FSCI Biological Consultants

November 4, 2016 Our File No.: FSCI-16-0024

Mr. Dave Crosby
Sunshine Coast Regional District
1975 Field Road
Sechelt, BC V0N 3A1

Re: Review of low summer flow on salmonid habitat/passage in Chapman Creek

Dear Mr. Crosby:

This letter provides an update and additional information on available anadromous fish habitat and upstream passage during low summer flows in Chapman Creek. The information provided has been merged with data collected in 2015[1] using 2016 low summer flow information and is intended to accompany my 2015 letter report.

There remains public and regulator concerns about possible detrimental effects of targeted low summer flows on rearing juvenile salmonids, specifically Coho salmon, Steelhead and Cutthroat trout and migrating adult Pink, Chum and early Coho salmon. In 2016 the SCRD, using recommendations presented in 2015[1], maintained an estimated summer flow of approximately 0.20-0.22 cms. The maintained flow occurred after water in Chapman Lake stopped flowing over the control weir. The habitat, stage and channel morphology data collected in 2016 targeted this period of instream flow.

The period of greatest concerns remains the same, namely August and September, as natural watershed flows decrease and regional potable water demands increase. It's during this period that Pink and early Coho salmon enter the river. The majority of Coho and Chum migration occurs in October/November with returning Chum peaking near the end of October. In most years the October rains return and river flows have increased by mid October. At that point upstream access is not an issue.

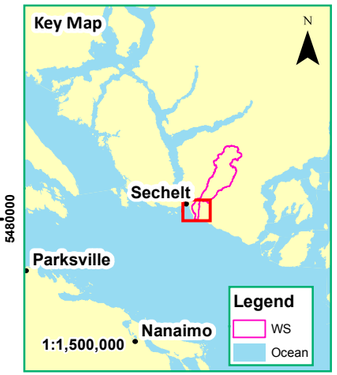
In order to update the summer low flow information and the influence on fish and fish habitat, habitat assessments were repeated on the anadromous reaches. These assessments and measurements occurred during the summer (August/September, 2016) and targeted 0.20 to 0.22 cms discharge. The assessment followed the modified fish habitat procedures used in 2015 (Johnston and Slaney, 1996[2]) and was completed for the same anadromous stream length reported in 2015 (**Figure 1**). This was approximately 3.5-km of river, which represents greater than 50% of the entire anadromous stream length. As in previous years the effort focused on Reach 1, 2 and the lower portion of Reach 3.

[1] Letter to Dave Crosby from D. Bates dated December 6, 2015.
[2] Johnston, N.T. and Slaney, P.A. 1996. Fish Habitat Assessment Procedures. Watershed Restoration Technical Circular No 8., BC Ministry of Environment, Lands and Parks, Victoria, BC.

8-5520 McCourt Road, Sechelt, BC, Canada, V0N 3A7
604-740-2637 (tel)
dbates@fsci-biological.ca

Chapman Creek Anadromous Reaches

November 4, 2016



Legend

- Chapman Creek WS
- Reach Break
- Cross Section
- Temperature loggers
- Hatchery Intake
- Passage Barrier
- SCRD Intake
- Streams
- Roads
- Species Observed

Source: Province of British Columbia
Scale: 1 : 20,000
Map projection: UTM Zone 10N
Datum: NAD 1983

DISCLAIMER: This document and the statements within have not been formally reviewed or approved by the organization(s) representing FSCI Biological Consultants. They are presented for GIS data consultation, viewing and collection purposes only, and are subject to change. This document should not be used for navigational purposes.

