

# Bings Creek Watershed Habitat Assessment and Restoration Plan.

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Prepared for



5-55 Station Road  
Duncan B.C. V9L 1M2

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Table Of Contents	
Introduction .....	4
Methods .....	4
Personnel .....	4
Stream Survey Method .....	4
Fig. 1 USHP Survey Habitat And Riparian Data Card .....	6
Survey Area .....	7
Table 1 – Survey Reach Description .....	7
Figure 2: Somenos Watershed Map .....	8
Figure 3. Survey Reach Map .....	9
Results and Discussion –Habitat Survey .....	10
Reach 1 .....	10
Fig . 4 Bings R1 .....	11
Reach 1 Habitat Photos .....	12
Table 1 - Reach 1 Habitat and Water Quality Summary Results .....	13
Table 2 - Reach 1 Riparian Results .....	13
Reach 2 .....	15
Table 3 - Reach 2 Habitat and Water Quality Summary Results .....	15
Reach 2 Habitat Photos .....	17
Table 4 - Reach 2 Riparian Results .....	18
Reach 3 .....	20
Table 5 - Reach 3 Habitat and Water Quality Summary Results .....	20
Reach 3 Habitat Photos .....	22
Table 6 - Reach 3 Riparian Results .....	23
Reach 4 .....	24
Table 7 - Reach 4 Habitat Summary Results .....	24
Reach 4 Habitat Photos .....	25
Table 8 - Reach 4 Riparian Results .....	26
Reach 5 .....	27
Table 9 - Reach 5 Habitat and Water Quality Summary Results .....	27
Reach 5 Habitat Photos .....	29
Table 10 - Reach 5 Riparian Results .....	30
Reach 6 .....	31
Table 11 - Reach 6 Habitat and Water Quality Summary Results .....	31
Table 12 - Reach 6 Riparian Results .....	32
Reach 6 Habitat Photos .....	35
Reach 7 .....	36
Table 13 - Reach 7a & 7B Habitat and Water Quality Summary Results .....	36
Table 14- Reach 7a/b Riparian Results .....	36
R8 – Headwaters .....	37
Menzies M1 .....	38
Table 15 - Reach 6 Habitat and Water Quality Summary Results .....	38
Table 16 - Reach M1 Riparian Results .....	38
M2 – Headwaters .....	39
Reach 7 Habitat Photos .....	41
Bings R8 Headwaters Habitat Photos .....	42
Discussion .....	43
Survey Efficiency and Limitations .....	43
Bings Creek Habitat Comparison .....	43
Reach Comparison .....	43
Table 17 – Bings Creek Reach Habitat and Riparian Summary .....	43
Vancouver Island Habitat Comparison .....	44

Table 18 - Fish Habitat Deficiency (x) Comparison of Bings Creek and 14 Vancouver Island Streams .....	44
Bings Watershed- Restoration Sites.....	45
Table 19 -Garbage Impacted Sites - Bings Creek.....	46
Table 20 - Restoration Sites - Bings Creek v2 .....	47
Bings Watershed Garbage Site Photos .....	53
R1 Restoration Photos .....	54
R2 Restoration photos.....	55
R3 Restoration photos.....	56
R4 Restoration Photos .....	57
R5 Restoration Photos .....	58
R6 Restoration Photos .....	59
R7 Restoration Photos .....	60
Restoration Prescriptions .....	61
High Priority Restoration Activities* .....	61
Table 21) High Priority Restoration Sites .....	61
Conclusion .....	62
Appendix 1 – Reach 1 Habitat Data .....	64
Appendix 2 – Reach 2 Habitat Data .....	64
Appendix 3 – Reach 3 Habitat Data .....	65
Appendix 4 – Reach 4 Habitat Data .....	65
Appendix 5 – Reach 4 Habitat Data .....	66
Appendix 6 – Reach 4 Habitat Data .....	66
Appendix 7 – Reach 7a/b Habitat Data.....	67
Appendix 8 – Menzies Reach 1 Habitat Data .....	67
Appendix 9 – Reach 1-6 Habitat Summary.....	68
Appendix 10 – Reach 7a/b & Menzies R1 Habitat Summary .....	69
Appendix 11 - Narrative Summary of level 1 and 2 assessment.....	70
Appendix 12 – Spawning Gravel Placement Methods .....	76
Appendix 13 – Bank Erosion/LWD Placement example (French Creek).....	80

## Introduction

The Somenos Marsh Wildlife Society (SMWS) are interested in the health and recovery of the Bings Creek Watershed. An Urban Salmon Habitat Assessment was conducted to measure the condition in representative reach areas through out the watershed. This report identifies the habitat condition of the Bings Creek Watershed as well as restoration opportunities.

## Methods

### Personnel

Involved local SMWS volunteer stewards, land owners, staff and professionals. These people included;

- SMWS: Program Manager Elodie Roger, coordination of survey, personnel, and assist in data collection.
- SMWS: Fisheries Technicians, Chelsea April, Spencer Lapp, Emma Ross, Makenna Stobbe. Data collection on iPad, habitat and water quality measures, landowner contact
- SMWS: Society President; Paul Fletcher. Contract
- Land owners along the survey reaches were contacted by Elodie Roger of the SMWS prior to the survey. We contacted several more on the day of survey. All were welcoming of the effort. Names withheld for privacy.
- Biologist; Dave Clough, RPBio. Lead on scientific collection.

### Stream Survey Method

The Urban Salmon Habitat Program (USHP) survey<sup>1</sup> was utilized. This method of survey was initiated in 1997 by the Ministry of Environment in concert with Vancouver Island stewardship groups. The Urban Salmon survey methodology has now been used by the majority of stewardship groups on Vancouver Island and the lower mainland. The survey data collection objective was to undertake a minimum of 10 habitat units or 100m of representative segments of each reach of the watershed within the 3 days of survey August 19, 20 & 21, 2020.

The USHP survey method involves habitat and riparian assessments as well as water quality assessment. The habitat and riparian data collection items and their definitions are shown in the USHP Field Survey Card (Figure 1). Fish habitat was measured using staffs, tapes, chains and clinometers. The sites were identified with flagging tape, a georeferenced place mark and a site photograph. The field data was recorded on an iPad © or iPhone © using a customized file (pdf schema) written by D.R. Clough Consulting. We used the application Avenza PDF © and a GIS enabled PDF map. The data was then exported off the devices as \*.csv and \*.kml files for use in the USHP program and Google Earth ©.

Water quality was measured in the field at representative reach segments each day of survey from August 19-21, 2020. The Temperature, Oxygen, pH, Conductivity and Total Dissolved Solids were measured using field equipment (Oxygard Meter, Lamotte Wide Range pH kit, Lamotte TDS and Conductivity meter). Flow was estimated by stage height (0-100% bankfull). This data was recorded on the iPad. The results were compared with Module 3 Water Quality Survey in “The Streamkeepers Handbook”<sup>2</sup>.

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<sup>1</sup> Michalski, T.A., G.E. Reid, G.E. Stewart, 1997. Urban Salmon Habitat Program ,Assessment And Mapping Procedures for Vancouver Island. Ministry of Environment, Lands and Parks, Fisheries Section. Nanaimo B.C.

<sup>2</sup> The Streamkeepers Handbook- A practical guide to stream and wetland care. 1995, SEP, DFO Vancouver B.C.

The data points are collected for individual stream habitat units (pool or riffle). The data collection and assessment follows the B.C. Environment and DFO fish habitat assessment standards (Johnston & Slaney 1996<sup>i</sup>). The field data was transcribed into the USHP excel program which uses macros to collate and rate the data to published habitat standards<sup>3</sup>. The reach habitat parameters were summarized, rated and scored using the macro enabled excel program created by the USHP. Scoring is based on the Fish Habitat Assessment Procedures (Johnston & Slaney 1996). This method converts the results into numbers thus offering a scoring system that can compare reaches or other streams.



Fish Habitat Parameter	Score
Good	1
Fair	3
Poor	5

A Good result is scored as a 1, a Fair result scored as a 3 and a Poor result scored as a 5. The lower the score, the better the habitat as per the standards identified in methods. For the Ratings Result scoring, Ratings were calculated to a decimal point then rounded to whole numbers for this report.

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<sup>3</sup> Johnston ,N.T. & P.A. Slaney,1996. Fish Habitat Assessment Procedures. WRP Tech Circ.#8, MOELP & MOF  
Bings Watershed Habitat Assessment 2020

Fig. 1 USHP Survey Habitat And Riparian Data Card

Stream Name	<i>Fish C.</i>	<p><b>Habitat and Riparian Card Instructions</b></p> <ol style="list-style-type: none"> <li>1. Measure <u>all</u> habitat parameters at the <u>beginning</u> of the reach and <u>every 200 meters</u>. Measure all parameters twice if the reach is less than 200 meters long;</li> <li>2. Measure riparian parameters (black boxes) <u>every 100 meters</u>;</li> <li>3. Measure the start, finish &amp; wetted width for <u>pools only</u>; take data for all other shaded boxes along <u>entire stream length</u>.</li> </ol> <p><b>Abbreviations and Definitions</b></p> <p>A/E/O: Altered sites, Erosion sites, Obstructions  Bankfull Width: the horizontal distance from rooted terrestrial vegetation to rooted terrestrial vegetation.  Crown Cover: streamside vegetation at least 1 meter above water surface that provides shade over the habitat unit.  Gradient: slope of the stream, measured with a clinometer  Habitat Type: P=pool or R=riffle  Instream Cover: B=boulder C=undercut banks  LWD=large woody debris O=other  V=instream vegetation (includes algae)  Land Use: C=commercial I=industrial  EX=exposed L=lawns  FC=farms/cattle N=natural  FG=farms/grass R=roads or residential  GC=golf course  Livestock: note the length, in meters, of the site where any type of livestock have access to the stream.  LWD: deadwood &gt;10cm in diameter and &gt;2m. long and stable in the <u>wetted</u> channel  Obstructions: BD=beaver dam  CV=culvert X=log jam  D=dam EBB=other  F=falls  Off-Channel: includes ponds and lateral channels; note the bank side,<sup>1</sup> channel length and width  Riparian Slope: the slope of the bank above the high water mark to the far end of the riparian vegetation or break in slope; include distance if on floodplain  Stability: H=high; M=medium; L=low  Vegetation: Br=broadleaf forest Mix=mixed  Con=coniferous forest Sh=shrub  Gr=grasses  Wetted Width: the width of the water surface measured at right angles to the direction of flow</p> <p><sup>1</sup> NOTE: Bank side is determined when facing downstream</p> <p> measure along stream length; note start and end for pools only       measure every 100 meters</p>
Reach / pg. #	<i>R2/pg1</i>	
Habitat Type (P/R)	<i>P</i>	
Start (m)	<i>10 m</i>	
End (m)	<i>20 m</i>	
Wetted Width	<i>2 m</i>	
Bankfull Width	<i>3 m</i>	
Average Depth	<i>0.5 m</i>	
% Bedrock	<i>20%</i>	
% Boulders	<i>20%</i>	
% Cobble	<i>30%</i>	
% Gravel	<i>20%</i>	
% Fines	<i>10%</i>	
Instream Cover (type/%)	<i>C-10% B-2%</i>	
% Crown Cover	<i>60%</i>	
Gradient	<i>2%</i>	
# LWD	<i>10</i>	
A/E/O	<i>E-10m A-20m</i>	
Off-Channel Habitat	<i>L/bank 20*2m</i>	
Land Use (L/R)	<i>N/R</i>	
Vegetation (L/R)	<i>CF/G</i>	
Vegetation Depth (L/R)	<i>30+2</i>	
Riparian Slope (%) (L/R)	<i>10/15</i>	
Stability (L/R)	<i>M/L</i>	
Livestock Access (L/R)	<i>20m/0</i>	
Photos	<i>1,2,3</i>	
Comments	<i>1,2</i>	

## Survey Area

The Somenos Watershed is a special ecological area connected to the lower Cowichan River. It offers an extensive array of lake, pond and stream habitat for fish and wildlife. The Somenos Watershed is comprised of Bings Creek as the largest stream followed by Richards and Averill Creeks representing the other significant streams (Figure 2). There are several other smaller unnamed streams that also enter Somenos Creek (i.e. Chesterman Park, Driving Range, Lakes Road). Quamichan Creek joins at its confluence with the Cowichan River.

Bings Creek has a mainstem that is approximately 10 km long. It drains from Mt. Prevost to the valley floor and is joined by Menzies Creek on the west side above the town of Duncan. Only the lowest reaches below the Lake Cowichan Road at the Hospital offer access to salmon (R1-R3). The upper reaches have resident trout (R4-R7 & Menzies). Fish sampling was not done but observations of fish were noted during the survey.

The survey objective was to measure the representative habitat in the main salmon and trout segments of the watershed. Each of the survey reaches would have 10 or more habitat units surveyed or at least 100m of stream length. The degree of effort was determined by timing and budget to the anticipated three days from August 19, 20 and 21 of 2020. Each day 2-3 reach segments were surveyed by the team. We started at the lowest reaches and worked upstream. The reach segments are described below and shown in Figure 3. The stream channels were segregated by reaches. Reaches were identified as contiguous habitat types based on confinement, gradient and riparian characteristics (Table 1).

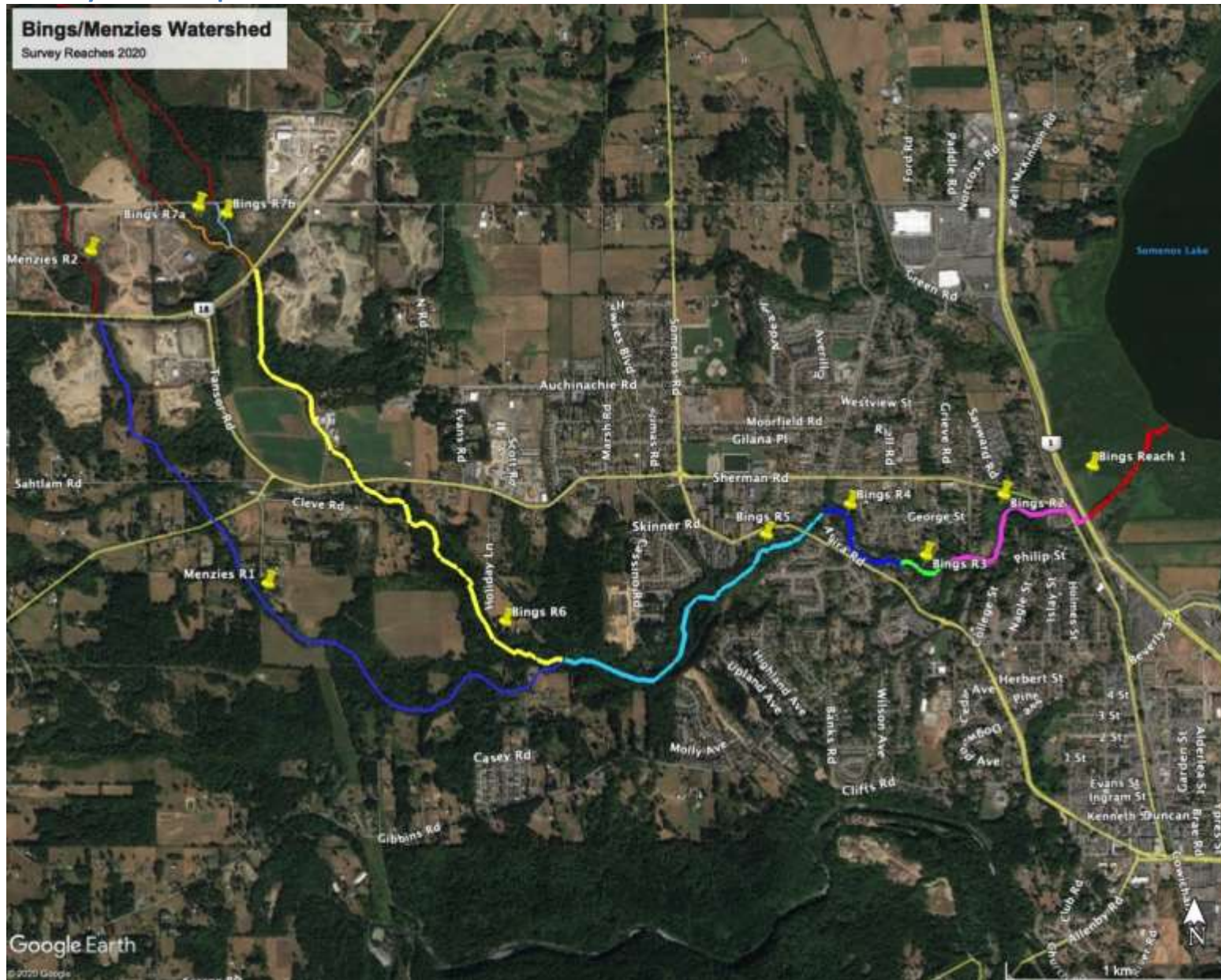
**Table 1 – Survey Reach Description**

Reach	Length (m)	Description
Reach 1;	602	Somenos Lake upstream to Hwy 1. Salmon accessible historically ditched and farmed. Was ditched entire length
Reach 2:	879	Hwy 1 to above Mary St. Salmon accessible. Wide floodplain, re-routed Canada Ave to E& N Rail.
Reach 3;	249	In bedrock ravine up to Falls at end of Salmon access.
Reach 4;	515	Above Falls in ravine to TC Trail. Confined steep, resident trout
Reach 5;	1607	CV Trail to Menzies fork. Semi confined Resident trout
Reach 6;	2563	Menzies Fork up CV Trail to Hwy 18. Resident trout
Reach 7a/7b;	789	Above Hwy 18 to Drinkwater Road. Seasonally dry Alongside the Recycle/Landfill 2 <sup>nd</sup> growth forest, flat
Reach 8	3000	Headwaters to Mt Prevost, parts have resident trout Steep confined, 2 <sup>nd</sup> growth forest
Menzies Reach 1:	3227	Along farm land, ends at Hwy 18. Resident trout.





Figure 3. Survey Reach Map



## Results and Discussion –Habitat Survey

The fish habitat and riparian data was summarized for each survey reach following the USHP format. The field survey dates were August 19, 20 & 21, 2020. Bings reaches R1-R7 as well as Menzies M1 were surveyed. Water quality sampling was conducted in Reach 1,2,3 and 6. The entire data set for each stream reach used in the USHP habitat assessment is in the appendices. The complete field survey data collection is also stored in a file provided to the SMWS. The files attached to this document include;

- Excel © table of compiled habitat data Bings Reach 1-7 and Menzies R1
- Kmz file of survey locations and photo points.

