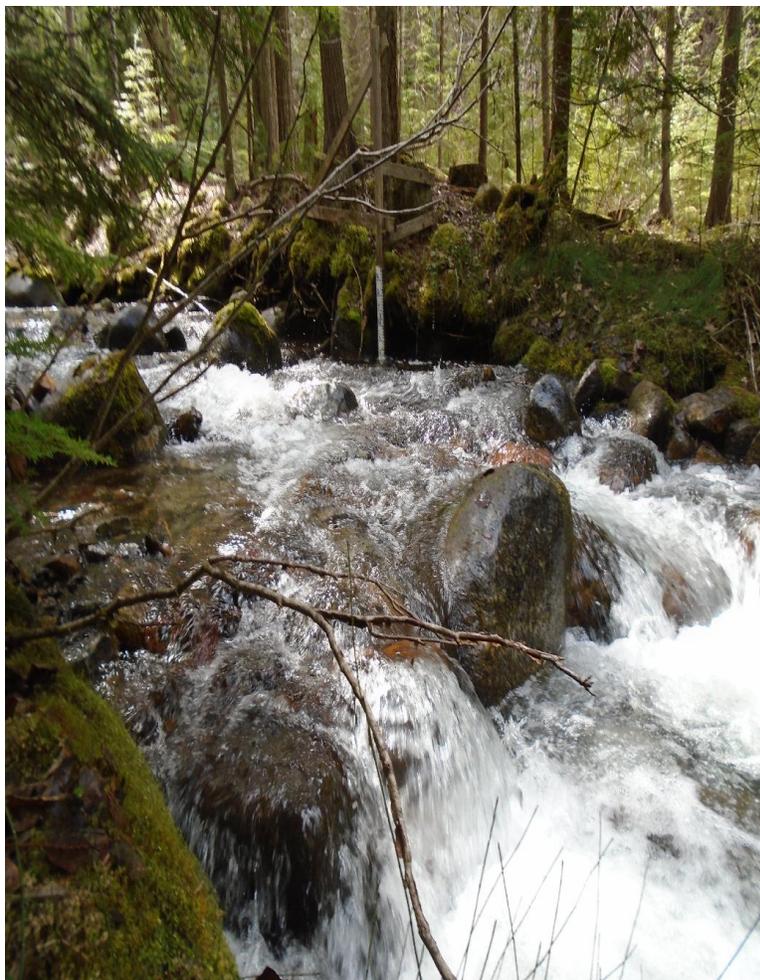


Mill and Narrows Creek Monitoring

Report 2015



Narrows Creek

Report Prepared For:

The Harrop Proctor Watershed Protection Society

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Mill and Narrows Creeks Monitoring Summary Report for 2015

Written by Jennifer Yeow, Passmore Laboratory Ltd and submitted May, 2016

Background

This report reviews monitoring data and presents findings on Mill (Harrop)Creek and Narrows Creek for the Harrop-Proctor Community Co-Operative. The Co-Operative holds a Community Forest License which lies within Mill and Narrows Creek watersheds. The water monitoring program was initiated in 1999 to obtain baseline data, characterize water quality and assess changes associated with climate and development activities in the watersheds managed by the Co-Operative. The following information documents findings from January 2015 to April, 2016. Narrows and Mill creeks have been monitored since 1999 and 2002 respectively.

The program

The structure of the present monitoring program is based on recommendations given in “ Monitoring Guidelines to Evaluate the Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska” by L.H. MacDonald. Sample frequency was established based on recommendations of local scientists and forest hydrologists in Canada and Idaho State, USA. The program relies on manual reading of instream flow gauges. The gauges are calibrated by creek channel metering using a Price Current meter (RIC standard procedures) at intervals of 6 to 12 inches across the stream and 4-5 metering sessions cross channel per year. Regression formulas that are consistent with the manual method are used to calculate stage-discharge tables to three decimal places. In 2015, deviations for each calculated discharge ranged from 0.3 - 14.6 % (average 6.9%) for Mill Creek and 0.3 - 12.6% (average 5.9%) for Narrows Creek (see attached hydrometric summary). A stage discharge curve was developed for each creek. Strategic collection of water samples (Mill) and 43 samples (Narrows) 46 samples were based on the following criteria:

- collect during and after storm events and/or heavy rain
- collect more samples during spring freshet and fall rain events
- collect when creek water appears turbid
- keep samples cool and dark prior to delivery to lab within one week

In addition to flow readings, samples were tested for suspended solids when turbidity readings were greater than 0.5 NTU. Confirmed coliforms, thermotolerant coliforms and E.coli bacteria were also tested. The frequency of sample collection for these parameters is based on recommendations in the B.C. Ministry of Environment Water Quality Guidelines and specifies five samples over thirty days during late summer. However, in 2015 only two collections per creek were made. Water temperature readings were taken hourly via temperature Hobo Temp Pro data loggers.