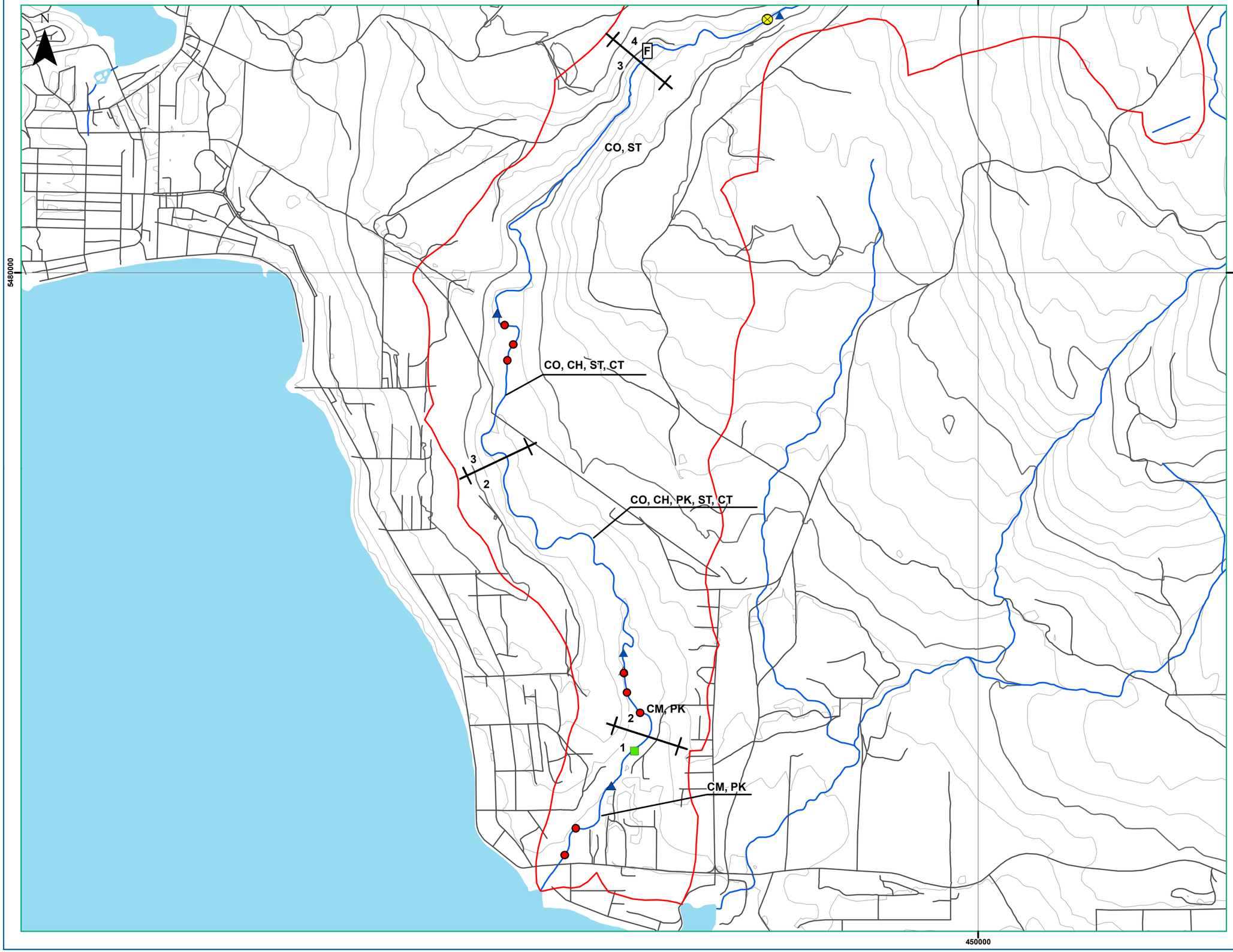
FSCI Biological Consultants

Prepared For: Proprietary Purposes
Prepared On: November 04, 2016
Prepared By: FSCI Biological Consultants
NOT INTENDED FOR NAVIGATIONAL PURPOSES.

1:20,000

0 125 250 500

Meters



In addition to the habitat survey a series of 8 cross sections were established throughout the 3 anadromous reaches (**Figure 1**). The cross sections were located in riffle areas, selected to represent areas that could be potential passage barriers at low flows. Cross-sections were benchmarked and pinned for future reference. The creation of barriers to migration may occur where insufficient swimming depth cannot be maintained. The selection of riffles was based on channel morphology (riffles) that could provide access issues.

Anadromous fish distribution in Chapman Creek varies throughout its accessible length (**Figure 1**). In the summer low flow period, Reach 1 (lower reach) must be passable by Coho, Chinook, Pink and Chum salmon while the majority of Reach 2 and 3 must be accessible for early Pink and Coho salmon and possibly Chinook salmon. It should be noted that Chinook access might always be problematic. This hatchery-enhanced species is typically large and may require substantial depth to migrate upstream. Design flows to accommodate the few returning large Chinook may not be possible. Minimum passage depths used to determine the possibility of passage at 0.20 cms are presented in **Table I**.

Table I: *Minimum water depth and maximum velocity that enable upstream migration of select adult migrating salmon (Thompson, 1972[3]).*

Species	Minimum migration depth (m)	Maximum migration velocity (m/s)
Summer Chinook	0.24	2.44
Pink Salmon	0.18	2.13
Chum Salmon	0.18	2.44
Coho Salmon	0.18	2.44

Finally, at each area with surveyed cross sections, stage changes were recorded using Solinst® pressure transducers. These will provide insight to daily fluctuations in stage height that may help direct planned releases for summer returns of Pink and early Coho salmon.

Results Summary

Results of the 2016 habitat assessments are similar to the information collected in 2015. Habitat at lower flows typically provides less available wetted area, although the quality of habitat is high (**Figure 2**). Juvenile salmonids were observed throughout the length of surveyed stream and when the available wetted habitat data collected in 2016 was plotted with the 2015 data the target of 0.20-0.22 cms appears to provide adequate available habitat (**Figure 3**). This is also consistent with the results provided in the 2015 report. As a result of the additional data, it is my opinion that rearing salmonid populations are afforded adequate protection at the target low summer flow of 0.20 cms,

[3] Thompson, K. 1972. Determining stream flows for fish life. Pages 31-50 in Proceedings, Instream flow requirements workshop. Pacific Northwest River Basins Commission, Vancouver, Washington.

