

Morison Creek Habitat Survey – 2018

On behalf of
Mid Vancouver Island Enhancement Society
(MVIHES)

January 2019

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Introduction

This is a fish habitat survey of Morison Creek, one of the four main anadromous tributaries (Centre Creek South Englishman River, Shelly Creek) of the Englishman River Watershed. The Mid Vancouver Island Enhancement Society funded the survey and assisted in the field data collection.

The objectives were;

- Survey the stream habitat of Morison Creek to understand its current features.
- Train MVIHES members on stream assessment methods.
- Interpret the stream habitat condition for any protection or restoration actions.

Methods

The Urban Salmon Habitat Program (USHP) survey¹ was utilized. This method of survey was initiated in 1997 by the Ministry of Environment in concert with Vancouver Island stewardship groups. Since then it has been used by the majority of stewardship groups on Vancouver Island and the lower mainland. Using a similar methodology offers comparative analysis of data².

The USHP survey method involves instream and riparian assessments as well as field water quality. The USHP survey method collects up to 40 data points on each habitat unit (pool or riffle) encountered (Figure 1). The USHP habitat data was measured using staffs, tapes, chains and clinometers. The data was collected using a software program (Avenza Map©) that was installed on an Apple iPhone and iPad dedicated to each survey team. Maps used in the survey were GIS enabled PDF maps of the watershed provided by the Regional District of Nanaimo through Julie Pisani, DWWP Program Coordinator. A customized interpretation of the USHP data table (schema) written by D.R. Clough Consulting was imported on to the map file of the application. All the data (habitat units, track, locations and photo points) was then exported as *.kml and *.csv files for interpretation and analysis using Google Earth © and Microsoft Excel © using the USHP data entry program. Data is compared to fish habitat assessment standards of instream and riparian health (Johnston & Slaney 1996³) of the Watershed Restoration Program.



The minimum data collection objective of the survey was to measure ten habitat units (pools or riffles) within each reach segment (each reach has a contiguous gradient, width and riparian cover) of the watershed. Three days of field collection were allocated with two teams each day. The field survey was conducted on March 15, 21 & 22, 2018. Participants were from the MVIHES; Terry Elliott, Dick Dobler, Barb Riordan, Carl Rathburn, Elaine Lefebvre, Gordon Weibe, Larry Williams, as well as Lauren Fegan from the RDN. The D.R. Clough Consulting group included Dave Clough, RPBio, Brad Remillard, RPBio, Spencer Lapp and Chelsea April (VIU Fisheries diploma). We also contacted several property owners on the survey reaches and some gave us access through their property.

¹ 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.

² Reid, G. & T. Michalski & T. Reid, 1999. Status of Fish Habitat on East Coast Vancouver Island Watersheds. Fisheries Section, MOELP Nanaimo B.C.

³ Johnston, N.T. and P.A. Slaney, 1996, Fish habitat Assessment Procedures, Watershed Restoration Circular No. 8, Ministry of Environment Lands and Parks and Ministry of Forests.

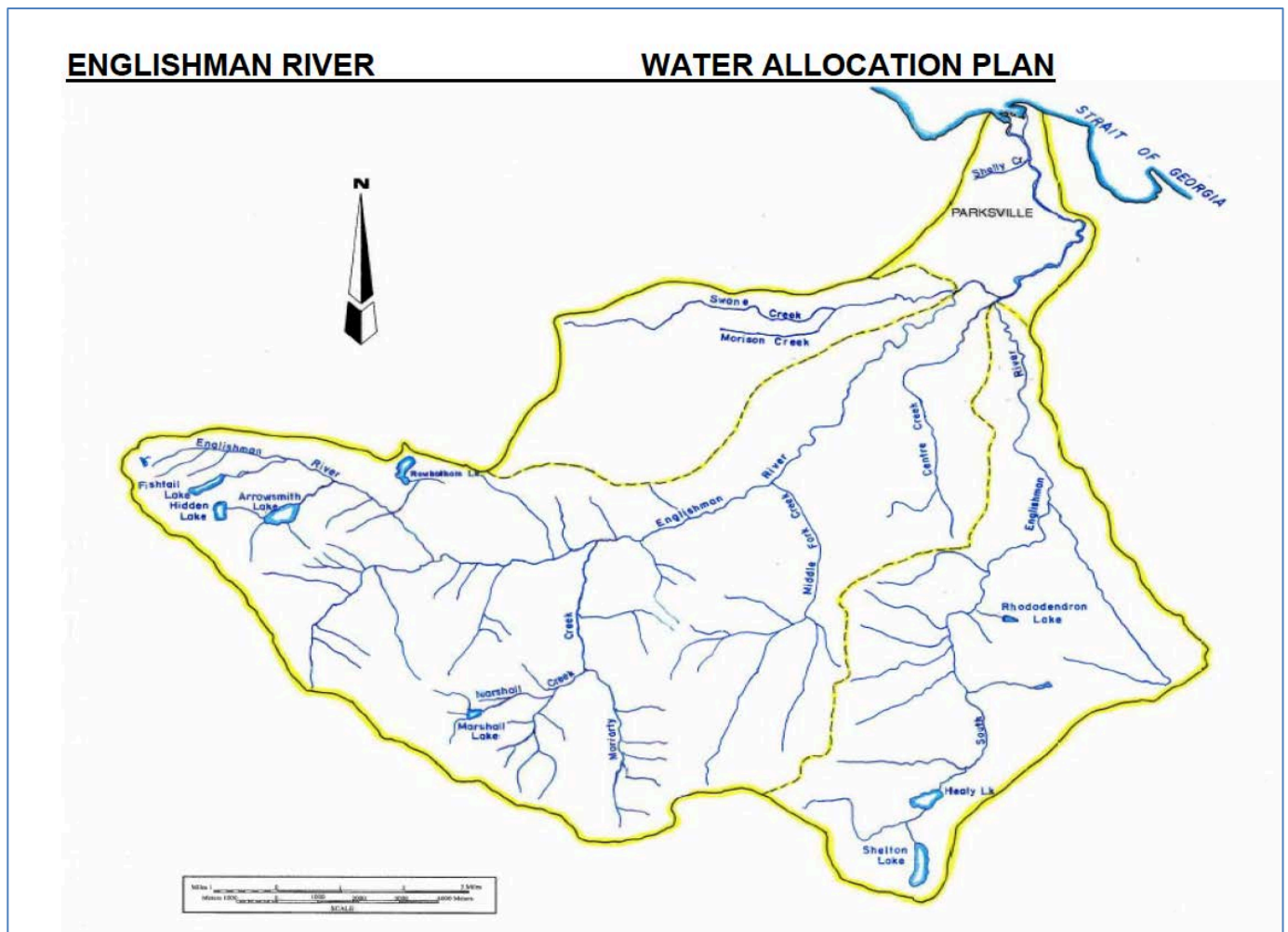
Figure 1: USHP Survey Data Card

Stream Name	<i>Fish C.</i>	<p>Habitat and Riparian Card Instructions</p> <ol style="list-style-type: none"> 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; 2. Measure riparian parameters (black boxes) <u>every 100 meters</u>; 3. Measure the start, finish & wetted width for <u>pools only</u>; take data for all other shaded boxes along <u>entire stream length</u>. <p>Abbreviations and Definitions</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 >10cm in diameter and >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,¹ 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>¹ 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>	

Watershed Area

Morison Creek is approximately 50 ha in size and represents 15% of the Englishman River Watershed area (324 ha)⁴. The sub basin of Morison Creek is located in the Regional District of Nanaimo, in the historic farming community of Errington B.C. Morison Creek drains off the east side of Rowbotham Ridge (approx. 600m elevation) through Island Timberlands Ltd. private forestry land down to 125m elevation where it levels out and has its lowest gradient through farm land areas along Errington Road. The final drop down to the Englishman River at 60m elevation is in a confined gully with several falls that block salmon alongside large rural residential lots at the top of the gully (Figure 2). Swayne Creek is a west fork of the mainstem.

Figure 2: Morison Creek, Englishman River Watershed (BC Env 1994)



⁴ Boom, Al & George Bryden, 1994, Englishman River Water Allocation Plan, Ministry of Environment, Nanaimo B.C.

Survey Area:

Morison Creek was identified by reach segments for the survey (Figure 3). Each reach was determined by having a contiguous section of riparian vegetation, channel characteristics (confinement/sinuosity, depth), significant change in gradient or barrier to fish migration (waterfalls). Every reach segment we surveyed has the potential for resident or anadromous fish populations. They are briefly described below;

Morison Reach 1: Approximately 2178m long from Englishman River to Triple Falls. The reach is in a confined gully 10- 30m deep and 30 to 50 m wide. This is the only reach accessible to anadromous salmon and trout. This reach was accessed from the trail at the end of Middlegate Road.