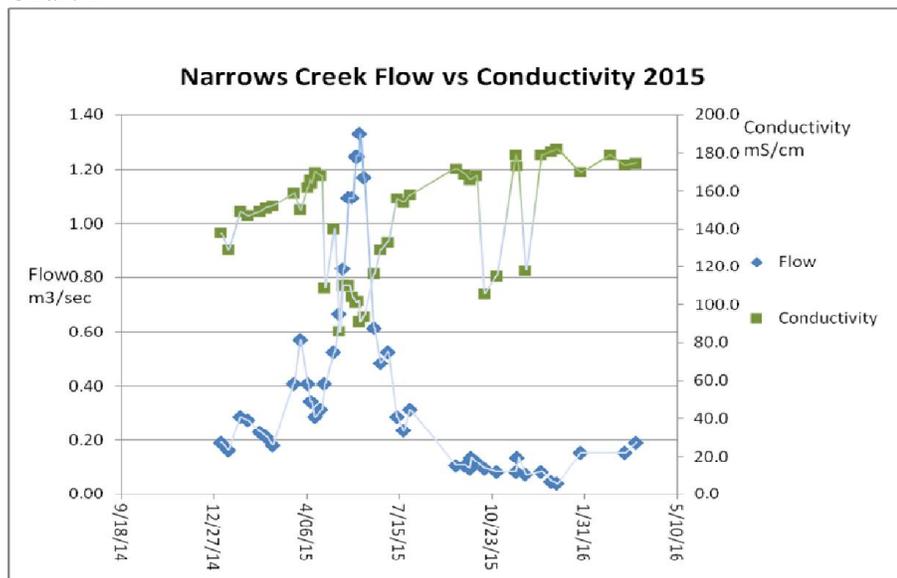
All physical and microbiological tests were performed at Passmore Laboratory Ltd. and followed methods outlined in the "Standard Methods for Examination of Water and Wastewater" published by the American Public Health Association 21st edition, 2005. Passmore Laboratory Ltd. is certified by the Provincial Enhanced Water Quality Assurance Program (EWQA) and participates in reviews through the University of British Columbia Clinical Microbiology Proficiency Testing (CMPT) Program.

Credit goes to Pamela Dykstra who read the gauges and collected samples during 2015.

The following table summarizes Narrows Creek data. No collections taken in 2002 and 2008

Table 1 Narrows Creek							
	Flow		Conductivity		Turbidity	Suspended Sediment	Number
	Maximum m ³ /sec	Minimum m ³ /sec	Maximum mmhos/cm	Minimum mmhos/cm	Maximum NTU	Maximum mg/l	Samples (n)
1999		1.86 (12/31)	157 (11/24)	86.2 (6/24)	0.9 (6/24)	9.0 (6/24)	25
2000	2.3 (6/17)	0.09(11/18)	210 (12/15)	74 (6/9)	1.7 (5/3)	3.3 (6/7)	26
2001	2.47 (5/25)	0.07 (2/23)	176 (4/13)	83.2 (5/25)	1.3 (5/25)	4.2 (5/25)	11
2003	3.6 (6/9)	0.158 (3/28)	164 (2/15)	75.4 (6/5)	3.2 (5/30)	30.6 (5/30)	41
2004	1.32 (6/20)	0.08 (12/1)	176 (3/19)	96.6 (6/14)	0.35 (5/5)	3.6 (5/5)	42
2005	1.95 (5/17)	0.099 (4/8)	167 (2/10)	90.5 (5/17)	0.45 (5/17)	1.5 (6/17)	40
2006	5.33 (5/20)	0.122 (2/25)	175 (2/11)	77.9 (5/20)	7.0 (5/20)	64.5 (5/17)	41
2007	3.87 (6/15)	0.087 (3/18)	168 (1/2)	76.7 (6/5)	4.0 (6/5)	58.5 (6/5)	13
2009	3.58 (5/31)	0.04 (3/20)	166 (3/10)	55.5 (5/31)	0.7 (5/31)	8.8 (5/31)	56
2010	2.4 (6/3)	0.134 (2/10)	170 (2/26)	87.9 (6/14)	0.55 (6/14)	5.3 (6/14)	36
2011	4.66 (6/21)	.094(12/10)	181 (4/20)	90.6 (6/21)	3.3 (6/6)	24.5 (5/12)	52
2012	4.0 (6/23)	0.09 (12/10)	180 (4/14)	82.1 (6/23)	8 (6/23)	126 (6/23)	39
2013	3.2 (6/23)	0.02 (10/05)	168 (4/23)	78.1 (5/12)	1.8 (5/08)	23.1 (5/06)	46
2014	2.13 (5/25)	0.08 (1/04)	148(12/06)	55.6 (5/23)	.95 (3/29)	5.1 (3/29)	57
2015	1.33 (6/2)	0.04 (1/1)	182 (1/1)	86.3 (5/11)	4.5 (10/6)	10.3 (5/21)	46

