FISH PASSAGE PLANNING: PUNTLEDGE RIVER WATERSHED
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Prepared for:

Ministry of Environment & Climate Change Strategy Ecosystem Branch
PO Box 9338 Stn Prov Govt
Victoria BC, V8W 9M1

Fish and Wildlife Compensation Program
6911 Southpoint Drive, 11th floor
Burnaby, BC V3N 4X8

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Prepared by:
Allan Irvine, R.P.Bio
Masse Environmental Consultants Ltd
812 Vernon Street
Nelson, BC, V1L 4G4

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EXECUTIVE SUMMARY

Fish passage impediments created by road crossing structures in British Columbia are a significant challenge that can have a substantial cumulative impact on local fish populations by reducing access to critical habitat and fragmenting populations. Closed bottom road crossing structures (culverts) can present barriers to fish migration due to a number of factors including increased water velocity, turbulence, a vertical drop at the culvert outlet and/or maintenance issues. The rehabilitation of fish passage at road crossing structure barriers presents tangible opportunities to reconnect habitat values within currently fragmented ecosystems.

For this project, fish passage planning maps and data tables/files have been prepared for the Puntledge River watershed, near Courtenay, on Vancouver Island. This work is intended to provide a product that will serve as a catalyst for the implementation of fish passage remediation projects in the watershed with the goal of restoration of fish passage into critical habitat areas for priority species.

The Puntledge River watershed was chosen for assessment planning due to a synergy between the objectives of the British Columbia Ministry of Environment and Climate Change Strategy- Conservation Section and the Fish and Wildlife Compensation Program (FWCP) – Coast Region objectives. An organized approach to fish passage remediation in the watershed takes action towards implementation of some of the high level objectives of both organizations which are included in the Puntledge River Watershed Action Plan:

- Conserving and restoring habitat capacity and diversity for fish and other aquatic organisms.
- Sustaining and increasing the population viability of anadromous salmon, steelhead, sea-run cutthroat trout and resident rainbow trout, kokanee and cutthroat trout.
- Maintain or improve opportunities to sustainably use ecosystem values for sustenance, social, ceremonial, recreational and commercial purposes.

A strategic approach to the planning and data collection at road crossing structures and the sharing of information provided by the Fish Passage Technical Working Group (FPTWG) provides a platform for an efficient allocation of effort towards the restoration of fish passage opportunities in the Puntledge River watershed with the highest ecosystem benefits. The FPTWG tools such as the data collection protocol documents and the Provincial Stream Crossing Inventory System database tools should be used so that data collection is consistent and can be shared.

In the Puntledge River watershed, 963 crossings were identified using the fish habitat model. Of these, 261 crossings are predicted to occur on modelled fish habitat, while the remaining 702 are predicted to be located on modelled non-fish habitat (above sections of stream >100m long with gradient >20%).

Assessment of modelled crossing locations on modelled fish habitat in the watershed is recommended and should be conducted according to FPTWG protocols. The FPTWG has prepared on-line training resources, field work guidance, field assessment protocols and data forms to help guide the collection of data and submission of assessment deliverables.

The maps and spreadsheets developed through this project are a step towards implementation of an inventory of closed bottom structures in the Ash River watershed (Phase 1). Following the assessment of fish passage at crossing structures, subsequent phases of the FPTWG's Fish Passage Strategic Approach can follow (Phase 2 – Habitat Confirmation, Phase 3 – Design, Phase 4 – Remediation), hopefully resulting in the restoration of fish passage into areas of critical habitat in the watershed for species of interest.

This project was funded in part by the Fish and Wildlife Compensation Program (FWCP) on behalf of its program partners BC Hydro, the Province of BC, Fisheries and Oceans Canada, First Nations and the public, who work together to conserve and enhance fish and wildlife impacted by the construction of BC Hydro dams. The project was also funded by the Ministry of Environment & Climate Change Strategy-Ecosystem Branch.

This project would not have been possible without the highly skilled GIS, data analysis, modelling and mapping support of Simon Norris from Hillcrest Geographics.

This report was prepared by:

Allan Irvine, B.Sc., R.P.Bio.
Masse Environmental Consultants Ltd

Reviewed by:

Ico de Zwart, Ph.D., R.P.Bio.
Masse Environmental Consultants Ltd
812 Vernon St, Nelson, BC, V1L 4G4

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ATTACHMENTS

1 INTRODUCTION

The health and viability of freshwater fish populations depends on access to suitable spawning, high water refuge, rearing and overwintering habitat. Watershed connectivity is important to accommodate population abundance fluctuations and the flow of genes that provides resilience to environmental stressors such as floods, landslides and extreme climate events.

Fish passage impediments created by road crossing structures in British Columbia are a significant challenge that can have a substantial cumulative impact on local fish populations by reducing access to critical habitat and fragmenting populations. Estimates based on fish passage data collected to date indicate that there are over 170,000 closed bottom culverts in the province that impede fish passage (FPTWG 2014). Closed bottom road crossing structures (culverts) can present barriers to fish migration due to increased water velocity, turbulence, a vertical drop at the culvert outlet and/or maintenance issues. Rehabilitation and replacement of crossing structure barriers can provide access to currently isolated high value habitats.

For this project, fish passage planning maps and data files have been prepared for the Puntledge River watershed near Courtenay on Vancouver Island, British Columbia. This work is intended to provide a product that will serve as a catalyst to the future implementation of fish passage remediation projects in the watershed with the goal of restoration of fish passage into critical habitat areas for priority species.

2 BACKGROUND

As a result of high-level direction from the provincial government, a Fish Passage Strategic Approach protocol has been developed for British Columbia to ensure that the greatest opportunities for restoration of fish passage are pursued. A Fish Passage Technical Working Group (FPTWG) has been formed to coordinate the protocol, and the data is continuously amalgamated within the Provincial Stream Crossing Inventory Database (PSCIS). The strategic approach protocol involves a four phase process as described in FPTWG (2014):

- Phase 1: Fish Passage Assessment – Fish stream crossings within watersheds with high fish values are assessed to determine barrier status of structures and document a general assessment of adjacent habitat quality and quantity.
- Phase 2: Habitat Confirmation – Assessments of crossings prioritized for follow up in Phase 1 studies are conducted to confirm quality and quantity of habitat upstream and down as well as to scope for other potential nearby barriers that could affect the practicality of remediation.
- Phase 3: Design – Site plans and designs are drawn for priority crossings where high value fish habitat has been confirmed.
- Phase 4: Remediation – Implementation of reconnection of isolated habitats through replacement, rehabilitation or removal of prioritized crossing structure barriers.

The scope of this project includes portions of the planning for the first phase of fish passage assessment in the Puntledge River watershed. The Puntledge River watershed was chosen for assessment planning because it is a watershed impacted by dam creation and operation, and there is a synergy between the objectives of the British Columbia Ministry of Environment and Climate Change Strategy – Ecosystem Branch and the Fish and Wildlife Compensation Program (FWCP) – Coast Region objectives. An organized approach to fish passage remediation in the watershed is a step towards addressing high level objectives of both organizations that are included in the Puntledge River Watershed Action Plan (FWCP 2017):

- Conserving and restoring habitat capacity and diversity for fish and other aquatic organisms.
- Sustaining and increasing the population viability of anadromous salmon, steelhead, sea-run cutthroat trout and resident rainbow trout, kokanee and cutthroat trout.
- Maintain or improve opportunities to sustainably use ecosystem values for sustenance, social, ceremonial, recreational and commercial purposes.