The results of the USHP survey are presented below for each reach. The appendices show the habitat survey data recorded into the spreadsheet files for each reach.

Each reach had 10 or more habitat units (Pools or Riffles) measured. The spreadsheet data is shown in Appendix 1-10. This data was then scored according to the USHP methodology and presented Reach Habitat and Riparian scores and ratings in Tables 1-16 below. A reach map is shown in Figures 4 – 12.

A reach comparison table for the Bings Watershed was summarized in Table 17. Table 18 compares the results to other Vancouver Island Streams.

Restoration opportunities were summarized in a daily narrative (Appendix 11). The survey identified Garbage sites are shown in Table 19 which were addressed by the SMWS in October 2020.

The Bings Watershed Restoration Summary Table and identifies the topics for each reach (Table 20);

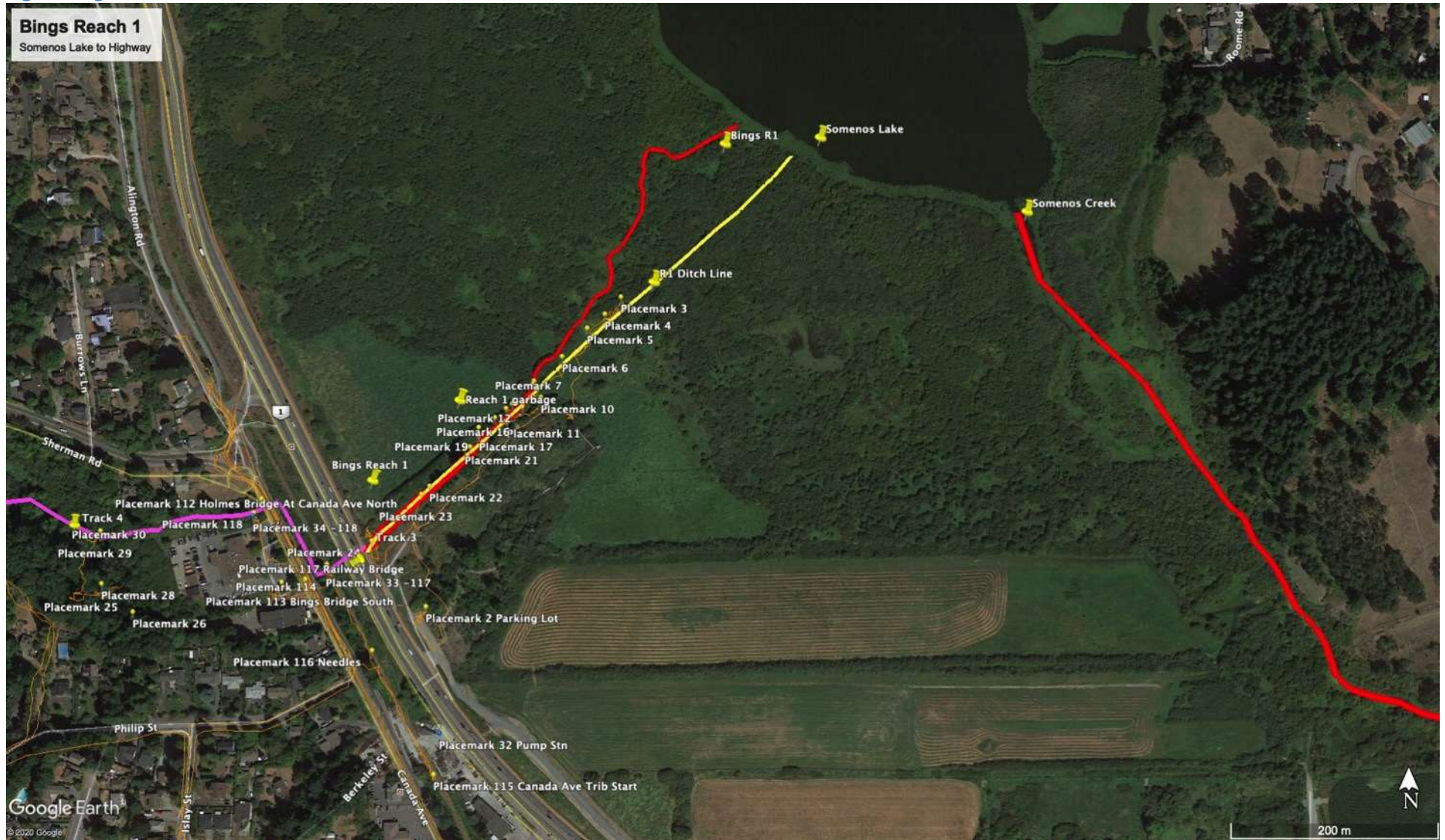
- Riparian Habitat
- Spawning Habitat
- Rearing Habitat
- Obstructions
- Erosion
- Alterations
- Water Quality
- Education/Awareness

These items are described in the reach sections below and in the discussion.

### Reach 1

Bings Reach 1 goes from Somenos Lake up to the Island Highway. This reach is a combination of lake floodplain and historic farm pastures. This reach is adjacent the Somenos Marsh community trail on a raised walkway. The reach is estimated to be 602m long. This reach is salmon and trout accessible. The reach was surveyed Aug. 19, 2020 with the channel at low summer flow. Our survey location was accessed from the raised boardwalk trail downstream through old farm pasture. We surveyed from below the trail upstream to the highway approximately 340m.

Fig . 4 Bings R1



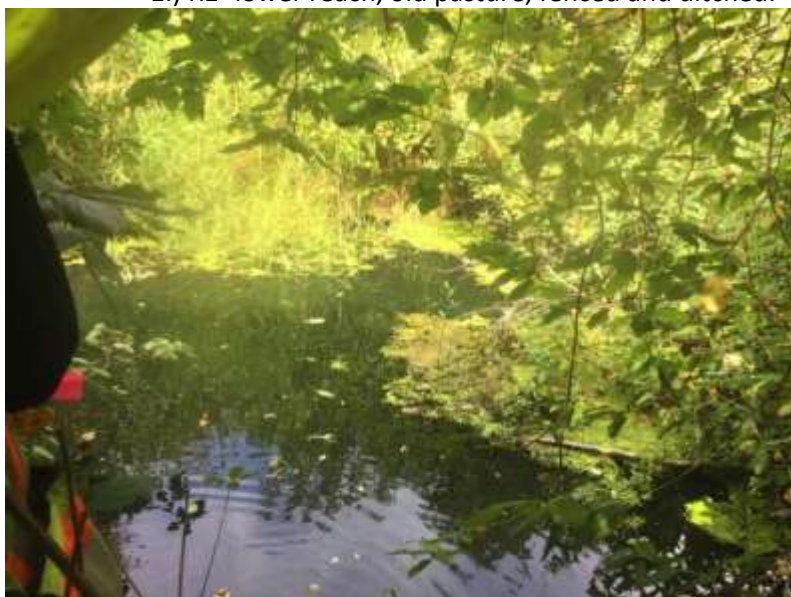
Reach 1 Habitat Photos



1.) R1- lower reach, old pasture, fenced and ditched.



2.) Site 7 –Shrub dominated, low banks, some gravel.



3.) Anoxic manmade offchannel ( O<sub>2</sub> - <3ppm)



4.) Upper reach Spruce tree plantings successful.

The USHP survey of Bings R1 on Aug. 19, 2020 captured ten pools and riffles over 231m. This reach had an average channel width of 4.0m and a wetted width of 3.0m. The reach is very low with a gradient of 0.5 %. The water temperature was 16C. No fish were observed in the channel during the survey but there were freshwater mussels in the gravel beds. The results are shown in the table below.

**Table 1 - Reach 1 Habitat and Water Quality Summary Results**

Habitat Parameter	Result	Ratings	Result
% Pool Area	96	1	Good
Large Woody Debris/Bankfull Channel Width	0.0	5	Poor
% Cover in Pools	32	1	Good
Average % Boulder Cover	0	5	Poor
Average % Fines	79	5	Poor
Average % Gravel	21	not rated	
% of Reach Eroded	0	1	Fair
Obstructions	0	0	Good
% of Reach Altered	100	5	Poor
% Wetted Area	76	3	Fair
Dissolved Oxygen	6.00	3	Fair
pH	7.00	1	Good
	Mean Score	2.9	Fair

The Riparian features of Reach 1 are shown in the table below taken from the USHP summary tables.

**Table 2 - Reach 1 Riparian Results**

Riparian Ratings	Result	Ratings	Result
Land Use	22	1	Good
Riparian Slope	22	1	Good
Bank Stability	66	3	Fair
% Crown Cover	82	1	Good
% of Reach Accessed	5	3	Fair
Average Vegetation Depth	14.5	5	Poor
Mean Score		2	Fair

The entire length of Bings Reach 1 was historically channelized into a straight ditch to accommodate drainage of hay pastures on either side. Farming has ceased but several wire fence lines remain adjacent the channel. Reach 1 is abandoning the ditch line and migrating north. The channel splits from the ditch near the bottom of the foot trail. The new route heads north in an unconfined route through floodplain that had saturated soils, small covered pools vegetated under dense shrubbery.

The reach 1 survey showed a Fair overall result. There was a lack of diversity of habitat units. The channel has accumulated gravel bars in the mid section that created riffles and pools. The reach is recovering with many good habitat aspects. The historic ditch would have scored much lower.

The fish habitat characteristics that were good are;

- High percentage of pool area.  
This is an important component as long as water quality remains good the dredged pools below the highway offer a large year round rearing/refuge area available for fish.
- No permanent barriers manmade or natural.  
There was only one small beaver dam that waters easily flood over or go around during fish migration.

The fish habitat characteristics that were poor are;

- Poor spawning habitat.  
Due to lack of spawning gravel and high sediment (21%) levels. The spawning gravel is cut off from upland supplies by the highway and railway culverts. Spawning habitat restoration with additional gravel placement is recommended in the areas showing recovery. The sediment sources require stream bank planting and highway storm water management improvements.
- Lack of instream Cover.  
Due to the historic clearing and ditching removing the trees and roots. Cover and scour structures designed to sustain flooding (small, well anchored) would help to improve the habitat recovery; conifer brush mats, 2-4m logs, or boulder groynes in areas of confinement.
- Poor Riparian Vegetation Depth.  
The riparian area was historically cleared for hay pastures with some areas as recently as 10 years ago. There has been successful tree planting along the upper reach. There are planted Sitka Spruce trees growing above the shrub line that now provide shade and bank stability to the site. It is a work in progress with continued riparian restoration required.
- Water Quality was Poor  
The Oxygen level was 4.3 ppm at 44% saturation in 16C temperature at the start of our survey near Somenos Lake. The off channel pond was less than 3ppm. The temperature is relatively low and non stressful on salmonids at this time of year. This temperature would normally permit oxygen levels of 6-8 ppm. Decomposition of organic material and sediment are depressing oxygen levels. Walking in stream results in hydrogen sulphide gas bubbles released in the grassy exposed areas (this represents high levels of decomposition). The oxygen levels were highest (6ppm) at the top end of the reach.

## Reach 2

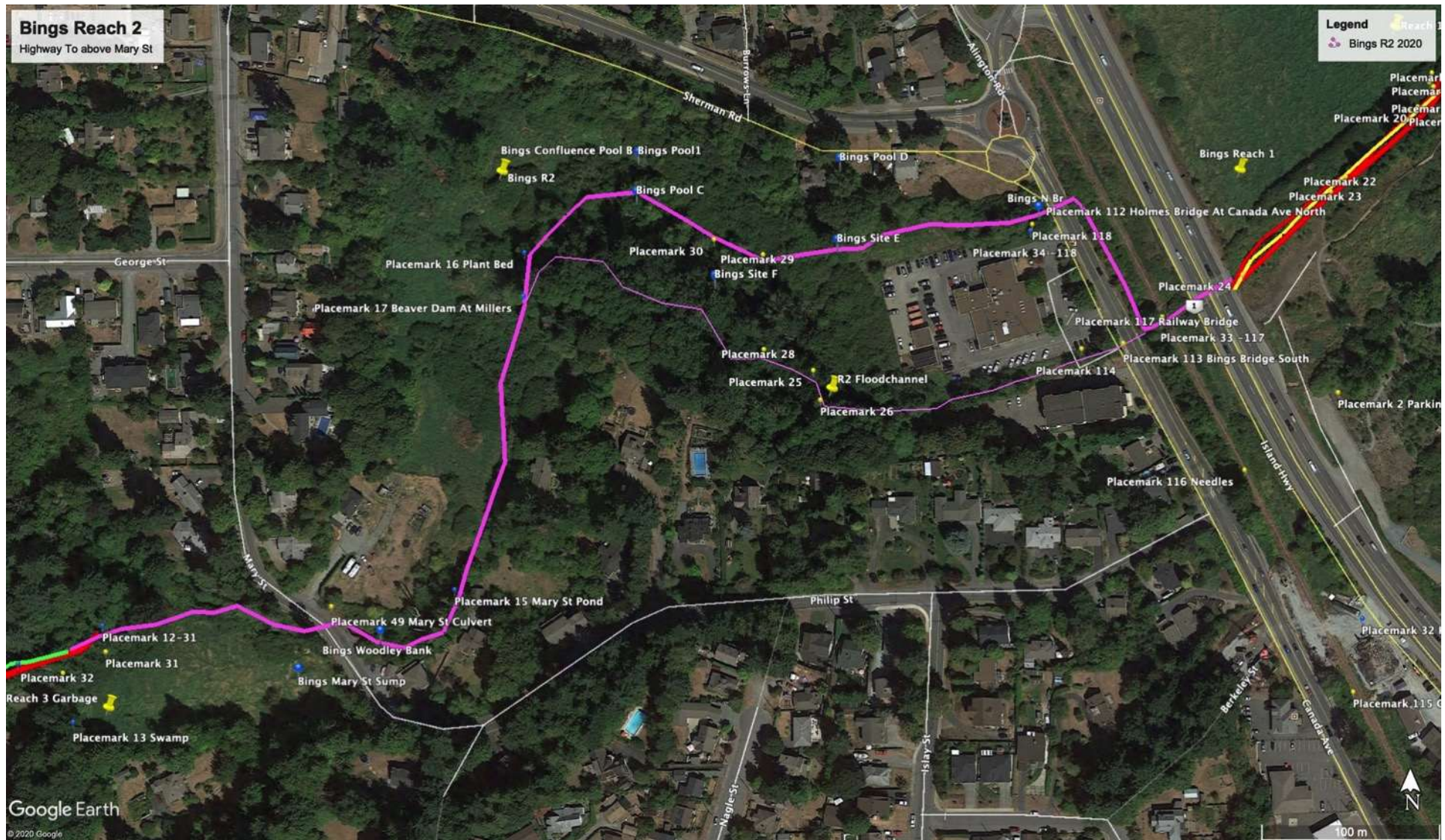
Bings Reach 2 is 879m long, beginning at the Trans Canada Highway upstream under the bridges and culverts at the E&N Railway and Canada Avenue. It follows a diversion around the RCMP property and through wide floodplain ending above the Mary Street Culvert. There is a seasonal fish accessible tributary that enters the right bank at the top end. This tributary drains from a small gully adjacent the Duncan Hospital parking lot. The tributary is braided and flows over vegetated hummocks near the confluence, it is confined above. It has seasonal flow and offers approximately 100m of limited fish access and habitat.

Reach 2 was the most heavily altered reach in the survey. Historically it was a Cedar and Spruce wetland based on the remaining stumps. It has been ditched and diverted to accommodate RCMP property and the transportation crossings. This reach has reduced habitat complexity with respect to pools and riffles due to relocation of the channel. The low gradient reach has flooded routinely due to beaver and debris in the channel or culverts. This reach is entirely salmon and trout accessible. During the survey juvenile Coho and Three Spine Stickleback were observed at the Mary Street Culvert.

The USHP survey on August 19, 2020 captured 5 pools and 2 riffles over 535 m. We started our survey adjacent the RCMP building and walked upstream on a channelized stream bed amid a wide floodplain. This reach had an average channel width of 6.0 m and a wetted width of 6.0m. The reach is very low with a gradient of 0.1 %. The water temperature was 18 C. The results are shown in the table below.

**Table 3 - Reach 2 Habitat and Water Quality Summary Results**

Habitat Parameter	Result	Ratings	Result
% Pool Area	99	1	Good
Large Woody Debris/Bankfull Channel Width	0.2	5	Poor
% Cover in Pools	11	3	Fair
Average % Boulder Cover	0	5	Poor
Average % Fines	66	5	Poor
Average % Gravel	26	not rated	
% of Reach Eroded	0	1	Good
Obstructions	0	0	Good
% of Reach Altered	74	5	Poor
% Wetted Area	100	1	Good
Dissolved Oxygen	6.50	3	Fair
pH	7.00	1	Good
	Mean Score	2.7	Fair





Reach 2 Habitat Photos



1.) R2 Site 117, E&N Bridge



2.) R2 Site 118 –RCMP property is channelized, close to pavement.



3.) R2 Site 26 Floodplain, feeds south arm



4.) R2 Beaver created pools below Mary St .

The Riparian features of Reach 2 are shown in the table below taken from the USHP summary tables.

**Table 4 - Reach 2 Riparian Results**

Riparian Ratings	Result	Ratings	Result
Land Use	22	1	Good
Riparian Slope	22	1	Good
Bank Stability	66	3	Fair
% Crown Cover	82	1	Good
% of Reach Accessed	5	3	Fair
Average Vegetation Depth	14.5	5	Poor
Mean Score		2	Fair

Reach 2 is altered by the dredging, diversion and transportation crossings. The entire channel has been dredged. The main flowing channel goes north around the RCMP property and completes two 90 degree bends to realign with the E&N culvert which was installed over 100 years ago. Another channel flows on the south side of the RCMP property and an apartment building. This may have been closer to the historic route. The south drainage is 4.1 m wide. It had standing water but not flowing and completely in filled with tall grasses and no other cover. We discovered a recently built 5.0 m wide and 1.2m high beaver dam 250m below the Mary St culvert. This results in extremely high pool area. Past surveys (DRC 2016) indicate without the beaver dam, there remain year round pools that support juvenile salmon and trout.