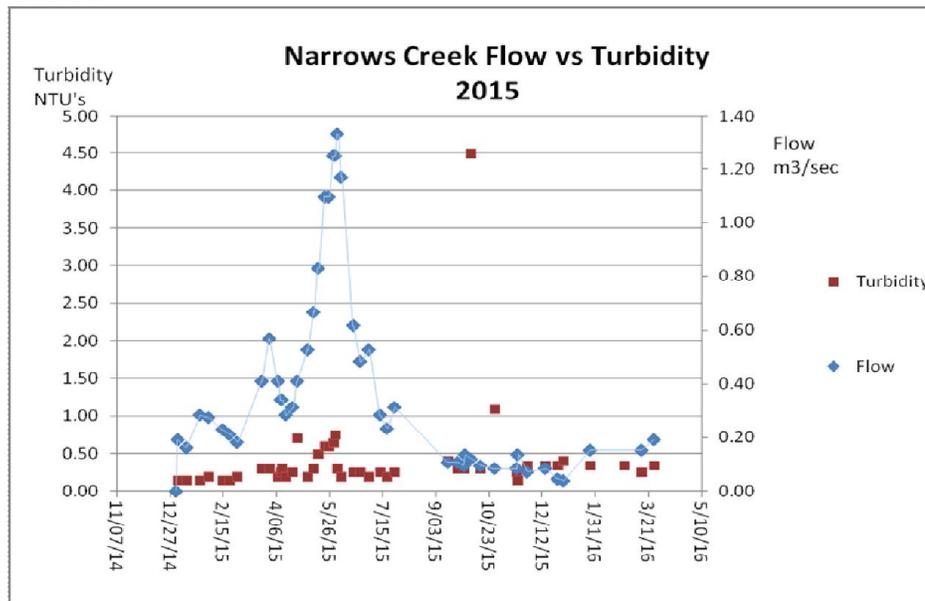
Chart 1



Narrows Creek Flow, Conductivity:

Narrows Creek peak flow normally occurs between mid May to mid June and low flow occurs in winter to early spring. The peak flow reading for 2015 observed on June 2nd was 1.133m³/sec. Low flow on January 1st was 0.04m³/sec. As seen in Table 1, five of the 9 lowest flow readings over 15 years of data are recorded during the last 5 years. The highest conductivity reading (182 m³/sec) was reported on January 1, 2015. The lowest conductivity reading (86.3mS/cm) was reported on June 11th.

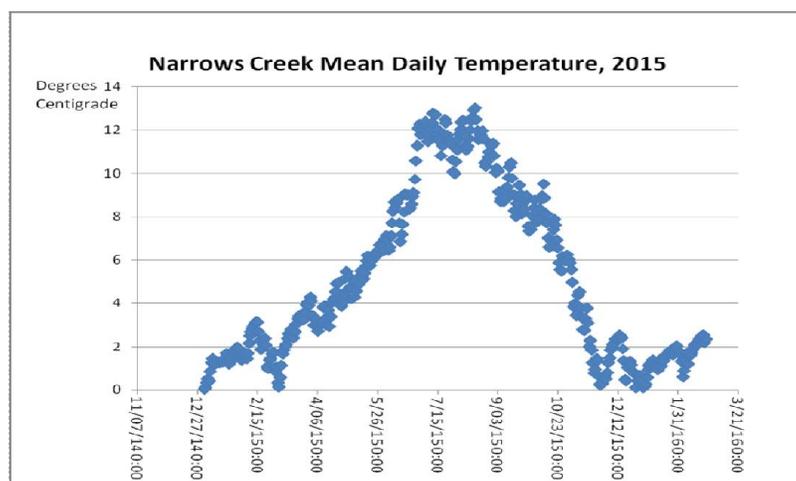
Chart 2



Narrows Creek Turbidity:

