



MONTHLY REPORTING PERIOD - DECEMBER, 2019

1. SUMMARY

The list below provides a summary of the water quality information collected by BMID in December, 2019. Documentation and figures are provided on the following pages to support this submission.

Source	Total (US Gals)	Total (Mega Litres)
Mission Creek	58,436.467	221.18
Well 4	2,554,000	9.67
Well 5	0	0
Well 6 (Irrigation Only)	0	0
Scotty Creek (Irrigation Only)	0	0
Total	60,990,467	230.85

1. A portion of the BMID's transmission main west of the Mission Creek Intake and east of the tunnel is located on an unstable slope. Slope movement has been minimal over the past 12 months. Monitoring showed a steady decline in groundwater levels in the winter of 2018 and spring of 2019, but has been level since. The hillside is being monitored for surface movement on a monthly basis and groundwater levels every two months.
2. Beginning on December 2 and ending on December 3, a series of ice-dams began to break apart in Mission Creek leading to recorded flows of over 90m³/second (significantly above the typical flow of under 5m³/second). The increased flow resulted in a spike in turbidity in the creek, however, BMID's automatic head-gates were closed before any poor-quality water could enter the balancing reservoirs;
3. Average daily turbidity levels at Mission Creek raw water intake, prior to any treatment, peaked at 3.01 NTU on December 7. The daily average turbidity at this location was 0.75 NTU for December. Note: Mission Creek's on-line turbidity meters were relocated during the December 2 and 3 flooding events. Results for these days are assumed to be lower than actual turbidity readings;
4. Turbidity levels at the Distribution Intake peaked at 0.46 NTU on December 9, 2019. Average turbidity for December was 0.37 NTU;
5. The highest monthly turbidity level recorded at the first customer (Booster #1) was 0.37 NTU on December 9. Average monthly turbidity was 0.29 NTU for December;
6. BMID's Ultraviolet Treatment Facility treated 225,264 m³ of water, none of which was "Off-Spec". Average UV Transmissivity was 87.35%. The average inlet chlorine residual was 1.51 mg/L in addition to an average of 1.51 mg/L for the outlet after UV treatment and the BMID sodium hypochlorite top-up system;
7. BMID's Scotty Creek source, used for irrigation in the north-end, was shut off for the year in September, 2019;
8. Well # 4 was used as the primary domestic water source in the north-end of the system starting on September 1st. Well # 4 provided domestic water throughout December;

9. Well # 5 was shut-off for year in September and will remain on stand-by until consumption rises in the spring of 2020;
10. Well #6, which supplies irrigation water to the twinned north-end water system, was not used throughout December;
11. *E.Coli* levels at Mission Creek's Point-of-Diversion (creek intake prior to WTP) had low counts throughout December with a peak count of 1 on December 23 and 30, 2019. At the Point-of-Diversion the average *E.Coli* count was 0.25 per sample based on the 8 samples taken throughout the month;
12. *E.Coli* levels in the raw water at the distribution system intake down-stream of the WTP, prior to disinfection, had zero counts throughout most of December, with a peak count of 1 on December 2, 2019. The reduction in *E.Coli* levels is credited to the performance of the WTP and settling of particles in the water after the water treatment plant;
13. No *E.Coli* or *Total Coliforms* or were found in treated water in the distribution system through third-party analysis. In addition, no positive samples were detected by BMID's in-house presence/absence testing;
14. The Water Treatment Plant ran throughout early December until water quality in Mission Creek improved enough to by-pass chemical treatment. On December 10, 2019, BMID's WTP was placed in stand-by, ready to resume treatment as required;

1.0 FLOWS - DECEMBER, 2019

Maximum Daily Flow was on December 6, 2019 at 2,340,180 US gallons (8.86 ML)

Minimum Daily Flow was on December 3, 2019 at 1,146,800 US gallons (4.34 ML)

Mission Creek provided 96% of domestic flow throughout December.