Reach 2 results scored an overall Fair result. The channel offers good fish rearing pools but very little spawning habitat.

The fish habitat characteristics that were good are;

- High percentage of pool area.  
There was a 5.0 m wide and 1.2m high beaver dam 250m below the Mary St culvert. This dam resulted in overly large and deep pool area. Past surveys (DRC 2016) indicate without the beaver dam, there are year round connected pools that support juvenile salmon and trout. This is a flood protection managed area for Mary St and local residences adjacent the floodplain and the dam will likely be removed if it doesn't blow out this winter.
- Water Quality was good.  
Water was sustainable for salmon and trout during the late August survey. The oxygen levels were 6ppm and 66% saturation. The water temperature of 16C in late August is very tolerable for salmonids as well. Normally a time of poorest conditions, the fair result is better than expected.

The fish habitat characteristics that were poor are;

- Flooding  
The reach has two floodplain areas above and below Mary St. Each offer approximately 100m wide wetted areas in winter. The annual flooding threatens the road and adjacent residential dwellings and property. The current beaver dam downstream floods the Mary

Street culvert ( 2.1m high and 3.9m wide) leaving only 50cm above water level. The dam will create flooding over Mary Street and possibly into residences if it remains at this height through winter. The negative effect of the flooding on fish habitat is sedimentation of spawning areas and infilling of scour pools. The flooding results in high nutrient loading and oxygen deficit of summer wetted areas. Removal of the dam is the short term solution to protect the road and residences. A bridge and relocated residences would be the present day development. The solution may be in a raised road, larger creek crossing and flood protection for residences incorporating a vegetated covenant on the dyke similar to the lower Somenos.

- Poor spawning habitat.  
There is a lack of spawning gravel and high sediment (26%) levels. The spawning locations are often flooded by beaver dams and debris jams except where channelized along Canada Avenue and the RCMP property. There was evidence of past spawning by salmon in the RCMP segment. The lack of gravel and spawning locations in this reach is very evident due to past dredging. There are accessible locations for spawning gravel addition along the RCMP run, and Canada Ave/E&N Bridge locations.
- Lack of Instream Cover.  
Trees and roots were removed from past logging and farming. There is one location of LWD material placed at the Mary Street culvert pool by the District of North Cowichan. The common cover type is submerged vegetation from grasses and shrubbery. It serves to hide fry but not adequate for adults and depresses water quality.
- Poor Riparian Vegetation.  
The riparian area was historically cleared for hay pastures in the upper reach. The adjacent trees suggest there were Cedar or Spruce historically. Due to the fluctuating water levels, there is a row of dead trees above Mary Street and virtually no tall trees below. The riparian area is dominated by regenerating shrubbery over a once ditched and cleared area. This shrubbery provides shade and bank stability but offers little scour adult cover or Coarse Woody Debris (CWD). The most common invasive species is Himalayan Blackberry found mostly near the open road areas. Planting for biodiversity is recommended. The strategy must consider the existing plant community and desired succession stages.
- Alterations – Channel altered for 74% of reach length.  
In Reach 2, the channel was ditched to align it from the Trans Canada Highway upstream to the E&N Culvert. It was turned in two right angles, to run under and along Canada Avenue 4.2m wide and 1.15 m high concrete box culvert and the north side of the RCMP property. Upstream of the RCMP property to Mary Street, the channel has been re-aligned to avoid the sewer trunk line. The north channel around the RCMP property captures the main flow and is wetted year round. There is a south channel between the RCMP property and an apartment block. It is a smaller (4.0 m wide) grass filled channel. It seasonally receives overflow from the floodplain upstream and has been known to jump its banks into the adjacent properties during larger events. The south channel is in a state of poor fish habitat as it lacks flow, spawning and rearing cover. The original stream channel route was likely closer to the south channel as it aligns with the Railway crossing. The south channel crosses Canada Avenue in a 4.2m wide and 1.6m high steel beam bridge with concrete deck and abutments. Just below Canada Avenue the north and south channels join and pass through 3.0m wide concrete abutments supporting the E&N Rail trestle. The Trans

Canada Highway bridge is 30m downstream and has a 7.1m span between concrete abutments. The abutments are supported by eroding riprap and concrete that projects into the channel.

### Reach 3

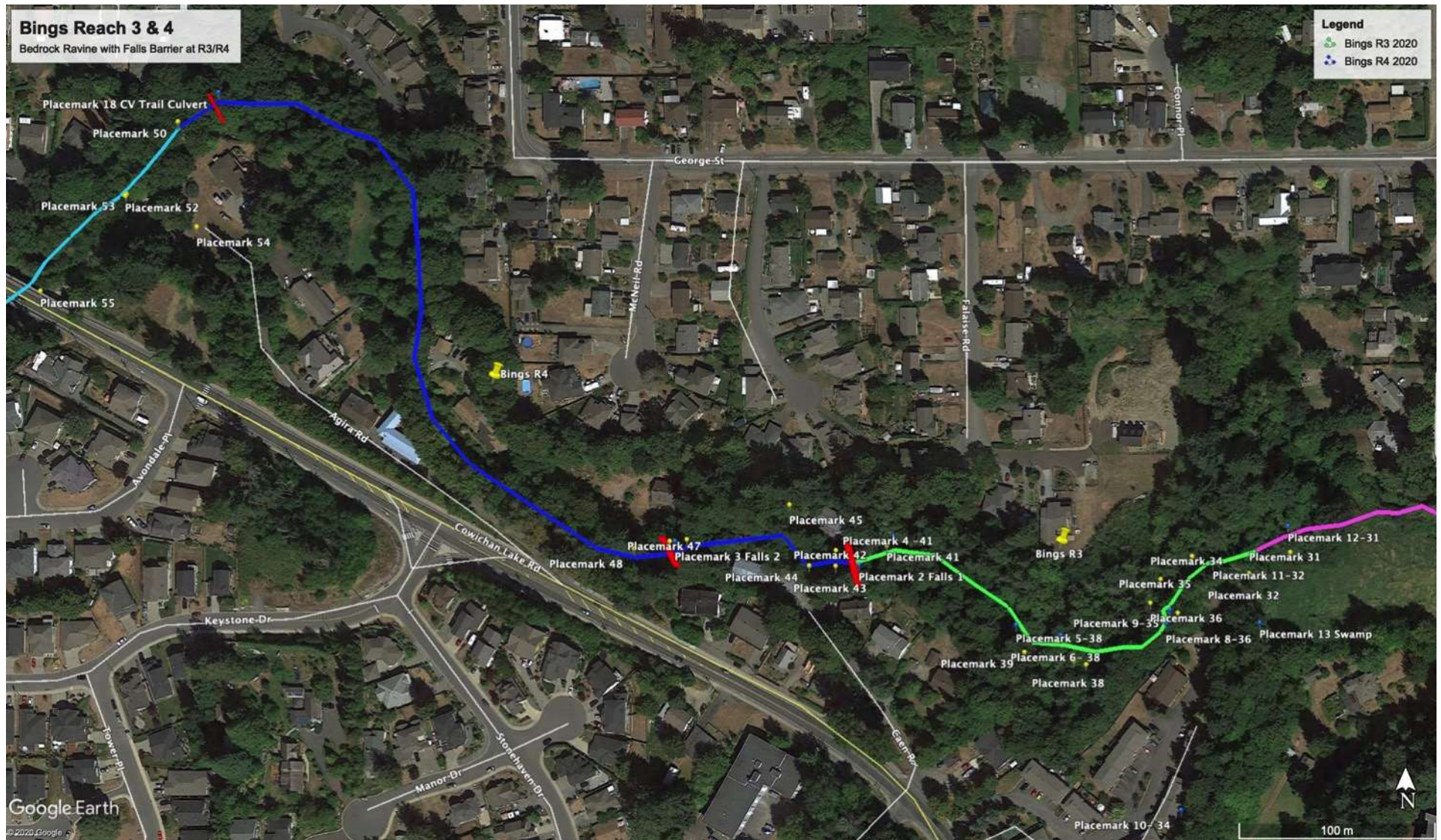
Bings Reach 3 is a confined reach flowing through a treed ravine bounded by residential houses at the top of the 30-50m sidewalls. There is no floodplain nor tributary entry in this reach. This is the last salmon accessible reach of Bings Creek.

The entire reach was surveyed Aug. 20, 2020. It consisted of four pools and three riffles over 249m. This reach had an average channel width of 11.1 m and a wetted width of 5.1m. The water temperature was 17C. The reach climbs from 1% gradient ending with 10 % at the base of a fish barrier falls.

The results are shown in the table below.

**Table 5 - Reach 3 Habitat and Water Quality Summary Results**

Habitat Parameter	Result	Ratings	Result
% Pool Area	65	1	Good
Large Woody Debris/Bankfull Channel Width	0.2	5	Poor
% Cover in Pools	7	3	Fair
Average % Boulder Cover	2	5	Poor
Average % Fines	57	5	Poor
Average % Gravel	11	not rated	
% of Reach Eroded	0	1	Good
Obstructions	1	1	Good
% of Reach Altered	0	1	Good
% Wetted Area	44	5	Fair
Dissolved Oxygen	8.00	1	Good
pH	7.00	1	Good
	Mean Score	2.6	Fair



Reach 3 Habitat Photos



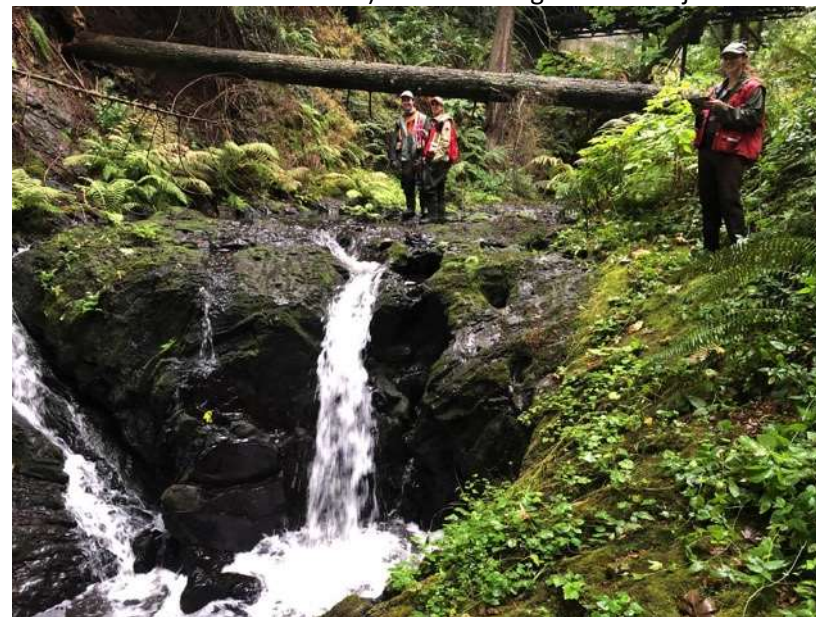
1.) R3 Site 37, this gravel offers the best salmon spawning habitat



2.) R3 Site 33 log and debris jam



3.) R3 - Site 38 good riparian zone, least altered reach



4.) R3 end at Bedrock Falls 2.2m (Site 42).

The Riparian features of Reach 3 are shown in the table below taken from the USHP summary tables.

**Table 6 - Reach 3 Riparian Results**

Riparian Ratings	Result	Ratings	Result
Land Use	14	1	Good
Riparian Slope	28	2	Good
Bank Stability	18	1	Fair
% Crown Cover	84	1	Good
% of Reach Accessed	0	0	Fair
Average Vegetation Depth	42	3	Poor
Mean Score	Mean Score	1	Good

This reach is the least altered segment in the entire stream. Reach 3 habitat results in an overall Fair score.

The fish habitat characteristics that were good are;

- High percentage of pool area.  
The reach has several long deep pools in the lower area that offer year round rearing habitat in the shade of the ravine. Most pools lack cover but there was a natural log jam at the Site 33 pool.
- This is the best spawning reach for salmon as it has the largest gravel deposits.
- Lack of Erosion, Obstructions or Alterations  
The lack of erosion and alteration is accredited to the bedrock dominated reach. The salmon barrier is a 2.2m vertical falls at the end of the Reach 3. Upstream the grade levels out for 75m then another 2.5m falls. Both barriers are made of bedrock substrates. There is no record of salmon getting above these barriers but passage improvement could be considered .
- Good Water Quality  
The Oxygen level was 8ppm and 87% saturation in 17C water temperature. The pH of 7 was neutral. The high oxygen levels and relatively low temperatures reflect the good aeration and shade of the bedrock canyon.
- Riparian  
Reach 3 Riparian characteristics were good. This reach has the healthiest riparian zone of the survey. The benefit of being in a protected bedrock gully resulted in an abundance and diversity of tall trees; second growth broad leaf (Maple, Red Alder) and conifers (Douglas Fir, Red Cedar). There is the potential for LWD input from these trees as well.

The Reach 3 fish habitat characteristics that were poor are;

- **Cover**  
There is a lack of LWD in the reach. The canyon area is likely too dynamic to permit logs to anchor. The lower area of the reach has one log jam with small wood debris piled against several large structural logs. The garbage should be removed. The logs should then be assessed for better positioning and anchor.
- **Boulders**  
The lack of boulders in the riffles limits habitat, especially for trout. This is a difficult site to access to add material.
- **Fines**  
Gravel quality is diminished by sediment . The deposition of fines in the pools are a product of upland erosion and sedimentation. Our survey of Reach 4 upstream found many sediment sources. Addressing reach 4 erosion will help the lower reaches.

#### Reach 4

Bings Reach 4 is a bedrock lined ravine above the salmon barrier. At the top of the banks are residential properties. It is approximately 515m long starting at the falls by Caen Road, going upstream along Agira Road and ending at the Cowichan Valley Trail culvert (historically this was the CNR rail route) just below and downstream of the Cowichan Lake Road near Agira Road. There is a barrier falls at the start and another falls (100m upstream) just above the bridge. Both are approximately 2.5m of drop from bedrock substrates.

It was surveyed from the falls at the end of Reach 3 and upstream 117m. This reach had three pools and five riffles surveyed. The survey area was steep walled with bedrock substrates below residential properties. We inspected the top end of the reach at the Cowichan Valley trail culvert as well. This reach had an average channel width of 7.9 and a wetted width of 4.5 m. The reach had a steep gradient of 8%. Water quality was not measured but can be assumed to be as good as Reach 3 in close proximity. Habitat results are shown in the table below.

**Table 7 - Reach 4 Habitat Summary Results**

Habitat Parameter	Result	Ratings	Result
% Pool Area	33	5	Poor
Large Woody Debris/Bankfull Channel Width	0.0	5	Poor
% Cover in Pools	7	3	Fair
Average % Boulder Cover	7	5	Poor
Average % Fines	0	1	Good
Average % Gravel	5	not rated	
% of Reach Eroded	0	1	Good
Obstructions	0	0	Good
% of Reach Altered	0	1	Good
% Wetted Area	56	5	Poor
Dissolved Oxygen	Not Surveyed		Not rated
pH	Not Surveyed		Not rated
	Mean Score	2.9	Fair



Reach 4 Habitat Photos



1.) R4 .Boulder riffle in bedrock, bridge crossing upstream.



2.) R4 below falls 2 is old water inlet structure



3.) R4 –Falls 2 is 2.2m ht on steps.



4.) R4 ends at CV Trail barrier culvert, Veg removal on right bank

The Riparian features of Reach 4 are shown in the table below taken from the USHP summary tables.

**Table 8 - Reach 4 Riparian Results**

Riparian Ratings	Result	Ratings	Result
Land Use	24	3	Fair
Riparian Slope	10	1	Good
Bank Stability	4	1	Fair
% Crown Cover	86	1	Good
% of Reach Accessed	0	0	Fair
Average Vegetation Depth	21	5	Poor
Mean Score		2	Fair

Reach 4 was found to be protected from disturbance by being in a bedrock gully. Small disturbances are related to where the stream was not protected by steep walls.

- Alterations

The reach has residential houses above on Caen and Agira Roads. While most property owners have generally left the bank vegetation undisturbed, there was one location with grass clippings being dumped on the bank. The residential bridge road crossing footings are in the active stream channel. There is an inoperative concrete caisson on the left bank that appears to be part of a historic dam and water inlet just above the second falls. .

- Habitat

Unfortunately the bedrock also prevents scour and there were no deep pools with cover in the reach. The reach is above salmon access and offers only resident trout habitat. The habitat in this reach is poor for winter rearing with no deep pools or cover. The substrates were 57% bedrock and only 5% gravel. Spawning habitat is also poor.

- Barriers

There is a barrier falls at the start and another falls (100m upstream) just above the bridge. Both are approximately 2.5m of drop from bedrock substrates. These are the main fish barriers to salmon and they do offer the possibility of fish access improvements. A drill rod was found in the bedrock of the first falls indicating they have been previously manipulated.

The third barrier is at the end of the reach at the CNR culvert under Cowichan Valley Trail. The 6 foot diameter metal pipe is a fish barrier. It is on 10% gradient with no residual depth and a bend in at the two pipe sections. There is a pile of garbage and debris at the top end of the pipe and a concrete splash apron at the outlet. The apron, gradient, bend and debris all contribute to fish passage difficulty. The pipe has bottom sections rusted out but it is not failing. If the pipe is replaced, a larger natural bottom crossing is recommended such as an Arch or Bridge. Based on the channel, debris buildup, it needs to be increased in size.

The riparian area of Reach 3 and 4 are similar and both relatively healthy. There were two locations where residential property owners have cleared the plant community to the banks in Reach 4. The average riparian depth is 21m and is along a bedrock ravine such that most property owners have

left it alone. The canopy is closed (86%) and made up of regenerating forest that is mostly Douglas Fir and Red Cedar. There are well vegetated understory shrubbery on the banks of the ravine; Sword Fern, Lady Fern, Salal, Indian Plum, Oregon Grape, Salmonberry and Huckleberry.