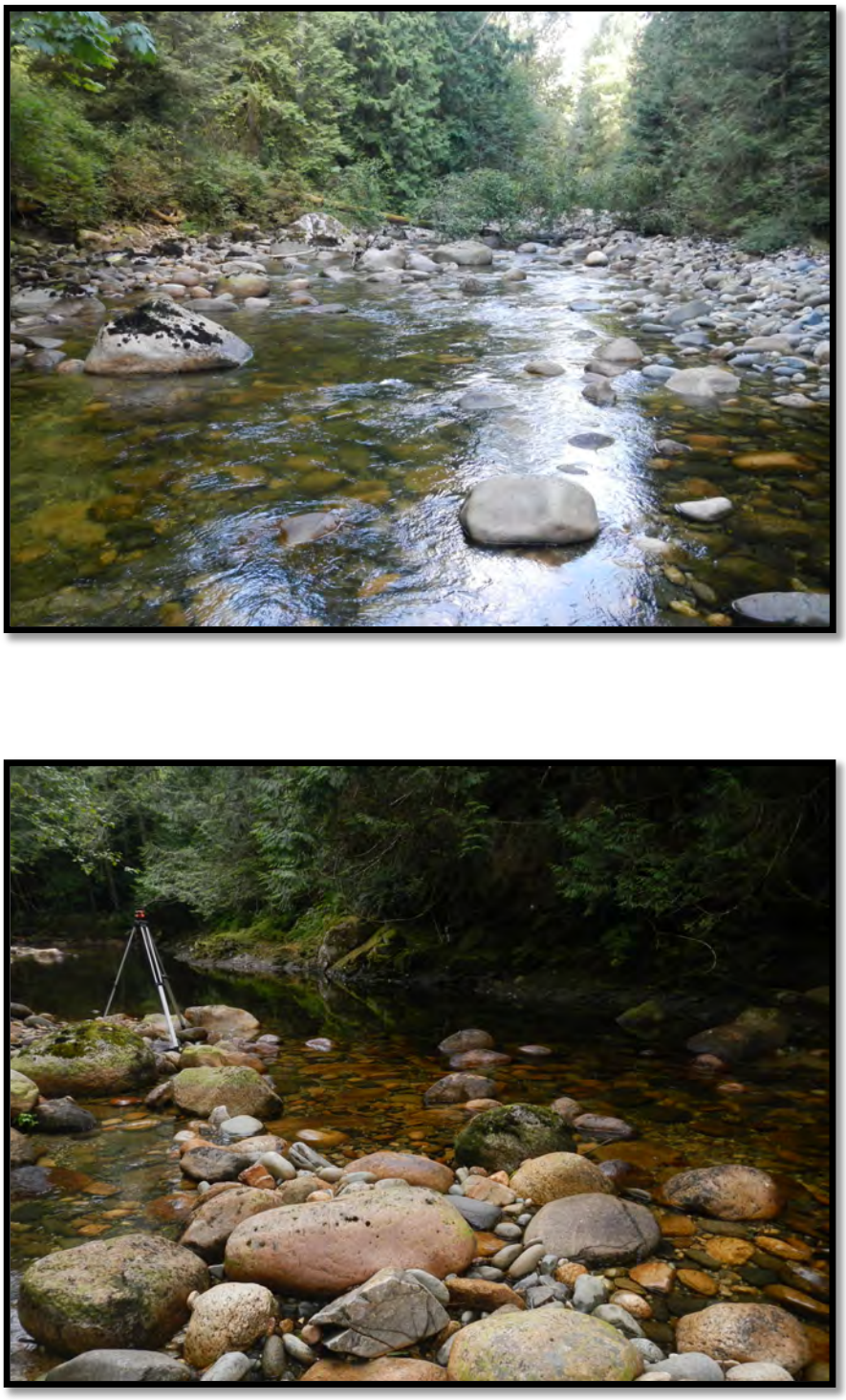


Figure 2: *Example of observed available rearing habitat found in Reach 2 and 3 of the Chapman Creek mainstem. The photos were taken August 10 at an estimated flow of 0.20 -0.22 cms.*

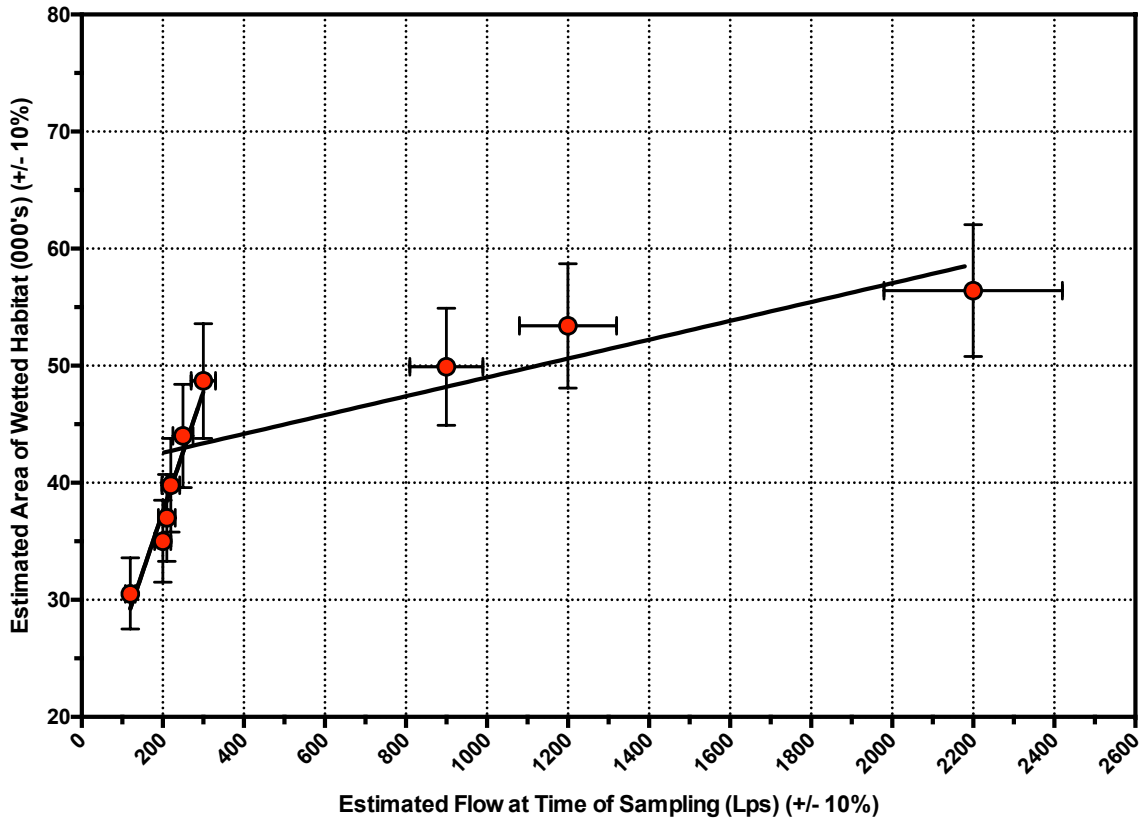


Figure 3: *The measured available wetted habitat versus the estimated flow (lops) documented on the lower anadromous length of Chapman Creek. The intersection or breakpoint of the linear relationships illustrates the point at which quality habitat area increase slows with increasing flow. This is intended as a guide representing a managed discharge to maximize habitat benefit.*

which has been estimated to represent approximately 5% of mean annual discharge below the intake[4].

While the target of 0.20 appear to provide abundant protection, it may be possible, under certain conditions to reduce the volume. This should only be considered in the event of emergency need and a robust water quality and habitat-monitoring plan should be implemented to ensure fisheries resources are protected. The greatest risk to severe reduced flows (0.10 cms) would be in mid August when solar heating and water temperatures are typically greatest.

