. Slimy sculpin numerically dominated the group (4.1%), while prickly sculpin (n = 6) and spoonhead sculpin (n = 2), were scarce.

TABLE 3 - NUMBER AND PERCENT COMPOSITION OF FISH SPECIES RECORDED IN THE HALFWAY RIVER (ADAPTED FROM MAINSTREAM 2012)

Group	Species	Number Percent	Percent
Sportfish	Arctic grayling	105	1.2
	Bull trout	102	1.2
	Burbot	6	0.1
	Kokanee	1	<0.1
	Mountain Whitefish	1,653	19.5
	Northern pike	3	<0.1
	Rainbow trout	75	0.9
	Walleye	1	<0.1
	Subtotal	*1,946*	*22.9*
Sucker	Largescale sucker	707	8.3
	Longnose sucker	2,436	28.7
	Subtotal	*3,143*	*37.1*
Minnows/Trout-perch	Flathead chub	2	<0.1
	Lake chub	419	4.9
	Longnose dace	1,514	17.9
	Northern pikeminnow	201	2.4
	Northern redbelly dace	4	<0.1
	Redside Shiner	891	10.5
	Trout-perch	3	<0.1
	Subtotal	*3,034*	*35.8*
Sculpin	Prickly sculpin	6	0.1
	Slimy sculpin	350	4.1
	Spoonhead sculpin	2	<0.1
	Subtotal	*358*	*4.2*
Totals		**8,481**	**100**

Figure 7 and the associated Table 4 below identifies more specific fish capture information within the reach of the Halfway River, 2 km upstream of the proposed intake location and 2 km downstream. The identified fish capture points in Figure 7 were obtained from a desktop review of Habitat Wizard[17], however all points identified were completed by Mainstream (2012).



Eco-Web Ecological Consulting	Eco-Web Ecological Consulting Ltd. 8211 93rd Street, Fort St. John, BC V1J 6X1 Tel. 250-787-1110	**ConocoPhillips** **Habitat Wizard Fish Capture**	Map Datum/Projection: **NAD 83** Date: **Oct 26, 2017** Drawn by: **L. Wilson**	Title: **Fish Capture Locations** Figure # **7**

FIGURE 7– FISH CAPTURE LOCATION WITHIN 2KM OF WITHDRAWAL LOCATION

[17] Habitat Wizard. Accessed at http://maps.gov.bc.ca/ess/sv/habwiz/. Accessed on October 26, 2017

TABLE 4- FISH SPECIES CAPTURED WITHIN 2 KM OF WITHDRAWAL LOCATION

Location	Fish Species	Date Captured
1	Mountain whitefish, longnose sucker, longnose dace, redside shiner, slimy sculpin	2009/08/16
2	Slimy sculpin, longnose sucker, mountain whitefish, bull trout, rainbow trout	2009/08/16
3	Mountain whitefish, lake chub, longnose dace, longnose sucker, slimy sculpin, largescale sucker	2009/08/16
4	Longnose sucker, burbot, arctic grayling, mountain whitefish, rainbow trout, slimy sculpin, bull trout	2009/08/16
5	Arctic grayling, slimy sculpin, redside shiner, longnose sucker, rainbow trout, mountain whitefish	2009/08/16
6	Longnose sucker, lake chub, redside shiner, rainbow trout, mountain whitefish, longnose dace, slimy sculpin	2009/08/16
7	Lake chub, longnose sucker	2009/08/16
8	Mountain whitefish, longnose sucker, lake chub, slimy sculpin, bull trout, longnose dace	2009/08/16

As represented in the above information the Halfway River supports a diverse fish community that includes sportfish, suckers, minnows, and sculpins. Some notable findings reported by Mainstream (2012) during their Halfway River assessment were as follows:

1. Ten species were widely distributed and were recorded throughout the Halfway River. These included arctic grayling, bull trout, mountain whitefish, rainbow trout, largescale sucker, longnose sucker, lake chub, longnose dace, redside shiner, and slimy sculpin. Five species were primarily restricted to the lower portions of the Halfway River (south of the Cameron River), including kokanee, northern pike, walleye, northern pikeminnow, and prickly sculpin. The five remaining species burbot, flathead chub, northern redbelly dace, trout-perch, and spoonhead sculpin, were scarce.

2. Age 0 bull trout, rainbow trout, and arctic grayling were scarce or absent indicating that the mainstem Halfway River is not a major spawning and/or early rearing area for these species; Halfway River tributaries likely provide these habitats.

3. Age 0 mountain whitefish were widespread and abundant.

4. Sucker and minnow species were numerically important downstream of the Cameron River confluence.

5. Adult fish of several sportfish and sucker species were recorded suggesting that the mainstem of the Halfway River supports resident large-fish (> 200 mm) populations.

6. The Halfway River watershed is a critical migratory corridor, spawning and rearing area for the Peace River bull trout population. Tributaries to the upper Halfway River system are important spawning and early rearing areas for bull trout. Movements of radio tagged bull trout into the Halfway River from the Peace River occurred as early as May and all the fish completed extensive upstream migrations in the Halfway River and a number entered the Graham River system, presumably to spawn.

Listed Species

The Halfway River supports one Red listed fish species and two blue listed fish species. The one red listed species is the spottail shiner and the blue listed species include northern pearl dace and bull trout.

Spottail shiners are red listed in BC but their occurrence in Halfway River is not that of indigenous origin. The only indigenous population of this species in BC is from Maxhamish Lake in Northern BC, but the species has been introduced (from Alberta) as a forage fish into Charlie Lake. From Charlie Lake, the spottail shiner has spread into other Peace River tributaries[18]. Only the Maxhamish Lake population is native and the other populations are not. There have only been 7 observation events of the spottial shiner in the Halfway River, all of which have occurred in the first 17 km of the river measuring upstream from the confluence at the Peace River[19], where as the proposed POD is approximately 65 km upstream from the Peace confluence. Due to their low numbers and undocumented occurrences near the POD location, spottail shiner are not anticipated to be affected by the construction of the proposed water intake system.

According to historical records (FIDQ[17]) there has only been one observation event of the blue listed northern pearl dace in the Halfway River. This occurred in 2006 approximately 27 km downstream of the proposed POD location. Northern pearl dace inhabit pools of creeks and small rivers as well as ponds and lakes. They usually occur over sand or gravel and spawning occurs during the spring[18]. Due to the low observation numbers, spring spawning behavior, and undocumented occurrences near the POD location, northern pearl dace are not anticipated to be affected by the construction of the proposed water intake system.

The other blue listed species, bull trout have been well documented and studied in the Halfway River system. Since bull trout are the most abundant of the listed fish species and will be utilizing the portion of the river at the POD location, thorough rationale and mitigation has been provided in this report.

Fall Spawning Species

CPC is proposing the dates for instream work July 15th to November 9th which falls outside the least risk window for Fall Spawners. This wide work window is necessary in order to account for the varying hydrology conditions found in the Halfway River and the most favourable period based upon close consultation with the Qualified Professionals for the project. In order to effectively work within these dates an understanding of the fall spawning fish species within the Halfway River needs to be identified. Out of the 20 fish species that occupy the Halfway River only 4 are identified as fall spawners. The list of fall spawners includes; bull trout, mountain whitefish, lake whitefish and kokanee.

Spawning tendencies and information of these above listed fall spawners is included below but the most sensitive fish identified in this list by the BC Conservation Data Center and identified as High Priority Wildlife by the BC Oil and Gas Commission is bull trout, so they will be the focal point of this discussion.

[18] FishBase. Page, L.M. and B.M. Burr 1991 A field guide to freshwater fishes of North America north of Mexico. Houghton Mifflin Company, Boston Klinkenberg, Brian. (Editor) 2017. E-Fauna BC: Electronic Atlas of the Fauna of British Columbia [efauna.bc.ca]. Lab for Advanced Spatial Analysis, Department of Geography, University of British Columbia, Vancouver. [Accessed: 15/12/2017 3:56:34 PM]

[19] BC ministry of Environment.2017. Fish Information Data Queries. Accessed at http://a100.gov.bc.ca/pub/fidq/infoSingleWaterbody.do. On Dec 2017.

BULL TROUT

The following section will identify the life history, habitat requirements and seasonal movements of the Halfway River bull trout population, in order to best be able to mitigate any potential impacts to this species based upon this project.

Bull trout are blue listed (i.e., a species of concern) in British Columbia[20]. In general, bull trout spawn between mid-August and late October but typically northern bull trout populations spawn earlier than southern populations and may be affected by annual climatic conditions[21]. Distance covered during spawning migrations and timing of migration varies and depends upon life history strategy. Resident populations tend to migrate short distances to spawning grounds, while migratory populations that utilize the Halfway river may travel up to or over 250 km[22]. Approximately 9°C appears to be the temperature threshold which bull trout begin their spawning activities, however this threshold doesn't necessarily pertain to some northern streams as the mean stream temperature in these areas sometimes do not reach 9^0 C.[23]

Timing of the spawning migration depends on a number of variables that include water temperature, habitat, genetic stock, and possibly daylight (photoperiod regulates endocrine control of these types of behaviour in other salmonids). Mature fish from fluvial populations make spawning migrations from large to smaller rivers in mid to late summer when the water temperatures are relatively high and water levels are typically declining[24]

Bull trout spawn in flowing water and show a preference for gravel and cobble sections in smaller, lower order rivers and streams. Bull trout tend to be very selective when choosing spawning locations. Spawning sites are characterized by low gradients (~1.0–1.5%); clean gravel <20 mm; water velocities of 0.03–0.80 m/s; and cover in the form of undercut banks, debris jams, pools, and overhanging vegetation.[25]

Specific to the POD location, a population of large, fluvial, migratory bull trout, known as the Peace-Halfway migratory population, resides in the Peace River and the Halfway River mainstem. Adults of this population make upstream movements to critical spawning habitat located in the upper Halfway River watershed past the POD location. Bull trout in this population appear to be phenotypically unique in that they are among the largest bull trout in the region. Peace-Halfway migratory bull trout use critical spawning habitat located in tributaries of the upper Halfway River watershed, including the upper Halfway River mainstem, Cypress Creek, the Chowade River, and Needham Creek[26]. Protection for these areas and the population is offered by the Identified Wildlife Management Strategy (IWMS) of the Forest and Range Practices Act. In 2002, under

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[20] B.C. Conservation Data Centre. 2017. Species Summary: *Salvelinus confluentus*. B.C. Ministry. of Environment. Available: http://a100.gov.bc.ca/pub/eswp/ (accessed Oct 30, 2017).
[21] Pollard, S.M. and T. Down. 2001. Bull Trout in British Columbia - A provincial perspective on status, management and protection. In Bull Trout II Conf. Proc. M.K. Brewin, A.J. Paul, and M. Monita (editors). Trout Unlimited Canada, Calgary, Alta., pp. 207-214.
[22] Burrows J., T. Euchner, and N. Baccante. 2001. Bull trout movement patterns: Halfway River and Peace River progress. In Bull Trout II Conf. Proc. M.K. Brewin, A.J. Paul, and M. Monita (editors). Trout Unlimited Canada, Calgary, Alta., pp. 153–157.
[23] Weaver, T.M. and R.G. White. 1985. Coal Creek fisheries monitoring study, No. III. Final report. Montana Coop. Fish. Res. Unit, Boseman, Mont.
[24] Pollard, S.M. and T. Down. 2001. Bull Trout in British Columbia - A provincial perspective on status, management and protection. In Bull Trout II Conf. Proc. M.K. Brewin, A.J. Paul, and M. Monita (editors). Trout Unlimited Canada, Calgary, Alta., pp. 207-214.
[25] 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. B.C. Min. Environ., Lands and Parks, Fish. Br., Victoria, B.C. Fish. Manage. Rep. No. 104.

the IWMS, bull trout Wildlife Habitat Areas (WHAs) were established to encompass critical sections of stream habitat where bull trout spawning activity is concentrated or where significant numbers of pre-spawning bull trout migrants are known to stage (Figure 8). Specifically, these WHAs are known as the Upper Halfway, Fiddes-Halfway, Upper Cypress, Middle Cypress, Chowade, and Needham bull trout WHAs.

These critical spawning areas are located over 70 km upstream of the proposed POD location. However, the bull trout of the Peace-Halfway bull trout population migrate up to 250 km from overwintering habitat in the lower Halfway River, Pine River and the Peace River mainstem as far downstream as the Clear River in Alberta[27] and these migrating bull trout will pass by the POD location. Burrows et al[22] all reported mixed fidelity to summer and fall habitat for feeding and spawning in the Halfway River; some radio-tagged bull trout had returned to locations where they had been previously located, but other fish remained in streams where they had not been previously observed. As well, resident bull trout have also been documented to reside solely in the Halfway River. This indicates that the primary concern with the water intake construction will be based around fish migrating past this location.

FIGURE 8 – BULL TROUT WILDLIFE HABITAT AREAS IN RELATION TO THE POD LOCATION

The literature review and site visit determined that the reach of the Halfway River at the POD location is not deemed critical spawning habitat, and therefore, will not be used for spawning activity by either resident or migratory bull trout. Baxter[34] states that bull trout have the most specific spawning habitat requirements of al

[27] Euchner and Mainstream 2011. Site C Clean Energy Project Fisheries Studies, 2010 Upper Halfway River Watrershed Bull Trout Spawning Survey 2011. Avialble at https://www.sitecproject.com/sites/default/files/2010-upper-halfway-river-watershed-bull-trout-spawning-survey-2011.pdf.

salmonids in BC. In fact, spawning site selection is so specific that redd superimposition is common and out of the potential 70 km of suitable spawning habitat in the Chowade River, bull trout only select and spawn within a specific 500 m stretch. Baxter[28] [35] indicates that suitable bull trout spawning habitat is comprised of areas consisting of the following: ground water upwelling, mean water depth of 45.4 cm, mean distance of 5.4 m to cover, mean velocity of 0.39 m/s, mean diameter of substrate ranging from 2-4 cm; but further concludes that the only reliable way to identify spawning sites is by finding spawning fish.

Although the POD location is not deemed as bull trout spawning habitat the proposed impact of the POD construction needs to be mitigated in response to the movements of migrating and resident fish. Appropriate mitigation techniques will need to be applied, including: adjusting construction timing to correspond with bull trout migration, segregating the worksite from the main channel to exclude fish from the work area and reducing/eliminating downstream siltation caused by construction. With this mitigation it is anticipated that the isolation of the narrow section of the Halfway River along the North bank will not affect the reproductive life cycle of the bull trout utilizing the Halfway River during the 2018 spawning season.

In order to accurately adjust the construction timing to correspond with the bull trout migration we have relied on past information collected from historical spawning research and migration monitoring. Based on bull trout telemetry monitoring[29] and previous redd counts[30] [31] [32], the Chowade River accounts for roughly two-thirds of all migratory bull trout spawning activity in the Halfway River watershed[29].

Baxter[33] [34] states that most of the bull trout that spawn in the fall will reach the upper river spawning areas by mid to late August. More specifically, immigration into the upper Chowade spawning zone begins between August 10 and 20 with peak spawning activity occurring between September 05 and 12. Spawning is typically complete by September 25, by which time bull trout have emigrated from the Chowade River to overwintering sites within the lower Halfway and Peace Rivers[34] [35] [36]. Evidence from snorkel surveys and radio telemetry data show that all mature bull trout leave the Chowade River when water temperatures drop to about 0^0C and move into the larger mainstems like the Halfway and Peace Rivers[28]. Based upon this, it would suggest that the installation of the sheet pile wall and silt curtain should occur either before mid-August or during the September 5-12th peak spawning period when bull trout are unlikely to be in the immediate area of the diversion. Likewise removal of the sheet piles has been slated for November when most non-resident bull trout have left the river (Figure 9).

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[28] Baxter and McPhail.1999. The influence of red site selection, ground water upwelling, and over winter incubation temperature on survival of bull trout (*salvelinus confluentus*) from egg to alevin. Can. J. Zool. 77

[29] B.C. Ministry of Environment, Lands and Parks). 2000. Peace-Halfway watershed bull trout telemetry data. Ministry of Environment, Lands and Parks, Fort St. John, B.C. Unpublished data files

[30] Euchner, T. 2002. Chowade River bull trout aerial and ground redd counts, distribution and density, norkel survey data summary. Prepared for Ministry of Water, Land and Air Protection, Fort St. John, B.C.

[31] Euchner, T. 2006. Chowade River bull trout population status – 2005. Prepared for Habitat Conservation Trust Fund, Victoria B.C. HCTF Project No. 7-295. 19 p.

[32] Euchner, T. 2007. Bull trout WHA effectiveness monitoring. Prepared for Ministry of Environment, Fort St. John, B.C. 10 p

[33] Baxter.1995. Chowade River bull trout studies 1995: habitat and population assessment. Report prepared for B.C. Min. Environ., Lands and Parks, Fish. Br., Fort St. John, B.C. 108 p

[34] Baxter, J. S. 1997. Aspects of the reproductive ecology of bull trout (Salvelinus confluentus) in the Chowade River, British Columbia, M.Sc. thesis, University of British Columbia, Vancouver.

During the 1996-1999 period, the BC Ministry of Environment (MOE) radio-tagged and tracked a considerable number of bull trout primarily from the upper Halfway River. AMEC[35] completed an analysis of this data and the bull trout tag detections were assessed to summarize seasonal movements within and between watersheds of the Peace River system. AMEC[35] divided the study area into two divisions: 1) Halfway River drainage (including the Graham, Chowade, and Cypress drainages); and 2) Peace River mainstem. Figure 9 below illustrates the relative proportions of bull trout that were detected in these two divisions, by month. AMEC[35] summarized the data as follows; Fish that were detected in more than one division during a given month were coded as 'moving' between divisions. During surveys conducted in July-September, the majority of bull trout detected were in the Halfway River system (overall: 193 of 273 detections; monthly percentages ranged from 63-77%). In all other months, the majority of bull trout detections were in the Peace River mainstem (overall: 488 of 734 detections; monthly percentages ranged from 56-75%). However 36% of the bull trout that were released in the Halfway River drainage did not emigrate from that river, indicating that suitable overwintering sites exist as illustrated by bull trout 1019 in Figure 11. The other 64% of bull trout that were released in the Halfway River drainage made at least one movement into the Peace River mainstem.

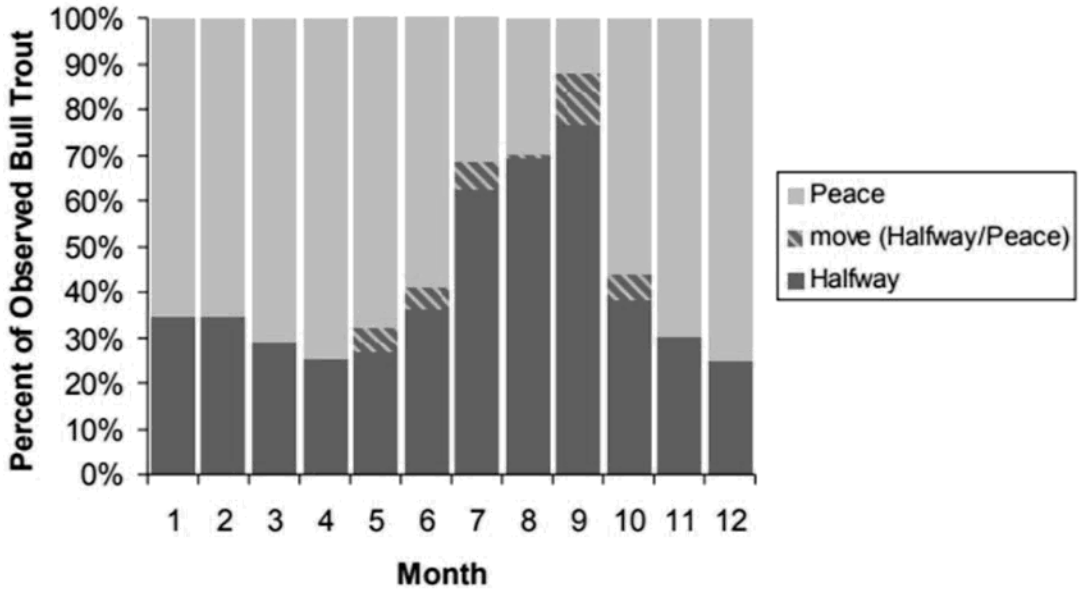

FIGURE 9 - SEASONAL DISTRIBUTION PATTERN OF BULL TROUT – ADAPTED FROM AMEC[35]

To add to the radio tracking information AMEC[36] conducted another radio telemetry study that was initiated in 2005 to expand on the previous movement on migrations of large-bodied fish in the Peace River watershed. This study included further tracking of bull trout using the Halfway River system. The updated findings provide supporting evidence that both resident and migratory bull trout occur in the Halfway River watershed. Like bull trout in the Halfway River system, Sukunka River bull trout as well as Pine River bull trout likely make long-distance migrations, although this is only based on few observations as illustrated by fish 322 in Figure 10. Information available to date indicates that Pine River bull trout migrate upstream through the Peace

[35] Amec Earth and Environmental and LGL Limited. 2010. Analysis and Assessment of the Ministry of Environment's Peace River Bull Trout and Arctic Grayling Radio Telemetry Database 1996 to 1999. 58 p.
[36] AMEC Earth & Environmental and LGL Limited (AMEC & LGL). 2009. Peace River Fisheries Investigations. Peace River and Pine River Radio Telemetry Study 2008. A report prepared for BC Hydro Environmental Resources, Vancouver, BC.

River into the Halfway River, whereas bull trout residing in the Halfway River migrate downstream through the Peace River, with some fish making extensive movements into Alberta. Movement data suggests that the migratory sector of bull trout in the Pine River may well be of fish that spawn in the headwaters of the Halfway River, which make feeding movements into the Pine River.

AMEC[36] summarized that bull trout typically made downstream movements in the spring and fall (September to March), and generally made upstream movements in the summer (May to August, especially July and August).

AMEC[35] summary of the MOE Radio tagged bull trout data from 1996-1999 showed that bull trout displacement was primarily upstream in July-August (pre-spawning) and pronouncedly downstream in September (post-spawning). The majority of bull trout detected were in the Halfway River system during the July-September period. In all other months, bull trout were more commonly detected in the Peace River mainstem, widely distributed from Hudson's Hope to the vicinity of the BC/Alberta border.

