Environmental Assessment: Trans Canada Highway No. 1 Malahat Corridor Improvements, Vancouver Island, BC

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Submitted to Ministry of Transportation & Infrastructure
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Our Passion.

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List of Acronyms

AQP	Appropriately Qualified Professional
AW_f	freshwater aquatic life
BC	British Columbia
BCAWQG	BC Approved Water Quality Guidelines
BGC	Biogeoclimatic
BMPs	Best Management Practices
CDC	Conservation Data Centre (BC)
CDF	Coastal Douglas Fir
CDFmm	Coastal Douglas Fir, Moist Maritime
CEMP	Construction Environmental Management Plan
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CRD	Capital Regional District
CSR	Contaminated Sites Regulation
CWH	Coastal Western Hemlock biogeoclimatic zone
CWHxm1	Coastal Western Hemlock, Very Dry Maritime
DFO	Fisheries and Oceans Canada
DSI	South Island Forest District
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
EM	Environmental Monitor
EMA	*Environmental Management Act*
ENV	Ministry of Environment and Climate Change Strategy (BC)
ESC	Erosion and Sediment Control
HADD	harmful alteration, disruption, or destruction
HWM	High-Water Mark
HWR	Hazardous Waste Regulation
IAPP	Invasive Alien Plant Program
IL	Industrial Land Use
FLNRO	Ministry of Forest, Lands and Natural Resource Operations (BC)
FLNRORD	Ministry of Forest, Lands and Natural Resource Operations and Rural Development
MBCA	*Migratory Birds Convention Act*
MBR	Migratory Birds Regulations
MOE	Ministry of Environment (BC)
MoF	Mistry of Forests (BC)
MoTI	Ministry of Transportation and Infrastructure (BC)
MWLRS	Ministry of Land, Water, and Resource Stewardship (BC)
NTU	Nephelometric Turbidity Units
ROW	right-of-way
SARA	*Species at Risk Act*
SEI	Sensitive Ecosystems Inventory
SHIM	Sensitive Habitat Inventory and Mapping
TEM	Terrestrial Ecosystem Mapping
TSS	Total Suspended Solids
WiTS	Wildlife Tree Stewardship
WSA	*Water Sustainability Act*
WSR	Water Sustainability Regulation

Executive Summary

McElhanney Ltd. (McElhanney) was engaged by the Ministry of Transportation and Infrastructure (MoTI) to conduct an Environmental Assessment (EA) for the 100% Detailed Design and planned construction of the Trans-Canada Highway No. 1 Malahat Corridor Improvements Project (the Project) on Vancouver Island, BC. The Project intends to improve approximately 1.5 km of highway adjacent to the Goldstream River. This EA was completed with information obtained from desktop studies, an overview site visit during the Project kickoff meeting, a detailed vegetation survey on 26 April 26, 2019, follow up field assessments and surveys between 2019 and 2023, and review of the engineering design drawings prepared for the 100% Detailed Design. The purpose of this EA was to identify environmentally sensitive features in and around the Project footprint, to determine potential impacts on those features that might be mitigated through design, to identify potential impacts that cannot be mitigated through design, and to determine regulatory compliance requirements to facilitate the successful completion of the Project.

At present, the current alignment takes into consideration the various constraints on the constructability of the Project. Geotechnical, environmental, and jurisdictional constraints have also influenced the proposed alignment. The proposed alignment takes all these constraints into consideration as widening to the east side would require retaining walls and / or cantilever structures to be placed adjacent to the Goldstream River, and widening to the west involves extensive amounts of blasting and rock excavation.

The Trans-Canada Highway No. 1 Malahat alignment crosses Goldstream River via a partial span bridge and several small, unnamed drainages via concrete culverts. These drainage culverts are for laminar stormwater flow from the highway and water flowing from the steep cliffs to the west of the alignment. Due to the sheer vertical drop from the cliffs to the highway, these drainages are impassable to fish. These drainages have been identified as non-fish bearing primarily based on terrain steepness and do not fall under the provincial regulator's definition of a 'stream'.

Based on the design, works will be occurring below the high-water mark (HWM) of the Goldstream River. A provincial Change Approval has been obtained under a Section 11 of the *Water Sustainability Act* for the cantilevers and retaining wall (November 5, 2021, Job #118863) while Notifications for the culverts, pedestrian bridge and stormwater outfall will be submitted well in advance of these works. The provincial least risk timing window for instream works is June 15 to September 15 of any given year. A federal Avoid and Mitigate Letter (LoA) under the *Fisheries Act* was also obtained for the works on November 30, 2021, for upstream habitat restoration works (21-HPAC-00853). The pedestrian trail bridge obtained an LoA on October 10, 2023 (23-HPAC-00734).

Environmental sensitivities identified within the study area include the potential presence of provincially listed ecosystems, plants, and wildlife species, based on available habitat. In addition, important riparian and coniferous forests are present in the study area which provide foraging and nesting habitat to wildlife and bird species, and several wildlife trees were observed throughout the alignment. Goldstream River is designated as a sensitive stream by the Province and provides spawning, rearing, and overwintering habitat for a variety of anadromous salmonid fish.

Potential direct environmental impacts associated with the proposed Project include loss of vegetation and wildlife habitat due to road construction, potential disturbance of sensitive life stages (breeding) of wildlife and birds during construction, as well as potential temporary impacts to water quality and fish habitat within the Goldstream River. Indirect Project impacts include the potential for disturbance of birds protected under legislation as follows: a) species listed under the federal *Species at Risk Act*, b) birds protected under the *Migratory Birds Convention Act*, and c) birds and active nests protected under the provincial *Wildlife Act* Section 34. Disturbance to other wildlife species including bats also has the potential to occur.

Large quantities of waste rock may be generated through controlled blasting activities. Indirect impacts of Project construction may be mitigated through the application of Best Management Practices such as construction phasing or scheduling to conduct certain noisy or potential disruptive construction activities outside the breeding season. Construction mitigation strategies will be planned and addressed in the Project-specific Construction Environmental Management Plan (CEMP) to be developed by the Contractor upon award of the Project.

The Contractor will employ the services of an Appropriately Qualified Professional (AQP) to develop the CEMP. A full time Environmental Monitor (EM) will be on site during sensitive construction phases and works within environmentally sensitive areas. The EM will be required to confirm that mitigation measures are appropriately installed or utilized and functioning as intended and to address other concerns should they arise.

1. Introduction

McElhanney Ltd. (McElhanney) was retained by the Ministry of Transportation and Infrastructure (MoTI) to conduct an Environmental Assessment (EA) for the Trans-Canada Highway No. 1 Malahat Corridor Safety Improvements Project (the Project). The Project is located on the southeast side of Vancouver Island, in the South Island Forest District (DSI), approximately 15 km northwest of Victoria, BC (*Figure 1*).

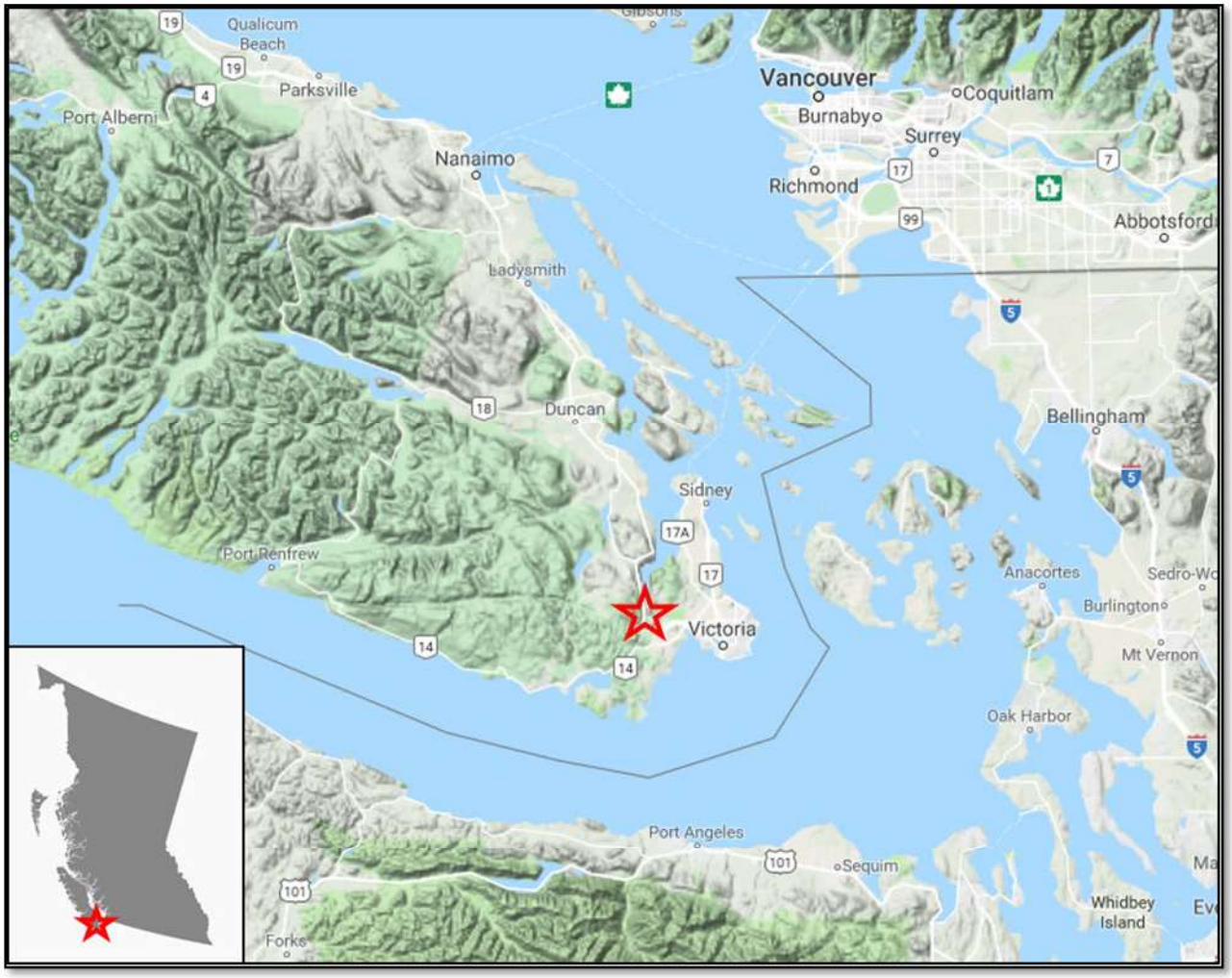


Figure 1. General location (Red Star) of the Site (Google Maps 2019).

The proposed road widening will improve an approximate 1.5 km section of the Trans-Canada Highway No. 1 Malahat Corridor (the Site), which is adjacent to Goldstream River and bordered by Goldstream River Provincial Park (*Figure 2*). This Project will upgrade the Malahat section of the Trans-Canada Highway No. 1 Malahat Corridor to improve safety.

The EA was conducted to determine environmentally sensitive features that may be present in and around the Project footprint (the study area) that may be directly or indirectly impacted by the Project. The primary focus of this study was to evaluate the natural environment both on the east and west sides of the current highway alignment.

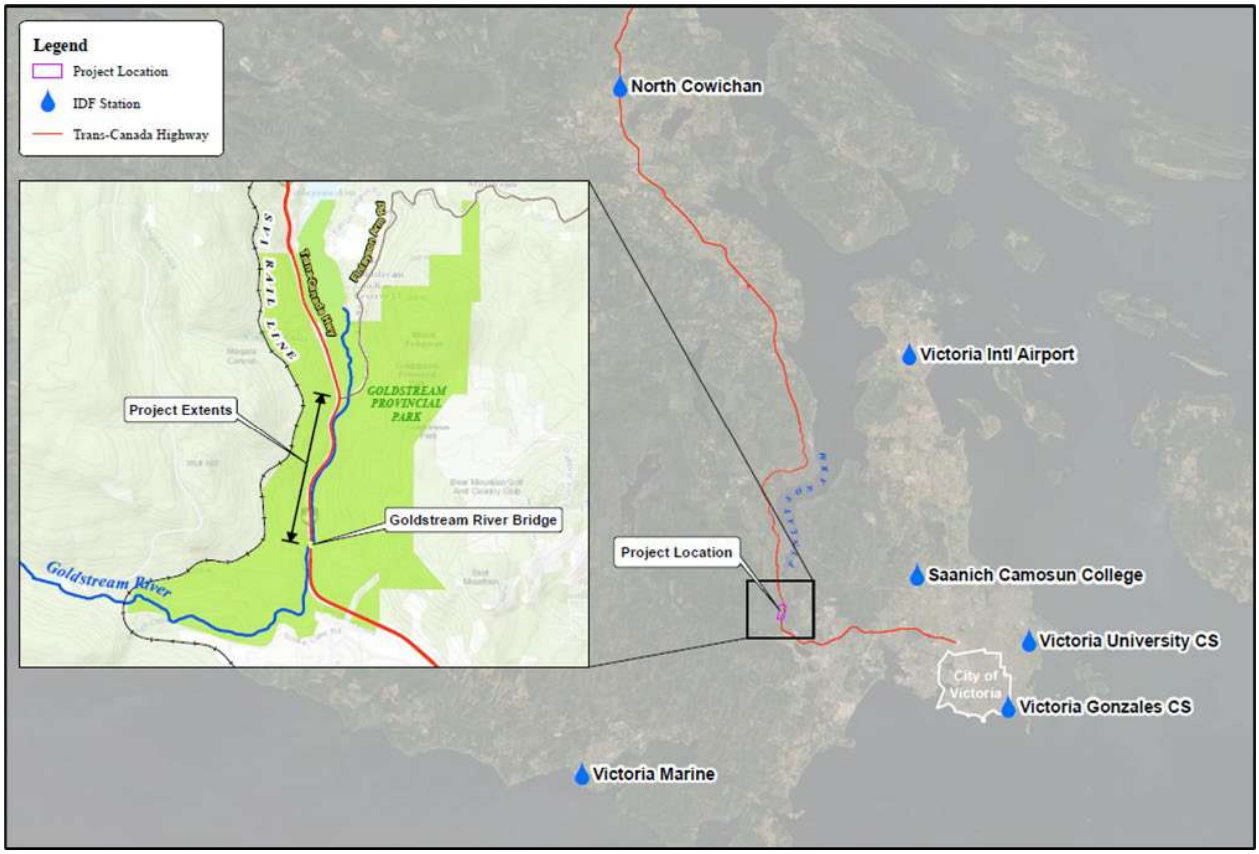


Figure 2. Approximate location of project limits (McElhanney 2022).

2. Project Description

The intent of the Project is to improve vehicle safety at the Site by dividing the highway with a centre median. Additional major design elements of the Project include a cantilever retaining wall, culvert crossings, a surface water management system, a pedestrian overpass on the highway south of the existing Goldstream River bridge, and a dedicated pedestrian underpass at the north end of the Project alignment. The goal of these design elements is improved and safer trail access along and across the highway, improved water quality in the adjacent Goldstream River, improved ability to manage spills on the highway, and improved safety for vehicles using the highway.

Adding a concrete median barrier requires highway widening to accommodate new infrastructure. Widening on the west side of the alignment exclusively would involve extensive amounts of blasting and rock excavation, whereas widening to the east side exclusively would encroach into the banks of the Goldstream River. The proposed alignment shown in the design drawings attempts to balance constraints and impacts, while achieving no new permanent instream footprint within the Goldstream River.

The Malahat alignment crosses several small unnamed drainages via concrete pipe culverts. These drainage culverts convey laminar stormwater flow from the highway towards the Goldstream River. Due to the steep topography of the drainage systems, these drainages are impassable to fish and have been identified as non-fish bearing primarily based on terrain steepness. Based on the final design, there are temporary works that will occur below the high-water mark (HWM) of the Goldstream River, as well as works with the riparian area of the Goldstream River; therefore, a Change Approval under Section 11 of the *Water Sustainability Act (WSA)* (BC 2014a) and federal Avoid and Mitigate Letters (LoA) from Fisheries and Oceans Canada (DFO) under Paragraph 35(2)(b) of the *Fisheries Act* (Canada 1985) are required. These permits have been obtained (Job#: 1187863 and 21-HPAC-00853/23-HPAC-00734) and are included in *Appendix A*.

2.1. PROJECT ACTIVITIES

The Project is at 100% Detailed Design and Project activities and their potential impacts are unlikely to change. Below is a summary of the typical major Project activities that may be required for the development and construction of the Trans-Canada Highway No. 1 Malahat Corridor Improvements Project:

- Clearing and grubbing of vegetation, including removal of detached stumps and roots.
- Stripping to remove topsoil and overburden.
- Milling of existing road surface.
- Rock blasting and excavation.
- Site preparation laydown areas.
- Preload embankment fill.
- Grading as needed.
- Import of clean fill for gravel road fill, base, paving and finishing.
- Replacement or installation of road culverts.
- Upgrades to drainage infrastructure.
- Site isolation and dewatering.
- Goldstream River Bridge rehabilitation.
- Construction of a new pedestrian overpass.
- Retaining wall and cantilever construction which will involve drilling and concrete works.
- Waste management and disposal during construction.
- Riparian restoration planting and reseeding.
- General site clean-up, and final stabilization.

2.2. PROJECT PHASES DESCRIBED

The following sections briefly describe the processes required for various Project construction phases. Construction and habitat off-setting activities were considered for determination of potential impacts to various environmental components. Operations phase impacts have generally not been included given the

Project intent to improve upon an existing highway; however, several items have been included for consideration as summarized in *Section 9* of this report.

2.2.1. Site Preparation or Preload

Clearing and Grubbing

Removal of vegetation will be required to accommodate the proposed road realignment, including areas for storage of rock spoil. Vegetated areas along the alignment consist primarily of remnant native ecosystems that include numerous invasive plant species.

Milling Existing Road Surface

Removal of the existing pavement will generate waste material which will need to be appropriately handled and either recycled or disposed of at a designated facility.

Blasting

Blasting will be required to excavate material from the west side of the alignment.

Stripping and Stockpiling

Overburden material such as organic soil and duff will be removed to expose underlying consolidated mineral soil in the rock stockpile areas. Stripping is commonly achieved by scraping surficial material with an excavator bucket.

Embankment Fill

Rock blasted from the west side of the alignment will be used to construct the embankment fill for the new roadway alignment.

2.2.2. Construction

Grading

To achieve final road grade, the embankment will be constructed using imported granular fill.

Culvert Installation and Stormwater Treatment System

Culvert installation, stormwater treatment system installation, and maintenance to existing structures will be required to route stormwater drainages through the Project footprint. A Notification under Section 11 of the *WSA* will be required.

Gravel Road Base Installation

Granular sub-base and crushed base coarse gravel will be applied over top of native soil or fills in areas designated to receive an asphalt surface layer.

Asphalt Paving

An emulsion of solvent and suspended asphalt will be applied to the gravel road base to protect the integrity of the underlying road base and to achieve a superior bond between road base and the paved asphalt surface. This will be followed by application of bitumen-based levelling and subsequent ‘lifts’.

Pedestrian Bridge Installation

A clear span pedestrian bridge will link the existing walking trails to the new pedestrian overpass and BC Park trials network. A Notification under Section 11 of the *WSA* and a DFO LoA has been obtained for this activity.

Retaining Wall

Installation of the retaining wall and cantilever structure will require that a work procedure be developed by the successful Contractor, based on SS165 Protection of the Environment (2020) and conditions under the regulatory permits obtained for the Project.

Reclamation and Landscaping

Areas of exposed native soil must be covered and stabilized once construction is complete. Common practice includes covering areas of final grade with an application of hydro-seed containing an appropriate seed mix for the area. In this case, the rock spoil area could potentially be terraced and replanted, using the woody debris for wildlife habitat.

2.2.3. Habitat Restoration

Restoration works to be completed in an area upstream of the Project location in order to enhance salmon spawning habitat.

2.3. OBJECTIVES

This EA was conducted to identify the presence of environmentally and ecologically sensitive features in the study area. The objective was to provide guidance concerning potential environmental impacts and recommend mitigation strategies to avoid or minimize impacts to environmental features through alterations in design or construction activities. This EA was conducted to meet the following objectives:

- Identify sensitive ecological features including species and ecosystems potentially located in the study area.
- Determine the potential negative impacts of the Project on environmental features.
- Make recommendations to avoid or minimize potential environmental impacts on environmentally sensitive features.
- Provide environmental information to factor into the Project design and facilitate the decision-making process.
- Identify environmental regulatory requirements for Project construction.
- Provide a framework for the contractor to develop a Project-specific Construction Environmental Management Plan (CEMP).

The engineering design features are at the final Detailed Design phase. The construction footprint and potential impacts on environmentally sensitive features are known and have been avoided, reduced, mitigated, offset, and permitted by regulatory agencies. This report outlines the general construction activities and impacts that are associated with achieving the above-mentioned objectives within the proposed Project footprint.

3. Scope

The scope of this EA encompasses the Project study area's terrestrial and aquatic features, and several Site visits and surveys have been completed to inform this assessment. Vegetation was defined as plant species, plant communities, and plant species at risk. Wildlife was defined as wildlife habitat and observations of animals / usage signs within the rural landscape around the Site. Aquatic features including fish and fish habitat, the Goldstream River, and drainage features within and adjacent to the study area.

Environmental features investigated within the study area included, but were not limited to, the following:

- Terrestrial vegetation features.
- Terrestrial wildlife and wildlife habitat features including wildlife trees.
- Fish and fish habitat.
- Presence / habitat of endangered, threatened, or vulnerable species federally or provincially designated.
- Drainages and watercourse features.

The scope of this investigation included the following:

- Desktop review and assessment of available information.
- Site visits providing a general overview of environmental features within the study area through incidental observations and photographic records taken within and around the current road alignment.
- Targeted assessments including those for bats and nesting birds.
- Preparation of a report summarizing:
    - Findings of the desktop study and Site visits/surveys.
    - Potential impacts related to construction activities as proposed in the design.
    - Recommended measures to avoid or mitigate impacts to environmentally sensitive features.
    - Residual effects, if any.

3.1. SPATIAL BOUNDARIES

The EA looked at the existing Project alignment and impacts from several perspectives: i) the regional environmental features of the area given the proximity to Goldstream River and ii) the Project footprint, which guided the determination of potential direct and indirect Project impacts on environmentally sensitive features.

3.2. TEMPORAL BOUNDARIES

Temporal boundaries of the assessment were limited to the construction of the Highway safety improvement Project. Currently the construction dates related to this Project are unknown. Temporary impacts associated with construction, such as noise, would be of short duration. Permanent impacts associated with excavation, infills, and placement of structures include removal of vegetation / wildlife habitat.

4. Regulatory Context

Federal and provincial environmental legislation that is applicable to the Project is summarized in *Table 1*. Listed wildlife and plant species at risk are subject to federal and provincial protection. General construction activities will occur near the Goldstream River and other drainages given the proximity to the highway alignment. Temporary works below the HWM will occur and require an Approval under the *WSA* and a LoA from DFO. The Project will conduct its activities in compliance with legislated acts associated with environmental protection.

Table 1. Environmental Legislation Applicable to the Project.

Legislation	Agency	Area of Regulation	Issue	Mitigations / Permits / Authorizations
Federal				
***Species at Risk Act (SARA)* (Canada 2002)**	Environment and Climate Change Canada (ECCC)	Protects wildlife and wildlife habitat listed as threatened or endangered	Construction Noise / Disturbance	Avoidance and mitigation strategies may be needed to avoid impacts to listed species. No permitting requirements.
Migratory Birds Convention Act (MBCA) (Canada 1994) and Migratory Birds Regulations (MBR) (Canada 2022)	ECCC	Prohibits injury, molestation and destruction of migratory birds and their nests	Construction Noise / Disturbance	No permitting required, operate under due diligence practices. Survey for nests of birds listed under Schedule 1 of MBR will be required prior to construction start.
***Fisheries Act* (Canada 1985)**	DFO	Prohibits introduction of deleterious substances to fish-bearing waters	Preventing the introduction of deleterious substances and sediment laden water from entering Goldstream River. Construction work to occur below the HWM of the River	The federal *Fisheries Act* (Canada 1985) and supporting policies aim to protect and manage all fish and fish habitats by providing protection against the death of fish, other than by fishing and the harmful alteration, disruption or destruction of their habitat (HADD). **A LoA was obtained from DFO 21-HPAC-00853 and 23-HPAC-00734.** Salvage permits are the responsibility of the Contractor.
Provincial				
***Water Sustainability Act (WSA)* (BC 2014a), Water Sustainability Regulation (WSR) (BC 2016)**	Ministry of Forests (MoF)	Protects freshwater features	Potential for construction work to occur below the high-water mark of Goldstream River	**Approval Job #118863 under Section 11 of the Act was obtained for the works.** Notifications for the ancillary works will be obtained by MoTI for one calendar year with the Contractor and their environmental monitor renewing those permits for the progress works.
***Weed Control Act* (BC 1996a)**	Ministry of Environment & Climate Change	Regulates control of designated noxious plants	Noxious weeds observed within study area	*Act* imposes a duty on all landowners to control designated noxious plants. Permits will be

Legislation	Agency	Area of Regulation	Issue	Mitigations / Permits / Authorizations
	Strategy (ENV)			required if chemical control methods are used.
***Wildlife Act* (BC 1996b)** ***Wildlife Act* Designation and Exemption Regulation (BC 2014c)**	Ministry of Land, Water and Resource Stewardship (MWLRS)	Regulates works that impact breeding birds and other wildlife in the area (i.e., reptiles)	Construction Noise / Disturbance	Protects birds and their nests during the bird breeding season as well as the nests, nest trees and eggs of certain species of birds all year. Bird nesting surveys may be needed prior to vegetation clearing. Nuisance birds and their nests are exempt from protection. No permitting anticipated. Pre-construction wildlife sweeps may be required including nesting bird surveys. Salvage permits are the responsibility of the Contractor.
Environmental Management Act (EMA) (BC 2003) ***Contaminated Sites Regulation (CSR) (BC 2021)*** ***Hazardous Waste Regulation (HWR) (BC 2021)***	ENV	Regulates control of contamination in soil, water, and hazardous waste	Disposal of wastes and management of soils	No permit required. Wastes will be managed by an AQP per the applicable requirements of the regulation

4.1. WATER QUALITY STANDARDS AND GUIDELINES

The BC Approved Water Quality Guidelines (BCAWQG) for freshwater aquatic life (AW_f)[1] are considered applicable to the Project. Any water associated with the Project that may be discharged to water or ground is subject to meeting the applicable water quality standards prior to discharge. *Table 2* and *Table 3* summarize BCAWQG applicable to the Project.

Table 2. BC Approved Water Quality Guidelines for Freshwater Aquatic Life (turbidity, TSS, pH and dissolved oxygen) (BC 2023a).

Turbidity	Total Suspended Solids (TSS)	pH	Dissolved Oxygen (mg/L)[2]
Clear flow conditions: • Maximum increase of 8 NTUs from background levels for a short-term exposure (e.g., 24-hour period). • Maximum average increase of 2 NTUs from background levels for a longer-term exposure (e.g., 30-day period).	Clear flow conditions: • Maximum increase of 25mg/L from background levels for short-term exposure (e.g., 24-hour period). • Maximum increase of 5 mg/L from background levels for longer term exposure (e.g., 30-day period)	6.5-9.0	Instantaneous minimum: • All life stages = 5 • Buried embryo/alevin = 9 30-day Mean: • All life stages = 8 • Buried embryo/alevin = 11

[1] BC CSR AW_f standards apply to freshwater and marine aquatic life.
[2] BCAWQG for dissolved oxygen are dependent on life stages and should be used based on instream conditions (i.e., spawning).

Turbidity	Total Suspended Solids (TSS)	pH	Dissolved Oxygen (mg/L)[2]
High flow or turbid waters: • Maximum increase of 5 NTUs from background levels at any one time when background levels are between 8 and 50 NTUs. • Maximum increase of 10% of background levels when background is >50 NTUs.	High flow or turbid waters: • Maximum increase of 10 mg/L from background levels at any time when background is 25 – 100 mg/L • Maximum increase of 10% from background levels at any time when background is > 100 mg/L		

Table 3. BC Approved Water Quality Guidelines for Freshwater Aquatic Life (temperature) (BC 2023a).

Temperature (°C)				
Species	**Incubation**	**Rearing**	**Migration**	**Spawning**
Chinook	5.0-14.0	10.0-15.5	3.3-19.0	5.6-13.9
Chum	4.0-13.0	12.0-14.0	8.3-15.6	7.2-12.8
Coho	4.0-13.0	9.0-16.0	7.2-15.6	4.4-12.8
Cutthroat trout	9.0-12.0	7.0-16.0	-	9.0-12.0
Rainbow trout	10.0-12.0	16.0-18.0	-	10.0-15.5

4.2. SOIL QUALITY STANDARDS AND GUIDELINES

Soils excavated during the construction of the Project must be managed in accordance with the BC *Environmental Management Act* (*EMA*), its supporting regulations (BC Contaminated Sites Regulation [CSR] and Hazardous Waste Regulation [HWR]), and associated BC Ministry of Environment and Climate Change Strategy (ENV) protocols and guidance documents. If soil is disposed of at an *EMA* authorized facility, it shall meet the permit requirements of that facility and be accepted by the operator in writing prior to movement to that facility.

For the purposes of disposal or off-site relocation, the BC CSR Schedule 3.1 soil standards for Industrial Land Use (IL) and BC HWR are considered applicable to this Project. The applicable BC CSR Schedule 3.1 consists of the following three parts:

- Part 1 – Matrix numerical soil standards.
- Part 2 – Generic numerical soil standards to protect human health.
- Part 3 – Generic numerical soil standards to protect environmental health.

The following matrix standards included in Part 1 of the BC CSR Schedule 3.1 are considered to apply in assessing soil quality for soil relocation or disposal:

- Intake of contaminated soil (mandatory).
- Groundwater used for drinking water (mandatory).
- Toxicity to soil invertebrates and plants (mandatory).
- Groundwater flow to surface water used by freshwater aquatic and marine life.

5. Methodology

Data was collected through desktop review of federal, provincial, and regional databases to identify any known environmentally sensitive features in the area. A literature review was conducted, and relevant background information was assessed.

Several Site visits were conducted between 15 March 2019, and 5 December 2023:

- A general overview Site visit was conducted during the Project kick-off meeting attended by MoTI, McElhanney staff, and geotechnical subconsultants on 15 March 2019. The purpose of the visit was to get an overall sense of Site conditions, receive input from MoTI, and document any ecologically sensitive features or heritage features present in the study area.
- A more in-depth study to assess the biological components of the Site was completed on 26 April 2019.
- Additional field surveys were conducted on 31 October and 1 November 2019, to assess bat habitat.
- A Site visit was completed on 26 March 2020, to assess instream characteristics of the Goldstream River.
- Additional Site walk throughs have been in coordination with BC Parks and the Malahat First Nations.
- Several targeted surveys were also completed in 2023 including to assess bat activity in areas of rocky cliff areas along the west side of the alignment, to identify any trees in the study area that contained nesting cavities of pileated woodpecker (*Dryocopus pileatus*), and to observe any obvious stick nests within or near to the Project footprint.

5.1. SOILS

The Soils of South Vancouver Island (Soil Survey Report No. 44, Sheet No.1) was reviewed to determine the soils series present at the Site. The Soil Survey Report comes from the data contained in the BC Ministry of Environment (MOE) Soils of Southern Vancouver Island MOE Technical Report 17 (Canada, 2013).

5.2. VEGETATION FEATURES

The ecological databases reviewed in the assessment of vegetation features included the following:

- Biogeoclimatic Ecosystem Classification Subzone / Variant Map for the South Island Resource District West Coast Region (FLRNO 2014).
- A Field Guide to Site Identification and Interpretation for the Vancouver Forest Region (Green and Klinka 1994).
- BC Conservation Data Centre (CDC 2023) database of provincially listed plant species including information from the federal Species at Risk Act (Canada 2002) and the Committee on the Status of Endangered Wildlife in Canada [COSEWIC].
- BC Species and Ecosystems Explorer (CDC 2023).
- E-Flora BC: Electronic Atlas of the Plants of British Columbia (E-Flora BC 2017b).

- Non-native invasive plant species (as listed in the Weed Control Act (BC 1996a).
- The Invasive Alien Plant Program (IAPP) Application (BC 2023b).
- Provincially listed ecological communities at risk (as defined in the BC Species and Ecosystem Explorer) (CDC 2023).
- Presence of wildlife trees supporting bald eagles or osprey nests (WiTS 2023).
- Sensitive Ecosystems Inventory (SEI): East Vancouver Island and Gulf Islands 1993-1997 (Environment Canada 1998).

Queries were conducted within the BC CDC Species and Ecosystems Explorer (CDC 2023) and iMapBC 4.0 (2023) databases for known at risk ecological communities, and vascular plant and non-vascular plant species associated with the Coastal Western Hemlock (CWH) and Coastal Douglas-fir (CDF) Biogeoclimatic zones (BGC zones).

A qualitative species inventory was conducted during the 26 April 2019, Site visit. Vegetation communities were delineated along the east and west side of the road alignment (*Figure 3*). This inventory provides an overview of plants occurring in the area including native and non-native / invasive species throughout the study area. Plant assemblages were characterized by the most dominant species within the habitat type.

Potential vegetation communities were identified through observations of vegetation assemblages throughout the study area. A combination of data obtained from both Site visits, aerial photograph interpretation, and the use of Google Earth Street View with imagery from September 2019, were combined to map the location of various vegetation community assemblages throughout the alignment.

5.3. TERRESTRIAL WILDLIFE FEATURES

The web-based databases considered in the assessment of wildlife use of the area and wildlife habitat include the following:

- CDC database of provincially listed wildlife species (CDC 2023), as well as species listed under the federal Species at Risk Act (Canada 2002) and COSEWIC.
- BC Species and Ecosystems Explorer (CDC 2023).
- E-Fauna BC: Electronic Atlas of the Wildlife of British Columbia (E-Fauna BC 2017a).
- BC Great Blue Heron Atlas (CMN 2018a).
- Wildlife Tree Stewardship Atlas (WiTS) (2023).

The Site was reviewed for evidence of wildlife including nests, scat, tracks and burrows during the 26 April 2019, Site visit. Wildlife and wildlife habitat were assessed for listed mammals, amphibians, reptiles, and terrestrial birds.

Wildlife habitat conditions were assessed by information obtained in the Site visits and supported by the literature review for species typical in the CWH and CDF BGC zones. This information was reviewed to get an overview of potential habitat suitability, wildlife movement, and / or level of disturbance.

5.3.1. Bat Assessments

Three sampling periods were employed to assess the potential for bat species to utilize the Project study area. Two of the sampling periods were in the early winter during the late stages of fall swarming and onset of hibernation, while one sampling session was completed in August near the end of the maternal roosting period. The Project intends to remove some trees and to modify four cliff faces via blasting to expand the transportation corridor. Bats can roost in a broad variety of habitat features but cliff faces are extensively used by most species; hence significant efforts were made to document bat activity and possible use of these cliff faces in advance of construction. Visual scanning of the cliffs was done to see if there were any crevices that could provide bat refuge.

Observational and acoustic surveys were located at four rock zones (*Figure 3*) along the west side of the highway alignment, and along the forested areas on the eastern side of the highway (*Appendix B*). Acoustic survey sessions relied on the use of an Echo Meter Touch 2 Pro Handheld Detector (EMT Pro) from Wildlife Acoustics. The EMT Pro was used to survey the Project footprint for evidence of echolocation calls from bats flying in the vicinity (within 50 m) of the detector. These recording devices consist of an ultrasonic microphone which is plugged into a smart phone or tablet and the user can see the sonogram of the echolocation calls and also see AutoID results (refer to *Figure 4*, below). The EMT Pro also records the calls for future analysis.