Figure 1.1 - Domestic Water System Flow

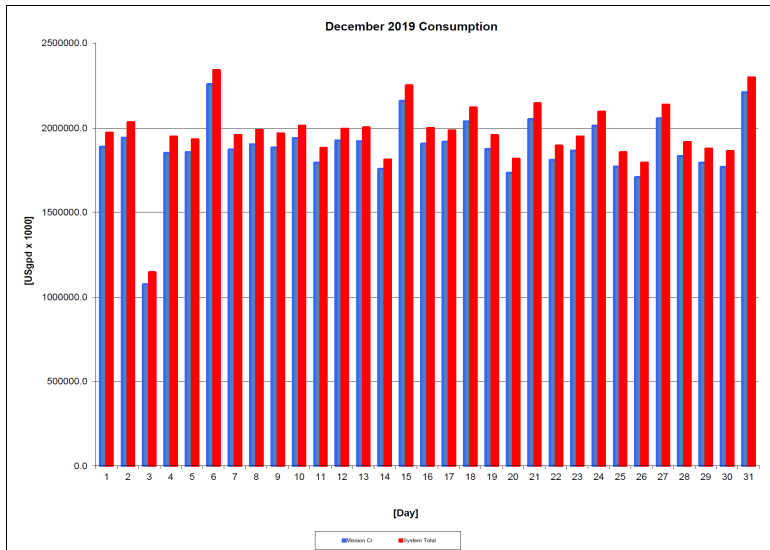


Table 1.2 - December 2019 - Daily Consumption Report

Year	Mission Cr	Well #4	Well #5	System Total	System Total
2019	Usgpd	Usgpd	Usgpd	Usgpd	ML/Day
1-Dec	1890240.0	82000.0	0.0	1972240.0	7.46
2-Dec	1943902.0	90000.0	0.0	2033902.0	7.70
3-Dec	1075800.0	71000.0	0.0	1146800.0	4.34
4-Dec	1853859.0	96000.0	0.0	1949859.0	7.38
5-Dec	1858720.0	75000.0	0.0	1933720.0	7.32
6-Dec	2258180.0	82000.0	0.0	2340180.0	8.86
7-Dec	1873630.0	86000.0	0.0	1959630.0	7.42
8-Dec	1903660.0	86000.0	0.0	1989660.0	7.53
9-Dec	1887010.0	82000.0	0.0	1969010.0	7.45
10-Dec	1940730.0	74000.0	0.0	2014730.0	7.63
11-Dec	1797417.0	86000.0	0.0	1883417.0	7.13
12-Dec	1927540.0	69000.0	0.0	1996540.0	7.56
13-Dec	1922796.0	82000.0	0.0	2004796.0	7.59
14-Dec	1759817.0	56000.0	0.0	1815817.0	6.87
15-Dec	2159202.0	91000.0	0.0	2250202.0	8.52
16-Dec	1908584.0	92000.0	0.0	2000584.0	7.57
17-Dec	1920014.0	67000.0	0.0	1987014.0	7.52
18-Dec	2039722.0	81000.0	0.0	2120722.0	8.03
19-Dec	1876975.0	82000.0	0.0	1958975.0	7.41
20-Dec	1737067.0	82000.0	0.0	1819067.0	6.89
21-Dec	2051911.0	94000.0	0.0	2145911.0	8.12
22-Dec	1811979.0	84000.0	0.0	1895979.0	7.18
23-Dec	1868489.0	82000.0	0.0	1950489.0	7.38
24-Dec	2013505.0	84000.0	0.0	2097505.0	7.94
25-Dec	1773973.0	84000.0	0.0	1857973.0	7.03
26-Dec	1711061.0	86000.0	0.0	1797061.0	6.80
27-Dec	2056354.0	82000.0	0.0	2138354.0	8.09
28-Dec	1835784.0	83000.0	0.0	1918784.0	7.26
29-Dec	1796498.0	83000.0	0.0	1879498.0	7.11
30-Dec	1771760.0	93000.0	0.0	1864760.0	7.06
31-Dec	2210288.0	87000.0	0.0	2297288.0	8.70
Totals Usgpd	58436467.00	2554000.00	0.00	60990467.00	230.85
Totals ML	221.18	9.67	0.00		
Avg's	1874205.97	7.09		1956439.30	7.41
Max	2258180.00	8.55		2340180.00	8.86
Min	1075800.00	4.07		1146800.00	4.34

2.0 RAW WATER QUALITY - BACTERIOLOGICAL MONITORING

Raw water samples were taken at three points at BMID settling ponds before chlorination

Samples were taken twice per week at the Distribution Intake's Point of Disinfection and at the Mission Creek raw water Point of Diversion; one sample is taken per week at Stevens Pond outlet (point halfway between WTP Outlet and Distribution Intake).