Baxter[34] states that as water levels recede after the spring freshet in July bull trout spawners begin their upstream migration and most of the spawners will reach the spawning area by mid to late August with males being the first to occupy the spawning areas and remain there longer then the females.

The following examples below indicate that bull trout captured in the Peace, Pine, and Sukunka River system incorporate the Halfway River into their life cycle.

The following is an example of a migratory bull trout's movement that was tagged and released in the Peace mainstem as summarized by AMEC[35]; *Fish 1049 was released at the Farrell Creek confluence of the Peace River in April 1997, moved downstream in the Peace mainstem and entered the Halfway River in mid-June and moved up into the Chowade River where it was detected on six occasions between 24 July and 18 August 1997, and shortly after returned to the release location where it was repeatedly detected from 3 October 1997 to 4 June 1998. The movements of this fish suggest it spawns and feeds in the Chowade River and over-winters in the Peace mainstem.*

The following is a summarized example by AMEC[36] of two migratory bull trout's movement that were tagged and released in the Pine and Sukunka River that utilized the Halfway River system. *Based on tag detections for a bull trout (Tag 273) that was initially released in the Pine River, it was concluded that this fish migrated approximately 447 km from its release location all the way to the upper Halfway River watershed in fall 2007 and then it returned to the Pine River to overwinter. In 2008, this fish was detected in the Peace River (near Wilder Creek) in May and then was subsequently detected in the Pine River in September. A similar pattern was observed for another bull trout (Tag 322; Figure 10) in 2007, which moved approximately 741 km between its release location in the upper Sukunka River and the upper Halfway River watershed and the Pine, where it remained in the lower Pine River for the rest of 2008.*

The following is a summarized example by AMEC[35] of a resident Halfway River bull trout's movements (fish 1019) that did not emigrate from the Halfway River watershed (Figure 11). *This fish was released in the Chowade River in September 1996, it then moved downstream in the Halfway River mainstem to the vicinity of the Graham River confluence and the proposed POD location where it spent more than a year, and was last detected at the mouth of the Chowade River in August 1998.*

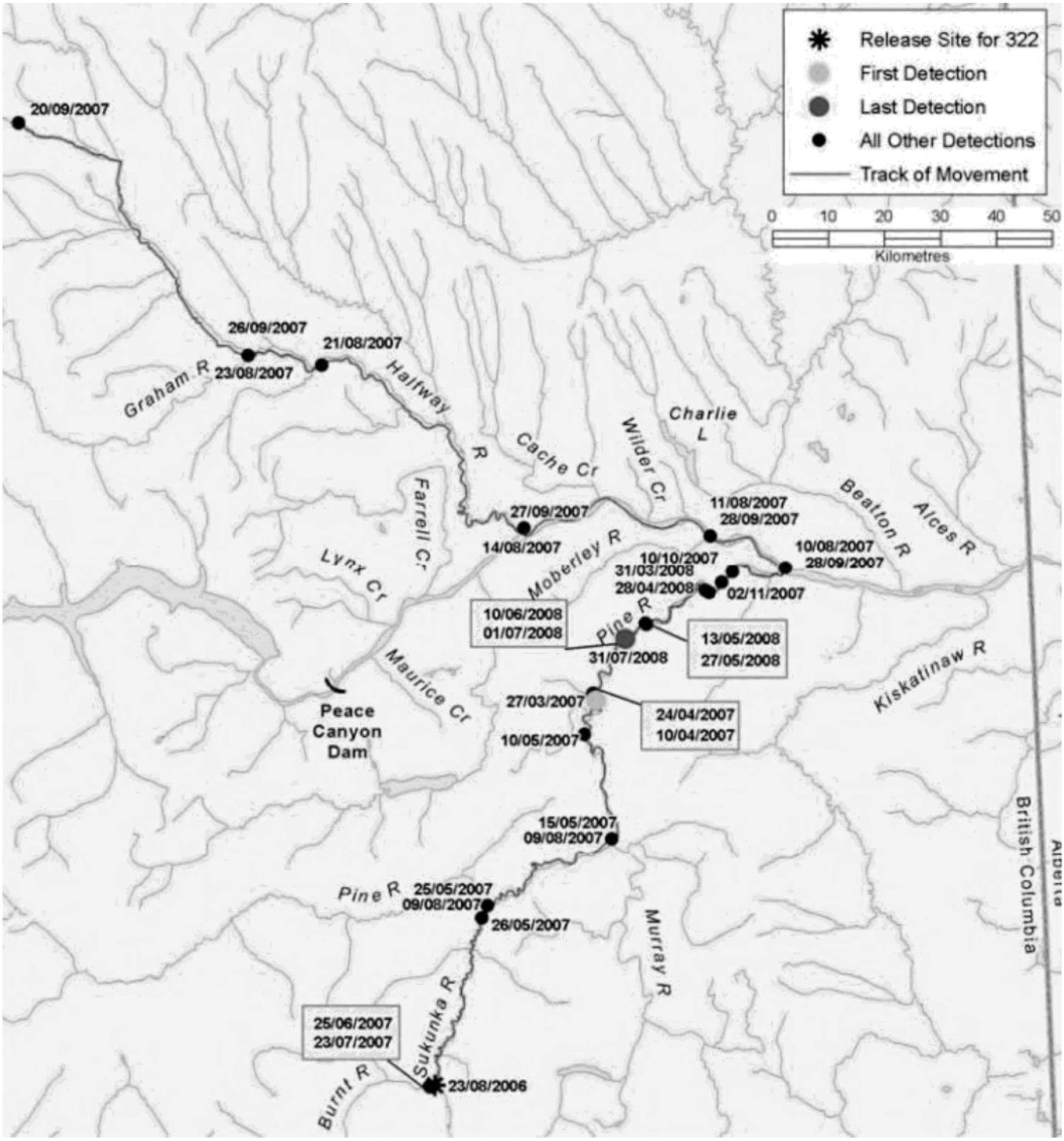

FIGURE 10 - TAGGED BULL TROUT 322 MIGRATION MOVEMENT OF 741KM - ADAPTED FROM AMEC[36]

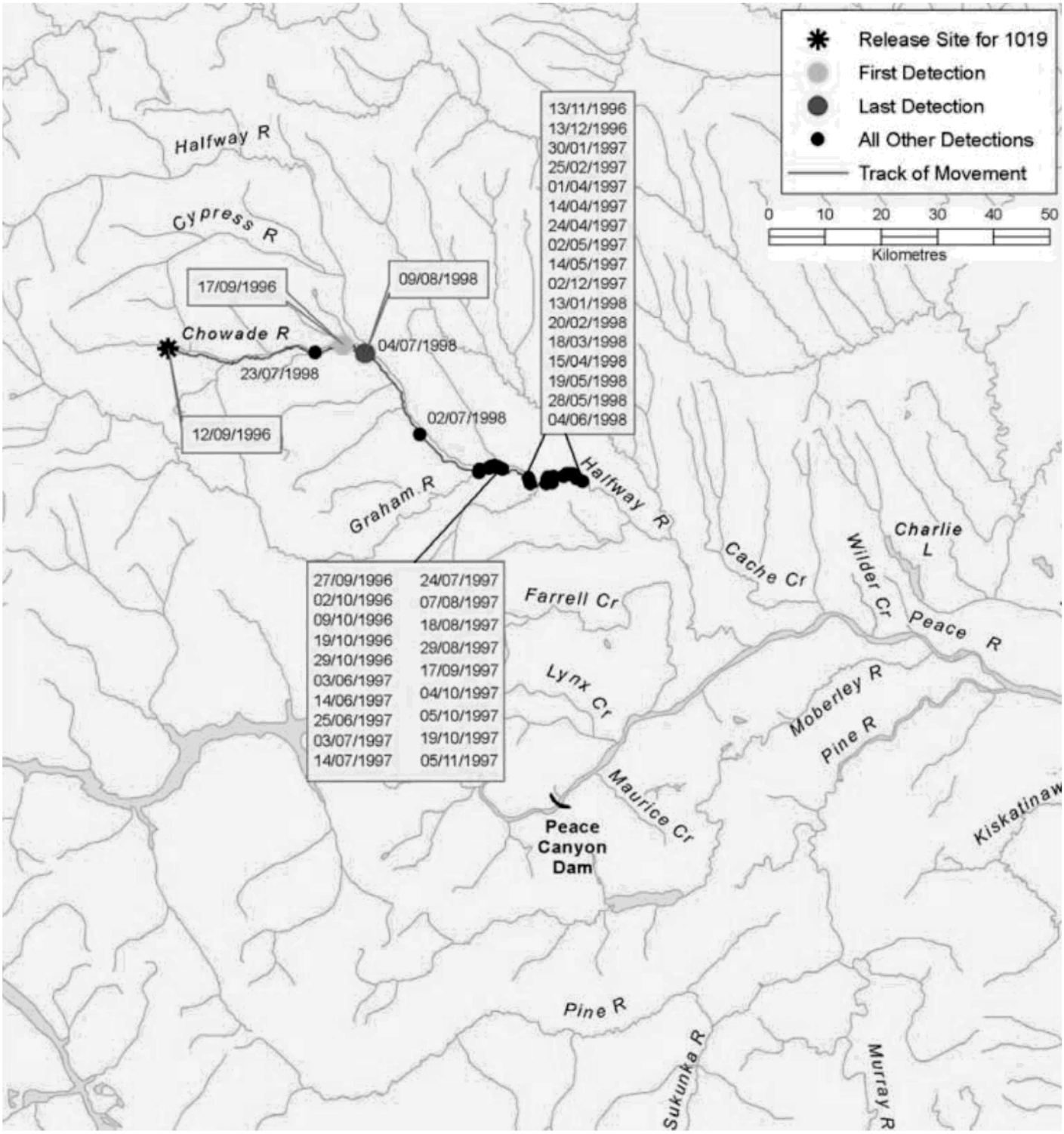

FIGURE 11 - RESIDENT HALFWAY RIVER BULL TROUT (FISH 1019) MOVEMENTS - ADAPTED FROM AMEC[35]

In summary, installation of the sheet pile wall and silt curtain should occur either before mid-August or during the September 5-12th peak spawning period when bull trout are unlikely to be in the immediate area of the diversion. Removal of the sheet pile wall, based upon anticipated construction duration should occur in early November when most non-resident bull trout have left the river.

MOUNTAIN WHITEFISH

Mountain whitefish are the most abundant fish in the Peace River and its tributaries, in both small and large fish communities[42] and are present in all major river drainages in mainland BC, except the Yukon River[40]. They have a generalist approach to egg laying, where they prefer to lay their eggs on gravel and cobble substrate on shallow lake shores, or in tributary streams, but will lay eggs over boulder and cobble substrate upstream of riffles and rapids in large rivers. The optimal temperature range for spawning is 3-5°C. The peak time of spawning is late October (Oct 21-26), which was demonstrated by noting body condition during upstream and simultaneous downstream captures during late September to early November[37]. This study also observed that there are many migrating mountain whitefish heading up the Halfway River to spawn. In 2006, Mainstream found that young of the year mountain whitefish were found in high densities only in the lower section of the Halfway River, suggesting that spawning has occurred close by. A summer survey conducted in 2008 found that there was an abundance of mountain whitefish in the Halfway River, with most of fish sampled aged 0 and 1, again the young of year suggests spawning activity[38].

Mountain whitefish are more adaptable in their environmental requirements than any other cold-water sports fish and they have maintained large populations[39]. Based upon the isolation installation timing occurring either before mid-August or between September 5 to 12 and the removal in early November, no conflicts are anticipated with mountain whitefish populations in the Halfway River. Fish will not have the opportunity to spawn within the isolated area and spawning will be complete before the isolation is removed.

LAKE WHITEFISH

Lake whitefish are a non-sport fish species which inhabit cool deep lakes as well as in large mainstem rivers[40]. They will spawn in lakes or rivers, with timing varying across range. In rivers, spawning takes place in shallow water over gravel, cobble, boulder, and sometimes sand, beginning in October[18]. Lake whitefish are scarce but found throughout the Peace River, primarily found at tributary confluences[41]. Spawning, and therefore conflict is unlikely to occur at this location as a result.

KOKANEE

Kokanee have been observed throughout the Peace River. They prefer to spawn in shallow water (<1 m) over gravel or cobble substrates. In 2008, a summary report indicated that there was kokanee sampled from the Halfway River[42]; however, in another 2008 investigation of spring and fall tributary fish use, kokanee were only found in Maurice Creek, with no evidence of them using the Halfway River37. Mainstream (2012) captured one kokanee in the Halfway River during their assessment but it was near the confluence of the Peace River not close to the POD location.

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[37] Mainstream Aquatics Ltd. 2009. Site C fisheries studies – Baseline Peace River tributaries fish use assessments in spring and fall 2008. Prepared for B.C. Hydro. Report No. 08008BF: 64 p. + Appendices

[38] Mainstream Aquatics Ltd. 2009. Site C fisheries studies – Juvenile fish use and habitat inventory of Peace River tributaries in summer 2008. Prepared for B.C. Hydro. Report No. 08008CF: 78 p. + Appendices.

[39] Alberta Environment and Parks, 2017. Mountain Whitefish (Prosopium williamsoni). [http://aep.alberta.ca/fish-wildlife/wild-species/fish/salmon-trout-related/mountain-whitefish/mountain-whitefish.aspx] Accessed Dec. 14, 2017

[40] Roberge, M., J.M.B. Hume, C.K. Minns, and T. Slaney. 2002. Life history characteristics of freshwater fishes occurring in British Columbia and the Yukon, with major emphasis on stream habitat characteristics. Can. Manuscr. Rep. Fish. Aquat. Sci. 2611: xiv + 248 p.

[41] Mainstream Aquatics Ltd. 2010. Site C fisheries studies – Peace River Fish Inventory. Prepared for BC Hydro Site C Project, Corporate Affairs Report No. 09008AF: 90 p. + plates (Volume 1) and appendices (Volume 2).

[42] Amec Earth and Environmental. 2008. Peace River Fisheries and Aquatic Resources Literature Summary. Prepared for B.C. Hydro. Report No. VE51567: 72 p.

OPERATIONAL ACTIVITIES AND TIMING DEVIATION RATIONALE

It is felt that the most disruptive activity towards fish during the construction of the river bed/bank infiltration system will be the installation and the removal of the steel sheet piling required to isolate the construction area. The sheet piling installation is estimated to take 7 days and the removal is estimated at 4 days.

Installing the sheet piling will require a shore based hoe or crane fixed with a vibrating head. The vibrating head will be used to vibrate the sheet pile into the river substrate to a specified depth. This installation procedure will result in increased underwater noise, vibration, and siltation. Mitigation measures to address these issues are featured below but here we are focusing on the timing mitigation of this activity. As such, CPC has reviewed the fall spawning species characteristics within the Halfway River and is proposing that the sheet pile installation will be complete before the end of the least risk timing window, August 15. However, if this timing is delayed due to high water levels or construction setbacks the installation of the sheet piling will be scheduled to occur at the peak of the bull trout spawning between September 05 and 12, after the bull trout have migrated upstream to their spawning areas, and sheet piling removal will commence November 1. This approach seems counterintuitive, installing during the peak of bull trout spawning, however, if we examine the bull trout's spawning regime and the other fall spawning fish as presented above we can conclude the following;

- The installation of sheet piling will occur while spawning bull trout are typically not within the reach of the river near the POD location as it is not deemed critical spawning habitat. Based on the historical data and movements of radio tagged bull trout it is evident that bull trout use the reach associated at the POD location as a migratory corridor as well as possible overwintering but not spawning.
- The critical bull trout spawning grounds are over 70 km upstream of the POD location.
- The majority of bull trout will have already passed the POD location during their upstream migration (July to August) to reach the identified spawning grounds.
- The peak spawning activity of both whitefish species is within October.
- The removal of the sheet piling is not anticipated to have the same noise or vibration levels and will occur starting November 1, when the majority of the bull trout will have already past the POD location returning to their overwintering areas and the peak of the whitefish spawning will be over.
- The Silt Curtain mitigative measure is anticipated to minimize the release of suspended silts or other materials that may be harmful to any resident or migratory fish near the POD construction area.
- The isolation area will encroach up to 10 m into the wetted width of the river (Figure 12). Based on a late summer/fall wetted width of 55-100 m, approximately 45-90 m of the wetted channel width will still be available for use by fish for migration or rearing.

Once the sheet pilling is installed and mitigated by placement of a surrounding Silt Curtain, it is felt that the standing sheet piling will have little impact on any migrating or resident bull trout or to the abundant population of mountain whitefish in the Halfway River. The lack of occurrence of lake whitefish and kokanee reported in the Halfway River allows for our mitigation measures to also protect these species spawning in the POD area. Mountain whitefish are the most abundant fish found in the Halfway River and the Peace River, making over 25% of all species captured[6]. So, while there is evidence of large numbers of mountain whitefish entering the Halfway River to spawn, there have been observed concentrations of them in spawning condition in the Peace, and as such, it is unclear the relevance of the Halfway River to the maintenance of the main Peace River population[37]. They are a generalist breeder, laying eggs over almost any substrate (gravel to boulders), with preference for gravel to cobble that is abundant in the Halfway River and not limited to the POD area. Since they are a versatile and an abundant species, the choice of timing for construction and the isolation of

the work area will result in little potential impact on the overall population of mountain whitefish with this mitigation strategy in place.

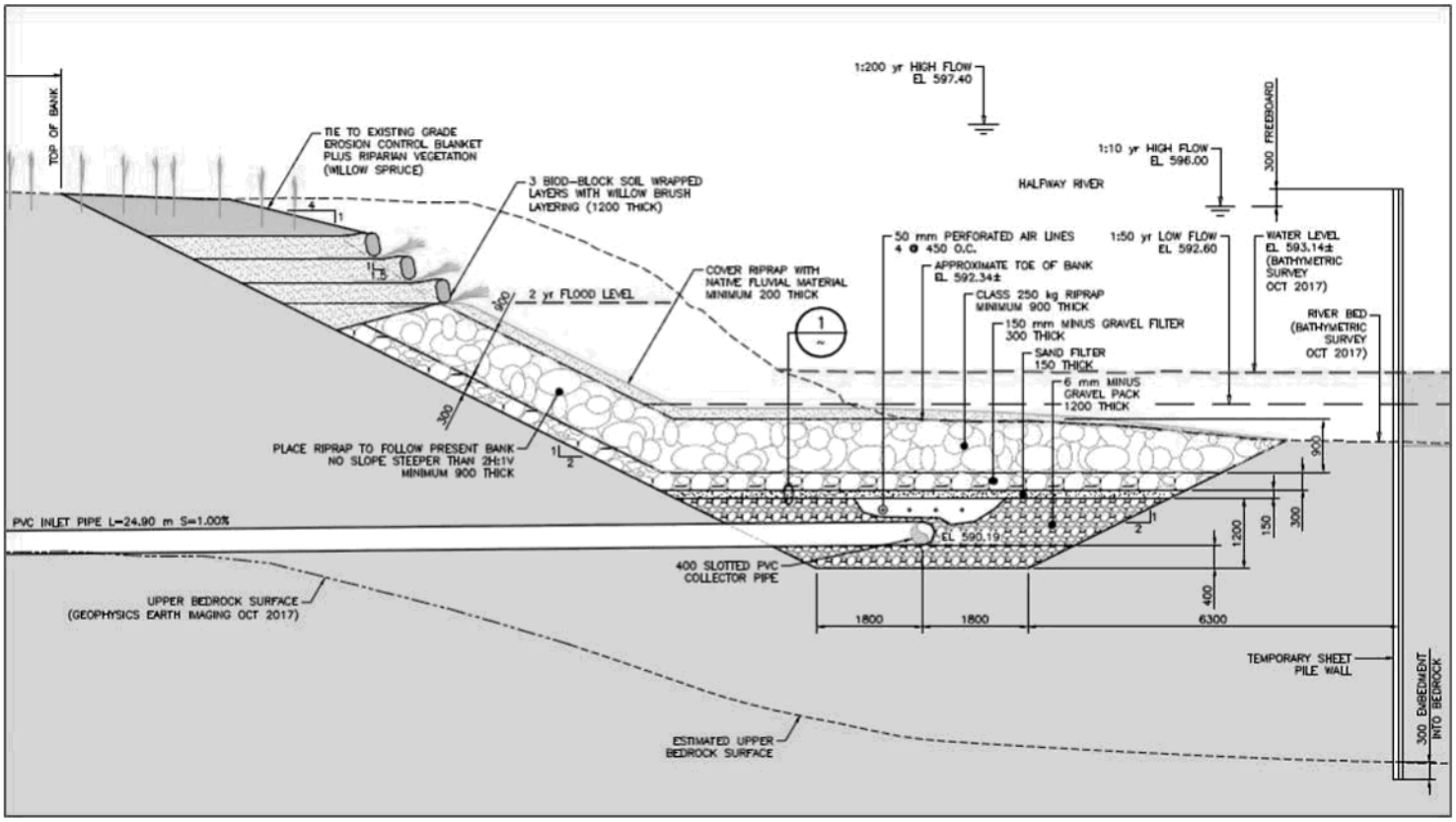

FIGURE 12- RIVER BED/BANK INFILTRATION SYSTEM DESIGN

PLANNING AND OPERATIONAL MEASURES

The potential areas of impact of the project on the watercourse are broken down as follows:

- Water intake design and effects on fish and fish habitat;
- Water withdrawal and potential water drawdown at the withdrawal site;
- Construction and installation of bed/bank infiltration system;
- Erosion and siltation/sedimentation control associated with the construction.

The following section breaks down these potential pathways and impacts into the different project phases.

The OGC expects operators to meet the objectives at the planning phase to limit environmental impacts, and apply recommended operational measures to minimize and mitigate any disturbance. Based on the Wildlife Planning and Operational Measures (POMS), species-specific operational objectives, planning and operational measures have been identified for High Priority Wildlife (HPW) as outlined in the OGC's Environmental Information Management System (EIMS)[43] .

