Central Squamish Estuary Salmon Passage Culvert

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Prepared by:
Edith Tobe, RPBio, Executive Director
Squamish River Watershed Society
Box 1791, Squamish, BC, V8B 0B3

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Executive Summary

The focus of the project for this year was to upgrade and replace the second culvert, Culvert #2, along the Squamish Training Berm with a fish-passage friendly structure as part of the Central Estuary Restoration Project (CERP) Phase 1. The CERP was developed in 2018 in partnership with Fisheries and Oceans Canada (DFO) and Squamish Nation with the intention of improving tidal connectivity and water quality within the network of channels in the Squamish estuary and connections to the Squamish River. The focus was on improving accessibility for outmigrating juvenile Chinook salmon and other salmonids to access the inner estuary as part of DFO's effort to increase Chinook salmon stocks. In addition, this work was also supported by Squamish Nation as part of efforts towards reconciliation. The CERP was planned in a three phased approach with Phase 1 to include upgrading and replacing culverts along the 5km Training Berm with fish-passage friendly culverts; Phase 2 involved modification of the lower 850m "spit" to restore river flow connectivity to the estuary; and Phase 3 was focused on improving water quality and tidal connectivity along the Little Bear Slough / Bridge Pond. Work this year focused on two areas within the Squamish estuary and included upgrading Culvert #2 along the Squamish Training Berm (CERP Phase 1) and developing plans to upgrade water flows along the Little Bear Slough / Bridge Pond (CERP Phase 3).

From 2019 to 2021 a portion of Phase 1 was realized with the replacement of two structures (Culvert #3 and #4) with fish-passage friendly box culverts. In September 2024 Culvert #1 was replaced and, as part of the current fiscal and with the support of FWCP funding, in March/April 2025 Culvert #2, the final stage of Phase 1, was realized. From 2022 to 2023 Phase 2 was completed with the modification of 850m of the lower Spit and the removal of the three redundant culverts (Culverts #7, #8, and #9).

As in the previous year, the monitoring program continued incorporating emerging technologies including radio tracking technology, data loggers, and statistical analytics on movement of juvenile Chinook salmon, water quality characteristics including changes in temperature, conductivity, and dissolved oxygen, and changes and movement of sedimentation.

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Abbreviations:

CERP – Central Estuary Restoration Project
CSEB – Canadian Society for Environmental Biologists
CVGD28 – Canadian Vertical Geodetic Datum 28 (defined by mean sea level)
DFO – Fisheries and Oceans Canada
DOS – District of Squamish
FWCP – Fish and Wildlife Compensation Program
IFR – InStream Fisheries Research
LBS – Little Bear Slough
MOE – Ministry of Forests, Lands, and Natural Resources, Development and Operations
PIT – Passive Integrated Transponder
SRKW – Southern Resident Killer Whale populations
SN – Squamish Nation
SNC-L – SNC Lavalin
SRWS – Squamish River Watershed Society
SWS – Squamish Windsports Society
TC – Transport Canada
TNTBC – Nature Trust of BC
WMA – Wildlife Management Area

1.0 Introduction and Project Description

The Central Estuary Restoration Project (CERP) is a multi-year project focused on improving access for salmonids between the Squamish River and the central estuary (Figure 1). The focus is to restore declining Chinook salmon populations by improving access to rearing habitat within the estuary by which the juvenile salmonids can grow before entering into the waters of the Salish Sea for their four-year ocean voyage.

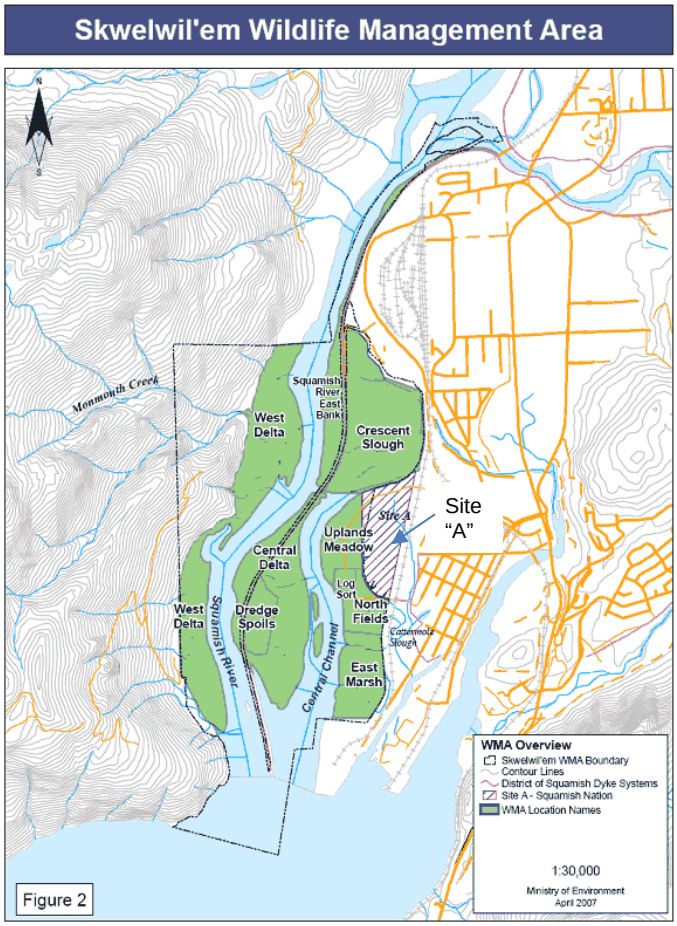

Figure 1 Location Map of Squamish and Skwelwile'em WMA (MOE 2007)

To achieve this objective, the scope of the project includes three phases (Figure 2):

- Phase 1 – Culvert Upgrades: replace culverts at key locations along Training Berm with fish passage friendly culverts (replacement of Culverts #3 and #4 completed in 2019 & 2020; replacement of Culvert #1 completed September 2024 and replacement of Culvert #2 from April to June 2025 as part of the current funding year.
- Phase 2 – Spit Modification: modification of the 850 m at the southern end of the Training Berm, also referred to as the Spit, to restore access for outmigrating juvenile Chinook salmon to over 300 hectares of estuarine habitat, including removal of 3 redundant culverts (Culverts #7, #8, and #9). Completed September 2023.

- Phase 3 – Bridge Pond Rewatering: restore tidal flows and improved water quality throughout the Bridge Pond/Little Bear Slough. Work on this phase of the project initiated in 2024. The intention is the planning undertaken in 2025 will result in physical works in 2026/2027 fiscal with support and input from DFO, Squamish Nation, District of Squamish and Nature Trust of BC.