Samples from the previous month are also provided to show a two-month trend

The WTP lowers colour, turbidity and particle counts in the raw water. The *E. Coli* readings are consistent with the reduction in those other parameters. The *E. Coli* readings confirm the WTP's effectiveness in reducing raw water quality risks with coagulation, flocculation, and sedimentation process followed by settling times across Stevens and Hadden Reservoirs.

Figure 2.1 - Raw Water *E. Coli* Readings (CARO Lab results) November-December 2019

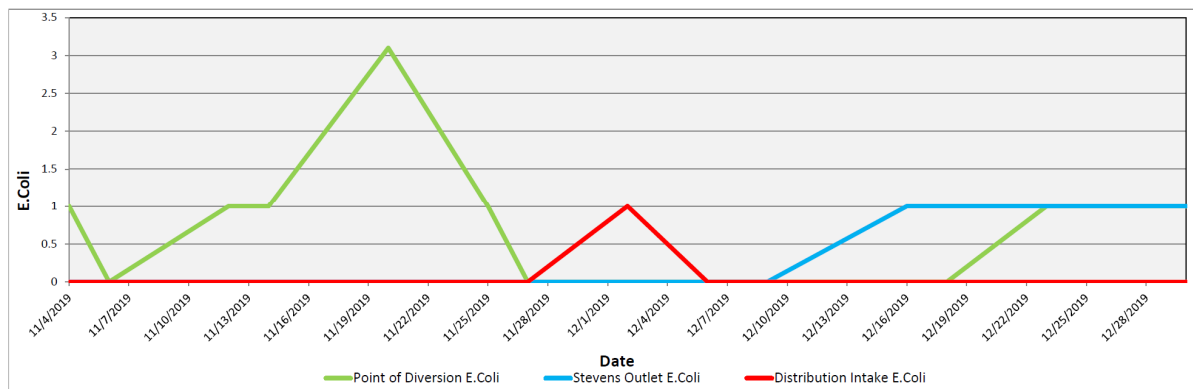


Table 2.1 - *E. Coli* Readings (CARO Labs)

Date	Point of Diversion E. Coli	Stevens Outlet E. Coli	Distribution Intake E. Coli
4-Nov-19	1	0	0
6-Nov-19	0	0	0
12-Nov-19	1	0	0
14-Nov-19	1	0	0
20-Nov-19	3.1	0	0
25-Nov-19	1	0	0
27-Nov-19	0	0	0
2-Dec-19	0	0	1
6-Dec-19	0	0	0
9-Dec-19	0	0	0
11-Dec-19	0	0	0
16-Dec-19	0	1	0
18-Dec-19	0	0	0
23-Dec-19	1	1	0
30-Dec-19	1	1	0

Stevens or WTP Intake (Raw) - Sampling of raw water at intake from Mission Creek

Stevens Outlet (Raw) - Sampling point after exiting 142,000 m³ 1st upper balancing reservoir (Stevens Res.)

Hadden Outlet (Raw) - Sampling point after exiting 75,000 m³ 2nd lower balancing reservoir (Hadden Res.)
(Hadden Outlet = Distribution Intake - Point of Disinfection)

3.0 RAW AND TREATED WATER TURBIDITY

Through December, 2019, turbidity for the Mission Creek source was measured at Booster Station No. 1 on Gallagher's Road, which is the approximate location of the first-customer. The highest turbidity level recorded at this location was 0.37 NTU on December 9. The average turbidity for the month was 0.29 NTU during December.