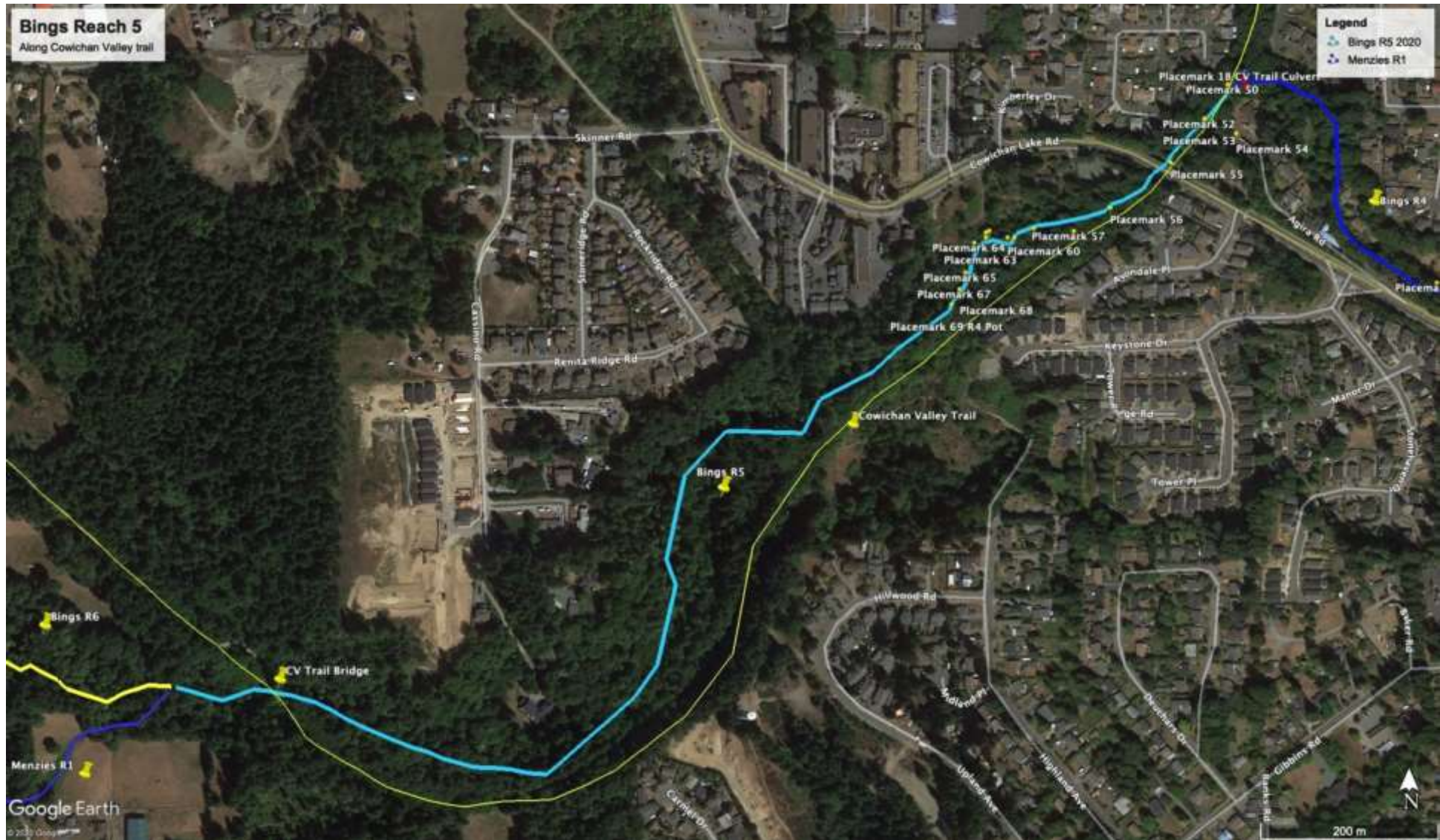
### Reach 5

Bings Reach 5 is adjacent the Cowichan Valley Trail which was the old CN Railway grade. This reach starts at the culvert by Lake Cowichan Road and goes up the confluence of Menzies Creek. The reach is approximately 1607m long. It is low gradient and has perennial pools. There are no salmon in this reach but resident trout were observed frequently during our August 20, 2020 survey.

We surveyed the section from above the Cowichan Valley Trail culvert, under the Lake Cowichan Highway Bridge and along the trail to the Keystone Drive access. Our survey captured six pools and five riffles over 150m. Pools represented 86% of the wetted area. This reach had an average channel width of 7.5 m and a wetted width of 4.3 m. The reach gradient was 1.6 %. Water Quality was not measured here but is expected to be similar to Reach 3 measures 500m below. The results are shown in the table below.

**Table 9 - Reach 5 Habitat and Water Quality Summary Results**

Habitat Parameter	Result	Ratings	Result
% Pool Area	86	1	Good
Large Woody Debris/Bankfull Channel Width	0.8	5	Poor
% Cover in Pools	6	3	Fair
Average % Boulder Cover	0	5	Poor
Average % Fines	43	5	Poor
Average % Gravel	55	not rated	
% of Reach Eroded	44	5	Poor
Obstructions	2	2	Good
% of Reach Altered	27	5	Poor
% Wetted Area	57	5	Poor
Dissolved Oxygen	Na		
pH	Na		
	Mean Score	4	Poor



Reach 5 Habitat Photos



1.) R5 .Stn 59 typical riffle/pool, Alder nearby overstory.



2.) R5 Pools have loose wood cover



3.) R5 Cowichan Trail, Conifers but no CWD



4.) R5- long pools with no cover (site 66)

The Riparian features of Reach 5 are shown in the table below taken from the USHP summary tables.

**Table 10 - Reach 5 Riparian Results**

Riparian Ratings	Result	Ratings	Result
Land Use	10	1	Good
Riparian Slope	16	1	Good
Bank Stability	68	5	Poor
% Crown Cover	90	1	Good
% of Reach Accessed	3	1	Good
Average Vegetation Depth	34	3	Fair
Mean Score		2	Good

Reach 5 is heavily influenced by the CN Rail route which was laid alongside or in the historic creek channel. The CN railway route was converted to the Cowichan Valley Trail. The trail runs almost immediately adjacent the right bank of the reach the entire length. This section of trail has buried sewer pipelines. The stream was channelized to the left side of the 30 -50m wide valley to accommodate the rail line. The habitat results reflect these historic alterations;

The fish habitat characteristics that were good are;

- High percentage of pool area (86%).  
The pools had a mean depth of 0.5m; which offers Resident Trout adequate depth to survive. The pool depth is a product of scour from regenerating tree roots, large woody debris (LWD) and small wood debris (SWD) that also provide cover habitat.
- Lack of Obstructions  
There are no obstructions to fish on this reach. The reach is crossed by bridges on the Lake Cowichan road and Valley Trail. There were minor debris jams through the lower reach from the second growth forest succession process. The debris was made up of Red Alder trunks and limbs. None were fish barriers.
- Riparian characteristics were Good. The canopy is not as old or nor as many conifers as Reach 4 but it is made up for in quantity and depth. The banks are low and wide offering good growing sites. The near stream canopy is older Red Alder that is thinning as it dies off in the heavily shaded canopy. There are concerns with the lack of understory conifer and shrubbery regeneration.

The fish habitat characteristics that were poor are;

- Cover  
There is a lack of conifer LWD in the entire reach. The stream has some confined locations where cover could be anchored to banks over deeper pools using the CV Trail for access.
- Boulders  
The lack of boulders in the riffles limits habitat for trout. These substrates were historically dredged along the trackside areas.

- **Spawning Habitat**  
The high (55%) percent gravel is offset by pollution of fines (43%) from the erosion along the trail side. The egg survival with sediment over 20% in gravels is very poor. The cause is erosion from the banks as discussed below.
- **Erosion**  
There was 44% of the survey area eroded. This poor result is due to weak altered banks that are having a difficult recovery from historic damage. The Cowichan Valley Trail runs alongside the river right bank and we observed a high amount of trampled banks and riparian vegetation from people leaving the main trail to access the creek. There are too many side trails with unmanaged access off the main trail. This is a very high impact on the plant community and bank stability. Addition of coarse woody debris (CWD) and fencing to control access followed by replanting and habitat structures is recommended.

The riparian area of Reach 5 is fairly wide and stable. It has 90% crown cover and is 34 m wide on average. The Red Alder and other understory trees are thinning out. The trees or the branches of Alders and subdominant Fir are falling into the stream and creating small woody debris jams. This results in braiding and erosion. The riparian area needs to be assessed for underplanting of conifers as well as removal or topping of failing trees adjacent the bank. The understory lacks CWD as the entire area was logged burned and cleared for the rail line. It needs stumps and logs in the riparian area. Placement of CWD in the riparian zone would reduce human caused erosion as well as wildlife habitat.

## Reach 6

Bings Reach 6 is located above the Menzies Creek confluence and heads north along the Cowichan Valley Trail and Cleve Road. It then crosses Tansor Road and goes through a farm and alongside a gravel pit to end at the Lake Cowichan Highway. The reach is approximately 2563 m long. Reach 6 runs parallel and 500-1000m to the east of Menzies Creek

The reach was surveyed on August 21, 2020. We accessed the reach off the end of Cleve Road on private land. We measured five pools and five riffles over 144m to end at the Valley Trail culverts. This reach had an average channel width of 7.4 m and a wetted width of 2.8 m. The reach gradient was 1.1 %. The water temperature was 15 C. Fish were observed in the larger pools during the survey. The results are shown in the table below.

**Table 11 - Reach 6 Habitat and Water Quality Summary Results**

Habitat Parameter	Result	Ratings	Result
% Pool Area	69	1	Good
Large Woody Debris/Bankfull Channel Width	0.1	5	Poor
% Cover in Pools	5	5	Poor
Average % Boulder Cover	0	5	Poor
Average % Fines	46	5	Poor
Average % Gravel	51	not rated	
% of Reach Eroded	47	5	Poor

Obstructions	0	0	Good
% of Reach Altered	0	1	Good
% Wetted Area	39	5	Poor
Dissolved Oxygen	6.40	3	Fair
pH	6.70	1	Good
	Mean Score	3.3	Fair

The Riparian features of Reach 6 are shown in the table below taken from the USHP summary tables.

**Table 12 - Reach 6 Riparian Results**

Riparian Ratings	Result	Ratings	Result
Land Use	12	2	Fair
Riparian Slope	6	1	Good
Bank Stability	26	4	Fair
% Crown Cover	78	1	Good
% of Reach Accessed	3	1	Good
Average Vegetation Depth	48	3	Fair
Mean Score		2.1	Fair/Good

Reach 6 has perennial pools but the riffle segments likely dry in most summers. The survey occurred after an unusually wet late August and we found the riffles to be flowing. The reach is relatively protected and shows no recent disturbances. Historic disturbances are still playing a role in disabling the riparian function; historic logging has resulted in a lack of LWD and a thin second growth forest. The historic farm clearing has left some stream banks exposed to sunlight and eroded due to lack of rooted vegetation. The historic railway culverts are a barrier to fish migration in most flow periods.

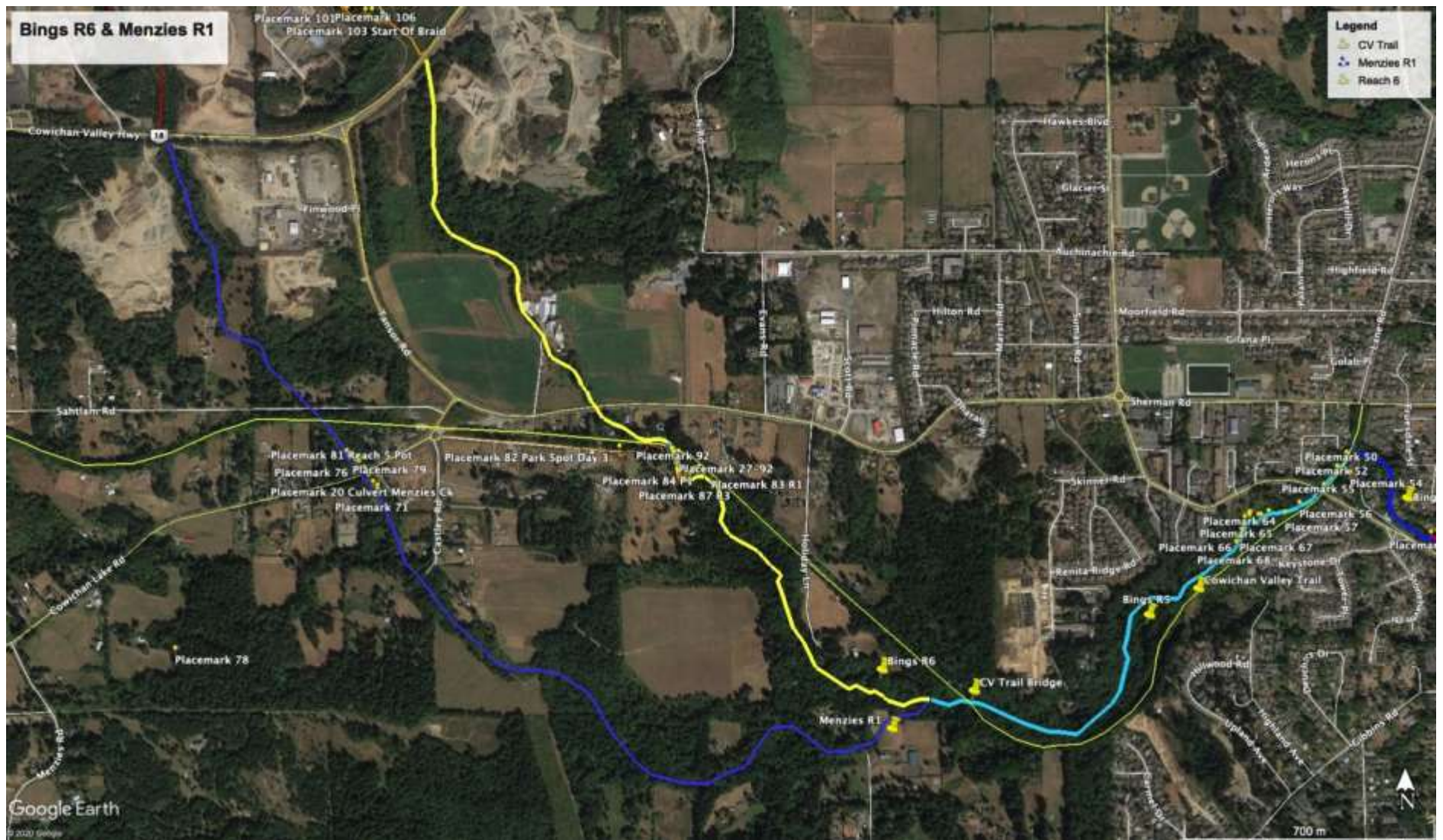
The fish habitat characteristics that were good are;

- High percentage of pool area (69%).  
The pool depth and area are beneficial to year round fish habitat.
- Spawning Gravel  
The reach substrates were 51% gravel. There were many areas of good spawning habitat.
- Lack of Obstructions  
There are no obstructions to fish on this reach. The Cowichan Valley Trail culverts at Cleve Road are hung 0.6m and will impeded extreme low and high flow fish passage.
- Riparian characteristics were Fair/Good. The canopy is fairly well shaded (78%). The riparian depth is an average of 48m. The canopy is regenerating conifer forest with a mix of deciduous trees.



The fish habitat characteristics in Reach 6 that were poor are;

- Cover  
There is a lack of instream cover. The undercut banks, boulders, LWD and vegetation are deficient or non existent.
- Erosion  
There was erosion in 47% of the survey area. The erosion is characterized as the result of high discharge rates exceeding the holding ability of the substrates and riparian vegetation. There were no livestock or recreational vehicle access erosion observed. The most significant erosion sites were observed on the Cleve Road farm banks and below the CV Trail culverts. The banks were slumped into the channel leaving behind 5-12m long exposed banks. The losses of bank material were actively depositing fine sediments below.
- The riparian area was generally good but the survey area below Cleve Road had localized problem areas associated with the bank erosion described above. The erosion had resulted in the trees falling into the stream and the banks requiring structural repair and planting.



Reach 6 Habitat Photos



1.) R6 . First riffle at Site 83, lots of gravel.



2.) R6 – typical pool 5.5 m wide but only 0.35m deep (Site 84)



3.) R6 Dead Grand Fir, need underplanting (Site 91)



4.) R6- Undercut bank offers cover but lacks root structure. (Site 89)

## Reach 7

Bings Reach 7a and 7b are seasonally dry forks of upper Bings Creek. They were dry during the August 21, 2020 survey. They were walked from their confluence 100m above the Lake Cowichan Highway culvert to the Drinkwater Road concrete box culverts.

Reach 7a is adjacent the regional recycling centre and was found to be 378m long on a gradient of 6 %. The channel was an average of 4.3m wide. There was no water in the channel.

Reach 7B is located to the east and joins 7a 100m above the Lake Cowichan Highway. It was found to be 232m long. The average gradient was 4% and 4.5m wide. The USHP survey did not identify any pool habitat in the dry reaches. The habitat characteristics were similar for both reaches. The results are shown in the table below.

**Table 13 - Reach 7a & 7B Habitat and Water Quality Summary Results**

Habitat Parameter	Result	Ratings	Result
% Pool Area	0.00	5	Poor
Large Woody Debris/Bankfull Channel Width	0.0	5	Poor
% Cover in Pools	0	5	Poor
Average % Boulder Cover	0	5	Poor
Average % Fines	15	3	Poor
Average % Gravel	40	not rated	
% of Reach Eroded	0	1	Good
Obstructions	0	0	Good
% of Reach Altered	0	1	Good
% Wetted Area	0.0	5	Poor
Dissolved Oxygen	na		
pH	na		
	Mean Score	3.3	Fair

The Riparian features of Reach 7a and 7b are shown in the table below taken from the USHP summary tables.

**Table 14- Reach 7a/b Riparian Results**

Riparian Ratings	Result	Ratings	Result
Land Use	6	3	Fair
Riparian Slope	2	1	Good

Riparian Ratings	Result	Ratings	Result
Bank Stability	10	5	Poor
% Crown Cover	75	1	Good
% of Reach Accessed	0	0	Good
Average Vegetation Depth	46	3	Fair
	Mean Score	2	Fair/Good

The results of the Reach 7 habitat survey show a Fair result. The stream channel that has been disturbed by historic logging. The channels are crossed with old log skid routes. The historic trees were all removed and Broadleaf Maple are now the dominant regenerating species. The 7a and 7b channels have a porous stream bed that is dry the entire summer. The low (<0.3m) banks are relatively strong as they are covered and crossed with large roots from the Maple trees. There is bed loading of gravels delivered from upstream sedimentation. The excess gravel fills the channel and results in numerous overflow locations. The drying and flooding are indicators of poor fish survival in the reach.