The Halfway River holds numerous fish species, one of which is bull trout which are blue listed in BC and identified as by HPW by the OGC. As such, specific deviations regarding the least risk timing window have

[43] BC Oil and Gas Commission. 2017. Environmental Information Management System. Available at https://eims.bcogc.ca/eims. Accessed December 2017.

been identified above for bull trout and concerns regarding an increase in sediments and erosion (above natural background levels) are undesirable and need to be further addressed. Increased siltation can degrade spawning and rearing habitat, and cause direct injury to fish, by:

- infilling gravel spawning substrate;
- infilling pool and riffle habitat;
- impairing feeding ability, through increased turbidity;
- reducing food availability for juvenile fish and lowering stream productivity, through smothering of aquatic insects; and
- clogging and abrading of fish gills.

More specifically, the OGC has identified the following planning measures and objectives for activities associated with bull trout habitat;

- Maintain spawning areas and migration corridors.
- Maintain stream temperatures.
- Minimize activities within the RMA of bull trout occupied streams.
- Minimize or avoid activities that pose significant risk to bull trout occupied streams during spawning and migration periods.
- Avoid creating access or alterations to bull trout habitat.

The aquatic setting and the proposed development, including construction and operation of the water withdrawal system, have been evaluated against the potential areas of impact of the project on the watercourse and appropriate mitigation put in place to ensure the project will not compromise bull trout and other aquatic life or their habitat.

This section will identify all measures that will be applied to eliminate or reduce impacts to fish and fish habitat with a focus on bull trout. The overall design of the withdrawal system has been tailored to reduce instream impacts by designing the intakes to be embedded below the river substrate. Specific planning and operational measures that CPC has committed to throughout the project phases to achieve the POMs throughout the construction and operational phase include:

- Project Planning and Design
- Erosion and Sediment Control
- Fish Protection
- Operation of Machinery
- Shoreline/Bank re-vegetation and Stabilization
- Monitoring Plan

Construction Planning and Operational Measures

Project Planning and Design

Efforts to minimize impacts towards the environment were paramount in the project planning and design and site placement:

TIMING

- Project timing will incorporate working within the least risk timing window where applicable and working during the lower flow periods. As mentioned above the most intrusive and disruptive activity associated with this project with be the installation of the sheet piling. As such, the installation is planned to proceed within the least window, but if this cannot occur it is planned to procced during

the next best available time, suggested at September 5-12, based on fish spawning and migration patterns.
- Construction is planned during the drier season late summer/early fall to mitigate for high water levels and wet and rainy periods that may increase the potential for erosion and sedimentation.

CONSULTATION

CPC has consulted with downstream water users potentially affected by the water withdrawal as part of their Water Licence application. The Halfway River Indian Reserve No. 168 (Plan T1365 CLSR and 1494 CLSR) is immediately downstream of the river bed/bank infiltration system and the Halfway River First Nation (HRFN) was consulted as part of this process. There are no water licenses and no water licence applications on the Halfway River between the proposed POD and the Peace River. There are two parties who are considered to have WSA rights, as riparian landowners proximal to the proposed POD. These are Peaceland Farm Ltd., and the Halfway River First Nation.

- *Given the proximity of the proposed POD, immediately west of the HRFN Reserve, ConocoPhillips' has engaged extensively with HRFN on the specifics of ConocoPhillips' water acquisition plans and the details of this application.*
- *Meetings with the Lands Department staff began in the spring of 2017 and with HRFN Chief and Council in the Fall, 2017. HRFN has communicated that their primary interests include:*
  - *Ensuring that any water withdrawals do not impact the fish and aquatic resources of the Halfway River;*
  - *Ensuring that any water withdrawals do not impact the HRFN community water supply.*
- *It is ConocoPhillips' view that the water withdrawals associated with this water licence application will have no effect on fish or aquatic resources of the Halfway River, because of: the high flows of the river, and that withdrawals would be very small in relation to river flows; the implementation of strict Environmental Flow Needs considerations in the water licence; and, monitoring to verify river discharge during periods of low flow, in addition to the three operating Water Survey of Canada gauges.*
- *It is ConocoPhillips' view that the water withdrawals associated with this water licence application will have no effect on the HRFN community water supply. The HRFN community water supply consists of two shallow water wells located on a terrace slope approximately 330 m north of the active river channel. The wells intercept shallow groundwater from the large alluvial aquifer along the north side of the Halfway River, and appear to not be directly connected to the Halfway River itself. These water wells are not currently licenced under the Water Sustainability Act. HRFN has a water licence (C033693, priority date 25-Oct-1967) for two spring water sources. One of these, referred to as "School Spring", is located approximately 100m west of one of the HRFN water wells. It is our understanding that this spring is not currently used as a community water source.*[44]
- As noted above, the Halfway River First Nation, located immediately downstream of the POD, has a water licence (C033693) for two springs that arise from the alluvial aquifer located along the north side of the river. The recharge areas for these springs, however, are not hydraulically connected to the Halfway River, and water withdrawal from the Halfway River will not affect the water availability from the springs.
- The Halfway River First Nation currently uses two water wells as their community water supply. Both wells are shallow (approximately 9m deep), drilled into the alluvial aquifer on the north side of the river, and are located approximately 330 m from the Halfway River. These wells do not currently have a water licence under the WSA, but we understand that they wish to obtain a water licence. It is likely that the wells will have minimal, if any, hydraulic connectivity to the Halfway River, due to their distance from the active channel and the low rate of pumping of the wells. It is ConocoPhillips'

[44] ConocoPhillips Canada Resources Corp. 2017. Halfway River Water Management Plan. Calgary, AB 48 pgs.

view that the water withdrawals associated with this water licence application will have no effect on the HRFN community water supply wells.

SITE SELECTION

- The placement of the intake is outside of any identified spawning areas or sensitive habitat.
- The intake system has been placed along a straight stretch of the river with adequate depths. This site selection will ensure reduced erosion and bank scour as well as ensure suitable depth for water withdrawal without impacting aquatic life and environmental flow needs.
- The infiltration system has been designed entirely subsurface and within the northern bank. As such no impediments to flow or narrowing of the river will occur and there will be no visual in stream components.
- Extensive hydrometric data has been analyzed at the selected site and a Water Management Plan has been incorporated into the design as well as future monitoring of water levels during periods of low flow.
- The isolation method has been specifically designed and engineered for the selected site and historical flows of the river.
- The overall design of the water intake system and site selection has been incorporated to minimize impacts on fish and to reduce the impacts on the habitat within the reach affected by the development.

CONTAINMENT AND SPILL MANAGEMENT

- All fuel storage and refueling have been planned to occur 100 m away from the river.
- All fuel storage will incorporate secondary containment.
- All equipment will be equipped with spill kits.
- A spill response plan has been incorporated in the project and can be found in Appendix IV
- All spill response will be following the ConocoPhillips Core Emergency Response Plan.

CONSTRUCTION

The infiltration system is estimated to require a 1330 m^2 bank excavation area and the facility location is planned to disturb a 70 m X 90 m area of riparian zone along the Halfway River. The intake has been designed to occur along and within the river bank edge below the bottom substrate, such that the flow pathway is not altered. Construction activities will include replacing existing bank with angular rip-rap substrate covered with native alluvial materials. The placement of the infiltration materials will not alter the channel morphology as the intake system will be embedded within the existing bed and bank.

During construction, heavy equipment will be used to work within the isolated area. Steel sheet piling will be installed within the river as per the engineered design featured in Appendix I. This approximate 10 m x 69 m in stream isolation will ensure the 1330 m^2 bank excavation area is isolated from the remainder of the Halfway River. To the extent possible, the construction activities have been timed to minimize impacts on fish and fish eggs and measures have been designed to reduce sedimentation, reconstruct the bank to prevent erosion and ensure the equipment does not leave contaminants from spills in channel.

Changes to surface water runoff due to project disturbances can be caused by alteration of the land characteristics within the contributing catchment area. These changes have the potential to affect the quality, quantity, timing and peak flows of the baseline runoff hydrograph. By planning and constructing proper erosion and sediment controls to the design, this factor will not result in a change for this section of the river, preventing harm to fish or fish habitat.

Works adjacent to a watercourse can result in the release of fine sediments and other deleterious substances which can cause problems to fish and other aquatic organisms, so these factors must be mitigated. This can lead to reduction of the availability and quality of aquatic habitats through the in-filling of critical types of habitats such as pools, riffles and spawning habitats.[45] A reduction in water clarity and visibility can impair the ability of aquatic life to find food, mate and escape predators. This project has mitigated these potential issues with appropriate mitigation techniques, such as isolating the work area, installing a silt curtain around the isolation area, installing silt fences, project timing during the predicted drier periods, utilizing a suitable grey water area with silt catchment methodology, fish salvage and the use of fish screens during dewatering activities within the isolated area.

The mitigation measures outlined in this report during construction will ensure that the construction of the water intake system will have minimal effects on river morphology and ecology. Disturbance to the northern bank will be mitigated by following the engineered reconstructive design that will ensure bank integrity and minimize the potential for local channel bank erosion.

Erosion and Sediment Control

The Erosion and Sediment Control Plan is designed to mitigate and minimize impacts of the water intake system during construction. Erosion and sediment control measures will be maintained and monitored until all disturbed ground has been permanently stabilized, suspended sediment has resettled, and grey water as well as runoff water is flowing clear. This includes:

- Installation of effective erosion and sediment control measures around the facility site and construction area before starting work to prevent sediment from entering the water body.
- Installation of an instream silt curtain around the isolation area for containing suspended sediment and ensure that downstream siltation does not occur.
- Installation of sheet piling as per the engineered design to isolate the instream construction area.
- A suitable, vegetated, grey water disposal area will be selected. Geotextile fabric or silt socks at the end of the trench discharge hoses while dewatering grey water will be incorporated. The end of the discharge hoses will be set up in such a way as to not allow sediment laden water back into the watercourse and to control erosion of the surrounding vegetation.
- Measures for containing/berming materials such as construction spoil, salvaged plants and stream substrate etc. above the high-water mark of the river to prevent re-entry will implemented.
- The regular inspection and maintenance of erosion and sediment control measures and structures during the course of construction will be ongoing.
- Repairs to erosion and sediment control measures and structures if damage occurs.
- Turbidity monitoring will occur throughout construction to document and ensure the downstream water profile does not increase by more than 8 NTU. Total suspended solids (TSS) have the most impact on fish and fish habitat and NTU is used as a correlative measure. If the 8 NTU range cannot be consistently maintained, then the TSS will be measured to determine if the change is resulting in an impact that would affect fish (ie. TSS change > 25 mg/L);
- Monitoring of construction activities will be conducted to ensure that mitigative measures and best management practices are being applied.

[45] Ministry of Environment. 2004. Standards and Best Practices for Instream Works. Victoria, BC

Fish Protection

Creating an isolated area within the Halfway River will require special fish protection measures. A silt curtain will be deployed in the river around the perimeter of the construction area prior to the installation of the sheet piling coffer dam. This silt curtain will help trap sediment and other suspended particles from being deposited downstream during the installation of the sheet piling as well as keep any fish from entering the work area. The sheet piling will create an isolated work area within the Halfway River and allow the estimated 1330 m^2 bank excavation area to proceed without any direct impacts to fish.

All fish within the Isolated area will be salvaged by a QEP (Qualified Environmental Professional) under appropriate permitting, categorized and released downstream of the isolation. This will occur as the isolation area is being dewatered. All dewatering of the isolated area will incorporate appropriate fish screen and pump intake velocities as per DFO guidelines. Once all fish have been salvaged and the isolation area dewatered construction can occur.

The area required for isolation measures ~10m into the river leaving approximately 45m of the predicted wetted width of the Halfway River left in a natural state for fish and other aquatic life to navigate around the isolated area.

During construction grey water pumps will be used to control the water level in the isolated work area and to pump silt-ladened water into silt traps within vegetated areas to allow it to clear before re-entering the river. Refer to the Sediment Handling and Grey Water Disposal Section above.

All efforts will be made to avoid serious harm to fish and eliminate or reduce impacts to fish and fish habitat to the extent practicable. The following outlines and summarizes specific fish protection measures which include:

- All instream activities will not interfere with fish passage, reduce flows, or result in the stranding or death of fish.
- All pump intakes associated with dewatering the isolation area will prevent entrainment or impingement of fish by following the Department of Fisheries and Oceans' "Freshwater Intake End-of-Pipe Fish Screen Guideline". All intakes will have maximum mesh size of 2.54 mm and a maximum screen approach velocity of 0.038 m/s.
- All pumps will be shut down when fish screens are removed for inspection and/or cleaning.
- As mentioned above the least risk timing windows will be followed to the extent possible and proposed rationale has been suggested for working outside of the window based on fish species present and life histories.
- A qualified environmental professional will be onsite to ensure appropriate protocols are applied, and applicable permits for relocating fish are obtained and to capture any fish trapped within the isolation area and safely relocate them downstream of the isolated area. As well the QEP will be onsite during all instream work and monitoring water quality as identified below in the monitoring plan.

Operation of Machinery

Heavy equipment will be required within the isolation area to complete the construction of the river bed/bank infiltration system. As such, the following measures will be incorporated:

- All machinery that arrives on site will be inspected to ensure it is in clean condition and is maintained free of fluid leaks, invasive species and noxious weeds.
- All machinery will be limited to working within the project boundaries and all instream work will only occur within the isolated area.
- No machinery will be allowed instream until the construction area is isolated and dewatered.
- All machinery will be equipped with spill kits.

- All machinery will be washed, refueled and serviced 100m back from the river. All fuel and other materials for the machinery will be stored in such a way as to prevent any deleterious substances from entering the river.

Stream Bank Restoration

This section offers further details on the stream bank restoration measures. The anticipated overall impact bank excavation area is 1330 m^2. As such, the following stream bank restoration will be implemented to restore the bank in order to sustain high flows, reduce bank erosion, and maintain river characteristics to the greatest extent possible.

- CPC has engaged with engineers to design the stream bank restoration to ensure there is no bank movement, as the design requires the river to maintain its current flow pathway and hydrological characteristics.
- The engineers have specified suitable rock rip rap that resists erosion through a combination of stone size and weight, stone durability, and the gradation and thickness of the riprap blanket.
- As per the BC Oil and Gas Commission's "Changes in and About a Stream Applications and Operations Manual", the bank erosion protection has been designed by a professional engineer. These rip rap designs will be provided to the OGC and DFO prior to construction.
- In addition to the rip rap, bio-engineering has been incorporated into the bank reconstruction to further aid in bank stability, to provide bank vegetation and over time to provide shade, cover, and food along the edge of the river.
- The top of bank area will have all salvaged topsoil and organics replaced. A suitable seed mix (erosion control mix with a native plant cover, plus a landowner mix for the upland areas) will also be broadcast to help revegetate the area and increase overall site stability where deemed necessary.

Monitoring Plan

Monitoring will occur throughout construction with a QEP on-site for all aspects of construction.

- Monitoring will follow the guidance in Section 8 and Appendix 14.4 of the MWLAP Standards and Best Practices for Instream Works (2004). "*Construction activities should be monitored full-time during start-up and any in stream works or sensitive activity, and on a daily basis during any other construction activity to the completion of the project. The environmental monitor must be an appropriately qualified professional and will be provided with written authority to modify or halt any construction activity if it is deemed necessary to do so for the protection of fish and wildlife populations or their habitats. Within 60 days of the project's completion have the environmental monitor complete and submit at least one copy of a monitoring report consistent with the recommended standard format.*"
- During isolation activities the turbidity in the river will be monitored and not allowed to increase by more than 8 NTU. If levels increase beyond this, operations will be halted until the water clears and plans altered prior to moving forward to address any siltation issues. Since TSS has the most impact on fish and fish habitat and NTU is used as a correlative measure, as discussed above, if the 8 NTU range cannot be consistently maintained then the TSS will be measured to determine if the change is resulting in an impact that would affect fish (ie. TSS change > 25 mg/L).
- The QEP will utilize this document to ensure that all best management practices and other recommendation listed here in are upheld and followed.
- The QEP will field questions from construction staff and in consultation with CPC provide recommendations to facilitate construction activities while remaining within environmental compliance.

Operational Planning and Operational Measures

The following factors are anticipated to present potential impacts to fish and fish habitat during the operational phase of the river/bed bank infiltration system.

- While the infiltration system is in operation, a maximum of 10,000 m^3 of water per day will be drawn from this intake on the Halfway River and a maximum of 3.65 million m^3 on a yearly basis will be drawn.
- Water withdrawal during periods of low flow.
- Backflushing events to clean out the infiltration system.
- Sedimentation and runoff from the constructed area.

In some situations, large water withdrawals can impact fish and fish habitat. However, that is not anticipated to be a concern with the CPC operations, where the maximum cumulative water demand of the CPC water licence combined with all other upstream water withdrawals is approximately 1% of the mean monthly runoff during the low flow winter months and about 2% of the lowest winter flows recorded in the past 30 years. It is anticipated that the water licence issued to CPC will have a "zero withdrawal threshold" and a requirement for discharge monitoring, to ensure that Environmental Flow Needs are not affected.

In normal operation of the infiltration gallery, water gravity drains through the filter media into the slotted pipe buried below the river bed, and flows through intake pipes into a caisson set back from the river bank. Water is pumped from the caisson into the pipeline, with caisson water level monitored to ensure sufficient performance of the gravity fed flow through the gallery. A mixed air/water backflush process will initiate in the case of degraded performance, and also at regular intervals to ensure the infiltration gallery performance does not degrade over time. The infiltration gallery has two independent collection and intake lines, splitting the intake into downstream and upstream halves. The backflush sequence would shut off one of the two intake lines, and pump water from the caisson with an independent backflush pump back out the isolated intake line. During this time, a compressed air blower will discharge air through independent air lines to the area being backflushed. The mix of air and water at high velocity will fluidize the bed in order to displace the fine particles that have settled in the filter media. Since only one intake and collection line is operational during a backflush, the main pipeline pump may need to ramp down, to avoid draining the caisson too low in low water level scenarios. The Process Flow Diagram (PFD) (Appendix I, Figure 14) illustrates the water backflush modes.

It is anticipated that each half of the infiltration gallery will be backflushed for 10 minutes, approximately once a week. Water levels in the caisson will be monitored relative to river level for increased suction head required to maintain performance of the infiltration gallery which could necessitate more frequent flushing during periods of high silt deposition.

Backflushing events may introduce suspended sediments into the water column. Future monitoring of backflushing events will determine the amount of introduced sediments through water quality monitoring and CPC is committed to ensuring that backflushing events will not introduce suspended sediments above the tolerable thresholds.

Once the bank infiltration system has been constructed and bank restoration/re-vegetation is completed. It is anticipated that no subsequent sedimentation issues will occur from the project. CPC has committed to ensuring that all reclamation activities will be adequate and monitored during their monitoring program.

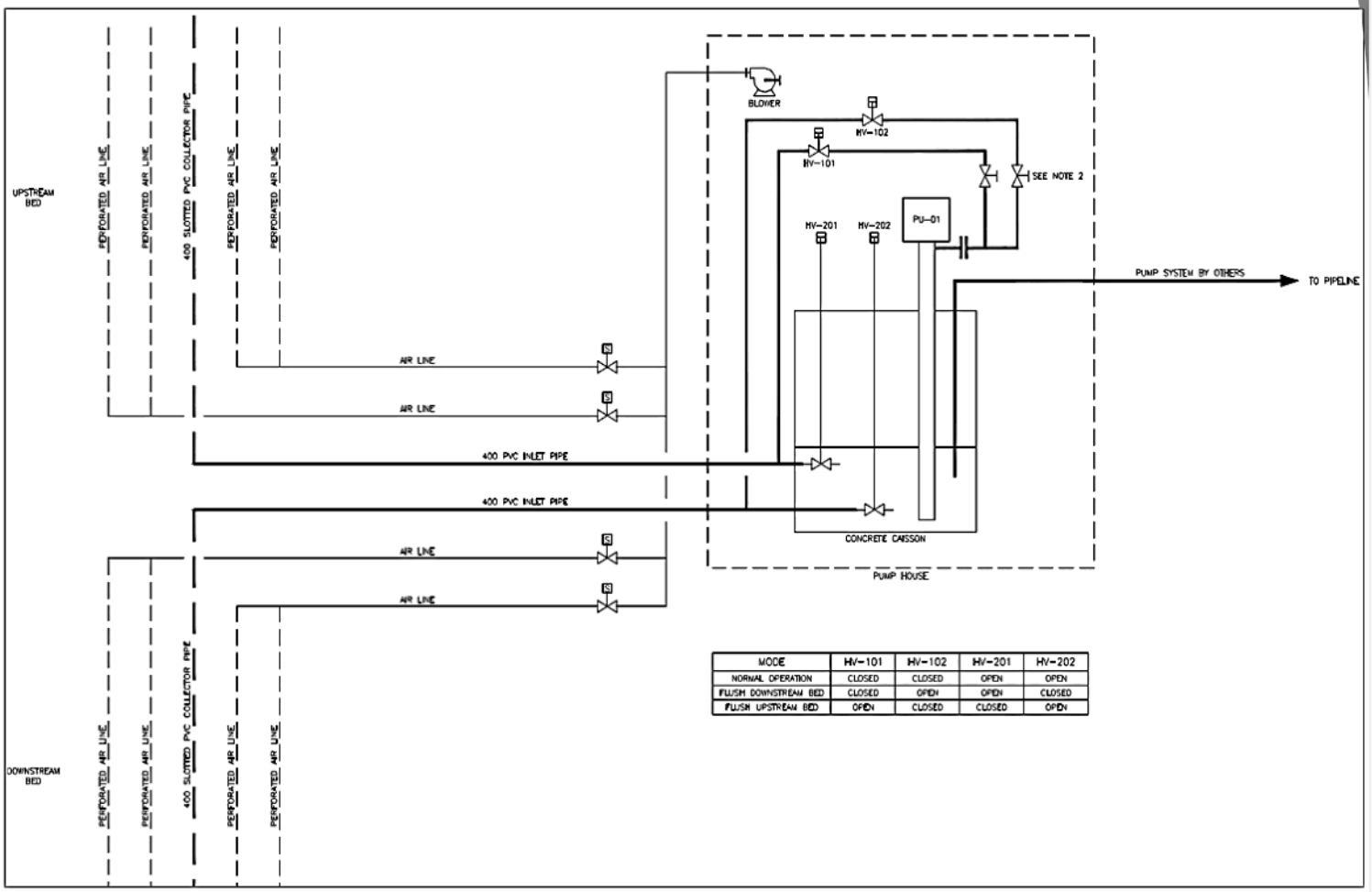

FIGURE 13 –PROCESS FLOW DIAGRAM

Project Planning and Design

This water infiltration system has been designed in such a way that no impacts towards fish or other aquatic life will be impacted during the operational phase. Once construction is completed the entire infiltration system will be underground below the river substrate. There will be no visible evidence of the intake system within the stream channel or along the river bank.