Mission Creek intake is the raw water turbidity reading taken directly from the creek prior to any form of treatment. The distribution intake is where the water leaves Hadden Reservoir. Turbidity levels are greatly reduced through the settling process as Mission Creek water makes its way through the reservoirs.

Figure 3.1 – Daily Turbidity Readings (Distribution Intake and Booster Station 1)

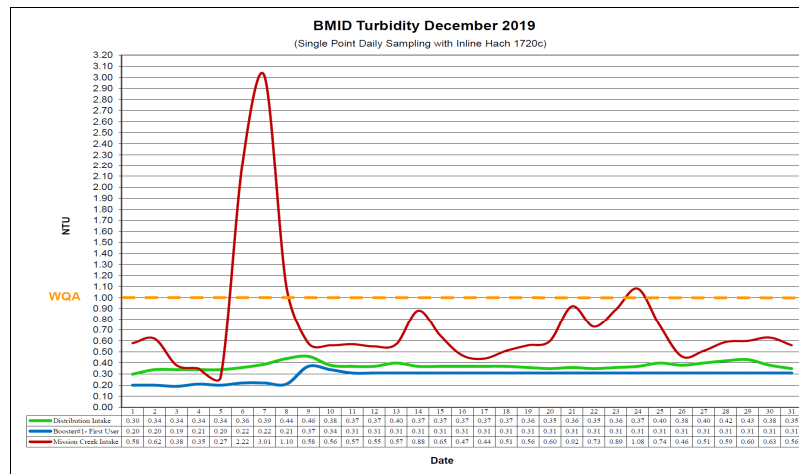


Table 3.1 - Daily Monitoring Record – Turbidity at Distribution Intake & Bst Stn 1

Turbidity Point Sampling for December 2019			
Date	Mission Creek Intake	Distribution Intake	Booster#1- First User
	Daily Average [NTU]	Daily Average NTU	Daily Average NTU
1	0.58	0.30	0.20
2	0.62	0.34	0.20
3	0.38	0.34	0.19
4	0.35	0.34	0.21
5	0.27	0.34	0.20
6	2.22	0.36	0.22
7	3.01	0.39	0.22
8	1.10	0.44	0.21
9	0.58	0.46	0.37
10	0.56	0.38	0.34
11	0.57	0.37	0.31
12	0.55	0.37	0.31
13	0.57	0.40	0.31
14	0.88	0.37	0.31
15	0.65	0.37	0.31
16	0.47	0.37	0.31
17	0.44	0.37	0.31
18	0.51	0.37	0.31
19	0.56	0.36	0.31
20	0.60	0.35	0.31
21	0.92	0.36	0.31
22	0.73	0.35	0.31
23	0.89	0.36	0.31
24	1.08	0.37	0.31
25	0.74	0.40	0.31
26	0.46	0.38	0.31
27	0.51	0.40	0.31
28	0.59	0.42	0.31
29	0.60	0.43	0.31
30	0.63	0.38	0.31
31	0.56	0.35	0.31
AVG	0.75	0.37	0.29

4.0 CHLORINE CONTACT TIME

Temperature, pH, current flow and chlorine residual levels are recorded to determine the CT levels that are required to provide 3 log inactivation of *Giardia*. Chlorine Contact times exceeded the CT levels required to provide 3 log (99.9%) inactivation of *Giardia Lamblia* throughout the month of December, 2019.