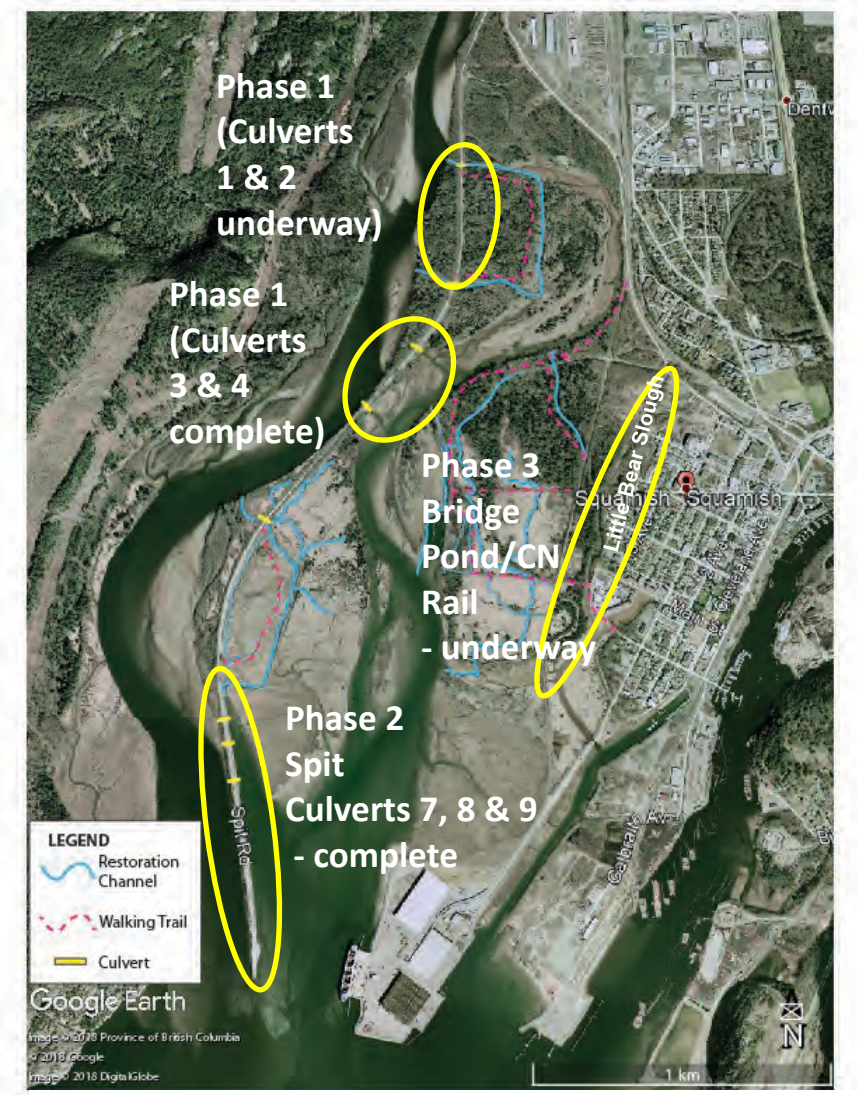

Figure 2: Central Estuary Restoration Project Phases

1.1 Project Site Location

The Squamish estuary, located approximately 52 km north of Vancouver, is situated at the head of Howe Sound where the Squamish River discharges a drainage area of over 3,650 km^2. The Squamish estuary encompasses the tidal waters of upper Howe Sound, from the confluence of the Squamish River upstream to the Mamquam, Cheakamus, Ashlu, and Elaho

Rivers. The CERP project site is located within the Skwelwil'em Squamish Estuary Wildlife Management Area (WMA) which is Crown land managed by the provincial government (MOE 2007). The entire CERP project site is located within the traditional territorial lands of Squamish Nation.

1.1.1 Background on the Squamish Estuary

The Squamish River estuary is a highly productive ecosystem providing diverse habitats for a variety of flora and fauna. It is an important wintering, migration, feeding and breeding habitat for resident and migratory waterfowl and shorebirds as well as raptors, passerines, and other species. It is also a feeding, spawning, and rearing ground for a variety of fish species including provincially and federally significant species such as Chinook, coho, chum, pink, and steelhead salmon, as well as herring and other forage fish, trout, and char. Furthermore, the estuary acts as a critical flood control mechanism for the Squamish town site, as well as filtering and purifying water from pollutants (MOE 2007). There have been numerous changes to the Squamish estuary since the first Europeans began to settle in the area in the late 1880s. These changes are captured in aerial photographs as depicted in Figure 3 below, illustrating the effects of infill, development, and land use changes from the 1930s to 70s.

1.1.2. Formation of Skwelwil'em Squamish Estuary Wildlife Management Area

The Skwelwil'em Squamish Estuary Wildlife Management Area (WMA) was established in 2007 following a 25-year estuary management planning process to maintain and restore fish, wildlife, and their supporting habitats (MOE 2007). The Squamish River estuary, located within the Salish Sea, is part of a fjordal system, a long narrow inlet with steep sides and cliffs created over the course of 10,000 years of glacial erosion. This area has been home to Squamish Nation members for thousands of years and has provided food, shelter, and a haven in which their community could expand and thrive. In the late 1870s Europeans first started settling in Squamish and almost immediately began making substantial changes to the estuary resulting in the loss of over 50% of productive habitat through the creation of the townsite, industrial facilities, and infrastructure (Hoos and Vold, 1975).

Imagery from 1930 to 1973 showing progression of development in the Squamish estuary:

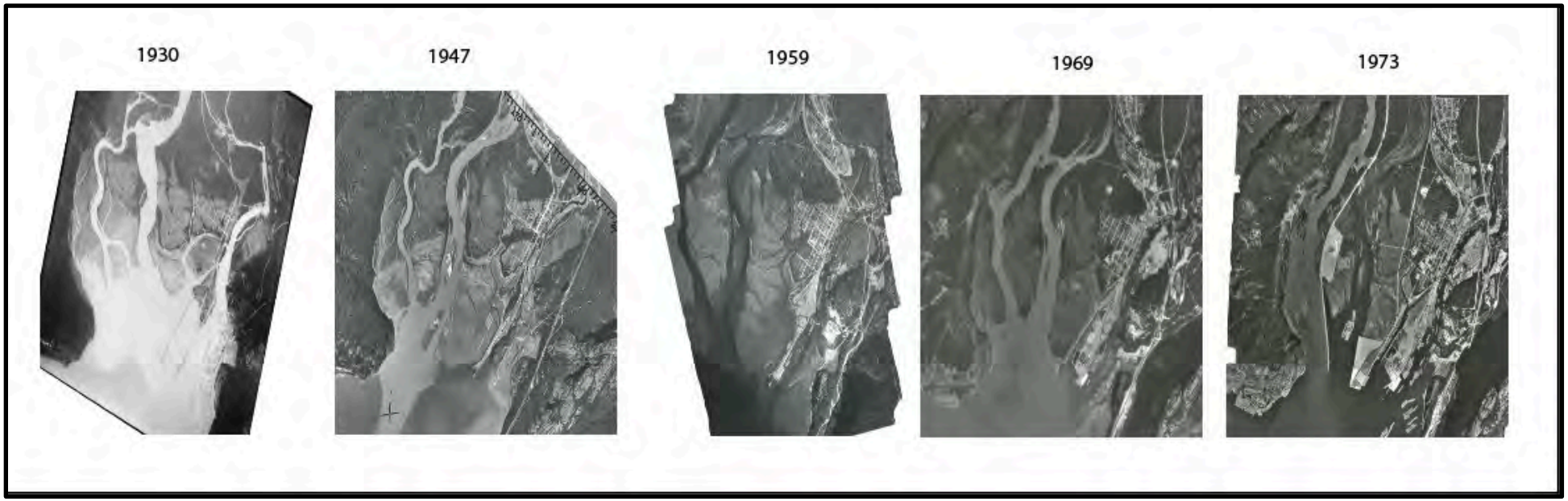

Figure 3 Development from 1930 to 1973 in the Squamish Estuary (prepared by P. Heintzman)

1.2 History of the Training Berm

The Training Berm (also referred to as the Squamish Spit Road) was constructed in the early 1970s by BC Rail and was originally intended to “train” the Squamish River along the western edge to facilitate the construction of a bulk coal loading facility in the estuary (Department of Environment, 1972). After commissioning a study in 1972, the “Effects of Existing and Proposed Industrial Development on the Aquatic Ecosystem of the Squamish Estuary”, the federal government of the day shut the port development down after determining the negative impacts this type of industry would have on the estuary and salmon populations. However, no requirement was made to remove the newly constructed 5km Training Berm, which all but severed connectivity between the river and estuary from the Mamquam River downstream to the head of Howe Sound.

In 1994, twin corrugated steel pipe (CSP) culverts were installed by Fisheries and Oceans Canada (DFO) at the site referred to as Culvert #3 (Figure 2). From 2001 until 2013 DFO installed an additional eight more culvert crossings to improve tidal exchange between the river and estuary. To determine the effectiveness of these culverts, from 2013 to 2017 the SRWS commissioned a study to monitor fish passage and determine how well the juvenile salmonids were utilizing these structures. The result of the study determined that salmonids were either unable to access the culverts or were severely limited in accessibility. The lack of access to the estuary for the juvenile salmonids may have resulted in the loss of a certain percentage of the juvenile Chinook salmon population as they were forced directly into Howe Sound (Lingard et al., 2018a).