Erosion and Sediment Control

Erosion and sediment control measures will be maintained and monitored until all disturbed ground has been permanently stabilized. Once the site restoration is complete potential erosion and off-site sedimentation is estimated to be very minimal.

Fish Protection

The proposed CPC water diversion comprises 0.17% of mean annual runoff, 1% of mean winter runoff (January-March, the months of lowest runoff), and <2% of runoff in the month of lowest runoff in the 30+ years of hydrologic records. Existing water demand from the Halfway River is low, and the CPC water licence in combination with all existing water licences will produce a maximum cumulative water demand of about 1.3% of mean daily winter discharge, and <2.1% of the lowest daily winter discharge in the 30+ year

period of record[46]. Using the framework of the BC Environmental Flow Needs Policy[47], the proposed water withdrawal by CPC as assessed as "Risk Level 1", indicating there "*is sufficient natural water availability for the proposed withdrawal period and that cumulative water withdrawals are below the specified threshold that might result in an impact on environmental flows*". Based on the environmental flow needs being met, fisheries protection has been taken into consideration during withdrawal activities.

Backflushing to clean out the infiltration system has the potential to introduce suspended sediments into the Halfway River. Backflushing will be scheduled at regular intervals, approximately once a week for 10 minutes in duration. Regular backflushing of the infiltration gallery is common and does not typically create a significant sediment release. However, CPC is committing to engage a QEP to monitor the initial backflushing events to document the difference in water quality pre, during and post backflush event. If water quality sampling during a backflush event exceeds the allowable increase of 8 NTU's, CPC will look into reducing their backflushing duration or timing until tolerable limits are achieved.

Operation of Machinery

Once the initial construction is complete the operation phase will not require the use of any heavy equipment. Electric pumps will be utilized in the caisson to provide water to the water pipeline. As such no fuel storage of the case pumps are anticipated, however, if fuel is to be stored, even temporarily, it will be in double walled tanks within secondary containment berms as per the BC Fuel Guidelines[48]. Spill kits will be present as per Appendix III.

Stream Bank Restoration

Once restoration is complete the engineered design will ensure the restored bank will be able to sustain high flows, reduce bank erosion, and maintain river characteristics to the greatest extent possible. Since no equipment will be required to access the infiltration system for maintenance purposes there will be no need to re-disturb the restored banks. The bank restoration will be monitored to ensure its integrity and revegetation as identified below in the monitoring plan.

Monitoring Plan

During the operational phase the first year of monitoring will be paramount to ensure that the facility erosion and sediment control is functioning and adequate, the bank restoration is functioning and holding up to the high flows, vegetation is infilling, and coverage is adequate, no weeds are present within the construction area, and the backflushing operations are within tolerable limits.

A bank restoration assessment will be completed immediately after the spring freshet to determine if the bank integrity has held up to the high flows. If repairs are required, regulatory authorization can be applied for immediately (if required) to ensure timely repairs are completed to reduce further downstream impacts.

A follow up assessment will occur after the first growing season to ensure that no off-site erosion or sedimentation is occurring. If there is evidence of offsite siltation occurring, repairs will need to be made and supplemental erosion control measure or methods will need to be incorporated. The follow up assessment will document the vegetative regrowth and supplementary seeding, or bio engineering will be

[46] Halfway River Water Management Plan. ConocoPhillips Canada Resources Corp., 401 9th Avenue SW, Calgary Alberta, 27-November-2017

[47] BC Environmental Flow Needs Policy (BC MOE and FLNRO), February 29, 2016. http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-rights/efn_policy_mar-2016_signed.pdf

[48] Ministry of Water, Land and Air Protection. 2002. A Field Guide to Fuel Handling, Transportation & Storage. Victoria BC 46 pages.

implemented to infill bare spots or as required. As well, an inspection for weed species will be completed and a weed control program will be initiated if required.

Water flow monitoring will be conducted on a seasonal basis and at the time of this report CPC was in the process of developing a Water Management Plan. Following the Water Management Plan and limiting water withdrawal as required during periods of low flow will be a stipulation of the Water Licence.

WORKS PLAN

A Works Plan has been outlined below and will be implemented following the applicable legislation, regulations and Acts for the construction and operation of the water withdrawal system:

- OGC Environmental Protection and Management Regulation (EPMR Version 2.4)
- MFLNRO - Standards and Best Practices for Instream Works (2004)
- Water Sustainability Act – Water Licence
- DFO -*Fisheries Act*

Environmental objectives associated with the Works Plan include:

- Protecting fish and wildlife;
- Protecting fish and wildlife habitat;
- Erosion and sediment control;
- Maintaining water quality; and
- Riparian area protection and restoration

The section below outlines the plan to implement Best Management Practices and to provide Mitigative Measures and Standards to reduce the overall project impacts.

Best Management Practices

Riparian Area Operational Best Practices

This section offers further details on construction activities within the riparian area. Riparian areas occur next to the banks of streams, lakes, and wetlands and include both the area dominated by continuous high moisture content and the adjacent upland vegetation. Streamside vegetation protects water quality and provides a "green zone" of vegetation that stabilizes stream banks, regulates stream temperatures, and provides a continual source of woody debris to the stream channel. The majority of fish food organisms come from overhanging vegetation and bordering trees while leaves and twigs that fall into streams are the primary nutrient source that drives aquatic ecosystems. Riparian areas frequently contain the highest number of plant and animal species found in forests, and provide critical habitats, home ranges, and travel corridors for wildlife. Riparian areas have a direct influence on aquatic habitat, and form important transition zones between the aquatic and upland environments. Therefore special mitigative measures and best management practices are required for construction activities within riparian areas.

CPC will abide by the following Riparian Procedures and Best Management Practices:

- Disturbance will be minimized in the riparian area to the extent practicable.
- Only undertake works during favourable weather and low water conditions.
- Complete the works as quickly as possible once they are started.
- A QEP will be retained for work within the riparian area and a pre-construction meeting will be held with construction and inspection personnel.

- Sediment control will be installed and maintained throughout construction until a suitable reclaimed or vegetated bank is in place.
- Ensure fill and spoil in areas adjacent to the river are inert, free of contaminants and will be placed so that they will not gain entry into the watercourse.
- Access construction will incorporate proper ditch and culvert placement to ensure natural drainage patterns are maintained and down-gradient water movement does not result in sedimentation of adjacent watercourses.
- As much upslope vegetation as possible will be kept, when working near the river, to reduce erosion potential.
- The area to be cleared will be clearly defined and only vegetation that is necessary for construction will be removed.
- Falling and yarding will be away from, or parallel to the river to reduce the disturbance within the riparian area.
- Salvage native plants wherever possible for replanting of the disturbed area. To ensure success of the transplants, at least 80% should survive within the first year of planting.
- Re-vegetate with appropriate native seed mix or erosion control mix where required.
- Construct any ditches, water bars or water diversions within the work area so they do not directly discharge sediment-laden surface flows to the river. Divert such flows to a vegetated area where flows can slowly infiltrate.
- Erosion control measures appropriate to the environmental setting will be implemented, i.e. bioengineering through live staking, erosion control blanket/coir matting of exposed soil slopes, installation of water diversion berms with appropriate sediment control at the outlets (temporary silt fence, rip rap, weed-free straw bales, etc.).
- Place excavated material from the excavation in a stable area, well above the high-water mark, as far as possible from the channel and if it is saturated, berm it to prevent silt ladened run-off from accumulating and entering the watercourse.
- Revegetate and stabilize the site to prevent post-construction erosion.

Additional Best Management Practices

The following sections have been referenced from Ministry of Environment's "Standards and Best Practices for Instream works"[49] as deemed applicable to this Work Plan.

TEMPORARY DIVERSION CONSTRUCTION AROUND A WORKSITE

- *If pumps, pipes or conduits are used to divert water around or through the worksite:*
  - *The pumps, pipes or conduits are sized to divert the 1 in 10 year maximum daily flow for the period of construction; and*
  - *Any pump or intake withdrawing water from fish bearing waters is screened in accordance with the Fish Screening Directive of the Department of Fisheries and Oceans (Canada).*
- *If cofferdams are used to isolate successive parts of the construction at the worksite:*
  - *The cofferdams are designed by a professional engineer and constructed in accordance with that design; and*
  - *The natural channel remaining outside of the cofferdams is adequate to pass the 1 in 10 year maximum daily flow during the period of construction.*

[49] Ministry of Water, Land and Air Protection. 2004. Standards and Best Practices for Instream Works. Victoria, BC.

MONITORING

- *Construction activities should be monitored full-time during start-up and any in stream works or sensitive activity, and on a daily basis during any other construction activity to the completion of the project. The environmental monitor must be an appropriately qualified professional and will be provided with written authority to modify or halt any construction activity if it is deemed necessary to do so for the protection of fish and wildlife populations or their habitats.*
- *Within 60 days of the project's completion have the environmental monitor complete and submit at least one copy of a monitoring report consistent with the recommended standard format.*

SEDIMENT CONTROL

- *Ensure that material such as rock, riprap, or other materials placed on the banks or within the active channel or floodplain of the watercourse is inert and free of silt, overburden, debris, or other substances deleterious to aquatic life.*
- *Ensure machinery is operated from the bank of the stream and not in the stream channel (unless isolated) to minimize impacts and to better enable mitigation of sedimentation.*
- *Minimize the disturbance to existing vegetation on and adjacent to the stream banks.*
- *Install suitable sediment control measures before starting any works that may result in sediment mobilization.*
- *Remove excavated material and debris from the site or place it in a stable area above the high-water mark or active floodplain of the stream, as far as possible from the channel.*
- *Use mitigating measures to protect excavated material from eroded and reintroduced into the watercourse. Such measures include, but are not limited to, covering the material with erosion blankets or seeding and planting it with native vegetation.*

VEGETATION MANAGEMENT

- *Limit the extent of vegetation clearing done for access to your site and at your work area.*
- *Wildlife trees are important for many wildlife, bird, and amphibian species. Avoid vegetation removal or management activities that will affect trees used by all birds and other wildlife while they are breeding, nesting, roosting or rearing young.*
- *Section 34(b) of the Wildlife Act protects the nests of eagles, peregrine falcons, gyrfalcons, ospreys, herons and burrowing owls year-round. This means that a tree or other structure containing such a nest must not be felled, even outside of the breeding season. As well, under the BC Wildlife Act it is an offence to destroy an active nest with eggs or young; therefore, if conducting tree clearing/logging operations between March 1 and August 31 (a suitable breeding bird window to take into account most species), it is recommended that a qualified professional be retained to conduct a nest search prior to the commencement of vegetation removal*
- *Retain large woody debris and the stubs of large diameter trees where it is safe to do so. These are important for preserving fish habitat and wildlife populations.*
- *Fall all trees away from the channel and so that the branches do not enter the stream channel. If any branches do inadvertently end up in the channel, remove them from the site to where they will not enter the channel during high flows. Removal of limbs from the channel must be completed in a manner that will not disturb aquatic organisms.*

SITE RESTORATION

- *Grade disturbed areas to a stable angle after work is completed and revegetate these areas to prevent surface erosion and subsequent siltation of the watercourse.*
- *Protect disturbed soil areas on the banks and areas adjacent to the stream from surface erosion by installing erosion blankets and silt fencing.*
- *Re-plant the top of bank to mimic the pre-disturbance vegetation (live staking or shrub planting), to revegetate and replace impacted riparian vegetation.*
- *Restore all in-channel or active floodplain habitats that have been disturbed during the completion of works to a condition that is enhanced from their original state.*
- *No-net-loss of fish and wildlife habitat is to be incurred.*
- *Remove any remaining sediment and erosion control measures (i.e., silt fence). Ensure all equipment, supplies, and non-biodegradable materials have been removed from the site.*
- *Complete post-construction multiyear monitoring to ensure your revegetation meets full survival.*

Construction Best Practices

This section addresses the environmental protection measures that CPC will comply with during construction of the bank infiltration system.

PRE - CONSTRUCTION

- A pre-construction meeting will be held between CPC representatives, construction supervisor, contractors and environmental consultants. This meeting will be to ensure all personnel understand the scope of work and any conditions of the approval or other requirements pertinent to construction.
- The construction supervisor and contractors will be provided with copies of all relevant reports/drawings prior to work commencing.
- All necessary approvals (OGC Permits, Water Licence, DFO etc), will be in place prior to commencing any works. Copies of all required approvals will be available on-site.
- Clearly mark out workspace and areas to be cleared.
- Ensure all equipment necessary is onsite. Communicate and ensure that the grey water pumps are capable of handling silt and debris laden grey water. Ensure that spare pumps and hoses are available, fuelled up and in good working condition.
- Ensure that all equipment scheduled to work in or along the watercourse is clean, free of leaks, and in good working condition. Prevent the discharge of materials toxic to fish or other aquatic life into the watercourse.
- Ensure all materials are on site in order to complete the job, including all reclamation materials and products.
- Postpone start of construction if excessive flow or flood conditions are present or anticipated that may compromise the effectiveness or safety of the project. Resume activities when water levels have subsided or equipment and techniques suitable for the conditions are deployed.

GENERAL CONSTRUCTION MEASURES

- Construction on sloping terrain will have control measures for surface run-off, erosion and seepage. Techniques should be adapted to specific situations: slope stabilization techniques, drainage structures, erosion matting and bars, ditch wattles / bio-logs, erosion control matting, and silt fences. Siltation control measures will be installed prior to construction and inspected periodically and maintained throughout the project.
- Access to the area will be via the newly constructed access road and facility site down to the infiltration system only.
- All equipment is to be clean and in a well-maintained condition prior to arriving on-site, including ensuring all hoses and fittings are in new/good condition with no leaks. Equipment is to be inspected at the beginning

and end of each shift to ensure it is still in good condition for in-stream work. Equipment is not to be cleaned within the riparian or river area.

- Equipment will be fueled and serviced 100 m back from the river. Secondary containment measures will be incorporated where fuel is stored or generators are required. All trucks with fueling equipment will be equipped with a Spill Kit.
- Contractors will ensure that: fuel, oil, hydraulic fluid, lubricants, antifreeze and any other deleterious substances are not released onto the ground or into the watercourse. In the event of a spill the Spill Procedures section in Appendix IV will be followed.
- All garbage will be stored in animal-proof containers and all lunches and personal garbage brought into the work site on a daily basis will be brought out and disposed of appropriately to ensure that no problems with canids, bears or other wildlife arise.
- No evidence of construction operations, such as; flagging tape, lathe, signs, spray paint, etc. shall be left behind. The contractor will use biodegradable products where possible.

CLEARING

- Clear only the area necessary to access the bank and install the infiltration system.
- Fell trees away from watercourse to reduce damage to banks, riverbed, and adjacent trees.

STRIPPING

- Grub and strip up to the banks. Do not disturb within 5 m buffer until immediately prior to in stream work. Only grub and strip what is necessary to install the infiltration system.
- If necessary grade away from river to minimize the introduction of soil and organic debris into the river channel. No windrowed or fill material shall be placed in the watercourse during grading.
- Keep stripped soil within site boundaries to minimize soil loss and degradation.
- Salvage strippings from all areas to be graded or excavated. Strip and salvage the LFH and Organic horizons with the surface soil for use in reclamation. These layers contain much of the seed bank and nutrients that will help re-establish native vegetation after construction.
- Ensure soil storage piles are stored away from the river and ensure that site runoff does not cause soil stripping pile to introduce off site sedimentation. Soil storage piles may need to incorporate silt fence isolation techniques.

SEDIMENT CONTROL AND GREY WATER DISPOSAL

- Install silt fence or other sediment control devices, such as straw wattles and weed free straw bales, along areas where drainage from the work area may enter the watercourse or other off site areas.
- A suitable, vegetated, grey water disposal area for any dewatering activities will be identified before construction commences.
- Grey water pumps will be used to control the water level in the isolated work area and to pump silt ladened water into suitable silt traps within vegetated areas to allow it to clear before re-entering the river.
- Geotextile fabric or silt socks at the end of the discharge hoses while dewatering the grey water will be utilized. The grey water disposal area will be constantly monitored to ensure that the end of the discharge hoses are set up in such a way as to not allow sediment laden water back into the river, ensure that it is not being overloaded with grey water, no scouring or erosion is occurring, and no excessive ponding is occurring.
- Ensure that the end of the discharge hoses is set up in such a way as to not allow sediment laden water back into the watercourse and to control erosion of the surrounding vegetation.

SILT CURTAIN INSTALLATION

- Personnel will check the flow and assess velocity levels prior to proceeding with Silt Curtain installation.

- The Silt Curtain will be installed with anchors prior to the sheet pile installation, then, if deemed necessary connected to the sheet pile coffer dam wall for the duration of construction.
- Install silt curtain as per manufacturer's recommendation.
- Ensure silt curtain is adequately installed around the isolation area.
- Ensure silt curtain remains functional during the stream isolation period.
- Boats to be used for installation will be launched from a local boat launch close to the project area.
- Boats will be equipped with spill kits and all fueling will be done out of the water.
- Silt Curtain removal will occur after the sheet pile wall has been removed.

SHEET PILE INSTALLATION

- Personnel will check the flow and assess velocity levels prior to proceeding with these steps. This will ensure the appropriate equipment will be onsite to handle the task when activities commence.
- All sheet piling installation will be achieved by equipment working from the stream bank above the water level. No machinery will be allowed instream during sheet pile installation.
- Sheet piling will be installed around the work area completely isolating the anticipated 1330 m^2 bank excavation area from the river.
- The sheet piling will be designed to accommodate any expected high flows of the river during the construction period.
- Megabags or suitable alternate temporary diversion measures may need to be placed on the upstream side to divert/dissipate some of the rivers water flow for successful installation of the sheet pile. These bags must be clean and filled with washed gravel. Bags are to be lowered into place with the aid of a crane or other equipment with suitable reach ensuring not to drag the bags along the river substrate. All placement of the diversion structures must be done from above the high water mark.
- Selected sheet piles will have hold back eyelets welded on the outside of the sheet piling to use with the installation of a silt curtain.
- Sheet piling will be installed by way of a crane or a long reach excavator fixed with a vibrating head that will allow the sheet pile to be vibrated into the river bottom to the required depth.
- Sheet pile installation will proceed once the silt curtain is in place to minimize downstream siltation. Additionally, turbidity monitoring will be conducted downstream of the work site (immediately downstream, 50 m downstream, 100 m downstream and further as required) and if the turbidity increases by more than an acceptable level (ie. 8 NTU increase, based upon clear waters[50]), operations will be shut down until the river clears up.

DE-WATERING ISOLATED AREA

- Suitable pumps will be utilised to dewater the isolated area. Select a pump screen with a maximum mesh size of 2.54 mm and a maximum screen approach velocity of 0.038 m/s (CAPP et al, 2005), and in accordance with the Department of Fisheries and Oceans' "Freshwater Intake End-of-Pipe Fish Screen Guideline"[51].
- During de-watering all clean water (ie. increase <8 NTU from background) will be pumped back into the river through a suitable dissipater to ensure that no scouring our increased sedimentation occurs within the river
- Water that is too turbid will be dispersed through a suitable grey water disposal area as described above.
- As the water level recedes QEPs will collect trapped fish through methods approved within the Scientific Fish Collection Salvage Permit. Salvaged fish will be placed downstream of the isolation area back into the Halfway River.

[50] Ministry of Environment. 2001. Ambient Water Quality Guidelines (Criteria) for Turbidity, Suspended and Benthic Sediments. Accessed online January 17, 2018 at: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/wqgs-wqos/approved-wqgs/turbitity-or.pdf

[51] Department of Fisheries and Oceans. 1995. Freshwater Intake End-of-Pipe Fish Screen Guideline. Ottawa, Ontario 28 pages.

- It is anticipated that the sheet piling will not achieve 100% water isolation. As such, clean water pumps will be situated in such a way to control water that is infiltrating through the sheet pile isolation and if the water is deemed clean (ie. increase <8 NTU from background) it will be pumped back into the river.
- Once the isolated area is free of water and all fish have been removed, construction can proceed.

INTAKE SYSTEM INSTALLATION

- Construction is to proceed as quickly as possibly once started.
- Light towers should be onsite and 24 hour pump watch must be initiated if grey water pumps need to be pumping to keep up to water seepage. Water that is clean (<8 NTU increase from background) may be pumped directly back into the river. Water above this threshold will be considered grey water and will be pumped into the grey water disposal area, or allowed to settle in a temporary settling pit prior to re-entering the river.
- Salvage and store riparian topsoil and organics separately from other stripping's.
- Salvage and store all river cobble and gravels separately for use in final reclamation.
- Stockpile all spoil inward of the river banks. Construct berms to prevent saturated spoil from flowing back into watercourse.
- Install the infiltration system as per the engineered design located in Appendix I. The following summary is provided below;
    - Install the two slotted 400mm PVC pipe within and along the approximately 55 m section of northern river bank of the Halfway River.
    - Install the 92 m^3 caisson and pumping facility
    - Install the two 25 m long underground 400mm PVC pipes to the caisson
- When backfilling the infiltration system, push any water in the excavation towards the trench pump for pump off to the grey water area. Do not backfill faster than the pump can control the water in the isolated area.