Morison Reach 2: Approximately 2088m long starting above Triple Falls in canyon all the way up to Swayne Creek confluence. It passes over Baxter Falls at approximately 1393m. This reach was accessed from the Stagdowne Road trail.

Morison Reach 3: Approximately 1219m long from Swayne Creek junction upstream in a confined channel to Errington Road bridge. Above Morison is fed by two main tributaries labeled Reach 4a and 4b.

Morison Reach 4a: Approximately 2190m of unconfined and altered segment from adjacent farming and forestry ending upstream where it is the product of several segments and wetlands.

Morison Reach 4b1: Approximately 2532m long farm ditch up from R3. Ends at forestry land start.

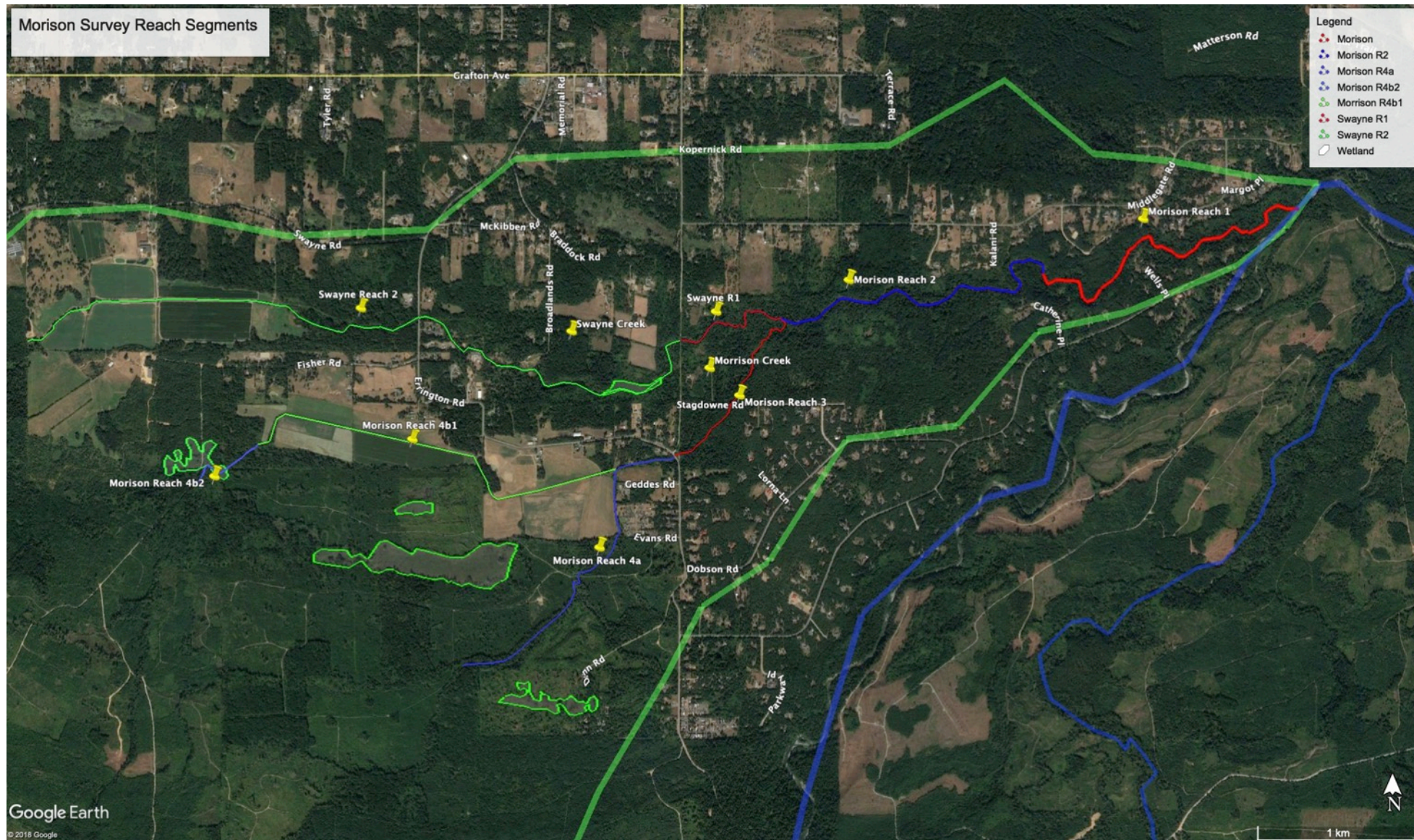
Morison Reach 4b2: The upper segment, approximately 532m of forested land to the top of Fisher Road where it is fed by wetlands and several branches.

Swayne Reach 1: Approximately 827m of confined canyon from Morison Reach 3 upstream to Hydro line crossing.

Swayne Reach 2: Approximately 4718 m of farmed and ditched channel going upstream across Errington Road to end above Fisher Road where it is fed by many small segments from wetlands.

Other Reaches: The top end of the Morison and Swayne waterways is on private forestry land. We did not survey these areas but a review of aerial photos and Google Earth © show many segmented and split channels and wetlands.

Figure 3: Survey Area



Results and Discussion –Habitat Survey

The fish habitat and riparian data was summarized for surveyed reach. As noted in Methods, the survey dates were March 15, 21 & 22, 2018. Reaches M1, M2, M3, M4a, M4b and S1 were surveyed. Note water quality sampling was not conducted as it was in the late winter and a monitoring program during low flow is done (RDN DWWP).

In the reach summaries below, the 10 most important habitat parameters are summarized, rated and scored. Scoring is based on the USHP rating system where 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. To determine the Result (Good, Fair, Poor) pre-rounded number were used. The appendices show the raw data as well as the sums and averages of all the detailed parameters (Appendix 1).

Reach 1

Approximately 2178m long from Englishman River to Triple Falls. The reach is in a confined gully 10 to 30m deep and 30 to 50m wide. This is the only reach accessible to anadromous salmon and trout. No adult fish were observed nor any redds were observed, although bear deposited bones of Coho were seen on the banks of the lower reach. This reach was accessed from the trail at the end of Middlegate Road. The reach was surveyed in two segments on March 21 & 22 to complete the survey of 20 pools and 20 riffles along 1229m or over 50% of the reach length. This reach has an average channel width of 11.1m. The channel rises 30m in elevation with an average slope of 1.5%. The results are shown in the table below.

Reach 1 Habitat Results

Habitat Parameter	R1	Ratings	Result
% Pool Area	29	5	Poor
Large Woody Debris/Bankfull Channel Width	0.2	5	Poor
% Cover in Pools	9	3	Fair
Average % Boulder Cover	4	5	Poor
Average % Fines	8	1	Good
Average % Gravel	9	not rated	
% of Reach Eroded	5	3	Fair
Obstructions	0	0	Good
% of Reach Altered	0	1	Good
% Wetted Area	82	3	Fair
Mean Score		2.9	Fair

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

Reach 1 Riparian Results

Riparian Ratings	R1	Ratings	Result
Land Use	80	1	Good
Riparian Slope	182	2	Fair
Bank Stability	230	3	Fair
% Crown Cover	68	3	Fair
% of Reach Accessed	2	1	Good
Average Vegetation Depth	37	1	Good
Mean Score		1.9	Good

While surrounded on both sides by a rural lot subdivision, Reach 1 is very well protected by the natural ravine feature. The ravine has 5 to 30m sidewalls that extend 30 to 100m from the banks. This offers the reach very good protection from people. There is only public access at the bottom at the Englishman River or at the top of the reach from the Triple Falls trail which the property owners at the top have recently blocked access. Unlike other streams near people, there was no sign of dumping, damaging trails or recent (it was historically logged) removal of vegetation.

Unfortunately due to the historic logging, the instream habitat has deficiencies. The channel had been disturbed by direct removal of trees as well as the flushing out of logs and substrates. The result was 50% of the substrate was Bedrock. The finer substrate materials (cobble, gravel, fines) had washed out. The head cut of channel bed was noticed along any remaining rooted streamside trees.