Figure 3. Cliff areas along the highway alignment that were surveyed for bat activity. The approximate Project alignment is indicated in red (base map courtesy of Google Earth 2023).

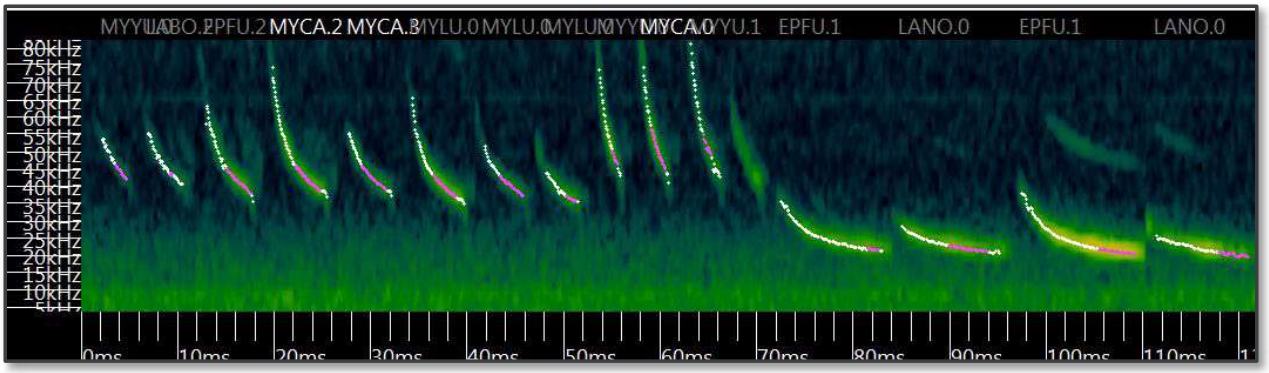


Figure 4. Example of a sonogram showing little brown myotis, California myotis, and silver-haired bat echolocation calls.

Acoustic bat call data that had been recorded using the EMT were processed using Kaleidoscope Pro Version 3.1.8. Calls were in full spectrum format (e.g., .wav files) with a maximum duration of any file being 15 seconds. AutoID software provides a good starting point for species identification but can produce incorrect results depending on the type of echolocation call recorded (i.e., search, approach, feeding buzz). Only search style calls provide diagnostic characteristics which can be used to identify species and the program encounters issues when more than one species of bat is recorded in the same time frame. Wildlife Acoustics provides the following disclaimer regarding their software:

"Automatic identification (AutoID) is not perfect and will result in false positive and false negative errors. Never rely solely on the output of this software to make land management decisions. The AutoID is intended only as a suggestion to facilitate analysis, not to replace human expert vetting of calls."

2019 Bat Assessment

Bat activity was first assessed on 31 October and 1 November 2019, in early winter conditions. Survey points were monitored for 15 mins at each location for a total of eight locations along the alignment and two locations north of the alignment based on what was considered high habitat potential. Visual observation points were also established at the four rock zones. Binoculars (10 x 42 magnification and objective lens) were used to visually investigate the rock zones for evidence of caves or crevasses suitable for bat summer roosting or winter hibernaculum. Visual observations of potential bat roosting and overwintering habitat were also investigated along the rock faces of the highway corridor. This methodology was used at dusk on both dates.

2023 Bat Assessment

Additional surveys targeting bat utilization of the Project study area were conducted in 2023 in consultation with a wildlife biologist specializing in bat biology and behaviour (Mike Sarell R.P.Bio. of Ophichius Consulting). M. Sarell provided arm-length guidance in the development of the assessment plan, as well as data interpretation, description of results collected, and some mitigation options.

Maternal roosting potential for bat species within the four rock zones was acoustically surveyed on 2 and 3 August 2023, at the end of the maternal roosting period. Driving transects that included the use of a Bat Detector angled out of the window of a moving vehicle were completed. The methodology entailed driving along the highway alignment from north to south while angling the Bat Detector towards the west side of

the highway where the cliffs are situated. Transects began approximately 10 mins before sunset for a one-hour duration. Several transects were completed over the course of two evenings.

Point count acoustic surveys were completed at the four rock zones on the evenings of 14 and 29 November 2023, in early winter conditions. Two AQPs completed the survey by standing across the highway from each rock zone with the Bat Detector angled at the cliff face for a duration of approximately 10 mins for every 50 m length of rock/cliff..

5.3.2. Pileated Woodpecker Cavities

A preliminary survey to assess the alignment for nest cavities of pileated woodpecker was completed on 9 August 2023. The survey focused on the potential for pileated woodpecker use based on tree preference within areas marked to be cleared for the Project. The survey was limited given the time of year (trees in full leaf) and access to several areas was restricted (i.e., areas above the cliff faces and several locations where pedestrian access was deemed unsafe). The survey was completed by two AQPs who surveyed the area on foot and used binoculars as needed.

A second survey was completed on 5 December 2023, as a follow-up on the results of the survey completed in August of 2023 and was completed using the same methodology (i.e., on foot with the use of binoculars).

5.3.3. Stick Nest Surveys

Stick nest surveys targeting cliff nesting bird species were completed on 9 August and 5 December 2023, utilizing the same methodologies as those completed for the pileated woodpecker nesting cavity surveys (i.e., on foot with binoculars).

5.4. WATERCOURSES AND AQUATIC FEATURES

A review of iMapBC 4.0 (2023) was conducted to determine mapped watercourses and potential water features in the study area. Nearby watercourses and aquatic features were confirmed or identified during the Site visits. The web-based databases considered in the assessment of watercourses and aquatic features include the following:

- DFO Aquatic Species at Risk Map (Canada, 2018a).
- Habitat Wizard.
- CRD Watercourse Mapping.
- Sensitive Habitat Inventory and Mapping (SHIM) (CMN 2018b).

This Project was undertaken to meet the requirements of the *WSA* and Water Sustainability Regulation (WSR) (BC 2014b, BC 2016). The intended methodology used to undertake a fish and fish habitat assessment was adapted from the Reconnaissance (1:20000) Fish and Fish Habitat Inventory: Standards and Procedures, version 2.0 (RISC 2001). Where possible, an assessment includes recording channel width measurements and substrate and cover descriptions. The percent cover and quality of several parameters should be qualitatively assessed including spawning, rearing, and overwintering values for all salmonid and trout species known to occur within the system. In this case, as all minor drainages within the Project footprint are non-fish bearing, this methodology was not used.

Stream profiles and an assessment of changes to the stream channel were conducted on 26 March 2020.

5.5. LISTED SPECIES / ECOSYSTEM DESIGNATIONS

The CDC compiles and maintains information on wildlife and plant populations in BC. As part of this system, the CDC assigns a provincial rank or listing that ascribes to each species a 'red', 'blue' or 'yellow' designation based on its population status within BC (CDC 2017). The rankings, described below, highlight the wildlife and plant species as well as natural plant communities that are at risk:

- **Red** – any indigenous species, subspecies or ecological community that is extirpated, endangered, or threatened in BC.
- **Blue** – any indigenous species, subspecies or ecological community considered to be vulnerable or of special concern in BC. Blue listed elements are at risk, but are not extirpated, endangered, or threatened.
- **Yellow** – any indigenous species, subspecies or ecological communities that are apparently secure and not at risk.

These designations were used in this report to indicate the status of species and ecosystems observed relative to the provincial and federal listings of species at risk.

5.5.1. Species at Risk

The BC CDC Species and Ecosystems Explorer database was accessed to determine vertebrate and invertebrate at risk species in the DSI (E-Fauna BC 2017a, iMapBC 2023).

COSEWIC was established under Section 14 of the federal *Species at Risk Act* (*SARA*) (Canada 2002). COSEWIC is a committee that assesses and designates which wild species of animal, plant, or other organisms are at risk of loss from the wild in Canada. Below is a listing of the federal status categories used by COSEWIC and *SARA* to rank or list a species:

- **Endangered** – a species facing imminent extirpation or extinction.
- **Threatened** – a species likely to become endangered if limiting factors are not reversed.
- **Special Concern** – a species that is particularly sensitive to human activities or natural events but is not endangered or threatened.
- **Data Deficient** – a species for which there is insufficient scientific information to support status designation.
- **Not at Risk** – a species that has been evaluated and found not to be at risk.
- **Extirpated** – a species that no longer exists in the wild in Canada but occurring elsewhere in the world.

Federally listed species and their critical habitats are protected under *SARA*. The above designations used in this report indicate the status of wildlife species potentially present as per the provincial and federal listings of species at risk.

6. Description of Existing Environment

6.1. LAND USE

The Project footprint lies within the existing highway right-of-way (ROW), adjacent to the Goldstream River Provincial Park property boundary. Existing features immediately adjacent to the current highway footprint include a gravel parking area, a gravel footpath, a grassy vegetated shoulder, drainage swales, cliffs, and the Goldstream River (*Photo 1* and *Photo 2*).

Photo 1. East side Highway barrier, foot path and Goldstream River, north view.

Photo 2. Cliff boundary on the west side of the Highway, west view.

An unofficial walking trail is located along the east edge of the highway between Goldstream River and the highway barrier.

6.2. GENERAL SOILS

Soil series present at the Site are summarized in *Table 4.* Based on available mapping, most of the soils located in the Site are fluvial and colluvial with a drainage class of rapid to well drained. Depositional origin of the soil is a result of runoff and glaciation.

Table 4. Summary of Soil Types Identified within the Study Area.

Soil Name		Material	Drainage Class
Quamichan	Fluvial	Includes marine / fluvioglacial deposits	Rapidly drained
Major: Chemainus R. Minor: Genoa Bay	Fluvial Fluvial	Stone-free, floodplain soils Gravelly floodplain soils	Rapidly to well drained
Major: Ragbark Minor: Somenos	Colluvium Moraine	Stony soils on steep slopes Moderately to strongly cemented pans	Rapidly to well drained

6.3. VEGETATION FEATURES

The Project alignment is located within the CDF Moist Maritime (CDFmm) BGC subzone with the CWH Very Dry Maritime, Eastern (CWHxm1) BGC subzone bordering the CDFmm to the west (FLNRO 2016a); see *Figure 5*. The Site is located within a ravine, with the elevation increasing dramatically on either side of the highway alignment. The study area consisted of a diverse ecosystem comprised of riparian, cliff, steep

slopes, and altered habitats. The steep topography provides variability in sun exposure due to aspect. Goldstream River is a distinguishing feature of the highway corridor.

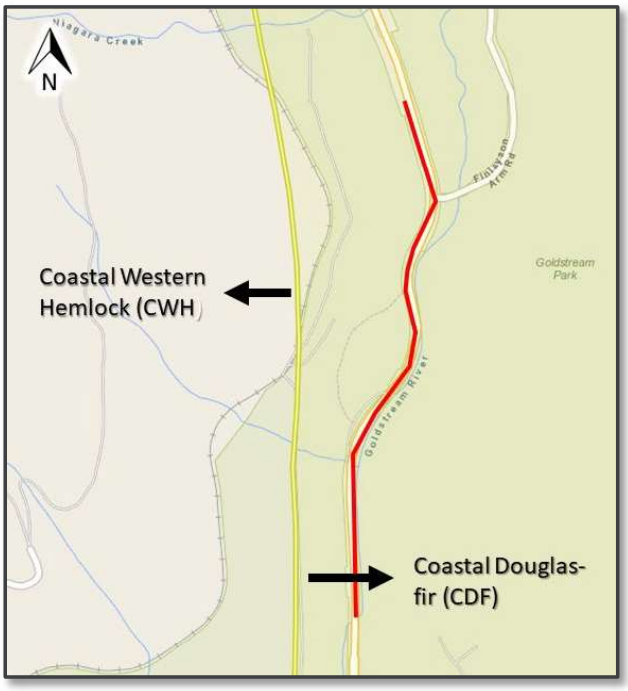


Figure 5. Biogeoclimatic zones in the study area. The approximate Project alignment is indicated in red (iMapBC 2023).

6.3.1. Ecosystems and Vegetation Communities

The Sensitive Ecosystem Inventory (SEI) database shows the Project alignment as overlapping with several ecosystems including mature riparian, older forest, and older second growth forest; shown in *Figure 6* (SEI 1999):

- R:6 – Riparian Mature Forest (80-250 years old),
- OF:co – Older Forest: coniferous (greater than 100 years old),
- OF:co / SG:co – Older Forest: coniferous and Older Second Growth Forest: coniferous (60-100 years old), and
- SG:co / OF:co – Older Second Growth Forest: coniferous, and Older Forest: coniferous.

Riparian ecosystems are defined by SEI as being distinct ecological systems that are differentiated from a “riparian zone” and are classified according to structural stages (1 through 7). Riparian ecosystems occur on floodplains next to bodies of water including lakes, streams, and rivers. These areas have naturally

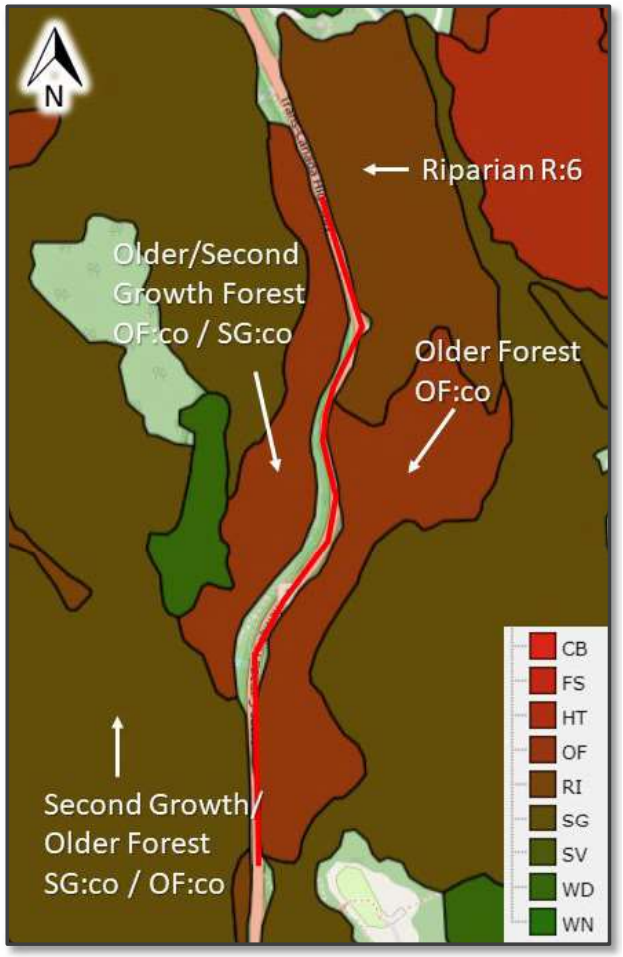


Figure 6. Sensitive Ecosystem Inventory (SEI) mapping in the Project area. The proposed Project alignment is indicated in red (reference).

higher soil moisture and light conditions that support plant communities distinct from surrounding terrestrial areas. Riparian ecosystems are dynamic and often multi-layered, commonly varying in dominant plant species, as well as vegetation age and structure, radiating out from the aquatic feature (SEI 1999).

Riparian ecosystems typically support a high degree of biodiversity of both vegetation and wildlife. These ecosystems also act to protect adjacent aquatic habitat through the addition of woody debris, shading, and bank stability (SEI 1999). Trees are typically a mix of flood-tolerant conifers including Western redcedar (*Thuja plicata*), sitka spruce (*Picea sitchensis*), and Western hemlock (*Tsuga heterophylla*) in mature stands, with red alder (*Alnus rubra*), black cottonwood (*Populus trichocarpa*), willows (*Salix* sp.), and bigleaf maple (*Acer macrophyllum*). Shrubs may include salmonberry (*Rubus spectabilis*), red elderberry (*Sambucus racemosa* subsp. *pubens*), and devil's club (*Oplopanax horridus*).

Older Forest (OF:co) is defined as conifer-dominated stands that are older than 100 years, while Older Second Growth (SG:co) is defined as conifer-dominated stands with less than 15% deciduous trees that are 60-100 years old. Older forests are biologically rich and support a higher biodiversity of wildlife, plant, and invertebrate species. These forests are distinct from younger, second-growth forests in both structure and composition. Trees in older forests are generally large and tall, and these forests are also structurally diverse. Snags and fallen logs are intermixed with live trees of varying ages, while shrubs and saplings grow dense and high where a gap in the forest canopy has formed. Structural features of older forests can take more than a century to develop in coastal forests, and on southeast Vancouver Island these forests are rare, with only remnants existing (SEI 1999).

Species assemblages (vegetation communities) were variable throughout the Project footprint due to micro-climates resulting from variations in aspect and slope, the presence of rocky outcrops, sheer rock surfaces to the west side of the alignment, and riparian communities on the east side. A total of 13 distinct vegetation communities were delineated within the Project footprint based on qualitative data from Site visits, aerial photograph interpretation, and Google Earth Street view imagery for areas along the alignment where data from the Site visit was insufficient. Each of these vegetation communities was confirmed as corresponding to the above listed ecosystems.

Notable native plant species observed and/or likely to occur within or adjacent to the study area based on the associated biogeoclimatic zones and results of the 2019 vegetation survey are listed in *Table 5* and *Table 6*. The typical mean percent cover is represented by the typical plant community composition for each BGC zone.

Figure 7 provides an approximate vegetation community map outlining eight vegetation communities along the west side of the highway alignment and five vegetation communities on the east side. Corresponding descriptions of each vegetation community are included in *Table 7*. A detailed map of the mapped vegetation communities is provided in *Appendix B*.

Several invasive plant species were observed during the 2019 Site visit. Additional information is provided in *Section 6.3.2.*

Table 5. Zonal Vegetation of the CDFmm and Observations During the April 26, 2019, Site Visit.

Common Name	Scientific Name	Type of Plant	Typical Mean % Cover
Douglas-fir	*Pseudotsuga menziesii*	Conifer tree	26 - 99%
Western redcedar	*Thuja plicata*	Conifer tree	11 - 25%
Grand fir	*Abies grandis*	Conifer tree	11 - 25%
Bigleaf maple	*Acer macrophyllurn*	Deciduous tree	2 - 5%
Western flowering dogwood	*Cornus nuttalli*	Deciduous tree	2 - 5%
Arbutus	*Arbutus menziesii*	Deciduous tree	0.1 - 1%
Salal	*Gaultheria shallon*	Shrub	26 - 99%
Dull Oregon grape	*Mahonia nervosa*	Shrub	26 - 99%
Ocean spray	*Holodiscus discolor*	Shrub	11 - 25%
Trailing blackberry	*Rubus ursinus*	Shrub	2 - 5%
Baldhip rose	*Rosa gymnocarpa*	Shrub	2 - 5%
Trailing snowberry	*Symphoricarpos mollis*	Shrub	2 - 5%
Red huckleberry	*Vaccinium parvifolium*	Shrub	0.1 - 1%
Western trumpet honeysuckle	*Lonicera ciliosa*	Shrub	0.1 - 1%
Common snowberry	*Symphoricarpos albus*	Shrub	0.1 - 1%
Mock-orange	*Philadelphus lewisii*	Shrub	0.1 - 1%
Bracken fern	*Pteridium aquilinum*	Fern	2 - 5%
Sword fern	*Polystichum munitum*	Fern	0.1 - 1%
Broad-leaved starflower	*Trientalis latifolia*	Herb	2 - 5%
Vanilla-leaf	*Achlys triphylla*	Herb	2 - 5%
Twinflower	*Linnaea borealis*	Herb	2 - 5%
Oregon beaked moss	*Kindbergia oregana*	Moss	26 - 99%
Step moss	*Hylocomium splendens*	Moss	2 - 5%
Electrified cat's tail moss	*Rhytidiadelphus triquetrus*	Moss	2 - 5%

Table 6. Typical Zonal Vegetation of the CWHxm1 and Observations During the April 26, 201,9 Site Visit.

Common Name	Scientific Name	Type of Plant	Typical Mean % Cover
Douglas-fir	*Pseudotsuga menziesii*	Conifer tree	26 - 99%
Western hemlock	*Tsuga heterophylla*	Conifer tree	11 - 25%
Western redcedar	*Thuja plicata*	Conifer tree	2 - 5%
Salal	*Gaultheria shallon*	Shrub	26 - 99%
Dull Oregon grape	*Mahonia nervosa*	Shrub	6 - 10%
Red huckleberry	*Vaccinium parvifolium*	Shrub	6 – 10%
Ocean spray	*Holodiscus discolor*	Shrub	0.1 - 1%
Trailing blackberry	*Rubus ursinus*	Shrub	0.1 - 1%
Baldhip rose	*Rosa gymnocarpa*	Shrub	0.1 - 1%
Prince's pine	*Chimaphila umbellata*	Shrub	0.1 - 1%
Bracken fern	*Pteridium aquilinum*	Fern	6 - 10%
Sword fern	*Polystichum munitum*	Fern	2 - 5%
Vanilla-leaf	*Achlys triphylla*	Herb	2 - 5%
Twin flower	*Linnaea borealis*	Herb	2 - 5%
Oregon beaked moss	*Kindbergia oregana*	Moss	26 - 99%
Step moss	*Hylocomium splendens*	Moss	11 - 25%
Flat moss	*Plagiothecium undulatum*	Moss	0.1 - 1%
Lanky moss	*Rhytidiadelphus loreus*	Moss	0.1 - 1%

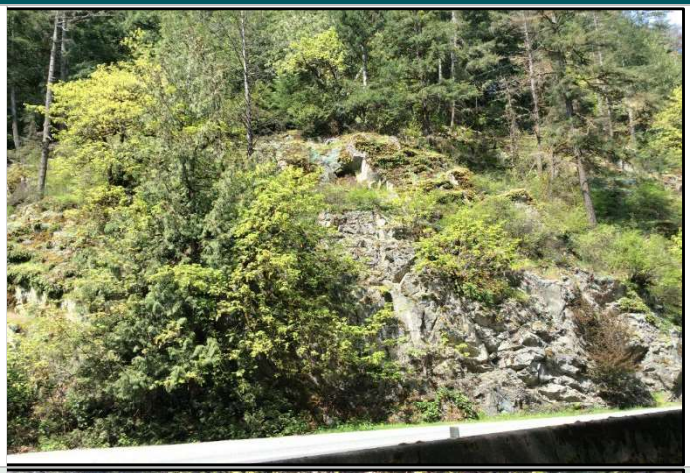
Figure 7. Map of the approximate location of vegetation communities identified as overlapping with the Project footprint (W = west side of highway alignment; W = east side of highway alignment).

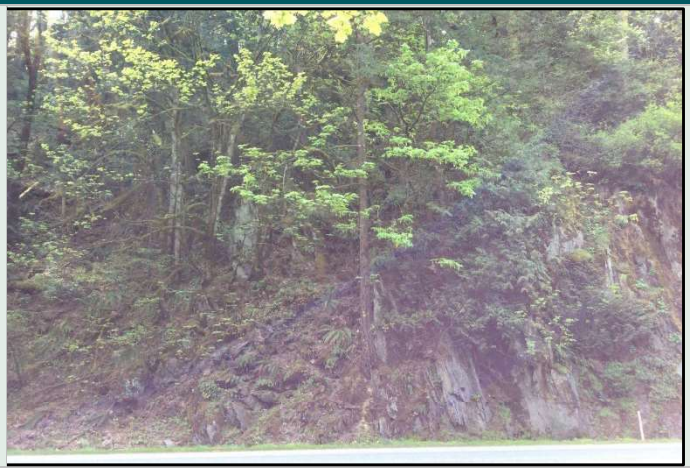
Table 7. Vegetation Communities Along the Highway 1 Alignment.

Location	Photo Representation	Description of Vegetation Community
E1		A herb and shrub layer largely dominated by invasive species. Soils within E1 appeared to be comprised of fill from previous highway works. The vegetation community was dominated by the invasive Scotch broom (*Cytisus scoparius*), and dandelion (*Taraxacum* sp.), as well as trailing blackberry (*Rubus ursinus*), a native plant species. Other species included Western flowering dogwood (*Cornus nuttalli*), bigleaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*), and cloudberry (*Rubus chamaemorus*).
E2		A flat bench of grasses and herbs are present along the footpath that runs parallel to the highway. The primary species include the invasive plant species smooth brome grass (*Bromus inermis*) and cleavers (*Galium aparine*), as well as miner's lettuce (*Claytonia perfoliate*), and trailing blackberry (both native species). The topography slopes from the highway down towards the Goldstream River where Western redcedar (*Thuja plicata*), sword fern (*Polystichum munitum*), and bigleaf maple are dominant.
E3		Two benches are present in this location as the Goldstream River meanders away from the highway. The dominant species include Western redcedar and bigleaf maple, with an understory of sword fern, salmonberry, evergreen huckleberry (*Vaccinium ovatum*) and an herb layer of invasive species including cleavers, smooth brome grass, dandelion and dove's foot geranium (*Geranium molle*).

Location	Photo Representation	Description of Vegetation Community
E4		A steep retaining wall is present along the highway alignment at this location. Bigleaf maple occur near the wetted edge of Goldstream River. Gravel substrates were observed adjacent to the edge of the highway barrier. Grasses and herbs are growing in areas not occupied by compacted gravel or boulders.
E5		The Goldstream River meanders away from the Highway alignment at this location. Gravel substrate occurs adjacent to the Highway barrier. This area is used by park visitors as an unofficial parking lot on the south side of Finlayson Arm Road. To the north of Finlayson Arm Road a retaining wall separates the gravel shoulder of the highway from a Western redcedar, sword fern, and Pacific waterleaf (*Hydrophyllum tenuipes*) vegetation community.
W1		Immediately adjacent to the highway footprint is a gravel pull out and BC Parks information sign. Natural forest habitat occurs beyond this location consisting of a canopy layer of bigleaf maple, Western redcedar, Western hemlock, and juvenile red alder. The shrub layer consisted of predominantly sword fern, dull Oregon grape (*Mahonia nervosa*), salmonberry, cloudberry, and salal (*Gaultheria shallon*). The herb layer consisted of invasive species including smooth brome grass, wild carrot (*Daucus carota*), and giant mullein (*Verbascum Thapsus*).

Location	Photo Representation	Description of Vegetation Community
W2		A shoulder swale that includes a herb layer of predominantly invasive species was observed in this location. A steep cliff bank extends beyond the highway shoulder that includes Western redcedar, bigleaf maple, Douglas-fir (*Pseudotsuga menziesii*) and Western hemlock trees along with a number of wildlife trees. Species observed on the rock face included stonecrop (*Sedum* sp.), licorice fern (*Polypodium glycyrrhiza*), and unidentified moss species.
W3		Mature forest habitat occurs adjacent to the highway alignment in this location. The forest floor contains ample large woody debris, and the existing drainage provides moist soil conditions and riparian ecosystem characteristics. The canopy cover included Western redcedar, grand fir (*Abies grandis*), Western hemlock, and Douglas-fir. The shrub layer consisted of red huckleberry (*Vaccinium parvifolium*), salmonberry, oceanspray (*Holodiscus discolor*), sword fern, stinging nettle (*Urtica dioica*), trailing blackberry, and Pacific waterleaf observed in low lying areas. Non-native species included mullein, and English holly (*Ilex aquifolium*).
W4		This location included a vegetated area between the old highway alignment that is now an unmaintained gravel road, and the current highway footprint. The canopy layer consisted of Western redcedar and bigleaf maple. The shrub layer consisted of sword fern, false lily-of-the-valley (*Maianthemum dilatatum*), Pacific bleeding heart (*Dicentra formosa*), salmon berry, and huckleberry. The herb layer included invasive smooth brome grass, cleavers, and dandelion.

Location	Photo Representation	Description of Vegetation Community
W5		Cliff habitat features adjacent to the highway alignment were observed in this location. Canopy cover consisted of Douglas-fir, bigleaf maple, and Garry oak (*Quercus garryana*) near the top of the cliffs. Licorice fern, stonecrop, sea blush (*Plectritis congesta*), and ocean spray were observed on the cliff face.
W6		Steep terrain with some bedrock outcrops was observed at this location, with a mix of Western red cedar, Western hemlock, bigleaf maple, and Douglas-fir canopy cover. Sword fern dominated the shrub layer.
W7		This location consisted of a narrow highway shoulder with steep, moss-covered bedrock slopes adjacent to the highway alignment. Canopy cover consisted of Douglas-fir and bigleaf maple. Licorice fern, stonecrop, sea blush, and ocean spray are present.

Location	Photo Representation	Description of Vegetation Community
W8		This location consisted of a narrow highway shoulder that quickly transitioned into steep terrain with some bedrock outcrops. The canopy cover consisted of a mix of Western redcedar, Western hemlock, bigleaf maple, and Douglas-fir. Sword fern dominated the shrub layer.

Note: Vegetation survey locations are denoted by “E” for the east side of the highway, and “W” for the west side of the highway.

6.3.2. Invasive Species

Historical disturbances associated with forest clearing and public infrastructure has contributed to development of a Site infiltrated by invasive plant species in areas that can limit the potential establishment of native species. A number of invasive plant species were encountered in the study area during the Site visits. Historical disturbance has resulted in several locations having patches of predominantly invasive species located along the ditches and roadside areas where there has been heavy anthropogenic impact.

Scotch broom was the most commonly observed invasive species and was primarily encountered adjacent to the highway on the west side of the Project footprint. The invasive or non-native plant species observed or mapped within 0.5 km of the Site are listed in *Table 8*; this table is not an exhaustive list. Invasive species have been previously mapped in the study area and along the current highway alignment (BC 2023b), thus providing a seedbank in the area. Control of designated noxious species by landowners is required under the provincial *Weed Control Act* (BC 1996a).

Table 8. Non-Native Plant Species Historically Present, Mapped, and/or Observed Within 0.5 km of the Site.

Common Name	Scientific Name	Type of Plant	Noxious Under BC Weed Control Regulation (Y / N)
Annual sow thistle	*Sonchus oleraceus*	Herb	***Y***
Bull thistle	*Cirsium vulgare*	Herb	N
Burdock species	*Arctium spp*	Herb	N
Canada thistle	*Cirsium arvense*	Herb	***Y***
Cleavers	*Galium aparine*	Herb	N
Curled dock	*Rumex crispus*	Herb	N
Cutleaf blackberry	*Rubus laciniatus*	Shrub	N
Dandelion	*Taraxacum* sp.	Herb	N
Dove’s foot geranium	*Geranium molle*	Herb	N
English holly	*Ilex aquifolium*	Shrub	N
Field bindweed	*Convolvulus arvensis*	Herb	N
Giant mullein	*Verbascum Thapsus*	Shrub	N
Gorse	*Ulex europaeus*	Shrub	***Y***
Hairy cat's-ear	*Hypochaeris radicata*	Herb	N

Common Name	Scientific Name	Type of Plant	Noxious Under BC Weed Control Regulation (Y / N)
Himalayan blackberry	*Rubus armeniacus*	Shrub	N
Lady's thumb	*Persicaria maculosa*	Herb	N
Poison hemlock	*Conium maculatum*	Shrub	N
Scotch broom	*Cytisus scoparius*	Shrub	N
Smooth brome grass	*Bromus inermis*	Grass	N
St. John's wort	*Hypericum perforatum*	Herb	N
Wild carrot	*Daucus carota*	Herb	N

6.3.3. Plant Species at Risk

The CDC database was reviewed and used to compile a list of at-risk plant species and plant communities with the potential to occur in the study area (CDC 2023). A review of the habitat available on the Site in combination with database search results indicated there may be potentially suitable habitat for some listed vascular plant species. Provincially and *SARA* listed vascular plant species with the potential to occur on the Site are listed in *Appendix C*.

Pacific Waterleaf (*Hydrophyllum tenuipes*) was observed during a Site visit as per Location W3 in *Table 7*. This species was downgraded in 2018 from being provincially red-listed to its current status as yellow-listed, based on the species being more abundant than previously thought in combination with its strong ability to disperse in appropriate habitat and its ability to tolerate some disturbance (CDC 2018). This species still has a provincial status of S3S4, meaning it is still somewhat vulnerable to extirpation and thus should be included in the effects assessment for the Project as a sensitive plant species.

Mapped occurrences of CDC listed plant species within 0.5 km of the Project footprint are listed in *Table 9*. These species were not observed during the Site visits.

Table 9. At Risk Plant Species Mapped Within 0.5 km of the Project Footprint.

Common Name	Scientific Name	BC List	COSEWIC
Deltoid Balsamroot	*Balsamorhiza deltoidea*	Red	E (April 2009)
Batwing vinyl	*Leptogium platynum*	Yellow	E (May 2011)
Banded Cord-moss	*Entosthodon fascicularis*	Blue	SC (May 2015)

6.3.4. Ecological Communities at Risk

Three at-risk ecosystems were identified as overlapping the Project footprint, as summarized in *Table 10.* Provincially and *SARA* listed ecological communities potentially occurring at the Site and in the surrounding area are listed in *Appendix D*.

There is a potential for direct impacts to at-risk ecosystems associated with Project activities; however, as the majority of works, including vegetation clearing, will be completed within previously disturbed areas, these impacts are anticipated to be minimal. Encroachment into listed ecological communities is addressed in the mitigation measures. An Overview Map that provides details of the location of the ecosystems at risk is included in *Appendix B*.

Table 10. Ecological Communities at Risk Mapped Within 0.5 km of the Project Footprint.

Common Name	Scientific Name	BC List	Provincial Status
Western Redcedar / Common Snowberry	*Thuja plicata / Symphoricarpos albus*	Red	S1 (2013)
Red Alder / Salmonberry / Common Horsetail	*Alnus rubra / Rubus spectabilis / Equisetum arvense*	Blue	S3 (2009)
Douglas-fir / Dull Oregon-grape	*Pseudotsuga menziesii / Berberis nervosa*	Red	S1 (2018)

*CDC. 2019. BC Species and Ecosystems Explorer. B.C. ENV Victoria, B.C. Available: http: / / a100.gov.bc.ca / pub / eswp / (accessed May 23, 2019)

6.3.4.1. Douglas-fir / Dull Oregon-grape

The Douglas-fir / dull Oregon grape (*Pseudotsuga menziesii / Berberis nervosa*) ecological community is generally described as older forest with moderately open to closed stands of Douglas-fir with some grand fir and western redcedar, with a moderate to dense shrub layer of dull Oregon-grape, salal, oceanspray, and trailing blackberry. The herb layer is sparse, but the moss layer is well-developed. This community occurs on middle slopes on all aspects at low elevations and is restricted to the CDFmm in areas long southeast Vancouver Island, the Gulf islands, a small area on the Sunshine Coast, and the Fraser River delta (Pojar et al. 2004).

These forests have been heavily logged and <1% remains in mature or old forest condition. Current threats including development and the introduction and spread of invasive species such as Scotch broom (Pojar et al. 2004).

6.3.4.2. Red Alder / Salmonberry / Common Horsetail

The red alder / salmonberry / common horsetail (*Alnus rubra / Rubus spectabilis / Equisetum arvense*) ecological community is a riparian ecosystem that experiences prolonged annual flooding from active fluvial processes. Soils are fine loams and sands, nutrient-enriched by the deposition of fine materials and organic matter (Mackenzie and Moran 2004). This ecological community occurs adjacent to river courses where flood duration is lengthy, and sedimentation is abundant. Red alder forms a closed tall shrub or low tree canopy. Red osier dogwood (*Cornus stolonifera*), stink currant (*Ribes bracteostum*), and salmonberry are prominent in the understorey, and common horsetail always persists but other species commonly occur (McKenzie and Moran 2004).