In order to assess the influence of 0.20 cms flow on water temperature a set of Onset® Tidbit data loggers were installed in the target reaches (**Figure 1**). Temperature data was recorded during the summer low flow period. Water temperature during the summer low flow ranged from a high of 18.6°C (August 16) to a low of 10.2°C (Sept 27) (**Figure 4**). At higher temperatures and lower flows, thermal refuge is available in abundant pool and complex instream habitats (**Figure 5**).

[4] Bates, D. 2008. Letter report to G. Wilson, BC MoE. Chapman Creek low flow-GBLR Mainland coast water for fish.

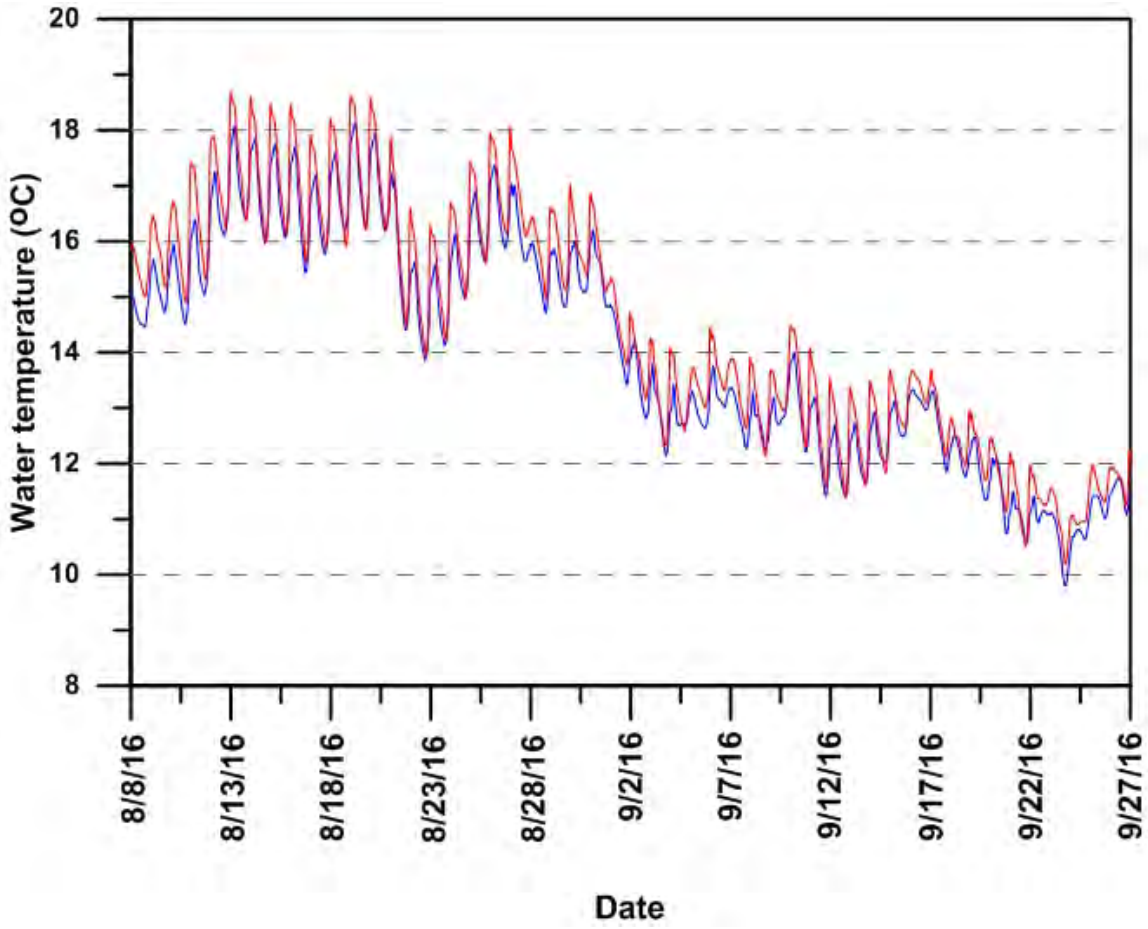


Figure 4: *Water temperatures recorded every 30 minutes from the beginning of August to the end of September 2016. The temperatures were recorded in Reach 2 (Red line) and 3 (Blue line). The temperatures peaked at daily highs greater than 18°C for a 10-day period.*

In Reach 1, water temperatures appeared to be higher during the same period. This will be confirmed after the next data download. It is probable that the diversion of surface water for the hatchery that subsequently reduces bypass flows, affects water temperature in this zone. The extent of difference has not been determined and will be provided to the SCRD once the loggers can be accessed.

There was no indication that the target flow (0.20 cms) has any detrimental affect on rearing salmonids with abundant quality and accessible habitat. While a flow of 0.20 cms appears adequate to protect rearing salmonids, there is a concern with lower flows creating a barrier to upstream migration. As described above a series of 8 cross sections were surveyed and the depth at these points measured to determine the depth through the thalweg. This thalweg depth determines the ability of larger adult salmonids to navigate upstream at lower flows.

In reviewing the surveyed cross sections reported above, all riffles were accessible at the target 0.20 cms (see attached). The cross sections represent sections of stream in each of the three reaches and areas that have access issues at low flows or have the potential to create access issues.

Figure 5: *Example of areas of instream habitat including cover and depth that provides thermal refuge during periods of increased water temperatures. The top photo is taken at a flow of 0.20 cms and the lower at 0.50 cms.*

These monitoring cross sections have been permanently fixed for continued monitoring as channel morphology changes.

The greatest area of concern is Reach 1, a channelized depositional reach. It is this area that most depth/barrier issues exist. Cross section 1 (see attachment of cross section plots) represents the first significant shallow riffle barrier. The survey shows a thalweg depth between 0.15 to 0.20 m at a flow of 0.20 cms. This flow, and associated depth may slow upstream migration and in years with a similar thalweg to 2016 and large Pink Salmon returns require "creative" mitigation to ensure spawning adults can move to spawning areas upstream.