Figure 4 View of Squamish Estuary 1954 with overlay of current structures (photo courtesy of Al Bird)

1.3 Alignment with Squamish Salmon Recovery Plan

Key factors addressed by CERP:

I. Restore access to estuary for juvenile salmonids, focus on providing rearing habitat for Chinook salmon. Estuary channels provide excellent rearing habitat for Chinook fry. Over 95% of the juvenile Chinook salmon captured migrating out of the Cheakamus River were first year fry (Lingard et al., 2018b). These Chinook fry require a period of residency in estuarine waters during their first spring prior to entry into saltwater. The Squamish River estuary and its tidal channels provide this critical Chinook salmon rearing habitat for the Cheakamus River Chinook salmon populations. Without adequate connections between the Squamish River and the estuary delta, fish passage is severely limited, and studies have indicated the habitat is underutilized (Lingard 2018).

II. The loss of fundamental estuarine flow processes where fresh water moves in diverse patterns and mixes with marine waters is another factor that is addressed in all three phases of the project.

III. Another limiting factor addressed is the potential to improve the growth and survival of Chinook salmon fry. A large component of the Chinook salmon fry produced from spawning grounds on the Cheakamus River leaves the river soon after emergence and rear and feed in the mainstem Squamish River and the estuary channels for some months prior to their migration into Howe Sound. By improving Chinook fry and smolt access to and use of the warm, nutrient rich waters of the Squamish River estuary their overall productivity and survival would be expected to increase (Mangusson and Hillborn 2003).

IV. Incidental benefits are also expected for other species of interest including steelhead and cutthroat trout, and pink, coho and chum salmon. As well, bull trout and coho salmon from the Cheakamus River watershed may spend varying periods of time in the Squamish River estuary during their life cycle. Herring and other marine species will also benefit from this project.

1.4 Project Urgency

Chinook salmon are recognized for their importance as a source of food and cultural significance to Squamish Nation, a source of revenue for sports and recreation fishing enthusiasts, and as a vital link to the health of the southern resident Killer Whale (SRKW) populations. In addition, Chinook salmon are of cultural and ecological importance in British Columbia and of federal conservation concern (COSEWIC 2019). Following the construction of the Training Berm in the early 1970s many stocks, including pink salmon and Chinook salmon runs, all but plummeted (SDU, 2021).

The restoration activities undertaken in the Squamish estuary are part of the larger initiative to restore Chinook salmon populations throughout the Salish Sea and are in concert with work being undertaken by Raincoast Conservation Foundation and their efforts to breach dikes and berms along the Fraser River, as well as the work being undertaken by Cowichan Tribes to improve connectivity and natural processes in the Cowichan / Koksilah estuary.

1.5 Benefit to Salmon

The Central Estuary Restoration Project was the result of a preliminary study of the Squamish River estuary and accessibility to juvenile salmonids (SRWS 2018). CERP was developed as a multi-year project to improve Chinook salmon (*Oncorhynchus tshawytscha*) populations and overall health or the species. However, the project also benefits coho salmon (*O. kisutch*), chum salmon (*O. keta*), pink salmon (*O. gorbuscha*), steelhead (*O. mykiss*), as well as other salmonids, char, herring, and marine habitat in general. By providing access to the nutrient rich brackish waters of the estuary the juvenile salmonids can feed throughout the numerous tidal channels for the period of time required for them to grow their scales from fry fingerlings to marine tolerant smolts thereby increasing their chances of survival as they enter into the marine waters of Howe Sound.

2.0 Goals and Objectives

The overall goal of this project is to restore Chinook salmon habitat within upper Howe Sound with the main focus being the interface between the Squamish River and the estuary. The objectives include improving tidal connectivity, improving water quality and base flows, and improving survival of outmigrating juvenile salmonids, with the focus on Chinook salmon, who benefit, if not require, a growth period of time in the estuary before entering into the marine environment of the Salish Sea.

Table 1. Summary of Project Phases & Monitoring Programs

Goal	Objective	Details	Date Achieved
Fisheries & Biophysical Monitoring	Establish baseline data followed by consistent monitoring design following physical works associated with Phases 1, 2, and 3	Fisheries monitoring using various techniques including PIT tags, acoustic tags, Gee trapping & seine netting at various locations in the Squamish River and Estuary. Biophysical monitoring for water quality, sediment transport, vegetation colonization at various locations in the Squamish River and estuary	2018 – 2024 2024 – 2029 ongoing monitoring

Phase 1: improve fish accessibility across Training Berm	Replace fish passage obstructing culverts across Squamish Training Berm	Culvert replacement at Location #3	May 2019
		Culvert replacement at Location #4	September 2020
		Culvert replacement at Location #1 (as part of the current years work)	September 2024
	Riparian planting	Planting of over 700 native riparian plants around Culvert #1	November 2024
		Replacement of Culvert #2	March to May 2025
	Riparian planting	Planting of over 700 native riparian plants around Culvert #1	April to June 2025
	Invasive species management	Removal of contaminated knotweed infestation	May 2025
Phase 2: modification of lower Spit to reopen lower 300 hectares of habitat	Modification of Spit	Wave modelling Spit Modification Modelling	June 2020 March 2021
		Meetings & consultation	2018 – September 2023
		Construction	February 1 – May 15, 2022: partial 300m removal; September 15, 2022 – Sept 15, 2023 for removal of remaining 550m
	Riparian planting	Planting 3,000 sedge plugs	May 2023 – June 2024
Phase 3: Little Bear Slough / Bridge Pond re-watering	Restore tidal connectivity into upper Bridge Pond and Little Bear Slough	Fisheries monitoring & Biophysical monitoring	Summer 2018 – 2026, with ongoing monitoring planned from 2026 – 2029
		Work Plan development	Initiated in September 2024 with formal concept and design established March 2026; engineering and detailed hydrology proposed from summer 2026.
		Design & Approval	Proposed design to be submitted for approvals and authorizations in June 2026
	Replacement of culvert connecting Little Bear Slough to Bridge Pond	Physical works / culvert connections	Work proposed from January to May 2027.

3.0 Study Area

The works associated with the FWCP funded portion of the project associated with CERP Phase 1 (Culvert #2 upgrade) are located within or adjacent to the Skwelwil'em Squamish Estuary Wildlife Management Area.

The physical work this year included the removal of the original twin 1.2 metre CSP's installed in 1999 by DFO with funding secured through the SRWS. In recent years the culvert was found to restrict passage of juvenile salmonids, in particular Chinook salmon, outmigrating down the Squamish River and unable to access the estuary. Culvert #2 Is located approximately 1,200 m south of the Fisherman's Entrance onto the Training Berm (area 'A' on Figure 7).