This community is typically a low bench ecosystem and is only known to occur in seven locations on southern Vancouver Island, including at the mouth of the Goldstream River. In this location the ecosystem is mapped as early shrub succession, occupying approximately 2.64 ha. This occurrence is based on Terrestrial Ecosystem Mapping (TEM) and has not been verified by site inspection. This ecological community coincides with the area mapped as OF:co as detailed in *Section 6.3.1.*

6.3.4.3. Western Redcedar / Common Snowberry

The Western redcedar / common snowberry (*Thuja plicata / Symphoricarpos albus*) ecological community is a high bench floodplain forest ecosystem. A number of small and degraded occurrences of this ecosystem have been mapped; however, there are no remaining occurrences with excellent or good ecological integrity. Significant loss and degradation has occurred in the past and numerous threat factors

are ongoing, including losses from development, impacts of invasive species, and climate change (CDC 2013).

The occurrence within the Project study area is comprised of mature western redcedar forest occupying approximately 1.32 ha (area based on TEM). This ecological community coincides with the area mapped as OF:co as detailed in *Section 6.3.1.*

6.4. TERRESTRIAL WILDLIFE FEATURES

The Project study area consists of a diversity and abundance of habitat elements, that likely provide habitat and foraging opportunities for a range of vertebrate and invertebrate wildlife species. There is the potential for at-risk wildlife species to utilize forested and riparian areas in proximity to the alignment, and there are multiple listed bird and mammal species that potentially use habitat in this area.

Mature trees adjacent to the Site and within the surrounding areas are likely to provide suitable habitat for nesting passerines and should be retained for the valuable wildlife habitat they provide for avian and other species, such as bats. Other functions of mature trees and wildlife trees, include feeding, communication (drumming, marking) roosting, shelter, and overwintering. When trees in settled areas are managed for wildlife, and trees with wildlife tree features are maintained, some wildlife species that depend on these trees can be expected to remain in, or even return to, highly fragmented urban and rural forests (Fenger, 2006).

Observations of wildlife during field reviews for this Project were restricted to observable evidence of habitat use or modification. Wildlife trees were defined as trees that had visible signs of nesting or foraging activity located within or very close to the study area.

6.4.1. Amphibians and Reptiles

Targeted assessments for amphibians and reptiles have not been completed for this Project, and no observations were recorded during the Site visits. However, several species are anticipated to be present within the study area based on habitat conditions and database search results.

Habitat value for reptiles may be considered moderate to high due to the availability of open areas which would allowing for sunning and thermoregulation (i.e., basking) that is required for these species. Rock crevices and coarse vegetation on the forest floor may also provide hibernacula potential (meaning a place to seek refuge) for reptiles. Streams, wetted areas, and riparian and \ terrestrial forests in proximity to the Project footprint would also provide moderate to high value habitat for several amphibian species. These species use many aquatic habitats including, but not limited to, wetlands, drainages, and roadside ditches.

Several herptile species were identified by F.C. Nuszdorfer, K. Klinka, and D.A. Demarchi (1991) as typical in habitats in the CDFmm zone similar to the Site and surrounding area. In addition, database searches were completed to identify incidental observations of herptile species within a 1 km search radius of the highway alignment to determine species that are most likely to be encountered in or near the Project footprint, with searches yielding several observations of both frog and salamander species. See *Table 11* for a summary of potential herptile species that may be expected at the Site. This list is based on queries completed through the CDC database including mapped occurrences and incidental observations of species at risk. The list was refined by available habitat and habitat conditions at the Site.

Details regarding at risk amphibian and reptile species that may be present at the Site are included in *Section 6.4.6*.

Table 11. Amphibian and Reptile Species with the Potential to be Present in the Study Area (Nuszdorfer et al. 1991, Habitat Wizard 2023).

Common Name	Scientific Name	Habitat Preference	Likelihood of Prescence based on Suitable Habitat
Frogs and Toads			
Northern Pacific tree frog	*Pseudacris regilla*	• Outside the breeding season, in early spring, found in woodlands, meadows, pastures, and even urban areas, often quite far from the nearest body of water. • During the breeding season, usually found in shallow, often temporary, wetlands, including ponds and woodland pools. Sometimes found in garden ponds, roadside ditches, and flooded forest service roads.	Low
Northern red-legged frog*	*Rana aurora*	• Optimal breeding habitats are highly vegetated, permanent water bodies up to 2400 m. • Outside of the breeding season, may disperse up to 4 km from breeding sites, often into moist forests. • Can be found in a variety of forest successional stages and may forage on land. • Hibernation may be aquatic or underground in terrestrial habitats.	High
Western toad*	*Anaxyrus boreas*	• Preferred breeding sites permanent or temporary water bodies that have shallow sandy bottoms. • After breeding, adults disperse into terrestrial habitats such as forests and grasslands. • They may roam far from standing water, but they prefer damp conditions.	Moderate to High
Salamanders and Newts			
Ensatina	*Ensatina eschscholtzii*	• Non-migratory, can be found in a variety of habitats but are typically seen in forests. • Fully terrestrial; require moist habitats., commonly associated with areas with abundant woody debris and leaf litter. • Overwinter in mammal burrows, root hollows, underground cavities.	High
Long-toed Salamander	*Ambystoma macrodactylum*	• Breed in large, shallow lakes and ponds with boggy edges and no predatory fish are best. • On land, valley bottoms and moist forests not far from water are preferred.	Low
Northwestern salamander	*Ambystoma gracile*	• Dependent on both forests and permanent water bodies. • Found in a wide variety of habitats, they are most common in mature, cool, moist forests, where they spend most of their time underground.	High
Roughskin newt	*Taricha granulosa*	• Adults primarily found in older mixed forests with abundant litter and woody debris, sometimes in cedar forests (rarely). • Breeding occurs in ponds, bogs, swamps, and slow-moving streams, mainly in the spring	Moderate to High

Common Name	Scientific Name	Habitat Preference	Likelihood of Prescence based on Suitable Habitat
Wandering salamander*	*Aneides vagrans*	• Fully terrestrial, require very moist environments. • Prefer coastal mature and old-growth forests, typically with stands of Douglas-fir and Western hemlock at low elevations. • Often found in trees. • Hibernate over winter below the frost line in talus slopes, mammal burrows, root hollows, and rock crevices.	High
Western red-backed salamander	*Plethodon vehiculum*	• Found in coniferous forests, on talus slopes and in shaded ravines from sea level to approximately 1200 m under rocks, logs, leaf litter and other forest debris. • Commonly associated with rocky areas and the edges of streams and seeps.	High
Reptiles			
Northern Alligator lizard	*Elgaria coerulea*	• Prefer rocky outcropping, talus slopes, and streams in Douglas-fir and Hemlock forests but will occupy a diversity of habitats. • Require a large amount of surrounding vegetation and rocks or debris for cover. • Hibernation occurs in rock crevices.	High
Northwestern gartersnake	*Thamnophis ordinoides*	• Terrestrial but often found near aquatic habitats in areas that are densely vegetated like meadows and forest edges. • Cover objects are important microhabitat features affording shelter and thermoregulation opportunities. • Hibernation is in deep rock caverns or crevices	High
Sharp-tailed snake*	*Contia tenuis*	• Hibernate in south-facing rocky slopes. • Spend most of their time underground or buried in the substrate. Otherwise found under cover objects like rock and coarse woody debris. • Associated with Coastal Douglas-fir and Arbutus forests. • Found in moist, open woodlands, near streams.	Moderate to High
Western gartersnake	*Thamnophis ordinoides*	• Primarily terrestrial, occurring in a variety of habitats including meadows, forest clearings, and along the edges of thickets. • Garter snakes rely on adequate cover from predators and are likely to spend much of their time thermoregulating under various types of cover.	Moderate to High

Note: *Indicates a species at risk in BC.

Pre-construction salvages under a valid Wildlife Permit obtained by the BC Ministry of Forests (MoF) will be required to relocate any individuals outside of the Project footprint and are the responsibility of the Contractor; refer to *Section 10.4.5 – Wildlife Salvages* for details.

6.4.2. Large Mammals

In CWH and CDF BGC zones the black-tailed deer (*Odocoileus hemionus columbianus*), black bear (*Ursus americanus*), and cougar (*Puma concolor*) are the most common large mammals (Pojar et al 1991; Nuszdorfer et al. 1991). No observations or evidence of large mammal presence occurred during the Site

visits. Given the narrow travel corridor, human activity, and high traffic volumes, it is unlikely that large mammals would frequent the Project the area.

6.4.3. Bat Species and Habitat

BC is the most diverse region in Canada for bats with at least 16 species found in the province. Bats are important components of healthy ecosystems and are thought to be important in nutrient cycling by moving nitrogen from aquatic systems (insects) to upland forests communities. Bats may also serve as indicators of the health of an ecosystem due to their sensitivity to pollution (Craig et al. 2014). At least nine bat species are anticipated to utilize habitats within the Project study area, as summarized in *Table 12*.

6.4.3.1. Habitat and Life Stages

Bat species require a variety of habitat features, including roosting spaces in rock features or trees. Preferred habitat for bats is generally in areas where they can find suitable roosting and foraging habitat close together (Craig et al. 2014). Rock crevices in any type of rock may also function as a hibernation site for bats. Rock features that may support bat use include crevices in rock or spaces in rock piles, cliff faces, rock outcrops, split boulders, stacked rock, and talus slopes (Craig et al., 2014, ENV 2019). Rock features such as cliffs are also utilized by bats, especially if the rock features have warm aspects. Connectivity of habitats is also critical, and roost and site fidelity is often high in bat species, meaning they will often re-use the same roosts and foraging areas every year, as long as they are available.

Tree characteristics that may support bat use include cavities in wildlife trees and older branches hidden by foliage. Generally, bats prefer old, dead, large diameter trees with features such as peeling bark (most bark intact but loosening), cracks and crevices; vertical hollow cavities accessed via a stem scar, or woodpecker excavations. They will use other trees in varying stages of decay as long as the tree provides a suitable crevice, hole or crack for roosting and suitable access and bat features are at least 3 m from the ground (Craig et al. 2014; ENV 2019).

Bats in temperate areas have two strategies to cope with winter (Brigham 1993):

1) One species migrates south to warmer areas where they may remain active or hibernate, returning north to breed (e.g., hoary bat); and
2) Most species hibernate rather than migrate (i.e., in sheltered spots including caves, abandoned mines, or deep rock crevices).

The mating period of most bats likely occurs from mid-September until the end of November, when adult male and female bats are reacquainted after spending the summer at separate roost sites. Most bat species exhibit swarming during the courtship period, often in close proximity to the hibernaculum. This heightened activity is detectible near the hibernaculum. Hibernacula sites are selected for their thermally stable conditions and for the protection from predators. While caves and deep crevices are used throughout BC, tree cavities are known to be used as well, especially in the parts of the province with mild winters. The hibernation period likely extends between November and March in the region. Winter hibernation sites are critical for bats as they have a finite amount of fat that must sustain them for the duration of the hibernating period. Disturbances causing arousal can burn extra fat. Continued disturbance to bats during hibernation can prove fatal by causing bats to starve once their energy reserves are depleted (ENV 2019). Relatively few bat hibernacula are known in BC, likely because most are in deep crevices and inaccessible to

Table 12. Bat Species Commonly Present in the Project area (Raincoast 2023; Pojar et al. 1991; Nuszdorfer et al. 1991; BC CDC 2023; Craig et al .2014l ENV 2019).

Common Name	Scientific Name	BC List	COSEWIC	SARA	Habitat Preferences	Summer / Maternity Roost	Winter Roost
California myotis	*Myotis californicus*	Yellow	-	-	Forages along edges or in interior forest habitat.	Roosts in rock and tree features such as snags, mines, bridges, rock outcrops & crevices. Tree roosts generally in old-growth, mature, old-seral trees.	Mostly unknown but should include deep crevices, caves, mines, and buildings
Little brown myotis	*Myotis lucifugus*	Blue	E (2013)	E	Forages in open habitats.	Roosts in rock and tree features such as snags, rock crevices, cliffs, mines. Tree roosts generally in old-growth, mature, old-seral trees.	Unknown but should include deep crevices, caves, and mines
Long-eared myotis	*Myotis evotis*	Yellow	-	-	Coniferous forests	Cliffs, snags, stumps, talus slopes, rock outcrops, crevices, mines	Mines, buildings
Long-legged myotis	*Myotis volans*	Yellow	-	-	Forages in open habitats.	Roosts in rock and tree features such as cliffs, rock crevices, snags, stumps. Tree roosts generally in old-growth, mature, old-seral trees.	Unknown but should include deep crevices, caves, and mines
Yuma myotis	*Myotis yumanensis*	Blue	-	-	Forages in open habitats.	Roosts in rock and tree features such as snags, rock crevices, mines. Tree roosts generally in old-growth, mature, old-seral trees.	Unknown but should include deep crevices, caves, and mines

Common Name	Scientific Name	BC List	COSEWIC	SARA	Habitat Preferences	Summer / Maternity Roost	Winter Roost
Big brown bat	*Eptesicus fuscus*	Yellow	-	-	Forages in open habitats.	Roosts in rock and tree features such as snags, cliffs, rock crevices. Tree roosts generally in old-growth, mature, old-seral trees.	Buildings, mines, and likely rock crevices
Hoary bat	*Lasiurus cinereus*	Blue	E (2023)	-	Uses older, tall, mature trees with open canopy; flies in open habitats. Often chooses the tallest tree available. Open understory is essential.	Roosts on small twigs in open foliage. Requires tall trees with open space below to “drop and fly”.	***Migrates***
Silver-haired bat	*Lasionycteris noctivagans*	Yellow	E (2023)	-	Forages in open habitats.	Trees, snags (cottonwoods)	Snags, mines, buildings
Townsend’s big-eared bat	*Corynorhinus townsendii*	Blue	-	-	Forages in riparian areas, wetlands, forest edges and open woodland.	Cliffs, caves, buildings, mines	Mines, caves, rock crevices

Note: COSEWIC designation ‘E’ indicates Endangered.

researchers. The loss of hibernacula and/or the bat populations that rely upon them from human activities can have severe impacts on the population within the region (Craig et al. 2014). Some bats species (i.e., big brown bat, Yuma myotis, Townsend's big-eared bat, silver-haired bat, and California myotis) naturally awaken infrequently over the winter from their torpid state and may be more active in winter than previously assumed with movements appearing to occur during warmer weather in winter. During these periods, bats may move to different roosting areas within the hibernation site or move outside the hibernation feature and relocate to alternate hibernacula.

Emergence from hibernation begins when the weather warms in March and likely extends through April in the study area. Pregnant females move to roosts near foraging areas and ultimately settle at established maternity roost sites by early summer where they remain until pups are born in late June. In BC, females only produce a single pup. Pups typically become volant by late July and the maternity colony may relocate to another roost later in August. When pups become volant there is a sharp increase in acoustic activity near maternity colonies. Bats are long-lived with one record of a little brown myotis exceeding 40 years (B. Fenton pers. comm.).

6.4.3.2. Bat Survey Results

Rocky cliff habitat as well as mature trees present within the study area has been identified as potentially providing roosting sites and overwintering hibernacula for bat species. Mature trees and wildlife trees along the alignment may also provide roosting habitat in both summer and winter.

The assessment completed in October and November of 2019 that targeted cliff areas along the western side of the alignment using an acoustic recording device did not result in the detection of bat activity. The results of the assessment completed in August of 2023 was completed by transect acoustic sampling that targeted potential maternal roosting colonies in cliff face areas during evening emergence times. The result of this assessment strongly suggest that there is roosting for a number of bat species along the cliffs.

Nine species were identified through the transect survey, as summarized in *Additional point* count surveys completed in November and December of 2023 attempted to detect bats that might be active during the early stages of hibernation. Fall is typically the time when most species mate and this often includes aerial displays and the generation of "songs". This activity usually occurs in the vicinity of a hibernacula. No detections were recorded during this survey period.

Environmental protection measures will be required to mitigate impacts to bat species, or their habitat/roosting sites, as associated with proposed Project activities. Mitigations associated with the protection of bat species is included in *Section 10.4.2.*

. Both the Townsend's big-eared bat and long-eared myotis were only detected once. Townsend's big-eared bats produce a low amplitude call so it is quite possible that other calls did not register on the detector. This Blue-listed species uses cavernous roosts in rocks. It is surprising that so few long-eared myotis were detected as they commonly use crevices in rock faces for roosting. The silver-haired bat had the most detections, this species has very flexible roosting habits so they could be using rock and/or trees as roost sites. Hoary bats were consistently recorded in relatively low numbers both nights which is not surprising given that they are solitary roosters, usually in tall trees. Big brown bats were only detected on the first night, which is not surprising as they are the first to emerge in the evening and the second night was staggered by 10 minutes to produce a temporal variation in data collection. The remaining Myotis species

occurred in moderate numbers but certainly indicate that rock crevice roosting was likely. The data obtained were not rigorous enough to enable the identification of maternity roosts, but it seems likely that some of the detections should be indicative of maternity roosts in the Project area.

Table 13. Bat Survey Acoustic Detections from 2023 summer transect recordings.

Species	August 2	August 3
Townsend's Big-eared Bat	1	0
Big Brown Bat	3	0
Hoary Bat	4	4
Silver-haired Bat	31	8
California Myotis	6	5
Long-eared Myotis	1	0
Little Brown Myotis	6	13
Long-legged Myotis	4	2
Yuma Myotis	3	2
TOTAL	**55**	**34**

Additional point count surveys completed in November and December of 2023 attempted to detect bats that might be active during the early stages of hibernation. Fall is typically the time when most species mate and this often includes aerial displays and the generation of “songs”. This activity usually occurs in the vicinity of a hibernacula. No detections were recorded during this survey period.

Environmental protection measures will be required to mitigate impacts to bat species, or their habitat/roosting sites, as associated with proposed Project activities. Mitigations associated with the protection of bat species is included in *Section 10.4.2*.

6.4.4. Birds

The Goldstream River Provincial Park contains old growth Douglas-fir forest, and the associated plant communities found in the area provide ample habitat for a variety of avian species. Typical bird species that utilize habitat types in the CWH and CDF BGC zones are summarized in *Table 14*. A targeted bird activity assessment was not completed during the Site visits completed for the Project; however, a pileated woodpecker was observed within the mature trees adjacent to the highway during the 26 April 2019, Site visit.

A targeted assessment for pileated woodpecker nesting cavities was completed in August and December of 2023 and is summarized below in *Section 6.4.4.2.*

Table 14. Typical bird species in the CWH and CDF BGC zones (Pojar et al. 1991; Nuszdorfer et al. 1991).

Common Name	Scientific Name	Habitat Preference
Great horned owl	*Bubo virginianus*	Old growth coniferous forest
Saw-whet owl	*Aegolius acadicus*	Old growth coniferous forest
Barred owl	*Strix varia*	Old growth coniferous forest
Sooty grouse	*Dendragapus obscurus*	Old growth coniferous forest
Ruffed grouse	*Bonasa umbellus*	Old growth coniferous forest
Band-tailed pigeon	*Patagioenas fasciata*	Old growth coniferous forest
Pileated woodpecker	*Dryocopus pileatus*	Old growth coniferous forest

Common Name	Scientific Name	Habitat Preference
Northern flicker	*Colaptes auratus*	Old growth coniferous forest
Hairy woodpecker	*Leuconotopicus villosus*	Old growth coniferous forest
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Old growth coniferous forest
Steller's jay	*Cyanocitta stelleri*	Old growth coniferous forest
Chestnut backed chickadee	*Poecile rufescens*	Old growth coniferous forest
Red-breasted nuthatch	*Sitta canadensis*	Old growth coniferous forest
Winter wren	*Troglodytes hiemalis*	Old growth coniferous forest
Common raven	*Corvus corax*	Various
Western flycatcher	*Empidonax difficilis*	Riparian
Black-headed grosbeak	*Pheucticus melanocephalus*	Deciduous thickets and shrubbery
White-crowned sparrow	*Zonotrichia leucophrys*	Deciduous thickets and shrubbery
Black swift	*Cypseloides niger*	Rocky cliffs
Cliff swallow	*Petrochelidon pyrrhonota*	Rocky cliffs

6.4.4.1. Protected Nests under Wildlife Act 34b

Section 34b of the provincial *Wildlife Act* states that it is an offence, except as provided by regulation, to possess, take, molest, or destroy the nests of a number of raptor and heron species in BC (Province of BC 1996b).

- The WiTS Atlas (2023) was reviewed for data on the presence of bald eagle *(*Haliaeetus leucocephalus) and osprey (Pandion haliaetus) nests in the study area; no known nests were mapped adjacent to the Project footprint, and the closest bald eagle nest was recorded within the estuary to the north of the Project footprint (approximately 600 m away).
- The British Columbia Great Blue Heron Atlas (CMN 2018a) was reviewed for the presence of recorded great blue heron (*Ardea herodias*) within or adjacent to the study area; no known nests or rookeries were mapped within 5 km of the highway alignment.
- Peregrine falcon (*Falco peregrinus*) typically nest on rock ledges high on steep cliffs, mostly in undisturbed areas (MOE 1998) from late March to late August. No obvious stick nests were observed during surveys completed at cliff areas along the western side of the highway alignment.

Protection measures associated with nests protected under Section 34b of the *Wildlife Act* is included in *Section 10.4.1.*

6.4.4.2. Migratory Birds Regulations Schedule 1

Updates to the Migratory Birds Regulations (MBR) (Canada 2022) under the *MBCA* came into force on 30 July 2022. The changes add new provisions for certain migratory birds and clarifies when their nests are protected. For most birds regulated under the *MBCA*, nests are protected when they contain a bird or viable egg. However, the 2022 MBR update provides year-round protection to the nests of 18 species now listed under Schedule 1, because they are re-used annually. For these nests, a designated waiting period is now

required. This means the nest must be protected year-round until the nest can be deemed abandoned. That is, the nest has remained unoccupied during a designated waiting period.

An understanding of potential *MBCA* protected species within the Project area is recommended. Adherence to this *Act* can typically be completed using best management practices (BMPs). Vegetation clearing within the bird breeding window will be required to adhere to this *Act* and typically requires an AQP to complete a pre-clearing or pre-construction survey to ensure no birds, their eggs, and/ or active nests, are situated within the Project footprint.

If there is a need to damage, disturb, destroy, or remove a nest of a Schedule 1 species, there is a new requirement to provide notice to Environment and Climate Change Canada (ECCC) and register a nest under the new Abandoned Nest Registry and monitor the nest for the designated waiting period to document that it is not in use.

Pileated Woodpecker

Nests of Pileated woodpecker have the potential to be present in the Project area and are included in the list of MBR Schedule 1 species as having a designated waiting period of **36 months**, even when unoccupied. Pileated woodpeckers may be considered a keystone species in that they have a significant influence on an ecosystem that they occupy by acting as a habitat modifier and that cavities provide habitat for many other species of birds and mammals that rely on these cavities for nesting/denning and overwintering survival (Aubry and Raley 2002; MoF 2023).

Trees used for nesting are typically in solid trees with heart rot and contain only one cavity. It is rare to find a tree with more than one nest cavity. If more than one nest cavity is identified in the same tree, they are usually more than 1 m apart. Nearby trees may also contain dummy cavities. Nest cavity entrances are typically round or slightly oval with a diameter of approximately 12 cm (MoF 2023).

Roosting cavities are used by pileated woodpeckers for sleeping or roosting at night. Roost trees are often hollow with several entrances, which are excavated in all seasons. Entrance holes to roost cavities may be less than 1 m apart and are slightly larger in diameter than nesting cavities. Nesting cavities may also be used as roosting cavities in the non-breeding season, making it difficult to determine the difference between roosting and nesting cavities outside of the breeding season. However, nesting cavities may eventually become roosting cavities as the tree ages (MoF 2023). Feeding cavities are different in that they have rough edges and don't lead to a large cavity (only excavated about 5 to 20 cm into a tree).

A study completed by Hartwig et al. (2004) that looked at cavity trees used by pileated woodpecker on southeast Vancouver Island confirmed that nest cavity trees used by this species are large in diameter and are more likely to be in older structural stages in maturing climax successional stages than non-cavity trees. Grand fir, Douglas-fir, and red alder were all used as nest trees, with Douglas-fir being the preferred species. The study concluded that the diameter of nest trees varies depending on the location, tree species, and forest characteristics, such as the availability of large dead trees (i.e., cavity trees are chosen based on the largest available tree in the area). The preference for large diameter trees probably relates to their need for suitably sized nest chambers in which to raise young (Hartwig et al. 2004).

Pileated woodpecker nesting cavity surveys were completed by AQPs on 9 August and 28 November 2023. Trees with nesting cavities were not identified within the clearing and grubbing boundaries surveyed for the Project; therefore, there is no need to register any cavities with ECCC under the Abandoned Nest Registry

at the time of writing. Several trees in the Project study area were noted to have evidence of pileated woodpecker use, with both inferred roosting and foraging cavities observed. Preferred tree characteristics for use appeared to be large diameter, dead, Douglas-fir trees.

Pre-construction surveys will still be required in advance of tree removal for the Project to ensure that trees suitable for nesting are still free of nesting cavities prior to removal (refer to *Section 10.4.1.3* for details).

6.4.5. Wildlife Trees

A wildlife tree is defined as a dead or deteriorating tree that provides essential habitat for any animal species. Several moderate to high valued wildlife trees were observed around the current road alignment during the Site visits. The trees were primarily coniferous snags that were in various stages of decay. Many of the wildlife trees provide suitable habitat or perches for birds of prey overlooking the river, and for woodpeckers. There were also several wildlife trees observed with cavities that are suitable for nesting.

Wildlife trees are one of the most valuable components of stand-level biodiversity providing wildlife habitat, a present and future source of coarse woody debris, a source of native mycorrhizal fungi, and habitat for invertebrates; over 70 vertebrate species are known to be critically dependent on wildlife trees (BC 2006).

6.4.6. Wildlife Species at Risk

Provincial databases were used to search known elemental occurrences and incidental observations of at-risk species records and mapped critical habitat within 5 km of the Site (CDC 2023; iMapBC 2023; Habitat Wizard 2023). Queries included those for regional listings of provincially and/or federally designated threatened or endangered vertebrates and invertebrates known to have habitat within the CDF and CWH BGC zones and recorded within 0.5 km of the Project alignment. Provincially and *SARA* listed wildlife species potentially occurring on the Site are listed in *Appendix E*.

A review of species-specific habitat requirements informed an assessment of potential species at the Site. CDC listed wildlife species potentially present within or near to the Project footprint based on mapped and occurrences, incidental observations, and habitat preferences are listed in *Table 15*. These species were not observed on the Site during the field visits; however, surveys specific to wildlife species at risk have not been completed for the Project to date.

Several BMPs and protection measures are recommended to avoid impacts to wildlife species at risk. Details are included in *Section 10*.

Table 15. Wildlife Species at Risk Potentially Present Within 0.5 km of the Project Footprint.

Common Name	Scientific Name	BC List	COSEWIC*	*SARA**	Likelihood of Occurrence
Birds					
Western screech-owl, *kennicottii* subspecies	*Megascops kennicottii kennicottii*	Blue	T (2012)	-	Moderate
Amphibians and Reptiles					
Northern red-legged frog	*Rana aurora*	Blue	SC (2015)	SC (2005)	High
Wandering salamander	*Aneides vagrans*	Blue	SC (2014)	-	High

Common Name	Scientific Name	BC List	COSEWIC*	*SARA**	Likelihood of Occurrence
Western toad	*Anaxyrus boreas*	Yellow	SC (2012)	SC (2018)	High
Sharp-tailed snake, pop. 1 (Pacific Coast population)	*Contia tenuis*	Red	T (2021)	E (2003)	High
Invertebrates					
Western branded skipper, *oregonia* subspecies	*Hesperia 5his5ado oregonia*	Red	E (2013)	E (2023)	Low
Common ringlet, *Insulana* subspecies	*Coenonympha tullia insulana*	Red	-	-	Low
Dun skipper	*Euphyes vestris*	Red	T (2013)	T (2003)	Low

Note: *COSEWIC and *SARA* designations are as follows: T – Threatened, SC – Special Concern, E – Endangered.

Western Screech-owl

Western screech-owl (*Megascops kennicottii kennicottii)* is a provincially blue-listed species that is considered Threatened by COSEWIC. Protected breeding sites for Western screech-owl occur within Goldstream Provincial Park. The main threats to populations are the influx of barred owls (*Strix varia*), habitat loss, and the removal of snags / dead trees that provide nest cavities (CDC 2023). Given the presence of standing dead trees within and adjacent to the Project footprint, there is a moderate likelihood of Western screech-owls occurring in the study area.

Northern Red-legged Frog

Northern red-legged frog (*Rana aurora*) is a provincially red-listed amphibian that is also listed as Special Concern by both COSEWIC and *SARA*. Mapped occurrences of this species were identified as overlapping with the Project footprint.

This species migrates between aquatic breeding sites, upland summer foraging areas, and overwintering areas during the active season. The primary threats to this species include predation by introduced species such as American bullfrog (*Lithobates catesbeianus*), road mortality, and urban development (CDC 2021).

Given the presence of aquatic and terrestrial habitats suitable for northern red-legged frog within the study area, there is a high likelihood of occurrence within or adjacent to the Project footprint. Mitigation measures could include limiting disturbance to vegetated areas along the river's edge and habitat enhancement of aquatic and riparian habitats.

Wandering Salamander

Wandering salamander (*Aneides vagrans*) is a provincially blue-listed species that is considered of Special Concern by COSEWIC. No mapped occurrences were identified during database queries; however, there is a known population of this species within the boundaries of Goldstream Park.

Wandering salamander is a terrestrial salamander species that inhabits low-elevation Douglas-fir and western hemlock forests of various ages. Their primary habitat is moist coniferous forests that have large woody debris or rock crevices. The primary threat to this species is logging and land disturbance (CDC 2022).

Given the presence of moist terrestrial habitats suitable for wandering salamander, there is a high likelihood of occurrence within or adjacent to the Project footprint. Potential mitigation measures could include retaining large woody debris and enhancing disturbed habitat by increasing habitat complexity. Wildlife surveys and salvages may be required to protect this species; refer to *Section 10.4.5* for details.

Western Toad

The Western toad (*Anaxyrus boreas*) is listed as Special Concern by both COSEWIC and *SARA* and is provincially yellow-listed. Although no mapped occurrences of this species have been noted in the Project area, there is a potential for its presence based on Site and habitat conditions.

This species is described as warty with yellowish, dusky, tan, gray or greenish dorsal colouring, with dark spots or mottling and a light strip along the middle of the back. Western toads occur in a wide variety of aquatic and terrestrial habitats including riparian and upland habitats around ponds, lakes, reservoirs, and slow-moving rivers and streams. Western toads also utilize a variety of terrestrial habitats in BC, including all forest and woodland types, shrubland, cropland/hedgerow, grassland/herbaceous cover, old fields, and suburban/orchard. Hibernacula are located in areas with loose soils and burrows. For shelter, they dig their own burrow in loose soil or use those of small mammals or seclude themselves under logs or rocks (CDC 2010a).

Western toads are active from spring until fall throughout their range, and migrate between aquatic breeding sites, upland summer ranges, and overwintering areas in spring and fall. They likely move very little in spring and summer, within small distinct home ranges less than or equal to about 0.1 ha. Toadlet dispersal involves forming large, post-metamorphic aggregations and moving away from aquatic breeding sites in large congregations (CDC 2010a).

Habitat characteristics observed at the Site have the potential to support this species (i.e., riparian and forested areas adjacent to the Goldstream River, proximity to estuarine/wetland areas at Finlayson Arm). Protection measures will likely be required during the Project to ensure no impacts to amphibian species associated with proposed activities.

Sharp-Tailed Snake

Sharp-tailed snake (*Contia tenuis*) are provincially red-listed, listed as Threatened by COSEWIC, and listed as Endangered by *SARA.* Although no mapped occurrences of this species have been noted in the Project area, there is a potential for its presence based on Site and habitat conditions, as well as its range which includes the southern end of Vancouver Island and the nearby Gulf Islands.

Sharp-tailed snake occur in a variety of habitats from relatively open Garry oak meadows to relatively open Douglas-fir stands. Habitat includes moist situations including at the edges of coniferous or hardwood forests. This snake generally is found under logs, rocks, fallen branches, or other cover (CDC 2010b).

This species is most active during the rainy season and likely moves into forested habitats in the winter and retreats underground during dry periods (CDC 2010b).

Habitat characteristics observed at the Site have the potential to support this species (i.e., riparian and forested areas). Protection measures will likely be required during the Project to mitigate impacts to reptile species associated with proposed activities.

6.4.7. Critical Habitat

Proposed critical habitat for western painted turtles occurs within the Project footprint. Western painted turtles require shallow waters of ponds, lakes, oxbows, and marshes, in slow-moving stream reaches, and in quiet backwater sloughs of rivers. Usually, their habitat contains muddy substrates with emergent aquatic vegetation, exposed vegetation root mats, floating logs, and open banks. The Project footprint does not provide suitable habitat for western painted turtles and no such no specific protection measures related to this species are required.

6.5. WATERCOURSES AND AQUATIC FEATURES

Goldstream River runs parallel to the Project alignment and is sourced by headwater lakes to the west. The river is a well confined watercourse with a riffle-pool-run morphology (*Photos 3* to *6*) and provides habitat for a variety of fish species. There are several smaller drainages crossing the existing highway alignment via culverts and flowing into Goldstream River, as well as a stone stacked wall in close proximity to the river supporting the existing road. A summary of the watercourses within the Project footprint, as well as known fish species, is provided in *Table 16*.

Table 16. Summary of Watercourses within the Study Area.

Gazetted Name	Watershed Code	Waterbody Identifier	Known Fish Species		SARA	COSEWIC
			Common Name	Scientific Name		
Goldstream River	920-211900	00000VICT	Chinook Salmon	*Oncorhynchus tshawytscha*	-	-
			Chum Salmon	*O. keta*	-	-
			Coho Salmon	*O. kisutch*	-	-
			Steelhead	*O. mykiss*	-	-
			Cutthroat trout	*O. clarkii*	-	-
			Rainbow trout	*O. mykiss*	-	-
			Smallmouth Bass*	*Micropterus dolomieu*	-	-
			Pumpkinseed*	*Lepomis gibbosus*	-	-
			Yellow Perch*	*Perca flavescens*	-	-
			Prickly Sculpin	*Cottus asper*	-	-
Unnamed tributary to Goldstream River	920-211900	N / A	N / A	N / A		

* Non-native species.

Source: Habitat Wizard (BC 2017) and iMapBC (iMapBC 2016) databases.

Multiple drainages were observed on the west side of the highway alignment that drain into Goldstream River by way of culverts underneath the highway. These drainages were considered non-fish bearing due to the steep gradient of the drainages coming off the cliffs. While these drainages do not provide direct fish habitat, they contribute food, nutrients, and base flows to Goldstream River. Measures to reduce the disturbance of these drainages should be considered.

The general fisheries timing windows for instream work on Vancouver Island is June 15 to September 15 (FLNRO, 2011), which the Project will be proceeding under as per approvals provided by federal and provincial regulators.

Photo 3. Goldstream River Bridge, south end of the alignment, north view.

Photo 4. Representative photo of the Goldstream River, upstream view.

Photo 5. Culvert outlet leading to the Goldstream River, upstream view.

Photo 6. Example of the stone stacked wall, south view

6.5.1. Groundwater

The Site is underlain by three aquifers, as summarized in *Table 17*. Groundwater flow is towards the river and regionally towards Finlayson Arm.

Table 17. Groundwater Aquifers underlying the Project site (iMapBC 4.0).

Aquifer Number	Aquifer Name or Description	Material Type	Subtype	Size (km^2)	Vulnerability
680	*Wark-Colquitz*	Bedrock	Fractured crystalline bedrock	209.0	Moderate
682	*Colwood, Langford, Metchosin*	Sand and Gravel	Unconfined sand and gravel – late glacial	24.1	Moderate
684	*Goldstream River mouth, Finlayson Arm*	Sand and Gravel	Unconfirmed sand and gravel – stream system	0.3	High

Three groundwater wells were identified within the park boundaries north of the Finlayson Arm Road turnoff, as summarised in *Table 18*.