The fish habitat characteristics that were good are;

- No barriers manmade or natural
- No garbage
- No stream bank alterations (hardened banks)
- No active erosion areas and fine sediments
- Good Riparian Depth on both banks (average 37m)

The fish habitat characteristics that were poor are;

- Lack of Pools
- Lack of Pool Depth
- Lack of Pool Cover
- Lack of Spawning Gravel

Reach 2

Approximately 2088m long starting above Triple Falls in canyon to Swayne Creek confluence. It passes over Baxter Falls at approximately 1393m. Triple falls is the anadromous barrier as the bedrock outcrop represents a 3 to 4m high series of drops. Baxter falls is a 3.5m drop over a bedrock crest and also a fish migration barrier. Resident Cutthroat Trout occupy this reach throughout and were observed during the survey. This reach was accessed from the Stagdowne Road trail and started the survey just above Baxter Falls. We surveyed 9 riffles and 11 pools over 334m. Reach 2 had a mean channel width of 12.5m on 2% gradient.

Reach 2 Habitat Results

Habitat Parameter	R2	Ratings	Result
% Pool Area	69	1	Good
Large Woody Debris/Bankfull Channel Width	1.4	3	Fair
% Cover in Pools	14	3	Fair
Average % Boulder Cover	1	5	Poor
Average % Fines	18	3	Fair
Average % Gravel	35	not rated	
% of Reach Eroded	31	5	Poor
Obstructions	4	4	Poor
% of Reach Altered	0	1	Good
% Wetted Area	62	5	Poor
Mean Score		3.3	Fair

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

Reach 2 Riparian Results

Riparian Ratings	R2	Ratings	Result
Land Use	20	1	Good
Riparian Slope	60	3	Fair
Bank Stability	82	4	Poor
% Crown Cover	74	1	Good
% of Reach Accessed	13	3	Fair
Average Vegetation Depth	100	1	Good
Mean Score		2.2	Fair

Reach 2 suffers from the same historic logging impacts as Reach 1, but no observed recent developments. The reach is in a ravine that is isolated by private property with none of the residences visible. There is one trail across the creek from Stagdowne Road to Leffler Road used mostly by horse riders. This crossing was an old logging road, it has no remaining structure and current crossings are made on the cobble bed with little observed detriment.

This reach had one significant bank erosion area just above Baxter Falls where approximately 30m of treed bank had slid down over the underlying bedrock into the channel creating a jam. The cause of the slide does not appear to have been aggravated by any recent human developments; an area of thin soils and poorly established roots. The consequence has been some opposite bank erosion and overflowing into a treed area which may cause more failure. The benefit of the slide was the introduction of considerable LWD creating the best fish cover we had observed in the lower river. A beaver had taken up residence and was using the wood material as foundation for a dam that will invariably blow out in winter.

The riparian area around the reach was healthy second growth forest aged 60 to 80 years with a 30m canopy height. The Red Alder were almost all aged out and replaced primarily by Douglas Fir and Western redcedar. A veteran Douglas Fir and older Western redcedar were observed on the river left bank in this reach.

The fish habitat characteristics in Reach 2 that were good are;

- Pool habitat is Good (69%)
- Good Riparian Depth (average 100m each side)
- Fair LWD which is remarkable as it has all been recruited over an 80 year succession since logging
- No manmade barriers
- No garbage or dumping from the access trail
- No recent stream bank alterations

The fish habitat characteristics in Reach 2 that were poor are;

- River right bank failure created considerable erosion and sediment and may create more
- Poor mean depth (0.47m) in winter indicates limited summer flow habitat
- No off channel refuge areas in the canyon during winter floods

Reach 3

Approximately 1219m long from Swayne Creek junction upstream in a confined channel to Errington Road bridge. Above Morison is fed by two main tributaries labeled Reach 4a and 4b. Reach 3 was found to have an average channel width of 6.6m on a gradient of 1.5%. We surveyed 10 Pools and 10 Riffles over 368m.

Reach 3 Habitat Results

Habitat Parameter	R3	Ratings	Result
% Pool Area	49	3	Fair
Large Woody Debris/Bankfull Channel Width	0.8	5	Poor
% Cover in Pools	9	3	Fair
Average % Boulder Cover	1	5	Poor
Average % Fines	9	1	Good
Average % Gravel	40	not rated	
% of Reach Eroded	20	5	Poor
Obstructions	1	1	Good
% of Reach Altered	0	1	Good
% Wetted Area	92	1	Good
Mean Score		2.8	Fair

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

Reach 3 Riparian Results

Riparian Ratings	R3	Ratings	Result
Land Use	40	1	Good
Riparian Slope	50	1	Good
Bank Stability	126	3	Fair
% Crown Cover	46	3	Fair
% of Reach Accessed	0	0	Good
Average Vegetation Depth	79	1	Good
Mean Score		1.6	Good

Reach 3 is only approximately half the channel width of reach 2 as it is above Swayne Creek confluence. Reach 3 has much lower banks that are composed of glacial till rather than bedrock. The reach was historically logged, and the riparian area is approximately 60 to 80m having more deciduous than lower reaches. Red Alder is very common but it is old and dying out with downed trunks lying in the channel and causing erosion from where their roots were on the bank. The Alder are surrounded by the maturing Douglas Fir that are the primary species beyond the bank. The understory has considerable Salmonberry in this reach. The fish spawning habitat in this reach features the highest gravel deposits (40%) found so far in the survey. The lack of consistent LWD cover is the product of historic logging but five of the ten pools were found to have high cover values from LWD, Boulders and Undercut banks.

The Reach 3 instream fish habitat characteristics that were good are;

- Good spawning gravel
- Good Riparian depth (79m)
- Lack of fish barriers
- Lack of garbage
- Lack of stream bank alterations
- Lack of significant invasive plants

The instream habitat characteristics that were poor are;

- Inconsistent wood cover (LWD)
- Higher bank erosion, primarily old trees falling

Reach 4a

Approximately 2190m of unconfined and altered segment from adjacent farming and forestry ending upstream where it is the product of several segments and wetlands. Starting at Errington Road, Reach 4a and 4b are the two major forks in upper Morison Creek. Reach 4a is fed from the south along Errington Road. The reach was surveyed by access downstream from Dunn Road. Four pools and four Riffles were surveyed over 129m. The channel was an average of 8.9m wide on a gradient of 1.5%. The survey location was near a logging road that had its bridge pulled but was still being crossed by mountain bike and quad routinely.

Reach 4a Habitat Results

Habitat Parameter	R4a	Ratings	Result
% Pool Area	85	1	Good
Large Woody Debris/Bankfull Channel Width	0.3	5	Poor
% Cover in Pools	6	5	Poor
Average % Boulder Cover	0	5	Poor
Average % Fines	30	5	Poor
Average % Gravel	62	not rated	
% of Reach Eroded	16	5	Poor
Obstructions	0	0	Good
% of Reach Altered	0	1	Good
% Wetted Area	52	5	Poor
Mean Score		3.6	Fair

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

Reach 4a Riparian Results

Riparian Ratings	R4a	Ratings	Result
Land Use	16	1	Good
Riparian Slope	28	2	Good
Bank Stability	80	5	Poor
% Crown Cover	31	5	Poor
% of Reach Accessed	16	3	Fair
Average Vegetation Depth	100	1	Good
Mean Score		2.8	Fair

Reach 4a is an altered reach. The lower portion adjacent farmland was ditched. The upper portion has been logged. The reach ends at a split in segments; a small tributary from Dunn Road enters at the lower end of a series of beaver ponds in the main channel. We surveyed the area below. This reach has been recently logged and the riparian area consists of dense shrubbery (Salmonberry), thriving deciduous (Alder) trees and small poles of conifers (almost entirely Douglas Fir). Erosion from the disturbances resulted in this channel being 2.3m wider than reach M3 below (8.9 versus 6.6m).

The Reach 4a instream fish habitat characteristics that were good are;

- High spawning gravel content
- Good pool frequency

The instream habitat characteristics that were poor are;

- Lack of wood cover (LWD)
- Erosion areas were significant
- Fine substrates were high confirming the sediment inputs from erosion
- Poor Crown Cover

Reach 4b1

This is a farm reach, it was not surveyed in 2018. It is approximately 2532m long ditch from Errington Road up to the end of Fisher Road. This channel was entirely ditched and is adjacent farm land. In the late 1980's the pastures were routinely flooded in winter resulting in loss of soil and crops into the stream. The fish habitat was also rapidly degrading from erosion and sediment deposition from the fields and poorly ditched stream banks. In 2002 a fisheries/farm committee formed with land owners in partnership with MVIHES. Work on channel restoration started in 2002 on this reach with excavation of sediment and planting. In 2003 the group committed to an engineering survey of Morison and Swayne farm reaches. It was professionally surveyed by Koers and Associates on behalf of MVIHES (contact Faye Smith) and a community farm committee (contact Paul Mullen). The survey was published in 2004 and channel restoration was conducted in earnest each summer until complete in 2006. The work included removing sediment buildup, reshaping the banks, adding riffle crests, spawning gravel, bridges, fencing and many plants.