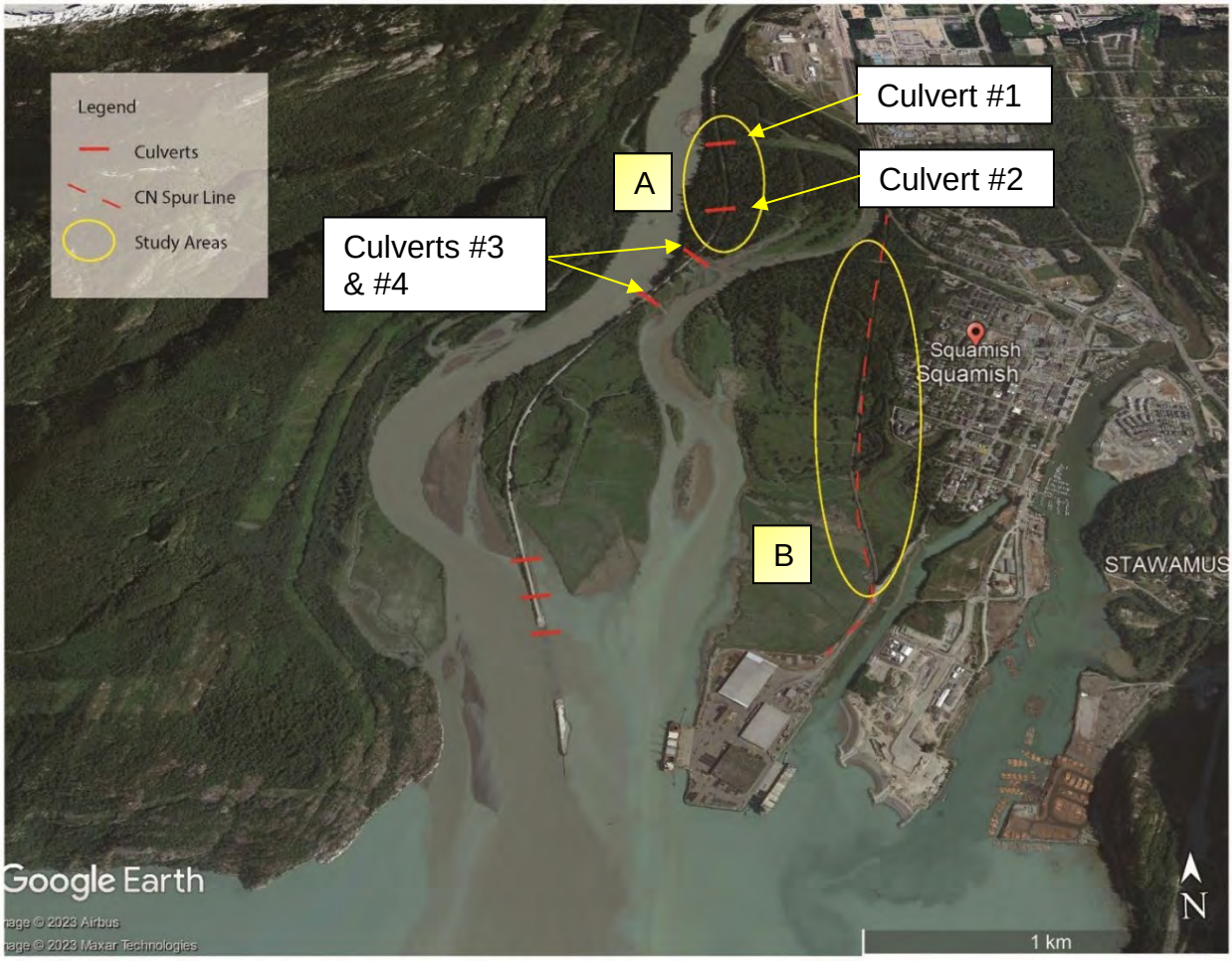

Figure 5 Project Site Map

4.0 Methods

4.1 CERP: Phase 1 – Culvert #2 Replacement

Following the completion of Culvert #1 upgrade in December 2024, discussions immediately commenced on replacement of Culvert #2 early on in January 2025. The project was kick-started with initial site meetings with the District of Squamish, project partners Squamish Nation and Fisheries and Oceans Canada, and with the project engineering team with WSP. The plans were solidified to replace Culvert #2 and remove the twin 1.2 m CSP culverts with a 3m by 3m concrete box culvert similar to the ones previously replaced. As part of the authorization process the “Culvert #2 Construction Methodology” was completed (WSP, February 27, 2025). By March 2025 all requisite permits and approvals were secured and work commenced in early April with securing the site, clearing the vegetation, and installing security fencing.

All major works were completed by July 2025 with riparian planting initiated at that time and additional planting planned for September/October 2025. A separate file contains a summary of the daily work undertaken prepared by WSP “Construction Field Summary Reports”.

The engineering team at WSP completed the detailed design drawings, hydrodynamic modelling, and included the previously completed flood-modelling memo that had been submitted for Culvert #1 and included Culvert #2 upgrades. Permits were required by the Province of BC as part of the Dike Management Act, Lands Authorization (for undertaking work on Crown Lands), Water Sustainability Act, Wildlife Act, as well as entering a memorandum of understanding with the District of Squamish, who manage the surface of the Training Berm as part of a lease with the provincial government. The SRWS prepared a Chance Find Procedural Manual for Squamish Nation to ensure all participants, contractors, and workers involved in the project have clear directions should any archaeological or cultural discoveries be made.

The site was closed off to the public with a safety gate installed at the entranceway. As well, fencing was put up around the construction site to ensure the site was secure from public access. Signage and notifications had been installed and shared on social media and in the local newspaper. Starting in early March the site was cleared of vegetation and trees in order to prepare the site. Once the trees had been removed the area around the culvert on the river and estuary side were isolated with the construction of cofferdams, with the riverside cofferdam constructed first followed by the estuary side cofferdam. This work had to be undertaken during low-tide periods to allow the work to be undertaken “in the dry”. Once the cofferdams were completed by mid-March, the original corrugated steel pipe culverts were removed and the base bedding and base were constructed as the foundation on which the

culverts would be placed. All material that was removed was stockpiled at a suitable location along the Training Berm to be replaced once the site was to be backfilled over the disturbed site around the newly installed culvert once construction was completed. Unbeknownst at the time, this stockpiled material turned out to be contaminated with Japanese knotweed (*Fallopia japonica*). See section Addendum B for details on the occurrence of this invasive plant and the efforts made to contain the contaminated materials.

The concrete box culvert, ordered from Langley Concrete, came in 13 segments, with each segment transported separately on a flatbed truck from Chilliwack up to Squamish. The delivery of the trucks took place over two days from May 12 to 13, 2025. Plans for delivery had been intended for mid-March but due to equipment breakdown at Langley Concrete the process was delayed for two months. The crane, provided by Gwil Crane, arrived and was set up on a pad that could reach the entire worksite a few days before the culvert delivery. The area had been excavated to the appropriate invert elevation with the base-rock and approved bedding placed with drainage channels alongside. Once the cofferdams had been completed pumps were installed on the estuary side to ensure the site was drained at all times from ground seepage. Unexpected base flows were encountered with the excavation and removal of the former culverts uncovering an underground stream. As a result, the main pump was required to operate 24/7 and a backup pump was kept on site in case of emergencies. The pumps were monitored on a regular basis.

4.2 Construction and Environmental Monitoring

A construction and environmental monitoring plan were drawn up for the project to include proper oversight throughout the duration of the project. Main components included salvaging fish from the site once the cofferdams were constructed. Fisheries and Oceans Canada staff oversaw the fish salvaging over the period of several days and had to navigate seasonal storm events. A total of 300 juvenile coho salmon were removed along with 75 sculpins, over 400 sticklebacks, and an assortment of other species including 2 adult Western toads. The WSP engineering team supervised the construction, materials, and compaction of the works to ensure all measures required by the Dike Management Act authorization were achieved. Environmental monitoring by a QEP was provided by DFO, the SRWS, and WSP over the duration of the project with daily site visits. Morning site meetings with the contractor, Whistler Excavations, occurred on a regular basis and, when necessary, were follow-up with end-of day site meetings. Due to the complexity of the project and issues around storm events and inclement weather, a large industrial pump was set up with a backup pump on-site in the event of failure. These were all components of QEP oversight to ensure the project was able to proceed without unexpected issues.

4.3 Fisheries and Biophysical Monitoring

For the past decade the Squamish River Watershed Society has engaged InStream Fisheries to assist with monitoring the movement of juvenile Chinook salmon to complement data on adult escapement data. As part of the current project, fisheries and biophysical monitoring were once again undertaken under the guidance and leadership of Stephanie Lingard who is also completing a PhD with the UBC Pacific Salmon Ecology and Conservation Laboratory on this work and project. The fisheries technical team was provided by InStream Fisheries Research and a copy of the “Central Estuary Fisheries Monitoring Program Summary” prepared by InStream Fisheries has been appended to this report (IFR 2024).