Table 18. Groundwater Wells in the study area (iMapBC 4.0).

Well Tag	Owner	Intended Water Use	Installation Date	Depth (m)	Static Water Level (m)
114703	BC Parks	Unknown	Unknown – before 2008	11.5	Unknown
20080	BC Parks	Water Supply System	01 AUG 1966	11.5	1.8
105828	BC Parks	Water Supply System	01 OCT 1974 **Decommissioned in 2009*	16.8	7.0

7. Description of Works

7.1. INSTREAM WORKS

Goldstream River provides substantial aquatic habitat for aquatic adapted species, fish, and waterfowl. Sensitive Habitat Inventory and Mapping (SHIM) data has mapped occurrences of Chinook and Coho salmon spawning habitat within the Project footprint (CMN 2018b; *Appendix B*). Spawning habitat extends the entire length of Goldstream River downstream from the Hydro Dam to the river delta at Finlayson Arm, as evident in the SHIM database and through field observations. The riffle-pool-run stream morphology in the river provides pockets of potential spawning habitat below the Hydro Dam. Goldstream River is a highly productive watercourse that is designated as a 'Sensitive Stream' under the *WSA*. Three areas of impact will occur along the banks of the Goldstream River based on the current engineering design.

7.1.1. Goldstream Park Middle Wall No. 10410R

A retaining wall is proposed along the left bank of Goldstream River to accommodate the road widening, referred to as the Goldstream Park Middle Wall No. 10410R. A detailed cross section and plan view is shown in *Figure 8*, along with photographs of the river at this location. The retaining wall will have concrete faced panels, which requires construction of formwork, placement of reinforced steel, and pouring of concrete via truck-mounted pumper truck. All works in this location are to be above the HWM; however, the work zone will require isolation from the river (i.e. installation of temporary cofferdams) to mitigate impacts to aquatic features associated with the retaining wall works.

This section of the Goldstream River is documented in *Appendix F* as Reach 1. Reach 1 had a channel width of 11.0 m, a wetted width of 10.0 m and an average depth of 0.5 m with a bankfull depth of 2.3 m. Water temperature was 6.73°C, pH was 6.47, dissolved oxygen was 13.82 mg/L, and the conductivity was 0.074 ms/cm. The stream substrate consisted of 55% boulders, 35% cobbles and 10% gravel and exhibited run and ripple stream morphologies. The left bank was predominantly boulders and the right bank consisted of predominantly bedrock with boulder / cobble sections. This Reach had 30% canopy cover and fish habitat features included moss, instream vegetation, boulder habitat and overhanging vegetation from tree branches.

Overall, there was good, uniform spawning habitat across this reach. Rearing habitat was moderate with cover provided by boulders and, to a lesser degree, overhanging vegetation. Overwintering habitat at the time of the assessment was minimal due to the low water levels (0.5 m) and no deep pools observed. Overall fish habitat was good with a high potential for fish presence throughout the year.

Immediately downstream of the proposed retaining wall there was large boulder within the stream channel. As of the summer of 2020, this obstacle has been removed and enhancements have been installed in the area.

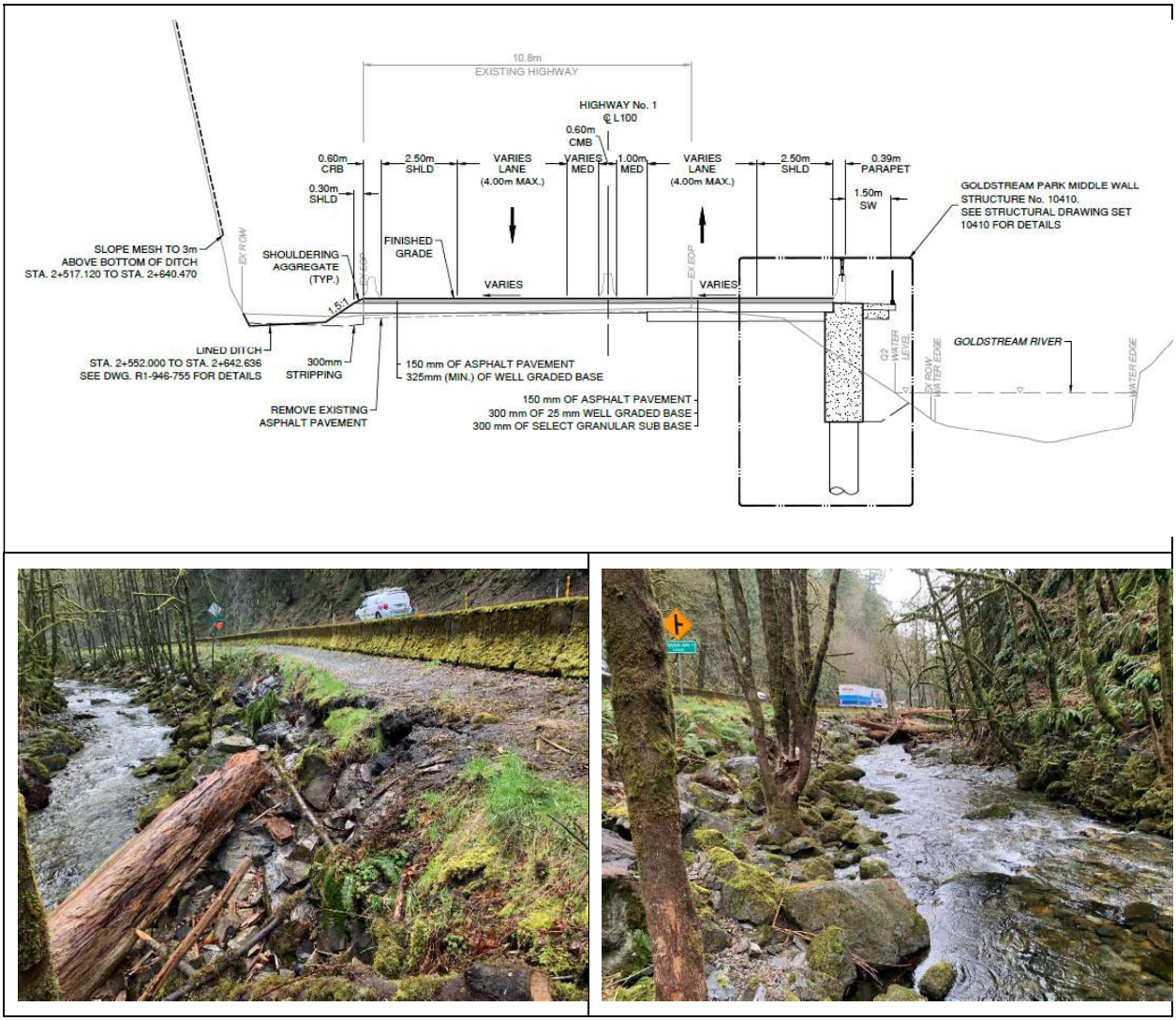


Figure 8. 100% Detailed Design Drawings of the proposed Retaining Wall at the north end of the Project (top row). Boulder and debris jam located at the downstream end of the proposed works (left photo – facing upstream, right photo – facing downstream). Debris jam and boulder were removed in May 2020.

7.1.2. Goldstream Park South Wall No. 14012R

A cantilever structure and associated retaining wall is proposed along the Goldstream River to accommodate the road widening while minimizing impacts to the Goldstream River. The detailed cross section is shown in *Figure 9*, along with a photograph of the river at this location. The scope of work in this location includes the removal of an existing stone stacked wall and construction of a new retaining wall (referred to as the Goldstream Park South Wall No. 14012R), as well as interlocking pile installation and excavation adjacent to the river associated with the cantilever construction. Isolation of a part of the river adjacent to the work zone will be required (i.e., installation of temporary cofferdams).

This section of the Goldstream River is documented in *Appendix F* as Reach 2. Reach 2 had a channel width of 13.0 m, a wetted width of 10.0 m, and an average depth of 0.34 m with a bankfull depth of 2.0 m. Water temperature was 6.73 °C, pH was 6.47, dissolved oxygen was 13.82 mg/L, and the conductivity was 0.074 ms/cm. The stream substrate consisted of 60% boulders, 30% cobbles and 10% gravel and exhibited run and ripple stream morphologies. The left bank consisted of a stone stacked wall, presumably constructed at the time of the original highway construction. The right bank consisted of predominantly bedrock with boulder / cobble sections. This Reach had 10% canopy cover and fish habitat features included moss instream vegetation, boulder habitat and overhanging vegetation from tree branches.

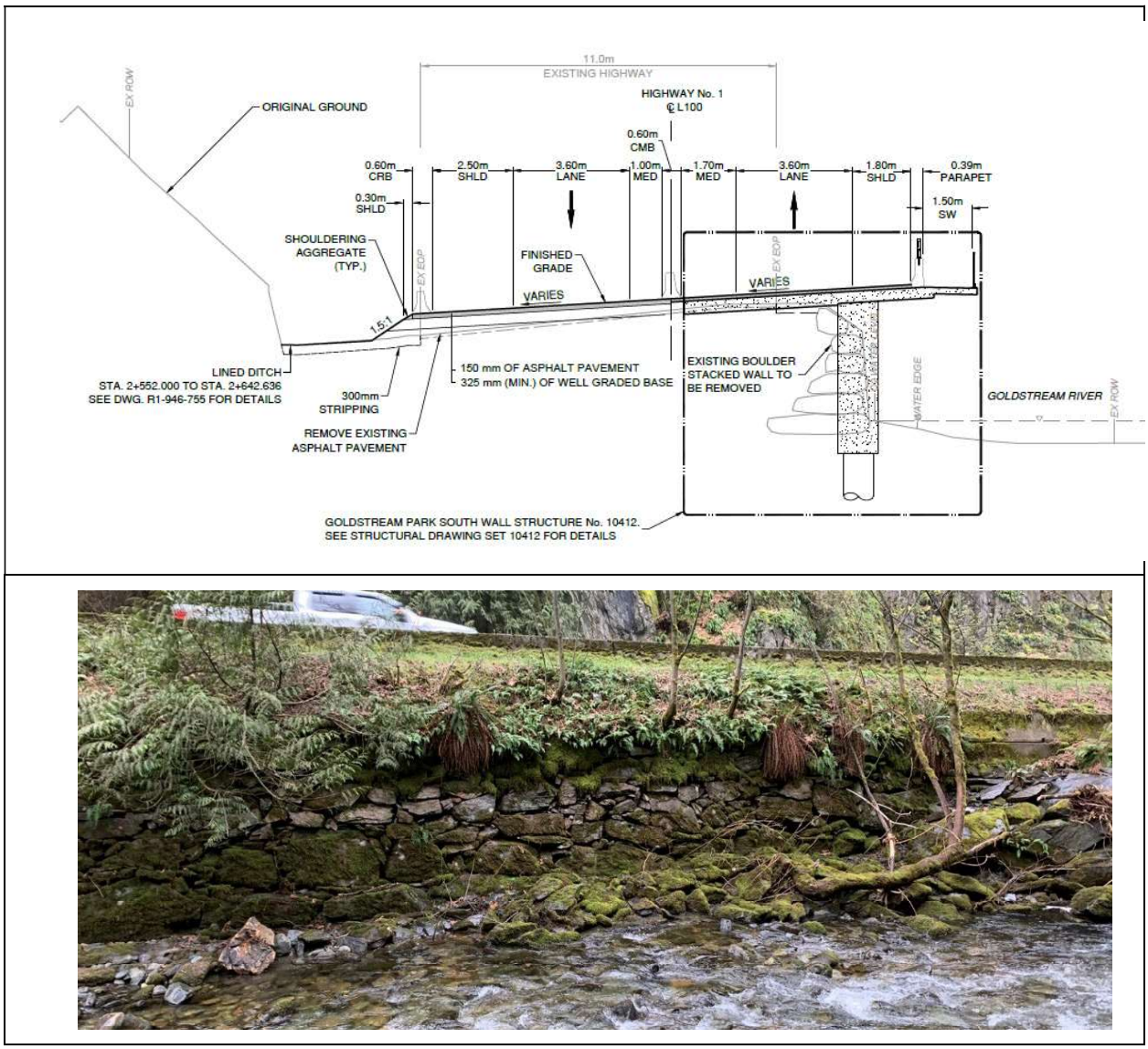


Figure 9. 100% Detailed Design Drawings of Cantilever structure (top row) at the Stone Stacked Wall (bottom row).

A Site visit conducted on 10 November 2021, with the Malahat First Nation, did reveal that as there were fish in the river system at the time, spawning activity/behavior could be observed 10 m upstream of the cantilever location. It was confirmed that there was reduced potential for spawning directly in front of the structure based on presence, behavior, and riverbed composition. Rearing habitat was moderate with cover

provided by boulders and, to a lesser degree, overhanging vegetation. Overwintering habitat at the time of the assessment was minimal due to the low water levels (0.34 m) and no deep pools observed. Overall fish habitat was good with a high potential for fish presence throughout the year.

7.1.3. Retaining Wall South End (S102)

A retaining wall is proposed along the Goldstream River to accommodate the road widening. The detailed cross section is shown in *Figure 10*. This section of the Goldstream River is documented in *Appendix F* as Reach 3.

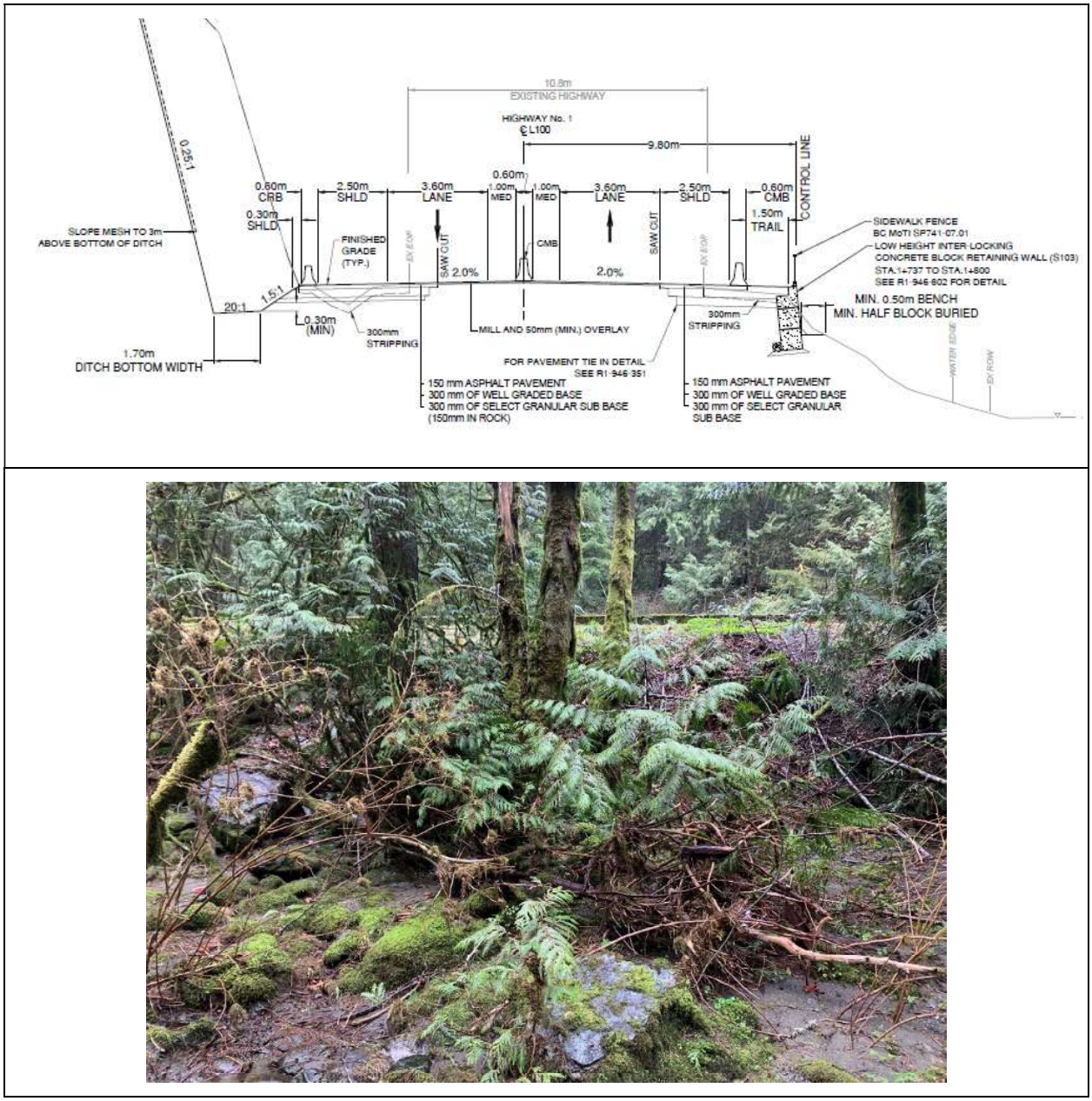


Figure 10. 100% Detailed Design Drawings of the Retaining Wall at the Southern End of the Project (top). View of the riparian area and the edge of the stream channel at the retaining wall location (bottom).

Reach 3 had a channel width of 19.0 m, a wetted width of 16.0 m and an average depth of 0.22 m with a bankfull depth of 1.3 m. Water temperature was 6.73°C, pH was 6.47, dissolved oxygen was 13.82 mg/L and the conductivity was 0.074 ms/cm.

The stream substrate consisted of 20% boulders, 60% cobbles and 20% gravel and exhibited run and ripple stream morphologies. The left and right bank consisted of a gently sloped vegetated riparian area. This Reach had 70% canopy cover and fish habitat features included moss instream vegetation, boulder habitat and overhanging vegetation from tree branches.

A high percentage of the stream was suitable as spawning habitat across this reach. Rearing habitat was moderate with cover provided by boulders and, to a lesser degree, overhanging vegetation. Overwintering habitat at the time of the assessment was minimal due to the low water levels (0.22 m) and no deep pools observed. Overall fish habitat was good with a high potential for fish presence throughout the year.

7.1.4. Stormwater Management System

There are five existing drainage culverts within the Project footprint that range between 400 mm and 600 mm and vary in length from 15 m to 48 m (McElhanney 2022). Four of the five existing culverts are undersized and do not meet MoTI conveyance standards; these culverts will require upgrades to meet MoTI's drainage criteria. One culvert does meet the MoTI standard and does not require upgrades under the current drainage pattern; however, replacement of this culvert is warranted due to the highway being widened by approximately 2 m. An additional storm sewer has also been added to the design at the north extent of the Project to convey any surface runoff to a detention tank and oil and grit separator unit for water to be treated before discharging into Goldstream River (*Figure 11*).

Figure 11. 100% detailed design of the stormwater management system (McElhanney 2022).

7.1.5. Pedestrian Bridge

A clear span pedestrian bridge is proposed to connect the roadside trail with the pedestrian overpass to allow safe passage across the highway and to allow foot access to the entire trail network within Goldstream Park (*Figure 12*). There will be no temporary or permanent impacts below the high-water mark associated with this scope of the Project (Drawing #: 10407-002).

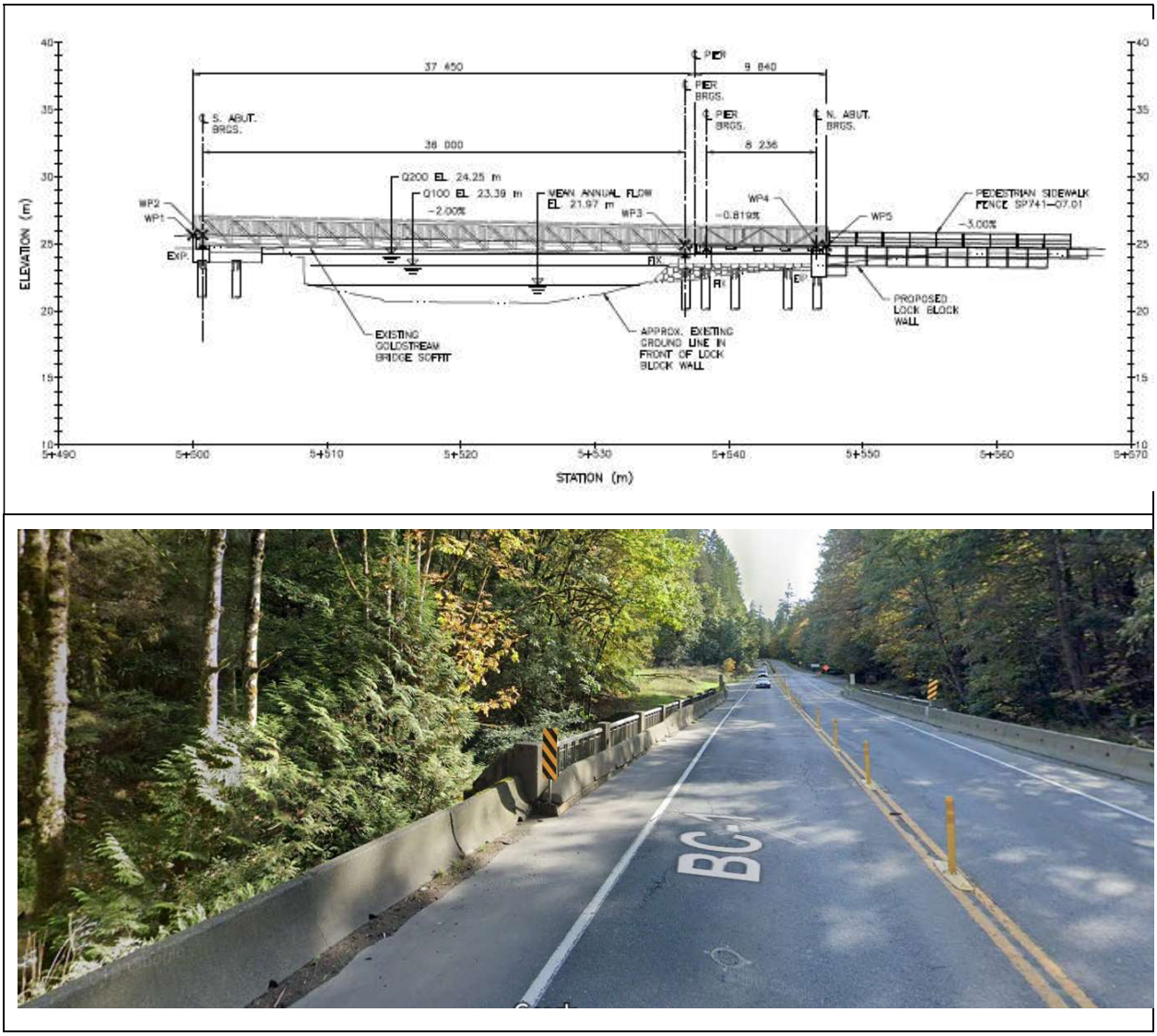


Figure 12. 100% detailed design of the pedestrian bridge crossing Goldstream River on the east side of the highway adjacent to the Goldstream River Highway Bridge.

7.1.6. Habitat Restoration

Habitat restoration has been proposed for an area upstream of the Project location within the Goldstream River where previous DFO habitat enhancements have occurred (*Figure 13*). The restoration works will add anchored large woody debris to provide instream fish habitat. Coho gravels will be imported in the areas between the large woody debris to provide future spawning potential. The root wads will provide habitat for insects and add nutrients to the soil. The tree trunks are designed to help deflect flows and prevent rafted woody debris piling up and blocking the DFO channel confluence. Large woody debris will be removed from

the historical DFO habitat enhancement channel and be dispersed in the planting area. Semi-buried woody debris will provide nutrients, bug habitat, and moisture retention within the planting area. Soils within the planting area will be treated with the “rough and loose” technique to provide enhanced ecosystem benefits and closer mimic natural riparian areas.

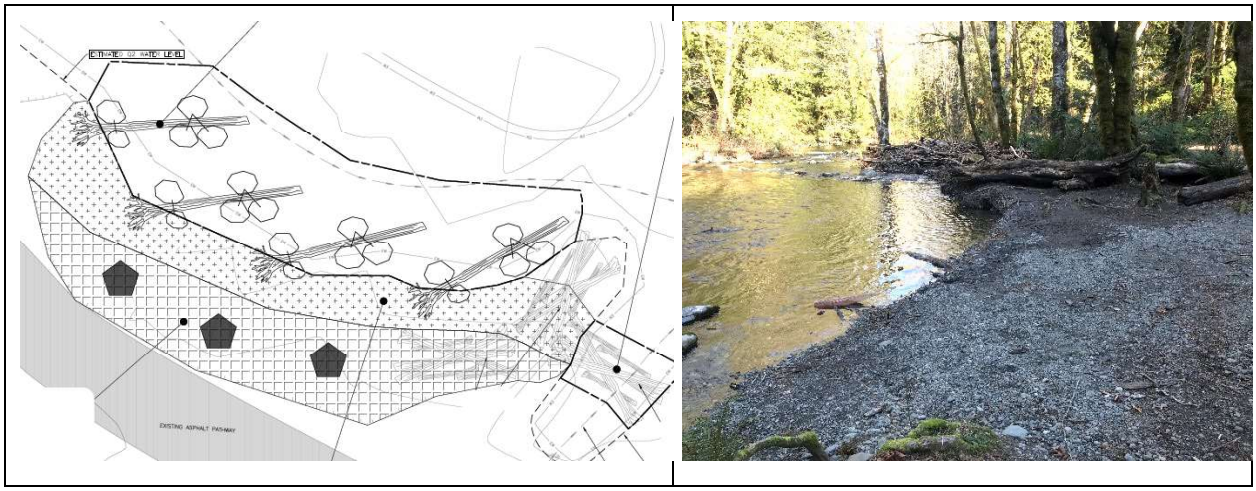


Figure 13. Habitat restoration approved for the banks of the Goldstream River, upstream from the Project location.

7.2. TERRESTRIAL WORKS

7.2.1. Pedestrian Overpass

A pedestrian overpass will be constructed to provide a safe crossing location near the Goldstream River bridge, at the south end of the alignment. This crossing will connect the existing trail network and provide safe access to all of the park trails (*Figure 14*).

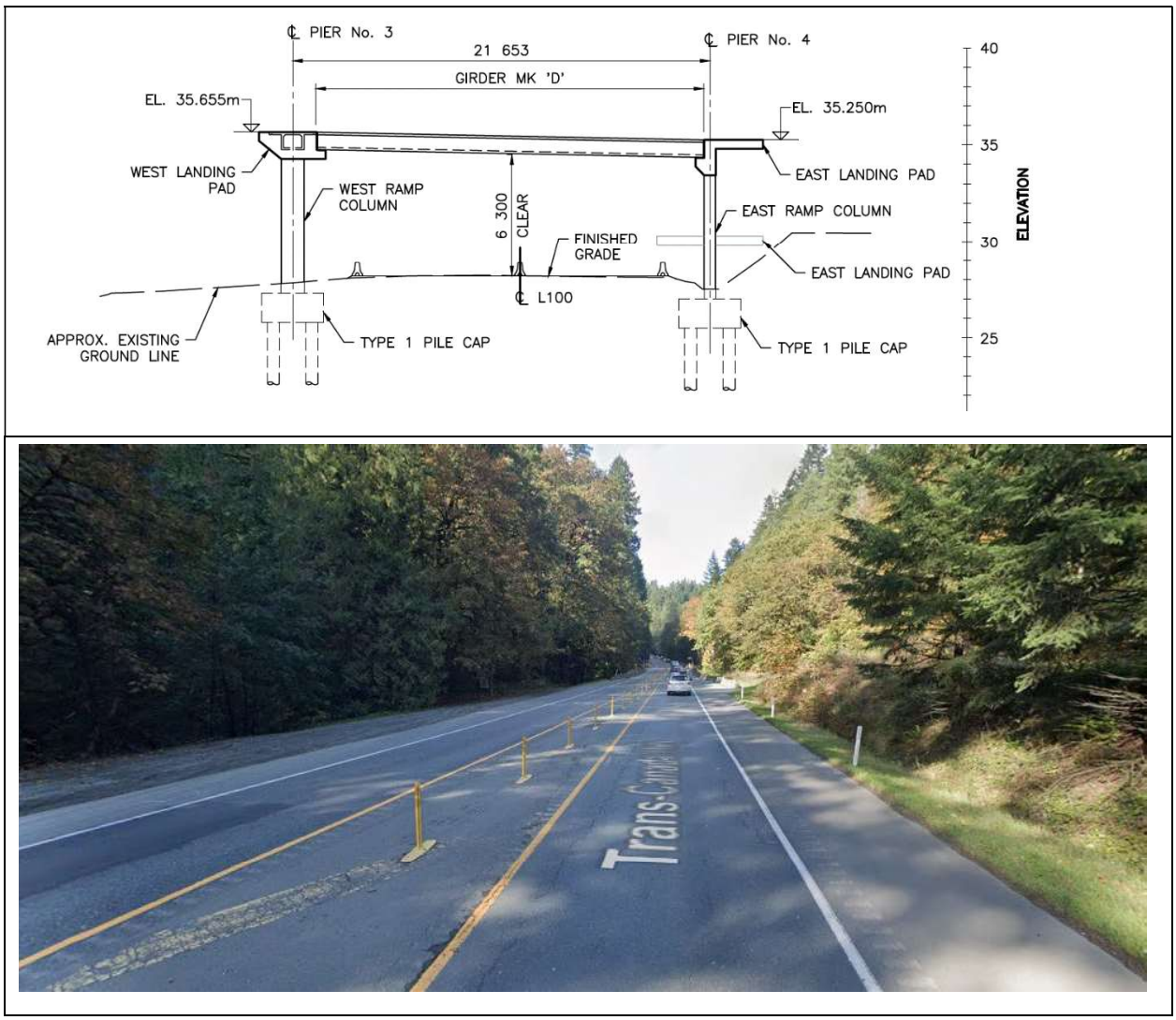


Figure 14. 100% detailed design for the pedestrian overpass (top). Location view of the overpass (bottom).

7.2.2. Pedestrian Underpass

A pedestrian underpass will be constructed to provide dedicated foot traffic an opportunity to safely cross the highway to access Niagara Falls from the main park (*Figure 15*). The underpass will connect the existing trail network and will not interfere with any water flows.

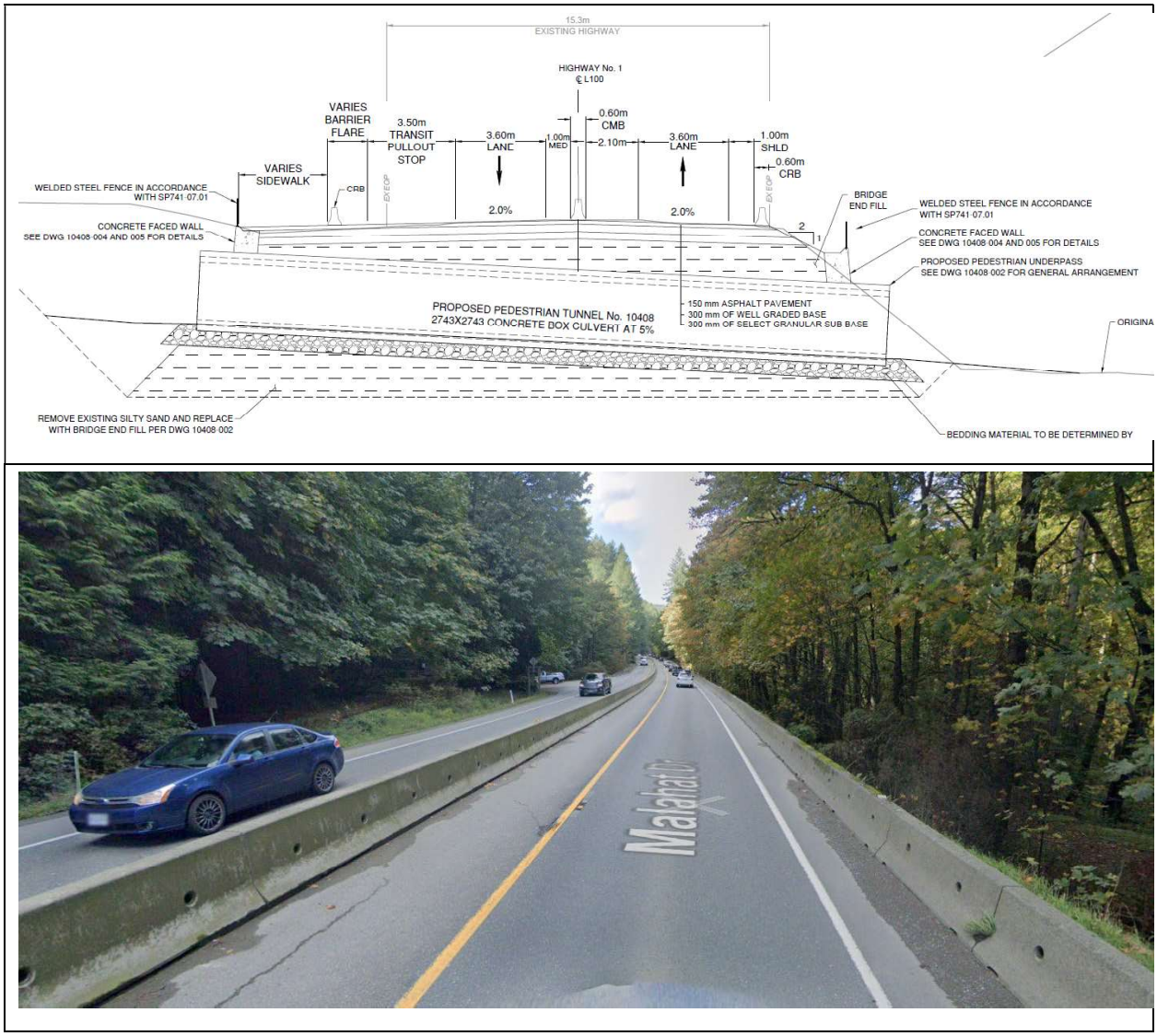


Figure 15. 100% detailed design of the pedestrian underpass (top). Location of the underpass (bottom).

8. Summary of Environmentally Sensitive Features

A variety of environmentally valuable components were considered in the development of this EA, including but not limited to soils, vegetation, ecosystems, wildlife and habitat, water quality, and fish habitat. Environmentally sensitive features have special attributes worthy of retention or special management attention to protect their value (MOE 2014a). The following criteria was used to facilitate the identification of potentially environmentally sensitive features within the study area (AEP 2015):

- *High Quality of Biotic Community:* minimally disturbed areas and / or areas with diversity for a specific habitat type. These biotic communities contain elements of conservation concern including species at risk and rare plants / ecosystems, riparian areas, or large natural areas.

- *Ecological Function—Natural*: The area is important for the healthy maintenance of a natural system with and / or beyond its boundaries by maintaining biodiversity and / or acting as a staging area or corridor for wildlife within the system.
- *Uniqueness*: The habitat or ecosystem component has limited representation within the province or municipality; and / or the area provides representative habitat for wildlife of recognized significance.
- *Important Aquatic Features*: Presence of rare or unique aquatic ecosystems and habitat including key areas that contribute to water quality, water quantity, and biological connectivity.

Several environmentally sensitive features have been identified in the study area and are outlined in the following sections. An assessment of environmental impacts associated with proposed Project activities is provided in *Section 9*.

8.1. VEGETATION FEATURES

There may be potentially suitable habitat for some sensitive vascular plant species located in the mature riparian forest areas, and at-risk ecosystems overlapping the Project footprint. It was determined that:

- The red-listed ecosystem western redcedar / common snowberry was present along the east side of the alignment on the north end.
- The blue-listed ecosystem red alder / salmonberry / common horsetail was present along the east side of the alignment on the north end.
- The red-listed ecosystem Douglas-fir / dull Oregon-grape was present along the west side of the alignment on the south end.
- Pacific waterleaf was identified by others in an area that aligned with W3 in *Table 4*.