Reach 4b2

The upper segment above farm ditches, approximately 532m of forested land to the top of Fisher Road where it is fed by wetlands and several branches. This reach was surveyed off the end of Fisher Road for 113m over six pools and five riffles. The average bankfull width was 3.5m on 1.5% gradient.

Reach 4b2 Habitat Results

Habitat Parameter	R4b2	Ratings	Result
% Pool Area	60	1	Good
Large Woody Debris/Bankfull Channel Width	0.5	5	Poor
% Cover in Pools	15	3	Fair
Average % Boulder Cover	0	5	Poor
Average % Fines	90	5	Poor
Average % Gravel	10	not rated	
% of Reach Eroded	0	1	Good
Obstructions	0	0	Good
% of Reach Altered	2	1	Good
% Wetted Area	98	1	Good
Mean Score		2.4	Fair

The Riparian features of Reach 4b2 are shown below taken from the USHP summary tables.

Reach 4b2 Riparian Results

Riparian Ratings	R4b2	Ratings	Result
Land Use	40	1	Good
Riparian Slope	68	2	Good
Bank Stability	164	4	Poor
% Crown Cover	79	1	Poor
% of Reach Accessed	0	0	Good
Average Vegetation Depth	116	1	Good
Mean Score		1.5	Good

The upper Morison Reach 4b2 was historically logged. The low banks, flooded forest area and veteran stumps indicate this area was a forested Western redcedar wetland. This recovering reach may represent what the other areas were like before the ditching along the farm areas. It

was logged approximately 80 years ago and the recovery has been slow; portions follow the transition from Salmonberry brush to Red Alder to conifer. The riparian area has patches of brush with aging Red Alder dominating the canopy near the channel. The conifer regeneration has been uneven with young Western redcedar establishing in patches and Douglas Fir mostly limited to dryer ground 30 to 100m away. There is no current development near the survey area but upland areas have private logging (with variable streamside retention).

The channel is low gradient and on fine clays and loam that are vulnerable and were damaged by historic logging. The low gradient waterway has little erosive power and appears to be following the ruts and disturbances of the old logging. The low banks are composed of Red Alder root masses that are covered in moss. There are numerous isolated pools in the forest from groundwater or flooding. The Alder trees have been dying and falling into the channel creating some cover. The substrates are very sandy and clean gravel areas are limited. From the survey results above, the pool area ratio is high with clear sandy bottoms. These shallow pools may not dry in summer benefiting from 70% or greater canopy closure from the Alders above. This area may offer small perennial pools for resident fish as well as being amphibian habitat with the many isolated forest pools and blow down debris.

Swayne Reach 1

Approximately 827m of confined channel from Morison Reach 3 upstream to the Leffler Road Hydro line crossing. The channel was surveyed for 307m along a 6.4m wide channel on 1.3% gradient. We surveyed 11 pools and 9 riffles. There is no recent development along this survey area, a farm is on river left bank approximately 100m away.

Reach S1 Habitat Results

Habitat Parameter	S1	Ratings	Result
% Pool Area	76	1	Good
Large Woody Debris/Bankfull Channel Width	0.4	5	Poor
% Cover in Pools	3	5	Poor
Average % Boulder Cover	1	5	Poor
Average % Fines	25	5	Poor
Average % Gravel	47	not rated	
% of Reach Eroded	0	1	Good
Obstructions	0	0	Good
% of Reach Altered	0	1	Good
% Wetted Area	88	3	Fair
Mean Score		2.9	Fair

The Riparian features of Reach S1 are shown below taken from the USHP summary tables.

Reach S1 Riparian Results

Riparian Ratings	S1	Ratings	Result
Land Use	40	1	Good
Riparian Slope	68	2	Good
Bank Stability	164	4	Poor
% Crown Cover	79	1	Good
% of Reach Accessed	0	0	Good
Average Vegetation Depth	116	1	Good
Mean Score		1.5	Good

This reach is recovering from historic forest harvesting. The pool and riffles are formed in a good frequency. While LWD cover was overall low, there were three pools that had more than adequate cover from stable clusters of Cedar logs anchored to the banks. The spawning habitat was also recovering with all sizes of gravel arranged in pool tail outs. The riffles were recovering and some had Boulder habitat. This reach had no active erosion, obstructions or alterations. The riparian area recovery is advancing well with a 100m wide stand of second growth Conifers.

Swayne Reach 2

Approximately 4718 m of farmed and ditched channel going upstream across Errington Road to end above Fisher Road where it is fed by many small segments from wetlands. This reach was entirely ditched and altered, it was not surveyed in 2018. It was surveyed in 2003 in a project by MVIHES and the local farm committee in an effort to develop a plan to improve drainage to minimize sedimentation and flooding. This reach has had some restoration in cooperation with property owners in 2005 and 2006 with sediment removed from the channel, fencing and streamside planting.

Summary & Recommendations for Fish Habitat Improvement

Reach	Habitat Impact	Recommended Remedial Action	Comments
1	Lack of pools and cover	No instream work recommended. Infill riparian areas if damaged.	No machinery access, confined fast moving reach in winter negates instream structure placement.
2	End of Salmon access	Fish passageway considered by agencies in 1980's.	Not a high return project as short run to next falls.
3	Riparian Transition	Under plant Red Alder riparian areas to ensure conifer success.	Access off Stagdowne, need property owner permission.
4a	Bank erosion	Install bridge at recreational crossings or block then plant.	Property owner permission (Island Timberlands) local bike club assistance in issue.
4b	Farm flooding	Work with farmers to improve channels; survey gradients, remove sediments, install crossings, add plants.	Past work by MVIHES with farms brought partnerships and successes, but no work in 10 years.
Swayne R1	Lack of cover	No instream work recommended. Infill riparian areas if damaged.	Farm trail along bank, good second growth riparian coming along its own.
Swayne R2	Farm Flooding	Work with farmers to improve channels; survey gradients, remove sediments, install crossings, add plants.	Past work by MVIHES with farms brought partnerships and success, but no work in 10 years.

Discussion

Morison Creek is one of the four anadromous tributaries on the Englishman River. It has a history of Coho, Cutthroat and Steelhead production in Reach 1. While it was historically logged, it has stabilized and is restoring its habitat features. No instream work is recommended other than monitoring the channel at least once a year to ensure no one or thing has created damage. Urbanization fortunately hasn't shown any impacts; the houses are well set back, there are no significant clearings, drainage ditches, accesses or dump areas. This is good news.

The upper reaches of Morison Creek are home to resident Cutthroat Trout. These fish have had to struggle at times to survive in an altered environment first from logging that clear cut virtually the entire watershed followed by farming that ditched extensively the upper reaches. The habitat in the upper reaches is also in recovery but at a lower succession level.

There are restoration opportunities on the farms in the watershed. These mid level areas are some of the most impacted habitat. The ditching that the early farmers did to channels and wetlands caused immediate harm to fish habitat and long-term problems for the farms. Over time, the farms were suffering from flooding. The heavily tilled peat based soils were shrinking and the soils and crop organic matter washing into the stream channel. The flooding would delay crop production or completely ruin pastures. These problems have been identified in every major farm area on Vancouver Island (pers. Comm Wayne Haddow, Min Ag.).

From the mid 1980's the farms had been cooperating with the author and DFO on a Coho recovery project. That study proved the farm areas remained viable fish producing habitat. In 2002 the Morison/Swayne area farmers formed a committee and approached the author about re-ditching the stream channels. We agreed work could not be the same as their predecessors. We met and discussed opportunities, which led to MVIHES getting involved. The MVIHES had been working on other tributaries in the watershed as part of the Englishman River Recovery Plan funded by the Pacific Salmon Endowment Fund. From 2002 to 2006 the farmers worked with the MVIHES on restoration of the channels. The five year long project included reshaping the channels to reduce erosion, riparian planting and fencing. There remain opportunities in this activity depending on the property owners and local stewards inclination.

Conclusions

The Morison Creek habitat survey completed several objectives;

- We educated and trained stewards in fish habitat assessment as well as gave them an understanding of the value of this habitat.
- The completed habitat survey is an important document for monitoring the health of the Morison Creek watershed.
- We found natural recovery of the mainstem reaches of Morison and Swayne Creeks.
- We suggest the habitat restoration opportunities lie in the upper reaches on farms which had worked with the MVIHES in the past.