This reach and the first riffle area changes seasonally and changes following each large flood event. The modified and channelized Reach is typically characterized by large bedload build-up and will continue to provide challenging conditions for upstream migration. Monitoring of adult salmon buildup should be implemented in partnership with local volunteer and regulatory agencies and a mitigation plan established for peak Pink salmon return years.

In reviewing the remaining cross sections (see attachments) there does not appear to be an issue with depth for upstream movement. The thalweg depth provides upstream access throughout Reach 2 and 3. The challenge in dry year with peak salmon returns will be facilitating adult movement through Reach 1 to Reach 2.

In summary, results of the 2016 assessment support the target flow of 0.20 cms and provide access to stable/quality rearing habitats during a critical growth period (summer). The target flow also provides adequate flow and depth to facilitate distribution of adult Pink and early Coho salmon in Reach 2 and 3. In Reach 1 access becomes more challenging at this volume and may require continual monitoring to ensure returning fish are not prevented from migrating up to and past the hatchery. The distribution, as reported in 2015 may require monitoring and planning to either entice movement with pulsed releases or physical movement.

It should be noted that the issue of shallow riffles and barriers in Reach 1 is not a reflection of the SCRD release flow (0.20 cms). This reach has been channelized (1950's) and confined, resulting in areas of significant bedload build-up (lower area near Highway 101 bridge) (**Figure 6**). These areas of deposition change seasonally and will present an ongoing challenge for migrating summer run salmonids (Pink salmon).

In closing I want to re-iterate that the 2016 results support the findings presented in 2015 and that a release target flow of 0.20 cms provides substantial quality rearing habitat. This same release target appears to provide adequate flows across riffles in Reaches 2 and 3, ensuring upstream adult movement. This flow may provide adequate conditions for upstream access in Reach 1 but this should be monitored. This will be important in the dominant Pink salmon return years (2017, 2019 etc.).

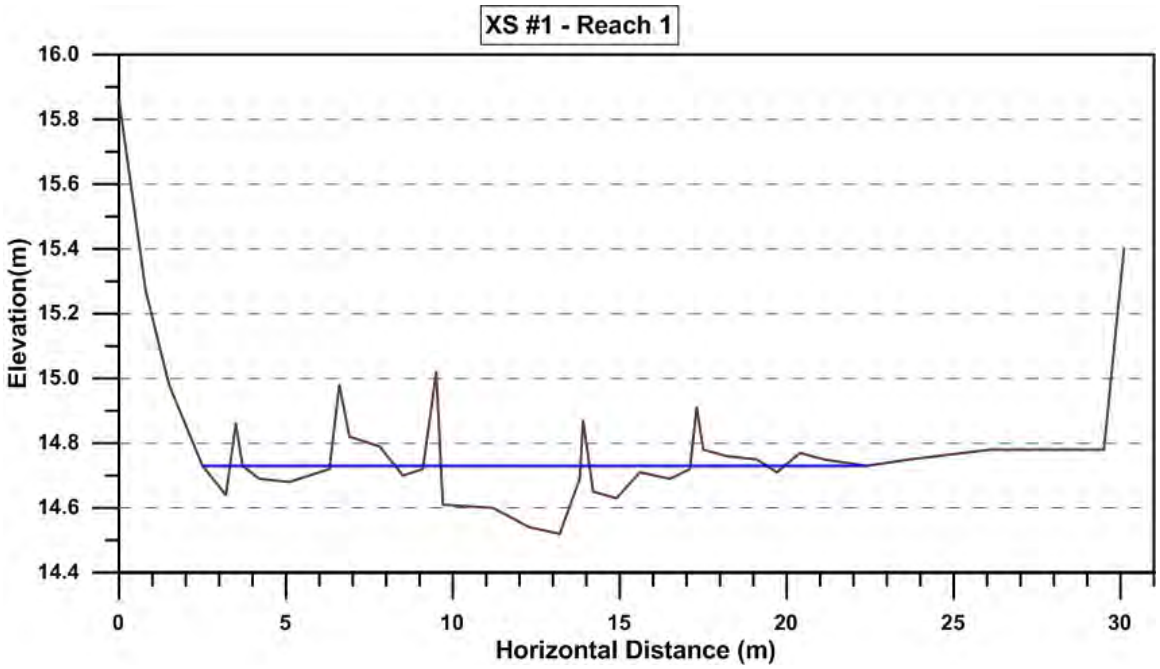
I trust this information is helpful. I welcome the opportunity to discuss in detail either the 2015 mitigation plans or the 2016 sampling results.