In addition, the Project area contains mature forest in several locations, including riparian forests that provide habitat for a number of wildlife species. Wildlife trees identified throughout the study area also provide high-quality habitat for birds and mammals.

Environmental protection measures will be required to minimize impacts on native vegetation species and ecosystems, including sensitive plant species and ecosystems classified as at-risk.

8.2. TERRESTRIAL WILDLIFE FEATURES

Forested and riparian areas provide potential habitat for numerous wildlife species including passerines, mammals, amphibians, and reptiles. The diversity of habitat elements in the Project area likely provide habitat and foraging opportunities for a variety of terrestrial wildlife species including species at risk. These habitat features include, but are not limited to, the following:

- Forested and riparian areas:
    - Habitat for passerines and raptors, including nesting sites, roosting/perching, and foraging opportunities.
    - Habitat for reptiles and amphibians.
    - Habitat and foraging areas for mammals.
- Wildlife trees may provide habitat and foraging opportunities for birds, bats, and mammals.

- Rock faces, snags, and trees have the potential to contain roosting sites for bat species.
- Rock stack wall areas may provide habitat for reptiles.

During the Site visits, several potential low to high-valued wildlife trees were observed. Wildlife trees can provide perching habitat for birds of prey overlooking the river as well as cavities for nesting for both birds and mammals. Wildlife trees may also be used by bat species as summer or winter roosting cavities.

Environmental protection measures are required to ensure that site-level development does not negatively impact wildlife in the Project area. Suggested mitigation measures are included in *Section 10*.

8.3. AQUATIC FEATURES

Several aquatic features were identified as having the potential to be impacted by proposed Project activities. The Goldstream River is designated as a 'sensitive stream' under the *WSA* and provides spawning, rearing, and overwintering habitat for a variety of anadromous salmonids. Riffle-pool-run stream morphology and water quality in the river also provides high quality habitat for stream invertebrates, an essential component of the aquatic food web. Protection measures will be required to ensure that impacts to aquatic features, including downstream receiving waters (i.e., Finlayson Arm), are not negatively impacted by the Project.

9. Assessment of Environmental Impacts

The study area was assessed for potential environmental impacts associated with the following Project components:

- Widening of the Trans-Canada Highway No. 1 Malahat Corridor to accommodate concrete median barrier
- Pedestrian bridge installation.
- Clearing and filling of the roadside shoulder on either side of the alignment and construction of laydown areas.
- Excavation and installation of retaining walls on the river side of the proposed alignment, including pile installation
- Installation of the habitat restoration plan.
- Rock blasting to facilitate the proposed rock-side alignment.
- Addition of lighting to pedestrian walkways.

9.1. KEY ENVIRONMENTAL COMPONENTS

Several environmentally sensitive features within the study area were identified. Mitigation of impacts to these sensitive features from the proposed Project construction activities include the application of BMPs, adherence to least risk timing windows, and implementation of measures to protect water quality.

Site specific environmental impacts identified include:

- Direct and indirect impacts on soils along the Project alignment.

- Direct impacts on vegetation along the Project alignment.
- Direct and indirect impacts on potential wildlife habitat along the Project alignment.
- Direct and indirect impacts on aquatic features along the Project alignment.
- Direct and indirect impacts on air quality during construction.

Table 19 below summarizes the general impacts of various Project related construction activities on environmentally sensitive features that require protection or compliance with legislation. Direct Project impacts on natural systems within or immediately adjacent to the Site will primarily occur during Site preparation activities such as clearing and grubbing, pavement milling, and stripping. Construction activities such as excavation and blasting can also result in direct impacts to the natural systems. Construction activities have the potential to cause the impacts to the environmental components discussed in subsequent sections.

Recommended environmental protection measures are outlined in *Section 10*.

Table 19. Environmental Impact Matrix

Environmental Features:	**Natural Systems**					**Soils**			**Water**			**Air Quality / Noise**		
PROJECT PHASES / COMPONENTS	Vegetation / Ecosystems	Wildlife and Habitat	Aquatic Features	Species at Risk	Invasive Species	Soil Quality / Compaction	Sedimentation	Erosion	Surface Water Quality	Surface Water Quantity	Groundwater Quality	Air Quality	Noise	Vibration
Site Preparation:														
Clearing and Grubbing	X	X	X	X	X	X	X	X	X	X		X	X	
Use of Industrial Equipment	X	X	X	X	X	X	X	X	X		X	X	X	X
Laydown Areas	X	X	X	X	X	X	X	X	X			X		
Pavement Milling			X				X		X	X		X	X	X
Stripping		X			X	X	X	X	X	X		X	X	
Construction:														
Use of Industrial Equipment	X	X	X	X	X	X	X	X	X		X	X	X	X
Excavation		X	X	X	X	X	X	X	X		X	X	X	
Grading		X	X	X		X	X	X	X			X	X	
Blasting	X	X	X	X			X	X	X			X	X	X
Pile installation	X	X		X	X	X	X	X	X		X		X	X
Work zone dewatering			X	X			X	X	X					
Road base installation						X			X			X		
Paving	X						X		X	X				
Concrete			X	X					X					
Landscaping / Restoration	X	X	X		X	X		X	X			X		
Habitat Restoration	X	X	X	X	X	X	X	X	X	X	X	X		

9.1.1. Soils

The Project will alter the landscape and natural environment. Cut and fill practices will be employed during the construction phase. It is anticipated that most embankment fills will be constructed with blast rock excavated from Site. Overburden materials (including topsoil) may be reused within the Project footprint.

Soil and landforms interact with living organisms by providing habitat. The quality of the soil is closely related to the vegetation that grows within an ecosystem, and the health of the soil is related to its ability to meet the range of ecosystem functions as appropriate to its environment. Impacts to soil have the potential to reduce soil health / quality, reducing the overall habitat quality of the Site.

Site preparation and construction activities may result in impacts to soils in the study area but can be reduced using mitigation measures discussed in *Section 10.2*. The following is a summary of potential impacts to soils (i.e., reduction in soil quality) associated with proposed Project activities:

- Erosion and compaction of soils from the use of industrial equipment.
- Contamination of soils from the accidental spill of deleterious substances such as fuel, oil, or spills from equipment.
- Erosion of soil surfaces from grade changes and alteration of local drainage patterns.
- Loss of native topsoil.
- Generation of sediment / dust laden runoff and potential release into the environment.

BMPs will be required to mitigate the potential risks to soils within the study area.

9.1.2. Vegetation Features

Vegetation removal will be required for the Project. Several forested and riparian areas will be altered and/or removed and replaced with rock and impervious surfaces. This may include clearing within provincially listed ecosystems. As certain vegetation provides nesting and foraging habitat for birds and other wildlife, BMPs will be required in order to satisfy the *Wildlife Act* (BC 2014c) and *the MBCA* (Canada 1994).

Construction disturbance in vegetated areas may also result in further loss of native biodiversity due to the spread or establishment of non-native invasive species. Noxious weed species present on or adjacent to the Site are potential seed sources that may facilitate invasion of these weed species to newly disturbed areas of the development.

The following impacts to vegetation features have the potential to occur:

- Loss of vegetation and a potential reduction in localized biodiversity due to direct removal of individual trees, shrubs and other vegetation located along the corridor.
- Reduction in ecosystem quality and/or biodiversity due to disturbance of ecosystems adjacent to or within the Project footprint from construction activities including at-risk ecosystems.
- Reduction in ecosystem quality and/or biodiversity from the spread or establishment of noxious weed species, including those regulated under the *Weed Control Act* (BC 1996a), due to proposed activities such as earth works and removal of vegetation in forested and riparian areas associated with both Project construction and restoration works.

- Reduction in vegetation/ecosystem health due to changes to soil quality, drainage patterns, or groundwater flow regimes.

9.1.3. Terrestrial Wildlife Features

There are moderate direct and indirect impacts to wildlife or wildlife habitat expected as a result of this Project. Habitat loss and fragmentation may result, including the removal of potential nest or foraging areas within the Project footprint.

Noise from construction activities may disturb breeding birds and their young during the bird breeding season. Nests may be ground-based or found within the canopies of shrubs and trees. Disturbance of nesting birds is prohibited under the provincial *Wildlife Act* (BC 2014c) and the federal *MBCA* (Canada 1994). Noise may also disturb roosting or hibernating bats within proximity to the Project alignment.

The following impacts to wildlife features may occur:

- Permanent loss of wildlife habitat through the creation of new hard surfaces covering soil surfaces and the removal of vegetation.
- Disturbance of bird species protected under *Wildlife Act* 34 (BC 2014c) and the *MBCA* (Canada 1994) including activities related to blasting, excavation, and paving.
- Disturbance to bat species during summer roosting or winter hibernation phases as related to activities such as blasting.
- Removal of habitat for bat species including vegetation removal and blasting of rock faces along the west side of the highway alignment.
- Reduction of breeding and foraging habitat for several species due to removal of vegetation and potential moderate to high-valued wildlife trees.
- Removal of amphibian or reptile habitat and/or disturbance to habitat due to vegetation removal, earthworks in riparian areas, ditchline and drainage modifications, riparian impacts including removal of vegetation and coarse woody debris, and rock stack wall removals.
- Indirect habitat loss from sensory disturbances (e.g., artificial light associated with new pedestrian walkways, increased noise from equipment and blasting).

9.1.4. Watercourses and Aquatic Features

Proposed Project activities have the potential to impact aquatic features within the Project footprint including instream works and ground-disturbing activities associated with drainage modifications and overall Project construction. The following impacts to watercourses and aquatic features may result from the Project:

- Degradation of water quality due to increased sedimentation related to:
    - Ground-disturbing activities (i.e., excavation, levelling, in-filling, stockpiling) that may disturb soils and create erodible soil surfaces.
    - Restoration activities (i.e., disturbance to sediments, riverbed substrates, and/or riparian areas).
    - Vegetation clearing and removal, particularly in riparian areas.
- Degradation of surface water quality and groundwater due to spills of deleterious substances to water or ground from industrial equipment or machinery.

- Degradation of water quality and impacts to aquatic features due to concrete placement activities adjacent to aquatic receptors.
- Degradation of water quality due to paving (i.e., flushing of contaminants from freshly paved surfaces).
- Degradation of water quality and impacts to salmonid species due to reduction in riparian/vegetation buffers and effects of 6PPD-q (pollutant sourced from vehicle tires).
- Reduction in aquatic habitat quality due to changes in riparian structure related to vegetation clearing including:
    - Reduction in shading and associated temperature changes.
    - Alterations to riparian or riverbank habitats (i.e., structure and cover).
    - Changes to drainage patterns including surface water or groundwater flow into the river.
    - Changes in nutrient inputs into the river system.
- Direct impacts on fish/eggs/ova (i.e., disturbance, injury, or mortality) from:
    - Placement of structures in the water (i.e., isolation and dewatering measures).
    - Use of industrial equipment related to restoration works.
    - Noise and vibration from compaction measures/pile installation or other high intensity activities including blasting.
    - Isolation and fish salvage associated with restoration activities and construction.

9.1.5. Air Quality / Noise and Vibration

Air quality, noise and vibration from construction activities can create negative impacts on environmental features including wildlife.

Air Quality

Construction related activities that have the potential to impact air quality include the following:

- Exhaust emission from diesel and gasoline powered construction equipment and vehicles.
- Construction activities with potential to generate dust including.
- Ground disturbance, vegetation and debris clearing.
- The removal of asphalt and concrete from road surfaces.
- Removal of existing structures and obstacles.
- Removal of construction debris.
- Filling activities and trucks transporting overburden and fill materials.
- Vehicular traffic on temporary unpaved roads.
- Wind erosion from stockpiles.

Noise and Vibration

Construction activities have the potential to generate noise levels that can create negative impacts on environmental receptors such as birds. The degree of the impact depends on factors such as noise level,

the duration of the activity, and its timing. The following impacts can be attributed to excessive noise and vibration:

- Noise and vibration from heavy equipment operation, pile installation, and blasting, may disturb breeding birds and their young during the bird breeding season.
- Wildlife may be impacted by noise from construction activities, especially if the timing or magnitude of noise and / or vibration is in proximity to sensitive species and / or habitats in which they are active (e.g., disturbance during breeding).

10. Mitigation Strategies

Mitigation strategies to reduce negative impacts associated with alteration of the landscape and natural environment are recommended in the following sections. These strategies are intended to reduce or mitigate the negative effects of site-level development on the environment. In areas that have already been modified by human activities, certain strategies may even enhance the natural environmental features and offset some of the disturbance to other areas

The Contractor will employ the services of an AQP to develop a CEMP. The CEMP will document how the Project will comply with all applicable environmental legislation, Project environmental approvals (whether obtained by MoTI or the Contractor), MoTI contract conditions, and MoTI Standard Specifications including SS 165: Protection of the Environment. A full-time Environmental Monitor (EM) will be on site during sensitive construction phases and works within environmentally sensitive areas. The EM will be required to confirm that mitigation measures are appropriately installed or utilized and functioning as intended, and to address other concerns should they arise.

Monitoring may be periodic (weekly) during routine construction. However, at key points of construction (clearing vegetation and works around water) daily, or full-time monitoring may be warranted and will be dependent upon the construction schedule. Full-time monitoring by the EM will be required for all works below the high-water mark of streams. Appropriate erosion and sediment control (ESC) will be dictated by provincial standards, stating that the monitoring be timed with substantial rainfall events (25 mm of precipitation in less than 24 hours[3]) to check that the work sites' installed water quality protections implemented through ESC measures have not been compromised.

Environmental components potentially impacted by the Project and recommended mitigation measures or BMPs to mitigate these potential impacts are summarized in the following sections.

10.1. CONTRACTOR SUBMISSIONS

Several Contractor submissions will be required to be developed by the Contractor, in addition to the CEMP, and submitted for review and approval prior to work commencing:

- Soil Management Plan.
- Restoration Planting Plan.

[3] Criteria for public weather alerts https://www.canada.ca/en/environment-climate-change/services/types-weather-forecasts-use/public/criteria-alerts.html#rainfall.

- Vegetation Management Plan (VMP).
- Invasive Plant Management Plan.
- Wildlife Salvage Plan.
- Concrete and Concrete Waste Management Plan.
- Fish and Fish Habitat Management Plan
- Instream Work Plan.
- Erosion and Sediment Control Plan.
- Blasting Management Plan.
- Wildlife Management Plan.
- Bird Nest Survey Plan.
- Nest Management Plan.
- Water Quality Monitoring and Sampling Plan.
- Noise and Vibration Management Plan.
- Spill Prevention and Response Plan.

10.2. SOILS

The various site preparation and construction activities will result in the disturbance of soils in the study area. Appropriate ESC strategies shall be designed, planned, and implemented for each construction activity to prevent erosion and sedimentation of downstream receiving environments. Contamination of soils and remediation is regulated under the *EMA*. The Project CEMP should include mitigation measures for erosion and sedimentation, and for accidental spills of deleterious substances, to minimize potential soil contamination. The Contractor shall also prepare and implement a Soil Management Plan that will outline soil handling, management, and disposal requirements for the Project.

Some examples of standard BMPs are summarized below to protect soils on the Site during construction:

- The Contractor will develop and implement a Soil Management Plan that outlines handling requirements for soils during Project construction, including sequencing, storage, transport, characterization, import requirements, and disposal.
- Topsoil and other salvaged soils can be stockpiled for reuse when sorted separately accorded to material type (topsoil and subsoil). Topsoil typically includes forest floor and / or A horizon.
- Where topsoil is less than 15 cm, conservation of soil can include the topsoil plus part of the upper subsoil (B horizon) up to a total depth of 15 cm (unless the B horizon is considered unsuitable chemically or physically).
- Spoil materials should be placed in a location where sedimentation cannot be introduced into a watercourse.
- Maximize the direct placement of salvaged soil to enhance native plant development.

- Reclamation materials (topsoil, subsoil, and coarse woody debris) can be stockpiled separately for use. These materials can be distributed evenly over the disturbed area for progressive (interim) and / or final reclamation.
- Soil erosion and sedimentation is to be prevented and controlled on all disturbed lands through the development of an ESC Plan (see *Section 10.5.3.1*).
- Stockpiled soils are to be covered with poly-sheeting or vegetative cover to prevent erosion.
- Exposed areas should be stabilized as soon as feasibly possible (i.e., covered, seeded, planted).
- Construction activities are to be suspended during adverse ground conditions such as heavy rainfall events.
- Machinery should use biodegradable oils/fuels when feasible to reduce potential impacts of accidental spills to the environment.
- Machinery and equipment left on the Site overnight should have drip trays secured beneath.
- Limit the movement of machinery and equipment into vegetated areas to reduce compaction and erosion.
- Ensure imported fill materials are certified free of invasive weed species.

10.3. VEGETATION FEATURES

Construction of the Project will result in vegetation being permanently removed from the landscape, resulting in the loss of portions of native forested vegetation and potential wildlife habitat. A replanting / restoration plan has been developed for this Project, with a combination of replanting and seeding exposed areas of soil. Both BC Parks and local First Nations have been involved in determining the species composition. The CEMP along with a Vegetation Management Plan (VMP) will need to be developed by the Contractor to deal with the potential presence of *SARA* species and at-risk ecological communities overlapping the Project footprint. Some examples of standard BMPs are summarized below:

- Only areas that have been approved for construction and marked or delineated as such will be cleared.
- Retain as much vegetation as possible including old growth trees, large diameter trees, and wildlife trees.
- Areas of sensitive habitat will be clearly marked, protected, and conserved where possible.
- Leave low-growing vegetation intact within the riparian zone.
- Revegetate as soon as possible once construction in that area is complete.
- Prepare a Restoration Planting Plan to revegetate disturbed areas by planting or seeding native tree and shrub species, or provincially approved seed stock or plantings (to be approved by MoTI). Consider planting a slower growing species to replace faster growing deciduous.
    - Areas to be restored or replanted will be restored through removal of any temporary support decking, removal and restoration of any construction accesses, re-grading any excavation areas to match the natural contours of the area and with a rough and loose finish, and re-

vegetating disturbed areas with native vegetation in accordance with the Landscape Drawings.

- Incorporate the utilization of course woody debris to aid in restoration of disturbed areas in providing habitat for wildlife.

In addition, protection measures to avoid or reduce impacts to at-risk ecosystems identified in the Project area should be implemented. These shall include, but not be limited to, the following:

- Pre-clearing vegetation surveys to be completed to identify any at-risk ecosystems that may be impacted by the Project.
- If at-risk ecosystems are identified as overlapping with the Project footprint, or in close proximity to areas of disturbance, the boundaries of these ecosystems will be flagged or marked, as appropriate.
- At-risk ecosystems will be retained as much as is possible. If impacts to at-risk ecosystems cannot be avoided, off-setting measures will be implemented and included in the Project VMP and replanting/reseeding plan.

10.3.1. Invasive Species

Control of designated noxious and invasive species is required by the Province under the *Weed Control Act* (BC 1996a). Noxious weed species present on or adjacent to the Site are seed sources that may facilitate invasion of these weed species to newly disturbed areas of the development and may increase the presence of invasive species in areas directly adjacent to the Site.

The Contractor will be required to develop and implement an Invasive Plant Management Plan as part of the CEMP that will outline Project requirements to avoid the spread or introduction of invasive plants during construction. Management of invasive plants into the operational phase is a commitment of the BC Parks Use Permit obtained for the Project.

Recommended general mitigation measures include:

- All equipment brought on Site must be thoroughly cleaned (e.g., remove dirt from other work sites that has accumulated on the tracks, undercarriage, tires) prior to arrival and departure.
- Check clothing and footwear regularly for seeds or plant matter and, if materials are detected, remove and segregate as to not infest the area.
- Areas requiring clearing and grubbing should be screened for the presence of invasive plants. If invasive species are identified, they should be removed, segregated, and transferred under cover to a facility capable of accepting such material.
- Equipment traffic should stay within pre-approved and established/marked access.
- Parking, unloading, or storing equipment in areas with known invasive weed species should be avoided.
- Know the origin of gravel or other fill used and that it is free of invasive plant species, invasive plant seeds, or rhizomatous plant parts. Avoid using fill from known sites of invasive plant infestation.

- Noxious weeds and invasive plant species that are encountered and are to be removed to facilitate construction activities will be bagged to prevent spread or disbursement and removed from site for incineration at an approved facility.
- Do not reuse soil on Site that is sourced from areas infested with invasive plant species or their seeds.
- Bag or tarp plants, plant parts, and seeds before transporting weeds to a designated disposal site (e.g., landfill) for deep burial.
- Care should be taken to ensure that plant parts are not distributed during transport.
- Special care must be taken when removing invasive weeds near flowing water to avoid the movement of plant parts downstream.

Three species were identified in proximity to the Site that are listed on Schedule A of the *Weed Control Act:* annual sow thistle (*Sonchus oleraceus*), Canada thistle (*Cirsium arvense*), and gorse (*Ulex europaeus*). Additional recommendations for management of these species are detailed below. A full list of noxious and undesirable weeds and exotic / introduced plants and control measures are available from the BC Ministry of Environment in collaboration with the Invasive Species Council of BC as mandated by the BC *Weed Control Act* (1996c)[4].

10.3.1.1. Annual Sow Thistle

Annual sow thistle has yellow, dandelion-like flowers that are grouped in flat or round-topped clusters that only open in the morning. Mature plants can be up to 1.0 m tall, and plants can be found on disturbed sites such as roadsides and logging areas. Seeds are distributed by wind. Several control and/or removal methods are recommended (SSISC, 2021).

- Pull or dig up small infestations – in order to ensure eradication, the taproot must be removed.
- Mowing repeatedly prior to seed set may help control by height must be <20 cm to prevent re-growth.

10.3.1.2. Canada Thistle

Canada thistle has white or purple flower heads and a sweet vanilla scent and is commonly found on roadsides and other disturbed areas. Several control and/or removal methods are recommended (ISC, 2019a):

- Remove the plant completely by digging it out at the roots, bagging, and disposing at a landfill.
- Plants may be cut, although this is unlikely to kill the plant.
    - If plants are cut prior to flowering, the plant material may be left on the site to decompose.
    - If plants are cut after flowering, all plant parts including flower heads should be bagged and disposed of at a landfill.

[4] https://bcinvasives.ca/wp-content/uploads/2021/02/Field_guide_to_Noxious_Weeds_11th_2021.pdf.

10.3.1.3. Gorse

Gorse is a spiny shrub that forms vigorous stands that grow outward and crowd out other vegetation. Seeds are distributed by being released from the plant in an explosive manner, and then being further carried by water, animals, people, machinery, and ants. New plants may also sprout from root fragments. Several control and removal methods are recommended (ISC, 2019b):

- Digging up small infestations including all root parts may be effective.
    - Follow-up treatments may be required to remove seedlings that may sprout from root fragments or from seed banks.
    - Equipment may be required to dig up larger plants or infestations.
- Do not mow as this promotes growth.
- Cutting is not recommended as cutting above the roots encourages re-growth. Cutting will, however, prevent seed-set for a growing season.
- Repeated mowing may deplete root reserves; recommended to move prior to flowering.

10.4. TERRESTRIAL WILDLIFE FEATURES

Proposed Project activities have the potential to impact terrestrial wildlife features including the clearing of vegetation, and the use of high impact activities including the use of explosives (i.e., blasting). Construction of the Project will require the implementation of provincial guidelines and BMPs to comply with federal and provincial environmental protection legislation..

General BMPs as they relate to the protection of wildlife and wildlife habitat are recommended:

- The Contractor should schedule the Project in adherence with recommended wildlife timing windows or species-specific buffers in the event Project activity occurs within a timing window (refer to the following sections for details).
- A Wildlife Management Plan indicating the BMPs that will be placed to mitigate construction related impacts to wildlife life in the Project area will be developed by the Contractor's AQP.
- The Contractor should retain an AQP to conduct a wildlife sweeps and salvages as necessary.
    - Wildlife (e.g., small mammals, herptile, species at risk) salvage plans will be developed and implemented by the Contractor's AQP.
    - Bird Nest Survey Plans, including protection for Pileated Woodpeckers, will be developed by the Contractor's AQP.
- Wildlife access to and from the Goldstream River will be maintained during construction.
- Any important wildlife features including active nests and hibernacula must be marked, and appropriate minimum buffer distances established.
- Work areas must be kept completely free of uncontained wildlife attractants such as food, waste materials, cleaning products, and fuel.
- Limit the amount of vegetation removed during clearing, particularly in riparian habitats, as much as possible.

- Clearing define and mark the limits of areas to be cleared.
- Design artificial light sources so as to minimize impacts on bird, bat, insect, and other species that me be affected.

10.4.1. Birds and Bird Habitat

Protection measures for birds and bird habitat within and near the Project footprint are required for works that may disturb or lead to the degradation or loss of habitat. Several activities are proposed that have the potential to impact birds and their habitat, including vegetation removal and high impact activities such as blasting. Mitigation measures related to these activities are outlined below.

Prior to construction, the final alignment should be surveyed for nests protected under *Wildlife Act* 34b (BC 1996b) (i.e., nests of eagle, peregrine falcon, gyrfalcon, osprey, or heron) and Schedule 1 of the MBR.

10.4.1.1. Timing Windows and Vegetation Removal

As vegetation provides potential nesting and foraging habitat for birds and other animals, there is the potential to contravene the *Wildlife Act* and *MBCA* with the cutting of trees and shrubs for Project construction. Noisy activities such as blasting, excavation, and road construction have the potential to impact breeding birds utilizing the adjacent vegetated areas.

Construction timing windows for birds are the most suitable periods for performing works that would otherwise impact sensitive life stages. Birds and their active nests are protected in Canada by the federal *MBCA* and in BC most birds are protected while nesting under Section 34 of the BC *Wildlife Act*. The BMPs outlined in 'Develop with Care' (MOE 2014a) recommend tree and vegetation clearing outside of the bird breeding period. While the breeding season for bird species varies by species, the general bird breeding period is late-March to mid-August (Canada, 2018b). The least risk windows for activities with the potential to impact breeding birds within the study area are listed in *Table 20*.

If vegetation clearing or other disruptive activities must be conducted during the breeding period, an AQP should be engaged to survey the site for active nests and to flag no-go buffer zones around active nests. AQP monitoring of active nests for disturbance within 200 m of construction noise is recommended (MOE 2014a). If active or protected nests are identified within the Project footprint or in the vicinity of high-impact or noisy activities that may result in disturbance, a Nest Management Plan will be developed by the Contractor's AQP that includes such protection measures as buffer limits and monitoring procedures.

Nests should be monitored for signs of disturbance behavior until each nest has fledged. Clearing vegetation outside the bird breeding season does not require a pre-clearing survey other than those surveys required for species protected under Subsection 34(b) of the *Wildlife Act* which provides year-round protection to bald eagle, osprey, and great blue heron nests (among others), no matter the nest condition or activity (MOE 2014b, c). If Project activity occurs near a protected nest, a protective buffer is required so that damage or disturbance to the nest and nest tree does not occur (MOE 2013).

Table 20. Bird Breeding Season and Least Risk Timing Windows for Compliance with Wildlife Act 34.1.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bald eagle												
Other birds												
Great blue heron												
Migratory birds (nesting)												

[1](MOE 2014 a, b, c)

Breeding Window Least Risk Window

As per the Guidelines for Raptor Conservations (MOE 2013), bald eagles are moderately to highly tolerant of human activities and have an ability to co-exist. The recommended minimum buffer for nesting raptors that have a moderate to high ability to co-exist is 200 m in an undeveloped area, with an additional 100 m buffer during the breeding season. The closest recorded nest is approximately 600 m from the Project footprint. As the nests have the potential to occur within 200 m of the Project footprint, this will need to be considered during construction.

Additional mitigations related to vegetation removal include the retention of as many snags/wildlife trees as possible and installing snags at the upstream off-setting area to provide additional roosting and nesting cavities.

10.4.1.2. High Impact Activities

High impact activities such as blasting and other noise generating activities (i.e., jack-hammering) are proposed for this Project. To reduce the risk disturbance of birds, and of egg or nestling abandonment, the following BMPs are recommended:

- Develop and implement a Blasting Management Plan to define mitigation and management measures to reduce effects to the acoustic environment and to mitigate potential impacts to birds.
- Complete blasting activities outside of the breeding bird season and within the least risk window for birds.
- Maintain buffers of 1,000 m between active nest sites and blasting sites (MOE 2013).
    - The recommended buffer for blasting near active urban eagle nests may be relaxed where it is demonstrated that the eagles have habituated to human disturbance but requires provincial government approval.
- Blasting mats should be placed atop the blasting holes to minimize the scattering of blast debris around the area.
- Large charges should be subdivided into a series of smaller charges and time-delayed to reduce the overall detonation to a series of smaller detonations.
- Minimize blast charge weights used and subdivide each charge into a series of smaller charges in blast holes with a minimum 25 millisecond (1/1000 seconds) delay between charge detonations.

10.4.1.3. Pileated Woodpecker

Surveys targeting pileated woodpecker nesting cavities did not identify any trees with nesting cavities within the clearing limits surveyed for the Project. However, if any large trees are to be removed as part of the

Project, a pre-clearing survey completed by a qualified AQP experienced in identifying pileated woodpecker nesting cavities must be completed, as new cavities may be excavated before the Project commences.

In addition, a survey for nesting cavities should be completed in advance of high-impact activities, such as blasting, to ensure that appropriate buffers are established around any active nests, including those being utilized by pileated woodpeckers.

10.4.2. Bats and Bat Habitat

Protection measures for bat species that utilize areas within and near the Project footprint are required for works that may disturb bats during sensitive life stages (i.e., summer maternity roosting or winter hibernation), or that may damage or eliminate bat habitat. *Table 21*, below, provides a generalized summary of bat life stages in order to support Project planning and scheduling of specific activities that have the potential to negatively impact bats.

Table 21. Generalized Activity Timing for Bat Species in southern Vancouver Island (adapted from Craig et al. 2014).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bat Species												

	Hibernation		Emergence/ Migration		Summer Roosting / Maternity	
	Roost		Fall swarming / migration			

The following general BMPs for protection of bats are recommended for this Project:

- Complete an additional survey of the upper cliff areas to ascertain potential use by bat species for roosting or hibernation. Preliminary surveys completed as part of this assessment suggest that these areas are likely not utilized by bats; however, a more comprehensive survey is recommended in order to confirm bat use.
- Complete vegetation clearing outside of sensitive life periods for bats.
- Avoid high impact activities during sensitive periods for bats. High impact activities are those that create excessive noise (>80 dB) and/or high frequency sound between 20-200 kHz. High impact activities may include blasting and jackhammer-type activities.
- Avoid pesticide use within areas known to be frequented by bats.

10.4.2.1. Vegetation Removal and Bat Protection

Vegetation removal required for this Project has the potential to impact bats and their habitat. Bats typically utilize tree habitat that includes features in large, older, dead trees including loose bark or cavities. Bats use these tree roosts as daytime roosts in the summer months (non-maternal), and sometimes for hibernation in the winter months. Vegetation removal planned during the least risk window for birds (i.e., after September) aligns with less sensitive life stages for bats. The following BMPs related to vegetation removal and protection of bats and their habitat are recommended:

- Retain, as much as is feasible, wildlife trees and/or larger diameter trees with features suitable for use by tree-roosting bats.

- Avoid clearing of large diameter trees or trees with features suitable for tree hibernating bat use during bat hibernation periods (i.e., November to April). If vegetation clearing is planned for this time period, **a survey of trees with potential bat use must be completed in advance of clearing**.
    - Vegetation clearing in the fall (i.e., September/October) is preferred as it aligns with less sensitive life stages of bats in this area.
- Retain connectivity of forested areas as much as possible to support healthy bat populations in the Project area.

10.4.2.2. Blasting and Bat Protection

Blasting activities proposed along the western side of the highway alignment have the potential to impact bat species by altering or eliminating roosting habitat, and/or disturbing or injuring bats that are utilizing roosting habitat during sensitive life stages (i.e., maternal roosting or hibernation). The following BMPs are recommended in order to provide protection to bat species that may utilize cliff areas within the Project footprint:

- Develop and implement a Blasting Management Plan that includes BMPs for the protection of bats and their habitat, including scheduling of blasting activities outside of sensitive life stages for bats.
- Complete blasting activities outside of sensitive periods for bats (i.e., hibernation or summer roosting between April and October) as follows:
    - Spring (April/May) – complete low velocity blasting of upper cliff areas (assuming no use by bats as per additional survey recommended above).
    - Fall (Sept/Oct) – complete blasting of main rock faces prior to hibernation.
- Large charges should be subdivided into a series of smaller charges and time-delayed to reduce the overall detonation to a series of smaller detonations.
- Minimize blast charge weights used and subdivide each charge into a series of smaller charges in blast holes with a minimum 25 millisecond (1/1000 seconds) delay between charge detonations.
- Install artificial roosts prior to shotcreting.

Spring preparation (i.e., grading/blasting) of upper cliff areas may still disturb bats that may be utilizing rocky areas along the main rock faces below; however, as this work is proposed at the end of the hibernation phase, it is likely that this disturbance would be localized and that any long-term impacts to bats would be negligible. The main blasting of lower rock faces should be completed in the fall months prior to bat hibernation. Additional mitigations may include the installation of artificial roosts on cliff faces prior to shotcreting, and/or installation of bat boxes in forested areas within the highway ROW.

10.4.3. Amphibians and Reptiles

The *Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia* (BC 2014a) provides BMPs for the protection of herptiles (i.e., amphibians and reptiles). Suitable habitat for both reptiles and amphibians is present at the Site; therefore, there is a potential for Project activities to impact these species and/or habitat including the provincially blue listed Northern red-legged frog *(Rana aurora).*

Table 22 below outlines active/sensitive periods for several of the species that have the potential to be present at the Site. Proposed Project activities that have the potential to impact amphibian and reptile species should be completed with this timing in mind.

Injury and mortality to herptiles which may enter the work zone during construction can be mitigated through the installation of exclusion fencing, if needed. This will eliminate access to the work zone where activities are occurring that could harm wildlife. This fencing can also function to prevent sediments from entering watercourses which could potentially harm the amphibians that utilize the area.

The Contractor's EM will be required to obtain appropriate permits for pre-construction surveys and salvages, and for the potential incidental handling and relocation of amphibians and reptiles within the work zone, if required.

Table 22. General active/sensitive periods for herptiles with the potential to be present at the Site.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Northern red-legged frog*		Eggs/tadpoles				Toadlets						
Pacific treefrog		Eggs/tadpoles				Toadlets						
Roughskin newt		Eggs/larvae					Juveniles					
Western toad*			Eggs/tadpoles			Toadlets		Migration				
Ensatina			Eggs						Breeding/juvenile emergence			
Long-toed salamander		Eggs						Juveniles				
Northwestern salamander		Eggs/larvae										
Western red-backed salamander			Eggs/juveniles						Breeding			
Snakes and lizards				Migratory/active			Breeding	Migratory/active				

Recommended BMPs to avoid impacts to amphibian and reptile species, include, but are not limited to, the following:

- Surveys and salvages of amphibian and reptile species to be completed in advance of any vegetation clearing, grubbing, or removal of coarse woody debris. Refer to *Section 10.4.5* for details on salvage procedures.
- Avoid moving or removing coarse woody debris in vegetated areas as much as possible.
- Clearly mark any vegetated areas to be cleared, and/or known areas of amphibian or reptile presence.
- Minimize movement of machinery, vehicles, and personnel into vegetated areas.

10.4.4. Wildlife Encounters

There is a potential for wildlife encounters and conflicts to occur during the Project works. Wildlife conflicts may consist of relatively minor nuisances or more serious health, safety, or conservation concerns. Minor issues are typically related to animals feeding on garbage and causing damage to property. Encounters with large predators may result in more serious consequences such as injury or death to both humans and animals. Large carnivores are an integral component of natural ecosystem functioning, they keep ungulate populations healthy, which in turn keep wildlife habitats healthy (MOE 2014a).