Narrows Creek normally has very low turbidity. Samples with turbidity over 0.5 NTU are tested for suspended solids and in 2015 six samples were tested. Values ranged from 4.0 (10/28) to 10.9mg/l (4/25 and 5/21). Provincial Guidelines recommend for raw waters of exceptional clarity (less than or equal to 5 NTU) which normally do not require treatment to reduce natural turbidity, total turbidity should not exceed 5 NTU at any time (2). No samples were above 5 NTU but two samples were above 1NTU. The samples above 1 NTU were seen on 10/6 (4.5NTU) and 1.1 NTU on 10/28.

Chart 3



Narrows Creek Temperature

Temperature for Narrows in 2015 was measured hourly and converted to "daily mean" in the chart above. Eighty three percent of all readings for 2015 were less than 10C, the recommended temperature for drinking water.

Table 2. Narrows Creek Coliforms 2015	Total Coliforms per 100ml	Thermotolerant Coliforms per 100ml	E.coli per 100ml
9/30/2015	40	1	1
10/06	15	0	0

Narrows Creek Coliforms

Water samples are normally collected in late summer when water temperatures are high. There are no official provincial standards for untreated drinking water. While total coliforms are not associated with human infection, thermotolerant or fecal coliforms and E.coli should not be present. See Health Canada "Bacterial Waterborne Pathogens" : www.hc-sc.gc.ca

In 2015, two samples were collected. E.coli and thermotolerant coliforms were present in one sample collected Sept 30th.