Figure 4.1 - CT Trending – BMID Mission Creek Source – December 2019

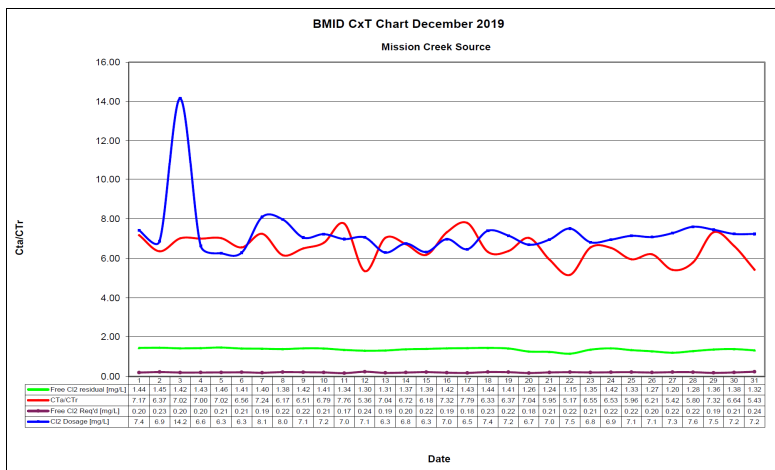


Table 4.2 - CT Table – Mission Creek Source

BMID December 2019 Mission Creek Source													
DATE	pH	TEMP	PEAK	Free Cl ₂	CT	CT	CTa/CTr	Free Cl ₂	Cl ₂	VOLUME	TIME	FLOW	CL ₂ DOSAGE
	(Average)	Present	FLOW	residual	achieved	req'd		Req'd	Dosage	TOTAL	[mins]	Daily Average	Average
December		[°C]	[USgpm]	[mg/L]				[mg/L]	[mg/L]	[USgal]		[USGPM]	[PPD]
1	7.50	3.7	2401	1.44	1589.1	221.5	7.17	0.20	7.4	2649600	1104	840	75
2	7.51	3.7	2712	1.45	1416.6	222.6	6.37	0.23	6.9	2649600	977	922	76
3	7.51	3.8	2434	1.42	1545.8	220.3	7.02	0.20	14.2	2649600	1089	450	77
4	7.51	3.7	2436	1.43	1555.4	222.1	7.00	0.20	6.6	2649600	1088	910	73
5	7.51	3.8	2489	1.46	1554.2	221.2	7.02	0.21	6.3	2649600	1065	965	73
6	7.52	3.7	2561	1.41	1458.8	222.4	6.56	0.21	6.3	2649600	1035	1082	82
7	7.52	3.2	2226	1.40	1666.4	230.0	7.24	0.19	8.1	2649600	1190	752	73
8	7.52	3.0	2548	1.38	1435.0	232.7	6.17	0.22	8.0	2649600	1040	768	74
9	7.53	3.5	2552	1.42	1474.3	226.6	6.51	0.22	7.1	2649600	1038	861	73
10	7.53	3.5	2431	1.41	1536.8	226.3	6.79	0.21	7.2	2649600	1090	859	75
11	7.53	3.5	2037	1.34	1743.0	224.6	7.76	0.17	7.0	2649600	1301	849	71
12	7.54	3.5	2865	1.30	1202.3	224.4	5.36	0.24	7.1	2649600	925	880	75
13	7.54	3.5	2195	1.31	1581.3	224.6	7.04	0.19	6.3	2649600	1207	984	75
14	7.55	3.5	2379	1.37	1525.8	227.0	6.72	0.20	6.8	2649600	1114	876	71
15	7.55	3.5	2619	1.39	1406.2	227.5	6.18	0.22	6.3	2649600	1012	1052	80
16	7.56	3.2	2197	1.42	1712.5	233.8	7.32	0.19	7.0	2649600	1206	889	75
17	7.56	3.1	2063	1.43	1836.6	235.7	7.79	0.18	6.5	2649600	1284	961	75
18	7.56	3.1	2553	1.44	1494.5	235.9	6.33	0.23	7.4	2649600	1038	871	78
19	7.57	3.1	2484	1.41	1504.0	236.0	6.37	0.22	7.2	2649600	1067	859	74
20	7.57	3.2	2058	1.26	1622.2	230.5	7.04	0.18	6.7	2649600	1287	877	71
21	7.58	3.2	2395	1.24	1371.8	230.7	5.95	0.21	7.0	2649600	1106	932	78
22	7.58	3.1	2566	1.15	1187.5	229.7	5.17	0.22	7.5	2649600	1033	809	73
23	7.58	3.0	2303	1.35	1553.2	237.0	6.55	0.21	6.8	2649600	1150	914	75
24	7.58	2.9	2395	1.42	1571.0	240.4	6.53	0.22	6.9	2649600	1106	939	78
25	7.58	2.9	2484	1.33	1418.7	238.1	5.96	0.22	7.1	2649600	1067	850	73
26	7.58	2.9	2292	1.27	1468.1	236.4	6.21	0.20	7.1	2649600	1156	851	72
27	7.58	2.8	2483	1.20	1280.5	236.1	5.42	0.22	7.3	2649600	1067	934	82
28	7.58	2.8	2453	1.28	1382.6	238.4	5.80	0.22	7.6	2649600	1080	839	77
29	7.58	2.7	2031	1.36	1774.2	242.2	7.32	0.19	7.5	2649600	1305	844	76
30	7.58	2.7	2270	1.38	1610.8	242.8	6.64	0.21	7.2	2649600	1167	861	75
31	7.58	2.7	2671	1.32	1309.4	241.1	5.43	0.24	7.2	2649600	992	991	86
Averages	7.55	3.24	2405.90	1.36	1509.31	230.93	6.54	0.21	7.27				