Black bears occur in high densities on Vancouver Island and bear encounters are common in remote locations. BMPs recommend identifying any potential bear conflicts and provide information and training to those working in the area related to bear safety (MOE 2014a). Reduction of wildlife encounters can be accomplished through the development of a Wildlife Management Plan which should address the use of deterrents and the reduction of attractants. The feeding of wildlife should be prohibited, and all waste should

be adequately stored in wildlife proof containers. If a bear exhibits aggressive or threatening behaviour it should reported to the Ministry Call Centre (1-877-952-7277).

Wildlife encounters may also include vehicular contacts with wildlife attempting to cross the existing highway alignment. An historical lack of wildlife corridor or crossing at this location has meant that any wildlife attempting to cross the highway are at risk of injury or death from vehicle traffic. Improvements to access and crossings for pedestrians will indirectly provide additional corridors for wildlife crossings. However, given the steep slopes on the western side of the alignment, it is unlikely that regular crossing of the highway by wildlife is occurring or will occur.

10.4.5. Wildlife Salvages

Herptiles and other wildlife may be present within the study area and may require survey and salvage prior to the start of construction to mitigate potential impacts. In areas where there may be water flowing and along the edges of drainages, pre-construction surveys should be conducted to identify presence. Species at risk that will require targeted salvage and relocation include Northern red-legged frog. Additional amphibian and reptile species will also be relocated during these salvages.

The salvage and relocation work can be conducted in stages during the progress of construction. Only those areas to be affected by construction works should be targeted for salvage. The wildlife surveys and salvaging should consist of the following:

- Visual surveys will be completed for terrestrial stage wildlife prior to works beginning each day, with a more in-depth survey completed for new work locations.
- Prior to instream works along ditches and at drainage crossings, a preliminary survey should be conducted within the work area, following the protocols established under the provincial government (RIC 2000).
- **Salvages will be done under the valid MoF Wildlife permit to be obtained by the Contractor.**
- If wildlife is identified within the work area, exclusion fencing consisting of something like hardware cloth affixed to wooden stakes will be installed to isolate the survey site.
- Following isolation of the work area, a complete survey and salvage will be conducted within the exclusion zone.
- Survey methods for amphibian and reptiles will again be consistent with the provincial standard (RIC 2000), and salvage techniques will follow those recommended for lotic habitat amphibians in the provincial BMP for Amphibian and Reptile Salvages in British Columbia (FLNRO 2016b), including hand capture using aquarium nets, rock rolling, and hand sweeps through gravel beds and along stream edges.
- Dip nets and hand collection will be used to remove tadpoles and adults (when possible).
- Individuals captured will be photographed and relocated to an appropriate habitat outside of the work zone.
- Survey and salvage results will be documented and monitored, where needed, for the duration of the construction works.

10.5. WATERCOURSES AND AQUATIC FEATURES

Both Goldstream River water quality and surface water quality present in stormwater drainage channels have the potential to be impacted by construction activities. The federal *Fisheries Act* (Canada 1985) legislates that no deleterious substances may be released into fish-bearing waters. A substance is deleterious if it is harmful to fish or wildlife, if it limits the use of fish by humans, or if, by going through some process of degradation, it harms the soil or water quality (for example, oxygen-depleting wastes) (MOE 2014a). A substance is also deleterious if it exceeds a level prescribed by regulation and includes sedimentation of water.

A stormwater system is included in the Project design to be installed near Finalyson Arm Road. This treatment system will capture part of the highway drainage and will include a holding tank and oil and grit separator to ensure that surface water runoff from the highway is as clean as possible prior to discharging to a vegetated swale on the west side of the river.

10.5.1. Fish and Fish Habitat

Harm to fish and risk of HADD is a risk presented during construction activities for this Project. Project activities will involve works below the HWM of the Goldstream River, as well as high-impact activities in proximity to water, and therefore will require the implementation of federal DFO "measures to protect fish and fish habitat." Impacts to sensitive features can be minimized through the implementation of environmental BMPs to be detailed in the contractor's CEMP and associated plans. Recommended mitigation strategies to avoid causing fish mortality or a HADD are outlined below and in the following sections.

- The Contractor will develop and implement a Fish and Fish Habitat Management Plan that addresses potential Project-related effects on fish and fish habitat including mitigation and monitoring measures.
- The Contractor will develop and implement an Instream Work Plan that includes procedures for completing in-water work such as work zone isolation and dewatering, and fish salvages.
- The Contractor will develop and implement a Water Quality Monitoring and Sampling Plan that includes all requirements for monitoring water quality during the Project.
- In-water works will be conducted during the general fisheries timing window for Vancouver Island is June 15th to September 15th (FLNRO, 2011) (see *Figure 16*). The Project is anticipated to take three years to complete, with works being carried out during multiple least risk fish windows.
- DFO BMPs for Pile Driving and Related Operations will be adhered to at all times during construction (DFO 2003).
- Visual and hydroacoustic monitoring will be required during high-impact activities such as pile-driving and blasting:
    - A suitable qualified EM and/or acoustic monitor will be present to visually monitor for distressed, injured, or dead fish.
    - Fish salvage associated with isolation and dewatering of work areas to be completed by an appropriately trained AQP under permit (MoF and DFO). Permit acquisition is the responsibility of the Contractor.

- Acoustic thresholds should not exceed 205 dB re 1µPA and a SELcum of 186dB re 1µPA2s (NOAA 2018; DFO 2003).
- If acoustic thresholds are exceeded, or a fish kill is evident, the Contractor will introduce effective means of reducing the disturbance.

- Measures to protect water quality will be implemented at all times, including those related to erosion and sediment control and spills of deleterious substances. Refer to *Section 10.5.2* below for details.
- Post habitat restoration monitoring will be completed for a period of 8-10 years to ensure two cycles of salmon returns are monitored.

Reduced Risk Work Windows for Fish and Wildlife for Vancouver Island

Location	Species	Reduced Risk Work Window	
		Start Date	Finish Date
Throughout	All Species*	June 15	September 15
Throughout	Steelhead	June 15	September 15
Throughout	Rainbow Trout	August 15	September 15
Throughout	Cutthroat Trout	August 15	September 15
Throughout	Dolly Varden	June 15	September 1
Throughout	Chinook	July 15	September 15
Throughout	Chum	May 15	September 15
Throughout	Coho	June 15	September 15
Throughout	Pink	May 1	August 15
Throughout	Sockeye	June 1	September 15
Throughout	Kokanee	June 1	September 15

*The general fisheries timing window for instream work on Vancouver Island is June 15th to September 15th. When more detailed information is available w.r.t. fish species present at the (work) site, then the applicable timing window (above) for that species should be applied.

Figure 16. Reduced Risk Timing Window for Vancouver Island (FLNRO, 2011).

10.5.1.1. Blasting

Blasting in or near water may produce shock waves that can damage the swim bladders of fish, rupture internal organs, and kill or damage fish eggs or larvae. The following BMPs are recommended to minimize impacts to fish during blasting activities proposed for the Project:

- A Blasting Management Plan shall be developed and implemented by the Contractor to ensure protection of aquatic features during the Project.
- Large charges should be subdivided into a series of smaller charges and time-delayed to reduce the overall detonation to a series of smaller detonations.
- Minimize blast charge weights used and subdivide each charge into a series of smaller charges in blast holes with a minimum 25 millisecond (1/1000 seconds) delay between charge detonations.
- Maintain appropriate on-land set-back distances from the blast site to a watercourse based on the maximum weight of the charge to be detonated at one instant in time and the type of fish and fish habitat in the area of the blast (refer to *Table 23*).

- If blasts are required nearer to the watercourse than indicated in *Table 23*, then additional mitigation measures should be initiated (e.g., installation of bubble/air curtains to disrupt the shockwave).

- Blasting mats should be placed atop the blasting holes to minimize the scattering of blast debris around the area.
- Ammonium nitrate-based explosives (i.e., Ammonium Nitrate Fuel Oil mixtures, or ANFO) should not be used in or near water due to the production of toxic by-products (ammonia).

Table 23. Minimum required distances from a watercourse for blasting (confined charges) (DFO 2022).

Habitat	Weight of explosive charge (kg)					
	0.5	**1**	**5**	**10**	**25**	**50**
H1	7 m	10 m	15 m	20 m	35 m	50 m
H2	15 m	20 m	45 m	65 m	100 m	143 m

H1 = rearing/general fish habitat
H2 = spawning habitat where egg or early fish development is occurring

10.5.2. Instream Works

Instream works are defined as those activities that are planned to be completed below the HWM of the Goldstream River, within riparian areas, and those that require isolation of work areas from river flows. Erosion and sediment control measures will be required for instream work activities, and all work must be undertaken in a manner to prevent the discharge or introduction of soils, sediment, or sediment-laden water into the receiving environment.

General BMPs to be applied to the Project include, but are not limited to, the following:

- The Contractor will oversee the development and implementation of an ESC Plan (refer to *Section 10.5.3*).
- Non-natural discharge of water, including surface water generated within Project limits, shall be compliant to the appropriate water quality guidelines for discharge into aquatic habitat a(refer to *Section 4.1 – Water Quality Standards and Guidelines*).
- Runoff from suspect or known contaminated soils must be managed.
- The removal or installation of temporary isolation material must not lead to channel or slope instability or increase the risk of sedimentation into the river.
- An AQP retained by the Contractor will assist with isolating the work zone(s) from flowing water and salvaging amphibians and fish, as needed (refer to *Section 10.4.5 – Wildlife Salvages* for details)..
- The EM will be present full time during instream works and/or works in proximity to watercourses and riparian areas, and will ensure the maintenance of water quality in the Project area.

10.5.3. Water Quality

Mitigation measures and BMPs to protect surface water quality during construction include:

- A Water Quality Monitoring and Sampling Plan will be developed and implemented by the Contractor's AQP. The plan will include sampling sites, frequency of sampling, and calibration methods. (
- Effective management of Site construction water and ESC measures will be required to protect water quality.
- Control of waste and potential contaminants from construction equipment will be maintained.

The objectives for the environmental monitoring associated with this Project will be outlined in the CEMP. The BC ENV has developed criteria for acceptable sedimentation levels for water discharged to aquatic environments (MOE 2006). Approved BC Water Quality Guidelines are presented in *Table 2* and *Table 3* in *Section 4.1*. Sediment inputs are measured as water clarity (nephelometric turbidity units or NTU) or as sediment mass in the water column (TSS in mg/L). Any water associated with the Project that may be discharged to water or ground is subject to meeting the applicable water quality standards prior to discharge.

10.5.3.1. Erosion and Sediment Control

Several water quality protection measures will be required in order to protect water quality from sedimentation related to proposed Project activities. These include, but are not limited to, the following:

- The Contractor will develop and implement a Site-specific ESC Plan outlining appropriate ESC measures and procedures (refer to section below).
- Appropriate ESC measures will be installed prior to the onset of construction works and sufficient supplies will be maintained on site at all times.
- Soil disturbance will not occur in heavy rain conditions and any soil removed will be placed in a location that ensures that sediment or debris does not enter aquatic receptors (i.e., drainage or watercourses).
- Any areas that are disturbed during the work (such as exposed soil) must be covered and stabilized promptly.
- Install and maintain ESC measures around exposed or disturbed soil, and in any areas or locations where there is a risk of migration of sediments, sediment-laden water, and/or debris from the work area.
- Water that contains sediment must be managed (pumped, treated, or monitored) to minimize releases.
- Install sediment fencing to prevent the movement of sediment-laden water into the receiving environment or off of the Site (if applicable).
- If any silt, sediment, debris, or Project-related water is observed leaving the work area and entering the receiving environment (i.e., ditches, watercourses, drainages), work will be temporarily halted, and ESC measures will be adjusted accordingly.

Erosion and Sediment Control Plan (ESC Plan)

The Contractor is to develop and implement a Site-specific ESC Plan outlining appropriate ESC measures and procedures required for the Project. The ESC Plan should identify measures and BMPs to be implemented for the management of erosive soil surfaces and to prevent runoff of sediment-laden water

from the Project site. The efficacy of the ESC Plan shall be evaluated in the field as part of the EM duties. The ESC Plan and implementation will be adjusted as needed to achieve regulatory compliance.

The ESC Plan shall reference MoTI's Erosion and Sediment Control Manual (2020), available online5.

The ESC Plan will include the following components:

- A site plan illustrating the location of effective ESC measures to be installed prior to onset of work.
- Definition of storm and runoff discharge points.
- Detailed list of types and quantities of ESC products that correspond with the nature and duration of the Project (e.g., sandbags, filter cloth, silt fencing, etc.). When possible, the Contractor should consider the use of biodegradable products and should select products that are not potential wildlife attractants and do not contain invasive species (i.e., straw bales).
- Measures for managing water flowing onto the Site (i.e., to divert surface runoff away from exposed areas and excavations).
- Measures to protect drainages and flow pathways potentially influenced by construction or truck hauling activities, with protective inserts maintained in clean condition.
- Methods to limit the area of disturbance to the immediate area of construction or excavation.
- Measures to cover or secure bare erodible surface areas to avoid erosion.
- Measures to monitor water quality including specific sampling locations and frequency. The water quality monitoring plan shall include procedures for non-compliance.
- Measures to maintain clean condition of paved surfaces on or off the Site.
- Procedures for the management of excess soil and fill material.
- Procedures for the management of stockpiles or fill to be retained on site including the use of plastic sheeting (or the equivalent) to cover piles and prevent erosion from rainfall.
- Procedures for the suspension of work activities during adverse weather conditions, such as heavy rainfall events (defined as 25 mm in a 24-hour period), including measures for additional monitoring following the rainfall event.
- Procedures for dewatering excavations (if required) such that sediment is filtered out prior to the water entering a watercourse. For example, pumping/diversion of water to a vegetated area, construction of a settling basin or other filtration system.

10.5.3.2. Machinery and Equipment

The use of machinery and equipment in or near water has the potential to result in the introduction of deleterious substances to water (i.e., fuel, oil, sediment). The following general BMPs are recommended:

- Equipment must be in good mechanical condition and, when operating near aquatic features, the operator must prevent entry of any deleterious substance, sediment, debris, or material (e.g.,

[5] https://www2.gov.bc.ca/assets/gov/driving-and-transportation/transportation-infrastructure/engineering-standards-and-guidelines/environment/references/erosion-and-sediment-control-manual.pdf.

hydrocarbons, silt) into the aquatic environment to retain the integrity of said environment and to prevent harm to fish and or wildlife.

- Machinery (e.g., excavators, bobcats, generators) must be stored, maintained, and refueled on a flat surface, outside the drip line[6] of trees and a minimum of 30 m from waterbodies, as measured from the high-water mark; increase the 30 m buffer depending on level of risk and site-specific conditions. Refueling must take place on a tarp or portable berm, or on compacted ground.
- Gas generators must be secured to prevent movement during operation and set up on an impermeable fuel mat with a berm or within a container that can contain 110% of the volume of fuel in the generator.

10.5.3.3. 6-PPD-quinone

6PPD-quinone (6PPD-q) is a chemical that comes from 6PPD (6 p-phenylenediamine), a compound found in tires and recycled tire products that has been found to cause pre-spawn mortality of coho salmon when tire dust is washed into aquatic receptors with precipitation on both roads and tires (Washington 2022). Ongoing studies aim to improve stormwater management strategies to reduce contamination of freshwater features. To date, the most effective strategies to mitigate the effects of 6PPD-q in watercourses include stormwater source controls and treatment that includes infiltration, sorption, filtration, and settling. Source controls include operational controls such as street sweeping, but these have not been found to be overly effective in high traffic areas but may be effective in combination with other methods of treatment. The most effective site-level protection measures have therefore been found to include the use of bioswales, or the infiltration of stormwater to vegetated areas, as 6PPD-q binds to soils and solid particles rather than remaining in a dissolved state.

Recommended mitigation measures for the Project include, but are not limited to, the following:

- Ensuring soils at the Project site have ample sorptive properties and plant-supporting characteristics to provide effective soil ecosystem function, sediment capture, and to encourage infiltration. Capacity to control contaminants including 6PPD-q from runoff directed to vegetated areas and to allow infiltration of the stormwater on site.
- Limiting the reduction of riparian vegetation buffers that act as a natural filter for 6PPD-q.
- Ensuring project design includes stormwater capture and treatment to the greatest extent possible.

10.5.3.4. Paving and PAHs

Stormwater runoff from roads has been shown to have high levels of pollutants (EPA 2011), and impermeable asphalt pavement has been attributed to pollution of water sources due to materials that collect on their surface during dry periods and are subsequently washed into receiving environments during precipitation events (Gilbert and Clausen 2006; EPA 2011).

In addition, when rain comes into contact with fresh asphalt, it causes the oil in the asphalt to rise to the surface, which can result in the movement of hydrocarbon oil sources into freshwater environments (Gilbert and Clausen 2006).

[6] The area defined by the outermost circumference of a tree canopy where water drips from and onto the ground.

The following BMPs are recommended to limit the amount of pollutants moving into vegetated and/or freshwater environments due to paving and/or installation of impermeable surfaces:

- Ensure paving is completed during clear weather.
- Protect freshly paved asphalt surfaces from rainfall as much as is practical.
- Complete regular street-sweeping particularly in advance of a precipitation event that is forecasted to take place after a period of dry weather.

10.5.3.5. Concrete and Grout Management

The Project may include concrete and/or grout work. Run-off from concrete or grout leachate may be strongly alkaline; therefore, water runoff from an area where concrete or grout is curing could affect water quality in downstream receiving environments. The Contractor is responsible for all works involving the use of concrete, cement, mortars, and other Portland cement or lime-containing construction materials. The Contractor will ensure that they will not deposit, directly or indirectly, sediment, debris, concrete and concrete fines, wash or contact water, into any watercourse or to an uncontained area where materials are able to move from the Site and into the receiving environment.

The following BMPs shall be followed as they relate to concrete or grout activities completed for the Project:

- The Contractor will develop and implement a Concrete Waste and Wash Water Management Plan.
- Work will be completed in a manner that prevents concrete wash-water and concrete or grout contact waters from entering the environment.
- Concrete wash-water will be contained and disposed of off-site at a suitable approved and permitted facility (not discharged to ground).
- Tools, pumps, pipes, hoses, and trucks used for finishing, placing or transporting fresh concrete will be washed off in such a way as to prevent the wash off water from entering the environment.
- Avoid concrete and/or grout activities during heavy rainfall events.
- Ensure a CO_2 bubbler is on Site at all times and that personnel are trained in its use.
- Water quality monitoring by the Project EM shall include pH monitoring during concrete placement activities.

The Contractor's Concrete Waste and Wash Water Management Plan will outline specific concrete handling procedures and water quality protection measure to be enacted during the Project including, but not limited to, the following:

- Identification of specific Project works likely to generate construction water impacted by concrete, cement, grouts and other Portland cement or lime containing construction materials.
- Concrete pouring procedures, management of wastes and equipment.
- Methods for the management of concrete wash-water and cleaning of tools and equipment.
- Spill prevention and management procedures.
- Water quality monitoring criteria.

10.5.4. Water Quantity

Runoff from newly constructed hard surfaces in areas where surfaces had been previously permeable to rainfall may reduce ground water recharge and can increase volume of surface water runoff and erosion potential. The final design will replace the existing storm drainage culverts in a way that is appropriate for the area of disturbance and non-permeable surfaces. A stormwater system installed near Finalyson Arm Road will capture part of the highway drainage and will include a holding tank and oil and grit separator to ensure that surface water runoff from the highway is as clean as possible.

10.5.5. Groundwater

Groundwater quality in the Project area may be impacted by accidental spills of deleterious substances to ground or water. In addition, residual petroleum hydrocarbon groundwater contamination may be present in the vicinity of a 2011 fuel spill that occurred approximately 300 m south of the Finlayson Arm Road intersection[7]. Any groundwater that requires management during the Project, including dewatering of excavations, must be sampled for potential contaminants of concern (PCOCs). These PCOCs including the following:

- LEPHw
- EPHw10-19
- VPHw
- VHw6-10
- PAH
- Benzene
- Toluene
- Ethylbenzene
- Xylenes

10.6. AIR QUALITY / NOISE AND VIBRATION

Air quality management should be addressed in the Project CEMP and monitored by a qualified EM. Mitigation measures to be considered include:

- Controlling dust generated during blasting and construction with the application of water.
- Minimizing airborne materials by use of rubber mats while blasting.
- Road sweeping during construction and operations.
- Implementing anti-idling procedures for vehicles and equipment.
- Providing speed limits within the construction area.
- Securing excavated loads on haul trucks.

[7] https://www2.gov.bc.ca/assets/gov/environment/air-land-water/spills-and-environmental-emergencies/docs/goldstream_spill.pdf.

Preparation and implementation of a Noise and Vibration Management Plan should cover scheduling activities like blasting or any loud noises outside the bird breeding season as well as sensitive periods for bats, if / when possible. Additional mitigation measures associated with blasting activities should be included in the contractor's Blasting Management Plan.

10.7. SUMMARY OF ENVIRONMENTAL COMPONENTS

The following table summarizes potential Project impacts to environmental components and recommended mitigation strategies (*Table 24)*. Final design plans and contractors work procedures will determine the extent of actual impacts to be mitigated and the selection and refinement of mitigation strategies to be developed within the Project CEMP.

Refer also to the management plans listed in *Section 10.1* to be developed by the Contractor prior to Project construction. The intent of these management plans, in addition to the CEMP, is to provide specific mitigation measures, protection procedures, and requirements for use by Project personnel in order to mitigate negative environmental effects of site-level development. The recommended mitigation and protection measures summarized in *Table 24* are to be detailed within the CEMP and specific management plans.

Table 24. Summary of Environmental Components, Impacts, and Recommended Mitigation Strategies.

Environmental Component	Project Activities That May Impact Environmental Features	Description of Potential Environmental Impacts	Recommended Mitigation / BMPs
Soils	• Use of Industrial Equipment	• Soil compaction resulting in reduced permeability	• Restrict vehicles and equipment from accessing natural soil surfaces to be retained. Where possible provide exclusion fencing for no-go zones.
		• Soil contamination from accidental spills of deleterious substances	• Spill contingency plan. • Spill kits on heavy equipment & throughout Project site. • Segregate suspect contaminated soils to avoid cross-contamination.
		• Soil erosion resulting in a release of sediment to nearby watercourses	• Design and implementation of ESC protections, including ESC Plan. • Stabilize soils as soon as practical and before a rain event. • Install ESC measures prior to work commencing.
		• Soil erosion resulting in the generation of dust	• Design and implementation of ESC protections, including ESC Plan.
	• Excavation works and soil management	• Direct loss of native topsoil	• Salvage and reuse topsoil where appropriate (i.e., not sources from areas clearly infested with invasive plants).
		• Erosion and off-site movement of sediments	• ESC Plan to include soil management such as stockpile management and tracking of soil onto paved surfaces. • Street sweeping where appropriate.
	• Grading and alteration of local drainage patterns	• Erosion of soil surfaces	• Design and implementation of ESC protections, including ESC Plan. • Stabilize soils as soon as practical and before a rain event. • Install ESC measures prior to work commencing.
Vegetation Features	• Vegetation clearing and grubbing	• Potential loss of wildlife habitat and wildlife trees	• Retain or provide for the reuse of wildlife trees. Leave cut trees on the remaining forest floor to provide habitat and foraging opportunities.
		• Impacts to retained trees by compaction of tree root zone	• Protection fencing is recommended around retained trees. • Equipment and machinery to be restricted from entering vegetated areas.
		• Direct loss of vegetation including removal of provincially listed ecosystems	• Develop and implement a Vegetation Management Plan. • Areas to be cleared should be clearly marked. • Impacts to provincially listed vulnerable forest ecosystems should be avoided or impact minimized as much as possible.
		• Establishment of invasive plant species	• Develop and implement an Invasive Plant Management Plan. • Due care should be taken to protect the site and surrounding area from the introduction or spread of invasive plants during construction. • Monitor areas with disturbed soils and remove regulated weeds as per the *Weed Control Act*.

Environmental Component	Project Activities That May Impact Environmental Features	Description of Potential Environmental Impacts	Recommended Mitigation / BMPs
			• Revegetate exposed soils with native species as soon as possible and where practical.
		• Reduction in local biodiversity and/or ecosystem quality	• Limit the amount of vegetation to be removed or impacted. • Develop and implement a Vegetation Management Plan that includes replating/seeding with native species.
	• All ground disturbances	• Spread or establishment of invasive weed species leading to degradation of ecosystem quality/biodiversity	• Proper removal and handling of noxious weeds. • Methods to prevent spread of propagules on tires of vehicles. • Provide protective cover of disturbed soils through native species revegetation.
		• Reduction in vegetation/ecosystem health due to changes in soil quality	• Salvage and reuse topsoil where appropriate (i.e., not sources from areas clearly infested with invasive plants).
	• Import of fill materials	• Introduction of invasive weed species leading to degradation of ecosystem quality/biodiversity	• Ensure imported materials are certified weed-free.
	• Modification of drainage patterns	• Reduction in vegetation/ecosystem health due to changes in groundwater flow regimes and/or surface water inputs	• Minimize changes to drainage patterns as much as is practical. • Ensure soil health in all areas to be restored/modified to ensure ecosystem and plant health is maintained.
Terrestrial Wildlife Features	• Vegetation clearing and grubbing	• Direct loss of wildlife habitat	• Minimize forest clearing and cutting through reduced footprint. Replant non-hard surfaces with native vegetation. • Avoid clearing large mature trees and wildlife trees wherever possible. If such trees cannot be avoided, it is recommended that they be reused on site as large woody debris for wildlife habitat. • Pre-clearing surveys for pileated woodpecker nesting cavities required prior to removal of large diameter trees. • Retain connectivity of forested areas.
		• Disturbance to nests and/or nesting birds, including at-risk species, resulting in egg or nest abandonment, injury, or mortality (non-compliance with the *Wildlife Act*)	• Develop and implement a Wildlife Management Plan. • Timing constraints: Follow least risk timing windows for clearing vegetation and schedule construction activities that generate noise that could disturb breeding birds within the least risk window. • Provide an AQP to monitor active bird nests within the study area during construction outside the least risk window. AQP monitoring of active nests for disturbance within 200m of construction noise is recommended (MOE 2014a). • Buffer zones to be placed around active nests. Monitoring of active nests for disturbance during construction. AQP to determine impacts.

Environmental Component	Project Activities That May Impact Environmental Features	Description of Potential Environmental Impacts	Recommended Mitigation / BMPs
			• Salvage of organisms from wildlife habitat to be impacted by construction of the project. • Removal of protected nests under *Wildlife Act* 34b is not permitted.
		• Disturbance to amphibians and reptiles, including at-risk species, leading to injury, mortality, or loss of habitat	• Wildlife surveys and salvages to be completed prior to vegetation clearing and grubbing. • Vegetation removal including removal of coarse woody debris to be completed outside of sensitive life stages for amphibians and reptiles. • Salvages to be completed under permit to be obtained by the Contractor's AQP.
		• Disturbance to bats resulting in injury or mortality.	• Avoid clearing of large diameter trees between November and April to avoid direct impacts to hibernating bats. If clearing of trees is to be completed during this time, a pre-clearing survey is required.
		• Wildlife encounters resulting in disturbance, injury, or mortality	• Develop and implement a Wildlife Management Plan. • AQP on site during site clearing and grading to salvage and relocate wildlife. • Develop a plan to reduce attracting birds and other wildlife to construction site during construction by proper waste control.
		• Injury/mortality of amphibian and reptile species.	• Complete clearing and grubbing works in forested and riparian areas outside of active/sensitive periods for these species. • Amphibian and reptile surveys and salvages will be required prior to clearing of vegetation and grubbing.
	• All ground disturbances	• Reduction in soil/ecosystem/vegetation health resulting in degradation of habitat quality	• Limit the amount of vegetation to be removed or impacted. • Develop and implement a Vegetation Management Plan that includes replating/seeding with native species. • Ensure measures to avoid the spread or establishment of invasive plant species are implemented for the Project.
		• Injury/mortality of amphibian and reptile species.	• Complete ground-disturbing works in forested and riparian areas outside of active/sensitive periods for these species. • Pre-construction surveys and salvages will be required.
	• Blasting and high-impact activities	• Disturbance to nesting birds resulting in egg or nest abandonment, injury, or mortality	• Follow least risk timing windows for high-impact and schedule construction activities that generate noise that could disturb breeding birds within the least risk window. • Develop and implement a Blasting Management Plan. • AQP on-site monitoring. • Salvage of organisms from wildlife habitat to be impacted by construction of the project. • Use blasting mats to contain the blast, prevent flying rocks, and suppress dust. • Permits for salvage, if the need arises, may be required from ENV.

Environmental Component	Project Activities That May Impact Environmental Features	Description of Potential Environmental Impacts	Recommended Mitigation / BMPs
		• Loss of bat roosting habitat	• Complete additional surveys of upper cliff areas prior to blasting. • Schedule blasting activities to coincide with non-sensitive life stages for bats.
		• Disturbance to bats resulting in injury or mortality.	• Complete blasting activities outside of sensitive periods for bats. • Sequence blasting activities as suggested in *Section 10.4.2.2*. • Minimize blast charge size where possible.
	• General Project construction	• Wildlife encounters	• Appropriate management of waste required including wildlife attractants. • Install exclusion fencing to limit the movement of amphibians, reptiles, and/or small mammals into work areas.
Watercourses and Aquatic Features	• Excavation and earth works • Overburden stripping	• Reduction in water quality due to erosion or disturbed surfaces, tracking of soils onto paved surfaces, vegetation removal	• Limit impacts to on-site vegetated and adjacent riparian areas. • Apply ESC measures and BMPs to control erosion and sedimentation. • Water quality parameters such as TSS and turbidity will be monitored by an AQP during construction activities that have the potential to release turbid water to the aquatic environment. • EM on site to monitor effectiveness of ESC measures. • Contain and collect all effluent and debris from construction activities and disposed of in accordance with BC *Environmental Management Act.*
	• Clearing and grubbing	• Reduction in water quality due to erosion of disturbed areas following vegetation removal	• ESC Plan to be developed and implemented by the Contractor. • All disturbed surfaces to be stabilized as soon as is practical. • Water quality parameters such as TSS and turbidity will be monitored by an AQP during construction activities that have the potential to release turbid water to the aquatic environment. • EM on site to monitor effectiveness of ESC measures.
		• Degradation of habitat quality due to removal of vegetation and associated shading and potential temperature increases	• Retain as much as riparian vegetation as possible. • Ensure riparian areas that are disturbed during construction are replanted with suitable species to restore or improve habitat quality.
		• Increased levels of 6PPD-q and other contaminants in the river leading to injury/mortality of fish due to reduced vegetation buffers adjacent to the river.	• Maintain sufficient areas of riparian vegetation to allow infiltration of run-off from paved surfaces. • Ensure highway drainage is directed through the oil and grit separator prior to discharge.
	• Habitat restoration works • Bridge maintenance / alteration	• Erosion and sedimentation causing increased turbidity in the water	• Manage through standard ESC Plan (e.g., sediment fences for clearing areas, use of straw wattles and inlet protection) • EM on site to monitor effectiveness of ESC measures.

Environmental Component	Project Activities That May Impact Environmental Features	Description of Potential Environmental Impacts	Recommended Mitigation / BMPs
	• In-water works and works below the HWM	• Reduction of water quality due to disturbances to the river bed	• All instream works to be completed within appropriate least risk windows. • EM on site for all in-water or near-water works. The EM will monitor water quality and ensure BMPs are being followed. • Equipment and material used within the watercourse to be ensured clean before use. • Isolation and dewatering methodologies to be overseen by the EM. • Fish salvage to be completed by an appropriately trained AQP under permit (MoF and DFO).
		• Direct impacts to fish/eggs/embryos due to installation of temporary cofferdams in the river	• All instream works to be completed within appropriate least risk windows. • EM on site for all in-water or near-water works. The EM will monitor water quality and ensure BMPs are being followed.
	• Use of industrial machinery and equipment in and adjacent to water	• Contamination of watercourses due to accidental spills of deleterious substances • Negative impacts to fish and fish habitat from degradation of water quality and/or exposure to contaminants	• Contractor to develop and implement a spill prevention and response plan. • Spill kits on heavy equipment & throughout Project site. • Machinery to be inspected prior to use. • Machinery working in or near water to use biodegradable fuels and have hydraulic connections wrapped at all times. • EM on site for all in-water or near-water works. The EM will monitor water quality and ensure BMPs are being followed.
	• Blasting and high-impact activities	• Direct (injury/mortality) and indirect (disturbance/vibration) to fish, eggs, embryos as a result of activities such as pile-driving and blasting.	• DFO BMPs for pile-driving to be adhered during pile installs and blasting activities. • Visual and hydroacoustic monitoring will be required during all high-impact activities. • A Blasting Management Plan will be developed and implemented by the Contractor. • Appropriate on-land set-back distances from the blast site to the watercourse based on maximum weight of the blast charge to be detonated will be followed at all times.
	• Concrete placement	• Increased pH levels in downstream receiving environments leading to injury/mortality to fish	• The Contractor will develop and implement a Concrete Waste and Wash Water Management Plan. • No concrete waste or wash-water will be permitted to be released to the environment (ground or water). All concrete waste material and liquids will be disposed of off-site at an appropriately licensed facility. • Avoid completing concrete placement activities during heavy rainfall events. • Contractor to have a CO_2 bubbler on site at all times with personnel trained in its use. • The EM will complete water quality monitoring for pH during all concrete placement activities.

Environmental Component	Project Activities That May Impact Environmental Features	Description of Potential Environmental Impacts	Recommended Mitigation / BMPs
	• Paving	• Increased levels of hydrocarbon contaminants leading to injury/mortality of fish due to asphalt paving.	• Ensure paving activities are completed during clear weather. • Complete regular street sweeping. • Maintain sufficient areas of riparian vegetation to allow infiltration of run-off from paved surfaces. • Ensure highway drainage is directed through the oil and grit separator prior to discharge.
Air Quality / Noise and Vibration	• General Project construction including use of industrial equipment, earth works, soil management, high-impact activities	• Reduction in air quality in the Project area due to airborne exhaust and/or dust	• Manage through standard ESC Plan • Implement no-idling policy for vehicles • Ensure all machinery and vehicles in good working condition and operating at optimum condition to reduce exhaust emissions.
		• Reduction in wildlife habitat quality due to noise and disturbance	• Follow least risk timing windows for high-impact and schedule construction activities that generate noise that could disturb breeding birds or other wildlife within the species appropriate least risk window. • Develop and implement a Blasting Management Plan.

11. Residual Impacts

Residual impacts are expected to include:

- Permanent loss of mature coniferous forest habitat, including potential loss to red and blue listed ecosystems.
- Permanent loss or alteration of aquatic salmonid and amphibian habitat associated with removal of riparian vegetation / habitat in proximity to the Goldstream River.
- Loss of wildlife habitat through reduction in wildlife vegetation along the alignment and habitat fragmentation.
- Potential loss of bat roosting habitat in cliff areas.

A number of supplementary activities have been included in the Project scope in order to offset any negative environment impacts associated with site-level development, including upstream habitat restoration activities, riparian restoration planting and addition of coarse woody debris in riparian areas, removal of existing invasive weed species within the Project footprint, and highway drainage improvements including stormwater treatment and an expected associated reduction in 6PPD-q concentrations in the Goldstream River.

12. Conclusions

This EA was completed with information obtained from desktop studies, site orientation, field visits, and engineering design drawings prepared for the 100% Detailed Design. Environmentally sensitive features within the study area were identified and located and potential impacts to be mitigated during the design and construction of the project were identified. Environmental legislation was reviewed to determine the regulatory compliance requirements for the successful construction of the project.