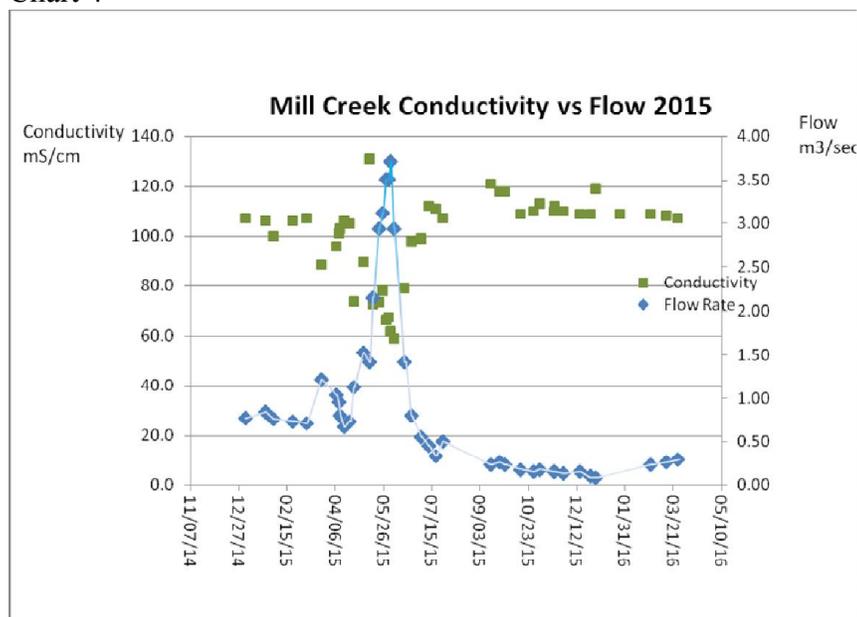
Mill Creek Summary Table

Table 3 Mill Creek Summary Sheet							
	Flow		Conductivity		Turbidity	Max Sediment	Number
	Max m3/sec	Min m3/sec	Max mmhos/cm	Min mmhos/cm	NTU	mg/l	Sample (n)
2002			95.8 (8/8)	51.4 (6/17)	1.9 (6/17)	12.6 (5/29)	15
2003	2.8 (6/10)	0.15 (3/8)	119 (9/20)	52.2 (6/10)	2.5 (5/5)	32.1 (10/31)	32
2004	2.6 (5/28)	0.28 (3/13)	111 (1/31)	59.0 (4/16)	0.55 (3/26)	2.7 (6/27)	17
2005	4.2 (5/17)	0.30 (12/10)	106 (4/05)	59.6 (5/17)	0.85 (6/17)	12.6 (6/17)	35
2006	11.8 (5/18)	0.30 (3/29)	115 (10/12)	45.7 (5/18)	13.0 (5/18)	149.0 (5/18)	39
2007	6.9 (6/6)	0.10 (1/10)	119 (9/28)	50.8 (6/6)	1.3 (6/6)	11.4 (6/16)	22
2008	5.6 (6/1)	0.20 (2/24)	115 (3/17)	55.3 (6/1)	0.65 (5/19)	7.4 (5/19)	21
2009	3.2 (5/31)	0.30 (3/4)	154 (11/18)	58.2 (6/16)	0.55 (5/31)	5.5 (5/17)	11
2010	3.3 (6/14)	0.20 (2/9)	137 (8/8)	59.5 (6/14)	0.55 (4/22)	6.7 (6/24)	40
2011	4.03 (5/26)	0.27 (3/15)	122 (12/9)	55.9 (6/6)	3.0 (6/6)	8.0 (5/25)	47
2012	7.8 (6/2)	0.217 (9/27)	122 (12/19)	48.4 (6/22)	2.3 (6/07)	42.9 (6/16)	55
2013	10.6 (5/13)	0.366 (9/02)	158 (6/22)	50.0 (5/13)	2.3 (5/12)	37.7 (5/12)	54
2014	3.71 (5/25)	0.149 (1/18)	171 (2/15/)	55.5 (5/25)	2.8 (4/5 & 4/12)	65.9 (4/05)	55
2015	3.7 (6/2)	0.08 (1/1)	131 (5/5)	59.0 (6/6)	0.7 (5/21)	4.8 (5/25)	43

Mill Creek Flow and Conductivity :

Mill Creek high flow normally occurs between mid May to early June and low flow occurs in Fall to early Spring. In 2015, the recorded high flow at 3.7 m³/sec occurred on June 2nd. Low flow occurred between September and February and the lowest value was reported on January 1st at 0.08m³/sec. This was the lowest seen in 13 years of recording. However, there does not appear to be a long term trend towards lower flows (see table 3).

Chart 4



Characterization of Mill Creek (Turbidity)

In 2015, 43 samples were tested and 38 or 88% were less than 0.5NTU. Five sample values were greater than 0.5 NTU. Between September 23rd and March 26th, 2016, eight samples were between 0.45 and 0.5 NTU. The previous year (2014) during the same time period, 2 samples were between 0.45 - 0.5 NTU. Mill does have a lot of variation from year to year at low turbidity levels See Chart 5.

Table 3 Date	Turbidity NTU's	Suspended Solids mg/l
5/21	0.7	Not done
5/25	0.55	4.8
5/29	0.65	4.3
5/31	0.6	0.8
12/5	0.5	Not Done

Mill Creek cont.