5.0 ULTRAVIOLET DISINFECTION

Total Water Treated: 225,264 m³ 100.000 %
On-Spec Water: 225,264 m³ 100.000 %
Off-Spec Water: 0 m³ 0.000%

Average monthly chlorine residual before UV Treatment was 1.51 mg/L
The average monthly chlorine residual after UV treatment and re-chlorination was 1.51 mg/L.

Figure 5.1 - UV Disinfection – BMID Mission Creek Source – December 2019

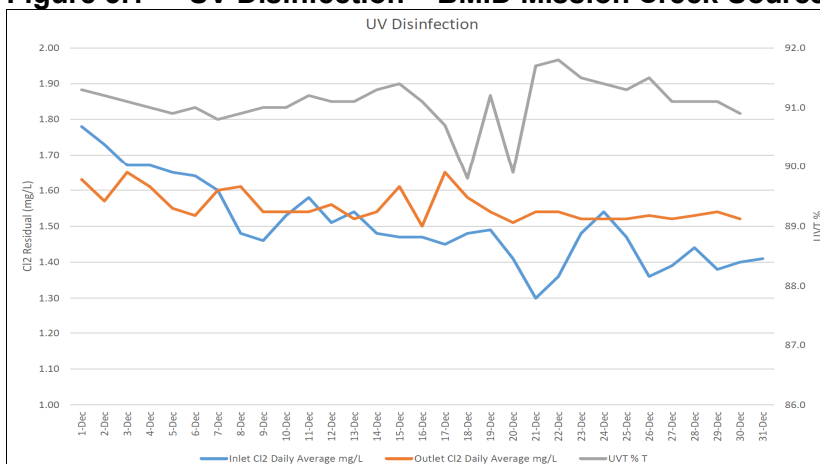


Table 5.2 - UV Disinfection Table – Mission Creek Source

Date	Inlet Cl2 Daily mg/L	Outlet Cl2 Daily mg/L	UVT % T	In Spec Water Volume Cubic Meters	Off Spec Water Cubic Meters	Off Spec % of Water Percentage
1-Dec	1.78	1.54	90.9	7,203	0	0.00%
2-Dec	1.73	1.53	90.8	7,409	0	0.00%
3-Dec	1.67	1.51	91.6	7,739	0	0.00%
4-Dec	1.67	1.51	91.3	6,967	0	0.00%
5-Dec	1.65	1.51	90.5	6,994	0	0.00%
6-Dec	1.64	1.50	90.1	8,610	0	0.00%
7-Dec	1.60	1.49	89.9	7,199	0	0.00%
8-Dec	1.48	1.46	89.0	7,267	0	0.00%
9-Dec	1.46	1.48	88.5	7,184	0	0.00%
10-Dec	1.53	1.50	87.8	7,459	0	0.00%
11-Dec	1.58	1.50	87.9	6,866	0	0.00%
12-Dec	1.51	1.50	87.8	7,385	0	0.00%
13-Dec	1.54	1.49	88.0	7,331	0	0.00%
14-Dec	1.48	1.50	88.2	6,745	0	0.00%
15-Dec	1.47	1.50	87.9	8,243	0	0.00%
16-Dec	1.47	1.50	87.7	7,317	0	0.00%
17-Dec	1.45	1.50	87.3	7,343	0	0.00%
18-Dec	1.48	1.51	86.8	7,823	0	0.00%
19-Dec	1.49	1.49	86.5	7,204	0	0.00%
20-Dec	1.41	1.50	86.3	11,463	0	0.00%
21-Dec	1.30	1.50	86.2	7,867	0	0.00%
22-Dec	1.36	1.51	85.3	6,955	0	0.00%
23-Dec	1.48	1.52	84.3	8,963	0	0.00%
24-Dec	1.54	1.50	82.7	7,732	0	0.00%
25-Dec	1.47	1.50	83.7	6,799	0	0.00%
26-Dec	1.36	1.50	85.8	6,568	0	0.00%
27-Dec	1.39	1.54	84.4	7,886	0	0.00%
28-Dec	1.44	1.56	85.2	7,047	0	0.00%
29-Dec	1.38	1.56	84.2	6,889	0	0.00%
30-Dec	1.40	1.56	84.5	6,811	0	0.00%
31-Dec	1.41	1.56	84.6	8,463	0	0.00%
Average	1.51	1.51	87.35	Total 225,264	0	0.000%