To date, within the Puntledge River watershed, no fish passage assessments (Phase 1) are documented within the PSCIS database. PSCIS data is accessed through Imap BC or with information downloaded directly from the British Columbia Data Catalogue. Data uploaded includes assessment data and links to project reports and photos.

3 OBJECTIVES

An objective of this project is to provide some of the background and field work tools necessary to facilitate an inventory of stream crossing structures on fish bearing and potentially fish bearing streams in the Puntledge River watershed according to the FPTWG standards (MoE 2011).

This work is intended to provide a product that will serve as a catalyst to the future implementation of fish passage remediation projects in the watershed with the goal of restoration of fish passage into critical habitat areas for priority species.

Deliverables of this project are intended to encourage the collection of future fish passage data according to FPTWG standards including upload into the PSCIS database. This is so that the work will not be unnecessarily repeated and so that further phases of the Fish Passage Strategic Approach protocol can be prioritized on a watershed and province wide basis towards road structure barriers providing the best opportunities for rehabilitation.

4 STUDY AREA

The Puntledge River watershed is located on the east side of Vancouver Island, and drains into the Tsolum River and then the Courtenay River at Courtenay (Figure 1). The watershed has a diverse group of users. Industrial uses include hydro-electric generation, forestry and mining. The watershed is used recreationally by hunters, anglers, boaters, campers, hikers, mountain bikers, off-road motorized recreationists, swimmers and tubers. The Puntledge River lies within the traditional territory of Hupacasath, K'ómoks, Qualicum, We Wai Kai and Wei Wai Kum First Nations. The majority of the upper watershed is privately-held land (owned by TimberWest Forest Corp.), although the headwaters are located in Strathcona Provincial Park and there is some Crown Land to the south of Comox Lake (FWCP 2017). The Puntledge River watershed is within the Campbell River Natural Resource District.

The Puntledge River is a 6th order stream that drains an area of 598 km^2 in a generally easterly direction. Stream discharges are typical of British Columbia coastal basins (Figure 2). The hydrology is predominantly dominated by spring snow melt and fall/winter storms (FWCP 2017). BC Hydro operates a series of dams and diversions in the watershed which can modulate downstream flows depending on operations. Comox Dam is located at the outlet of Comox Lake, and the Puntledge Diversion Dam diverts water from the Puntledge River via a 5 km penstock to a powerhouse on the lower Puntledge River (FWCP 2017). Both the Diversion Dam and the Comox Dam have fishways to facilitate upstream fish passage.

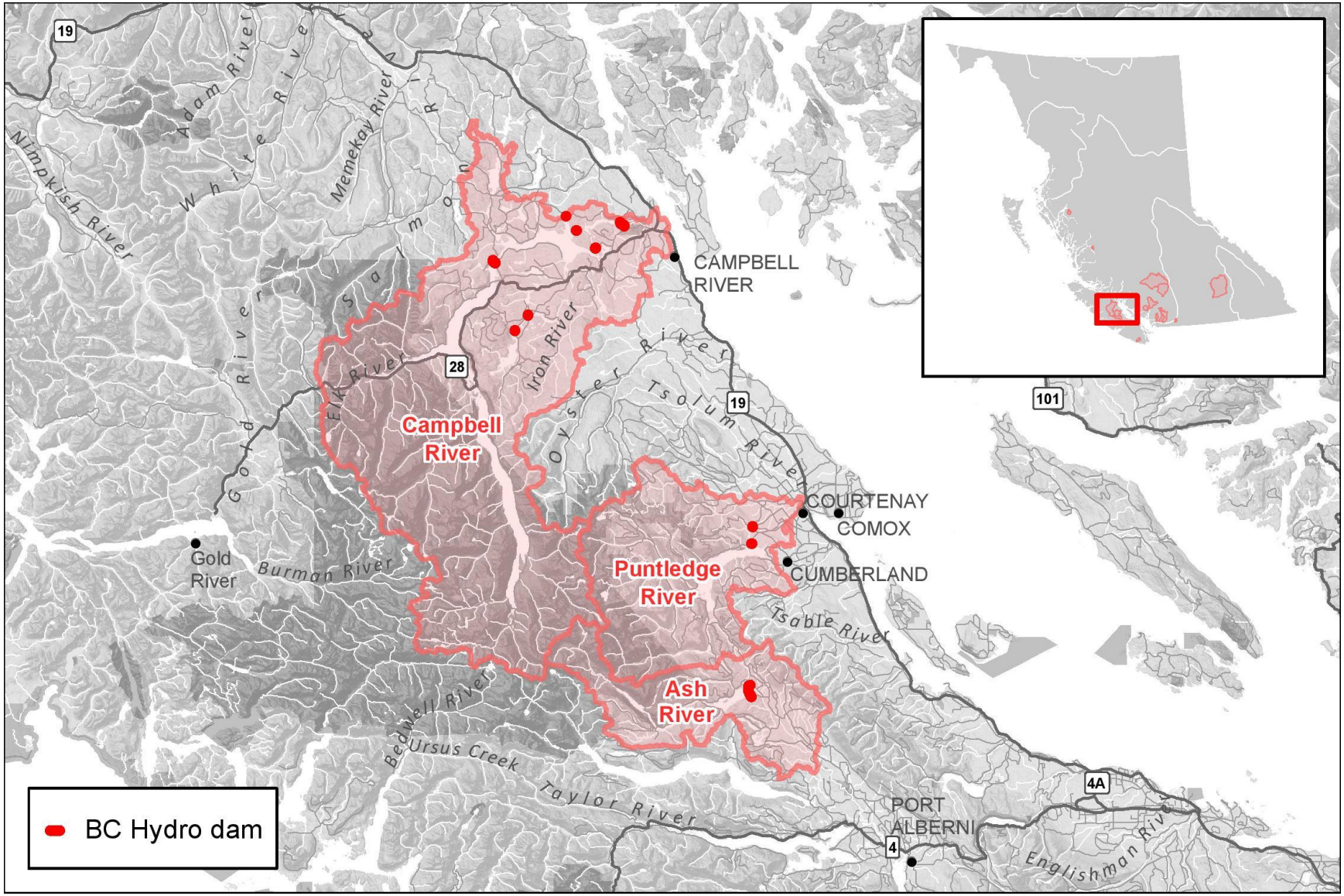

Figure 1. Map of study area.