BANK RESTORATION

- Restore bed and banks to pre-disturbance profile where disturbed during the water intake installation as per engineered drawings. Ensure that there is no realignment of the watercourse or changes to its hydraulic characteristics.
- Install rip rap as per the engineered construction plans and incorporate specific bio-engineering as identified in Appendix I (Figure 12);
    - The engineered design features riprap covered by native material up to the 1.5 to 2.0 year flood level and bio-engineering techniques along the bank edge and riparian areas to increase bank stability and to provide overhanging cover to the river edge as a fish habitat compensation measure.
    - The coarse rip rap will be covered with native fluvial material (<20 cm).
    - The toe of the reconstructed bank with blend in seamlessly to the native channel bottom.
    - Three 65m long BioD-Block robust soil wrap layers will be incorporated into the rip rap scheme.
    - Three willow brush layers supplementing the Bio-D Blocks will incorporated with locally sourced willows from the adjacent land
    - The top of bank above the BioD-Blocks will be gently graded bank at a 4 :1 ratio to match the existing topography
    - Re-plant the top of bank to mimic the pre-disturbance vegetation
    - Installing coir/coconut mat erosion control blankets on top of bank across the disturbed area.
- BioD- Block description – The BioD-Block system is an excellent tool to construct vegetated soil-lifts for slope stabilization, streambank and shoreline restoration (Figure 14). They are made entirely from biodegradable materials, these blocks work to stabilize a location until vegetation is able to take root. BioD-Block is a coir fiber block system consisting of a densely-packed mattress coir fiber block attached to a bristle coir woven fabric (BioD-Mat® 70 erosion control blanket). The fabric is connected to the coir block on three sides leaving the other side open to fill with dirt. Each coir block has a female and a male end. These male and female ends

in BioD-Block create a strong connection between blocks and avoid failures through the connections. The tightly-packed coir blocks provide a strong face to the soil layers while protecting the dirt behind the blocks.

- Water diversion berms will be integrated into the top of the bank to divert any drainage from the water intake facility site from entering the river
- Replace salvaged soil and organics on top of bank to promote vegetative cover and help protect banks from erosion.
- If deemed necessary, the river banks will be seeded with an erosion control mix (fescue) and a native cover crop at high seeding rates of 50 kg/ha.
- As required until vegetation becomes established, silt fence will be properly installed above the river banks to filter any runoff water before entering the river channel. This will be completed when all aspects of the project are complete and removed within one growing season once vegetation has been established.

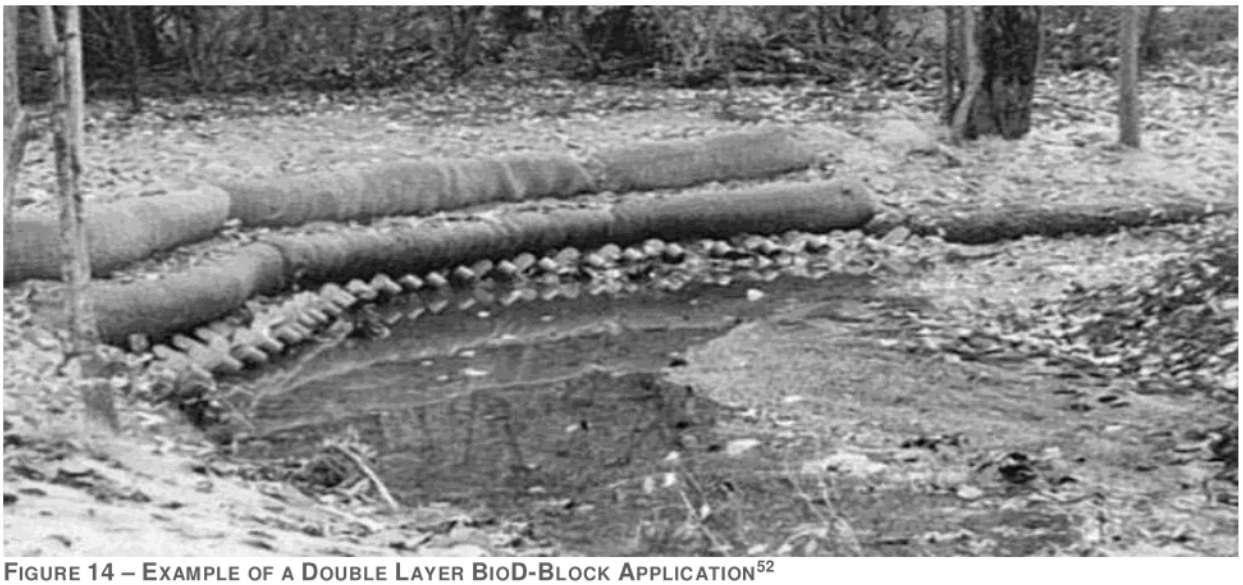

FIGURE 14 – EXAMPLE OF A DOUBLE LAYER BIOD-BLOCK APPLICATION[52]

REMOVAL OF STREAM ISOLATION

- Once the stream bank has been restored to a satisfactory state as deemed by the onsite QEP (where further activities will not impact the river or water quality), the sheet piling will be removed.
- Crews will ensure that no other work is required within the isolation area prior to removing the sheet piling.
- All unwanted materials such as lath, flagging, hoses, tools etc. will be removed from the isolated construction area.
- Once removal starts crews will work in a timely manner to remove the sheet piling.
- Sheet pile removal will proceed with the silt curtain in place if possible, to minimize downstream siltation. This will require to ensure the silt curtain is adequately connected to the river anchors prior freeing it from the sheet pile wall. Additionally, turbidity monitoring will be conducted downstream of the work site (immediately downstream, 50 m downstream, 100 m downstream and further as required) and if the turbidity increases by more than an acceptable level (ie. 8 NTU increase, based upon clear waters[53]), operations will be shut down until the river clears up.
- All sheet piling removal will be achieved by working from the stream bank above the water level. Once the isolation is breached no machinery will be allowed instream.

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[52] RoLanka International Inc. 2018. Web Page Advertisement available at https://rolanka.com/biod-block/. Accessed January 2018.

[53] Ministry of Environment. 2001. Ambient Water Quality Guidelines (Criteria) for Turbidity, Suspended and Benthic Sediments. Accessed online January 17, 2018 at: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/wqgs-wqos/approved-wqgs/turbitity-or.pdf

- All megabags or alternate temporary diversion measures must be removed from the river. Bags are to be removed by lifting straight up and not dragged along the river substrate.

RIPARIAN RESTORATION

- All salvaged topsoil and organics will be replaced within the riparian area.
- Re-plant the top of bank to mimic the pre-disturbance vegetation (live staking or shrub planting).
- Incorporate roll back and course woody debris where applicable.
- Where deemed necessary, areas will be seeded with a suitable seed mix, (ie. An erosion control mix and native cover on the river banks and a seed mix approved by the private land owner on the upper banks).
- As required, silt fence will be properly installed where required within the riparian area to filter any runoff water before entering the river channel. This will be completed when all aspects of the project are complete and removed within one growing season once vegetation has been established

POST CONSTRUCTION

- Conduct an inspection during high water flow in the following season to ensure that there is no erosion or other issues.
- Monitor the work area for weeds and ensure a weed control program is in place until planted vegetation can successfully establish in the work areas.
- Ensure siltation control measures remain functional and the site is not resulting in any siltation issues within the river.

CLOSURE

CPC is proposing to construct and operate a water withdrawal operation by way of an embedded river bed/bank infiltration system along the Halfway River in northeastern British Columbia. CPC intends to utilize this water for their oil and gas drilling and completions activities in the area. The project design and methods of construction have addressed the identified potential impacts. The main areas of concern associated with this project is the installing the sheet piling for the isolation of the work area, construction proceeding outside of the least risk window, and compromising the northern banks and riparian area of the river. These components may have impacts related to increased sediment loading, stream bank migration, impacting fish behavior during construction activities and water withdrawal impacting water levels in the river. Given the above concerns, mitigation measures for those concerns have been incorporated into the design and monitoring by a Qualified Professional will ensure the mitigation measures are being followed and are effective. By designing the water withdrawal operations with environmental impacts in mind, CPC has sought to reduce, to the extent practicable the environmental impact of the proposed development, and as a result no serious harm to fish will occur. This report has provided best management practices and mitigation measures to ensure these activities and the associated water withdrawal system meet this objective.

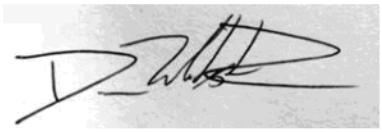
Sincerely,

ECO-WEB ECOLOGICAL CONSULTING

Prepared by:

Landon Wilson RBT.
Registered Biology Technologist

Reviewed by:



Dan Webster, B.Sc., P.Ag., R.P.Bio., P.Biol.
Professional Biologist

DISCLAIMER

This report was prepared by Eco-Web Ecological Consulting Ltd. (Eco-Web) for ConocoPhillips Canada Resources Corp. (CPC). The material contained in this report reflects Eco-Web's best judgment in light of the information available at the time of preparation. The information collected for the purposes of this report was interpreted solely for the purposes stated and reflects the available data at the time of creation. Any information provided by a third party was assumed to be accurate.

Although the information was obtained at specific locations, the reported information contained herein is believed to provide a reasonable representation of the general environmental conditions at the site. The findings outlined herein, however, do not preclude the existence of additional habitat features in areas of the site not specifically investigated.

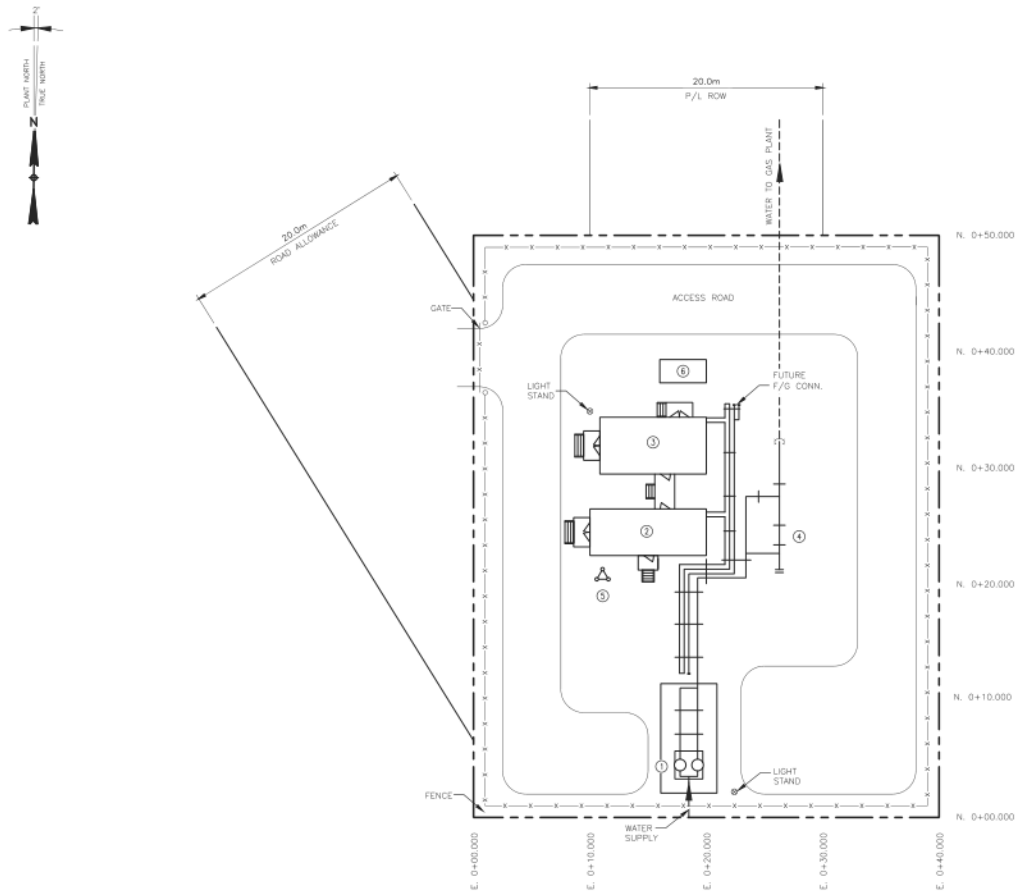
Eco-Web has exercised due diligence and care in preparing this report, but makes no guarantees or warranties as to the accuracies or completeness of neither the information, nor the acceptance and implementation of such recommendations during the Project's construction, reclamation, operation, and decommissioning.

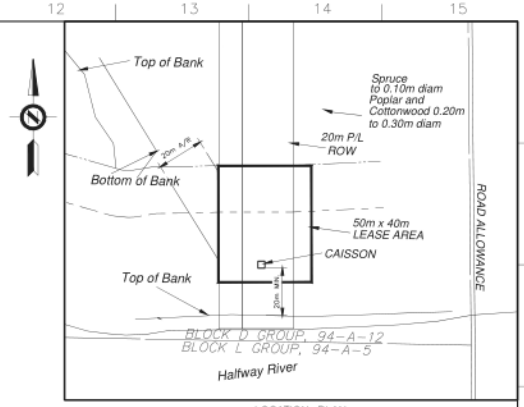
Eco-Web does not accept any responsibility if the following report is used for any purpose other than outlined and is also not responsible if a third party group chooses to use whole or part of the following information for alternative uses. Please contact Eco-Web for any replication, copying, recording or duplication by any other means prior to use.

This report has been prepared for CPC's Water Licence and Land Act Applications to the BC Oil and Gas Commission (BCOGC) and is solely based on the information either publically available, provided to Eco-Web or gathered during the field investigation. The BCOGC can use the information and recommendations contained within this report for the purpose of determining whether CPC's Project meets all applicable regulatory requirements. Any use, reliance on, or decision made by any person other than Eco-Web's client, based on this report is the sole responsibility of that person. This report has been prepared based upon current regulations and regulatory guidance, directives and policies. If the applicable standards change, or if site conditions change and/or additional information become available from feedback, report modifications may be required.

It is also assumed that due diligence with respect to compliance with all pertinent operational guidelines relative to protection of the fish resources by the BCOGC, Ministry of Forests, Lands and Natural Resource Development, Environment Canada and the DFO will be exercised and complied with.

APPENDIX I –ENGINEERED DRAWINGS





LOCATION PLAN
SCALE 1:1000

EQUIPMENT LIST		
ITEM	TAG NUMBER	DESCRIPTION
1	–	CAISSON (2.4m X 2.4m)
2	9-BU-1000	INSTRUMENT AIR/MCC BUILDING
3	9-BU-1300	GENSET BUILDING
4	–	RISER AREA
5	–	COMM. TOWER
6	9-BU-1360	EMERGENCY BACK-UP GENERATOR

NOTES:
1. GRID SPACING = 10m INTERVALS

REFERENCE DRAWINGS

DWG No.	TITLE

PROJECT VERSION (Clear cell info prior to returning to CPC)

VER.	DATE	BY	CHK'D DFTG	CHK'D ENG	APP'D PM	VERSION ISSUE

REVISIONS

REV.	DATE	BY	CHK'D DFTG	CHK'D ENG	APP'D PM	REVISION ISSUE
A	2017-11-06	JDL		RB	WM	ISSUED FOR REVIEW (CPC-108 BY EPFC)
B	2018-01-10	JDL				RE-ISSUED FOR REVIEW (CPC-108 BY CPFC)
C	2018-01-11	JDL	GK	RB	WM	ISSUED FOR OGC APPROVAL (CPC-108 BY EPFC)
D	2018-01-15	MQS	GK	RB	WM	ISSUED FOR OGC APPROVAL (CPC-108 BY EPFC)

ENGINEERING SEAL

PREPARED BY
EPFC
PERMIT

ConocoPhillips Canada

BLUEBERRY FIELD

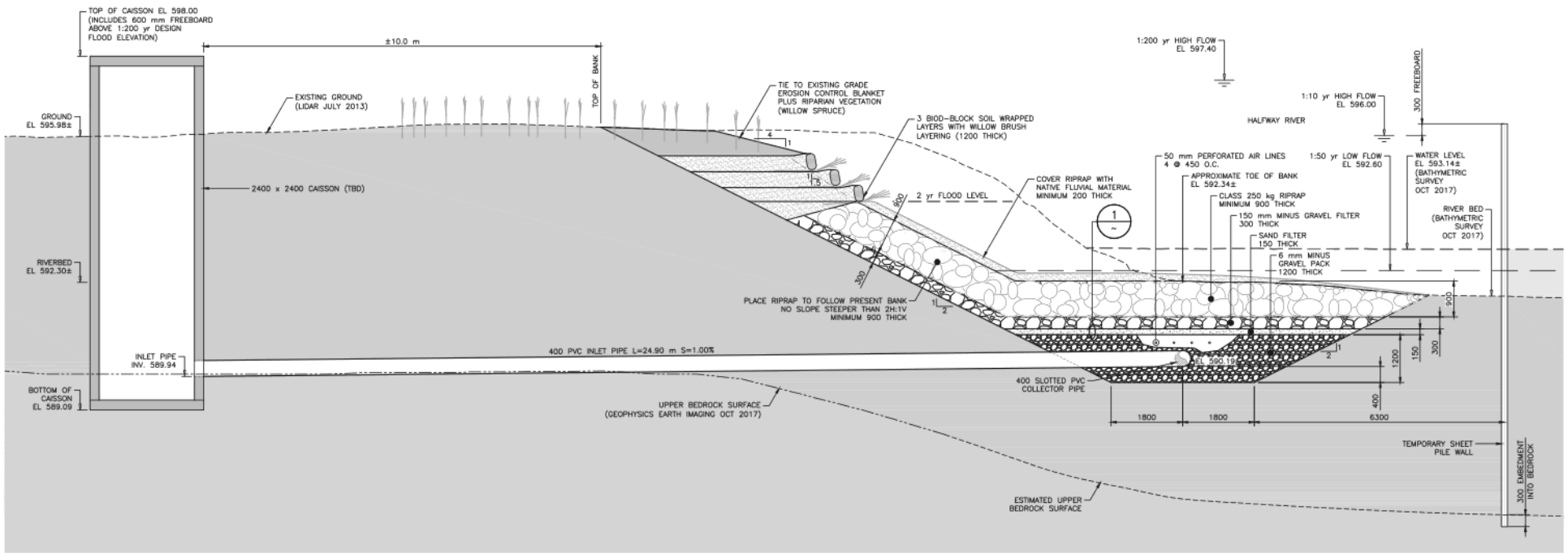
BLUEBERRY FIELD DEVELOPMENT
A-9-D/94-A-12 FRESH WATER BOOSTER STATION
PLOT PLAN

LEGACY DWG NO.:	SCALE: 1:200	CPC DWG. NO.: BLU-PI-PPL-0003	REV.: D
ENG. CO. PROJ. NO.: CPC-108	DATE: 2017/10/11		

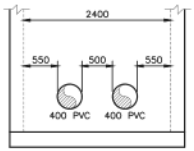
PLOTTED: Wednesday, October 11, 2017 3:43:21 PM

NOTES

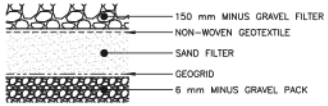
1. ALL COORDINATES SHOWN ARE UTM ZONE 10 NAD 83 DATUM COORDINATES.
2. ALL STATIONS, ELEVATIONS AND COORDINATES ARE IN METRES AND DECIMALS, AND ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.



A FIG-001 SECTION 1:50



DETAIL – CAISSON PIPE PENETRATIONS
NTS



1 ~ SAND FILTER
NTS

REFERENCE DRAWINGS		REVISIONS						
NUMBER	TITLE	NO.	ISSUE	DATE	BY	CHK'D	ENG	APP'D
-	-	A	ISSUED FOR APPROVAL	2018.JAN.16	KS	BR		RM

0 2.5 5 Meters

ConocoPhillips Canada

DL 1300 / 94-A-51

HALFWAY RIVER WATER INTAKE
INFILTRATION GALLERY
SECTION

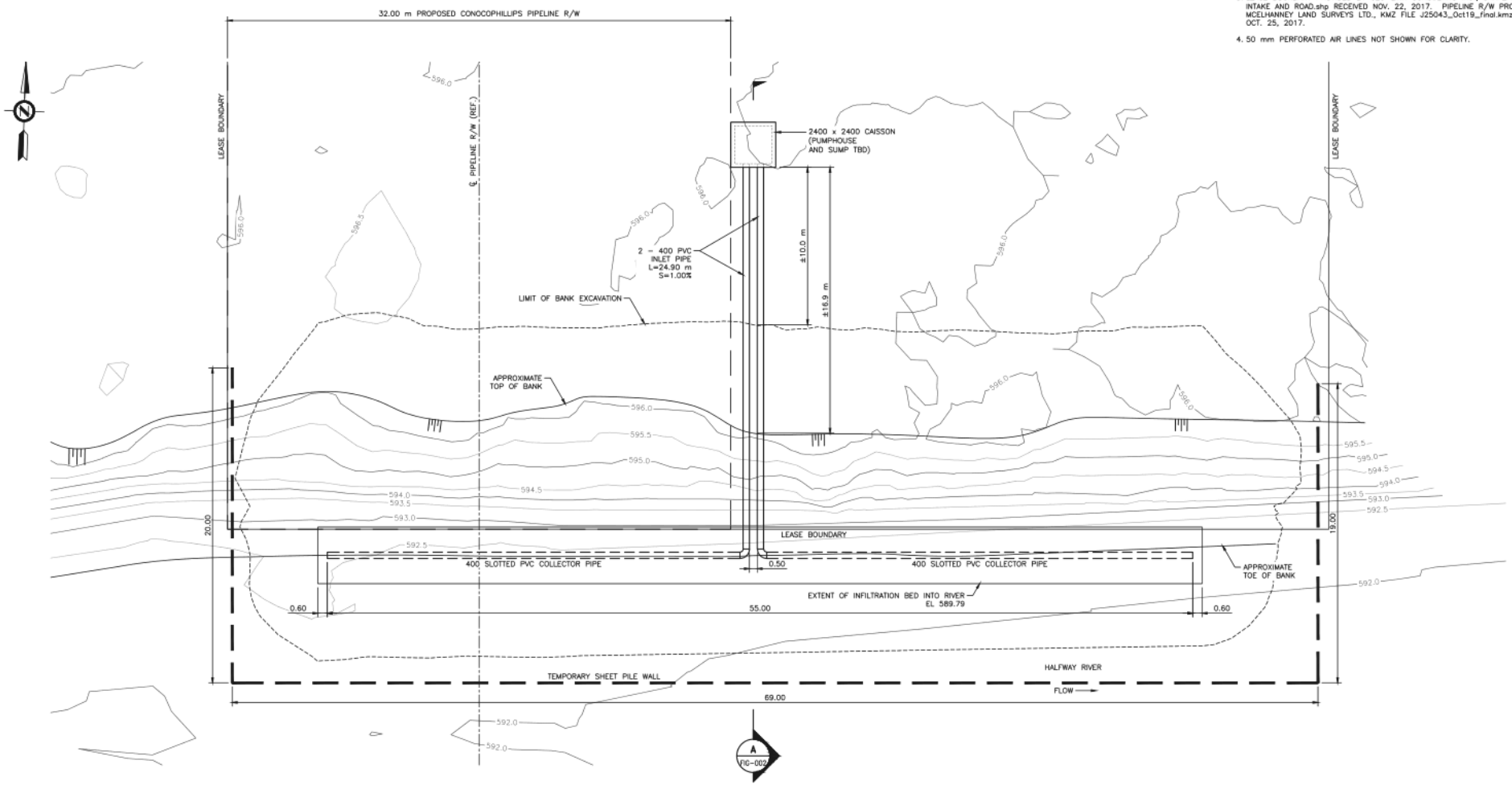
PROJ. NO.	CPC17003		
CADFILE	CPC17003-FIG-002.DWG	DRAWING NO.	REV.
SCALE	1:50	CPC17003-FIG-002	A

PLOTTED: 23/01/2018 2:55:17 PM BY: KURT STASIUK
LAST SAVED: 23/01/2018 2:55:16 PM BY: KURT STASIUK

D:\DROPBOX (HGC)\CPC17003 HALFWAY RIVER WATER INTAKE\5.0 DRAFTING\CPC17003-FIG-002.DWG

NOTES

1. ALL COORDINATES SHOWN ARE UTM ZONE 10 NAD 83 DATUM COORDINATES.
2. ALL STATIONS, ELEVATIONS AND COORDINATES ARE IN METRES AND DECIMALS, AND ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. LEASE BOUNDARY PROVIDED BY GEO-LINK CONSULTING INC., SHAPEFILE WATER INTAKE AND ROAD.shp RECEIVED NOV. 22, 2017. PIPELINE R/W PROVIDED BY MCELHANNEY LAND SURVEYS LTD., KMZ FILE J25043_Oct19_final.kmz RECEIVED OCT. 25, 2017.
4. 50 mm PERFORATED AIR LINES NOT SHOWN FOR CLARITY.