6.0 WATER DISTRIBUTION SAMPLING (TREATED)

Third Party Analysis (CARO Analytical Services)

- Samples taken once per week at ten locations around the BMID service area
- 50 samples were found to be absent of Coliforms.
- 50 samples were found to be absent of *E. Coli*.

Table 6.1 - CARO Independent Lab Testing – Total Coliforms – E.Coli

Date	2921 Belgo Rd		Booster 1		Elison Blow-Off		Elison School		3976 Highway 97		Prospect Reservoir		Tower Reservoir		Well #4		Kirschner Res		Pearson School	
	Coliforms	E. coli	Coliforms	E. coli	Coliforms	E. coli	Coliforms	E. coli	Coliforms	E. coli	Coliforms	E. coli	Coliforms	E. coli	Coliforms	E. coli	Coliforms	E. coli	Coliforms	E. coli
4-Nov-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Nov-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Nov-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Nov-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Nov-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Dec-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9-Dec-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Dec-19	0	0	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Dec-19	-	-	-	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Dec-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Dec-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6.3 – Disinfection By-Products - THM and HAA Results

Location	THM	HAA
Kirschner Reservoir		0.0775
2921 Belgo Rd	0.1080	
Pearson School	0.0474	0.0583
3976 Highway 97	0.0787	

In-House Analysis (BMID Staff)

- Presence/Absence samples taken on a three-week cycle at seven sites around the BMID service area.
- All 12 samples were found to be absent of both Total Coliforms and *E. Coli*.

Table 6.4 - BMID In-house Testing – Presence Absence

Location	12/2/2019				12/9/2019				12/16/2019				12/23/2019				12/30/2019			
	Cl2	Temp.	Pres.	Abs.	Cl2	Temp.	Pres.	Abs.	Cl2	Temp.	Pres.	Abs.	Cl2	Temp.	Pres.	Abs.	Cl2	Temp.	Pres.	Abs.
Sylvania Cres					0.77	10.8	-	X									0.82	9.0	-	X
170 Kneller Rd					0.77	10.6	-	X									0.86	8.8	-	X
2105 Morrison	0.76	11.4	-	X									0.66	9.2	-	X				
Staymen Rd	0.66	11.4	-	X									0.67	8.6	-	X				
260 Campion Rd									0.43	10.0	-	X								
Fenwick Rd									0.41	11.1	-	X								
Solly Ct					0.78	10.6	-	X									0.95	9	-	X

- BMID Population = 25,000

RECOMMENDED TESTS

- Recommended number of samples per month = 25
(as per Guide for Canadian Drinking Water Quality)

ACTUAL TESTS

- Total tests by BMID staff (presence/absence) = 12
- Total tests sampled by BMID and tested by Caro Labs = 50
- Total tests sampled in BMID treated distribution system = 62 (Zero Positive Samples)