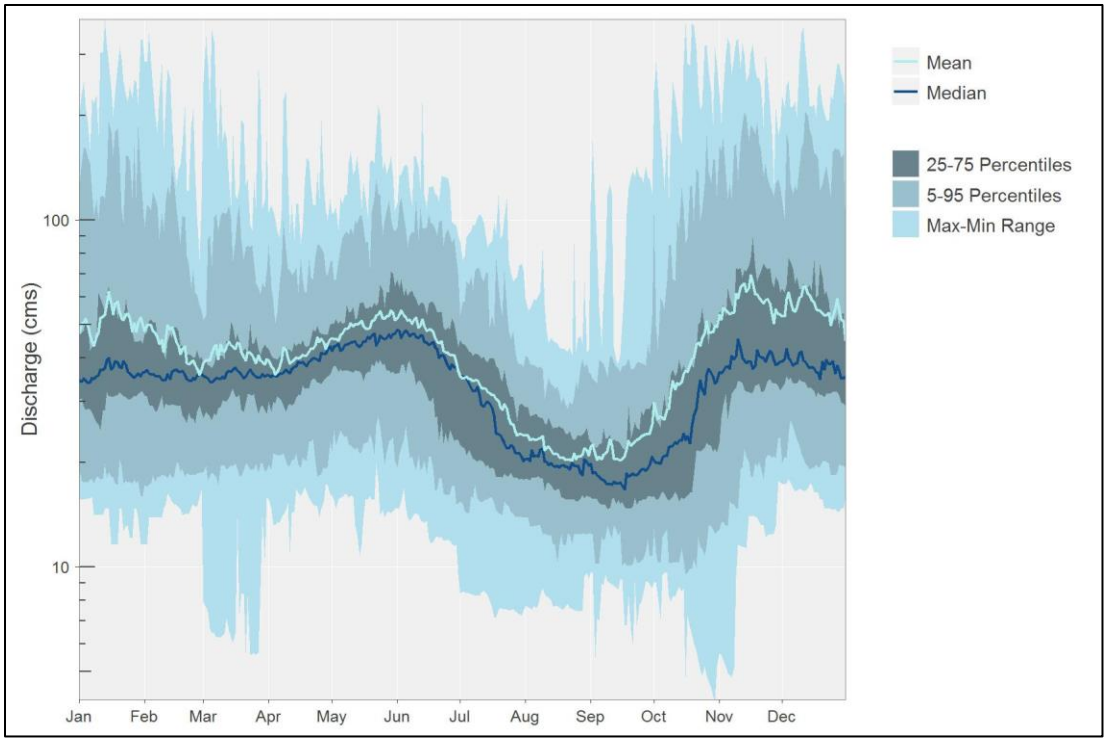

Figure 2. Puntledge river at Courtenay (Station #08HB006 - Lat 49.68803 Lon -125.034187). Available daily discharge data from 1914 to 2016 plotted in R with fasstr (Goetz and Schwarz NA).

4.1 Fisheries

The Puntledge River has a diverse fish assemblage (Table 1). The river is an important coastal salmon stream with all five species of salmon native to the North Pacific Basin present: chinook salmon (O. *tshawytscha*), coho salmon (*O. kisutch*), sockeye salmon (*O. nerka*), chum salmon (*O.keta*) and pink salmon (*O. gorbuscha*) (Table 1). Pacific lamprey (*Lampetra tridentata*), steelhead (*O. mykiss*) and anadromous coastal cutthroat are also fund in the Puntledge River system. Resident fish species include rainbow trout (*O. mykiss*), cutthroat trout (*O. clarkii spp.*), coast range sculpin (*Cottus aleuticus*), threespine stickleback (*Gasterosteus aculeatus*), as well as a population of kokanee (*O. nerka*) in Comox Lake (FISS 2018). Summer-run chinook salmon in the Puntledge River watershed are considered a species of high conservation concern by Fisheries and Oceans Canada (FWCP 2017). Western brook lamprey (*L. richardsoni* var*. marifuga*) in Morrison Creek, a small tributary watershed to the Puntledge River are considered endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2010). A recovery strategy was published for the species in 2007 and an action plan was released in 2017 (NRTMCL 2007, DFO 2017).

Both the Puntledge Dam and Puntledge Diversion Dam are passable to fish. There are two sets of natural falls, Stotan Falls and Nib Falls, that restricted migration of anadromous and resident fish. Improvements to their passability were made between 1923 and 1977 by selective blasting, and BC Hydro increases flows to facilitate passage at certain times of the year (FWCP 2017).

Coastal cutthroat trout, steelhead, and rainbow trout have been stocked in the watershed, beginning as early as 1944 (FISS BC). Salmon stocks are also augmented by the Putledge River Hatchery (FWCP 2017).

In 2015, fish passage was improved at two locations in Morrison creek. The project restored passage for the endangered Morrison Creek lamprey, as well as other species including adult pink salmon and juvenile salmonids (Wong and Palmer 2016).

Table 1. Fish species present in the Puntledge River watershed (FISS 2018).

Scientific name	**Species name**	**Species code**
Cottidae	Sculpin (General)	CC
Cottus aleuticus	Coastrange Sculpin (formerly Aleutian Sculpin)	CAL
Cottus asper	Prickly Sculpin	CAS
Gasterosteidae	Stickleback (General)	SB
Gasterosteus aculeatus	Threespine Stickleback	TSB
Lampetra richardsoni var. Marifuga	Morrison Creek Lamprey	MCL
Lampetra tridentata	Pacific Lamprey	PL
Lepomis gibbosus	Pumpkinseed	PMB
Oncorhynchus clarki clarki	Coastal Cutthroat Trout	CCT
Oncorhynchus clarki spp.	Cutthroat Trout (Anadromous)	ACT
Oncorhynchus gorbuscha	Pink Salmon	PK
Oncorhynchus keta	Chum Salmon	CM
Oncorhynchus kisutch	Coho Salmon	CO
Oncorhynchus mykiss	Rainbow Trout	RB
Oncorhynchus mykiss	Steelhead	ST
Oncorhynchus mykiss	Steelhead (Winter-run)	WST
Oncorhynchus nerka	Kokanee	KO
Oncorhynchus nerka	Sockeye Salmon	SK
Oncorhynchus tshawytscha	Chinook Salmon	CH
Petromyzontidae	Lamprey (General)	L
Salmonidae	Cutthroat Trout	CT
Salvelinus malma	Dolly Varden	DV

5 METHODS

To amalgamate maps and datasheets for crossing structure inventory, potential stream crossing locations were derived and analyzed within the Fish Habitat Model (MoE 2016). The Fish Habitat Model identifies potential stream crossing locations and models known and potential fish habitat based on gradient.

Gradient is a key factor in fish distribution and channel type. High value rearing, overwintering and spawning habitat is often located within channel types with lower gradients, while high gradient sections typically present upstream migration barriers and/or lower quality e habitat. Gradient categories are used in the Fish Passage Model to identify potential gradient barriers as well as to help characterize habitat associated with rehabilitation opportunities by estimating the slope and quantity of potential fish habitat upstream of a crossing.

The Fish Habitat Model utilized stream segments from the GIS stream layer (1:20,000) of the Freshwater Atlas for its gradient analysis (MoE 2016). For this project, the gradient categories detailed in Table 2 were utilized to delineate and classify habitat. The model starts at the mouth of a stream and iterates through each vertex of the stream flow line, calculating the gradient between the given vertex and the next vertex at least 100m upstream. It delineates additional stream segments at locations where the gradient exceeded the defined thresholds. Following delineation, the average gradient of each stream layer segment located within potential fish habitat was calculated with results classified according to the channel type categories. Finally, for potential habitat upstream of each crossing, stream lengths were summed within the average gradient categories with total areas of wetland and lake habitat also calculated.

Table 2. Stream gradient threshold and average gradient categories generated from the Fish Habitat Model and associated channel type.