REFERENCE DRAWINGS		REVISIONS						
NUMBER	TITLE	NO.	ISSUE	DATE	BY	CHK'D	ENG	APP'D
-	-	A	ISSUED FOR APPROVAL	2018.JAN.16	KS	BR		RM

0 6 12 Meters

PROJ. NO.	CPC17003		
CADFILE	CPC17003-FIG-001.DWG	DRAWING NO.	REV.
SCALE	1:125	CPC17003-FIG-001	A

ConocoPhillips Canada

DL 1300 / 94-A-51

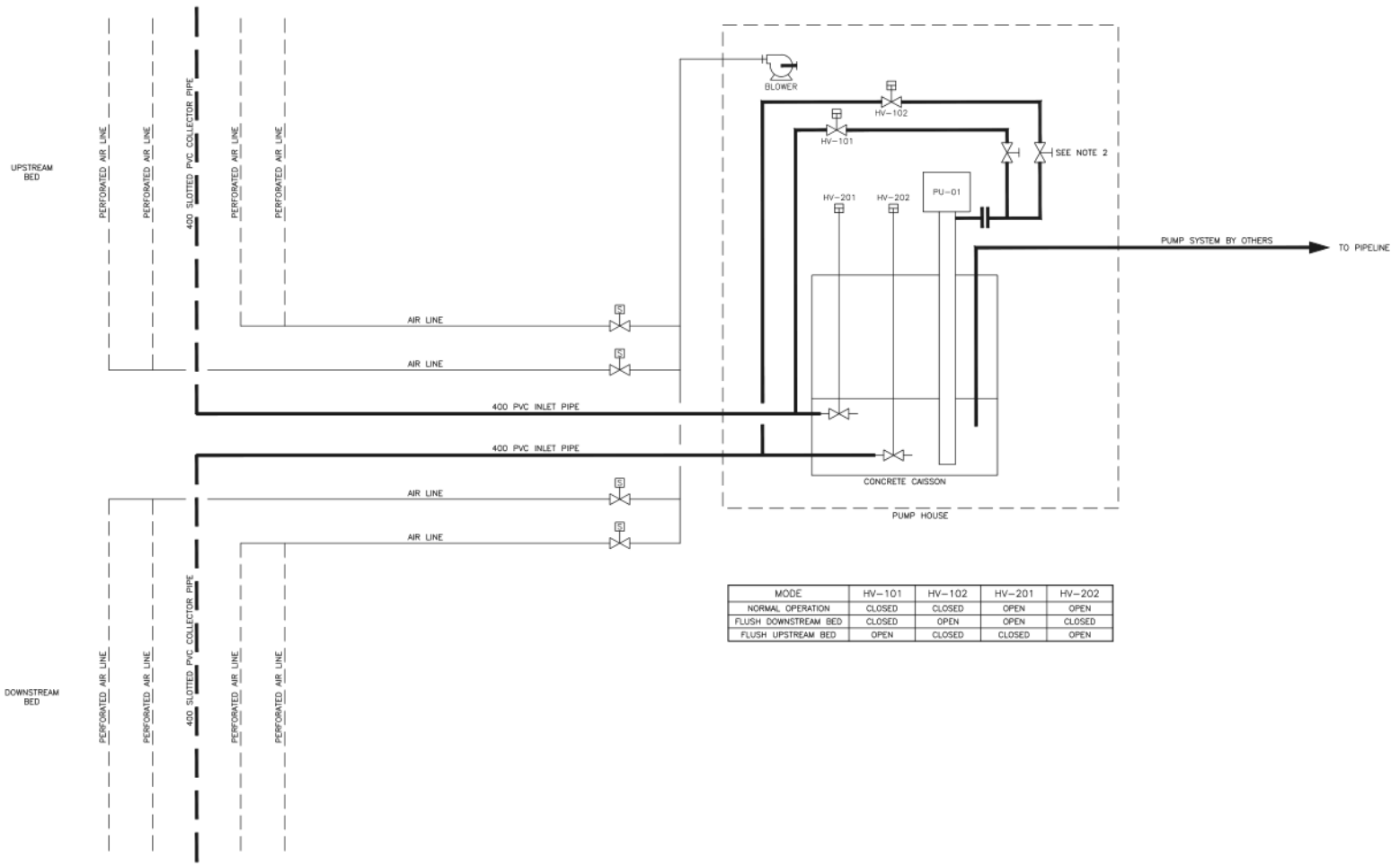
HALFWAY RIVER WATER INTAKE
INFILTRATION GALLERY
PLAN

PLOTTED: 16/01/2018 9:33:22 AM BY: KURT STASIUK
LAST SAVED: 16/01/2018 9:31:03 AM BY: KURT STASIUK

D:\DROPBOX (HGC)\CPC17003 HALFWAY RIVER WATER INTAKE\5.0 DRAFTING\CPC17003-FIG-001.DWG

NOTES

1. TAG NUMBERS TO BE DETERMINED.
2. THROTTLING VALVES TO BE SET DURING COMMISSIONING FOR 10,000 m^3/DAY AND LOCKED IN PLACE.



MODE	HV-101	HV-102	HV-201	HV-202
NORMAL OPERATION	CLOSED	CLOSED	OPEN	OPEN
FLUSH DOWNSTREAM BED	CLOSED	OPEN	OPEN	CLOSED
FLUSH UPSTREAM BED	OPEN	CLOSED	CLOSED	OPEN

REFERENCE DRAWINGS		REVISIONS						
NUMBER	TITLE	NO.	ISSUE	DATE	BY	CHK'D	ENG	APP'D
-	-	A	ISSUED FOR REVIEW	2018.JAN.23	KS	BR	BR	RM

ConocoPhillips Canada

DL 1300 / 94-A-51

HALFWAY RIVER WATER INTAKE
PROCESS FLOW DIAGRAM

PROJ. NO.	CPC17003		
CADFILE	CPC17003-PFD-001.DWG	DRAWING NO.	REV.
SCALE	N.T.S.	CPC17003-PFD-001	A

PLOTTED: 1/23/2018 2:03:27 PM BY: BRAD BIGGER
LAST SAVED: 1/23/2018 1:24:11 PM BY: AUBRY STASIUK

C:\USERS\BRAD\DROPBOX (HGC)\CPC17003 HALFWAY RIVER WATER INTAKE\5.0 DRAFTING\CPC17003-PFD-001.DWG

APPENDIX II – FISH AND FISH HABITAT FIELD REPORT WITH UAV PICTURES

Eco-Web Ecological Consulting Ltd.
Reducing the consequences of man`s influence on nature
www.eco-web.ca

Fish and Fish Habitat Assessment Field Report

ConocoPhillips Halfway River POD Location

Eco-Web Project #: H2-2024

Assessment Date: October 6. 2017

Report Date: 26-Oct-17

Prepared for:Allan Chapman

ConocoPhillips Canada Resources Corporation

8211 93rd Street, Fort St. John. BC V1J6X1 (o)250-787-1110 (f) 250-787-1175 / Grande Prairie, Alberta (c) 780-933-5475

Fish and Fish Habitat Assessment Form

POD Location

General Crossing Information

Client	ConocoPhillips	**Date**	October 6, 2017
Proposed Development	Water Withdrawal Location	**Ecologist**	LWD Distribution
UTM Coordinates At POD	562722 6262165	**Eco-Web Job #**	H2-2024

Area Surveyed	PoC Coordinates	562647 6262189	PoT Coordinates	562860 6262225	Length 200m
Stream Name	Halfway River		**Watershed Code**	235	
Tributary to:	Peace River		**General Location:**		
Stream Class:	S1		**Fish Bearing:** ☐ Yes ☑ No		**Permanent / Ephemeral**

Fish species present in stream:
Arctic Grayling, Bull Trout, Burbot, Flathead Chub, Kokanee, Lake Chub, Lake Whitefish, Largescale Sucker, Longnose Dace, Longnose Sucker, Mountain Whitefish, Northern Pearl Dace, Northern Pike, Northern Pikeminnow, Peamouth Chub, Prickly Sculpin, Rainbow Trout, Redside Shiner, Sculpin (General) Slimy

Information source used to determine species composition (ie. anecdotal, FISS, Fish Wizard, maps, sampling):
FISS

Fish Permit #: NA **Survey Intensity:** visual

Type of Crossing ☐ Pipeline ☐ Temporary Access ☐ Permanent Road ☑ Other POD

Type and Dimension of Crossing Structure (temp - snowfill/ice bridge/bridge; permanent -bridge/culvert/arch):	**Water withdrawal - Bank infiltration system**	**Type of Pipeline Crossing** (Dry Open Cut, Isolated Open Cut, Punch/Bore, Trenchless Bore, Directional Drill, HDD): **NA**

In-Stream Work Window: July 15 to August 15 **Proposed Dates of Work:** July 15 to August 31

Channel Info

	method	Est						Average
W1-Channel Width (m)		140	161	199	237	265	285	**214.5**
W2-Bottom Width (m)		NA	NA	NA	NA	NA	NA	**NA**
Wetted Width (m)		60	65	53	50	52	52	**55.3333**
Bankfull Depth (m)		4.1	4.6	4.4	4.3	4.4	4	**4.3**
Res. Pool Depth (m)		>1.35	>1.35	>1.35	>1.35	>1.35	>1.35	**1.35 to 2**
Velocity (m/s)		NA	NA	NA	NA	NA		**NA**

High Water Mark (m): 4.4m
Stream Gradient %: US 1 DS 1
Stage L (M) H
Temp 4.6 °C
pH 7.98
Cond. 304 µS/cm
Turb. T M L (C)

Channel Description
Did Not Find ☐
Dry/Int. Channel ☐
Dewatered Channel ☐
Braided ☐

Cover/Morphology

	Cover Total						
Type	**SWD**	**LWD**	**B**	**U**	**DP**	**OV**	**IV**
Amt	T	N	M	N	M	N	T
Loc	P	P	P	P	P	P	P

Crown Closure *(circle one)*: (0) 1-20% 21-40% 41-70% 71-90% >90%

Bed Material: *Dom.* *Cobble* *Subdom.* *gravel*

LWD Function: (N) F A
LWD Distribution: NONE
Instream Vegetation: N (A) M V

	Left Bank	Right Bank
Height (m)	4.4	unk
Slope °:	80	10
Shape:	V	S
Texture	F G C B	F G C B
Rip. Veg.:	M W	M W
Stage:	yf	yf

Morphology

Pattern	TM	ME	IM	(IR)	SI	ST	Diagram
Islands	N	O	(I)	F	I	AN	
Bars	N	SIDE	DIAG	(MID)	SPAN	BR	
Coupling	DC	PC	(CO)				
Confinement	EN	CO	(FC)	OC	UN	N/A	
Description	LARGE S1 RIVER						

Habitat

Stream Bed Material:	Percent	
Fines/Organics (clay, silt, sand)	20	D
Small Gravels (.2-1cm)		
Large Gravels (1-6cm)	20	
Small Cobbles (6-12cm)		D90
Large Cobbles (13-25 cm)	50	0.41
Boulders (>25cm)	10	
Bedrock		

Habitat Type	**Above POD**	**At POD**	**Below POD**
Pool		Pool	Pool
Riffle	Riffle		
Glide		Glide	Glide
Other			
Side Channel			
Confinement			

Features

Barriers to Fish Passage	**N**	**NA**	**E**		**Type**		**Photo**	See photoplate	
	N	NA	**E**		**Type**		**Photo**		
Disturbance and Features	**N**	**Na**	**E**		**Type**		**Photo**		
	N	**NA**	**E**		**Type**		**Photo**		

Photos	**U/S at PoC**		**U/S at CL**		**U/S at PoT**		**Other**	
	D/S at PoC		**D/S at CL**		**D/S at PoT**		**Other**	

Habitat Quality

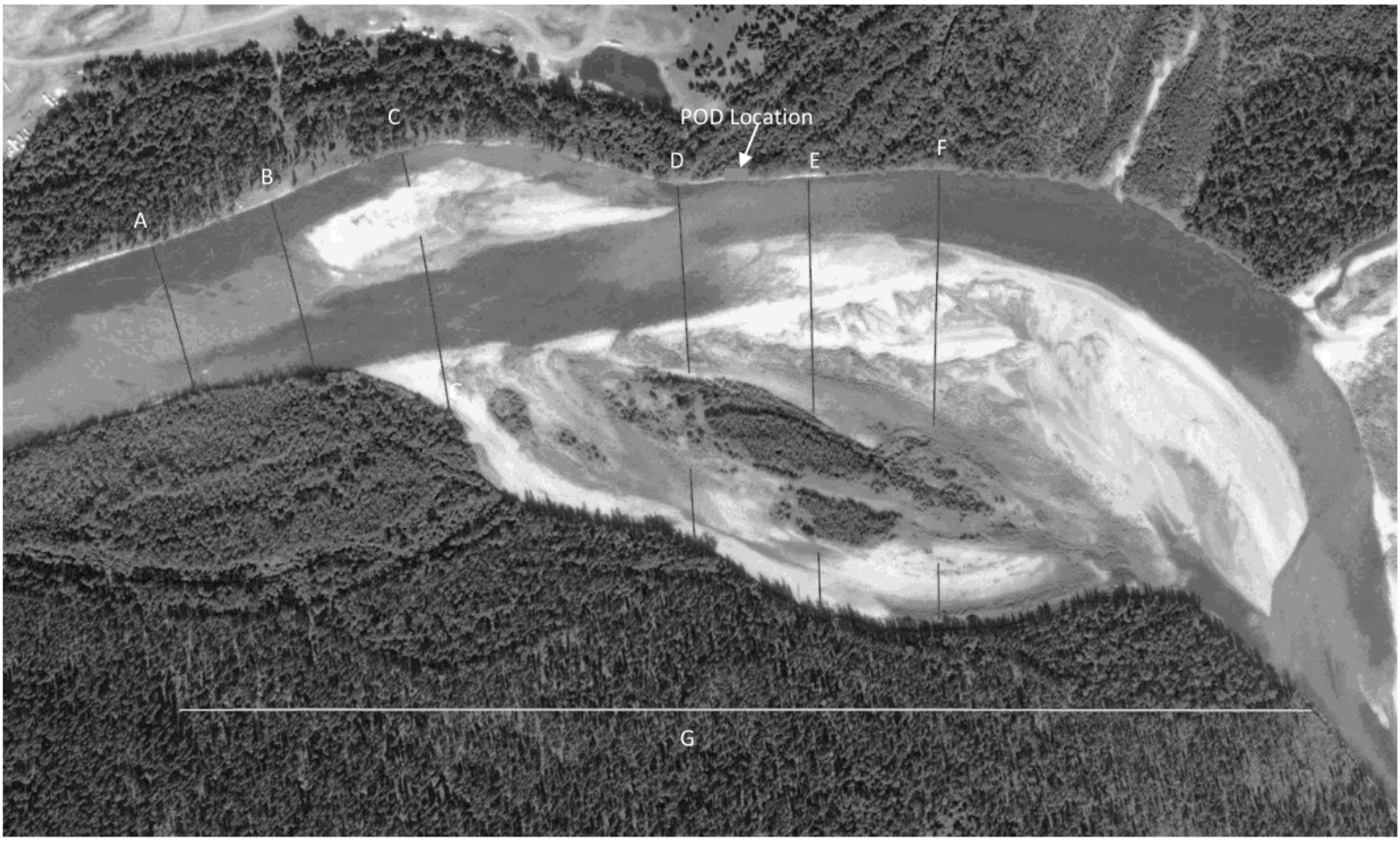
Rank habitat using *Critical,* (*Important*) *Marginal* provide brief justification

Spawning	minimal spawning gravels present
Rearing	This segment of the reach is suitable for Rearing due to depth and habitat structure
Overwintering	This segment of the reach is suitable for Overwintering due to depth
Migration	This segment of the reach is suitable for Migration due to depth and continuity

Wildlife Observations
None at time of assessmnet - deer tracks present- Riparian Habitat consisits of (overstory)=Cotton wood, white spruce, aspen (understory)= Prickly rose, willow, grass and moss Sp.

Comments
Only the north bank was assessed due to access. A UAV was utilized to fly the area and provide overview shots and obtain estimated channel width measurements

Halfway River Channel Widths at POD location



A = 140m

B= 161m

C = (33+166) = 199m

D = (174+63) = 237m

E = (215+50) = 265m

F = (234+51) + 285m

G = 1000m

Fish and Fish Habitat Assessment Pictures

Client	ConocoPhilips	**Assessment by:**	Landon Wilson
POD	Halway River		
Project Number	H2-2024		
Surveyed by:	LW and VS		

Photo 1: Looking upstream from POD location

Photo 2: Looking downstream from POD location

Photo 3: looing across at the south bank

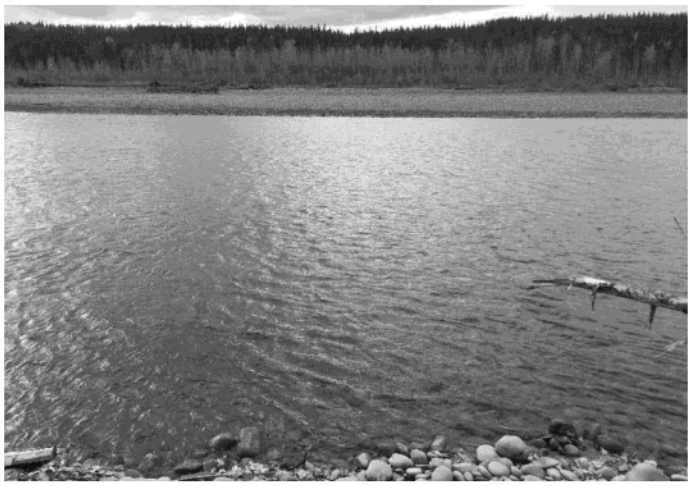
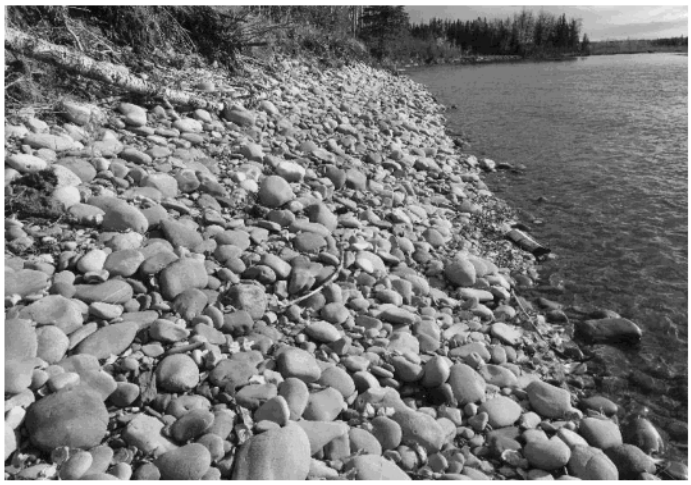


Photo 4: Adjacent riparian vegetation

Photo 5: Looking at POD location

Photo 6: typical substrate at POD location



Fish and Fish Habitat Assessment Pictures

UAV Pictures

Client	ConocoPhilips
POD	Halway River
Project Number	H2-2024
Surveyed by:	LW and VS
Assessment by:	Landon Wilson

Photo 1: Looking downtream from POD location

Photo 2: Looking upstream from POD location

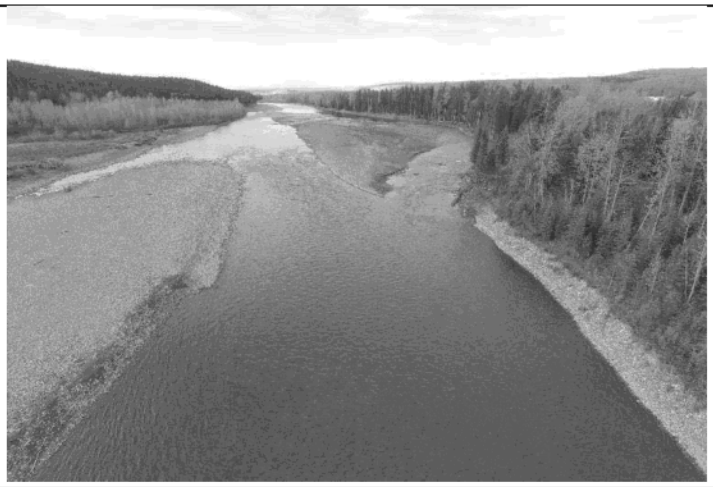


Photo 3: Looking downstream from POD location

Photo 4: Looking upstream from POD location

Photo 5: Lookingacross from POD at southern bank

Photo 6: Looking north inland from POD location

Fish and Fish Habitat Assessment Pictures

UAV Pictures

Client	ConocoPhilips
POD	Halway River
Project Number	H2-2024
Surveyed by:	LW and VS
Assessment by:	Landon Wilson

Photo 1: Looking upstream from POD location at riffle section

Photo 2: Looking downstream along POD location on north bank

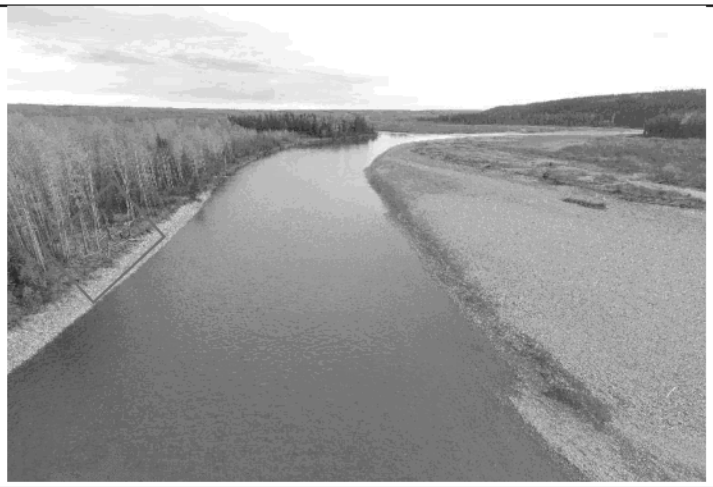


Photo 3: Looking downtream from riffle section at POD location

Photo 4: Looking upstream at POD location from Approximately 250 downstream of POD

Photo 5: Looking across from southern bank at POD location

Photo 6: Looking at north bank POD location

APPENDIX III - EMERGENCY SPILL RESPONSE

Spill Procedures

The following section outlines spill prevention measures, as well as the appropriate steps to take in the event of a spill.