Chart 5

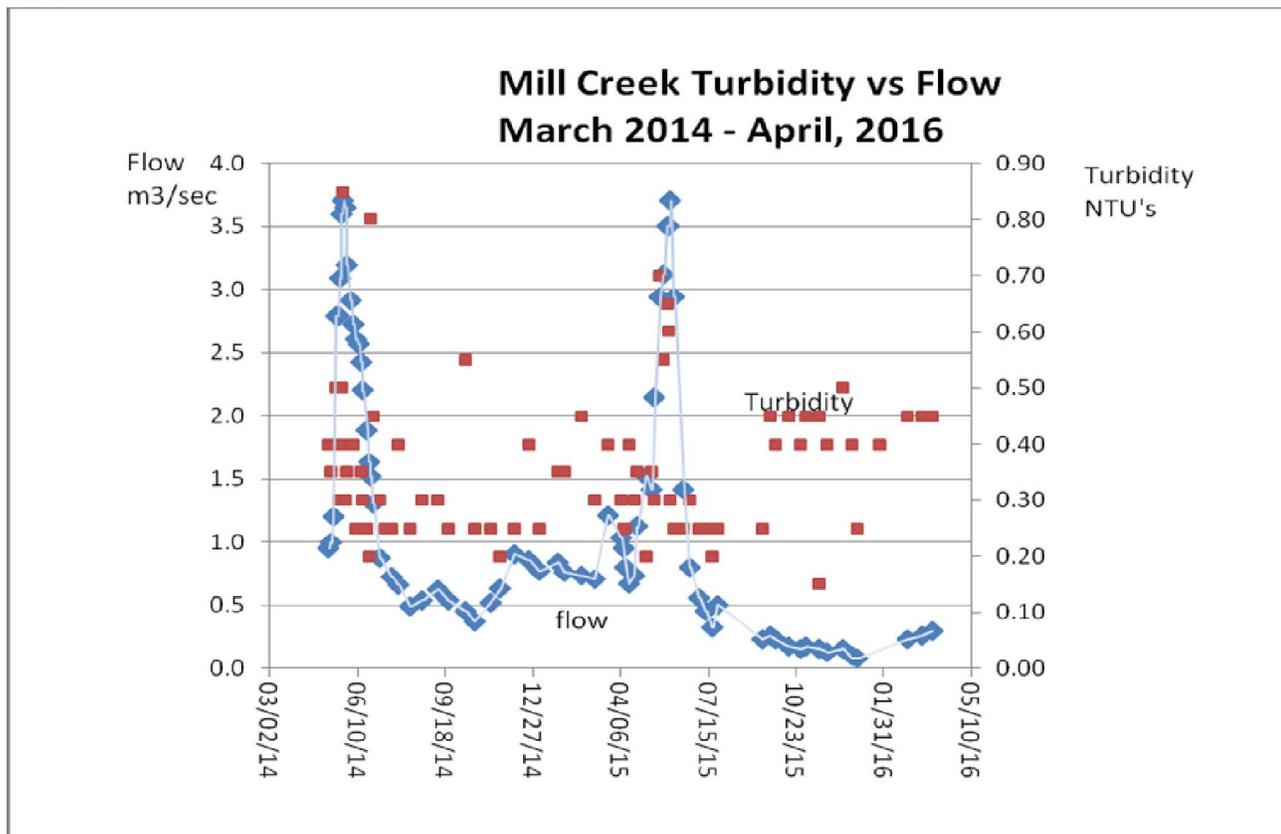
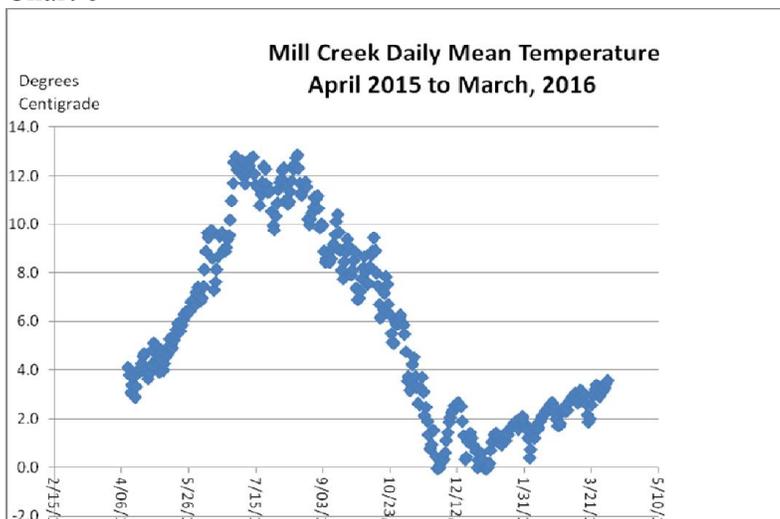


Chart 6



Mill Temperature

Between April, 2015 and March, 2016 three hundred and fifty six daily temperature averages were calculated based on hourly readings. Of these, 290 or 81% were less than 10 C.

Mill Creek cont.

Coliform Bacteria

In year 2015 two samples were collected. One (9/24) was positive for E.coli and Fecal Coliforms See Table 4.

Table 4 Mill Creek Coliforms for 2015	Total Coliforms per 100ml	Thermotolerant Coliforms per 100ml	E.coli per 100ml
9/24	46	2	2
9/29	6	0	0

References

1. Water Survey Canada's website: <http://scitech.pyr.ec.gc.ca/waterweb>
2. Water quality guidelines from the Provincial Govt's website:
http://www.env.gov.bc.ca/wat/wq/BCguidelines/approv_wq_guide/approved.html#1
3. Monitoring Guidelines to Evaluate the Effects of Forestry Activities on Streams in the Pacific Northwest & Alaska, L.H McDonald EPA 910/9-91-001
4. Wildland Water Quality Sampling and Analysis, John D. Stednick
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6. Harrop and Narrows Creeks Monitoring Summary Report for 2014, J. Yeow

Respectfully Submitted

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