***Gradient Range**	**Channel Type**
0 – 5%	Riffle and cascade pool
6 – 13%	Step pool
14 – 20%	Step pool - very steep
>20%	Non fish habitat

*Rounded to the nearest percent

Gradient threshold and average gradient categories were rounded to the nearest percent. Segments downstream of sections up to 13% grade were delineated and classified according to channel type groupings adapted from the British Columbia Channel Assessment Procedure Guidebook which include riffle and cascade pool and step-pool (FPC 1996, Table 2). Stream segments with sections containing gradients from 14 – 20% were classified as step pool - very steep. Stream segments upstream of 100 m sections with an average gradient >20% were considered non fish habitat Although fish have been reported to utilize habitat with gradients up to 30% (Baxter 1999), a cutoff of 20% was used as the goal was to identify and prioritize crossing rehabilitation opportunities. Stream segments with gradients between 20-30% are extremely steep and do not typically provide high value spawning or rearing habitat.

6 RESULTS

In the Puntledge River watershed, 963 crossings were modelled using the fish habitat model (Table 3). Of these, 261 crossings are predicted to occur on modelled fish habitat, while the remaining 702 are predicted to be located on modelled non-fish habitat (above sections of stream >100m long with gradient >20%). Maps of the watershed are provided as Attachment 1 and a summary of modelled crossing characteristics (stream name, road name, modelled habitat characteristics upstream, area of wetlands/lakes/reservoir upstream, etc.) are provided as Appendix 1 with a more detailed digital summary provided as Attachment 2. A key to the data included in Attachment 2 is detailed in Appendix 2.

Table 3. Summary of modelled crossings within the Puntledge River watershed.

Crossings	Number
On observed or modelled potential fish habitat	261
On modelled non-fish habitat	702
Total	**963**

7 NEXT STEPS

7.1 Phase 1 - Fish Passage Assessment

7.1.1 Preparing for the Field

Maps and datasheets provided as deliverables for this project can be used to prioritize stream crossing structure inventories based on sub-watersheds of interest, species of interest as well as quantities and types of habitat upstream and downstream of modelled crossings. To compliment these materials, field work guidance has been provided by the FPTWG. Fisheries literature for the watershed should be reviewed to gather information on fish bearing stream reaches as well as non-fish bearing reaches in preparation for field assessment. Stream reconnaissance reports showing non-fish bearing status can provide the information necessary to greatly reduce the number of crossings requiring inventory. FISS sample sites and obstacles to fish passage have been included on maps to aid in background review of watershed information. Details related to each of these points can be accessed through Imap BC or with information downloaded directly form the British Columbia Data Catalogue. Additionally local knowledge from government, First Nations and industry fisheries/habitat staff should be used to augment the modeled fish habitat data and background fisheries information when possible.

7.1.2 Data Collection

The FPTWG has prepared on-line training resources as well as the procedural document titled "Field Assessment for Determining Fish Passage Status of Closed Bottom Structures" and details assessment deliverables to help guide data collection and submission. A brief summary of data collection, data submission protocols and reporting is included below.

Each watershed should be systematically approached to assess crossings identified as fish bearing or potentially fish bearing. Additional closed bottom crossings encountered incidentally in the field can also be assessed if they occur on unmapped streams and appear to have potential for fish presence. Drainage culverts should not be assessed unless mapped and identified as potentially or known fish bearing.

For all crossings assessed, including open bottom structures and fords, photos should be taken that include images of the crossing inlet, crossing outlet, crossing barrel, channel downstream and channel upstream and any relevant features (ex. natural barriers, road signs adjacent to crossing to aid in location, significant habitat features, etc.). Additionally, the following information should be recorded for all surveyed crossings on standardized filed forms found in MoE 2011: date of inspection, crossing reference, crew member initials, Universal Transverse Mercator (UTM) coordinates, stream name, road name and kilometer, road tenure information, crossing type, crossing subtype, culvert diameter or span for OBS, culvert length or width for OBS. A more detailed "full assessment" was completed for all closed bottom structures.

In addition to the above information full assessments should include the following parameters: presence/absence of continuous culvert embedment (yes/no), average depth of embedment, whether or not the culvert bed resembled the native stream bed, presence of and percentage backwatering, fill depth, outlet drop, outlet pool depth, inlet drop, culvert slope, average downstream channel width, stream slope, presence/absence of beaver activity, presence/absence of fish at time of survey, type of valley fill, and a habitat value rating. Some of this information is utilized to determine the barrier status of the crossing based on data obtained from various studies (Clarkin et al. 2003; Robison and Walsh 2003) and scored according to the values provided in the MoE protocol (MoE 2011, Tables 4 – 5).

Table 4. Fish barrier scoring.

Risk	Embedded	Value	Outlet Drop	Value	Slope	Value	SWR	Value	Length	Value
LOW	>30cm or >20% of diameter and continuous	0	<15	0	<1	0	<1.0	0	<15	0
MOD	<30cm or 20% of diameter but continuous	5	15-30	5	1-3	5	1.0-1.3	3	15-30	3
HIGH	No embedment or discontinuous	10	>30	10	>3	10	>1.3	6	>30	6

Table 5. Fish barrier result.

Cumulative Score	Result
0-14	Passable
15-19	Potential Barrier
≥20	Barrier

Habitat value ratings should be given for each stream where a crossing is assessed and should be based on channel morphology, flow characteristics (perennial, intermittent, ephemeral), fish migration patterns, the presence/absence of deep pools, un-embedded boulders, substrate, woody debris, undercut banks, aquatic vegetation and overhanging riparian vegetation (Table 6, MoE 2011). For crossings determined to be potential barriers or barriers based on the data, a culvert fix should be recommended based on options provided in MoE 2011 which include:

1. Removal
2. Open Bottom Structure
3. Streambed Simulation
4. Additional Substrate Material
5. Backwater

Table 6. Habitat Value Criteria.

Habitat Value	Fish Habitat Criteria
High	• The presence of high value spawning or rearing habitat (e.g., locations with abundance of suitably sized gravels, deep pools, undercut banks, or stable debris), which are critical to the fish population.
Medium	• Important migration corridor. • Presence of suitable spawning habitat. • Habitat with moderate rearing potential for the fish species present.
Low	• The absence of suitable spawning habitat, and habitat with low rearing potential (e.g., locations without deep pools, undercut banks, or stable debris, and with little or no suitably sized spawning gravels for the fish species present).

All field data collected including photos must be uploaded to the Provincial Stream Crossing Inventory System (PSCIS) by using the excel PSCIS Assessment Form via the Electronic Submission Framework (ESF). A user's guide for the PSCIS system is provided on the Fish Passage Activity website.

Reporting for fish passage assessments should include the following as summarized in the FPTWG assessment deliverables:

- Executive Summary.
- Study Area – description and map.
- Scope of works completed.
- Methods.
- Results including a data summary table with structures number and fish passage score and description of fish presence determination.

- Analysis of data collected including Habitat Gained Index (amount of suitable habitat potentially available upstream of the crossing).
- Recommendations - Priorities for fish passage restoration and any limitations and linkages. (ex. structure is a priority but road that crosses downstream was not assessed and other crossings on the same system should be fixed in conjunction to realize highest habitat gains).
- Map showing priority restoration sites.
- Conclusions.