Spill Prevention Measures:

This section outlines the procedures to be followed in order to prevent a spill of deleterious substances into the watercourse. These general measures will be followed by all on-site staff.

- The work site will be constructed to take into account preventing deleterious substances and silt laden run off from entering the watercourse;
- All equipment and machinery will be kept in good operating conditions with no leaks and clean with no extra oil or grease on it. Equipment to be used in or near watercourses will contain only non-toxic hydraulic fluids;
- Fluids from fuelling and servicing of equipment will be properly contained to ensure that no deleterious substances are spilled in the work area. Fuelling and servicing of equipment will not be done within 100 m of any watercourse;
- Servicing of equipment (i.e. maintenance, oil changes, hydraulic repair) completed on the right of way will be done on oil resistant impermeable liners, to prevent spills;
- Any waste oil, grease, hydraulic fluid, coolant or other potentially hazardous waste products will be collected and contained in appropriate hazardous waste containers and shipped to an approved disposal facility;
- All fuelling stations, service trucks with tidy tanks or other fuel storage devices will be properly contained and will have a spill kit available to deal with initial clean-up. All personnel will be briefed on the spill kit locations and use of the kits. A minimum recommended spill kit inventory would include: sorbent pads, sorbent booms, plastic bags, nitrile gloves, plug kit and shovel;
- On-site there will also be access to a suitable commercial sorbent material for ground spills, 5-10 Hazco bags and for any crossings near a major stream; river booms and/or floating sorbent boom, silt fence, sand bags or an AquaDam with suitable pumping equipment to divert the 1 in 10 year high flow of the creek, shovel, axes and assorted hand tools;
- All wastewater returns will be run through a minimum of 5 m of vegetation outside of the high watermark to prevent silt-laden water from entering the watercourse;
- Fueling of pumps will be done outside of the high watermark, using drip trays to prevent fuel from entering any watercourse. A spill kit will be located at each pump station;

If spill response is the responsibility of the contractor, they will provide information on qualified personnel responsible for spill containment and clean-up, procedures to be used in the event of a spill above and beyond these general measures and equipment (and location of) to be used for containment and clean-up.

Spill Response Measures:

Spills will be managed following ConocoPhillips Core Emergency Response Plan (ERP), and BC Oil and Gas Commission Emergency Response Manual. A copy of the ERP will be kept on site during construction.

In the event of a spill, the first responder and will take on the *Incident Commander* role until the Site Manager is notified and Incident Command System (ICS) is implemented.

The first responder role includes the following responsibilities:

- Protect lives and the well-being of the spill responder(s)
- Only attempt what they are capable of completing safely
- Sound the alarm with a call for help.

Once the spill has been notified, spill responders may be dispatched to the site to complete the following tasks:

- Verify the spill
- Gain site control
- Assess the incident
- Make appropriate contacts
- Develop an incident action plan
- Isolate the release point
- Initiate containment and recovery if safe to do so.

In the event that the spill can be managed by on-site personnel, and/or do not meet reportable requirements, the following steps may be implemented:

- For land spills, contain and remove all impacted soils to an approved disposal facility, followed by sampling of affected areas by a qualified professional to ensure the soil and/or groundwater has not been contaminated;
- For spills into watercourses, contain the substance using booms and sorbents (i.e. petroleum product spill) or dam the creek and pump (silt laden sediment) clean water from upstream to a clean location downstream using either sandbags, Aquadams or whatever means necessary to prevent impacts to downstream reaches. Retaining a qualified spill response specialist is recommended for any spill into a watercourse

In the event that the spill has been identified and cannot be managed by on-site personnel, or requires aid beyond the knowledge or capabilities of the CPC Incident Command team, transfer of command may be moved to a third party Spill Response Team, or in extreme cases, government control of the spill may be implemented through British Columbia's Emergency Response Management System (BCERMS). The initiation of a third party will be decided by the person in the Incident Command role at the time.

Environmental Emergency

Concern	Contact	Telephone Number	Reference
Spill into waterway, spill exceeds reportable volumes	Emergency Management BC	1-800-663-3456	*Environmental Management Act* Division 2.1 Spill Preparedness, Response and Recovery
Spill into waterway, spill exceeds reportable volumes	Oil and Gas Commission	1-800-663-3456	*Oil and Gas Activities Act*
	Oil Spill Area C – Western Canadian Spill Services, Fort St. John	250-785-5755	BC Inland Oil Spill Response Plan
	Fisheries and Oceans Canada Spill Report Line	1-800-889-8852	
Contravention of the *Water Act*	Ministry of Environment – Peace Region	250-787-3411	*Water Act*
Contravention of the Federal *Fisheries Act*	Fisheries and Oceans Canada – Pacific Region (Prince George)	1-800-845-6776	Section 35 Federal Fisheries Act

Spill Response Reporting Requirements:

Emergency Management BC is required to be notified of a spill if:

a) *The spill enters, or is likely to enter a body of water, or*
b) *The quantity of the substance spilled is, or is likely to be, equal or greater than the listed quantity for the listed substance.*

Oil and Gas Commission requires the spill to be notified if one of the following criteria is met:

- Spill or release of any amount of materials that impacts waterways
- Hydrocarbons; 100 litres where the hydrocarbon contains no toxic materials
- Produced salt/water; 200 litres where the fluid contains no toxic materials
- Fresh water; 10,000 litres
- Drilling or invert mud; 100 litres
- Sour natural gas; 10 kg or 15m^3 by volume where operating pressure is >100 psi
- Condensate; 100 litres
- Any fluid including hydrocarbons, drilling fluids, invert mud, effluent, emulsions, etc. which contain toxic substances; 25 litres.

Other reportable spills are outlined in the Oil and Gas Commission *Incident Risk Classification*, and this form is required to be completed for all incidents submitted to Oil and Gas Commission. End-of-spill reporting is required by Oil and Gas Commission.

Fish and Wildlife Application

Tracking Number: 100238831

Applicant Information

If approved, will the authorization be issued to an Individual or Company/Organization?	Company/Organization
What is your relationship to the company/organization?	Employee

APPLICANT COMPANY / ORGANIZATION CONTACT INFORMATION

This is the submitter information section

Name:	ECO-WEB ECOLOGICAL CONSULTING LTD.
Doing Business As:	
Phone:	250-787-1110
Fax:	250-787-1175
Email:	dwebster@eco-web.ca
BC Incorporation Number:	BC0743528
Extra Provincial Inc. No:	
Society Number:	
GST Registration Number:	815467675RT0001
Contact Name:	Daniel James Webster
Mailing Address:	8211 93rd Street Fort St. John BC V1J 6X1

CORRESPONDENCE E-MAIL ADDRESS

If you would like to receive correspondence at a different email address than shown above, please provide the correspondence email address here. If left blank, all correspondence will be sent to the above given email address.

Email:	lwilson@eco-web.ca
Contact Name:	Landon Wilson

TECHNICAL INFORMATION

APPLICATIONS

You may submit one or more application(s) Click on the 'Add Application' for each application you would like to add. In order to submit multiple applications together they must be for one applicant and in the same region.

Type
Scientific Fish Collection Permit

SCIENTIFIC FISH COLLECTION PERMIT – ELIGIBILITY

Do all applicants and co-applicants meet the eligibility criteria for the appropriate category as listed below?

Question	Answer	Warning
Are all applicants 19 years or older?	Yes	

SCIENTIFIC FISH COLLECTION PERMIT

Please provide us with the following information about the Scientific Fish Sampling:

SCIENTIFIC FISH COLLECTION PURPOSE

Please provide us with the following information about the Research Purpose

What is the purpose for the Scientific Fish Collection?	Fish Salvage
Applicant Date of Birth (DD/MM/YYYY)	

SAMPLING PROGRAM

Please provide us with the following information about the Sampling Program

Will collection activities involve live transport?	No
Will collection activities involve any tagging, marking, or lethal sampling?	No
Will collection activities involve angling in contravention of existing sport fishing regulations?	No
Will collection activities involve any variances to the listed Permit Conditions?	No
Will collection activities involve any Species at Risk?	No

SAMPLE PERIOD

Please provide us with the following information about the Sampling Period.

Start Date:	Jul 15, 2018
End Date:	Sep 15, 2018
Please select the intended activity:	Fish Salvage

SAMPLE LOCATION(S)

Please provide us with the following information about the Sampling Period. Water shed codes can be found here.

Ministry of Environment Region	Waterbody	Watershed Code
7B	Halfway River	235

SAMPLING OBJECTIVES

Please describe project and / or project area – must include rationale, methodologies. You are required to obtain separate permits for additional activities.

ConocoPhillips Canada Resources Corp (CPC) has applied to the British Columbia Oil and Gas Commission (OGC) for a water licence under the Water Sustainability Act, to withdraw water (10,000 m3/day and up to 3,650,000 m3/year) from a Point of Diversion (POD) on the Halfway River in northeastern British Columbia. CPC contracted an engineering company for the bed/bank water infiltration gallery engineering designs and plans, and further contracted with Eco-Web Ecological Consulting Ltd. (Eco-Web) to complete an Aquatic Effects Assessment, to support a review by the Department of Fisheries and Oceans under the Fisheries Act. The river bed/bank water intake is designed to be constructed along a 55 m length of the north bank of the Halfway River channel, extending about 10 m into the river from the north bank (the River is approximately 150 m wide at this location). Construction of the in-stream components will begin on or about July 15, at the start of the July 15 - August 15 “least risk fisheries timing window”, and is estimated to require 8 weeks to complete. Because discharge and river velocities are high in July from the late snowmelt, CPC is proposing to isolate the infiltration gallery construction area behind a temporary steel sheet pile barrier, with a silt curtain barrier to control sediment. As mentioned, the timing of the sheet piling isoaltion will be dictated by the river water levels, as such this fish colelction permit is requested to span from July 15 to September 15, 2018. The fish collection permit is required to salvage any fish that may become trapped within the sheet pile isolation area. All salvaged fish will be catalogued and released downstream of the isolation area. The proposed isolation area is centred around the following UTM coordinate; E562722 / N6262165.

SAMPLING TECHNIQUES

Please indicate all the sampling techniques, check all that apply.

Sampling Technique	Code
Dip Netting	DN
Electrofishing	EF
Minnow Trapping	MT
Seining	SN

SPECIES TO BE SAMPLED

Please provide us with the following information about the Species to be sampled, use species codes listed on Appendix B Table 2

Is this sampling program targeting specific species?	No

SPECIES INFORMATION

Please identify all target species/potential species encountered. A complete species list can be found here

Common Name	Scientific Name	Code
Arctic grayling	Thymallus arcticus	GR
Bull trout	Salvelinus confluentus	BT

Burbot	Lota Lota	BB
Mountain whitefish	Prosopium williamsoni	MW
Northern pike	Esox lucius	NP
Rainbow trout	Oncorhynchus mykiss	RT
Largescale sucker	Catostomus macrocheilus	CSU
Longnose sucker	Catostomus catostomus	LSU
Lake chub	Couesius plumbeus	LKC
Longnose dace	Rhynichthys cataractae	LNC
Northern pikeminnow	Ptychocheilus oregonensis	NSC
Northern redbelly dace	Phoxinus eos	RDC
Redside shiner	Richardsonius balteatus	RSC
Troutperch	Percopsis omiscomaycus	TP
Prickly sculpin	Cottus asper	CAS
Slimy sculpin	Cottus cognatus	CCG
Spoonhead sculpin	Cottus ricei	CRI
Flathead chub	Platygobio gracilis	FHC

ADDITIONAL PERSONS

Please provide the additional persons other than the applicant conducting work under this permit. It is required for you to list the full name of the additional person(s). * Refer to item 9, Appendix "A". Any workers not listed must be supervised by the applicant or one of the additional persons named below.

Landon Wilson, Dan Webster, Jodi Fleming, Sigrid Moe, Steve Holtman, Jayson Brogan, Lenore Mallis, Valerie Schmidt, Kim Warner

SCIENTIFIC FISH COLLECTION PERMIT - APPENDIX

Please refer to the following Appendix pertaining to your Fish Collection Permit and its Conditions here.

ATTACHED DOCUMENTS

Document Type	Description	Filename
Generic Document Upload	Supporting documentation describing project and proposed mitigation and Best Management Practices	2024 OGC FFHA and Works Pla...

PRIVACY DECLARATION

☑ Check here to indicate that you have read and agree to the privacy declaration stated above.

IMPORTANT NOTICES

Please review the clauses and conditions associated with your application below.

DECLARATION

☑ I acknowledge that the information I have provided is true and that I fulfill the requirements for the applications.

OTHER INFORMATION

Is there any other information you would like us to know?

The extended time frame of the requested FCP (July 15 to September 15) is required due to the unknown water levels of the Halfway River during this time frame. The proposed Isolation area will only be feasible when water levels allow, resulting in a larger time frame required for fish salvage.

APPLICATION AND ASSOCIATED FEES

Item	Amount	Taxes	Total	Outstanding Balance
Scientific Fish Collection Fee	$25.00		$25.00	$0.00

OFFICE

Office to submit application to: Fort St. John

OFFICE USE ONLY

Office Fort St. John	File Number	Project Number
	Disposition ID	Client Number

From: Hopkins, Breanna FLNR:EX
To: Peace_WAPITI ENV:EX; Elsner, Rick FLNR:EX
Cc: Hunjen, Selena FLNR:EX; O"Brien, Laura FLNR:EX
Subject: Request RM Consideration_SFC permit_ECO-WEB_289344_100238831_Amendment
Date: Wednesday, June 13, 2018 9:10:58 AM
Attachments: image003.jpg
image001.jpg

Hello,

Could I please request an amendment for a draft SFC permit located here: 289344

The amendment is a request to extend the permitted sampling period from September 15, 2018 to November 15, 2018.

Regards,

Breanna Hopkins

Fish & Wildlife Permit Clerk | FrontCounter BC

Ministry of Forests, Lands, Natural Resource Operations and Rural Development

Suite 100, 10003-110th Avenue, Fort St. John, BC, V1J 6M7

Ph: (250) 787-3465

FrontCounter BC Website | Toll-Free Contact Centre: 1-877-855-3222

Tell us about your experience with FrontCounter BC: Complete an Online Comment Card

---

From: O'Brien, Laura FLNR:EX
Sent: Friday, February 16, 2018 1:36 PM
To: Peace_WAPITI ENV:EX
Cc: Elsner, Rick FLNR:EX
Subject: Request RM Consideration for a SFC permit_ECO-WEB_289344_100238831

Hello,

Could I please have RM Consideration for a draft SFC permit located here: 289344

Please note the following:

- Our records do not indicate any outstanding SFC reports for this applicant/company.

Supporting Documents:

- Application
- Mike Eastwood's report (Consultative Areas)

Please advise if another jurisdiction's consideration is required.

Regards

Laura O'Brien, BBA
Fish & Wildlife Permit Clerk
FrontCounter BC | Ministry of Forests, Lands, Natural Resource Operations and Rural Developments
100 10003 110 AVE | Fort St John, BC V1J 6M7
Tel: 250-787-3465 | Email: laura.obrien@gov.bc.ca

FrontCounter BC Website | Toll-Free Contact Centre: 1-877-855-3222
Tell us about your experience with FrontCounter BC: Complete an Online Comment Card

Laura O'Brien, BBA
Fish & Wildlife Permit Clerk
FrontCounter BC | Ministry of Forests, Lands, Natural Resource Operations and Rural Developments
100 10003 110 AVE | Fort St John, BC V1J 6M7
Tel: 250-787-3465 | Email: laura.obrien@gov.bc.ca

FrontCounter BC Website | Toll-Free Contact Centre: 1-877-855-3222
Tell us about your experience with FrontCounter BC: Complete an Online Comment Card

From:	Eastwood, Michael S FLNR:EX
To:	O"Brien, Laura FLNR:EX
Subject:	RE: Scientific Fish Collection_Location Request_ ECO-WEB_289344_100238831
Date:	Friday, February 16, 2018 1:44:30 PM
Attachments:	image002.png image003.jpg

Here you go.

```
================================================================================
Watershed Code 235-000000-00000-00000-0000-0000-000-000-000-000-000-000
falls within the following CAD boundary(ies).
================================================================================
- Dene Tha' First Nation - Area B
- Blueberry River First Nations - Area A
- Blueberry River First Nations - Area B
- Saulteau First Nations
- Regional Coal Agmt-Coal Area-Halfway /Saulteau/West Moberly
- Regional Coal Agmt-Coal Area-Halfway /Saulteau/West Moberly
- Regional Coal Agmt-Coal Area-Halfway /Saulteau/West Moberly
- Halfway River First Nation
- Tsay Keh Dene Band
- Horse Lake - Area B
- West Moberly First Nations
- Doig River First Nation
- Halfway River - Core Area
================================================================================
```


Mike Eastwood, **ADGISA**
Geospatial Services
North East Region [Fort Nelson]
Ministry of Forests, Lands, Natural Resource Operations and Rural Development
250-774-5502

From: O'Brien, Laura FLNR:EX
Sent: Friday, February 16, 2018 1:36 PM
To: Eastwood, Michael S FLNR:EX
Subject: Scientific Fish Collection_Location Request_ ECO-WEB_289344_100238831

Hi Mike,

Could you please complete a report showing the CAD boundary (ies) for the attached Watershed code(s).

Halfway River
(235)

Thank you

Laura O'Brien, BBA
Fish & Wildlife Permit Clerk
FrontCounter BC | Ministry of Forests, Lands, Natural Resource Operations and Rural Developments
100 10003 110 AVE | Fort St John, BC V1J 6M7
Tel: 250-787-3465 | Email: laura.obrien@gov.bc.ca

FrontCounter BC Website | Toll-Free Contact Centre: 1-877-855-3222
Tell us about your experience with FrontCounter BC: Complete an Online Comment Card

From: Lavallee, Michel FLNR:EX
To: O'Brien, Laura FLNR:EX
Subject: RE: READY FOR DEICION_ SFC permit_ECO-WEB_289344_100238831
Date: Monday, March 26, 2018 10:00:47 AM
Attachments: image002.png
image003.jpg

Good morning Laura,
I approve Eco-Web's Scientific Fish Collection permit and I will support their timing window variance request (proposed: July 15 – Sept 15) from the least-risk timing window of July 15-Aug 15 to allow the proponent to initiate in-stream works when the site can be effectively isolated during lowest flow (not always mid/late July based on the data provided).
The majority of the First Nation concerns have been addressed in the supporting documents. I am unable to accommodate the request to maintain a 1.5km no-development buffer along the Halfway River for this project; the water in-take structure is designed to be placed below the Halfway River which requires construction within the proposed buffer.