Yours Truly,

A handwritten signature in black ink, appearing to read "David Clough". The signature is fluid and cursive, with the first name "David" being more prominent than the last name "Clough".

David R. Clough RPBio

Figure 4: Morison/Swayne Watershed Restoration Map

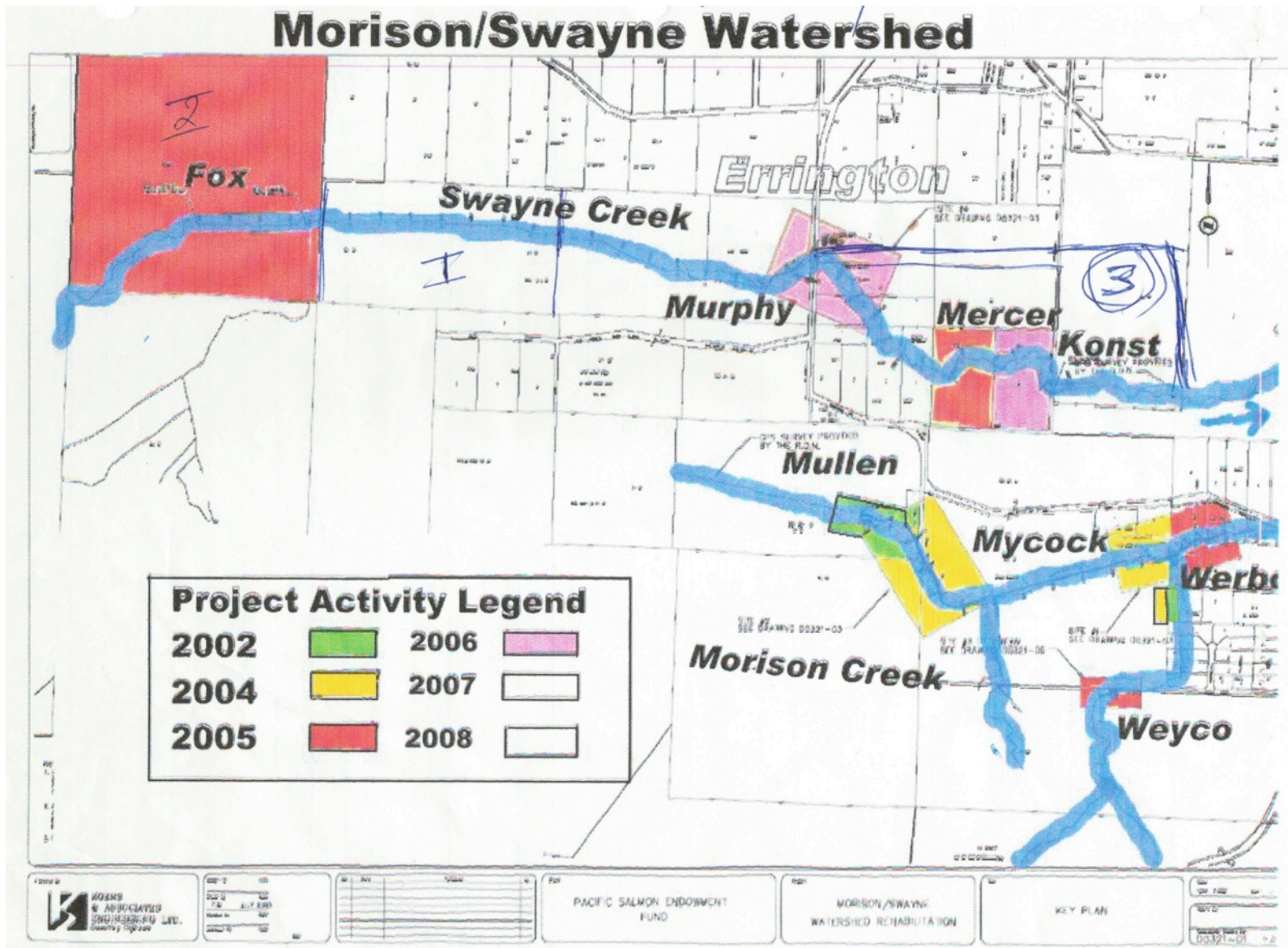


Figure 5: Morison Reach 1 Photo Page



1.) Riffle 1 in lower Morison



2.) Pool 5 in lower Morison



3.) Riffle 20 below Triple Falls



4.) Pool 16 at old erosion site

Figure 6: Morison Reach 2 Photo Page



1.) Baxter Falls



2.) Pool 2 at jam created by right bank slide



3.) Stagdowne Trail Crossing at Riffle 5



4.) Beaver dam pool 4

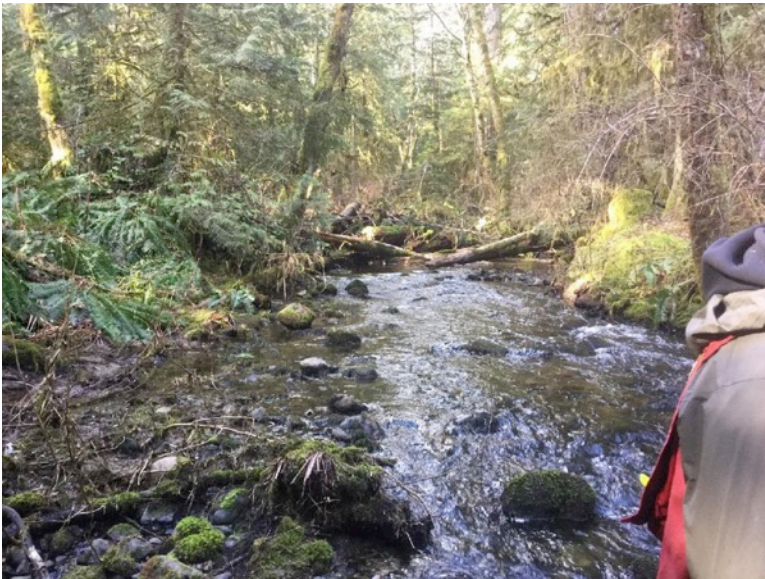
Figure 7: Morison Reach 3 Photo Page



1.) Reach 3 at confluence with Swayne



2.) Pool 2 in Reach 3 with Alder root wad



3.) Typical riffle with Alder canopy and debris



4.) Brush and Alder roots provide pool cover

Figure 8: Morison Reach 4a and 4b2 Photo Page



1.) Reach 4a at quad trail crossing



2.) Reach 4a at mountain bike crossing



3.) Reach 4b2 typical disturbed channel



4.) Reach 4b2 with aging Alder and young Cedars

Figure 9: Swayne Reach 1 Photo Page



1.) Swayne R1 is confined and treed



2.) Typical riffle with good mix of substrates



3.) Overhead canopy is a recovering conifer forest



4.) There are some good cover locations (LWD)

Appendix 2 - Reach 2 Habitat Data

Stream Name: Morison
 Watershed Code: 920-462800-24400-32500
 Date: March 22, 2018
 Reach Name: M2
 Discharge Depth #1: 334.00
 Velocity T1: T1
 Site Length: 334.00
 Dissolved Oxygen: [Green checkmark]
 pH: [Green checkmark]
 Total Dissolved Solids: [Green checkmark]
 Temp C: [Green checkmark]
 at Beginning of Reach Chainage at End of Reach: 0.00
 Discharge Depth #2: T2
 Discharge Depth #3: T3
 Velocity (m/s): [Green checkmark]

Habitat Information (All Pool and Cross Section Data) Start above Baxter Falls end at Stagdowne Trail