The proximity of the recycle centre has resulted in Reach 7a being littered with debris. Wildlife (20 Ravens observed) and wind have moved this material to the creek bed. The garbage is in the stream bed and hanging in the tree branches. This material has washed downstream to lower areas.

The riparian area is regenerating and offers shade and stability but the logging historic disturbance resulted in a lack of diversity of the trees. Broadleaf Maple dominate the riparian area tree species and appear to be suppressing emergence of understory conifer species.

This reach offers little fish productivity. It has spawning gravel but due to drying and flooding there will be elevated fish mortality. There is also a lack of aquatic invertebrate food supply due to drying. The reach has a debris jam at the lower confluence of the two channels with a 10m wide braid; it limits fish access to high flows only. This impediment to fish access is beneficial to preventing fish from dying in this reach. There is no need to improve fish access until the channel is more adequately recovered. The riparian vegetation needs more time to recover with more conifer species, which should bring longer periods of water flow.

## R8 – Headwaters

The headwaters of Bings Creek above Drinkwater Road flow for most of the year alongside the Bings Creek community trail. As it flattens out it dries in summer by Drinkwater Road. The channels in the headwater drain Mt. Prevost west side from 728m elevation down to 109m at Drinkwater Road. The upper reaches have two forks are over 3.0 km long. The reach is fish accessible for approximately 1500m but very limited in fish habitat area due to drying or small wetted areas observed. The Bings Creek community trail follows along this reach and where it is nearby the creek there is erosion due to poor surfacing and drainage. The first footbridge is too low and washes out seasonally. Improvements to the trail would also benefit the stream channel.

The riparian vegetation along the stream is primarily good with a closed canopy of Douglas Fir with some Red Cedar, Hemlock and Grand Fir. The headwaters of Bings Creek are primarily in the managed woodlot operated by the District of North Cowichan. Air photos show some logging in the watershed but the locations appear away from the main channels.

## Menzies M1

Menzies Reach 1 is located from the confluence of Bings Creek and lies west to cross old Lake Cowichan Road ending at the Lake Cowichan Highway. The 3227m long reach runs through a rural residential/farm area its entire length. It was sampled below and above old Lake Cowichan Road. The survey was completed August 20, 2020 over 130m of length measuring six pools and five riffles. No water quality measures were taken in this reach.

This reach had an average channel width of 4.4 m and a wetted width of 2.8 m. The reach gradient was 2 %. The results are shown in the table below.

**Table 15 - Reach 6 Habitat and Water Quality Summary Results**

Habitat Parameter	Result	Ratings	Result
% Pool Area	66	1	Good
Large Woody Debris/Bankfull Channel Width	0.1	5	Poor
% Cover in Pools	8	3	Poor
Average % Boulder Cover	2	5	Poor
Average % Fines	22	5	Poor
Average % Gravel	34	not rated	
% of Reach Eroded	28	5	Poor
Obstructions	0	0	Good
% of Reach Altered	10	3	Good
% Wetted Area	63	5	Poor
Dissolved Oxygen	Na		
pH	na		
	Mean Score	3.5	Fair/Poor

The Riparian features of M1 are shown in the table below taken from the USHP summary tables. This reach was a mix of regenerating riparian areas from historic clearing.

**Table 16 - Reach M1 Riparian Results**

Riparian Ratings	Result	Ratings	Result
Land Use	20	1	Fair
Riparian Slope	22	1	Good
Bank Stability	26	1	Fair
% Crown Cover	79	1	Good

Riparian Ratings	Result	Ratings	Result
% of Reach Accessed	2	1	Good
Average Vegetation Depth	26	5	Fair
Mean Score		2.0	Fair/Good

Menzies Reach 1 has perennial pools but the riffle segments likely dry in most summers. It is similar in habitat condition to Bings Reach 6 which lies parallel on the east side of Tansor Road.

The fish habitat characteristics that were good are;

- High percentage of pool area (66%).  
The perennial pools were abundant and most had wetted riffles offering food, migration and aeration.
- Riparian characteristics were Fair to Good.  
The canopy is diverse mix, but mainly Red Alder and Douglas Fir. The trees are providing good shade (79%) for their short depth (26m). The farm edges inspected were fenced and there were no livestock intrusions.

The fish habitat characteristics that were poor are;

- Cover Habitat  
There is a lack of LWD in the entire reach. The reach has been historically cleaned of debris. The narrow and confined channel has 1.5 to 2.0 m bank heights with little floodplain to permit debris jams to form and create meander. It is likely that every tree that falls in this reach is cut by property owners to avoid flooding on the pastures. Adding debris would be limited to wider locations such as at Old Lake Cowichan Road where it is 8.5m wide.
- A mean depth of 0.34m is barely adequate for trout survival. The lack of LWD reduces the scour depth and cover for fish.
- Obstructions/Erosion  
The Cowichan Road culvert is approximately 6.0 ft diameter on 0% gradient. It is hung 0.75m. The road culvert site has a 10m eroding left stream bank. There are also active eroding banks at Site 70 and 73 below the road.
- Obstructions/Erosion  
An abandoned culvert lies sideways in the creek bed 80m below the Cowichan Lake road (Site 70). It has collected small woody debris and is resulting in bank erosion. There is potential access through the adjacent farm to remove the pipe.

## M2 – Headwaters

The headwaters of Menzies Creek above the Cowichan Lake Highway are fed by the western ridgeline of Mt Prevost. The beginning of the reach is the start of seasonal flow and diminished fish habitat. Given the time limitations of the survey it was not inspected. The reach is likely similar to Bings R7 and headwaters. Water Quality monitoring is recommended.





Reach 7 Habitat Photos



1.) R7 Debris and sediment at confluence of 7a & 7b tributaries



2.) R7a – below Drinkwater rd culvert: long dry gravel run



3.) R7b below culvert, dry, low banks.



4.) R7b- wide floodplains interconnect 7a & 7B (Site 108)

Bings R8 Headwaters Habitat Photos



1.) R8 – Headwater forest, dry channel.



2.) R8- Footbridge is inadequate size, results in stream walking

## Discussion

### Survey Efficiency and Limitations

The level 2 habitat survey of Bings Creek covered 2166m out of a total length of 10431m of the mainstem and Menzies Reach 1. We did not survey the estimated 3km long headwaters on Mount Prevost. Our survey resulted in 20% of the overall stream length being covered. The survey sample of 20% exceeded the target and the provincial standards of 10% of reach length. The lower salmon bearing waters (R1-R3) were 50% to 100% surveyed. The survey effort was biased to the reaches of highest salmon value. Their entire lengths were inspected for signs of alteration, erosion or obstructions (AEO). Unfortunately these salmon bearing reaches were also the locations of highest alteration.

The fact that we exceeded our target 10% goes to the credit of the skill of the Somenos Marsh Wildlife Society. Using skilled persons doubled our efficiency. The good preparation started with the entire crew being equipped in chest waders, field vests, and data collection gear. They were well versed in stream characteristics and made the correct decisions in regard to habitat types and measures. The crew size was three or four persons throughout the survey. There were no injuries to report despite some challenging wading and walking areas. Prior to the survey, the Society contacted land owners and received permission, allowing field time to be dedicated to collecting data.

### Bings Creek Habitat Comparison

#### Reach Comparison

The interpretation of the USHP survey was compared in the reach summary tables presented in the Results above. The summary tables identified a numeric score for Good (1), Fair (3) and Poor (5). Converting the values into a numeric score permits reaches to be compared amongst each other or over time. The table below shows a review of the seven Bings mainstem reaches and Menzies M1.

**Table 17 – Bings Creek Reach Habitat and Riparian Summary**

Reach	Habitat	Result	Riparian	Result
Reach 1	2.6	Fair	1	Good
Reach 2	2.9	Fair	2	Fair/Good
Reach 3	2.6	Fair	1	Good
Reach 4	2.9	Fair	2	Fair/Good
Reach 5	4	Fair/Poor	2	Fair/Good
Reach 6	3.3	Fair	2.1	Fair/Good
Reach 7	3.3	Fair	2	Fair/Good
Menzies 1	3.5	Fair/poor	2	Fair/Good
<b>Mean Score</b>	<b>3.1</b>	<b>Fair</b>	<b>1.8</b>	<b>Fair/Good</b>

Based on overall reach scores in Table 17; the instream habitat results in Bings/Menzies scored 3.1 for a resulting overall value of Fair. This was a consistent habitat score for every reach. While none of the reaches were particularly good, Reach 5 was the poorest (4) due to the high amount of alteration and erosion along the Cowichan Valley Trail.

The overall riparian mean score of 1.8 is Fair to Good. It was consistent throughout all reaches that there were no significant barren areas along the stream. The age and diversity of the riparian area is the weakest factor. More plant diversity is needed and continued protection of the depth of the riparian area.

### Vancouver Island Habitat Comparison

The USHP survey of Bings Creek can be compared with other streams on Vancouver Island that were surveyed using the same methods. Table 18 below compares Bings Creek to other surveyed streams on Vancouver Island;

**Table 18 - Fish Habitat Deficiency (x) Comparison of Bings Creek and 14 Vancouver Island Streams <sup>4</sup>**

Watershed	Percent Pool Area (<55%)	Large Woody Debris (<2)	Percent In-stream Cover (<20%)	Percent Fines (10-20%)	Percent Wetted Area (<90%)	Critical Flow (<10% MAD)	Impervious Surface (>10%)
<b>Bings Creek (2020)</b>		X	X	X	X	No Data	
Ayum Creek	X				X	X	X
Beach Creek		X		X	X	X	
Bear Creek		X	X	No Data	X	X	X
Fairways Creek		X	X	No Data	X	No Data	
Kingfisher Creek	X	X	X	X	X	No Data	
Little Oyster R.		X	X	No Data	X	X	
Little River		X		X	X	X	
Nile Creek		X	X	No Data	X		
Piercy Creek	X	X	X	X	X	No Data	X
Scales Creek	X	X		X	X	No Data	No Data
Simms Creek	X	X	No data	No Data	X	No Data	X
Thatcher Creek		X	X	X	No Data	No Data	
Woodhus Creek	X	X	X	No Data	X	X	
Woods Creek		X		X	X	No Data	

\*An X entry represents a rating poorer than the proposed cutoff for acceptable habitat quality.

The Table 18 comparison shows Bings Creek is deficient in 4 of 7 categories. Unfortunately this puts the stream score in the middle of the comparable east Coast Vancouver Island streams. Bings Creek suffers from similar legacies of historic logging and dredging that have removed the pools and LWD that was in them. It was fortunate to have more summer wetted area than most; a product of its very low gradient more so than water flow. There are large standing pools backed up a long way due to debris and beaver dams. Knowing there are streams in similar habitat condition may permit comparison of management and restoration applications. Stewardship groups on Vancouver Island have been very active for decades doing restoration on these and other streams. There has been an improvement of techniques over the years. Restoration strategies are discussed below.

<sup>4</sup> Reid et al. 1999

## Bings Watershed- Restoration Sites

The field survey in August resulted in many ideas for restoration. As we measured habitat, we were also considering the restoration plans for the site. We itemized the impacts and restoration options of each reach segment. At days end, a narrative was written of all the items we encountered. Elodie Roger, project manager, and the SMWS team put together the daily list of our observations and is recorded in Appendix 1. After the habitat survey was completed the habitat data and daily observations were reviewed for the restoration plan. Table 20 below shows the summary of restoration plans for the Bings Watershed. The restoration categories we used were:

- Garbage
- Riparian Habitat
- Spawning Habitat
- Rearing Habitat
- Obstructions
- Erosion
- Alterations
- Water Quality
- Education/Awareness

Garbage was separated into Table 19 below for action in 2020. Tables 19 and 20 have a priority ranking for the restoration activity. The ranking of high, medium or low is based on a combination of factors; the ecological hazard and the benefit (cost, access, partnerships) of doing the activity. Table 20 shows the high priority restoration sites and activities highlighted in red.

**Table 19 -Garbage Impacted Sites - Bings Creek**

Reach	Location	Description	Priority
1	Most below highway, along railway. Noted at sites 7,14-24. Access via nature boardwalk	Small floating material and homeless camp debris. Most is accessible on near bank or wearing gumboots to cross at low water, waders optional.	2
2	Clean	No significant debris observed	na
3	Access from Savory (Mary St) property or Westwood Apartments (Lk Cow Rd), Along banks and in log jam above wetland.	Tires, lumber, garbage tossed from upstream. This is a wetted area, need waders and removal plan to avoid harm in this Coho spawning area	4
4	Falls to TC trail culvert. No safe access to sites in the ravine.	Lawn and garden debris tossed over bank. Talk to property owners on Caen and Agira Rd.	na
5	Along TC Trail, at culvert under road and in patches along creek and in debris jams. Most is at bridge area and Avondale/Keystone access.	Hand tossed and homeless debris spread along entire area most near town and on dry land or in shallow areas accessed by gumboots.	1
6	Clean (along TC and Cleve Rd)	No significant debris observed, this is just below the TC and no one is littering the creek here.	na
7	Adjacent Drinkwater landfill/recycle centre	Animal (mostly birds) distributed small debris from dump to highway (350m), Seasonally dry channel.	3
8	Clean, (Above Drinkwater Rd in woodlot)	Active trail adjacent the stream little garbage, lots of trail erosion.	na
Menzies 1	Access from Old Lake Cowichan Road	Large debris – metal culvert below rd, footbridge above, Wetted site need a permit to remove.	5

Table 20 - Restoration Sites - Bings Creek v2

Reach	Issue	Location	Prescription	Priority
Reach 1	Riparian Restoration Logged and farmed riparian area entire length. It was flattened for farming and the recovery is hampered by uniformity of the old pastures.	Both Banks starting where left off and also underplanting for diversity (Spruce at Stn 17-22)	The previous Spruce planting was successful, do more further downstream. Highest priority is 100m along south bank to end of walkway. It will require approximately 150 trees infilling the 5-10m riparian area to the lowest walkway .  The lower routinely flooded grassy areas require Cottonwood and Willow/Osier planting as well as other shrubbery –Salmonberry, Indian Plum. The understory is poorly seeded. Suggest getting wild seed sources for understory from duff transplants from nearby healthy areas.	H
R1	Riparian lack of CWD	Both sides in upper reach less flooded areas.	The riparian area was leveled for pasture and lacks diversity add CWD. The CWD placement must not float away – use less buoyant species (Cottonwood, Hemlock) and anchor with rock or soil.	L
R1	Riparian – too flat, no diversity	Near access (for truck or excavator) on south side	A placement of planting mounds (>3x5x1m) in the floodplain would help native trees establish above the flood/grass zone. This has been experimented in reach 2 and should be assessed first.	L
R1	Pond water quality not suitable for fish	Constructed Pond – Stn 9	The Station 9 pond is anoxic, high leaf input from adjacent vegetation. Not good fish habitat but offers amphibian potential (none observed). Pond lacks flushing flows to remove nutrients that delete oxygen. The intake may be plugged. More Conifer under-planting on spoil around the pond for replacement of the deciduous leaf litter will help. The beaver may eat the seedlings if not wrapped in wire.	M
R1	Spawning Gravel /Boulders Lack of substrate in dredged channel. The channel below the highway is dug 1.5m below grade for 50m.	Placements to improve re-establishing sites at 3-4 mid reach sites (Stn 7, 13-16).	Add spawning gravel in shallow bars in mid reach (below the deepest highway dredging). Access is challenging, suggest import gravel around the planted trees with power wheel barrow from right bank trail. There are approx. 4-6 sites each with area of approx. 3x3m. Requires approx. 4-6 yards gravel and boulders for anchoring. Hand hauled buckets of gravel would help if no machine access.  The highway outlet pond is another good potential spawning site. But it was dredged deep and would require a rock crest at the outlet for support of gravel placement (the crest would help aeration as well). This site is approx. 5m x8m and would require an excavator to build the crest and place the gravel. There is machine access. This activity would require highways approval/assistance as it is in their easement.	H  M
R1	Cover Habitat	In mid reach where there	Small well anchored LWD placements in the few confined areas of the	M

	Lack of Cover, dredged channel, virtually no LWD or rooted banks	was shallow confinement (stn 7-17)	recovering channel, located in confined shallow areas by anchoring 3-5m long cedar logs in A frames anchored with boulders or duckbills	
R1	Obstructions	Beaver dam at Pond outlet (Stn 8)	No fish obstructions to normal migration water flows/levels; monitor the site only.	L
R1	Obstructions	There are old farm fence lines blocking flow and wildlife passage	Remove the old fence lines in the riparian and floodplain	M
R1	Water Quality There was adequate oxygen (4-6ppm) and temperature (16C) levels during the survey	Bing Creek Watershed water quality monitoring program	Routine (annual seasonal) Water Quality monitoring of each reach in Bings Creek is highly recommended. Collect laboratory water samples, conduct field measures and set up data loggers. The RDN DWWP <sup>5</sup> offers a template for stewardship groups to follow.	H
R1	Education/Partnerships	Wetland trail entrance	Maintain watershed information signage at entrance to boardwalk. Ensure that garbage and encroachment are minimized.	L
<b>Reach 2</b>				
R2	Riparian Restoration	Entire length	Historically logged, lacks conifer regeneration, some areas even lack shrubbery. Below Canada Ave – add more shrubs ie willow/osier along dredged banks  Above Canada Avenue lacks Conifer regen due to altered low lying landscape. Plant conifer polygons in elevated areas. More deciduous trees in low lying grass openings.	M-H  M-H
R2	Spawning Gravel	Dredged and lacks substrates in most areas	Add gravel (with larger anchor rock) at confined sites along RCMP, Canada Ave and Railway, there is good access. These sites may require additions on routine basis as it is used or washes out.	H
R2	Cover Habitat	Lacks LWD, rooted banks throughout	Add LWD cautiously in floodplain areas where it may wash away. Use brush mats in confined high fish use pools at Canada Ave and Railway pools.	M
R2	Obstructions	From Railway crossing upstream along RCMP property is a major diversion	The channel was diverted in 2 right angles. It results in flooding, sedimentation and drowning of riparian areas. The redirection of this channel through the RCMP property would provide a better habitat opportunity. The work would require considerable review and	M