7.2 Phase 2 – Fish Habitat Confirmation

Following the assessment of closed bottom structures in an area of interest, highest priority crossings can progress to the second phase of the FPTWG strategic protocol (Fish Habitat Confirmation). Preparation before going out to the field as well as field sampling and data collection should follow the steps outlined in FPTWG 2011 – "A Checklist for Fish Habitat Confirmation Prior to the Rehabilitation of a Stream Crossing". The main objectives of these fish habitat assessments are to confirm the presence of high value fish habitat, a large amount of habitat gain through remediation and the absence of fish migration barriers immediately downstream of crossings.

7.2.1 Step 1: Preparation Before Going Out to the Field

Step 1 of the habitat confirmation protocol involves a background review of all relevant access and fisheries information. All provincial fish habitat modeling should be reviewed and government information databases should be searched for relevant background information. Local regulatory biologists should be consulted regarding local fisheries information and insights into fish species utilizing study area watersheds.

Maps and/or web mapping services should be reviewed to determine distance to any potential barriers downstream and upstream of the crossings. PSCIS information on any downstream or upstream crossings located within the watershed should also be reviewed to determine if they have been assessed for fish passage. Fish sampling permits should be obtained for electrofishing to facilitate assessment of fish bearing status and fish species present in subject streams.

7.2.2 Step 2: Field Sampling and Data Collection

Step 2 consists of surveying all the culvert crossings identified as high priority as well as the fish habitat upstream and downstream of the crossing. Each culvert should be flagged and labeled in the field including the crossing ID, date and crew initials. The crossings should be assessed again for fish passage following the procedures outlined in "Field Assessment for Determining Fish Passage Status of Closed Bottomed Structures" (MoE 2011) to confirm the accuracy of the original assessment and determination that the crossing was a barrier to fish passage.

The stream should be surveyed upstream and downstream of the crossing to assess habitat quality. Any upstream crossings should be assessed for fish passage and habitat at access points on the stream should be assessed to determine quality of habitat at The crew should survey the stream downstream of the crossing to the point where fish passage has been previously confirmed. When necessary, electrofishing should be conducted to aid in the determination of fish bearing status and species identification. Any potential barriers to fish passage should be inventoried with photos, physical descriptions and locations recorded. Surveyed routes should be recorded using GPS units. Each habitat type within the surveyed area should be described, photographed and rated.

7.2.3 Step 3: Submit Survey Summary and Conclusions

A brief documents should be drafted for each habitat confirmation conducted and should include maps and photos and use the headings below as detailed in FPTWG (2011):

- Site Location
- Findings from Background Information Search
- Stream Characteristics at Crossing
- Stream Characteristics Downstream
- Stream Characteristics Upstream
- Conclusions

8 CONCLUSION

In the Puntledge River watershed, 963 crossings were identified using the fish habitat model. Of these, 261 crossings are predicted to occur on modelled fish habitat, while the remaining 702 are predicted to be located on modelled non-fish habitat (above sections of stream >100m long with gradient >20%). Assessment of crossing locations on modelled fish habitat in the watershed is recommended and should be conducted according to FPTWG protocols. The FPTWG has prepared on-line training resources, field work guidance, field assessment protocols and data forms to help guide the collection of data and submission of assessment deliverables.

The rehabilitation of fish passage at road crossing structure barriers presents tangible opportunities to reconnect habitat values within currently fragmented ecosystems. A strategic approach to the planning and data collection at road crossing structures and the sharing of information provided by the FPTWG tools such as the data collection protocol documents and the PSCIS database provides a platform for an efficient allocation of effort towards the restoration of fish passage opportunities with the highest ecosystem benefits. Following implementation of an inventory of closed bottom structures in the Puntledge River watershed (Phase 1) subsequent phases of the FPTWG's Fish Passage Strategic Approach can follow (Phase 2 – Habitat Confirmation, Phase 3 – Design, Phase 4 – Remediation) hopefully resulting in the restoration of fish passage into areas of critical habitat for species of interest in the watershed.

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Appendix 1

Modelled Crossings on Known and Potential Fish Habitat

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	*Road Tenure
3400009	092F118	Morrison Ck	Willemar Ave	354596 5505705	18.6	7	CH,CO,CT,PK,ST	Local
3400010	092F118		Powerhouse Road	353368 5505276	0.2			Local
3400011	092F118	Morrison Ck	Arden Rd	354104 5505006	16.1	7	CH,CO,CT,PK,ST	Local
3400012	092F118	Arden Ck	Arden Rd	354355 5504691	0.3			Local
3400013	092F118	Morrison Ck	Webb Road	353628 5504612	14.9	7	CO,CT,PK,ST	MoTI
3400017	092F118		Medicine Bowl Road	346813 5504772	0.2			MoTI
3400019	092F117		Strathcona Parkway	334330 5511786	0.1			Collector
3400020	092F117		Strathcona Parkway	334305 5511824	0.1			Collector
3400062	092F118		Johnson Road	349886 5505871	3.5			Local
3400070	092F118		Rte 19 NB - Island Highway	349455 5507276	3	5.3	CO	MoTI
3400072	092F118		Rte 19 SB - Island Highway	349439 5507277	3	5.3	CO	MoTI
3400076	092F118		Rte 19 NB - Island Highway	351483 5504493	4.3	7.8	CT	Freeway
3400077	092F118		Rte 19 SB - Island Highway	351482 5504477	4.3	7.8	CT	Freeway
3400109	092F117			333873 5512266	0.1			
3400111	092F117		Nordic Drive	334056 5511532	0.5			MoTI
3400112	092F117		Arrowsmith Ridge	334116 5511594	0.5			Strata
3400115	092F118	Arden Ck	Timberlane Road	354235 5504515	0.1			Local
3400130	092F118	Morrison Ck	1st St	354580 5505778	18.7	7	CH,CO,CT,PK,ST	Local
3400136	092F118	Perseverance Ck	Comox Lake Rd	351101 5498816	12	21.8	CO,CT,DV	Local

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	*Road Tenure
3400137	092F118	Morrison Ck	MIROMAR ROAD	352570 5503329	12.8	7	CO,CT,PK,ST	MoTI
3400164	092F117	Ramparts Ck	Strathcona Parkway	335387 5511345	1.2			Collector
3400193	092F118			348934 5501097	0.3			
3400196	092F118		Piercy Road	350927 5506979	4.7	5.3	CO	Local
3400203	092F118		Rte 19 NB - Island Highway	350649 5505572	0.5			Freeway
3400204	092F118		Rte 19 NB - Island Highway	350327 5506006	4			Freeway
3400205	092F118		Rte 19 SB - Island Highway	350319 5505999	4			Freeway
3400206	092F118		Rte 19 SB - Island Highway	350647 5505556	0.4			Freeway
3400234	092F118	Beech Ck	Comox Lake Mainline	341168 5496812	7.6		CT,RB	Resource
3400235	092F118		Forbidden Plateau Road	346991 5504624	1.3			MoTI
3400274	092F118	Morrison Ck	Timberlane Rd	353906 5504930	15.4	7	CO,CT,PK,ST	Local
3400275	092F118	Willemar Ck	Timberlane Road	353986 5504829	0.3			MoTI
3400279	092F118	Morrison Ck	Afton Road	352665 5503535	13.1	7	CO,CT,PK,ST	MoTI
3400295	092F118	Morrison Ck	TURNSTALL ROAD	352600 5503408	12.9	7	CO,CT,PK,ST	Trail
3400319	092F118			350373 5505363	0.1			Trail
3400332	092F118	Morrison Ck	Salsbury Road	353297 5504690	14.6	7	CO,CT,PK,ST	Trail
3400366	092F118	Morrison Ck	Munster Road	352850 5503962	13.6	7	CO,CT,PK,ST	Trail
3400552	092F118		Pardiac Road	353303 5505225	0.1			Trail
3400553	092F118		Pardiac Road	353269 5505198	0.1			Trail