4.4 Engagement with the Public, Stakeholders, and Community

Ongoing meetings and discussion throughout the year have been undertaken to update the project team, including Squamish Nation, Fisheries and Oceans Canada, the Province of BC, District of Squamish, Squamish Terminals, and Transport Canada on the work completed to date and the plans for future activities. A workshop was held on November 20th, 2024, engaging those involved in the Squamish River watershed who have an interest with salmon, restoration activities, monitoring, or citizen science. Over 37 people attended the workshop and shared their knowledge and participated in discussions around future restoration priorities. A follow-up meeting was held March 5, 2026 in which 38 participants attended discussing the next five to ten years restoration activities within the watershed.

4.5 Educational Outreach Programming

An important component of this project is public outreach and engaging with the community. Events such as Earth Day and Rivers Day helped to highlight the work being undertaken by the SRWS in the estuary. The public also was invited to assist with the riparian planting of the site once the work had been completed.

A separate report “Education and Outreach Programs Report” can be found in the file under educational programming.

4.6 Japanese Knotweed Contaminated Soil

Refer to memo in Addendum B at the end of the report.

5.0 Results and Outcomes Culvert #2

Work this year focused on the replacement of Culvert #2 with a fish-passage friendly concrete box culvert. This upgrade will provide a more stable tidal connection between the central estuary and Squamish River across the Training Berm and completed the final culvert upgrade as part of CERP Phase 1. The Squamish River thalweg is constantly in motion and the current configuration has resulted in a stable gravel bar and side channel of the river hugging the left bank alongside the Training Berm. The culvert itself has a length of 35 metre and spans an area of 107 square metres connecting the river and estuary through a channel of over 5,000 square metres providing access to over 300 hectares of estuarine habitat. Over 500 native riparian trees and shrubs were planted on the disturbed areas associated with the construction. Results also included the ongoing fisheries and biophysical monitoring summarized in a report prepared by Senior Fisheries Biologist and Masters graduate Stephanie Lingard “CERP Effectiveness Monitoring Project Summary 2020 – 2025” (Lingard, March 12, 2026) that is being finalized. The fisheries monitoring report from the previous year by InStream (InStream, 2024) confirmed juvenile Chinook salmon were utilizing the culvert upgrades at Locations #3 and #4. The monitoring program will be continued in 2026 to study how the fish are making use of the current upgrade at Culvert #2. Furthermore, flood modelling of potential risk to modifying Culverts #1 and #2 was completed by WSP indicating negligible changes or increases to flooding with the upgrades of the larger concrete box culverts at Culvert Locations #1 and #2.

5.1 Permits, Approvals, and associated Documents with Culvert #2

Summary of reports and studies completed in association with the project:

- Initial Flood Modelling Results of Culvert Opening (#1 and #2) Memo. Completed by WSP November 23, 2023.
- Preliminary Design Scope and Project Design for Culverts #1 & #2 Replacement Memo. Completed by WSP March 13, 2024.
- Geotechnical Memorandum – Squamish River Dike Culvert #2 Design. Prepared by WSP, December 18, 2024.
- Squamish River Spit Road Culvert #2 Replacement. Completed by WSP January 7, 2025
- CERP Culvert #2 Construction and Environmental Monitoring Plan. Prepared by SRWS February 15, 2025.
- Squamish Nation Archaeological Chance Find Procedure for Culvert #1 Replacement. Prepared by SRWS October 10, 2024.
- Memo – Tree Removal Plan for Culvert #2. Prepared by SRWS, March 4, 2025.
- Japanese Knotweed Remediation Summary. Prepared by WSP, September 8, 2025.
- CERP Effectiveness Monitoring Project Summary 2020 to 2026 – Draft. Prepared by S. Lingard. March 12, 2026.

Summary of Permits and Approvals

Permit/Authorization	Agency	Date Obtained	File #
Notification of Authorized Changes	Ministry of Water, Land, and Resource Stewardship	March 3, 2025	100461854
Wildlife Act Section 4(4)	Ministry of Water, Lands, and Resource Stewardship	December 19, 2024	39580-24
Memorandum of Understanding	District of Squamish	March 13, 2025	N/A
Dike Management Act	Ministry of Water, Land and Resource Stewardship	March 12, 2025	100461935
Authorization to work on Crown Land	Ministry of Water, Land, and Resource Stewardship	December 10, 2024	N/A
Fish Collection Licence	Fisheries and Oceans Canada	November 28, 2024	XR 156 2025

5.2 Riparian plants for Culvert #2

Common Name	Latin Name	# of plants
Nootka Rose	*Rosa nutkana*	70
Purple spirea (hardhack)	*Spirea douglasii*	89
Red flowering currant	*Ribes sanguineum*	25
Salmonberry	*Rubus spectabilis*	125
Sitka willow	*Salix sitchensis*	75
Snowberry	*Symphoricarpus albus*	25
Thimbleberry	*Rubus parviflorus*	100
Sword fern	*Polystichum munitum*	150
Vine Maple	*Acer circinatum*	15
TOTAL		674

6.0 Discussion

The works undertaken this year along with the various planning processes were very ambitious and included the completion of CERP Phase 1 culvert upgrades, developing CERP Phase 3 rewatering of LBS, and ongoing discussions with DFO, District of Squamish, Squamish Nation, the province, Nature Trust of BC, and the local community. The focus has been to not just improve accessibility throughout the estuary for juvenile Chinook and other

salmonids but to improve water quality and overall estuarine function. To that end, the upgrade of Culvert #2 was a huge triumph to that effect.

This project is of importance to improve the overall health of Chinook salmon stocks and restore the estuary to previous pre-development conditions. Support has also been recognized from the local sports fish advisory board, recreational fishing groups, Ministry of Forests, Lands, and Natural Resource Operations, and other community stewards. The results of the restoration efforts to restore Chinook salmon access to the estuary are an important program for the Salish Sea. Closer to home it allows Squamish Nation's ability to harvest local salmonids, as well as provide educational programming. The project has encouraged engagement with local universities, technical institutes, and local schools in hands-on experiential learning opportunities including tree planting, mapping, monitoring, and the development of long-term post-graduate research studies. In addition to involving community and student engagement, the SRWS has been able to sponsor a University of British Columbia Master's student to study Chinook salmon behaviour associated with the restoration efforts. Students from School District #48 regularly participate in special events, programs, and activities directly associated to this project including studying wildlife and fish movement, planting native riparian vegetation, undertaking tree and bird surveys, and learning about the natural habitat and environment.

7.0 Recommendations

This fiscal year proved to be a busy and productive one with the completion of CERP Phase 1 with the final installation of the fourth and final culvert. This project has been extremely instrumental in the ongoing efforts to restore accessibility from the Squamish River to the estuary for outmigrating juvenile salmonids. The ongoing discussions with the community, partners, land users, and respective groups remain an important component to the overall success of the future of this project. The coming year will focus on CERP Phase 3, upgrading the culvert along the Little Bear Slough to improve water quality, tidal connectivity, and fish passage throughout this system. This will be achieved by continued discussions with the project partners, Squamish Nation and DFO, and the District of Squamish, Nature Trust of BC, Province of BC and other local groups and organizations. The year also included an important community workshop held on March 5, 2026, with the various representatives within the watershed exploring the next decade of salmon restoration in the Squamish River watershed. The ongoing educational outreach programming will continue into the new year along with the fisheries monitoring work. Plans are in place to complete CERP Phase 3 in the upcoming fiscal and continue with ongoing biophysical, fisheries, and sediment transport monitoring for the coming 2026/2027 fiscal year and continued engagement with the project partners, community, and environmental leaders!

8.0 Acknowledgement

We would like to thank our project partners Fisheries and Oceans Canada and Squamish Nation and Fish and Wildlife Compensation Program for financial and other support of this project.