Environmental impacts determined at this design phase include loss of wildlife habitat and vegetation due clearing activities and road construction, disturbance and loss to aquatic habitat due to impacts to riparian areas which may provide refuge for amphibians or the introduction of sediment laden water, and disturbance of sensitive life stages (breeding) of wildlife and birds by construction activities.

Indirect project impacts include the potential for disturbance of birds protected under legislation as follows:

a) species listed under the federal *Species at Risk Act* (Canada 2002),

b) birds protected under the *Migratory Birds Convention Act* (Canada 1994), and

c) birds and active nests protected under the provincial *Wildlife Act* Section 34 (BC 2014c).

Indirect impacts of project construction may be mitigated through the application of BMPs such as construction phasing or scheduling to conduct certain noisy or potential disruptive construction activities outside the breeding season.

While web-based reviews of provincial and regional databases indicate the potential presence of plants and wildlife species at risk in the region around the study area, Pacific waterleaf, a red listed plant species was observed during the site visit. Blue and Red listed ecosystems also occur adjacent to the project footprint.

Blasting, clearing, and infilling to accommodate the new highway alignment can be conducted in a low impact manner to reduce disturbance of wildlife and wildlife habitat and other environmental features or features within the project boundaries. Construction mitigation strategies will be planned and addressed in a Project specific CEMP or specific work procedure. A full time EM during sensitive construction phases is recommended to address any species at risk or other wildlife concerns should they arise.

The Project has obtained the necessary permits under the *WSA* and *Fisheries Act* to preform the works below the HWM through an Approval and Letter to Avoid and Mitigate under the Section 11 of the *WSA* (BC 2014b) and paragraph 35(2)(b) of the *Fisheries Act* (Canada 1985), respectively. The Project will also submit *WSA* Notifications for the clear span pedestrian bridge, culverts and the storm water outfall within legislated timelines in advance of construction, and has obtained the LoA from DFO for the clear span pedestrian bridge. The Project will conduct its activities in compliance with legislated acts associated with environmental protection.

Environmental impacts associated with proposed Project activities are intended to be avoided, mitigated, and/or managed through the application of mitigation measures and BMPs outlined in *Section 10* of this EMP. Residual environmental impacts identified for the overall Project are intended to be offset through the implementation of activities such as habitat restoration, riparian area improvements, and stormwater treatment installation and associated water quality enhancements in the Goldstream River.

13. Closing

The information presented in this report is for use by the MOTI as part of their requirement for a review of potential environmental impacts associate with the Trans-Canada Highway No. 1 Malahat Corridor Improvements Project. This EA was prepared based on review of the 100% Detailed Design options and includes all the Project impacts requiring mitigation. We trust the information provided is sufficient to meet the needs of this Project.

Prepared by:

COLLEGE OF APPLIED BIOLOGISTS
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CAB January 15, 2024

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APPENDIX A
PERMITS AND APPROVALS

November 5, 2021

Job Number: 118863
vFCBC Tracking Number: 100353490

Ministry of Transportation and Infrastructure
3-2100 Labieux Road
Nanaimo, British Columbia
V9T 6E9

Dear Ministry of Transportation and Infrastructure,

Change Approval - Changes In and About a Stream (File 1005214)

A Change Approval for the above application has been granted and a *Water Sustainability Act Section* 11(1) Changes In and About a Stream Approval document verifying this is attached.

This Change Approval does not authorize occupation of private or Crown owned land. Permission of the affected landowner, or a permission to occupy Crown land, must be obtained and should be in writing for your protection.

The holder of this approval shall ensure that any proposed development and/or changes do not impact traditional or special sites in accordance with the *Heritage Conservation Act* and the ability of First Nation community members to participate in traditional activities on the land and water.

This approval does not constitute authority of any other agency. The holder of this approval shall have the necessary permits from other agencies concerned prior to the commencement of the works authorized herein. The permit holder is required to adhere to all other applicable Provincial and Federal Regulations.

Archeological sites (both recorded and unrecorded) are protected under the *Heritage Conservation Act* and must not be altered or damaged without a permit from the Archeology Branch. The holder of this approval must advise everyone who will be involved in ground-disturbance and construction that if archeological materials are encountered, activities must be halted and the Archeology Branch contacted at 250-953-3334 for direction.

We wish to inform you that the water bodies may serve as spawning and rearing areas for fish. The protective requirement of the federal *Fisheries Act* must be met. Accordingly, it is necessary for you to screen your water intake to protect against entry

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

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Web: https://www2.gov.bc.ca/gov/content/environment/air-land-water/water

of small fish as per Freshwater Intake End-of-Pipe Fish Screen Guidelines (Department of Fisheries and Oceans, 1995). Please refer to www.dfo-mpo.gc.ca/Library/223669.pdf) for this publication.
Section 105 of the *Water Sustainability Act* gives the recipient of this notice the right to appeal my decision. You may file an appeal within 30 days of the date indicated on this letter. Information on filing an appeal can be found on the Environmental Appeal Board WEB site at http://www.eab.gov.bc.ca/.

If you have any questions or concerns regarding the document issued or this letter please feel free to contact me, Annette Bailey, Water Officer, by email at Annette.bailey@gov.bc.ca or by phone at 250-736-6843.

Sincerely,

Rhonda (Morris) Coleman
District Manager

Enclosure: Change Approval

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

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V8J 1G8

November 30, 2021

Our file *Notre référence*

21-HPAC-00853

B.C. Ministry of Transportation and Infrastructure
Attn.: Virginia Dragan
310 – 1500 Woolridge Street
Coquitlam, BC
V3K 0B8

Via email: Virginia.Dragan@gov.bc.ca

Subject: Highway 1 Malahat Corridor Improvements at Goldstream River, Near Victoria BC – Implementation of Measures to Avoid and Mitigate the Potential for Prohibited Effects to Fish and Fish Habitat

Dear Virginia Dragan:

The Fish and Fish Habitat Protection Program (the Program) of Fisheries and Oceans Canada (DFO) received your proposal on July 15, 2021. We understand that you propose to:

- Upgrade and widen a section of Highway 1 along the Goldstream River (bordering Goldstream Provincial Park) which involves riparian clearing, excavation, isolation of the watercourse, dewatering, fish salvage, concrete works, pile driving, and armoring.
- Construct a retaining wall and cantilever structure using cast in place concrete and pile driving techniques above the High Water Mark (HWM).
- Conduct restoration of a historic habitat enhancement site through complexing with large woody debris, boulders, spawning gravels, riparian plantings and bank stabilization.

Our review considered the following information:

- *Site Visit* February 9, 2021 conducted by Andrew MacInnis (DFO), Patty Burt (McElhanney), Darren Englund (MOTI), and Victoria Dragan (MOTI);
- *Request for Review* form prepared by McElhanney Ltd. (Langley), submitted by email on July 15, 2021;
- *Project Overview Report: Regulatory Submission Highway No. 1 Malahat Corridor Improvements*, dated July 2021, prepared by McElhanney Ltd. (Langley), submitted by email on July 15, 2021;
- *Ministry of Transportation and Infrastructure (MOTI) Environmental Project Environmental Specifications and Provisions V2*, dated July 13, 2021, prepared by MOTI, submitted by email July 15, 2021;

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- Emails between Patty Burt and Sean Hollis (the Program) in November, 2021 regarding project details surrounding footprints and construction methods; and,
- Meeting between Ian Bergsma (the Program), Sean Hollis, Patty Burt and Virginia Dragan on November 24, 2021.

Your proposal has been reviewed to determine whether it is likely to result in:

- the death of fish by means other than fishing and the harmful alteration, disruption or destruction of fish habitat which are prohibited under subsections 34.4(1) and 35(1) of the *Fisheries Act*; and
- effects to listed aquatic species at risk, any part of their critical habitat or the residences of their individuals in a manner which is prohibited under sections 32, 33 and subsection 58(1) of the *Species at Risk Act*.

The aforementioned outcomes are prohibited unless authorized under their respective legislation and regulations. As of the date of this letter, no individuals of any aquatic species listed under the *Species at Risk Act* were identified in the vicinity of the proposed project.

To avoid and mitigate the potential for prohibited effects to fish and fish habitat (as listed above), we recommend implementing the measures listed below:

- Limit riparian clearing to the extent possible and clearly mark areas of riparian vegetation that is not to be disturbed. Re-vegetate disturbed areas with native species suitable for the site.
- Avoid conducting any project works outside of the least risk window (June 15 – September 15).
- Conduct project works below the HWM in-the-dry during a period of low flow and favourable weather conditions. Monitor weather forecasts and implement contingency measures in the event of bad weather advisories.
- Isolate and conduct a fish salvage prior to dewatering areas.
- Monitor the dewatered area and conduct a fish salvage if the area becomes re-watered.
- Restore stream geomorphology surrounding the road structure (*i.e.*, restore the bed and banks, gradient and contour of the waterbody) to its pre-existing condition.
- Limit the duration of project works below the HWM.
- Following restoration of the stream bed and bank, flush the isolated work area with water and pump any sediment laden water into vegetated areas (or dispose of), prior to removing isolation, to avoid introduction of sediment laden water into the downstream habitat.
- Effectively implement, monitor and maintain erosion and sediment control measures.
- Use biodegradable erosion and sediment control materials whenever possible and remove all exposed non-biodegradable sediment control materials once site is stabilized.

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- Dispose of removed materials at an approved upland location where it cannot be mobilized into any waterbody.
- Operate machinery in a manner that minimizes disturbance to the watercourse bed and banks. Use methods to prevent substrate compaction (e.g., swamp mats).
- Machinery is to be clean, free of debris and leaks, and it is to be regularly inspected.
- Retain the services of a Qualified Environmental Professional to provide services as an Environmental Monitor (EM) to be on-site during all project activities which have the potential to impact fish and fish habitat.
- Do not deposit any deleterious substance that can enter a waterbody. Ensure that sufficient spill response equipment is on-site and readily available.
- Uncured concrete and concrete wash water should be effectively contained to ensure it does not enter any waterbody. Treatment measures (e.g., CO_2 and diffusers) should be readily available and deployable onsite in the event of a release of concrete or concrete wash water into or connected to fish bearing waters.
- Ensure rip rap is non-acid generating and free of dirt or debris before placing at the toe of the road structure.
- Adhere to guidelines and measures found in the following DFO Interim Codes of Practice (https://www.dfo-mpo.gc.ca/pnw-ppe/practice-practique-eng.html) including Notification to DFO:
    - End-of-pipe fish screens for small water intakes in freshwater.
    - Temporary cofferdams and diversion channels.

Provided that you incorporate these measures into your plans, the Program is of the view that your proposal is not likely to result in the contravention of the above mentioned prohibitions and requirements.

Should your plans change or if you have omitted some information in your proposal, further review by the Program may be required. Consult our website (http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html) or consult with a qualified environmental consultant to determine if further review may be necessary. It remains your responsibility to remain in compliance with the *Fisheries Act*, the *Species at Risk Act* and the *Aquatic Invasive Species Regulations.*

It is also your Duty to Notify DFO if you have caused, or are about to cause, the death of fish by means other than fishing and/or the harmful alteration, disruption or destruction of fish habitat. Such notifications should be directed to the DFO-Pacific Observe, Record and Report phone line at 1-800-465-4336 or by email at DFO.ORR-ONS.MPO@dfo-mpo.gc.ca.

We recommend that you notify this office 10 days before starting your project and that a copy of this letter be kept on site while the work is in progress. It remains your responsibility to meet all other federal, provincial and municipal requirements that apply to your proposal.

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Note that this Letter of Advice does not provide relief from the obligations set out in the government of British Columbia's Riparian Areas Protection Regulations (RAPR), and cannot be construed to provide authorization pursuant to section 3(2) of the RAPR, for any work, undertaking or activity within the Riparian Assessment Area. For more information on the RAPR, including contacts, please visit: https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/fish/aquatic-habitat-management/riparian-areas-regulation.

Please note that the advice provided in this letter will remain valid for a period of one year from the date of issuance; should substantial works have been completed within the one year period this letter will continue to remain valid. If you plan to execute your proposal after the expiry of this letter, we recommend that you contact the Program to ensure that the advice remains up-to-date and accurate. Furthermore, the validity of the advice is also subject to there being no change in the relevant aquatic environment, including any legal protection orders or designations, during the period in which the project is to be completed.

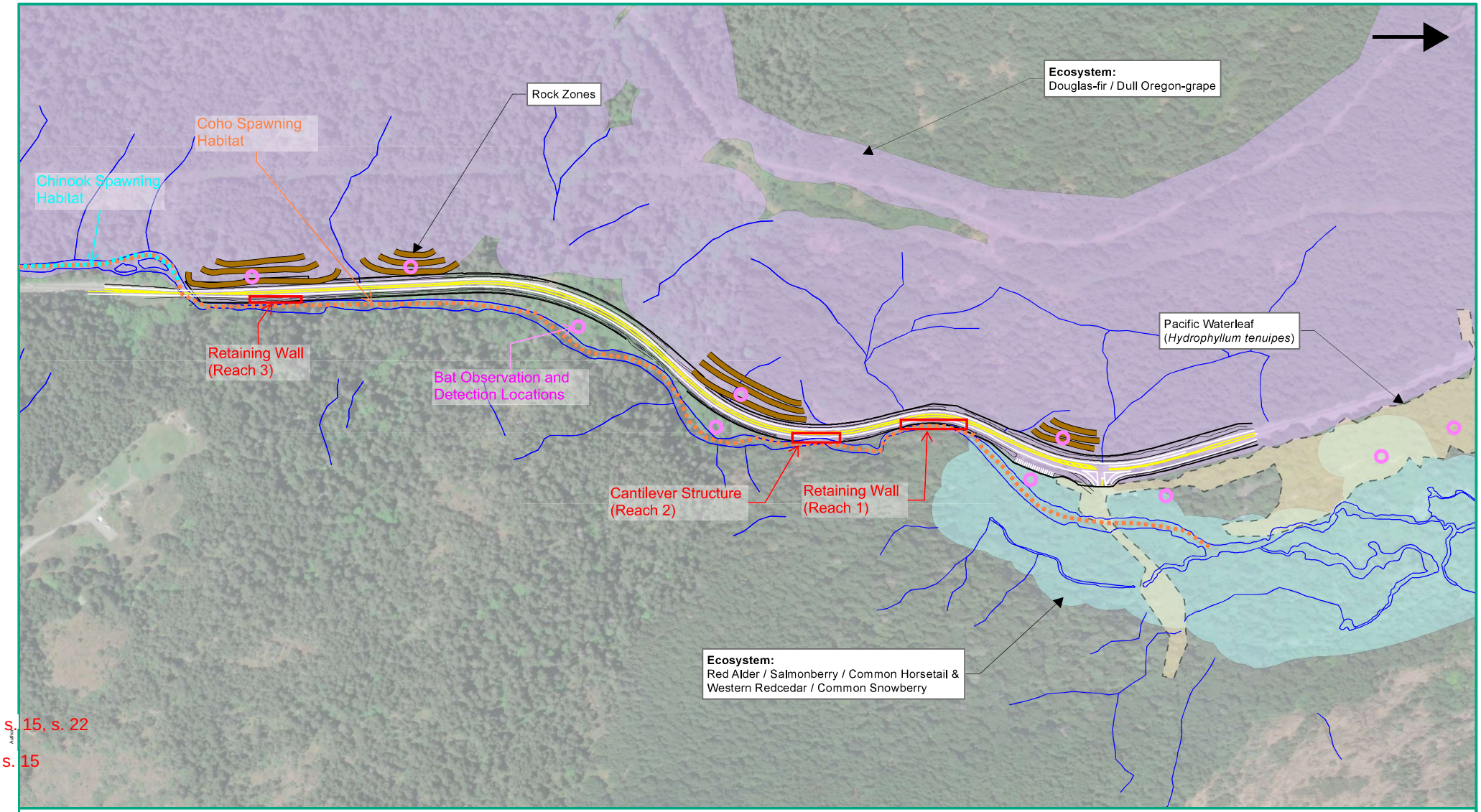
If you have any questions with the content of this letter, please contact Sean Hollis at our Nanaimo office by email at Sean.Hollis@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,

Ian Bergsma
A/Senior Biologist
Fish and Fish Habitat Protection Program

c.c.: Patty Burt, McElhanney Ltd. (Langley), pburt@mcelhanney.com
Mark Trousdell, McElhanney Ltd. (Langley), mtrousdell@mcelhanney.com

APPENDIX B
OVERVIEW MAP



s. 15, s. 22

s. 15

HALF SIZE

FOR REGULATORY DISCUSSION PURPOSES ONLY

Drawing No. Goldstream Sept 2019

Overview Environmental Effects Assessment:

Project 2121-00428-01
Hwy1 at Goldstream

Coordinate System: NAD 1983 UTM Zone 10N

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- Site
- Sensitive_Line
- Sensitive_Poly
- Ecosystem: Douglas-fir / Dull Oregon-grape
- Ecosystem: Red Alder / Salmonberry / Common Horsetail and Western Redcedar / Common Snowberry

APPENDIX C
PROVINCIALLY & SARA LISTED VASCULAR PLANT SPECIES POTENTIALLY OCCURRING ON THE SITE

Scientific Name	English Name	Name Category	Provincial	BC List	COSEWIC	SARA
Bartramia aprica	rigid apple moss	Bryophyte	S2 (2015)	Red	E	1-E (2003)
Brotherella roellii	Roell's brotherella	Bryophyte	S3 (2023)	Blue	E	1-E (2018)
Fissidens pauperculus	poor pocket moss	Bryophyte	S1 (2015)	Red	E	1-E (2003)
Seligeria acutifolia	acuteleaf small limestone moss	Bryophyte	S1 (2015)	Red	E	1-E (2021)
Syntrichia laevipila	twisted oak moss	Bryophyte	SU (2023)	Unknown	SC	1-SC (2005)
Cladonia decorticata	strip-tease pixie	Lichen	S3 (2019)	Blue		
Collema flaccidum	flaking tarpaper	Lichen	S1S3 (2019)	Red		
Dermatocarpon intestiniforme	quilted stippleback	Lichen	S2S3 (2019)	Blue		
Erioderma sorediatum	vole felt	Lichen	S2S3 (2019)	Blue		
Hypogymnia heterophylla	seaside bone	Lichen	S3S4 (2023)	Yellow	NAR	1-T (2010)
Leioderma sorediatum	felted elf	Lichen	S2S3 (2010)	Blue		
Nephroma occultum	cryptic paw	Lichen	S3 (2019)	Blue	T	1-SC (2007)
Pannaria rubiginosa	considerable gingerbread	Lichen	S2 (2019)	Red		
Physconia detersa	bottlebrush frost	Lichen	S2? (2019)	Red		
Scytinium californicum	midlife vinyl	Lichen	S2S3 (2010)	Blue		
Scytinium platynum	batwing vinyl	Lichen	S3S4 (2018)	Yellow	E	1-E (2017)
Scytinium polycarpum	peacock vinyl	Lichen	S4 (2018)	Yellow	SC	1-SC
Abronia latifolia	yellow sand-verbena	Vascular Plant	S3 (2019)	Blue		
Allium amplectens	slimleaf onion	Vascular Plant	S3 (2019)	Blue		
Amauropelta nevadensis	Nevada marsh fern	Vascular Plant	S1 (2019)	Red		
Aphyllon pinorum	pine broomrape	Vascular Plant	S1S2 (2019)	Red		
Balsamorhiza deltoidea	deltoid balsamroot	Vascular Plant	S2 (2019)	Red	E	1-E (2003)
Bidens amplissima	Vancouver Island beggarticks	Vascular Plant	S3 (2019)	Blue	SC	1-SC (2003)
Calystegia soldanella	beach bindweed	Vascular Plant	S3 (2019)	Blue		
Camissonia contorta	contorted-pod evening-primrose	Vascular Plant	S1S2 (2022)	Red	E	1-E (2007)
Carex tumulicola	foothill sedge	Vascular Plant	S3S4 (2019)	Yellow	E	1-E (2010)
Castilleja ambigua var. *ambigua*	estuarine paintbrush	Vascular Plant	S3 (2019)	Blue		

Castilleja levisecta	golden paintbrush	Vascular Plant	S1 (2019)	Red	E	1-E (2003)
Castilleja victoriae	Victoria's owl-clover	Vascular Plant	S1 (2019)	Red	E	1-E (2012)
Cephalanthera austiniae	phantom orchid	Vascular Plant	S2 (2019)	Red	E	1-E (2019)
Clarkia purpurea ssp. *quadrivulnera*	wine-cup clarkia	Vascular Plant	S2 (2019)	Red		
Claytonia washingtoniana	Washington springbeauty	Vascular Plant	S3 (2022)	Blue		
Crassula connata	Erect Pigmyweed	Vascular Plant	S2S3 (2019)	Blue		
Dryopteris arguta	coastal wood fern	Vascular Plant	S3 (2019)	Blue	SC	1-SC (2003)
Elatine brachysperma	short-seeded waterwort	Vascular Plant	S1 (2019)	Red		
Epilobium densiflorum	dense spike-primrose	Vascular Plant	S2 (2019)	Red	E	1-E (2006)
Epilobium torreyi	brook spike-primrose	Vascular Plant	SH (2019)	Red	E	1-E (2007)
Erigeron philadelphicus var. *glaber*	salt marsh Philadelphia daisy	Vascular Plant	S2S3 (2022)	Blue		
Euonymus occidentalis var. *occidentalis*	western strawberry-bush	Vascular Plant	S1 (2019)	Red		
Eurybia radulina	rough-leaved aster	Vascular Plant	S2 (2022)	Red		
Githopsis specularioides	common bluecup	Vascular Plant	S3 (2019)	Blue		
Glehnia littoralis ssp. *leiocarpa*	American glehnia	Vascular Plant	S3 (2019)	Blue		
Hosackia gracilis	seaside bird's foot lotus	Vascular Plant	S2 (2019)	Red	E	1-E (2003)
Hosackia pinnata	bog bird's-foot trefoil	Vascular Plant	S2? (2019)	Red	E	1-E (2005)
Juncus hemiendytus var. *hemiendytus*	Hermanns dwarf rush	Vascular Plant	S2 (2019)	Red		
Juncus kelloggii	Kellogg's rush	Vascular Plant	S1S2 (2019)	Red	E	1-E (2005)
Lathyrus littoralis	silky beach pea	Vascular Plant	S2 (2019)	Red	T	1-T (2023)
Limnanthes macounii	Macoun's meadow-foam	Vascular Plant	S2? (2019)	Red	T	1-T (2006)
Lomatium dissectum	fern-leaved desert-parsley	Vascular Plant	S2 (2019)	Red		
Lomatium papilioniferum	butterfly bearing lomatium	Vascular Plant	S2 (2019)	Red	T	1-T (2011)
Lupinus lepidus	prairie lupine	Vascular Plant	S1 (2019)	Red	E	1-E (2003)
Lupinus microcarpus var. *microcarpus*	dense-flowered lupine	Vascular Plant	S1 (2019)	Red	E	1-E (2006)
Lupinus oreganus var. *kincaidii*	Kincaid's lupine	Vascular Plant	SU (2019)	Unknown	XT	1-XT (2011)
Marah oregana	coast manroot	Vascular Plant	S1 (2019)	Red	E	
Meconella oregana	white meconella	Vascular Plant	S1S2 (2019)	Red	E	1-E (2006)

Microseris bigelovii	coast microseris	Vascular Plant	S2 (2019)	Red	E	1-E (2007)
Mitellastra caulescens	leafy mitrewort	Vascular Plant	S3 (2019)	Blue		
Montia chamissoi	Chamisso's montia	Vascular Plant	S3 (2022)	Blue		
Nuttallanthus texanus	Texas toadflax	Vascular Plant	S3 (2019)	Blue		
Orthocarpus bracteosus	rosy owl-clover	Vascular Plant	S1 (2019)	Red	E	1-E (2005)
Plagiobothrys figuratus ssp. *figuratus*	fragrant popcornflower	Vascular Plant	S1 (2019)	Red	E	1-E (2010)
Plagiobothrys tenellus	slender popcornflower	Vascular Plant	S1? (2019)	Red	T	1-T (2011)
Platanthera ephemerantha	white-lip rein orchid	Vascular Plant	S3 (2019)	Blue		
Polygonum paronychia	black knotweed	Vascular Plant	S3 (2019)	Blue		
Polystichum californicum	California Sword-fern	Vascular Plant	S1 (2019)	Red		
Prosartes smithii	Smith's fairybells	Vascular Plant	S3? (2022)	Blue		
Psilocarphus elatior	tall woolly-heads	Vascular Plant	S2 (2019)	Red	E	1-E (2003)
Pyrola aphylla	leafless wintergreen	Vascular Plant	S3 (2019)	Blue		
Ranunculus alismifolius var. *alismifolius*	water-plantain buttercup	Vascular Plant	S1 (2019)	Red	E	1-E (2003)
Ranunculus californicus	California buttercup	Vascular Plant	S2 (2019)	Red	E	1-E (2011)
Ranunculus lobbii	Lobb's water-buttercup	Vascular Plant	SH (2019)	Red		
Rubus lasiococcus	dwarf bramble	Vascular Plant	S3 (2019)	Blue		
Sabulina pusilla	dwarf sandwort	Vascular Plant	S1 (2019)	Red	E	1-E (2005)
Sanicula arctopoides	bear's-foot sanicle	Vascular Plant	S2 (2019)	Red	T	1-T (2003)
Sanicula bipinnatifida	purple sanicle	Vascular Plant	S2 (2019)	Red	T	1-T (2003)
Sericocarpus rigidus	white-top aster	Vascular Plant	S3 (2019)	Blue	SC	1-SC (2003)
Sidalcea hendersonii	Henderson's checker-mallow	Vascular Plant	S3 (2021)	Blue		
Silene scouleri ssp. *scouleri*	coastal Scouler's catchfly	Vascular Plant	S1 (2019)	Red	E	1-E (2005)
Sisyrinchium idahoense var. *segetum*	Idaho blue-eyed-grass	Vascular Plant	S1 (2014)	Red		
Tonella tenella	small-flowered tonella	Vascular Plant	S3 (2019)	Blue	E	1-E (2005)
Trifolium depauperatum var.	poverty clover	Vascular Plant	S3 (2019)	Blue		
Trifolium dichotomum	Macrae's clover	Vascular Plant	S2 (2021)	Red		
Triphysaria versicolor ssp. *versicolor*	bearded owl-clover	Vascular Plant	S1 (2019)	Red	E	1-E (2003)

Triteleia howellii	Howell's triteleia	Vascular Plant	S1 (2005)	Red	E	1-E (2005)
Uropappus lindleyi	Lindley's microseris	Vascular Plant	S1S2 (2019)	Red	E	1-E (2010)
Utricularia ochroleuca	ochroleucous bladderwort	Vascular Plant	S2S3 (2019)	Blue		
Viola howellii	Howell's violet	Vascular Plant	S1S2 (2019)	Red		
Viola praemorsa var. *praemorsa*	yellow montane violet	Vascular Plant	S1 (2019)	Red	E	1-E (2003)
Woodwardia fimbriata	giant chain fern	Vascular Plant	S3 (2019)	Blue		
Zeltnera muehlenbergii	Muhlenberg's centaury	Vascular Plant	S1 (2019)	Red	E	1-E (2010)

APPENDIX D
PROVINCIALLY & SARA LISTED ECOLOGICAL COMMUNITIES POTENTIALLY OCCURRING ON THE SITE

Scientific Name	English Name	Ecosystem Group	Provincial	BC List
Carex lyngbyei Herbaceous Vegetation	Lyngbye's sedge herbaceous vegetation	Estuarine Realm: Estuarine Marsh Class (Em)	S1 (2022)	Red
Deschampsia cespitosa - Sidalcea hendersonii	tufted hairgrass - Henderson's checker-mallow	Estuarine Realm: Estuarine Marsh Class (Em)	S1S2 (2004)	Red
Distichlis spicata - Sarcocornia pacifica	seashore saltgrass - Pacific swampfire	Estuarine Realm: Estuarine Marsh Class (Em)	S1S2 (2018)	Red
Ruppia maritima Herbaceous Vegetation	beaked ditch-grass Herbaceous Vegetation	Estuarine Realm: Estuarine Marsh Class (Em)	S2 (2013)	Red
Sarcocornia pacifica - Lysimachia maritima	American glasswort - sea-milkwort	Estuarine Realm: Estuarine Marsh Class (Em)	S2 (2013)	Red
Sidalcea hendersonii Tidal Marsh	Henderson's checker-mallow Tidal Marsh	Estuarine Realm: Estuarine Marsh Class (Em)	S1 (2004)	Red
Deschampsia cespitosa ssp. *beringensis - Hordeum brachyantherum*	tufted hairgrass - meadow barley	Estuarine Realm: Estuarine Meadow Class (Ed)	S2 (2013)	Red
Juncus arcticus - Plantago macrocarpa	arctic rush - Alaska plantain	Estuarine Realm: Estuarine Meadow Class (Ed)	S1 (2007)	Red
Artemisia campestris - Festuca rubra / Racomitrium canescens	northern wormwood - red fescue / grey rock-moss	Terrestrial Realm - Beach Group (B): Beachland Class (Bb)	S1 (2008)	Red
Carex macrocephala Herbaceous Vegetation	large-headed sedge Herbaceous Vegetation	Terrestrial Realm - Beach Group (B): Beachland Class (Bb)	S1S2 (2008)	Red
Leymus mollis ssp. *mollis - Lathyrus japonicus*	dune wildrye - beach pea	Terrestrial Realm - Beach Group (B): Beachland Class (Bb)	S1S2 (2008)	Red
Polygonum paronychia - Abronia latifolia	black knotweed - yellow sand-verbena	Terrestrial Realm - Beach Group (B): Beachland Class (Bb)	S1 (2011)	Red
Picea sitchensis / Rubus spectabilis Very Dry Maritime	Sitka spruce / salmonberry Very Dry Maritime	Terrestrial Realm - Flood Group (F): Highbench Flood; Terrestrial Realm - Forest: Mixed -	S2 (2004)	Red
Thuja plicata / Symphoricarpos albus	western redcedar / common snowberry	Terrestrial Realm - Flood Group (F): Highbench Flood; Terrestrial Realm - Forest: Mixed -	S1 (2013)	Red
Alnus rubra / Rubus spectabilis / Equisetum arvense	red alder / salmonberry / common horsetail	Terrestrial Realm - Flood Group (F): Low Bench Flood Class (Fl)	S3 (2009)	Blue
Populus trichocarpa / Salix sitchensis	black cottonwood / Sitka willow	Terrestrial Realm - Flood Group (F): Low Bench Flood Class (Fl); Terrestrial Realm - Forest:	S2S3 (2004)	Blue
Populus trichocarpa - Alnus rubra / Rubus spectabilis	black cottonwood - red alder / salmonberry	Terrestrial Realm - Flood Group (F): Middle Bench Flood Class (Fm); Terrestrial Realm - Forest:	S3 (2010)	Blue
Arbutus menziesii / Arctostaphylos columbiana	arbutus / hairy manzanita	Terrestrial Realm - Forest: Broadleaf - dry	S1S2 (2021)	Red

Quercus garryana - Arbutus menziesii	Garry oak - arbutus	Terrestrial Realm - Forest: Broadleaf - dry	S1 (2004)	Red
Quercus garryana / Bromus carinatus	Garry oak / California brome	Terrestrial Realm - Forest: Broadleaf - dry	S1 (2022)	Red
Quercus garryana / Holodiscus discolor	Garry oak / oceanspray	Terrestrial Realm - Forest: Broadleaf - dry	S1 (2004)	Red
Pseudotsuga menziesii - Arbutus menziesii	Douglas-fir - arbutus	Terrestrial Realm - Forest: Coniferous - dry	S2 (2021)	Red
Pseudotsuga menziesii / Melica subulata	Douglas-fir / Alaska oniongrass	Terrestrial Realm - Forest: Coniferous - dry	S1 (2018)	Red
Pseudotsuga menziesii - Pinus contorta / Cladina spp.	Douglas-fir - lodgepole pine / reindeer lichens	Terrestrial Realm - Forest: Coniferous - dry	S2 (2004)	Red
Pseudotsuga menziesii / Polystichum munitum	Douglas-fir / sword fern	Terrestrial Realm - Forest: Coniferous - dry	S2 (2019)	Red
Pseudotsuga menziesii - Tsuga heterophylla / Gaultheria shallon Dry Maritime	Douglas-fir - western hemlock / salal Dry Maritime	Terrestrial Realm - Forest: Coniferous - dry	S2 (2019)	Red
Abies grandis / Mahonia nervosa	grand fir / dull Oregon-grape	Terrestrial Realm - Forest: Coniferous - mesic	S1 (2009)	Red
Pseudotsuga menziesii / Mahonia nervosa	Douglas-fir / dull Oregon-grape	Terrestrial Realm - Forest: Coniferous - mesic	S1 (2018)	Red
Thuja plicata / Polystichum munitum Very Dry Maritime	western redcedar / sword fern Very Dry Maritime	Terrestrial Realm - Forest: Coniferous - mesic	S1S2 (2021)	Red
Tsuga heterophylla - Pseudotsuga menziesii / Kindbergia oregana	western hemlock - Douglas-fir / Oregon beaked-moss	Terrestrial Realm - Forest: Coniferous - mesic	S2 (2013)	Red
Abies grandis / Tiarella trifoliata	grand fir / three-leaved foamflower	Terrestrial Realm - Forest: Coniferous - moist/wet	S1 (2013)	Red
Thuja plicata / Achlys triphylla	western redcedar / vanilla-leaf	Terrestrial Realm - Forest: Coniferous - moist/wet	S1 (2013)	Red
Thuja plicata / Lonicera involucrata	western redcedar / black twinberry	Terrestrial Realm - Forest: Coniferous - moist/wet	S1 (2019)	Red
Thuja plicata / Oemleria cerasiformis	Western Redcedar / Osoberry	Terrestrial Realm - Forest: Coniferous - moist/wet	S1 (2006)	Red
Thuja plicata - Pseudotsuga menziesii / Kindbergia oregana	western redcedar - Douglas-fir / Oregon beaked-moss	Terrestrial Realm - Forest: Coniferous - moist/wet	S1 (2013)	Red
Thuja plicata / Rubus spectabilis	western redcedar / salmonberry	Terrestrial Realm - Forest: Coniferous - moist/wet	S1S2 (2019)	Red