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	*Road Tenure
3400573	092F118			352819 5501812	0.1			Unclassified
3400575	092F118			347611 5500771	3.2			Unclassified
3400581	092F118			346734 5503952	0.2			Unclassified
3400582	092F118	Nellie Ck		352500 5502287	0.4	2		Unclassified
3400584	092F118	Supply Ck		347776 5503123	0.7			Unclassified
3400588	092F118			347588 5503728	1.1			Unclassified
3400589	092F118			346624 5503976	0.1			Unclassified
3400591	092F118			349113 5499350	0			Unclassified
3400593	092F118			352777 5501344	0.2			Unclassified
3400594	092F118			352740 5501434	0.6			Unclassified
3400599	092F118			341501 5505030	0			Unclassified
3400616	092F118	Wattaway Ck		341530 5504406	0.3			Unclassified
3400621	092F118	Morrison Ck		353358 5504677	14.6	7	CO,CT,PK,ST	Unclassified
3400626	092F118			351729 5498081	0.6	5.1		Unclassified
3400682	092F118			350920 5507001	4.7	5.3	CO	Unclassified
3400688	092F118			350711 5506149	4.4			Unclassified
3400725	092F117			331816 5501446	0.2			Unclassified
3400730	092F117			332045 5505328	10.8	39.8	RB	Unclassified
3400769	092F117			340898 5506631	0.1			Unclassified
3400773	092F118	First Supply Ck		352006 5502346	0.9		CO	Unclassified
3400775	092F118			346712 5504881	0.7			Unclassified
3400785	092F118			351498 5504071	0.9			Unclassified
3400791	092F118			351556 5505017	4.9	8.8	CO,CT	Unclassified
3400805	092F117	Ramparts Ck		335353 5511361	1.1			Unclassified

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	*Road Tenure
3400807	092F118	Morrison Ck		353111 5501850	2.2		CO,CT,ST	Unclassified
3400810	092F118	Morrison Ck		352807 5502049	5.2	1.6	CO,CT,ST	Unclassified
3400811	092F118	Morrison Ck		352810 5502398	5.6	1.6	CO,CT,ST	
3400837	092F117			335416 5509903	0.5			Unclassified
3400852	092F117			336046 5505574	0.9			Trail
3400869	092F112			337397 5489448	3.1		CAL,CT	Unclassified
3400877	092F113			342096 5490125	0.5			Unclassified
3400898	092F117	Beech Ck		338940 5499767	7.5		CT	Unclassified
3400907	092F117	Beech Ck		339916 5497911	7.5		CT	Unclassified
3400908	092F117	Beech Ck		339768 5498565	7.5		CT	Unclassified
3401229	092F118			349510 5505380	2.8			Unclassified
3401281	092F118			349019 5496789	0.3	0.8		Unclassified
3401282	092F118			349017 5496444	0.3			Unclassified
3401283	092F118	Boston Ck		341389 5501769	0.5		RB	Unclassified
3401289	092F117	Boston Ck		340796 5502129	0.1		RB	Unclassified
3401304	092F112			337780 5493604	0.3			Unclassified
3401306	092F117	Beech Ck		337568 5502561	3.8		CT	Unclassified
3401314	092F117			332348 5501872	0.1			Unclassified
3401563	092F117	Boston Ck		341046 5501915	0.1		RB	Unclassified
3401569	092F118			349003 5496446	0.3			Unclassified
3401581	092F118	Cumberland Ck		350748 5496242	1.9	0.8	CT	Unclassified
3401614	092F117			338158 5503165	0.9			Unclassified
3401619	092F117	Beech Ck		337503 5502817	3.7		CT	Unclassified
3401621	092F117			337738 5501848	0.1			Unclassified

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	*Road Tenure
3401624	092F117			335423 5500827	0			Unclassified
3401637	092F117			332309 5501901	0			Unclassified
3401640	092F117			332848 5504002	0.3			Unclassified
3401641	092F117			332993 5503947	0.5			Unclassified
3401647	092F117			332032 5505276	10.8	39.8	RB	Unclassified
3401669	092F113			343503 5490630	0.3			Unclassified
3401705	092F113			345666 5487066	0			Resource
3401710	092F113			343099 5491264	1.3			Unclassified
3401714	092F113			341904 5488983	0.1			Unclassified
3401715	092F113			341945 5488887	0.1			Unclassified
3401716	092F113			342017 5488764	0.2			Unclassified
3401743	092F118		Westfair Road	346647 5504929	0.6			Trail
3401753	092F118			346542 5504973	0.5			Unclassified
3401778	092F118	Morrison Ck	Rte 19 SB - Island Highway	352510 5503251	12.7	7	CO,CT,PK,ST	Freeway
3401779	092F118	Morrison Ck	Rte 19 NB - Island Highway	352521 5503262	12.7	7	CO,CT,PK,ST	Freeway
3401780	092F118		Rte 19 SB - Island Highway	352759 5502765	3.2		CO	Freeway
3401781	092F118		Rte 19 NB - Island Highway	352772 5502766	3.2		CO	Freeway
3401784	092F118		Duncan Bay Mainline	350827 5505913	0.9			Local
3402063	092F117			333205 5512093	1			
3402064	092F117			333204 5511981	0.1			
3402065	092F117			333240 5511856	0.6	15	RB	

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	*Road Tenure
3402066	092F117	Paradise Ck		333381 5511812	3	17.9	RB	
3402109	092F117	Paradise Ck		333068 5512207	0.9	2.5		
3402119	092F117			334491 5509824	0.4			Resource
3402120	092F117			334885 5509407	0.7			Resource
3402121	092F117		Village Run Trail	333524 5512332	0.5			Trail
3402149	092F117	Ramparts Ck		334689 5511887	0.1			Trail
3402200	092F117	Ramparts Ck		336476 5510353	3			Resource
3402201	092F117			336390 5510811	1.2			Resource
3402202	092F117			336536 5510177	0			Resource
3402203	092F117	Paradise Ck		336389 5509141	8.1	24.9	RB	Resource
3402204	092F117			336402 5508191	0			Resource
3402205	092F117	Browns R		336782 5509571	25.1	113.9	CT,RB	Resource
3402224	092F117			336801 5510630	0.3			Resource
3402225	092F117			336730 5510549	0.5			Resource
3402226	092F117			336554 5510580	1.9			Resource
3402227	092F117			336688 5510516	0.5			Resource
3402242	092F117	Browns R		338940 5509111	33.7	114.1	CT,RB	Resource
3402292	092F117			336384 5511121	0			Resource
3402299	092F117			336031 5511057	0.7			Unclassified
3402540	092F118			349028 5505082	2.3			Resource
3402541	092F118	Nellie Ck		352544 5502629	0.8	2		Resource
3402543	092F118			346848 5502018	1.4			Resource
3402544	092F118			347700 5502430	0.9			Resource
3402552	092F118			347639 5505856	0.2			Resource