Habitat Type	Start (chainage at start)	Finish (chainage at end)	Unit Length	Wetted Width	Pool Area	Wetted Reach Area	%Pool Area	Mean Depth (m)	Percent Gradient	Bankfull Width(m)	Average Percent Wetted Area	Substrate Percent					Percent Instream Cover					Percent Cr	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)	On-Channel Habitat (bank side)	Land Use Right	Land Use Left	Vegetation Type		Riparian Slope	Stability		Vegetation Depth		Livestock Access		Photos	Comments		
												Bed	Bld	Cob	Grv	Fine	LWD	Cutbk	Veg	Other	Right												Left	High		Med	Low	High	Med	Low	Right			Left	Right
Pool	0.00	43.00	43.00	8.30	356.90			1.00	0.00	10.30		70	5	5	0	20	0	0	0	0	5	80.00	6		0	0	1	0	0	0	Nat	Nat	Mix	Mix	80	20	High	Med	200	200	5	5	0		Baxter Falls
Riffle	43.00	50.50	7.50	10.00	0.00			0.20	3.00	11.90		0	40	40	10	10	5	0	0	0	0	80.00	1		5	0	0	0	0	0	Nat	Nat	Mix	Mix	80	20	Low	Med	200	200	0	0	0		Overflow L
Pool	50.50	69.50	19.00	9.50	180.50			0.60	0.00	19.00		0	50	25	0	25	0	50	0	0	0	70.00	15		10	0	1	0	0	0	Nat	Nat	Mix	Mix	80	20	Med	Low	200	200	0	0	0		bank, debris
Riffle	69.50	84.50	15.00	8.00	0.00			0.20	5.00	11.00		0	0	0	70	30	0	50	0	0	0	70.00	5		15	0	1	0	0	0	Nat	Nat	Mix	Mix	20	80	Low	Low	200	200	0	0	0		
Pool	84.50	111.50	27.00	6.00	162.00			0.50	0.00	8.50		5	0	5	70	20	0	0	5	0	0	80.00	2		27	0	0	0	0	0	Nat	Nat	Mix	Mix	20	80	Med	Low	200	200	0	0	0		
Pool	111.50	157.50	46.00	3.00	230.00			0.10	5.00	12.50		0	0	0	0	0	0	0	0	0	80.00	4		46	0	0	0	0	0	0	Nat	Nat	Mix	Mix	20	80	Med	Low	200	200	0	0	0		plain
Pool	157.50	202.50	45.00	11.50	517.50			0.60	0.00	13.00		0	0	15	45	40	0	20	0	0	0	60.00	5		0	0	1	0	0	0	Nat	Nat	Mix	Mix	20	75	Low	Low	200	200	4	4	0		
Riffle	202.50	218.00	15.50	4.00	0.00			0.10	5.00	18.00		0	0	15	60	5	0	0	0	0	0	70.00	0		0	0	0	15	1	0	Nat	Nat	Mix	Mix	20	75	Low	Low	200	200	0	0	1		
Pool	218.00	275.00	57.00	6.30	359.10			0.35	0.00	9.00		75	5	0	10	10	0	0	0	0	0	70.00	0		0	0	0	0	0	0	Nat	Nat	Mix	Mix	15	85	Low	High	200	200	0	0	1		
Riffle	275.00	334.00	59.00	9.30	0.00			0.20	2.00	11.50		0	5	15	60	20	5	0	0	0	0	80.00	0		0	0	0	0	0	0	Nat	Nat	Mix	Mix	15	80	Low	Low	200	200	0	0	1		
Reach Totals and Averages		334	237	7.8	1806	2602	69	0.39	2.0	12.5	62	15	11	12	35	18	1	12	1	0	1	74	38	1	31	0	4	4					22	38	40	42	200	200	3	3					

Appendix 3 – Reach 3 Habitat Data

Stream Name: Morison
 Watershed Code: 920-462800-24490-32500
 Date: March 15, 2018
 Reach Name: M3 BRR
 Discharge Depth #1: T1
 Velocity: T1
 Site Length: [blank]
 Discharge Depth #2: T2
 Discharge Depth #3: T3

Habitat Information (All Pool and Cross Section Data) Start Point at Swayne Confluence walk upstream on Morison Ck

Habitat Type	Start (chainage at start)	Finish (chainage at end)	Unit Length	Wetted Width	Pool Area	Wetted Reach Area	%Pool Area	Mean Depth (m)	Percent Gradient	Bankfull Width(m)	Percent Wetted Area	Substrate Percent					Percent Instream Cover				Percent Crown 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			
												Bed	Bld	Cob	Grv	Fine	LWD	Outbk	Veg	Other																										
Riffle	0.00	22.00		4.30	0.00			0.10	4.00	4.70		0	15	40	30	15	0	10	0	0	0	70.00	0	5	0	0	0	0	Nat	Nat	Mix	Mix	40	10	Med	High	100	100	0	0	0					
Pool	22.00	42.00	20.00	5.30	106.00			0.50	0.00	6.30		10	15	40	25	10	10	0	0	0	0	65.00	2	6	0	0	0	0	Nat	Nat	Mix	Mix	40	10	Med	High	100	100	0	0	0					
Riffle	42.00	53.00		5.30	0.00			0.20	2.00	6.00		10	15	25	30	20	0	5	0	0	0	70.00	1	6	0	0	0	0	Nat	Nat	Mix	Mix	45	15	Med	High	100	50	0	0	0					
Pool	53.00	61.00	8.00	5.30	42.40			0.80	0.00	6.00		0	5	40	25	30	0	0	5	0	0	65.00	1	0	0	0	0	0	Nat	Nat	Mix	Mix	45	10	High	High	100	50	0	0	0					
Riffle	61.00	106.00		4.60	0.00			0.30	3.00	5.00		0	10	20	20	50	5	0	0	0	0	60.00	0	10	0	0	0	0	Nat	Nat	Mix	Mix	50	10	High	High	100	100	0	0	0					
Pool	106.00	114.00	8.00	5.70	45.60			0.60	0.00	5.00		0	5	50	30	15	0	5	0	0	0	50.00	1	0	0	0	100	4	0	Nat	Nat	Mix	Mix	25	40	High	High	100	50	0	0	0				
Riffle	114.00	128.00		6.80	0.00			0.10	2.00	7.20		0	20	50	20	10	0	0	0	0	0	65.00	0	0	0	0	0	0	Nat	Nat	Mix	Mix	25	30	High	High	100	100	0	0	0					
Pool	127.00	147.00	20.00	7.70	154.00			0.80	0.00	8.00		0	10	40	20	30	0	50	0	0	0	70.00	20	0	0	1	0	0	Nat	Nat	Mix	Mix	20	15	Med	Med	100	100	0	0	0					
Pool	147.00	176.00	29.00	6.50	188.50			1.50	0.00	8.80		0	0	50	50	0	10	0	5	0	0	0.00	1	0	0	0	100	0	Nat	Nat	Mix	Mix	30	5	Med	Low	100	100	0	0	0					
Riffle	176.00	207.00		6.50	0.00			0.30	1.00	8.80		0	0	50	50	0	0	5	0	0	0	65.00	1	0	0	0	0	0	Nat	Nat	Mix	Mix	20	10	High	High	100	100	0	0	0					
Pool	207.00	234.00	27.00	7.20	194.40			0.60	0.00	7.20		0	0	40	60	0	0	0	10	0	0	60.00	2	10	0	0	0	0	Nat	Nat	Mix	Mix	10	30	Med	Med	100	100	0	0	0					
Riffle	234.00	258.00		5.70	0.00			0.10	2.00	7.00		0	0	50	50	0	0	0	0	0	0	60.00	0	0	0	0	40	0	Nat	Nat	Mix	Mix	10	30	Low	Low	100	100	0	0	0					
Pool	258.00	279.00	21.00	5.90	123.90			0.60	2.00	6.30		0	0	50	50	0	0	0	0	0	0	0.00	1	5	0	0	40	0	Nat	Nat	Mix	Mix	30	10	Low	Low	100	50	0	0	0					
Riffle	279.00	294.00		5.30	0.00			0.10	3.00	6.80		0	0	60	40	0	0	0	0	0	0	50.00	0	5	0	0	0	0	Nat	Nat	Mix	Mix	15	15	Low	Low	100	50	0	0	0					
Pool	294.00	300.00	6.00	5.30	31.80			0.80	1.00	6.00		0	0	50	50	0	0	15	0	0	0	60.00	2	10	0	0	0	0	Nat	Nat	Mix	Mix	25	25	Low	Low	50	50	0	0	1					
Riffle	300.00	307.00		6.10	0.00			0.30	3.00	6.50		0	0	50	50	0	0	20	0	0	0	60.00	4	6	0	0	0	0	Nat	Nat	Mix	Mix	10	10	Low	Low	50	50	0	0	1					
Pool	307.00	325.00	18.00	8.00	144.00			0.90	1.00	10.00		0	0	50	50	0	0	0	0	0	0	0.00	4	7	0	0	0	0	Nat	Nat	Mix	Mix	15	40	Low	Low	50	50	0	0	1					
Riffle	325.00	328.00		6.50	0.00			0.10	4.00	7.20		0	0	50	50	0	0	0	0	0	0	0.00	0	0	0	0	0	0	Nat	Nat	Mix	Mix	10	50	Med	Low	50	50	0	0	1					
Pool	327.00	337.00	10.00	6.80	68.00			0.50	0.00	7.20		0	0	50	50	0	0	30	0	0	0	50.00	4	5	0	0	0	0	Nat	Nat	Mix	Mix	10	50	Med	Low	50	50	0	0	1					
Riffle	337.00	368.00		6.10	0.00			0.10	2.00	5.00		0	0	50	50	0	0	0	0	0	0	0.00	1	0	0	0	0	0	Nat	Nat	Mix	Mix	0	0	Med	Low	50	50	0	0	1					
Reach Totals and Averages																																														
	368		167	6.0	1099	2225	49	0.47	1.5	6.6	92	1	5	45	40	9	1	7	1	0	0	46	45	1	20	0	1	76					26	24	62	64	85	73	0	0						