Project Team:

- Edith Tobe, Project Manager, Squamish River Watershed Society
- Silvi Cafarella, Education Outreach Coordinator and Field Support, SRWS
- Becca Gray, Restoration Technician, SRWS
- Jasmine Muncaster, Squamish Nation
- Patricia Heintzman, SRWS Communications & Project Support
- Francesca Knight, Project Support
- Murray Manson and Rebecca Seifert, Fisheries Protection Biologist, Fisheries and Oceans Canada and all those from DFO who helped out
- WSP Team: Kevin Henshaw and Vahid Norouzi
- Stephanie Lingard, Senior Fisheries Biologist, SRWS
- Paige Freeman and the InStream Fisheries Research team
- Laura Holt and Carl MacNaughton, Nature Trust of BC

We would also like to thank:

- Councillor Joyce Williams, Squamish Nation and Rachel Munger and Donnah MacKinnon, Squamish Nation staff
- Alison Martin, Ministry of Forests, Lands, and Natural Resource Operations
- Whistler Excavations Ltd
- DOS David Roulston and Sarah McJannet
- Nature Trust of BC

9.0 Project Signage and Photos

Construction signage erected on-site:

Electronic signage on road

Gate closed at entranceway to Berm

September 19, 2025 with support from Youth Climate Action Team and Capilano University

10.0 References

Bouchard, Randy & Dorothy Kennedy. January 2007. Aboriginal History of the Squamish Estuary. Prepared on behalf of Squamish Nation. 2007.

COSEWIC. **(**2019) COSEWIC assessment and status report on the Chinook Salmon *Oncorhynchus tshawytscha*, Designable Units in Southern British Columbia (Part One – Designable Units with no or low levels of artificial releases in the last 12 years), in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxxi + 283 pp. (Species at Risk Public Registry).

Department of Environment. “Effects of Existing and Proposed Industrial Development on the Aquatic Ecosystem of the Squamish Estuary”. Prepared for the Federal-Provincial Task Force on the Squamish Estuary Harbour Development. October 1972.

Fish and Wildlife Compensation Program. “Cheakamus River Watershed Action Plan”. November 14, 2017

Hoos, Lindsay M, Cecily Vold. “The Squamish River Estuary Status of Environmental Knowledge to 1974”. Prepared for the Estuary Working Group, Department of the Environment, Regional Board Pacific Region. January 31, 1975.

InStream Fisheries Resource Inc. “Squamish River Central Estuary Restoration Effectiveness Monitoring”. December 2020.

Lingard, S. (2018) “Squamish Estuary Juvenile Chinook Salmon Habitat Usage Survey” Prepared by InStream Fisheries for Squamish River Watershed Society. August 20, 2018.

Lingard, S., Putt, A., Burnett, N., & Melville, C. (2018a) Cheakamus River juvenile salmonid outmigration enumeration final data report: 2001-2018. May 3, 2018.

Lingard, S., Martin, C., Putt, A., & Swainson, D. (2018b) Squamish River Estuary Culvert Monitoring. Report prepared for the Squamish River Watershed Society. October 18, 2018

Lingard, S. Central Estuary Fisheries Monitoring Program Summary 2020 – 2021 Funding Year. March 3, 2022.

Magnusson, A., & Hilborn, R. (2003). Estuarine influence on survival rates of coho (Oncorhynchus kisutch) and Chinook salmon (Oncorhynchus tshawytscha) released from hatcheries on the US Pacific coast. Estuaries, 26(4), 1094-1103.

Ministry of Environment, Environmental Stewardship Division. “Skwelwil’em Squamish Estuary Wildlife Management Area Management Plan”. August 2007.

Salmon Data Unit., Fisheries and Assessment Data Section., Baxter B (2021). NuSEDS - New Salmon Escapement Database System. Version 1.7. Fisheries and Oceans Canada. Sampling event dataset https://doi.org/10.15468/atjqs6 accessed via GBIF.org on 2022-03-17.

Squamish Estuary Management Plan. 1999.

Squamish River Watershed Society. “Squamish River Estuary Training Dike Fish Passage Feasibility Study Report – March 2018”. Prepared by E. B. Tobe Enterprises and the Squamish River Watershed Society. March 31, 2018.

ADDENDUM A: Tree Removal Memorandum

From: Edith B. Tobe, RPBio, Executive Director/Project Manager

Date: March 4, 2025

Regarding: Tree Removal Plan Culvert #2

Google Earth map of Culvert #2 crossing

The purpose of this memo is to identify the total number of trees that will be impacted as part of the replacement of the twin corrugated steel pipes (CSP) with a single concrete box culvert at Culvert #2 along the Squamish Training Berm. The site is located around coordinates 49.709824lat x -123.168438long. The construction is intended to take place starting the week of March 17th with plans for tree removal and site preparation the week of March 10th and will include the construction of cofferdams on the east and west side of the culvert to isolate the site. The cofferdam located on the east side of the Training Berm will also provide an access route for equipment once the road has been excavated. Every effort has been made to minimize the disturbance to the trees. No coniferous trees will be removed as they are all located outside of the work area. The majority of the trees to be removed consist of red alder and black cottonwood although there is one mature bigleaf maple located on the east side that unfortunately will have to be removed.

Site Survey:
Several site meetings were held the week of February 17th and 24th between the contractor, Whistler Excavations, the engineer, Kevin Henshaw with WSP, and Fisheries and Oceans Canada biologist, Rebecca Seifert.

On March 4th Whistler Excavation surveyed the site and placed orange flagging tape to establish the permitter of the trees to be removed. The flagged trees are to remain untouched, and the area has been defined to allow for the construction of cofferdams on each side of the culvert to isolate the site from the river to the west and the tidal flow through the slough to the east.

Table 1. Summary of Trees to be removed

Species	Latin name	Plot #1 (east side)	Plot #2 (west side)
Act	*Populus trichocarpa > 8" dbh*	3	12
Act	*Populus trichocarpa < 8" dbh*	2	3
Dr	*Alnus rubra > 8" dbh*	2	25
Dr	*Alnus rubra < 8" dbh*	69	4
Blm	*Acer macrophyllum*	11	
	TOTAL TREES		131

Tree Removal:
Tree removal is planned to take place the week of March 10, 2025 by Windfirm. The larger cottonwood trees will be cut into large pieces to be reincorporated into either the restoration site or the park at the south end of the Training Berm. The larger mature alder will be stockpiled at the side of the construction site and may be available to Squamish Nation for use, if desired. The smaller alder and cottonwood will be chipped and can either be dispersed on-site or removed to the land-fill site or to a suitable location. The large leaf maple will also be cut down and stock-piled at the side of the work site and either made use of by Squamish Nation, if so desired, or reincorporated into the post-construction restoration site.

Planting Plan:
Revegetation of the site will either take place following construction in late May early June or in the fall from October to November. Some adjustments to the planting scheme may incorporate a two-year planting scheme depending on the predicted summer temperatures. All plants will be either one gallon or two gallons unless otherwise noted.

Photos of Site:

Drone overflight of culvert August 2017 (river is on right, estuary on left, and top is facing south)

East side facing towards Training Berm and twin culvert

West side facing towards river from top of Training Berm (note culverts are buried behind debris)

ADDENDUM B: Japanese Knotweed Soil Remediation

Memo: June 19, 2025 (Updated July 10, 2025)

From: Edith B. Tobe, RPBio, Executive Director/Project Manager

Regarding: Japanese Knotweed infestation throughout organic material at Culvert #2

Figure 1. Google Earth map of Culvert #2 crossing

From March 15 through to May 30th, the Squamish River Watershed Society, in partnership with Fisheries and Oceans Canada and Squamish Nation, undertook the restoration of Culvert #2 replacing the former twin 1.2m CSP culvert with a 3m x 3m concrete box culvert. At part of the preparation of the site, the organic material alongside the Squamish Training Berm was stripped and stockpiled to be redistributed once the culvert installation was complete.