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	*Road Tenure
3402558	092F118			349002 5507751	2	5.3		Resource
3402559	092F118			349129 5507603	2.2	5.3		Resource
3402560	092F118			349210 5507245	0.2			Resource
3402561	092F118			350200 5505930	3.9			Unclassified
3402562	092F118			350365 5507239	4.1	5.3	CO	Resource
3402563	092F118			350800 5507068	4.5	5.3	CO	Resource
3402564	092F118			350575 5507128	4.3	5.3	CO	Resource
3402566	092F118			350952 5505960	1			Resource
3402567	092F118			350730 5505785	0.7			Resource
3402568	092F118			350757 5505810	0.7			Resource
3402569	092F118			350789 5505856	0.8			Resource
3402570	092F118	First Supply Ck		352337 5502626	1.4		CO	Unclassified
3402574	092F118	Supply Ck		347171 5503009	0.1			Resource
3402575	092F118			348942 5507901	0.9	4.8		Resource
3402577	092F118			349286 5500963	0.1			Trail
3402578	092F118			349865 5502952	0.6		CT	Unclassified
3402579	092F118			347971 5503431	4.7			Unclassified
3402582	092F118			350872 5505941	0.9			Unclassified
3402583	092F118			351054 5505972	1.1			Unclassified
3402595	092F118			346946 5501301	2.2			Unclassified
3402596	092F118		Forbidden Plateau Road	349789 5504331	0.7			MoTI
3402600	092F118			351188 5503809	2.5		CT	Unclassified
3402601	092F118	Morrison Ck	Lake Trail Road	352489 5503084	12.5	7	CO,CT,PK,ST	Local
3402603	092F118		Comox Lake	347083 5500891	2.6			Resource

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	*Road Tenure
			Mainline					
3402604	092F118	Boston Ck	Comox Lake Mainline	345750 5500385	1		RB	Resource
3402614	092F118		Forbidden Plateau Road	350112 5505905	3.8			Local
3402617	092F118		Lake Trail Road	350612 5503043	1.4		CT	Local
3402618	092F118	Morrison Ck	Comox Logging Rd	352878 5504067	13.7	7	CO,CT,PK,ST	Local
3402650	092F118			353761 5502580	1.4			
3402651	092F118			353827 5502862	1.1			
3402652	092F118			353739 5502485	1.5			
3402653	092F118			353752 5502539	1.4			
3402654	092F118			353978 5503177	0.7			
3402655	092F118			353797 5502761	1.2			
3402656	092F118			353728 5502431	1.5			
3402657	092F118			353819 5502840	1.1			
3402658	092F118			353774 5502643	1.3			
3402659	092F118			353755 5502552	1.4			
3402660	092F118			353310 5502326	2.5			Resource
3402661	092F118			353494 5502326	2.2			Resource
3402662	092F118	Arden Ck		354722 5505519	1.4			Unclassified
3402664	092F118			353725 5502418	1.5			
3402672	092F118			353031 5502560	2.9		CO	Unclassified
3402673	092F118			353347 5502283	2.4			Unclassified
3402674	092F118			353279 5502344	2.5			Unclassified
3402675	092F118			353216 5502381	2.6			Unclassified

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	*Road Tenure
3402681	092F118			350926 5497974	0.1			Resource
3402683	092F113			342940 5494391	0			Resource
3402685	092F113			342838 5494554	0.3			Resource
3402686	092F113			342847 5494363	0.1			Resource
3402706	092F118	Perseverance Ck		352434 5496397	3.6		CT	Resource
3402707	092F118			352708 5496520	0.1			Resource
3402709	092F113			353286 5495657	2.3			Resource
3402725	092F118			351180 5499072	1			Unclassified
3402726	092F118			350691 5498294	0			Unclassified
3402727	092F118	Cumberland Ck		351586 5497022	1.9	2.7	CT	Unclassified
3402728	092F118	Perseverance Ck		352373 5496763	4.7		CO,CT,DV	Unclassified
3402729	092F118			352511 5496566	0.3			Unclassified
3402749	092F117			335945 5500023	0.1			Resource
3402784	092F117			337092 5503785	0.1			Resource
3402786	092F117			335937 5504241	1.1			Resource
3402787	092F117	Beech Ck		336491 5503554	3.7		CT	Resource
3402799	092F117			335354 5501541	0.5			Resource
3402802	092F117			335404 5501302	0.8			Resource
3402823	092F117	Eric Ck		330484 5501600	3.4			Resource
3402824	092F117			334894 5502330	0.1			Unclassified
3402840	092F117			338217 5503041	0			Unclassified
3402841	092F117			338217 5503023	0			Unclassified
3402859	092F117			332740 5497197	0			Resource
3402861	092F117	Rees Ck		333718 5496957	3.8		CO	Resource

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	*Road Tenure
3402894	092F117			335034 5497220	0.2			Unclassified
3402901	092F112			337761 5494774	0.1			Unclassified
3402904	092F112			337467 5489974	0.2			Resource
3402913	092F113			341495 5485863	0			Resource
3402916	092F112			337626 5485767	0			Resource
3402928	092F113			344961 5487331	0			Resource
3402932	092F112			337548 5490932	0			Resource
3402933	092F112			337297 5490219	0.3			Resource
3402936	092F112			337734 5490359	0.1			Resource
3402948	092F113	Nimnim Ck		342081 5486251	0.3			Resource
3402951	092F113			341384 5486084	0.3			Resource
3402953	092F113			341290 5486072	0.1			Resource
3402954	092F112	Puntledge R		339954 5486553	18.8	59.4	CC,CO,CT,DV,KO,TSB	Resource
3402959	092F112			339550 5486320	0			Resource
3402962	092F112			339657 5486819	0.1			Resource
3402979	092F113			342055 5487874	0			Resource
3402982	092F113			342162 5487477	0.1			Resource
3402986	092F112			339944 5494508	0.4			Resource
3402988	092F113			342032 5491511	0			Resource
3402989	092F113			342063 5491161	0.2			Resource
3402991	092F113			342252 5488630	0			Resource
3403004	092F113			344133 5488603	0.3			Resource
3403005	092F113			343742 5489586	0.5			Resource
3403007	092F113			343322 5491597	0.1			Resource