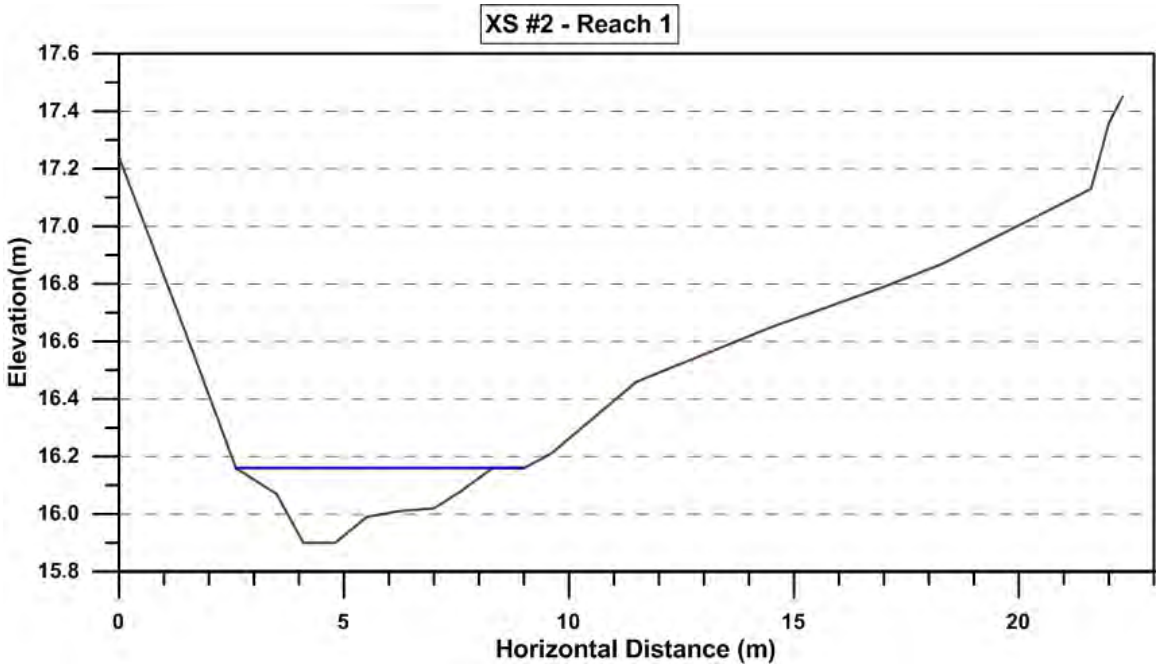
Sincerely

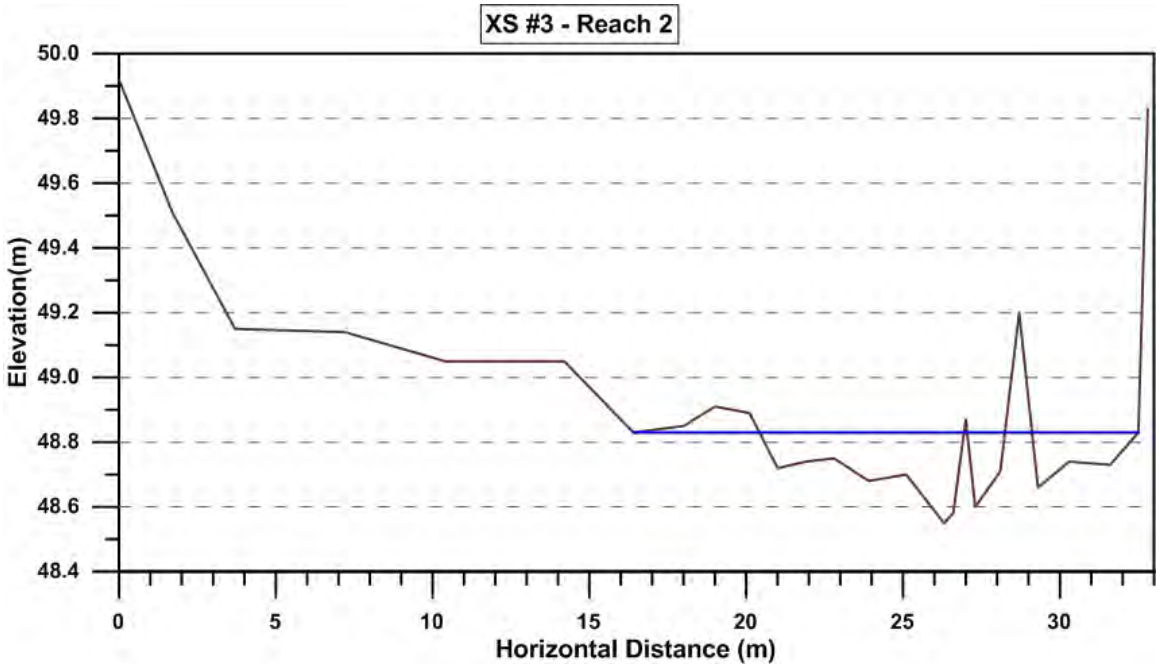
D. Bates, RPBio (#405)
Fisheries Biologist

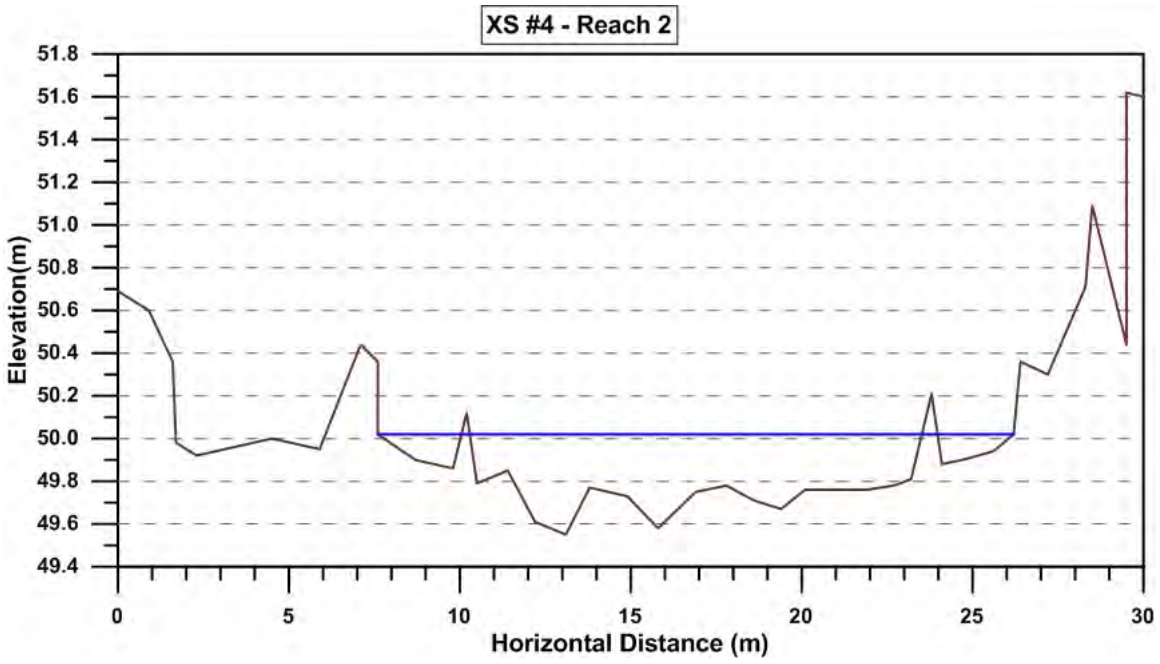
Figure 6: Photos of the first riffle above the high tide mark on lower Chapman Creek. This area is characterized by extensive bedload build-up and in some years presents a migration barrier at low flows. The pool immediately downstream provides the first significant adult holding location.