<sup>5</sup> Regional District of Nanaimo Drinking Water and Watershed Protection Program; <https://www.rdn.bc.ca/drinking-water-and-watershed-protection>  
Bings Watershed Habitat Assessment 2020



		channel	expense. But there are examples of this in streams such as Departure Creek in Nanaimo that took over a parking lot.	
R2	Water Quality	No concerns from survey	Water Quality Monitoring program is highly recommended as a first priority item.	H
R2	Education/Partnerships	Entire length	Highways, Railway, District N Cowichan, City Duncan, RCMP all have infrastructure in this reach. Cowichan Tribes would also be very interested in the resource improvements.	
<b>Reach 3</b> to falls	Riparian Restoration	Most bank areas are regenerating mixed forest	There may be localized infill planting for biodiversity	M
R3	Spawning Gravel	Well distributed throughout	Plenty of gravel passing through reach, no need for additions.	L
R3	Cover Habitat	Lower reach 3 lacks cover over pools	The lower reach is more open pools on low gradient, lacks stable LWD but has several debris jams offering cover that may be stabilized with anchoring using duckbills. Importing material into the site difficult access. Brush mats may be placed in some pools to add cover	M
R3	Obstructions	Reach 3 end	There are no man made obstructions, the debris jams are passable. There has been interest in making a fishway at the falls. This would be expensive and first require agency approval and considerable fish population information.	L
R3	Water Quality	No concerns from survey	Water Quality Monitoring program is highly recommended as a first priority item.	H
<b>Reach 4</b> Falls Ravine to TC Trail	Riparian Restoration	Entire length has steep bank that is mostly unchanged	Infill planting in gap areas with property owner permission.	L
R4	Spawning Gravel	Poor opportunity- too confined and fast		L
R4	Cover Habitat	Poor opportunity – too confined and fast		L
R4	Obstructions	Natural barriers (2) Man Made (CNR culvert)	Fishway construction to permit salmon access has been historically considered – review with agencies  The CNR/Valley Trail culvert is collecting debris and appears undersized. A plan should start on its replacement and it must be designed according to agency fish passage criteria.	L  M

R4	Water Quality	No concerns from survey	Water Quality Monitoring program is highly recommended as a first priority item.	H
<b>Reach 5</b> TC Trail to Menzies Fork	Riparian Restoration	The Cowichan Valley Trail runs	Alongside the river right bank and we observed a high amount of trampled banks and riparian vegetation from people. There are too many side trails and unmanaged access sites off the main trail. This is a very high impact on the plant community and bank stability. Addition of Coarse Woody Debris (CWD) and fencing to control access followed by replanting of trees and shrubbery in protected areas.	H
R5	Spawning Gravel	Gravel in entire reach	No addition , lots of gravel, addressing erosion will clean up gravel.	L
R5	Cover Habitat	Lacking Boulder cover through reach 5	Add single or sets of boulders throughout the reach in pool tailouts and riffles to aerate and provide habitat. The basket ball sized rocks could be wheel barrowed into sites due to the many trails in the lower reach.	M
R5	Cover Habitat	Entire length lacks pool cover	Add structures to improve cover. Brush covers are lowest risk and can be hand placed in sensitive areas. Addition of LWD cover logs/stump placement in select sites with confinement, access and anchoring. There are several sites with good machine access along the trail where LWD and CWD can be prescribed.	M
R5	Erosion	Along R5 near Cowichan Valley Trail	Block trail with CWD, fencing to deactivate harmful trails, then plant the erosion sites. Addition of LWD and rock anchors for cover may also protect damaged banks.	H
R5	Obstructions	No barriers		L
R5	Water Quality	Entire length	No pollution sources identified. Monitoring recommended.	H
<b>Reach 6</b> Menzies Fork To Lk Cow Hwy	Riparian Restoration	Infill planting in bare patches off Cleve Rd.	In concert with bank restoration there is 10-15m of exposed bank at 2 sites (Trail culvert and Cleve farm)	H
R6	Spawning Gravel	Gravel in entire reach	Addressing erosion will clean up fines and improve gravel quality.	L
R6	Cover Habitat	Entire length	Add anchored brush mats over pools that are unstable/unconfined until they recover. LWD is recommended only in culvert pool and farm pool (see erosion)	L
R6	Obstructions	Valley Trail Crossing	Three 4 foot metal culverts are hung 2 foot above low water. Need to add a pool crest to raise water level or replace with fish friendly	M

			structure.	
R6	Water Quality	Entire length	No pollution sources identified. Monitoring recommended.	H
R6	Erosion	Cleve Road	Cleve farm pasture right bank (10m) in need of erosion protection (taper bank, add stumps/Rock, replant)	H
R6	Erosion	Valley trail culvert by Cleve Rd	Trail culvert outlet hung and along 5m right bank in need erosion protection (taper bank, add stumps/Rock, replant)	M-H
<b>Reach 7</b> Highway to Drinkwater	Riparian Restoration	Entire reach length	Maple dominated canopy needs understory conifer planting.  Riparian area is CWD deficient. There are old routes to permit machinery delivery into the riparian areas. Silviculture prescription for planting may include removal of select Maple trees which would then contribute to the CWD. This would improve wildlife and amphibian habitat in the reach.	M  L
R7	Spawning Gravel	Entire reach length	Gravel is plenty but dries and is instable, not a good candidate until the channel is stable with more water.	L
R7	Cover Habitat	Entire reach length	Instream cover LWD is very low. Channel is unstable and lacks placement opportunity. Seasonal use limits cover benefits at this stage of recovery.	L
R7	Obstructions	At lower end	There is a braid and debris jam at the confluence. That is not recommended to remediate unless it threatens downstream habitat.	L
R7	Water Quality	Entire reach length	No pollution sources identified. Monitoring recommended. There may be some concern from runoff from landfill debris that water measures will eliminate. The Waste Centre may be monitoring the surface and ground water in the proximity of the property.	H
<b>Reach 8</b> Bings Headwaters	Riparian Restoration	Lower reach	Managed woodlot and park. Riparian canopy is good. Planting streamside shrubbery in erosion areas along trails recommended.	M
R8	Spawning Gravel	Entire reach	Low fish use and plenty of gravel	L
R8	Cover Habitat	Entire reach	Low fish use. No debris jams observed in lower 1500m.	L
R8	Obstructions	Entire Reach	None observed	L
R8	Erosion	Lower reach near trail	First crossing washes out, too low and erodes footings every year. Replace with proper bridge (contact district)	M

R8	Water Quality	Entire reach length	No pollution sources identified. Monitoring recommended.	H
<b>Menzies R1</b> Bings to Lk Cow Hwy	Riparian Restoration	Entire reach	In the Lake Cowichan Road survey area, there are smaller polygons 5-10m in length where infill planting is recommended (with private land owner permission) .	M
M1	Spawning Gravel	Entire reach	No need for gravel addition. Localized erosion sources adding sediment.	L
M1	Cover Habitat	Entire reach	Confined channel adjacent farm pastures. The reach was historically managed for debris removal. Due to head cutting and erosion, the channel is incised and narrow. These are poor areas for LWD placement without considerable bank pull back to accommodate flow. The sites for LWD placement need to be wide; such as the culvert outlet pool below Cowichan Road where the channel is eroded to 8.5m wide along 10m of left bank. This work should be done in conjunction with improving the culvert fish access.	M
M1	Obstructions	Cowichan Road Culvert	The Cowichan Road culvert is approximately 6.0 ft diameter on 0% gradient, but is hung 0.75m from low water due to headcutting of the channel from the discharge. This is a point of difficult fish passage.	M
M1	Erosion	Cowichan Road Culvert	The falling water out of the pipe is digging into the left bank and resulting in 10m of bank erosion. Addition of LWD anchored with rock would protect the bank and add habitat. Rock weir to lift water level.	M
M1	Erosion	An abandoned 5m section of culvert lies sideways in the creek bed 80m below the Cowichan Lake road.	This pipe is collecting branches and debris and is eroding both banks. The adjacent farm owners would likely approve and possibly assist in its removal to protect their fence and pasture.	H
M1	Water Quality	Menzies Reach 1	A water quality monitoring program is recommended in this reach; monitoring locations at the Cowichan Road and Curry Rd near its confluence.	H
<b>M2</b> Headwaters	Water Quality	Highway	Water quality monitoring is recommended at the bottom of the reach at the highway.	M

Bings Watershed Garbage Site Photos



R1-Next to Boardwalk



R7- Near Drinkwater Rd Waste management site



R5 near CV Trail



R1- October 20,2020 SMWS Garbage removal results

R1 Restoration Photos



R1 Spawning Gravel addition – sites 7,13,14,15,16,17,20,22.



R1- Riparian planting Spruce with beaver protection



R1- LWD Sites 13, 16, 19,



R1 -Garbage Cleanup – instream & banks

R2 Restoration photos



R2- Spawning Gravel addition sites 117,118



R2 – Beaver dam(Site 17) floods to Mary St.



R2 – Riparian planting on grass (Site 16)



R2 Beaver flooding Mary St culvert

R3 Restoration photos



R3 -Log jam has garbage deposits as well, needs cleaned.



R3 –Falls are small, stepped, a fishway may be possible.



R3 –Riparian Area is healthy and regenerating.



R3 – abundant gravel deposits for spawning.



R4 Restoration Photos



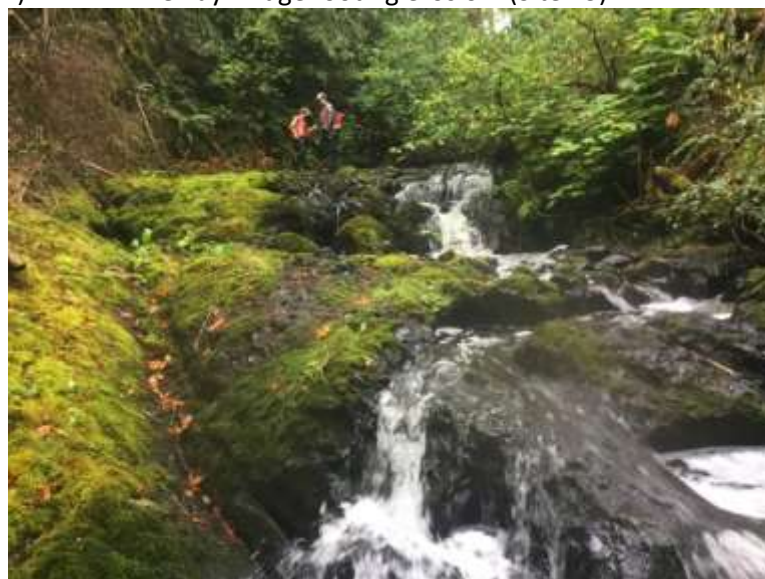
R4 - Lawn clippings dumped on bank by falls (Site 42).



R4 - Driveway Bridge footing erosion. (Site 43)



R4 - Site 46, decommissioned water inlet, no concerns.



R4 - Falls 2 (Site 47) is stepped with fishway potential

R5 Restoration Photos



R5 – Garbage and debris plugging CV Culvert (Site 50)



R5 –Sewer line runs parallel Creek. (Site 69 near Keystone)



R5.Debris jams from thinning Alders need maintenance



R5 erosion on right bank is significant from people

R6 Restoration Photos



R6 – Farm Bank Erosion from blowdown/undercutting (Site 88)



R6– Eroding left bank Clay bank (Site 92).



R6. Hung CV Trail culverts near Cleve Road (Site 94)



R6 – CV Trail Culverts opposite bank erosion.

R7 Restoration Photos



R7b at Site 107 with 15m wide alluvial fan, lack of



R7a – Site 103 debris jam & garbage



R7a.) Garbage litters riparian ( Site 100) next to dump



R7b – Low banks, lack of conifers, dry channel Site 109

## Restoration Prescriptions

The restoration projects identified are monitoring water quality, riparian planting and instream works i.e. garbage removal, spawning gravel , boulder and LWD placement.

### Permits

Work instream that could result in disturbance to fish or their habitat is done under a water act permit. Generally riparian planting and surface garbage clean up does not require a permit. This permit is available online through Frontcounter B.C. <http://www.frontcounterbc.gov.bc.ca>. For fish habitat restoration the permits are submitted as *notifications* and signed off by Fisheries and Oceans, The District of North Cowichan or other government. The restoration design is taken from the data provided in the habitat survey (i.e. location, channel width).

### Designs

Stream habitat restoration requires designs to plan the work and submit for permit. Table 20 identifies the restoration prescription. The table describes the type of restoration to be applied to the site. The designs for the sites are based on standard practices developed and published for stream restoration projects. The B.C. Watershed Restoration Program provides a standard reference for stream restoration techniques in “Fish Habitat Rehabilitation Procedures”<sup>6</sup>. This manual is often referred for acceptable restoration practices including rock log and gravel placements in streams.

The Pacific Streamkeepers Federation Streamkeepers Handbook is another very useful guide for restoration and monitoring examples such as;

- Module 3 – Water Quality Survey
- Module 6 – Stream Clean up
- Module 7 – Streamside Planting

Examples of spawning gravel placement by the author is shown in Appendix 12 and bank erosion restoration ( i.e. for R6) is shown in Appendix 13.

## High Priority Restoration Activities\*

Table 21) High Priority Restoration Sites

Reach	High Priority Restoration Activity	Description
1	Riparian Planting	Spruce previously successful
	Spawning Gravel	Several small sites
2	Spawning Gravel	Along RCMP and below
3		No high impact
4		No high impact
5	Riparian restoration	CV Trail impact
	Erosion control	CV Trail impact
6	Riparian restoration	Cleve Rd
6	Erosion control	Cleve farm right bank failing
M1	Erosion/debris	Pipe laying in creek bed

- Water Quality monitoring is considered a high priority in all fish bearing reaches.
- Garbage removal prioritized and completed in Table 19

<sup>6</sup> Slaney, P.A. and D. Zaldokas, 1997. Fish Habitat Rehabilitation Procedures, Watershed Restoration Program, MOELP, UBC , Vancouver BC.

## Conclusion

The Urban Salmon Habitat Survey of the Bings Creek watershed serves as a reference for both monitoring and restoring a watershed. The baseline survey of fish habitat with reference locations offers repeatable surveys critical to understanding the current and future stream health. The USHP survey also provides the data on the functional components used for recovery of the watershed. This information is the basis for restoration planning. The USHP provides specific data on the length width and character of the instream and riparian area.

The results of the habitat survey of Bings Creek indicate positive transition. It is recovering from the historic logging impacts that removed all old growth from the survey area. The recovery is readily observable by the height and depth of trees along most of the waterway. The current health of the watershed scored Fair in overall USHP ratings. The harmful historic impacts are receding; unfortunately newer impacts are depressing the recovery. Urbanization has more recently diverted, culverted and encroached the stream channel. Long term planning is essential for the protection of Bings Creek. Looking at the current image through Google Earth © shows the Bings Creek Watershed has four distinct land types of approximately equal proportions; forested (headwaters), industrial (upper & mid reach), Rural/Farm (mid reach) and residential/urban (lower). The industrial and urban areas are growing and have the highest potential impact to the watershed. Local government planning and zoning have the biggest role to play in how the land is developed, i.e. Cowichan Valley, North Cowichan Regional Districts and Cowichan Tribes.

Watershed based planning is key to protection of the waterways, fish and wildlife values. A good plan equally protects homes and infrastructure. Higher level guidance is available for communities from the B.C./DFO Develop With Care Guidebook and Waterbucket.ca. Establishing these principles in the OCP of local government is vital to protecting Bings Creek. The District of North Cowichan recently completed the Bonsall Creek Watershed Management Plan <sup>7</sup> in 2015. This study is a good template for the Bings Watershed and should be endorsed to incorporate into the Official Community Plan (OCP).

The Bings Watershed Habitat Assessment itemized over 50 restoration activities on Table 20. These actions were designed for Streamkeepers to undertake. The Somenos Marsh Wildlife Society has taken the lead on this project but other groups may be involved based on their mandates and past involvement. Nature Trust, Cowichan Community Land Trust, Cowichan Tribes and Cowichan Stewardship Roundtable have been involved in stewardship activities in the watershed. The District of North Cowichan has done significant projects that incorporated restoration of Bings Creek as well.

The focus of restoration on Bings Creek should not start with this list; it should start with forming partnerships with the local government and land owners. The priority of activities in the restoration plan is not necessarily the order in which they should be done. Restoration is best done with willing land owners and partners. Bringing in the property owners and local residents as active participants is vital to long term success. The SMWS made a successful first step by contacting property owners about the survey. It is important to share the results and plans with them as a follow up. Thus any restoration on their property would be more likely approved by the land owner.

Restoration should start small with monitoring to avoid big failures which early in the process would defeat the effort. Small failures are learning opportunities and permit adjustments. In 2020 the SMWS did the garbage cleanup identified in this survey in October. This was an important and successful first activity that benefits the environment and builds exposure and partners.

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<sup>7</sup> <https://www.northcowichan.ca/EN/main/departments/planning-development/community-planning/bonsall-creek-watershed-management-plan.html>

There are many smaller projects identified in this survey. Garbage clean up, riparian planting and water quality monitoring are important projects that are scalable to any group size. They usually require only property owner permission, can be done at any time of the year and are lower cost. At the opposite scale are larger projects that require instream work permits and use heavy equipment. These projects incorporate stewards as well but require professional oversight to sign off on the permits and environmental aspects. An example may be bank restoration with excavator placed LWD and anchor rocks.

Over the last 30 years, there has been a transition of the boots on the ground restoration personnel from government only, to activities led by stewardship groups working in partnership with government and property owners. It has been the successful formula. The SMWS has put a lot of effort into the Somenos Watershed over the years. They have been undertaking water quality and fish monitoring, invasive species removal, native plant restoration, garbage removal, public awareness/education, watershed planning including mapping, landscape planning and committee and partnership building. They have broken out the Somenos Watershed into sub basins for assessment. This restoration plan offers a list of restoration prescriptions as well as important baseline habitat data on Bings Watershed. We hope this report brings more successful projects for the Somenos Marsh Wildlife Society.