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	*Road Tenure
3403010	092F112			337749 5490353	0.1			Unclassified
3403011	092F112			337618 5491256	0.1			Unclassified
3403015	092F112	Capes Ck		337747 5493362	1.4		RB	Unclassified
3403018	092F113		Comox Lk Mainline	342232 5491175	0.4			Resource
3403019	092F113		Comox Lk Mainline	342218 5490439	0.8			Resource
3403020	092F113			341997 5490083	0.4			Unclassified
3403021	092F113			341836 5489503	0.4			Unclassified
3403022	092F113			341930 5489726	0.4			Unclassified
3403023	092F113			341552 5489313	0			Unclassified
3403024	092F113			342226 5487512	0.1			Unclassified
3403025	092F113			342176 5488263	0.1			Unclassified
3403026	092F113			342191 5487870	0.2			Unclassified
3403027	092F113			344169 5489403	0			Resource
3403028	092F113			343219 5490375	0.4			Unclassified
3403029	092F113	Toma Ck		343469 5490401	9.9	5.2	CO,CT,DV	Unclassified
3403031	092F112			337712 5488046	0.4			Unclassified
3403044	092F112	Comox Ck		335139 5490537	1.2		RB	Unclassified
3403051	092F112	Datsio Ck		335455 5489925	0.2		DV	Unclassified
3403054	092F112	Ginger Goodwin Ck	Comox Lk Mainline	340637 5495220	0.6			Resource
3403057	092F112			338864 5493821	0			Unclassified
3403058	092F112			339717 5493851	0			Unclassified
3403059	092F112			339273 5493787	0			Unclassified
3403060	092F112			340320 5494024	0.4			Unclassified
3403061	092F113			343114 5491416	1.1			Unclassified

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	*Road Tenure
3403062	092F113			343027 5492064	0.9			Unclassified
3403068	092F113		Comox Lake Mainline	342229 5491578	0.2			Resource
3403096	092F113			345003 5487839	0			Resource
3403099	092F113			344751 5488035	0.3			Unclassified
3403100	092F113	Toma Ck		345660 5487005	2.9	5.2		Resource
3403102	092F113			345687 5486966	0.1			Resource
3403168	092F117		Henry Road	333423 5512296	0.6			Local
3403169	092F117		Nordic Drive	333369 5512295	0.7			MoTI
3403254	092F118		2	349224 5505232	2.5			Huock Forests Ltd.
3403297	092F118		1	348371 5505529	1.1			Huock Forests Ltd.
3403309	092F118		DUNCANBM.7	350471 5506121	4.2			Timberwest Forest.
3403326	092F118		1	347099 5503836	0.6			Truewood Forests.

Appendix 2

Key to Attachment 2 - Digital Summary of Modelled Crossing Characteristics on Known and Potential Fish Habitat

Table heading	**Column Name (BC data distribution)**	**Details/attribute**	**Source/URL**
crossing_id / stream_crossing_id	stream_crossing_id	Unique crossing ID	Fish Habitat Model / pscis-assessments
map_tile	map_tile	1:50,00 mapsheet	nts-50k-grid-digital-baseline-mapping-at-1-50-000-nts
stream_name	gnis_name	The BCGNIS (BC Geographical Names Information System) name associated with the GNIS feature id	freshwater-atlas-stream-network
stream_order	stream_order	The calculated modified Strahler order.	freshwater-atlas-stream-network
road_name	road_name_full or rfi_highway_description or road_section_id	Dependent on logic incorporating distance of modelled crossing to associated road layers and presence absence of forest tenure information	digital-road-atlas-dra-master-partially-attributed-roads ministry-of-transportation-mot-road-features-inventory-rfi forest-tenure-road-segment-lines
fish_habitat_threshold_type_atcrossing		Stream threshold category of stream at crossing (ex. FISH HABITAT - INFERRED - 055-135PCT = no fish habitat downstream of crossing with gradient > 13.5% for more than 100m)	Fish Habitat Model freshwater-atlas-stream-network
habitat_gain_threshold_sub035		Total linear length (m) of inferred or observed fish habitat upstream of the crossing that does not exceed 3.5% gradient for more than 100 m.	Fish Habitat Model freshwater-atlas-stream-network
habitat_gain_threshold_sub05		Linear length (m) of inferred or observed fish habitat upstream of the crossing that does not exceed 5.5% gradient (cascade) for more than 100 m.	Fish Habitat Model freshwater-atlas-stream-network
habitat_gain_threshold_sub13		Linear length (m) of inferred or observed fish habitat upstream of the crossing that does not exceed 13.5% gradient (step-pool) for more than 100 m.	Fish Habitat Model freshwater-atlas-stream-network
habitat_gain_threshold_sub20		Linear length(m) of inferred or observed fish habitat upstream of the crossing that does not exceed 20.5% gradient (step pool – very steep) for more than 100 m.	Fish Habitat Model freshwater-atlas-stream-network
*slope		Derived slope of stream at crossing (rise/run)	Fish Habitat Model freshwater-atlas-stream-network
upstr_len_slope_0_035		Linear length (m) of inferred or observed fish habitat upstream of the crossing with average gradient ≤3.5% (riffle).	Fish Habitat Model freshwater-atlas-stream-network
upstr_len_slope_035_055		Linear length (m) of inferred or observed fish habitat upstream of the crossing with average gradient from 3.5 - 5.5% (cascade).	Fish Habitat Model freshwater-atlas-stream-network

Table heading	Column Name (BC data distribution)	Details/attribute	Source/URL
upstr_len_slope_055_135		Linear length (m) of inferred or observed fish habitat upstream of the crossing with average gradient 5.5 - 13.5% (step-pool).	Fish Habitat Model freshwater-atlas-stream-network
upstr_len_slope_135_205		Linear length(m) of inferred or observed fish habitat upstream of the crossing with average gradient 13.5 - 20.5% (step pool – very steep).	Fish Habitat Model freshwater-atlas-stream-network
upstr_len_slope_sub_205		Total linear length(m) of inferred or observed fish habitat upstream of the crossing with average gradient < 20.5%.	Fish Habitat Model freshwater-atlas-stream-network
lake_area_ha	area_ha	Total area of lake habitat upstream of crossing and stream segments modelled with habitat threshold <20.5%.	Fish Habitat Model freshwater-atlas-stream-network freshwater-atlas-lakes
wetland_area_ha	area_ha	Total area of wetland habitat upstream of crossing and stream segments modelled with habitat threshold <20.5%.	Fish Habitat Model freshwater-atlas-stream-network freshwater-atlas-wetlands
spp_upstream	species_code	Codes for fish species located on stream segments upstream of the subject crossing.	known-bc-fish-observations-and-bc-fish-distributions
road_tenure	road_class client_name	Dependent on logic incorporating distance of modelled crossing to associated road layers and presence absence of forest tenure information as well as presence of key words in attribute names (ex. FSR is output when "FSR" contained within DRA layer attribute "road_name_full" when DRA layer attributre "road_class" = "resource".	digital-road-atlas-dra-master-partially-attributed-roads ministry-of-transportation-mot-road-features-inventory-rfi forest-tenure-road-segment-lines
upstr_crossing_ids		Unique identifiers for all modelled or PSCIS crossings located upstream of the subject modelled crossing on stream segments modelled as <20.5% threshold.	Fish Habitat Model
dnstr_crossing_ids		Unique identifiers for all modelled or PSCIS crossings located downstream of the subject modelled crossing.	Fish Habitat Model
*habitat_value_code	habitat_value_code	Habitat value code assigned during PSCIS assessment.	pscis-assessments
*Prioritized		Reference to assessment report where crossing was prioritized.	
*assessment_comment	assessment_comment	Assessment comments recorded in database from PSCIS assessment.	pscis-assessments
*image_view_url	image_view_url	Link to photos taken during PSCIS assessment.	pscis-assessments