Michel Lavallée, M.SEM., P.Ag., R.P.Bio.
Authorized Decision Maker by Regional Manager
Ministry of Forests, Lands, Natural Resource Operations, and Rural Development
Suite 400, 10003-110th Avenue, Fort St. John, BC, V1J 6M7
Ph: 250-787-3324

From: O'Brien, Laura FLNR:EX
Sent: Friday, March 23, 2018 11:38 AM
To: Lavallee, Michel FLNR:EX
Subject: READY FOR DEICION_ SFC permit_ECO-WEB_289344_100238831
Please see below

From: Scheck, Joelle L FLNR:EX
Sent: Friday, March 23, 2018 11:36 AM
To: O'Brien, Laura FLNR:EX
Subject: Re: READY FOR DEICION_ SFC permit_ECO-WEB_289344_100238831
Hi Laura,
This one can go to Rick for decision. I expect he should be around next week but if not, then Michel can deal with it. Can you forward it to him?
Thanks,
Jo

From: O'Brien, Laura FLNR:EX
Sent: 23 March 2018 11:33
To: Scheck, Joelle L FLNR:EX
Subject: READY FOR DEICION_ SFC permit_ECO-WEB_289344_100238831
Good morning Joelle,
Consultation is now complete for SFC Eco-Web 298344
Documents:
Application
Draft Permit
Consultation Log
Consultation Log
DRFN: Requested a time extension on this file, Rick Elsner did not approve the extension. Did not receive any further communication on this file.
HRFN:
Issues/Concerns/Potential Impacts:
Contact Halfway River First Nation for all of the following:
- If scope of the project changes
- Other concerns that arise- Cultural or environmental issues
Contact the Halfway River First Nation in a timely manner if any issues arise during this course of the design phase, construction, post construction and operation of the project.
Social/Cultural/TLUS or other data:
Concerns raised by members: The operator and other related employees must fuel (and store) all equipment at least 30 m away from watercourses, muskeg areas, and any surface drainage or tributary channel. The operator must ensure that there are spill tanks that can accommodate at least twice the amount of fuel to be used at the fill site. Spill kits to be accommodate with all machinery's. The contractor shall perform and record the daily inspections of all equipment, vehicles and storage containers used on site for leaks, staining or other signs of discharge.
Vehicles and equipment must be serviced, inspected, and pressure washed off-site, prior to construction works to remove surface oil, grease, weed seeds, and other undesirable or deleterious substances. The contractor will ensure all hydraulic machinery working within or directly adjacent to any watercourses or surface water drainage utilizes environmental sensitive hydraulic fluids that are non-toxic to aquatic life and that are readily or inherently biodegradable.
Other Concerns: Ensure that an approximate (1.5km) no development buffer is maintained around all water bodies. (etc. Ponds, streams, Rivers, creeks, wetlands) this buffer should increase beyond the slope break where the river valley slopes are steep. This would apply to all wellsite's, cut lines, roads, pipelines, forestry cut blocks or other facilities.
The operator must ensure erosion control along the access and around the lease site to prevent sedimentation from entering water courses. The erosion control must be set back from water courses by 200 meters or more to ensure an adequate buffer. Installation of silt fencing should be used and checked frequently to ensure functional integrity. Ensure proper installation of silt fence by digging a trench and back filling material to bury the base of the fabric. Ensure the fence is tight and erect. Several erosion control methods may need to be employed during times of heavy precipitation or seasonal flooding events.
Provide buffers to avoid drainage into creek during rain and flooding seasons and monitor turbidity for the duration of the project.
Questions/Clarification: Most of the info sharing is when they start to put in the water pump, and water lines going to water hub.
Additional comments Halfway River First Nation has a team of skilled technical and cultural environmental monitors available to provide environmental monitoring services during construction and post-construction phases. The Proponent will provide project details, location and scheduling information to HRFN in a timely fashion to allow HRFN to coordinate environmental monitors. HRFN environmental monitors will work with the Proponent to manage the project in accordance with the permit conditions, following applicable legislation, and in a culturally responsible fashion.
The Proponent will be responsible for funding time and expenses for the HRFN environmental monitors.
Tsay Keh Dene: The province did not receive any comments regarding this file
Technical Review

Eco-Web	Landon Wilson		289344			salvage around conoco philips construction of point of diversion associated with water licence to withdraw water.	July 15 to Sept 15 2018	Halfway River 235		no technical concerns, limit sampling area to occur within 1 km upstream and 1 km downstream of UTM E 562722, N 6262165	16-Feb-18		salvage

Please let me know if you need anything further,
Laura

From: O'Brien, Laura FLNR:EX
Sent: Friday, February 16, 2018 1:36 PM
To: Peace_WAPITI ENV:EX
Cc: Elsner, Rick FLNR:EX
Subject: Request RM Consideration for a SFC permit_ECO-WEB_289344_100238831
Hello,
Could I please have RM Consideration for a draft SFC permit located here: 289344
Please note the following:

- Our records do not indicate any outstanding SFC reports for this applicant/company.

Supporting Documents:

- Application
- Mike Eastwood's report (Consultative Areas)

Please advise if another jurisdiction's consideration is required.
Regards

Laura O'Brien, BBA
Fish & Wildlife Permit Clerk
FrontCounter BC | **Ministry of Forests, Lands, Natural Resource Operations and Rural Developments**
100 10003 110 AVE | Fort St John, BC V1J 6M7
Tel: 250-787-3465 | Email: laura.obrien@gov.bc.ca

FrontCounter BC Website | Toll-Free Contact Centre: 1-877-855-3222
Tell us about your experience with FrontCounter BC: Complete an Online Comment Card

Laura O'Brien, BBA
Fish & Wildlife Permit Clerk
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100 10003 110 AVE | Fort St John, BC V1J 6M7
Tel: 250-787-3465 | Email: laura.obrien@gov.bc.ca

FrontCounter BC Website | Toll-Free Contact Centre: 1-877-855-3222
Tell us about your experience with FrontCounter BC: Complete an Online Comment Card

From:	O"Brien, Laura FLNR:EX
To:	"Landon Wilson"
Subject:	ISSUED: Scientific Fish Collection Permit - ECO-WEB_289344_100238831
Date:	Wednesday, March 28, 2018 2:47:25 PM
Attachments:	Eco-Web_SFC(SA)_289344_Permit.pdf image001.jpg

Hello,

Please find attached your approved Scientific Fish Collection permit.

Regards

Laura O'Brien, BBA
First Nation Relations Coordinator
FrontCounter BC | Ministry of Forests, Lands, Natural Resource Operations and Rural Development
100 10003 110 AVE | Fort St John, BC V1J 6M7
Tel: 250-261-2072 | Email: laura.obrien@gov.bc.ca

BRITISH COLUMBIA | Ministry of Forests, Lands and Natural Resource Operations

FISH COLLECTION PERMIT
Fish Salvage

File: 34770-20

ATS Project: 269983
Permit No.: FJ18-289344

Permit Holder: Eco-Web Ecological Consulting Ltd. – Landon Wilson
8211 93 Street
Fort St John, BC V1J 6X1

Authorized Persons: Landon Wilson, Dan Webster, Jodi Fleming, Sigrid Moe, Steve Holtman, Jayson Brogan, Lenore Mallis, Valerie Schmidt, and Kim Warner

Pursuant to section 19 of the *Wildlife Act*, RSBC 1996, Chap. 488, and section 18 of the Angling and Scientific Regulations, BC Reg. 125/90, the above named persons are hereby authorized to collect fish for scientific purposes from non-tidal waters subject to the conditions set forth in this Permit:

Permitted Sampling Period: July 15, 2018 to September 15, 2018

Permitted Waterbodies: Peace Region – Halfway River (235)

Permitted Sampling Techniques: DN, EF, MT, SN (subject to permit terms and conditions)

Potential Species: See Appendix C (subject to permit terms and conditions)

Provincial Conditions: (Permit holders must be aware of all terms and conditions):
See Appendix A.

Region Specific Conditions:
See Appendix A.

Authorized by:

Michel Lavallee
Fish and Wildlife Section Head
A person authorized by the Regional Manager
Recreational Fisheries and Wildlife Programs

Date: March 28, 2018 Permit Fee $25

Any contravention or failure to comply with the terms and conditions of this permit is an offense under the *Wildlife Act*, RSBC 1996, Chap. 488 and B.C. Reg. 125/90.

Appendix A: Fish Collection Permit Conditions

Any Variation of the following terms and conditions will require explicit authorization by the appropriate regional Fish & Wildlife Section Head.

Provincial Conditions

1. This collecting permit is not valid
   - in national parks,
   - in provincial parks unless a Park Use Permit is also obtained,
   - in tidal waters,
   - for eulachon or for salmon* other than kokanee, or
   - for collecting fish by angling unless the permit holder and crew members possess a valid angling licence.

   This collecting permit is **only** valid for species listed as threatened, endangered or extirpated under the Species at Risk Act (SARA) **in conjunction with a permit issued under Section 73 of SARA from Fisheries and Oceans Canada.**

   *Contact the Department of Fisheries and Oceans for fish collecting permits for salmon, eulachon or SARA listed species (see Appendix B).

2. The permit holder (or the project supervisor) named on the application for a scientific collection permit will carry a copy of this permit while engaged in fish collecting and produce it upon request of a conservation officer, fisheries officer or constable.

3. Any specimens surplus to scientific requirements and any species not authorized for collection in this permit shall be immediately and carefully released at the point of capture.

4. Fish collected under authority of this permit shall not be used for food or any purpose other than the objectives set out in the approved application for a scientific collection permit. The permit holder shall not sell, barter, trade, or give away, or offer to sell, barter, trade or give away fish collected under authority of this permit. Dead fish shall be disposed of in a manner that will not constitute a health hazard, nuisance or a threat to wildlife.

5. No fish collected under authority of this permit shall be
   - transported alive unless authorized by this permit, or
   - transplanted unless separately authorized by the Federal/Provincial Fish Transplant Committee.

6. The permit holder shall, within 90 days of the expiry of this permit, submit a report of fish collection activities. Interim reports may also be required and shall be submitted as required by the permit issuer. All submissions must be filed electronically to: http://www.env.gov.bc.ca/fish_data_sub/index.html

   Reporting specifications, information and templates are available from this website and outline the mandatory information requirements. Prior notification of submission or questions regarding data report standards can be made to: fishdatasub@gov.bc.ca

7. This collecting permit is subject to cancellation at any time and shall be surrendered to a conservation officer on demand or to the issuer upon written notice of its cancellation.

8. This permit is valid only for the activities approved on the application form and in accordance with any restrictions set out therein.

9. This permit is valid only for trained, qualified staff named in the Application. The permit holder will comply with all Worker's Compensation Board requirements and other regulatory requirements. Permit holders are responsible for ensuring staff members listed on the permit are properly certified for specific sampling methods or activities (e.g. electroshocking).

10. Any workers not listed on the permit must be supervised by the permit holder or one of the additional persons as named on the permit.

Appendix A: Fish Collection Permit Conditions Continued

11. All sampling equipment that has been previously used outside of B.C. must be cleaned of mud and dirt and disinfected with 100mg/L chlorine bleach before using in any water course to prevent the spread of fish pathogens (e.g. Whirling disease) and / or invasive plant species. Any washed off dirt or mud must be disposed of in a manner such that it cannot enter a watercourse untreated.

12. No electrofishing is to take place in waters below five degrees C.

13. Electrofishing may not be conducted in the vicinity of spawning gravel, redds, or spawning fish, or around gravels which are capable of supporting eggs or developing embryos of any species of salmonid at a time of year when such eggs or embryos may be present.

14. Angling must only occur in accordance with the regulations specified in the current BC Freshwater Fishing Regulations Synopsis.

Region Specific Conditions

Peace Region

- The permit holder must advise Region 7B (Peace) of sampling activities 48 hrs prior to field operations. Please complete the following notification form: http://www.env.gov.bc.ca/pasb/reports/fish/permit_notify7b.html
- Voucher specimens for all regionally significant red and blue-listed species (3 per species) must be submitted to the Regional Fish Information Specialists as per RISC standards.
- No electrofishing will be permitted between September 15 and June 15 in streams containing bull trout.
- All sampling gear follow Association of Professional Biologists' advisory practice bulletin #5. Practice Advisory – Didymo, see: https://www.professionalbiology.com/sites/default/files/pdfs/Didymo.pdf

Appendix B: Table 1 - Species at Risk

The following are species at risk that have been listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as either endangered, threatened or a species of special concern. Species also listed under the Species at Risk Act (SARA) are identified with an asterisk, and are subject to additional permitting requirements through the Federal Department of Fisheries and Oceans (DFO).

Common Name	Scientific Name
Benthic Paxton Lake Stickleback	**Gasterosteus sp.*
Benthic Vananda Creek Stickleback	**Gasterosteus sp.*
Limnetic Paxton Lake Stickleback	**Gasterosteus sp.*
Limnetic Vananda Creek Stickleback	**Gasterosteus sp.*
Nooksack Dace	**Rhinichthys sp.*
Morrison Creek Lamprey	**Lampetra richardsoni*
Vancouver Lamprey (Cowichan Lake Lamprey)	**Lampetra macrostoma*
Cultus Pygmy Sculpin	**Cottus sp.*
Shorthead Sculpin	**Cottus confusus*
Hotwater Physa	**Physella wrighti*
Limnetic Enos Lake Stickleback	*Gasterosteus sp.*
Benthic Enos Lake Stickleback	*Gasterosteus sp.*
Salish Sucker	*Catostomus sp.*
Speckled Dace	*Rhinichthys osculus*
Charlotte Unarmoured Stickleback	*Gasterosteus aculeatus*
Columbia Mottled Sculpin	*Cottus bairdi hubbsi*
Giant Stickleback	*Gasterosteus sp.*
Green Sturgeon	*Acipenser medirostris*
Umatilla Dace	*Rhinichthys umatilla*
West Slope Cutthroat Trout	**Oncorhynchus clarki lewisi*
White Sturgeon	*Acipenser transmontanus*

Applications for permits to specifically collect and retain listed species must be reviewed by the appropriate provincial expert, who will screen permits to ensure that any impacts on listed species are acceptable. For white sturgeon the contact is Steve McAdam (steve.mcadam@gov.bc.ca). For listed non-game freshwater fish the contact is Jordan Rosenfeld (jordan.rosenfeld@gov.bc.ca).

Appendix B: Table 1 – Potential Species

Arctic grayling	*Thymallus arcticus*	GR
Bull trout	*Salvelinus confluentus*	BT
Burbot	*Lota Lota*	BB
Mountain whitefish	*Prosopium williamsoni*	MW
Northern pike	*Esox lucius*	NP
Rainbow trout	*Oncorhynchus mykiss*	RT
Largescale sucker	*Catostomus macrocheilus*	CSU
Longnose sucker	*Catostomus catostomus*	LSU
Lake chub	*Couesius plumbeus*	LKC
Longnose dace	*Rhynichthys cataractae*	LNC
Northern pikeminnow	*Ptychocheilus oregonensis*	NSC
Northern redbelly dace	*Phoxinus eos*	RDC
Redside shiner	*Richardsonius balteatus*	RSC
Troutperch	*Percopsis omiscomaycus*	TP
Prickly sculpin	*Cottus asper*	CAS
Slimy sculpin	*Cottus cognatus*	CCG
Spoonhead sculpin	*Cottus ricei*	CRI
Flathead chub	*Platygobio gracilis*	FHC

From:	Lavallee, Michel FLNR:EX
To:	Hopkins, Breanna FLNR:EX
Subject:	RE: Request RM Consideration_SFC permit_ECO-WEB_289344_100238831_Amendment
Date:	Friday, July 20, 2018 3:49:54 PM
Attachments:	image002.png image004.jpg image005.jpg

Good afternoon Breanna,
I approve Eco-Web's scientific fish collection permit application. I acknowledge Halfway River First Nation has recommended construction practices; I am unable to incorporate those recommendations within the scope of this permit.

Michel Lavallée, M.SEM., P.Ag., R.P.Bio.
Decision Maker Authorized by the Regional Manager
Recreational Fisheries and Wildlife Programs
Region 7B - Peace
Ministry of Forests, Lands, Natural Resource Operations, and Rural Development
Suite 400, 10003-110th Avenue, Fort St. John, BC, V1J 6M7
Ph: 250-787-3324

From: Hopkins, Breanna FLNR:EX
Sent: Thursday, July 19, 2018 4:29 PM
To: Lavallee, Michel FLNR:EX
Subject: FW: Request RM Consideration_SFC permit_ECO-WEB_289344_100238831_Amendment
Hi Michel,

I received a call from Landon with ECO-WEB today wondering about the status of this application for a SFC permit. It had originally gone through consultation but the proponent requested to extend the permitted sampling period permit from September 15 until November 15th. We are wondering if you are willing to provide a decision on the permit for us so we can have it issued somewhat on time – the start date was supposed to be July 15th.

Please view all documents here: 289344
- Draft amended permit
- Application
- Works Plan

If you require any other information, please let me know.
Thanks and have a great weekend!

Breanna Hopkins
Fish & Wildlife Permit Clerk | FrontCounter BC
Ministry of Forests, Lands, Natural Resource Operations and Rural Development

From: Hopkins, Breanna FLNR:EX
Sent: Wednesday, June 13, 2018 9:11 AM
To: Peace_WAPITI ENV:EX; Elsner, Rick FLNR:EX
Cc: Hunjen, Selena FLNR:EX; O'Brien, Laura FLNR:EX
Subject: Request RM Consideration_SFC permit_ECO-WEB_289344_100238831_Amendment
Hello,
Could I please request an amendment for a draft SFC permit located here: 289344
The amendment is a request to extend the permitted sampling period from September 15, 2018 to

November 15, 2018.

Regards,

Breanna Hopkins
Fish & Wildlife Permit Clerk | FrontCounter BC
Ministry of Forests, Lands, Natural Resource Operations and Rural Development
Suite 100, 10003-110th Avenue, Fort St. John, BC, V1J 6M7
Ph: (250) 787-3465
FrontCounter BC Website | Toll-Free Contact Centre: 1-877-855-3222
Tell us about your experience with FrontCounter BC: Complete an Online Comment Card

---

From: O'Brien, Laura FLNR:EX
Sent: Friday, February 16, 2018 1:36 PM
To: Peace_WAPITI ENV:EX
Cc: Elsner, Rick FLNR:EX
Subject: Request RM Consideration for a SFC permit_ECO-WEB_289344_100238831

Hello,

Could I please have RM Consideration for a draft SFC permit located here: 289344

Please note the following:

- Our records do not indicate any outstanding SFC reports for this applicant/company.

Supporting Documents:

- Application
- Mike Eastwood's report (Consultative Areas)

Please advise if another jurisdiction's consideration is required.

Regards

Laura O'Brien, BBA
Fish & Wildlife Permit Clerk
FrontCounter BC | Ministry of Forests, Lands, Natural Resource Operations and Rural Developments
100 10003 110 AVE | Fort St John, BC V1J 6M7
Tel: 250-787-3465 | Email: laura.obrien@gov.bc.ca

FrontCounter BC Website | Toll-Free Contact Centre: 1-877-855-3222
Tell us about your experience with FrontCounter BC: Complete an Online Comment Card

Laura O'Brien, BBA
Fish & Wildlife Permit Clerk
FrontCounter BC | Ministry of Forests, Lands, Natural Resource Operations and Rural Developments
100 10003 110 AVE | Fort St John, BC V1J 6M7
Tel: 250-787-3465 | Email: laura.obrien@gov.bc.ca

FrontCounter BC Website | Toll-Free Contact Centre: 1-877-855-3222
Tell us about your experience with FrontCounter BC: Complete an Online Comment Card

From:	Hopkins, Breanna FLNR:EX
To:	"Landon Wilson"
Subject:	ISSUED: Scientific Fish Collection Permit - ECO-WEB_289344_100238831_Amendment
Date:	Monday, July 23, 2018 9:00:56 AM
Attachments:	Eco-Web_SFC(SA)_289344_Permit (Amendment).pdf image001.jpg

Hi Landon,

Please find attached your approved amended Scientific Fish Collection Permit.

If you have any questions, let me know.

Breanna Hopkins

Fish & Wildlife Permit Clerk | FrontCounter BC

Ministry of Forests, Lands, Natural Resource Operations and Rural Development

From: O'Brien, Laura FLNR:EX
Sent: Wednesday, March 28, 2018 2:47 PM
To: 'Landon Wilson'
Subject: ISSUED: Scientific Fish Collection Permit - ECO-WEB_289344_100238831

Hello,

Please find attached your approved Scientific Fish Collection permit.

Regards

Laura O'Brien, BBA
First Nation Relations Coordinator
FrontCounter BC | Ministry of Forests, Lands, Natural Resource Operations and Rural Development
100 10003 110 AVE | Fort St John, BC V1J 6M7
Tel: 250-261-2072 | Email: laura.obrien@gov.bc.ca

From:	Elsner, Rick FLNR:EX
To:	Hopkins, Breanna FLNR:EX
Subject:	RE: FJ18-289344_ECO WEB_SFC(SA)
Date:	Thursday, November 1, 2018 8:22:59 AM
Attachments:	image001.jpg

Approved.

From: Hopkins, Breanna FLNR:EX
Sent: Tuesday, October 30, 2018 4:32 PM
To: Elsner, Rick FLNR:EX
Subject: FJ18-289344_ECO WEB_SFC(SA)

Hi Rick,

I received a call from Landon Willson from Eco-Web, he's wondering if this permit can be extended an extra 5 days until November 20th (currently is good until Nov 15). For reference, I have attached their permit. Please advise if I can extend the permit.

Thanks,

Breanna Hopkins
Fish & Wildlife Permit Clerk | FrontCounter BC
Ministry of Forests, Lands, Natural Resource Operations and Rural Development
Suite 100, 10003-110th Avenue, Fort St. John, BC, V1J 6M7
Ph: (250) 787-3465
FrontCounter BC Website | Toll-Free Contact Centre: 1-877-855-3222
Tell us about your experience with FrontCounter BC: Complete an Online Comment Card

From:	Hopkins, Breanna FLNR:EX
To:	"Landon Wilson"
Subject:	ISSUED: Scientific Fish Collection Permit - ECO-WEB_289344_100238831_Amendment 2
Date:	Thursday, November 1, 2018 8:42:50 AM
Attachments:	Eco-Web_SFC(SA)_289344_Permit (Amendment 2).pdf image001.jpg

Hello,

Please find attached your amended SFC permit.

Let me know fi you have any questions.

Regards,

Breanna Hopkins

Fish & Wildlife Permit Clerk | FrontCounter BC

Ministry of Forests, Lands, Natural Resource Operations and Rural Development

From: Hopkins, Breanna FLNR:EX
Sent: Monday, July 23, 2018 9:01 AM
To: 'Landon Wilson'
Subject: ISSUED: Scientific Fish Collection Permit - ECO-WEB_289344_100238831_Amendment

Hi Landon,

Please find attached your approved amended Scientific Fish Collection Permit.

If you have any questions, let me know.

Breanna Hopkins

Fish & Wildlife Permit Clerk | FrontCounter BC

Ministry of Forests, Lands, Natural Resource Operations and Rural Development

From: O'Brien, Laura FLNR:EX
Sent: Wednesday, March 28, 2018 2:47 PM
To: 'Landon Wilson'
Subject: ISSUED: Scientific Fish Collection Permit - ECO-WEB_289344_100238831

Hello,

Please find attached your approved Scientific Fish Collection permit.

Regards

Laura O'Brien, BBA
First Nation Relations Coordinator
FrontCounter BC | Ministry of Forests, Lands, Natural Resource Operations and Rural Development
100 10003 110 AVE | Fort St John, BC V1J 6M7
Tel: 250-261-2072 | Email: laura.obrien@gov.bc.ca