The organic material was spread along the four sectors of the culvert (see illustration below) along with access ramps constructed with excavated roadbed from the berm. Two weeks ago, our crew noticed emerging shoots of Japanese knotweed emerging from the organic material. No material was introduced from outside the Culvert #2 work area and the assumption is that unbeknownst to us bags of knotweed were likely dumped along the

slopes, likely years ago, that our machine operator unwittingly scooped up and became intermixed throughout the pile of organic material.

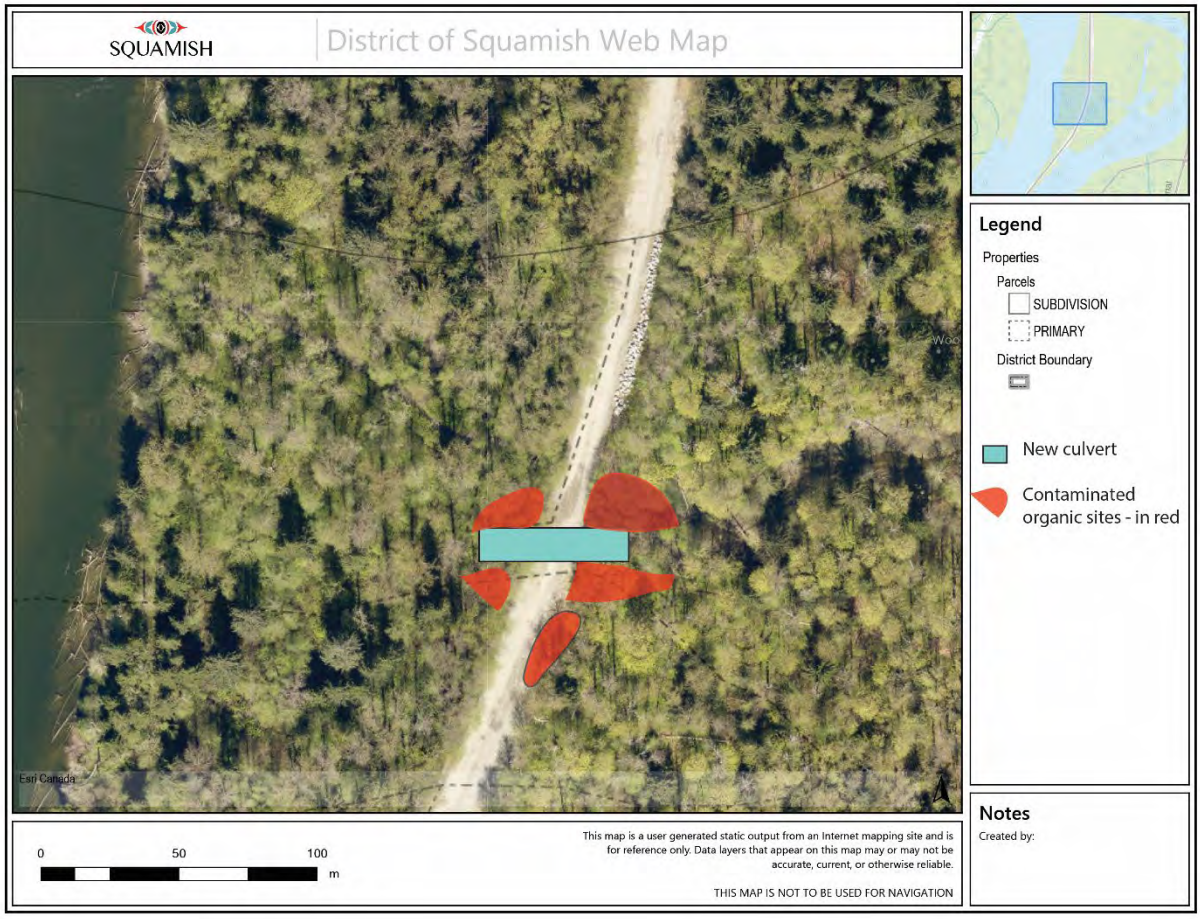

Figure 2. Location map of contaminated organic material alongside newly constructed culvert

Our intention at this time is to remove all the JK impacted material from the site and dispose of the material at a suitable location as per provincial and municipal guidelines for the removal of knotweed.

Facing east towards central estuary – note organic placement on each side of culvert

Facing west towards Squamish River

UPDATE: July 10, 2025

Location of “pit” (10U 487770.12m E x 5506181.45m N):

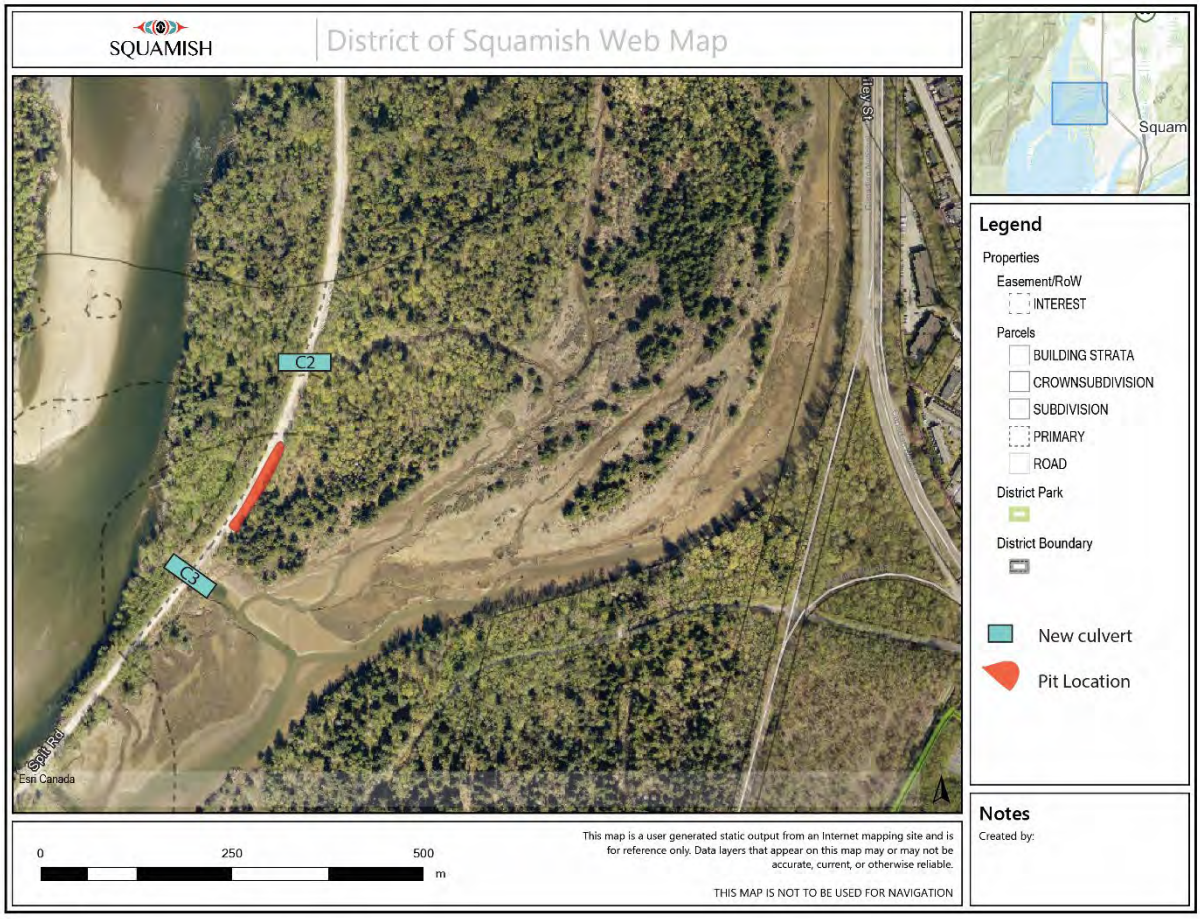

Figure 3. Containment Pit location. Approximate size of storage pit is 50m x 10m (at top and 8m at base); depth is 4m. Estimate of soil with JK is approximately 600 cubic metres.