Submitted by

David R. Clough, RPBio





Appendix 3 – Reach 3 Habitat Data

Stream Name	Bings	Watershed Code	1234	Date	Aug.20/20	Reach Name	Bings R3	Discharge Depth #1	0.00	Velocity	T1	Site Length																																								
Water Quality Information																																																				
Dissolved Oxygen	8.00	pH	7.00	Total Dissolved Solids	133.00	Temp C	17.00	Discharge Depth #2	0.00	T2																																										
Velocity (m/s)		Average Depth (at flow site)	0.00	Wetted Width (at flow site)	0.00	Discharge (m3/s)	249.00	Discharge Depth #3	0.00	T3																																										
Habitat Information (All Pool and Cross Section Data)																																																				
Habitat Type	Start (chainage at start)	Finish (chainage at end)	Unit Length	Wetted Width	Pool Area	Wetted Reach Area	%Pool Area	Habitat unit Depth (m)	Percent Gradient	Bankfull Width(m)	Average Percent Wetted Area	Substrate Percent					Percent Instream Cover				Percent Cr own Cover	Large Woody Debris	LWD/bank-full channel width	Erosion Sites (length)	Altered Stream Sites (length)	Obstructions (number)	Off-Channel Habitat (length)	Off-Channel Habitat (width)	Off-Channel Habitat (bank side)	Land Use Right	Land Use Left	Vegetation Type Right	Vegetation Type Left	Riparian Slope Right	Riparian Slope Left	Stability Right	Stability Left	Vegetation Depth Right	Vegetation Depth Left	Livestock Access Right	Livestock Access Left	Photos	Comments									
Pool	0.00	19.00	19.00	3.70	70.30	70.30	0.40	0.00	0.00	7.50		0	0	0	10	90	0	0	5	0	75.00	1							Nat	Nat	Mix	Mix	10	10	Med	Med	50	50			Stn 34	rock										
Riffle	19.00	32.00	13.00	1.60	0.00	20.80	0.10	1.00	14.10			0	0	0	10	90	0	0	5	0	75.00	0							Nat	Nat	Mix	Mix	35	10	Med	Med	50	50			Stn 35	bedrock sides										
Pool	32.00	75.00	43.00	8.00	344.00	344.00	0.60	0.00	8.90			0	0	0	20	80	0	10	0	80.00	1							Nat	Nat	Mix	Mix	35	10	0	0	30	40			Stn 36												
Riffle	75.00	85.00	10.00	5.90	0.00	59.00	0.30	0.00	12.00			0	0	10	20	70	0	10	0	80.00	1							Nat	Nat	Mix	Mix	35	10	0	0	30	40			Stn 37	nice SG											
Pool	85.00	124.00	39.00	7.30	284.70	284.70	0.30	0.00	19.00			5	0	5	10	70	0	5	0	90.00	1							Nat	Nat	Mix	Mix	40	25	High	High	60	80			Stn 38												
Riffle	124.00	221.00	97.00	3.90	0.00	378.30	0.20	10.00	9.10			85	5	5	5	0	5	0	0	95.00	0							Nat	Nat	Mix	Mix	70	50	High	High	25	25			Stn 39	atleep											
Pool	221.00	249.00	28.00	5.30	148.40	148.40	1.70	0.00	10.00			100	0	0	0	0	10	0	0	90.00	0							Nat	Nat	Mix	Mix	90	90	High	High	30	30			Stn 41	Falls pool											
Reach Totals and Averages													249.00	129.00	5.10	847.40	1305.50	64.91	0.51	1.57	11.51	44.29	27	1	3	11	57	2	4	1	1	83.57	4	0.18	0	0	1	0	7	7			15	13	9	9	39.29	45.00	0	0		

Appendix 4 – Reach 4 Habitat Data

Stream Name	Bings	Watershed Code	1234	Date	Aug.20/20	Reach Name	Bings R4	Discharge Depth #1		Velocity	T1	Site Length																																								
Water Quality Information																																																				
Dissolved Oxygen		pH		Total Dissolved Solids		Temp C		Discharge Depth #2	249.00	T2																																										
Velocity (m/s)		Average Depth (at flow site)		Wetted Width (at flow site)		Discharge (m3/s)	366.00	Discharge Depth #3		T3																																										
Habitat Information (All Pool and Cross Section Data)																																																				
Habitat Type	Start (chainage at start)	Finish (chainage at end)	Unit Length	Wetted Width	Pool Area	Wetted Reach Area	%Pool Area	Habitat unit Depth (m)	Percent Gradient	Bankfull Width(m)	Average Percent Wetted Area	Substrate Percent					Percent Instream Cover				Percent Cr own Cover	Large Woody Debris	LWD/bank-full channel width	Erosion Sites (length)	Altered Stream Sites (length)	Obstructions (number)	Off-Channel Habitat (length)	Off-Channel Habitat (width)	Off-Channel Habitat (bank side)	Land Use Right	Land Use Left	Vegetation Type Right	Vegetation Type Left	Riparian Slope Right	Riparian Slope Left	Stability Right	Stability Left	Vegetation Depth Right	Vegetation Depth Left	Livestock Access Right	Livestock Access Left	Photos	Comments									
Riffle	249.00	268.00	19.00	7.00	0.00	133.00	0.10	5.00	9.80			85	5	5	5	0	5			85.00	0							RS	RS	Br	Mix	40	40	0	0	30	30			Stn 43	Bridge footings											
Pool	268.00	283.00	15.00	4.90	73.60	73.60	0.60	0.00	7.10			50	25	25	0	0	5			85.00	0							RS	RS	Mix	Mix	40	40	0	0	10	10			Stn 44												
Riffle	283.00	334.00	51.00	3.30	0.00	168.30	0.10	3.00	6.70			50	20	10	20	0	10			90.00	0							RS	RS	0	0	40	40	High	High	10	15			Stn 45												
Pool	334.00	351.00	17.00	5.40	91.80	91.80	0.80	0.00	9.40			0	0	0	0	0				90.00	0							RS	RS	Mix	Mix	40	40	High	High	30	30			Stn 46	old inlet											
Riffle	351.00	366.00	15.00	1.80	0.00	27.00	0.10	30.00	6.70			100	0	0	0	0				80.00	0							0	0	0	0	40	40	0	0					Stn 47	Falls											
Reach Totals and Averages													117.00	32.00	4.48	166.30	493.60	33.49	0.34	7.80	7.94	56.42	57	10	8	5	0	7			86.00	0	0.00	0	0	0	0	0	12	12			5	5	2	2	20.00	21.25	0	0		

Appendix 5 – Reach 4 Habitat Data

Stream Name		Watershed Code		Date		Reach Name		Discharge		Velocity		Site Length																															
Bings		1234		Aug. 20/20		Bings R5		Depth #1		T1																																	
Water Quality Information				Field Crew		DRC, SL, ER		0.00																																			
Dissolved Oxygen		pH		Total Dissolved Solids		Temp C		Chainage at Beginning of Reach		Discharge Depth #2		T2																															
Average Depth (at flow site)		Average Width (at flow site)		Wetted Width (at flow site)		Discharge (m3/s)		Chainage at End of Reach		Discharge Depth #3		T3																															
Velocity (m/s)								150.00																																			
Habitat Information (All Pool and Cross Section Data)																																											
Habitat Type	Start (chainage at start)	Finish (chainage at end)	Unit Length	Wetted Width	Pool Area	Wetted Reach Area	%Pool Area	Habitat unit Depth (m)	Percent Gradient	Bankfull Width(m)	Average Percent Wetted Area	Substrate Percent				Percent Instream Cover				Percent Cr own Cover	Large Woody Debris	LWD/bank-full channel width	Erosion Sites (length)	Altered Stream Sites (length)	Obstructions (number)	Off-Channel Habitat (length)	Off-Channel Habitat (width)	Off-Channel Habitat (bank side)	Land Use Right	Land Use Left	Vegetation Type Right	Vegetation Type Left	Riparian Slope Right	Riparian Slope Left	Stability Right	Stability Left	Vegetation Depth Right	Vegetation Depth Left	Livestock Access Right	Livestock Access Left	Photos	Comments	
Pool	0.00	26.00	26.00	6.60	171.60	171.60	0.50	0.50	0.00	6.00	57	0	50	150	0	0	0	0	85.00	0	0	13	25	1				Nat	Nat	Mix	Mix	5	5	Low	Low	50	10	1	1	Stn 58	Trail, erosion,		
Riffle	26.00	32.00	6.00	3.30	0.00	13.80	0.50	0.50	0.00	6.30	57	0	75	25	0	0	0	0	85.00	0	0	0	0	0	0				Nat	Nat	Mix	Mix	5	5	Low	Low	50	10			Stn 59	strm edge, no	
Riffle	32.00	47.00	15.00	2.10	31.50	51.50	0.20	0.00	5.30	57	0	75	25	0	0	0	0	0	85.00	0	0	15	15	0				Nat	Nat	Mix	Mix	5	5	Low	Low	50	10			Stn 60			
Riffle	47.00	50.00	3.00	1.80	0.00	5.40	0.50	2.00	6.00	57	0	80	20	0	0	0	0	0	85.00	0	0	0	0	1				Nat	Nat	Mix	Mix	5	5	Low	Low	50	10			Stn 61			
Pool	50.00	62.00	12.00	5.70	68.40	68.40	1.00	0.00	5.90	57	0	20	80	0	0	0	0	0	85.00	15	0	0	0	0	0				Nat	Nat	Mix	Mix	5	5	Low	Low	50	10			Stn 62		
Riffle	62.00	75.00	13.00	3.70	0.00	15.10	0.20	0.00	2.70	57	0	75	25	0	0	0	0	0	85.00	1	0	0	0	0	0				Nat	Nat	Mix	Mix	5	5	Low	Low	50	10			Stn 63		
Pool	75.00	108.00	33.00	6.40	211.20	211.20	0.50	0.00	7.20	57	0	10	90	0	0	0	0	0	95.00	0	0	0	0	0	0				Nat	Nat	Mix	Mix	5	5	Low	Low	50	10			Stn 64		
Riffle	108.00	121.00	13.00	1.50	0.00	19.50	0.75	4.00	10.00	57	0	75	25	0	0	0	0	0	95.00	0	0	0	0	0	0				Nat	Nat	Mix	Mix	5	5	Low	Low	50	10			Stn 65		
Pool	121.00	130.00	9.00	4.00	36.00	36.00	0.40	0.00	8.90	57	0	25	25	50	0	0	0	0	100.00	1	0	0	0	0	0				Nat	Nat	Mix	Mix	25	25	Med	Low	40	30			Stn 66		
Riffle	130.00	133.00	3.00	8.00	0.00	24.00	0.50	2.00	12.00	57	0	95	5	0	0	0	0	0	100.00	0	0	2	0	0	0				Nat	Nat	Mix	Mix	25	25	Med	Low	50	50			Stn 67		
Pool	133.00	150.00	17.00	5.70	96.90	96.90	0.20	0.00	11.00	57	0	0	25	75	0	0	0	0	85.00	0	0	0	0	0	0				Nat	Nat	Mix	Mix	0	0	Low	Low	50	50			Stn 68		
Reach Totals and Averages				150.00	112.00	4.25	615.60	713.40	86	0.48	1.64	7.45	57	2	55	43	0	0	0	90	17	0.84	44	27	2	0				5	5			8	8	33	35	48.57	18.57	1	1		

Appendix 6 – Reach 4 Habitat Data

Stream Name		Watershed Code		Date		Reach Name		Discharge		Velocity		Site Length																																	
Bings		1234		aug. 21/20		Bings R6		Depth #1		T1																																			
Water Quality Information				Field Crew		DRC, ER, MS		0.00		0.00																																			
Dissolved Oxygen		pH		Total Dissolved Solids		Temp C		Chainage at Beginning of Reach		Discharge Depth #2		T2																																	
Average Depth (at flow site)		Average Width (at flow site)		Wetted Width (at flow site)		Discharge (m3/s)		Chainage at End of Reach		Discharge Depth #3		T3																																	
Velocity (m/s)								144.00																																					
Habitat Information (All Pool and Cross Section Data)																																													
Habitat Type	Start (chainage at start)	Finish (chainage at end)	Unit Length	Wetted Width	Pool Area	Wetted Reach Area	%Pool Area	Habitat unit Depth (m)	Percent Gradient	Bankfull Width(m)	Average Percent Wetted Area	Substrate Percent				Percent Instream Cover				Percent Cr own Cover	Large Woody Debris	LWD/bank-full channel width	Erosion Sites (length)	Altered Stream Sites (length)	Obstructions (number)	Off-Channel Habitat (length)	Off-Channel Habitat (width)	Off-Channel Habitat (bank side)	Land Use Right	Land Use Left	Vegetation Type Right	Vegetation Type Left	Riparian Slope Right	Riparian Slope Left	Stability Right	Stability Left	Vegetation Depth Right	Vegetation Depth Left	Livestock Access Right	Livestock Access Left	Photos	Comments			
Riffle	0.00	10.00	10.00	2.40	0.00	24.00	0.50	2.00	6.90	57	0	0	90	10	0	0	0	0	80.00	0	0	0	0	0	0				Nat	Nat	Mix	Mix	10	35	Med	Low	100	140			Stn 83				
Pool	10.00	29.00	19.00	4.30	81.70	81.70	0.35	0.00	5.50	57	0	0	20	80	0	0	0	0	80.00	1	0	5	0	0	0				Nat	Nat	Mix	Mix	10	10	Low	Low	50	50			Stn 84				
Riffle	29.00	43.00	14.00	2.20	0.00	50.80	0.10	3.00	12.20	57	0	0	80	20	0	0	0	0	80.00	0	0	0	0	0	0				Nat	Nat	Mix	Mix	10	10	Low	Low	50	50			Stn 85				
Pool	43.00	58.00	15.00	3.50	62.50	62.50	0.40	0.00	10.60	57	0	0	20	80	0	0	0	0	80.00	0	0	15	0	0	0				Nat	Nat	Mix	Mix	10	10	Low	Low	50	50			Stn 86				
Riffle	58.00	70.00	12.00	2.60	0.00	51.20	0.20	1.00	5.60	57	0	0	50	50	0	0	0	0	75.00	0	0	10	0	0	0				Nat	Nat	Mix	Mix	10	10	Low	Low	50	50			Stn 87				
Pool	70.00	97.00	27.00	4.00	108.00	108.00	0.30	0.00	7.00	57	0	0	50	50	0	0	0	0	70.00	1	0	10	0	0	0				FG	Nat	Gr	Mix	Mix	20	10	Low	Med	1	70	1	1			Stn 88	
Riffle	97.00	105.00	8.00	1.90	0.00	15.20	0.10	2.00	12.40	57	0	0	80	20	0	0	0	0	60.00	0	0	8	0	0	0				Nat	Nat	Mix	Mix	10	10	Low	Low	50	50			Stn 89				
Pool	105.00	112.00	7.00	3.40	23.80	23.80	0.60	0.00	3.40	57	0	0	50	50	0	0	0	0	85.00	0	0	0	0	0	0				FG	Nat	Mix	Mix	10	10	Low	Low	5	70			Stn 90				
Riffle	112.00	134.00	22.00	1.40	0.00	50.80	0.05	3.00	8.30	57	0	5	20	70	5	0	0	0	85.00	0	0	0	0	0	0				Nat	Nat	Mix	Mix	10	10	Low	Low	50	50			Stn 91				
Pool	134.00	144.00	10.00	2.80	28.00	28.00	0.60	0.00	5.10	57	0	0	10	0	90	0	0	0	85.00	0	0	10	0	0	0				Nat	Nat	Mix	Mix	0	0	Low	Low	50	50			Stn 91	clay pool			
Reach Totals and Averages				144.00	78.00	2.85	294.00	426.00	69.01	0.32	1.10	7.40	57	1	3	51	46	0	0	78.00	2	0.10	47	0	0	0				8	4			3	3	13	13	35.33	60.00	1	1				



Appendix 9 – Reach 1-6 Habitat Summary

Stream Name		Bings Creek												Watershed Code		920-257700-05700-66900	
Habitat Parameter	Bings R1	Ratings	Bings R2	Ratings	Bings R3	Ratings	Bings R4	Ratings	Bings R5	Ratings	Bings R6	Ratings	Total	AVG	AVG Score		
% Pool Area	96	1	99	1	65	1	33	5	86	1	69	1	10	75	2	good	
Large Woody Debris/Bankfull Channel Width	0.0	5	0.2	5	0.2	5	0.0	5	0.8	5	0.1	5	30	0	5	poor	
% Cover in Pools	32	1	11	3	7	3	7	3	6	3	5	5	18	11	3	fair	
Average% Boulder Cover	0	5	0	5	2	5	7	5	0	5	0	5	30	3	5	poor	
Average % Fines	79	5	66	5	57	5	0.00	1	43	5	46	5	26	48	4	poor	
Average % Gravel	21	not rated	26	not rated	11	not rated	5	not rated	55	not rated	51	not rated	--	28		poor	
% of Reach Eroded	0	1	0	1	0	1	0	1	44	5	47	5	14	15	2	good	
Obstructions	0	0	0	0	1	1	0	0	2	2	0	0	3	1	1	good	
% of Reach Altered	100	5	74	5	0	1	0	1	27	5	0	1	18	33	3	fair	
% Wetted Area	76	3	100	1	44	5	56	5	57	5	39	5	24	62	4	poor	
Dissolved Oxygen	6.00	3	6.50	3	8.00	1	.		.		6.40	3	10	7	3	good	
pH	7.00	1	7.00	1	7.00	1					6.70	1	4	7	1	good	
<b>Totals</b>		<b>30</b>		<b>30</b>		<b>29</b>		<b>26</b>		<b>36</b>		<b>36</b>	<b>187</b>		<b>31</b>		

Riparian Ratings																
Reach	Bings R1	Ave. Ratings	Bings R2	Ave. Ratings	Bings R3	Ave. Ratings	Bings R4	Ave. Ratings	Bings R5	Ave. Ratings	Bings R6	Ave. Ratings	Total			
Land Use	22	1	22	2	14	1	24	3	10	1	12	2.0	9	17	2	fair/good
Riparian Slope	22	1	14	1	28	2	10	1	16	1	6	1	7	16	1	good
Bank Stability	66	3	36	3	18	1	4	1	68	5	26	4	17	36	3	fair
% Crown Cover	82	1	76	1	84	1	86	1	90	1	78	1	6	83	1	good
% of Reach Accessed	5	3	0	0	0	0	0	0	3	1	3	1	5	2	1	good
Average Vegetation Depth	14.5	5	32	3	42	3	21	5	34	3	48	3	22	32	4	poor
<b>Totals</b>		<b>15</b>		<b>9</b>		<b>8</b>		<b>11</b>		<b>12</b>		<b>12</b>	<b>67</b>		<b>11</b>	