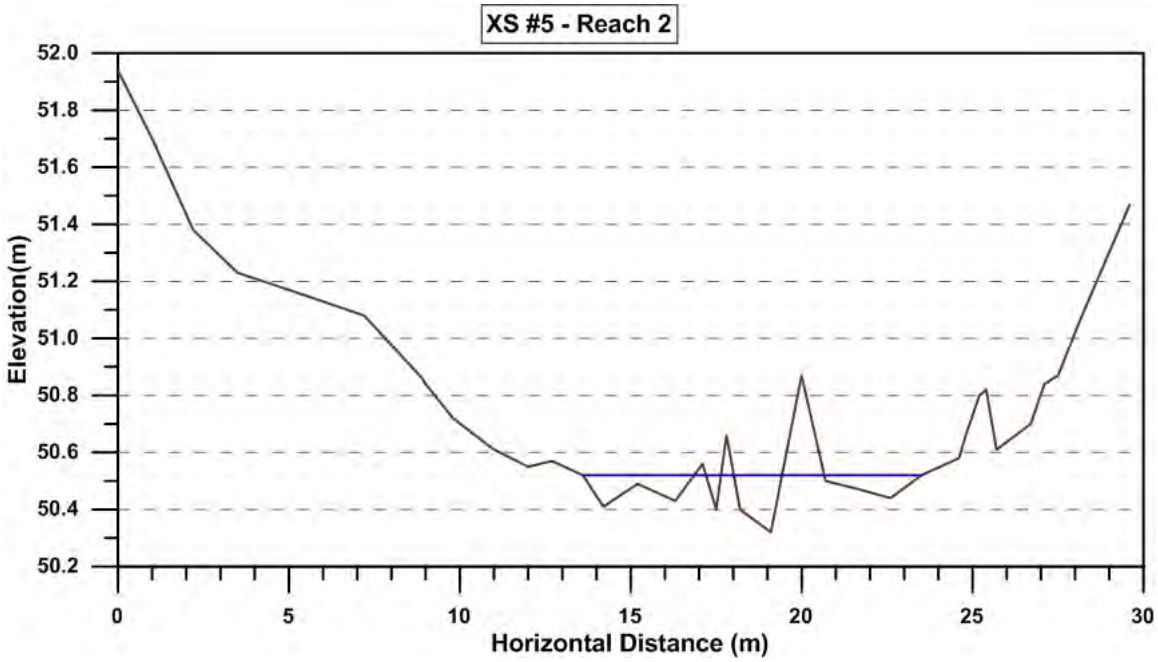
Attachment 1: Cross section plots of selected riffle crests that could, under summer low flow conditions present an upstream migration barrier to adult salmon. The plots show the approximate water surface level at 0.20 cms. The minimum depth for passage of key species is met at all locations.