Thuja plicata / Tiarella trifoliata Very Dry Maritime	western redcedar / three-leaved foamflower Very Dry Maritime	Terrestrial Realm - Forest: Coniferous - moist/wet	S2S3 (2013)	Blue
Tsuga heterophylla - Thuja plicata / Struthiopteris spicant	western hemlock - western redcedar / deer fern	Terrestrial Realm - Forest: Coniferous - moist/wet	S2 (2013)	Red
Thuja plicata / Carex obnupta	western redcedar / slough sedge	Terrestrial Realm - Forest: Coniferous - moist/wet; Wetland Realm - Mineral Wetland Group: Swamp	S2 (2021)	Red
Thuja plicata - Picea sitchensis / Lysichiton americanus	western redcedar - Sitka spruce / skunk cabbage	Terrestrial Realm - Forest: Coniferous - moist/wet; Wetland Realm - Mineral Wetland Group: Swamp	S3? (2004)	Blue
Thuja plicata / Polystichum munitum - Lysichiton americanus	western redcedar / sword fern - skunk cabbage	Terrestrial Realm - Forest: Coniferous - moist/wet; Wetland Realm - Mineral Wetland Group: Swamp	S3? (2012)	Blue
Festuca roemeri - Koeleria macrantha	Roemer's fescue - junegrass	Terrestrial Realm - Grassland Group (G): Grassland Class (Gg)	S1 (2004)	Red
Selaginella wallacei / Cladina spp.	Wallace's selaginella / reindeer lichens	Terrestrial Realm - Grassland Group (G): Grassland Class (Gg); Terrestrial Realm - Rock Group (R): Rock	S3 (2012)	Blue
Myosurus minimus - Montia spp. - *Limnanthes macounii*	tiny mousetail - montias - Macoun's meadow-foam	Terrestrial Realm - Hydrogenic Group (H): Vernal Pool Class (Hv)	S1 (2013)	Red
Bolboschoenus maritimus var. *paludosus* Alkali Marsh	seacoast bulrush Alkali Marsh	Wetland Realm - Mineral Wetland Group: Marsh Wetland Class (Wm)	S1 (2015)	Red
Carex sitchensis - Oenanthe sarmentosa	Sitka sedge - Pacific water-parsley	Wetland Realm - Mineral Wetland Group: Marsh Wetland Class (Wm)	S3 (2004)	Blue
Dulichium arundinaceum Herbaceous Vegetation	three-way sedge	Wetland Realm - Mineral Wetland Group: Marsh Wetland Class (Wm)	S1 (2022)	Red
Schoenoplectus acutus Deep Marsh	hard-stemmed bulrush Deep Marsh	Wetland Realm - Mineral Wetland Group: Marsh Wetland Class (Wm)	S3 (2020)	Blue
Typha latifolia Marsh	common cattail Marsh	Wetland Realm - Mineral Wetland Group: Marsh Wetland Class (Wm)	S3 (2020)	Blue
Eleocharis palustris Herbaceous Vegetation	common spike-rush Herbaceous Vegetation	Wetland Realm - Mineral Wetland Group: Marsh Wetland Class (Wm); Estuarine Realm: Estuarine	S3 (2004)	Blue
Alnus rubra / *Carex obnupta* [*Populus trichocarpa*]	red alder / slough sedge [black cottonwood]	Wetland Realm - Mineral Wetland Group: Swamp Wetland Class (Ws)	S2 (2022)	Red
Alnus rubra / Lysichiton americanus	red alder / skunk cabbage	Wetland Realm - Mineral Wetland Group: Swamp Wetland Class (Ws)	S2 (2010)	Red

Populus tremuloides / Malus fusca / Carex obnupta	trembling aspen / Pacific crab apple / slough sedge	Wetland Realm - Mineral Wetland Group: Swamp Wetland Class (Ws)	S1 (2018)	Red
Salix sitchensis - Salix lasiandra var. *lasiandra / Lysichiton americanus*	Sitka willow - Pacific willow / skunk cabbage	Wetland Realm - Mineral Wetland Group: Swamp Wetland Class (Ws)	S3 (2022)	Blue
Pinus contorta / Sphagnum spp. CDFmm	lodgepole pine / peat-mosses CDFmm	Wetland Realm - Peatland Group: Bog Wetland Class (Wb)	S1 (2004)	Red
Pinus contorta / Sphagnum spp. *Very Dry Maritime*	lodgepole pine / peat-mosses Very Dry Maritime	Wetland Realm - Peatland Group: Bog Wetland Class (Wb)	S2S4 (2021)	Blue
Rhododendron groenlandicum / Kalmia microphylla / Sphagnum spp.	Labrador-tea / western bog-laurel / peat-mosses	Wetland Realm - Peatland Group: Bog Wetland Class (Wb)	S3 (2004)	Blue
Carex lasiocarpa - Rhynchospora alba	slender sedge - white beak-rush	Wetland Realm - Peatland Group: Fen Wetland Class (Wf)	S2 (2022)	Red
Menyanthes trifoliata - Carex lasiocarpa	buckbean - slender sedge	Wetland Realm - Peatland Group: Fen Wetland Class (Wf)	S3 (2004)	Blue
Myrica gale / Carex sitchensis	sweet gale / Sitka sedge	Wetland Realm - Peatland Group: Fen Wetland Class (Wf)	S3 (2022)	Blue

APPENDIX E
PROVINCIALLY & SARA LISTED WILDLIFE SPECIES POTENTIALLY OCCURRING ON THE SITE

Scientific Name	English Name	Class (English)	Provincial	BC List	COSEWIC	SARA
Anaxyrus boreas	Western Toad	amphibians	S4 (2022)	Yellow	SC	1-SC (2018)
Aneides vagrans	Wandering Salamander	amphibians	S3 (2022)	Blue	SC	1-SC (2018)
Ascaphus truei	Coastal Tailed Frog	amphibians	S4 (2022)	Yellow	SC	1-SC (2003)
Dicamptodon tenebrosus	Coastal Giant Salamander	amphibians	S2S3 (2022)	Blue	T	1-T (2003)
Lithobates pipiens	Northern Leopard Frog	amphibians	S1 (2021)	Red	E	1-E (2003)
Rana aurora	Northern Red-legged Frog	amphibians	S3 (2022)	Blue	SC	1-SC (2005)
Rana pretiosa	Oregon Spotted Frog	amphibians	S1 (2022)	Red	E	1-E (2003)
Accipiter gentilis laingi	Northern Goshawk, *laingi* subspecies	birds	S2 (2010)	Red	T	1-T (2003)
Aechmophorus occidentalis	Western Grebe	birds	S1S2B,S2N (2023)	Red	SC	1-SC (2017)
Aeronautes saxatalis	White-throated Swift	birds	S3S4B (2022)	Blue		
Ammodramus savannarum	Grasshopper Sparrow	birds	S1B (2022)	Red		
Ammospiza nelsoni	Nelson's Sparrow	birds	S2B (2018)	Red	NAR	
Ardea herodias fannini	Great Blue Heron, *fannini* subspecies	birds	S3B,S4N (2022)	Blue	SC	1-SC (2010)
Asio flammeus	Short-eared Owl	birds	S3B,S1N (2022)	Blue	T	1-SC (2012)
Athene cunicularia	Burrowing Owl	birds	S1B (2020)	Red	E	1-E (2003)
Bartramia longicauda	Upland Sandpiper	birds	S2B (2022)	Red		
Botaurus lentiginosus	American Bittern	birds	S3B,SNRN (2015)	Blue		
Brachyramphus marmoratus	Marbled Murrelet	birds	S3 (2022)	Blue	T	1-T (2003)
Branta bernicla	Brant	birds	S3M (2015)	Blue		
Buteo lagopus	Rough-legged Hawk	birds	S3N (2015)	Blue	NAR	
Buteo swainsoni	Swainson's Hawk	birds	S2B (2022)	Red		
Butorides virescens	Green Heron	birds	S3S4B (2015)	Blue		
Calcarius pictus	Smith's Longspur	birds	S3S5B (2015)	Blue		
Calidris canutus	Red Knot	birds	S3?M (2022)	Blue	T	1-T (2010)
Cardellina canadensis	Canada Warbler	birds	S3B (2022)	Blue	SC	1-T (2010)

Chondestes grammacus	Lark Sparrow	birds	S2S4B (2022)	Blue		
Chordeiles minor	Common Nighthawk	birds	S3S5B (2022)	Blue	SC	1-SC (2023)
Coccothraustes vespertinus	Evening Grosbeak	birds	S5 (2022)	Yellow	SC	1-SC (2019)
Coccyzus americanus	Yellow-billed Cuckoo	birds	SXB (2022)	Red		
Contopus cooperi	Olive-sided Flycatcher	birds	S4B (2022)	Yellow	SC	1-SC (2023)
Cypseloides niger	Black Swift	birds	S2S4B (2022)	Blue	E	1-E (2019)
Dolichonyx oryzivorus	Bobolink	birds	S2?B (2022)	Red	SC	1-T (2017)
Eremophila alpestris strigata	Horned Lark, *strigata* subspecies	birds	SXB (2019)	Red	E	1-E (2005)
Euphagus carolinus	Rusty Blackbird	birds	S3S4B (2015)	Blue	SC	1-SC (2009)
Falco mexicanus	Prairie Falcon	birds	S1 (2018)	Red	NAR	
Falco peregrinus	Peregrine Falcon	birds	S3 (2015)	No Status	SC	1-SC
Falco peregrinus anatum	Peregrine Falcon, *anatum* subspecies	birds	S2? (2011)	Red	NAR	
Falco peregrinus pealei	Peregrine Falcon, *pealei* subspecies	birds	S3S4 (2019)	Blue	SC	1-SC (2003)
Falco rusticolus	Gyrfalcon	birds	S3S4B,SNRN (2015)	Blue	NAR	
Fratercula cirrhata	Tufted Puffin	birds	S3B,S4N (2023)	Blue		
Fratercula corniculata	Horned Puffin	birds	S2B (2015)	Red		
Fulmarus glacialis	Northern Fulmar	birds	S1B,S4N (2015)	Red		
Glaucidium gnoma swarthi	Northern Pygmy-Owl, *swarthi*	birds	S3S4 (2018)	Blue		
Hirundo rustica	Barn Swallow	birds	S4B (2022)	Yellow	SC	1-T (2017)
Hydroprogne caspia	Caspian Tern	birds	S3B (2015)	Blue	NAR	
Icteria virens	Yellow-breasted Chat	birds	S2B (2018)	Red	E	1-E (2003)
Larus californicus	California Gull	birds	S1B,SNRN (2022)	Red		
Limnodromus griseus	Short-billed Dowitcher	birds	S1S2B,S2S3M (2023)	Red		
Limosa haemastica	Hudsonian Godwit	birds	S1B (2022)	Red	T	
Megascops kennicottii	Western Screech-Owl	birds	S4 (2015)	No Status	T	1-T
Megascops kennicottii kennicottii	Western Screech-Owl, *kennicottii*	birds	S2S3 (2017)	Blue	T	1-T (2005)

Melanerpes lewis	Lewis's Woodpecker	birds	S2S3B (2022)	Blue	T	1-T (2012)
Melanitta americana	Black Scoter	birds	S3S4N (2015)	Blue		
Melanitta perspicillata	Surf Scoter	birds	S3B,S4N (2015)	Blue		
Nannopterum auritum	Double-crested Cormorant	birds	S3S4 (2015)	Blue	NAR	
Numenius americanus	Long-billed Curlew	birds	S4B (2022)	Yellow	SC	1-SC (2005)
Nycticorax nycticorax	Black-crowned Night-Heron	birds	S1 (2022)	Red		
Oporornis agilis	Connecticut Warbler	birds	S3B (2015)	Blue		
Oreoscoptes montanus	Sage Thrasher	birds	S1B (2022)	Red	E	1-E (2003)
Patagioenas fasciata	Band-tailed Pigeon	birds	S3S4 (2022)	Blue	SC	1-SC (2011)
Pelecanus erythrorhynchos	American White Pelican	birds	S1B (2022)	Red	NAR	
Phalaropus lobatus	Red-necked Phalarope	birds	S3B,SNRM (2023)	Blue	SC	1-SC (2019)
Pinicola enucleator carlottae	Pine Grosbeak, *carlottae* subspecies	birds	S3 (2005)	Blue		
Pluvialis dominica	American Golden-Plover	birds	S3S4B (2015)	Blue		
Pooecetes gramineus affinis	Vesper Sparrow, *affinis* subspecies	birds	S1B (2022)	Red	E	1-E (2007)
Progne subis	Purple Martin	birds	S3S4B (2022)	Blue		
Ptychoramphus aleuticus	Cassin's Auklet	birds	S2B,S3N (2018)	Red	SC	1-SC (2019)
Recurvirostra americana	American Avocet	birds	S2S3B (2023)	Blue		
Setophaga castanea	Bay-breasted Warbler	birds	S2B (2022)	Red		
Setophaga virens	Black-throated Green Warbler	birds	S3B (2015)	Blue		
Sterna forsteri	Forster's Tern	birds	S1B (2022)	Red	DD	
Strix occidentalis	Spotted Owl	birds	S1 (2018)	Red	E	1-E (2003)
Synthliboramphus antiquus	Ancient Murrelet	birds	S2S3B,S4N (2022)	Blue	SC	1-SC (2006)
Tringa incana	Wandering Tattler	birds	S3B (2015)	Blue		
Tyto alba	Barn Owl	birds	S3 (2022)	Blue	T	1-T (2018)
Uria aalge	Common Murre	birds	S2B,S3S4N (2015)	Red		
Uria lomvia	Thick-billed Murre	birds	S1B,SUN (2015)	Red		

Urile penicillatus	Brandt's Cormorant	birds	S1B,S4N (2015)	Red		
Musculium partumeium	Swamp Fingernailclam	bivalves	S2S4 (2015)	Blue		
Musculium transversum	Long Fingernailclam	bivalves	S3S5 (2015)	Blue		
Sphaerium occidentale	Herrington Fingernailclam	bivalves	S2S3 (2015)	Blue		
Sphaerium patella	Rocky Mountain Fingernailclam	bivalves	SH (2015)	Red		
Sphaerium striatinum	Striated Fingernailclam	bivalves	S3S4 (2015)	Blue		
Allogona townsendiana	Oregon Forestsnail	gastropods	S2 (2015)	Red	E	1-E (2005)
Carychium occidentale	Western Thorn	gastropods	S3 (2015)	Blue		
Cryptomastix devia	Puget Oregonian	gastropods	SX (2015)	Red	XT	1-XT (2005)
Deroceras hesperium	Evening Fieldslug	gastropods	SH (2015)	Red	DD	
Galba bulimoides	Prairie Fossaria	gastropods	S3? (2015)	Blue		
Galba dalli	Dusky Fossaria	gastropods	S3S4 (2015)	Blue		
Galba parva	Pygmy Fossaria	gastropods	S3S5 (2015)	Blue		
Galba vancouverensis	Vancouver Fossaria	gastropods	SH (2015)	Red		
Gyraulus crista	Star Gyro	gastropods	S3S4 (2015)	Blue		
Haliotis kamtschatkana	Northern Abalone	gastropods	S2 (2002)	Red	E	1-E
Hemphillia burringtoni	Keeled Jumping-slug	gastropods	S2? (2015)	Red	SC	1-SC (2005)
Hemphillia dromedarius	Dromedary Jumping-slug	gastropods	S2 (2015)	Red	T	1-T (2005)
Physella propinqua	Rocky Mountain Physa	gastropods	S3S4 (2015)	Blue		
Physella virginea	Sunset Physa	gastropods	S3S5 (2015)	Blue		
Planorbula campestris	Meadow Rams-horn	gastropods	S3S4 (2015)	Blue		
Pristiloma johnsoni	Broadwhorl Tightcoil	gastropods	S3 (2015)	Blue		
Promenetus umbilicatellus	Umbilicate Sprite	gastropods	S2S3 (2015)	Blue		
Prophysaon coeruleum	Blue-grey Taildropper	gastropods	S2S3 (2015)	Blue	T	1-T (2019)
Staala gwaii	Haida Gwaii Slug	gastropods	S2? (2015)	Red	SC	1-SC (2018)
Stagnicola caperata	Wrinkled Marshsnail	gastropods	S3S4 (2015)	Blue		

Stagnicola traski	Widelip Pondsnail	gastropods	S3S4 (2015)	Blue		
Vertigo rowellii	Threaded Vertigo	gastropods	S3 (2015)	Blue	SC	1-SC (2012)
Anarta edwardsii	Edwards' Beach Moth	insects	S1 (2020)	Red	E	1-E (2011)
Argia emma	Emma's Dancer	insects	S3S4 (2023)	Blue		
Argia vivida	Vivid Dancer	insects	S3 (2023)	Blue	SC	1-SC (2019)
Callophrys eryphon sheltonensis	Western Pine Elfin, *sheltonensis*	insects	S2 (2023)	Red		
Callophrys johnsoni	Johnson's Hairstreak	insects	S2? (2020)	Red	SC	
Callophrys mossii mossii	Moss' Elfin, *mossii* subspecies	insects	S2 (2021)	Red		
Cercyonis pegala incana	Common Wood-nymph, *incana*	insects	S2? (2021)	Red		
Chlosyne hoffmanni	Hoffman's Checkerspot	insects	S2 (2020)	Red		
Cicindela hirticollis	Hairy-necked Tiger Beetle	insects	S2S4 (2017)	Blue		
Coenonympha california insulana	Common Ringlet, *insulana* subspecies	insects	S1 (2021)	Red		
Copablepharon fuscum	Sand-verbena Moth	insects	S1 (2020)	Red	E	1-E (2005)
Danaus plexippus	Monarch	insects	S1?B (2020)	Red	E	1-SC (2003)
Enallagma clausum	Alkali Bluet	insects	S3 (2023)	Blue		
Epargyreus clarus californicus	Silver-spotted Skipper, *californicus*	insects	S1 (2023)	Red		
Erynnis propertius	Propertius Duskywing	insects	S2 (2020)	Red		
Euchloe ausonides insulanus	Large Marble, *insulanus* subspecies	insects	SX (2021)	Red	XT	1-XT (2003)
Euphydryas editha taylori	Edith's Checkerspot, *taylori* subspecies	insects	S1 (2021)	Red	E	1-E (2003)
Euphyes vestris	Dun Skipper	insects	S2S3 (2020)	Blue	T	1-T (2003)
Hesperia colorado oregonia	Western Branded Skipper, *oregonia*	insects	S2 (2021)	Red	E	1-E (2023)
Icaricia icarioides blackmorei	Boisduval's Blue, *blackmorei*	insects	S3 (2021)	Blue		
Icaricia saepiolus insulanus	Greenish Blue, *insulanus* subspecies	insects	SH (2021)	Red	E	1-E (2003)
Octogomphus specularis	Grappletail	insects	S2S3 (2023)	Blue	SC	
Omus audouini	Audouin's Night-stalking Tiger Beetle	insects	S1 (2017)	Red	T	1-T (2018)
Ophiogomphus occidentis	Sinuous Snaketail	insects	S3 (2023)	Blue		

Papilio indra	Indra Swallowtail	insects	S1 (2020)	Red		
Parnassius clodius claudianus	Clodius Parnassian, *claudianus*	insects	S3S4 (2023)	Blue		
Parnassius clodius pseudogallatinus	Clodius Parnassian, *pseudogallatinus*	insects	S3S4 (2023)	Blue		
Parnassius smintheus olympiannus	Rocky Mountain Parnassian,	insects	S3 (2021)	Blue		
Speyeria zerene bremnerii	Zerene Fritillary, *bremnerii* subspecies	insects	S2 (2023)	Red		
Sympetrum vicinum	Autumn Meadowhawk	insects	S3S4 (2015)	Blue		
Tanypteryx hageni	Black Petaltail	insects	S2S3 (2023)	Blue		
Tramea lacerata	Black Saddlebags	insects	S3 (2023)	Blue		
Entosphenus macrostomus	Cowichan Lake Lamprey	Lampreys	S2 (2019)	Red	T	1-T (2003)
Lampetra richardsoni pop. 1	Western Brook Lamprey (Morrison	Lampreys	S1 (2019)	Red	E	1-E (2003)
Stygobromus quatsinensis	Quatsino Cave Amphipod	malacostracans	S2S3 (2017)	Blue		
Aplodontia rufa	Mountain Beaver	mammals	S4 (2015)	Yellow	SC	1-SC (2003)
Cervus elaphus roosevelti	Roosevelt Elk	mammals	S3S4 (2017)	Blue		
Corynorhinus townsendii	Townsend's Big-eared Bat	mammals	S3 (2022)	Blue		
Eumetopias jubatus	Steller Sea Lion	mammals	S3S4B,S4N (2022)	Blue	SC	1-SC (2005)
Gulo gulo	Wolverine	mammals	S3 (2015)	No Status	SC	1-SC (2018)
Gulo gulo luscus	Wolverine, *luscus* subspecies	mammals	S3 (2010)	Blue	SC	1-SC (2018)
Gulo gulo vancouverensis	Wolverine, *vancouverensis* subspecies	mammals	SH (2017)	Red	SC	1-SC (2018)
Lasiurus cinereus	Hoary Bat	mammals	S3S4 (2022)	Blue	E	
Lepus americanus washingtonii	Snowshoe Hare, *washingtonii*	mammals	S1 (2011)	Red		
Microtus townsendii cowani	Townsend's Vole, *cowani* subspecies	mammals	S1 (2015)	Red		
Mirounga angustirostris	Northern Elephant Seal	mammals	S1B,S4N (2022)	Red	NAR	
Mustela frenata altifrontalis	Long-tailed weasel, *altifrontalis*	mammals	SH (2011)	Red		
Mustela richardsonii anguinae	Ermine, *anguinae* subspecies	mammals	S3 (2010)	Blue		
Myodes gapperi occidentalis	Southern Red-backed Vole,	mammals	S1 (2006)	Red		
Myotis lucifugus	Little Brown Myotis	mammals	S3S4 (2022)	Blue	E	1-E (2014)

Myotis yumanensis	Yuma Myotis	mammals	S3 (2022)	Blue		
Oreamnos americanus	Mountain Goat	mammals	S3 (2015)	Blue		
Pekania pennanti	Fisher	mammals	S3 (2020)	No Status		
Scapanus townsendii	Townsend's Mole	mammals	S1 (2015)	Red	E	1-E (2005)
Sorex bendirii	Pacific Water Shrew	mammals	S2? (2015)	Red	E	1-E (2003)
Sorex navigator brooksi	Western Water Shrew, *brooksi*	mammals	S2S3 (2018)	Blue		
Sorex rohweri	Olympic Shrew	mammals	S2? (2015)	Red		
Sorex trowbridgii	Trowbridge's Shrew	mammals	S3 (2015)	Blue		
Ursus arctos	Grizzly Bear	mammals	S3? (2015)	Blue	SC	1-SC (2018)
Acipenser medirostris	Green Sturgeon	ray-finned fishes	S2S3N (2019)	Blue	SC	1-SC (2006)
Acipenser transmontanus	White Sturgeon	ray-finned fishes	S2 (2018)	No Status	E/T	1-E
Acipenser transmontanus pop. 4	White Sturgeon (Lower Fraser River	ray-finned fishes	S1S2 (2018)	Red	T	
Catostomus sp. 4	Salish Sucker	ray-finned fishes	S2 (2019)	Red	T	1-T (2005)
Cottus aleuticus pop. 1	Coastrange Sculpin, Cultus Population	ray-finned fishes	S1S2 (2019)	Red	E	1-T (2003)
Gasterosteus aculeatus pop. 2	Little Quarry Lake Benthic Threespine	ray-finned fishes	S1 (2019)	Red	T	
Gasterosteus aculeatus pop. 3	Little Quarry Limnetic Threespine	ray-finned fishes	S1 (2019)	Red	T	
Gasterosteus sp. 16	Vananda Creek Limnetic Stickleback	ray-finned fishes	S1 (2018)	Red	E	1-E (2003)
Gasterosteus sp. 17	Vananda Creek Benthic Stickleback	ray-finned fishes	S1 (2018)	Red	E	1-E (2003)
Gasterosteus sp. 18	Misty Lake "Lake" Stickleback	ray-finned fishes	S1 (2018)	Red	E	1-E (2010)
Gasterosteus sp. 19	Misty Lake "Stream" Stickleback	ray-finned fishes	S1 (2018)	Red	E	1-E (2010)
Gasterosteus sp. 2	Enos Lake Limnetic Stickleback	ray-finned fishes	SX (2018)	Red	E	1-E (2005)
Gasterosteus sp. 3	Enos Lake Benthic Stickleback	ray-finned fishes	SX (2018)	Red	E	1-E (2005)
Gasterosteus sp. 4	Paxton Lake Limnetic Stickleback	ray-finned fishes	S1 (2018)	Red	E	1-E (2003)
Gasterosteus sp. 5	Paxton Lake Benthic Stickleback	ray-finned fishes	S1 (2018)	Red	E	1-E (2003)
Hybognathus hankinsoni - Pacific	Brassy Minnow - Pacific Group	ray-finned fishes	S2S3 (2019)	Blue	SC	
Oncorhynchus clarkii clarkii	Cutthroat Trout, *clarkii* subspecies	ray-finned fishes	S3S4 (2004)	Blue		

Rhinichthys cataractae - Chehalis	Nooksack Dace	ray-finned fishes	S1 (2019)	Red	E	1-E (2003)
Salvelinus confluentus	Bull Trout	ray-finned fishes	S3S4 (2018)	Blue	SC	
Salvelinus confluentus pop. 28	Bull Trout - South Coast Population	ray-finned fishes	S2S3 (2018)	Blue	SC	1-SC (2019)
Spirinchus sp. 1	Pygmy Longfin Smelt	ray-finned fishes	S2 (2019)	Red	DD	
Stenodus leucichthys	Inconnu	ray-finned fishes	S3 (2019)	Blue		
Thaleichthys pacificus	Eulachon	ray-finned fishes	S2S3 (2004)	Blue	E/T	
Charina bottae	Northern Rubber Boa	reptiles	S4 (2018)	Yellow	SC	1-SC (2005)
Contia tenuis	Common Sharp-tailed Snake	reptiles	S1S2 (2018)	Red	E/T	1-E (2003)
Pituophis catenifer	Gophersnake	reptiles	S3 (2018)	No Status	XT/T	1-XT/T (2005)
Pituophis catenifer catenifer	Gophersnake, *catenifer* subspecies	reptiles	SX (2018)	Red	XT	1-XT (2005)
Actinemys marmorata	Northwestern Pond Turtle	turtles	SX (2018)	Red	XT	1-XT (2005)
Chrysemys picta	Painted Turtle	turtles	S3 (2018)	No Status	T/SC	1-T/SC (2021)
Chrysemys picta pop. 1	Painted Turtle - Pacific Coast	turtles	S1S2 (2018)	Red	T	1-T (2021)
Dermochelys coriacea	Leatherback Sea Turtle	turtles	S1N (2018)	Red	E	1-E (2017)

APPENDIX F
STREAM CARDS

SITE CARD

Stream Name (Gazette): Goldstream River			(Local): Retaining Wall – Inside Bend (North end of works)	
Reach # 1	Site # 1	Site Length (m): 135	Drawing Location: 2+675	Fish Collection: No
Date: 2020-03-26		Time: 11:00	Agency: McElhanney Ltd.	
Crew: Mark Trousdell			Municipality: Capital Regional District (Langford)	

CHANNEL

Channel Width (m)	11.0	Gradient (%)	2	
Wetted Width (m)	10.0	Average Depth (m)	0.5	
Bankfull Depth (m)	2.3	Stage: Low Water		

COVER

Crown Closure: 21-40%	Type	SWD	LWD	B	U	DP	OV	IV
LWD FNC: Few	AMT	Trace	Trace	Dominant	None	None	Trace	Trace
Instream Vegetation: Mosses	LOC							

Left Bank

Shape	u☐	v☒	s☐	o☐			
Texture	f☐	g☐	c☐	b☒	r☒	a☐	
Rip. Veg.	n☐	g☐	s☒	c☒	d☐	m☐	w☐

Stage: Shrub

Right Bank

Shape	u☐	v☒	s☐	o☐			
Texture	f☐	g☐	c☐	b☒	r☒	a☐	
Rip. Veg.	n☐	g☒	s☒	c☐	d☐	m☒	w☐

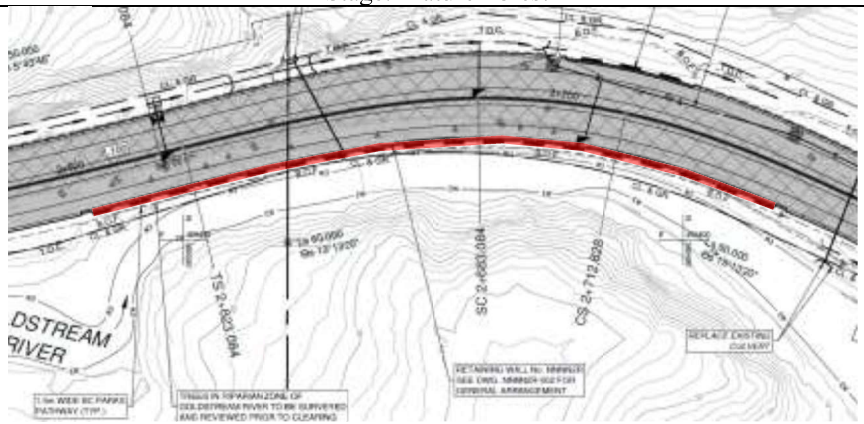
Stage: Mature Forest

MORPHOLOGY

Bed Material: Dom: Boulders (B) Sub: Cobbles (C)
Morphology: Riffle-Pool Pattern: Irregular Meander
Islands: None Bars: None
Coupling: Coupled Confinement: Confined

WATER

Temperature (°C): 6.73 Conductivity (ms/cm): 0.074
pH: 6.47 Turbidity: Clear
Dissolved Oxygen (mg/L): 13.82



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Upstream	Downstream
	
Left Bank	Substrate

SITE CARD

Stream Name (Gazette): Goldstream River			(Local): Stone Stacked Wall / Cantilever	
Reach # 2	Site # 1	Site Length (m): 75	Drawing Location: 2+525	Fish Collection: No
Date: 2020-03-26		Time: 12:00	Agency: McElhanney Ltd.	
Crew: Mark Trousdell			Municipality: Capital Regional District (Langford)	

CHANNEL

Channel Width (m)	13.0	Gradient (%)	2	
Wetted Width (m)	10.0	Average Depth (m)	0.34	
Bankfull Depth (m)	2.0	Stage: Low water		

COVER

Crown Closure: 1-20%	Type	SWD	LWD	B	U	DP	OV	IV
LWD FNC: Few	AMT	Trace	Trace	Dominant	None	None	Trace	Trace
Instream Vegetation: Mosses	LOC							

Left Bank

Shape	u☐	v☒	s☐	o☐			
Texture	f☐	g☐	c☒	b☒	r☐	a☐	
Rip. Veg.	n☐	g☒	s☒	c☐	d☐	m☐	w☐

Stage: Shrub

Right Bank

Shape	u☐	v☐	s☒	o☐			
Texture	f☐	g☒	c☒	b☒	r☐	a☐	
Rip. Veg.	n☐	g☒	s☒	c☐	d☐	m☒	w☐

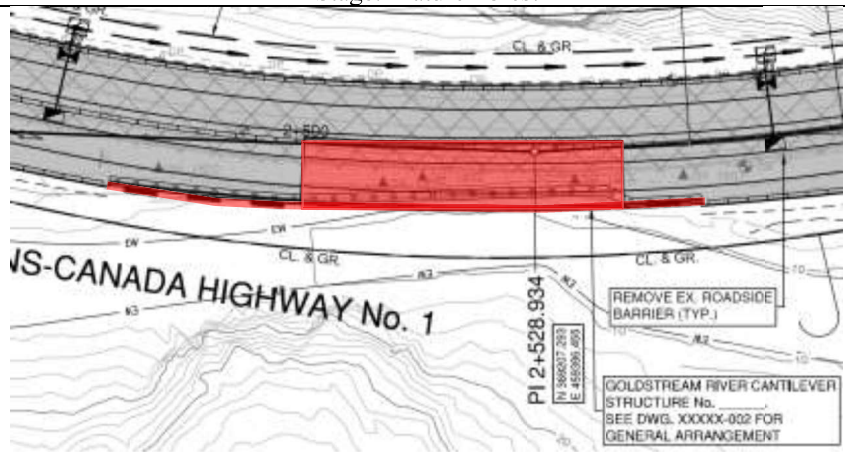
Stage: Mature Forest

MORPHOLOGY

Bed Material: Dom: Cobbles (C) Sub: Gravels (G)
Morphology: Riffle-Pool Pattern: Irregular Meander
Islands: None Bars: None
Coupling: Coupled Confinement: Confined

WATER

Temperature (°C): 6.73 Conductivity (ms/cm): 0.074
pH: 6.47 Turbidity: Clear
Dissolved Oxygen (mg/L): 13.82



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Upstream	Downstream
	
Left Bank	Substrate

SITE CARD

Stream Name (Gazette): Goldstream River			(Local): Retaining Wall – Straight (South end of works)	
Reach # 3	Site # 1	Site Length (m): 30	Drawing Location: 1+750	Fish Collection: No
Date: 2020-03-26		Time: 13:00	Agency: McElhanney Ltd.	
Crew: Mark Trousdell			Municipality: Capital Regional District (Langford)	

CHANNEL

Channel Width (m)	19.0									Gradient (%)	2						
Wetted Width (m)	16.0									Wetted Depth (m)	0.22						
Bankfull Depth (m)	1.3									Stage: Low water							

COVER

Crown Closure: 41-70%
LWD FNC: None
Instream Vegetation: Mosses

Type	SWD	LWD	B	U	DP	OV	IV
AMT	Trace	Trace	Dominant	None	None	Trace	Trace
LOC							

Left Bank							
Shape	u☐	v☐	s☒	o☐			
Texture	f☐	g☒	c☒	b☒	r☐	a☐	
Rip. Veg.	n☐	g☐	s☒	c☐	d☐	m☒	w☐

Stage: Mature Forest

Right Bank							
Shape	u☐	v☐	s☒	o☐			
Texture	f☐	g☒	c☒	b☒	r☐	a☐	
Rip. Veg.	n☐	g☐	s☒	c☐	d☐	m☒	w☐

Stage: Choose an item.

MORPHOLOGY

Bed Material: Dom: Cobbles (C) Sub: Boulders (B)
Morphology: Riffle-Pool Pattern: Irregular Meander
Islands: None Bars: None
Coupling: Coupled Confinement: Confined

WATER

Temperature (°C): 6.73 Conductivity (ms/cm): 0.074
pH: 6.47 Turbidity: Clear
Dissolved Oxygen (mg/L): 13.82

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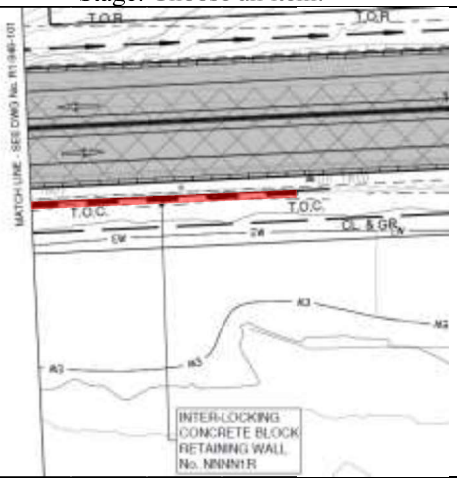

	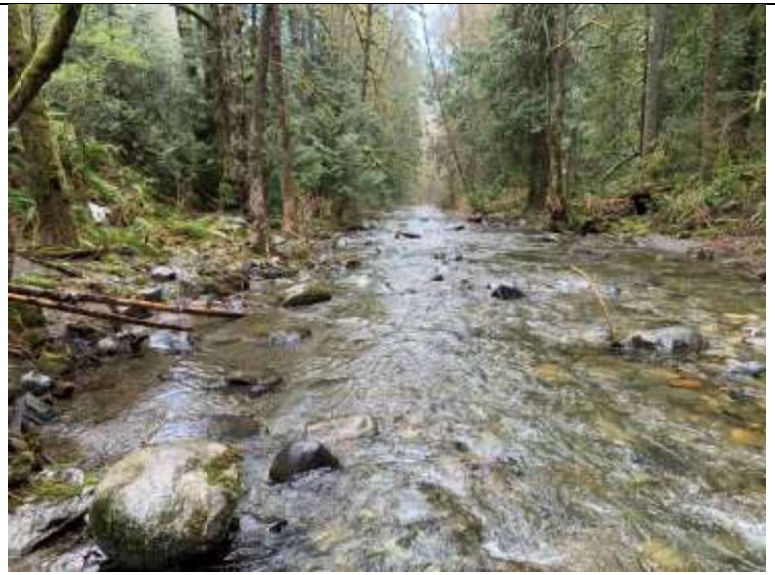
Upstream	Downstream
	
Left Bank	Substrate

APPENDIX G
STATEMENT OF LIMITATIONS

Statement of Limitations

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