Appendix 10 – Reach 7a/b & Menzies R1 Habitat Summary

Stream Name Bings Watershed Code 920-25770

Habitat Parameter	Bings R7a	Ratings	Bings R7b	Ratings	Menzies M1	Ratings
% Pool Area	0.00	5	0.00	5	66	1
Large Woody Debris/Bankfull Channel Width	0.0	5	0.0	5	0.1	5
% Cover in Pools	0	5	0	5	8	3
Average% Boulder Cover	0	5	0	5	2	5
Average % Fines	15	3	10	3	22	5
Average % Gravel	40	not rated	60	not rated	34	not rated
% of Reach Eroded	0	1	0	1	28	5
Obstructions	0	0	0	0	0	0
% of Reach Altered	0	1	0	1	10	3
% Wetted Area	0.0	5	0	5	63	5
Dissolved Oxygen	.		.		.	
pH						
<b>Totals</b>		<b>30</b>		<b>30</b>		<b>32</b>

Riparian Ratings						
Reach	Bings R7a	Ave. Ratings	Bings R7b	Ave. Ratings	Menzies M1	Ave. Ratings
Land Use	6	3	2	1	20	1
Riparian Slope	2	1	2	1	22	1
Bank Stability	10	5	10	5	26	1
% Crown Cover	75	1	75	1	79	1
% of Reach Accessed by Livestock	0	0	0	0	2	1
Average Vegetation Depth	46	3	35	3	26	5
<b>Totals</b>		<b>13</b>		<b>11</b>		<b>10</b>

## Appendix 11 - Narrative Summary of level 1 and 2 assessment

Elodie Roger, SMWS

**Wednesday Aug 19<sup>th</sup> 2020**

**Dave Clough, Elodie Roger, Chelsea April**

**Lower Bings creek Reach 1**

Start: Somenos Lake

End: Highway 1 north bridge (Holmes creek)

Parked at OAC Parking Lot

Accessed Bings Creek through North End of Boardwalk (climbed down)

Walk through flood plain grass to find creek

Creek flows through 4 habitat types

- *Salix spp.* - *Spirea douglasii* community (1/4 way away from Somenos lake, Shrub dominated habitat)
- Open flood plain, Reed Canary Grass dominated habitat
- Red Osier Dogwood and willow community (Shrub dominated habitat)
- Mix habitat, *Picea sitchensis* and deciduous trees community

Main threats to ecological health observed

- Anthropogenic stresses: garbage presence (cloths, bags, papers, rusty cans and more)

Anthropogenic activities observations

- Old fence line un-used and a disruption of flow and wildlife – needs to be removed.
- Historically ditched hwy to lake has disconnected old channel which appears to be further north. It may be worth considering plugging this channel to assist the natural channel recovery
- 
- Recent dredging closer to the bridge (upper part of Lower Bings Creek) has over excavated the channel to 2.0 m depth resulting in lack of outlet spawning opportunities. It may lack summer rearing being anoxic as a sediment trap to highway inputs. It should be vacced out at least.
- Invasive plants Himalayan balsam, Himalayan Blackberry, Reed Canary Grass, suspected presence of invasive willow species (unidentified)
- The riparian areas were historically cleared and farmed. Pastures existed 10 year s ago. More replanting in the pasture areas to encourage a biodiversity recovery, concerned about it all now being flat ground with no lumps for diversity.

Ecological indicators observed:

- Freshwater mussels: species unidentified on-site - to be ID'd (more info about freshwater mussels as [indicators](#) for fish habitat health)
- Sitka Spruce regenerating in upper part of the Lower Bings Creek
- Healthy pool and canopy coverage in multiple occurrences as creek is migrating to river left channel

Restoration recommendations:

- Historic restoration included riparian planting – was successful in upper areas, needs to be infil planted and extended downstream. Most successful to enter these areas and establish some mounds to get trees a head start.
- Historic restoration construction of a man made pond along the lower trail is anoxic due to lack of circulation and heavy leaf litter, nutrient loading. Has a beaver dam at the outlet. Not a very functional feature in this location as there is a big lake nearby as well as natural wetland areas functioning much better.
- 
- Spawning gravel addition in several pools and riffles in the confined areas below hwy
- Small woody debris additions for cover and scour - A-Frames installation to create pool scour in confined locations.

- Riparian vegetation planting with non-prolific native willow species (lower area), red osier dogwood and deciduous trees (middle), conifers and deciduous trees (upper section)
- Garbage clean up
- - possibility of bringing 4x4 wheelbarrow to transport gravel
- the man made pond is anoxic in summer due to leaf litter, lack of flush, encourage vegetation conversion to coniferous to reduce oxygen loading
- Highway Bridge footing reinforcement is eroding and may need repair soon, ask highways to remediate their easement under/around the bridge (contact sean wong hwys bio). The pool should be vacced of sediment  
The pool at the highway bridge could be rebuilt with cover added

**Friday Aug 21<sup>st</sup> 2020**

**Dave Clough, Spencer, Makenna Stobbe**

**Lower Bings Creek –**

Start: Bings Creek North arm at Canada Ave

End: Bings Creek Crossing at E&N Railroad

Accessed creek from Canada Ave assessing bridge crossings of creek

Main threats to ecological health observed

- Garbage in creek
- South arm of Bings Creek at Canada Ave not flowing/stagnant
- Urban encroachment on channel
- Road runoff

Anthropogenic activities observations

- Redirection and ditching of the channel to accommodate Canada Ave, Railway, TCH and the RCMP building site. There are 2 hard right angles in the channel..
- Garbage and debris, abandoned homeless camps (needles)
- Road runoff is direct with no storm water abatement
- Flooding in winter from altered channel

Ecological indicators observed:

- Old redd observed in North reach adjacent to RCMP station
- Some spawning gravel available

Restoration recommendations:

- Add spawning gravel at upstream of E&N crossing, good site access
- Move south arm of channel to middle of RCMP station if station is removed/remediated to Misery Meadows.
- Garbage/Needle pickup
- Add spawning gravel along RCMP station reach, good access, high fish use.
- Plant shrubs over the misery meadows ditch in front of apartment bldg. to kill grass in channel.

**Wedn Aug 19<sup>th</sup> 2020**

**Dave Clough, Elodie Roger, Chelsea April**

**Flood plain R2 below Mary St to Police stn**

Start: private property on Philip

End: Middle of flood plain behind police station

Parked car at Mary Street intersection with Bings Creek

Started assessment at 2889 Philip Street, Duncan

Walked East towards police station and down from Mary St to beaver dam

3 reaches found for Bings Creek through Police Station flood plain  
(South) - least healthy - flowing through South culvert on Canada Av  
(Middle) - Original

(North) - Healthier - flowing through North culvert on Canada Av

Main threats to ecological health observed

- Historical alteration of terrain geography
- Obstruction of flood plain
- South arm - causing a dead threat to fish (drying out)
- Middle arm - water “cul-de-sac” - dead zone
- 

Anthropogenic activities observations

- Sewer pipeline crisscross through floodplain and disrupt plants and drainage
- Drainage pattern altered, resulting in two discharge routes out of wetland to Canada Ave. Resulting in stranded fish as the south route dries
- Encroachment into wetland by private land owners – vegetation removal, hardened banks, alterations.

Ecological indicators observed:

- Wetland indicators: skunk cabbage
- Beaver Dam floods Mary St Culvert to the point of concern this winter.

Restoration recommendations:

- Tall shrub/tree planting to eliminate invasive grass and provide more structure
- Lacks Coarse woody debris – anchored stump/log placement to benefit wildlife
- Property owner education
- Consider ways to block the drying south channel or eliminate the drying tendencies
- Move the sewer lines? Or consider ways to eliminate their impacts on surface drainage, maintenance access, check for leakage?,

**Thursday Aug 20<sup>th</sup> 2020**

**Dave Clough, Spencer, Chelsea April, Emma Ross**

**Reach 2 and 3**

**Reach 2 upper – wetland above Mary St to top eve savory**

**Reach 3 – confined channel from Savory property up to Falls**

Start: Mary St/ Savory Residence

End: At Cowichan Lake Crossing above second falls

Parked at Mary St/Philip St interchange

Accessed Bings Creek through Eve's place at entrance of hospital tributary and floodplain confluence.

Creek flows through 3 habitat types

- Open flood plain, Reed Canary Grass dominated habitat (Eve's Place + Beaver Dam Reach)
- CwH/Conifer Forest (Falls Reach)
- Broadleaf/Conifer (

Main threats to ecological health observed

- Anthropogenic stresses: Garbage, Beaver Dam, Clearing in Riparian Area (crazy guy that hates biologists), Sedimentation, Invasive Plants, Road runoff, undersized culverts,
- 

Anthropogenic activities observations

- Culvert at Mary St. is flooded by beaver dam
- Mary street cuts right through a historic wetland and acts as a dyke
- Garbage is washing down from TC trail (shopping carts, tires, signs, fishing gear
- Sediment laden tributary from Hospital loads the floodplain alongside Savory house
- Private driveway bridge footings are located in stream channel and eroding( above falls (R4).
- Upstream development is adding sediments
- Himalayan balsam, Himalayan Blackberry, Reed Canary Grass, Japanese Knotweed, English Ivy, English Holly, Morning Glory

Ecological indicators observed:



- Some large, mature fir trees in reach 3 adding LWD and shade
- Adequate pool habitat for juvenile salmonid rearing
- Existing spawning gravel in pool tailouts
- Canopy cover at or above 80% throughout

Restoration recommendations:

- Spawning gravel addition in several pools and riffles
- Invasive removal
- Garbage clean up
- Consider fish ladder at 2.2m ht falls to (restore?) pass Coho/Steelhead

**Thursday Aug 20th 2020**

**Dave Clough, Spencer, Chelsea April, Emma Ross**

**Middle Bings Creek Reach 4 – Falls then along TC trail to stream forks**

Start: Keystone Subdivision off TCT

End: Same

Parked car at Keystone Dr and accessed TCT via right of way from subdivision

Started assessment at TCT culvert crossing

Main threats to ecological health observed

- Culvert at TCT eroding/failing, acting as physical barrier to upstream migration
- Garbage/homeless camps
- Excessive erosion to banks
- Lack of large trees along banks
- Small woody debris jam obstructions

Anthropogenic activities observations

- Heavy erosion from human access and uncontrolled foot paths from TCT
- Garbage and debris, abandoned homeless camps
- Possible poaching by homeless
- Reduced riparian shrubbery along banks
- Sewer and Gas line crossings disrupt creek
- Private property encroachment including foot bridges and rock walls

Ecological indicators observed:

- Many resident Cutthroat Trout observed throughout
- Some spawning gravel available
- Relatively shaded canopy lacks understory

Restoration recommendations:

- Add CWD stumps/logs to mitigate human access points & add habitat
- Deactivate trails
- Build protected stream viewing/education areas
- Plant in eroded or duntrodden areas
- Garbage cleanup
- Replace TCT culvert
- Spawning gravel sites can be improved with clean material, anchoring
- Rearing habitat can be improved with deeper pools and cover addition
- Cover habitat can be logs, stumps rocks or brush mats depending on sites

**Thursday Aug 20th 2020**

**Dave Clough, Spencer, Chelsea April, Emma Ross**

**Middle Menzies Creek**

Start: Cowichan Lake Road culvert near Tansor intersection

End: Same

Parked car on Cowichan Lake Road accessed creek from road shoulder  
Started assessment downstream of culvert

Main threats to ecological health observed

- Culvert at Cowichan Lake Road rotted, undersized, hung with debris spill pad at mouth.
- Garbage in channel
- Erosion to banks from road culvert and past development
- Small woody debris jam obstructions
- Water quality concern from road culvert rust/runoff

Anthropogenic activities observations

- Footbridge (upstream) and culvert (downstream) discarded in channel influencing flow/erosion, need to be removed
- Existing road culvert acting is a partial fish migration barrier
- Two wells located adjacent to creek on downstream side are a concern if used in summer low flow
- Shallow pool habitat from sedimentation and lack of LWD
- Most of riparian is thin band adjacent farm pastures
- barb wire fences everywhere including across the stream

Ecological indicators observed:

- Some spawning gravel available
- High canopy cover

Restoration recommendations:

- Remove debris and instream fence wire
- repair culvert crossing
- address erosion sites
- infill plants along narrow mostly Alder riparian area
- land owner education (farmers)

**Friday Aug 21<sup>st</sup> 2020**

**Dave Clough, Spencer, Makenna Stobbe**

**Upper Bings Creek**

**Reach 5 from Menzies confluence to TC trail**

Start: End of Cleve Road at Thorsen's property

End: At trans Canada trail crossing upstream

Parked car at end of Cleve Road, accessed stream from Thorsen property and conducted assessment upstream to TCT crossing.

Main threats to ecological health observed

- Eroding channel along property appears to be suffering recently from flooding
- Aggrading channel and large gravel bars
- Erosion to banks, loss of trees, widening channel
- TCT crossing culverts undersized, hung and eroding.
- Water quality concerns from upstream

Anthropogenic activities observations

- TCT culvert armored recently against erosion, also pointed directly at bank increasing erosion
- Some attempts to prevent erosion/tree loss on Thorson property
- Water clarity low, some turbidity after heavy rainfall

Ecological indicators observed:

- One large, deep pool at erosion site with large resident trout observed
- Mature forest along banks of stream throughout most of Thorsen property

- Adequate spawning gravel for trout

Restoration recommendations:

- Check upland development on this reach to determine the cause of recent flood erosion impact
- Repair eroding banks – rock, stumps, bioengineering w plants (thorsens is especially bad)
- Replace culvert crossing for improved fish passage and reduce erosion
- Remediate aggraded gravel bars ( excavate, live stake, divert flow)
- Infill plant trees in narrow riparian areas along entire reach

**Friday Aug 21<sup>st</sup> 2020**

**Dave Clough, Spencer, Makenna Stobbe**

**Upper Bings Creek Reach 7**

Start: West fork of Bings Creek crossing at Drinkwater Road

End: East fork crossing of Bings Creek at Drinkwater Road

Parked at West fork culvert

Accessed Bings Creek from road, walking downstream to the confluence with the east fork then walking up the east fork to the road

Main threats to ecological health observed

Anthropogenic stresses:

- Garbage,
- Stream was dry (note flow is year round upstream in next reach)
- aggraded channel, poor riparian tree diversity,
- minimal bank stability
- shallow banks

Anthropogenic activities observations

- Historically logged, limited conifer trees, large Maples dominate
- Garbage carried into stream by ravens
- Large cobble and boulder bars built up in channel
- Low channel stability and capacity
- Upstream development may be adding sediments

Ecological indicators observed:

- Large mature maple trees holding banks together

Restoration recommendations:

- Garbage clean up
- Debris jam clearing
- Investigate channel bed loading solutions (excavate, stabilize, divert or nothing)
- Monitor water quality as it is beside the recycling centre
- Monitor impacts on fish, see if many are trapped as it dries
- Plant conifers

## Appendix 12 – Spawning Gravel Placement Methods

### **D.R. Clough Consulting**

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July 2016

### **Spawning Gravel Placement .**

Written for Coho/Cutthroat low gradient streams with 1-5% gradient. If Chum are present they will use this material but will sort for the larger sizes. Pink salmon will choose the smaller material. But determine the rock sizes based on the stream hydrology, the fish will figure it out.

Spawning gravel will be a mix of washed round rock. There is enough dirt in most streams such that more is not needed, especially during the application process.

Do not use crush rock for the spawning substrates as the sharp edges cut the tails of the fish and are seldom a natural occurrence.

The gravel supply should be inspected prior to delivery. Most gravel suppliers will have a range of the appropriate sizes in screened piles. Identify the piles with the operator. Determine the amount required. Generally two or three piles will be loaded and mixed. In small loads, the mixing of gravels can be accomplished by loading all grades required in the dump truck.

### **Size**

The objective is to accommodate the channel and the species, heavier material in steep reaches, lighter in low gradient reaches. Below is a general mix ratio, adjust for gradient and discharge and avoid using just one size gravel.

Size (inches)	Ratio	Comments
1/2	15%	
1'	20%	
2"	20%	
3"	20%	
4"	15%	
6 – 12"	10 %	(these larges are aeration/bug/anchor rocks)

### **Depth**

Generally in small creeks (<5.0m) gravel is not functional or deeper than six inches, (due to average alluvial deposition rates in typical regenerating watersheds).

Calculation of depth; Place the gravel at 2-6 inches depth (average 4 inch/0.1m for calculation)

**Length**

If the average channel base width is about 5.5m, gravel is placed in the same width. Generally spawning areas are channel length to width ( i.e. a 5.5m by 5.5m area). Do not add excessively long runs of gravel, excess gravel will just wash out and fill in pools.

**Placement**

Look to augment a natural crest made of stable gravel, boulders, bedrock or logs, and generally located at a pool tail out. The best place to add gravel is the upstream side of the crest upstream into the pool. Note if the site has suffered alteration and has sediment, sticks or dirty gravel, it is best to remove this material first.

Many streams lack natural crests due to alteration to habitat from dredging, debris torrents or floods. Making a crest to hold gravel in place if one does not exist is possible and recommended.

Determine the crest material generally large rocks determined to be suitable for flood stability that will not blow out (i.e. manning formula). Angular rock is often used for its availability of uniform size and flat sides for anchoring against the bottom of the channel. Round rock looks more natural but are often harder to collect and anchor.

Digging a trench or machine punching to embed the crest rock to increase its anchoring/impermeability is recommended. The crests are generally perpendicular to flow but site location may call for angular installation.

Crests rocks are generally placed across the channel to above high water and/or well tucked in at outside corners to avoid erosion. The width of rock crest is determined by stream slope and height of rocks. Install the crest height to the gravel depth of 0.1-0.15 m. Low stream crests well embedded only require 2-3 cross rows of rock on a flat site, more on gradient. The crests must be sealed with hard packed fine sediments. A band of geotextile on the crest is often applied to assist in sealing.

**Discussion**

This is a brief summary for people who are interested in our experiences. There can be other ways and more detail. Note that monitoring/maintenance /replenishment is recommended. This is not always due to design imperfection but gravel starved salmon may "use up" all the gravel over time by pushing it over the crests while spawning. Attached photos below of typical SG Sites (adjustments necessary as they are sized for the specific stream)

David Clough, RPBio



Grandon Creek spawning crests with pools and cover logs added.



Swan Creek spawning gravel site



Swan Creek installing gravel/crests at low flow



Averill Creek – looking d/s note wide anchor crest apron to hold gravel in place.

## Appendix 13 – Bank Erosion/LWD Placement example (French Creek)

French Creek Stump Revetment- 2003