Appendix 4- Reach 4a Habitat Data

Stream Name: Morison
 Watershed Code: 920-462800-24400-32500
 Date: March 22, 2018
 Reach Name: M4a1 DRC
 Discharge Depth #1: T1
 Velocity: T1
 Site Length: T1
 Discharge Depth #2: T2
 Discharge Depth #3: T3

Water Quality Information:
 Dissolved Oxygen:
 pH Average:
 Temperature:
 Chainage at Beginning of Reach: 0.00
 Chainage at End of Reach: 129.00
 Discharge at Beginning of Reach: T2
 Discharge at End of Reach: 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/b ank-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 Left		Vegetation Type Right Left		Riparian Slope Right Left		Stability Right Left		Vegetation Depth Right Left		Livestock Access Right Left		Photos	Comments
Pool	0.00	32.00	32.00	7.00	224.00			0.20	0.00	9.00		0	15	115	60	120	0	0	0	0	80.00	0	1	0	0	0	0	0	Nat	Nat	Mix	Mix	10	10	Low	Low	100	100	4	4	1	Quad trail
Riffle	32.00	17.00	3.40	0.00	0.00			0.10	3.00	10.00		0	5	5	60	30	0	0	0	0.00	0	0	0	0	0	0	0	Nat	Nat	Mix	Mix	10	10	Low	Low	100	100	0	0	1		
Pool	49.00	67.00	18.00	4.30	77.40			0.45	0.00	7.00		0	5	5	60	30	0	0	0	0.00	0	17	0	0	0	0	0	Nat	Nat	Mix	Mix	10	10	Low	Low	100	100	0	0	1	bank bad	
Pool	67.00	78.00	11.00	3.50	38.50			0.50	0.00	8.00		0	5	5	40	50	0	0	0	70.00	0	1	0	0	0	0	0	Nat	Nat	Mix	Mix	50	10	Low	Low	100	100	0	0	1	erosion	
Riffle	78.00	86.00	5.00	0.00	0.00			0.10	5.00	10.00		0	0	0	80	20	0	0	0	60.00	0	0	0	0	0	0	0	Nat	Nat	Mix	Mix	50	10	Low	Low	100	100	0	0	1		
Pool	86.00	96.00	10.00	4.00	40.00			0.60	0.00	10.00		0	0	5	75	20	0	0	0	0.00	0	0	0	0	0	0	0	Nat	Nat	Mix	Mix	50	10	Low	Low	100	100	0	0	1		
Riffle	96.00	109.00	3.50	0.00	0.00			0.20	2.00	9.00		0	0	0	80	20	0	0	0	0.00	0	1	0	0	0	0	0	Nat	Nat	Mix	Mix	100	10	Low	Low	100	100	0	0	1		
Pool	109.00	129.00	20.00	6.40	128.00			0.40	0.00	8.00		0	0	10	40	50	0	0	0	60.00	4	1	0	0	0	0	0	Nat	Nat	Mix	Mix	30	60	Low	Low	100	100	0	0	1		
Reach Totals and Averages			129	91	4.6	508	598	85	0	1.3	8.9	52	0	3	6	62	30	0	0	4	2	0	31	4	0	16	0	0	8	8			18	10	40	40	100	100	3	3		

Appendix 5- Reach 4b Habitat Data

Stream Name: Morison
 Watershed Code: 920-462800-24400-32500
 Date: March 15, 2018
 Reach Name: M4b2 BRR
 Discharge Depth #1: T1
 Velocity: T1
 Site Length: T1
 Discharge Depth #2: T2
 Discharge Depth #3: T3

Water Quality Information:
 Dissolved Oxygen:
 pH Average:
 Temperature:
 Chainage at Beginning of Reach: 0.00
 Chainage at End of Reach: 113.30
 Discharge at Beginning of Reach: T2
 Discharge at End of Reach: 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/b ank-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 Left		Vegetation Type Right Left		Riparian Slope Right Left		Stability Right Left		Vegetation Depth Right Left		Livestock Access Right Left		Photos	Comments
Riffle	0.00	10.70	4.40	0.00	0.00			0.40	3.00	4.90		0	0	0	100	0	30	0	0	70.00	3	0	1	0	0	0	0	Nat	Nat	Mix	Mix	5	5	Low	Low	100	100	0	0	1		
Pool	10.70	24.00	13.30	3.20	42.56			1.20	0.00	3.20		0	0	0	20	80	0	50	0	70.00	4	0	1	0	0	0	0	Nat	Nat	Mix	Mix	5	5	Med	Med	100	100	0	0	1	Alt. Road	
Riffle	24.00	26.00	3.20	0.00	0.00			0.20	4.00	3.20		0	0	0	20	80	0	5	0	0.00	1	0	0	0	0	0	0	Nat	Nat	Mix	Mix	5	5	Med	Med	100	100	0	0	1		
Pool	26.00	29.50	3.50	3.80	13.30			0.50	1.00	3.80		0	0	0	100	0	0	0	70.00	0	0	0	0	0	0	0	0	Nat	Nat	Mix	Mix	5	5	Med	Med	100	100	0	0	1		
Pool	29.50	35.70	6.20	3.50	21.70			0.80	1.00	3.50		0	0	0	20	80	0	10	0	50.00	1	0	0	0	0	0	0	Nat	Nat	Mix	Mix	5	5	Med	Med	100	100	0	0	1		
Riffle	35.70	39.70	2.80	0.00	0.00			0.60	2.00	3.00		0	0	0	50	50	0	25	0	80.00	0	0	0	0	0	0	0	Nat	Nat	Mix	Mix	5	5	Med	Med	100	100	0	0	1		
Pool	39.70	49.10	9.40	2.50	23.50			0.80	1.00	2.50		0	0	0	100	0	30	0	0	40.00	6	0	0	0	0	0	0	Nat	Nat	Mix	Mix	5	5	Med	Med	100	100	0	0	1		
Riffle	51.00	56.60	3.00	0.00	0.00			0.80	1.00	3.00		0	0	0	100	0	0	0	0	70.00	0	0	0	0	0	0	0	Nat	Nat	Mix	Mix	5	5	Med	Med	100	100	0	0	1		
Pool	56.60	76.60	20.00	3.00	60.00			0.90	1.00	3.00		0	0	0	100	0	0	0	0	70.00	0	0	0	0	0	0	0	Nat	Nat	Mix	Mix	5	5	Med	Med	100	100	0	0	1		
Riffle	76.60	93.30	5.00	0.00	0.00			0.40	3.00	5.00		0	0	0	100	0	0	0	0	70.00	0	0	0	0	0	0	0	Nat	Nat	Mix	Mix	5	5	Med	Med	100	100	0	0	1		
Pool	93.30	113.00	19.70	3.70	72.89			1.50	1.00	3.70		0	0	0	100	0	0	0	0	70.00	0	0	0	0	0	0	0	Nat	Nat	Mix	Mix	5	5	Med	Med	100	100	0	0	1		
Reach Totals and Averages			113	72.1	3.5	234	392	60	0.7	1.6	3.53	98	0	0	0	10	90	0	11	3	0	65	15	0	2	0	0	11	11			11	11	35	35	100	100	0	0			

Appendix 6 – Swayne Habitat Data

Stream Name: Swayne R1 Watershed Code: 0000-0000-0000 Date: March 22, 2018 Reach Name: S1 DRC/CA Discharge Depth #1: Velocity: T1 Site Length: Chainage at Beginning of Reach: 0.00 Discharge Depth #2: T2
 Dissolved Oxygen: pH: Average Depth (at flow site): Total Dissolved Solids: Temp C: Chainage at End of Reach: 307.0 Discharge Depth #3: T3