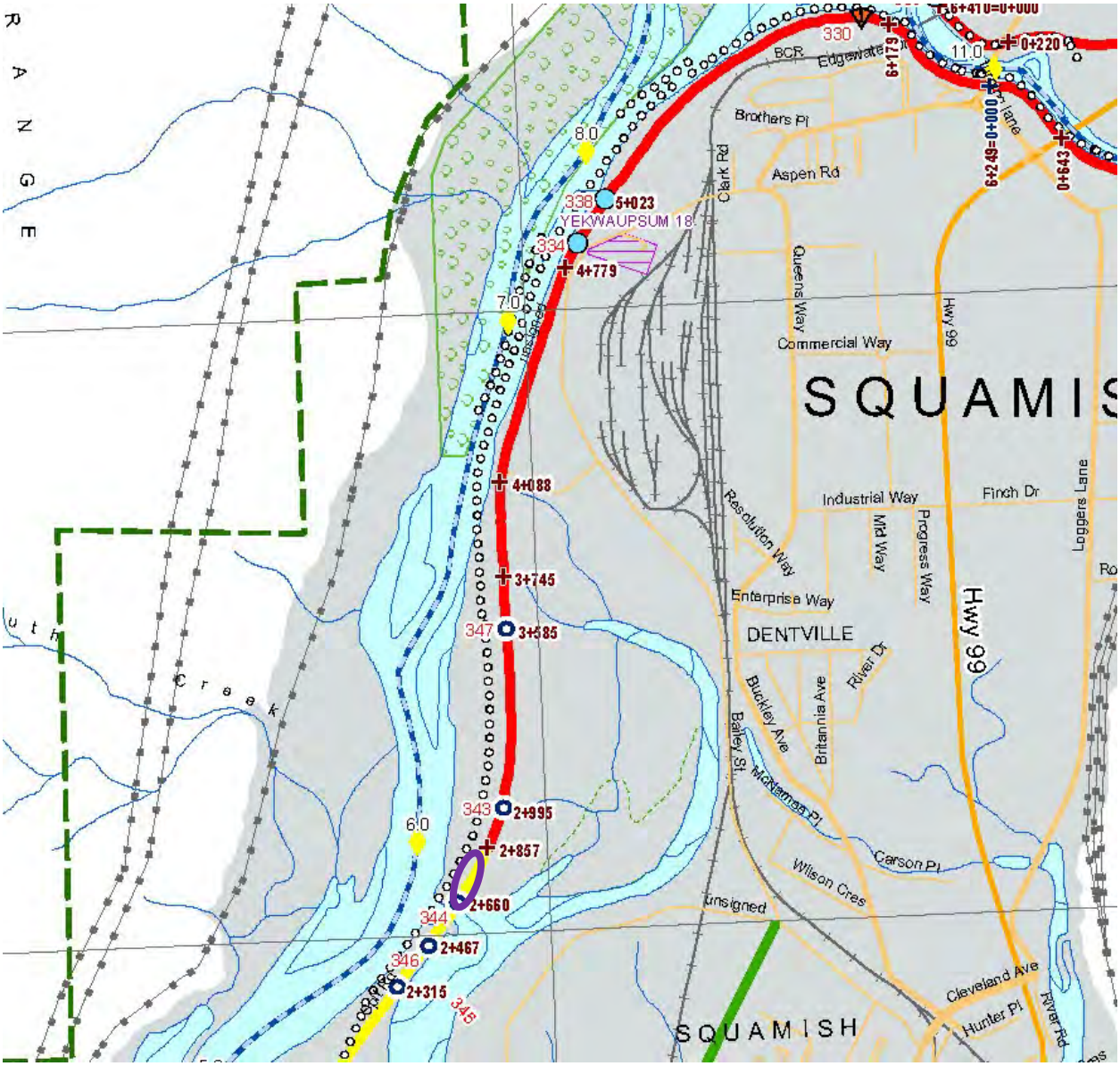

Figure 4. DOS Flood Dike Map (zoomed in on area south of culvert #2 where storage pit is located. Storage pit in PURPLE.

Photos of stockpiled JK tainted soil:

Stockpile of material from shoulder of road

Stockpiles on north and east side of Culvert #2 on estuary side (east side of road)

Photo of stockpiled material on south quadrant of west side of Culvert #2

Memo: July 28, 2025

From: Edith B. Tobe, RPBio, Executive Director/Project Manager

Regarding: Containment through Burying of JK soil on Training Berm / Spit Road

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As noted in previous memos, in early June the presence of emergent invasive Japanese knotweed (*Fallopia japonic*) was observed throughout the Culvert #2 upgrade location where organic material taken from the site had been spread.

Following provincial best management practices, it was determined the best course of action was to bury the JK infected material to a depth of 2m at a suitable location along the Training Berm / Spit Road. Following site meetings with the representatives from the Province of BC, District of Squamish, Squamish Nation, Sea to Sky Invasive Species Council, and Fisheries and Oceans Canada, a location was identified just to the south of location #2+857 on the District of Squamish Flood Map (Figure 1) within the “Fish and Wildlife Water Related Structure” section. No excavation was undertaken along the area identified as “Standard Dike”. Furthermore, the western portion of the Berm remained undisturbed.

The volume of contaminated soil was estimated to be approximately 500 cubic metres. Every effort was made to confine as much of the pit to the eastern edge of the Training Berm along the shoulder. However, the slope of the western edge of the JK material extended into the eastern portion of the Berm (see photos below). As the JK infected material was backfilled into place, any noticeable pieces of woody debris were placed along the easternmost section under the shoulder of the Berm. Once all the material had been backfilled it was covered over with an impermeable membrane liner[1] and the entire site was backfilled to the original road grade. During the entire operation, a Professional Engineer from WSP was on hand to supervise the backfilling and compaction, which was undertaken consistent to the backfilling of Culvert #2, with the compactor running over the site every metre of depth.

Samples of the JK material along with samples from the original road base were collected and sent to Metro for testing. The geotechnical engineering team at WSP is reviewing the results of the testing which we will share shortly. The initial analysis shows minimal to no difference in the organic composition of the JK material to that of the road composition.

The SRWS will continue to monitor the disturbed areas around Culvert #2, the eastern shoulder south of the culvert where the original JK impacted material had been stockpiled, along with the filled in pit location for the next three years or as needed. A cordon of trees and rocks have been placed to the southeast of Culvert #2 extending from the no-post barriers to prevent the public from driving along the shoulder where there remains potentially impacted material. We do not recommend the District of Squamish do any road maintenance in this area for the foreseeable future until we can confirm a complete absence of Japanese

[1] Layfield Geosynthetics EnviroLiner 1000 Geomembrane

knotweed. We plan to meet with DOS operations staff and develop a longer-term monitoring plan for the future maintenance of this site.

We appreciate the collaborative effort of all parties in resolving this unfortunate and unforeseen Japanese knotweed impacted soil and are grateful we were able to address it in a timely manner.

Photos of excavation site (facing north):

Photo 1. Approximate width of road depicted with yellow representing west lane of Berm/Spit Road and green representing east side. Orange line depicts approximate width of east shoulder. Pit dimensions approximately 13m in width at the surface and 8m at the base, 50m in length and the depth was 4m.

Photo 2. Placement of JK impacted fill complete. Note the western slope extends into the "road". The dimensions of the stockpiled contaminated soil were approximately 35m in length, 6-7m in width (wider at the base), and 2m in depth.

Photo 3. Placement of impervious liner covering entire JK soil complete.

Photo 4. Backfilling underway, note ribbons of “invasive species” flagging tape placed along top of liner and every metre until top of berm as warning for any future disturbance.

Photo 5. Road restored to original grade and compacted. Cordon of logs/rocks to prevent public from driving or parking along the shoulder and potential disturbance or distribution of knotweed.