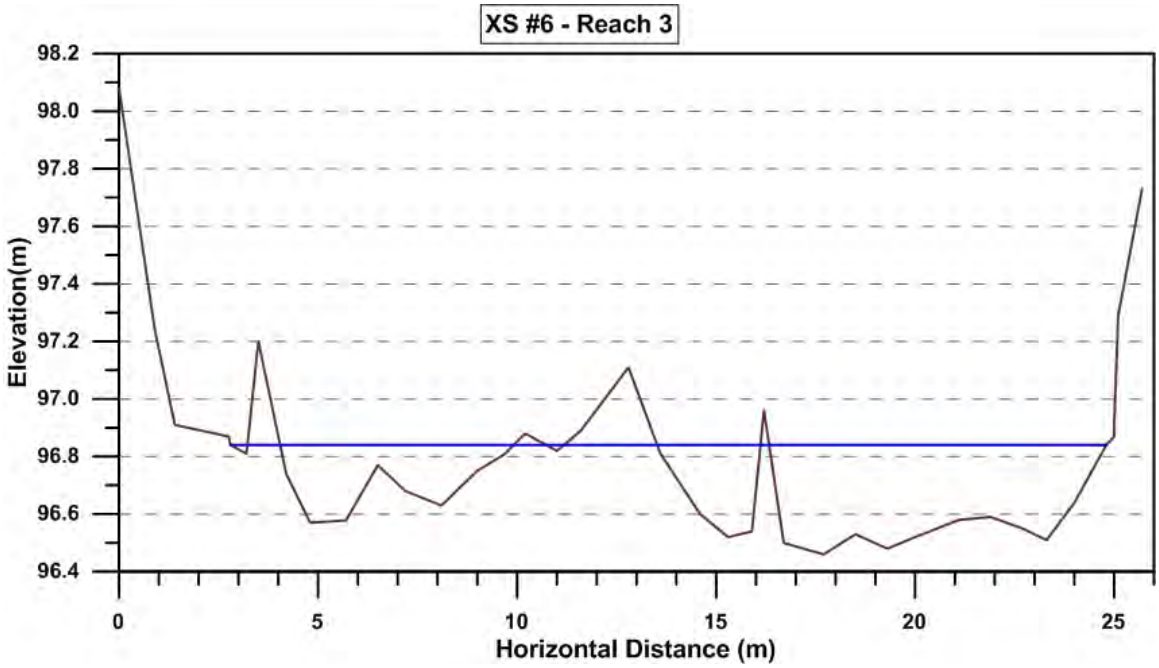


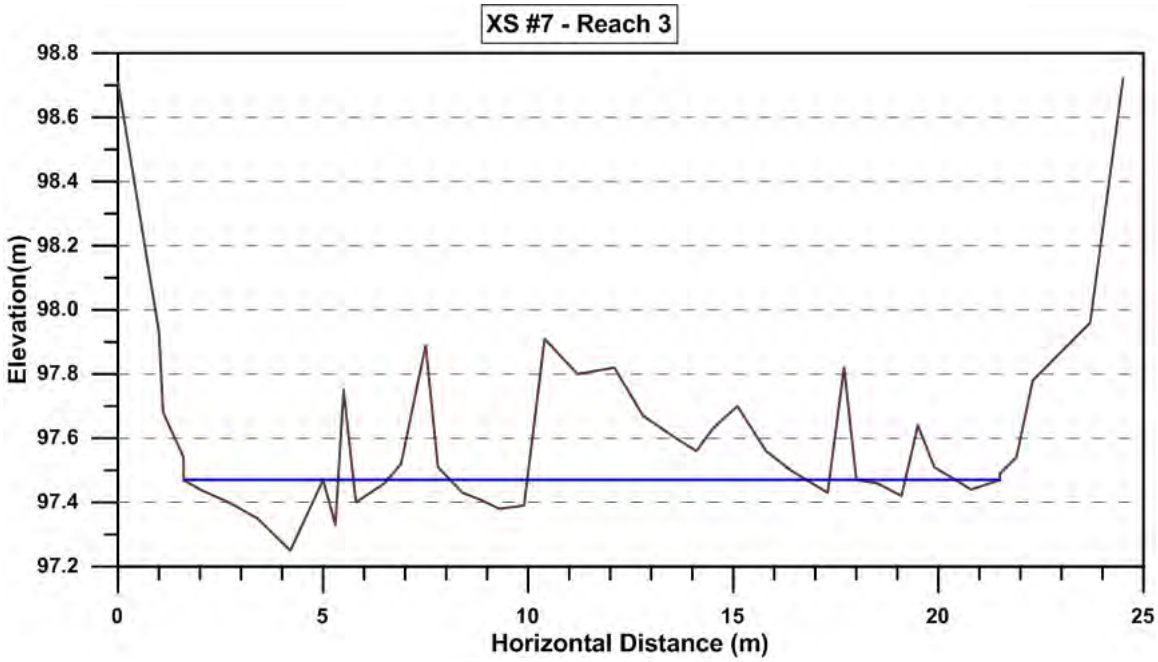


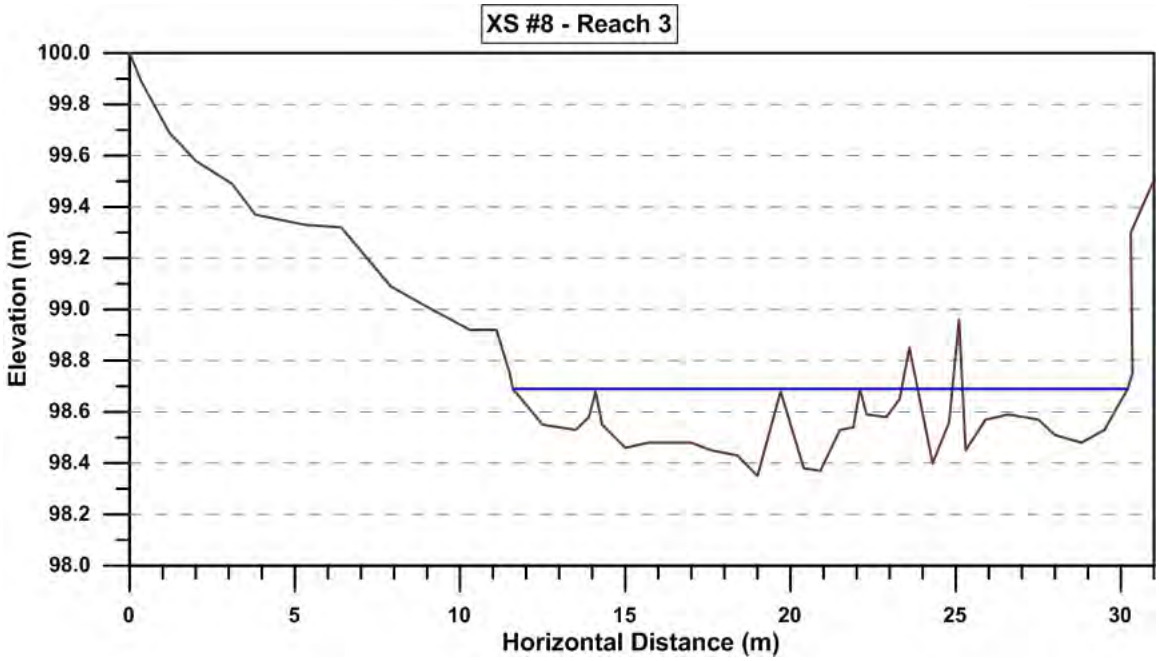

XS #3 - Reach 2
Elevation(m)
50.0
49.8
49.6
49.4
49.2
49.0
48.8
48.6
48.4
0
5
10
15
20
25
30
Horizontal Distance (m)


XS #4 - Reach 2
Elevation(m)
51.8
51.6
51.4
51.2
51.0
50.8
50.6
50.4
50.2
50.0
49.8
49.6
49.4
0
5
10
15
20
25
30
Horizontal Distance (m)


XS #5 - Reach 2
Elevation(m)
52.0
51.8
51.6
51.4
51.2
51.0
50.8
50.6
50.4
50.2
0
5
10
15
20
25
30
Horizontal Distance (m)


XS #6 - Reach 3
Elevation(m)
98.2
98.0
97.8
97.6
97.4
97.2
97.0
96.8
96.6
96.4
0
5
10
15
20
25
Horizontal Distance (m)


XS #7 - Reach 3
Elevation(m)
98.8
98.6
98.4
98.2
98.0
97.8
97.6
97.4
97.2
0
5
10
15
20
25
Horizontal Distance (m)


XS #8 - Reach 3
Elevation (m)
100.0
99.8
99.6
99.4
99.2
99.0
98.8
98.6
98.4
98.2
98.0
0
5
10
15
20
25
30
Horizontal Distance (m)