Habitat Information (All Pool and Cross Section Data)	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	Large Wood	LWD/bank-full channel width	Erosion Sites (length)	Altered Stream Sites (length)	Obstructions (number)	Of-f-h-a	Of-f-h-a	Land Use Right	Vegetation Type Right	Riparian Slope Right	Stability Right	Vegetation Depth Right	Livestock Access Right	Photos	Comments								
												Bed	Blk	Cob	Grv	Fine	LWD	Cutbk	Veg	Other		Debris																						
Pool	0.00	30.00	30.00	5.20	156.00	0	0	0.30	0.00	6.70		0	5	15	60	130	0	0	5	0	0	80.00	0	0	0	0	0		Nat	Nat	Con	Mix	80	15	Low	Low	50	100	0	0	0	0	Confined	
Riffle	30.00	35.00		5.80	0			0.10	4.00	6.50		0	40	25	30	5	0	0	0	0	0	80.00	0	0	0	0	0		Nat	Nat	Mix	Mix	65	25	Low	Low	50	100	0	0	0	0	r1	
Pool	35.00	42.00	7.00	5.40	38			0.20	0.00	6.90		0	0	15	60	10	5	0	0	0	80.00	0	0	0	0	0		Nat	Nat	Mix	Mix	65	25	Low	Low	50	100	0	0	0	0	P2		
Riffle	42.00	54.00		4.90	0			0.10	3.00	6.60		0	5	35	40	20	0	0	5	0	0	80.00	0	0	0	0	0		Nat	Nat	Con	Con	65	25	Low	Low	50	100	0	0	0	0	R2	
Pool	54.00	60.00	6.00	6.10	37			0.35	0.00	7.90		0	5	35	40	20	0	0	5	0	0	80.00	0	0	0	0	0		Nat	Nat	Con	Con	40	50	Low	Low	150	100	0	0	0	0	P3	
Riffle	60.00	64.00		6.00	0			0.10	0.00	7.30		0	15	25	60	0	0	0	0	0	0	80.00	0	0	0	0	0		Nat	Nat	Con	Con	35	60	Med	Med	150	100	0	0	0	0	R3	
Pool	64.00	82.00	18.00	5.80	104			0.40	0.00	7.50		0	25	10	20	65	0	0	5	0	0	80.00	0	0	0	0	0		Nat	Nat	Con	Con	35	45	Med	Med	150	100	0	0	0	0	P4	
Riffle	82.00	99.00		5.40	0			0.10	6.00	6.90		0	5	35	60	10	0	0	5	0	0	80.00	0	0	0	0	0		Nat	Nat	Con	Con	35	45	Med	Med	150	100	0	0	0	0	R4	
Pool	99.00	122.00	23.00	6.40	147			0.50	0.00	7.30		0	0	50	30	20	0	0	5	0	0	80.00	0	0	0	0	0		Nat	Nat	Con	Con	35	10	Med	Med	150	100	0	0	0	0	P5	
Riffle	122.00	127.00		5.60	0			0.10	3.00	9.60		0	0	60	35	5	0	0	0	0	0	75.00	0	0	0	0	0		Nat	Nat	Con	Con	35	15	Low	Low	150	100	0	0	0	0	R5	
Pool	127.00	159.00	32.00	7.00	224			0.40	0.00	8.30		0	5	60	20	15	0	0	5	0	0	75.00	3	0	0	0	0		Nat	Nat	Con	Con	50	35	Low	Med	150	100	0	0	0	0	P6	
Riffle	159.00	171.00		3.90	0			8.30	1.00	0.10		0	5	60	20	15	0	0	0	0	0	80.00	0	0	0	0	0		Nat	Nat	Con	Con	35	20	Med	Med	150	100	0	0	0	0	R6	
Pool	171.00	190.00	19.00	5.00	95			9.20	0.00	0.10		0	0	5	65	30	0	5	0	0	0	80.00	4	0	0	0	0		Nat	Nat	Con	Con	40	40	Low	Low	150	100	0	0	0	0	P7	
Riffle	190.00	195.00		5.00	0			9.20	4.00	0.10		0	0	0	70	30	0	0	0	0	0	80.00	0	0	0	0	0		Nat	Nat	Con	Con	35	30	Low	Low	150	100	0	0	0	0	R7	
Pool	195.00	202.00	7.00	4.90	34			0.30	0.00	6.50		0	5	10	60	25	0	0	0	0	0	80.00	0	0	0	0	0		Nat	Nat	Con	Con	35	30	Low	Low	150	100	0	0	0	0	P8	
Riffle	202.00	214.00		8.20	0			0.10	1.00	9.20		0	0	0	70	30	0	0	0	0	0	80.00	0	0	0	0	0		Nat	Nat	Con	Con	35	30	Low	Low	150	100	0	0	0	0	R8	
Pool	214.00	240.00	26.00	5.20	135			0.40	0.00	5.70		0	5	5	75	15	0	0	0	0	0	85.00	4	0	0	0	0		Nat	Nat	Con	Con	35	30	Med	Med	150	100	0	0	0	0	P9	
Riffle	240.00	247.00		5.00	0			3.00	7.00			0	5	5	75	15	0	0	0	0	0	75.00	0	0	0	0	0		Nat	Nat	Con	Con	35	30	Med	Med	150	100	0	0	0	0	R9	
Pool	247.00	259.00	12.00	5.60	67			0.30	0.00	9.60		0	0	15	45	50	0	0	0	0	0	75.00	0	0	0	0	0		Nat	Nat	Con	Con	50	15	Med	Med	150	100	0	0	0	0	P10	
Pool	259.00	307.00	48.00	5.60	269			0.50	0.00	7.90		0	5	15	0	80	0	15	0	0	0	80.00	10	0	0	0	0		Nat	Nat	Con	Con	35	25	Med	Low	150	150	0	0	0	0	P11	
Reach Totals and Averages		307.00	228.00	5.60	1307	1719	76	1.6	1.3	6.4	88	0	7	24	47	25	1	1	2	0	79	21	0.44	0	0	0	0	0	0	20	20			40	28	82	82	130.00	102.50	0	0	0	0	

Appendix 7 –Morison March 2018 Habitat Summary

Habitat Parameter	M1	Ratings	M2	Ratings	M3	Ratings	S1	Ratings	M4b2	Ratings	M4a1	Ratings	Total
% Pool Area	29	5	69	1	49	3	76	1	60	1	85	1	12
Large Woody Debris/Bankfull Channel Width	0.2	5.0	1.4	3.0	0.8	5.0	0.4	5.0	0.5	5.0	0.3	5.0	28
% Cover in Pools	9	3	14	3	9	3	3	5	15	3	6	5	22
Average% Boulder Cover	4	5	1	5	1	5	1	5	0	5	0	5	30
Average % Fines	8	1	18	3	9	1	25	5	90	5	30	5	20
Average % Gravel	9	not rate	35	not rate	40	not rate	47	not rate	10	not rate	62	not rate	--
% of Reach Eroded	5	3	31	5	20	5	0	1	0	1	16	5	20
Obstructions	0	0	4	4	1	1	0	0	0	0	0	0	5
% of Reach Altered	0	1	0	1	0	1	0	1	2	1	0	1	6
% Wetted Area	82	3	62	5	92	1	88	3	98	1	52	5	18
Totals	2.9	26.0	3.3	30.0	2.8	25.0	2.9	26.0	2.4	22.0	3.6	32.0	161.0
Off-Channel Habitat as % of Reach	11.4	5.0	4.5	5.0	76.1	1.0	0.0	5.0	0.0	5.0	0.0	5.0	26.0
Reach Lengths	1229.0	not rate	334.0	not rate	368.0	not rate	307.0	not rate	113.3	not rate	129.0	not rate	2480.3

Riparian Ratings													
Reach	M1	Ave. Ratings	M2	Ave. Ratings	M3	Ave. Ratings	S1	Ave. Ratings	M4b2	Ave. Ratings	M4a1	Ave. Ratings	Total
Land Use	80	1	20	1	40	1	40	1.00	22	1	16	1	6
Riparian Slope	182	2	60	3	50	1	68	1.70	22	1	28	2	11
Bank Stability	230	3	82	4	126	3	164	4.10	70	3	80	5	22
% Crown Cover	68	3	74	1	46	3	79	1.00	65	3	31	5	16
% of Reach Accessed by Livestock	2	1	13	3	0	0	0	0.00	0	0	16	3	7
Average Vegetation Depth	67	1	200	1	79	1	116	1.00	56	3	100	1	8
Totals	1.9	11	2.2	13	1.6	9	1.47	9	1.9	11	2.8	17	70