

MEMIRANDUM :

To: FCID Board

From: Kevin Jersey

Re: FCID Water Purification Project

Attached are two reports from 9 Dot Engineering received 13 December 2018:

1. Technical Summary of Flow Data
2. Water Quality Analysis

The flow data report indicates that the water usage by FCID rate payers is significantly below the maximum allowable, permitted by the water license. The maximum daily usage was recorded 45,844 USG (US Gallons), compared to the allowable of over 70,000 USG.

The current license permits an average of 72,064 USG to be taken from Fletcher Creek. The data provided from the study indicates an average of 19,728 USG being used by the FCID rate payers.

9 Dot Engineering has been made aware of periodic water shortages being reported in previous years.

The next phase of the project will include both purification plant and water intake recommendations, and is expected to be presented prior to the anticipated April 2019 FCID AGM. The latter will address the reported water shortages.

The water quality analysis will assist 9 Dot in the design of the components required in the purification plant to provide water quality accepted by the current legislation and IHA.

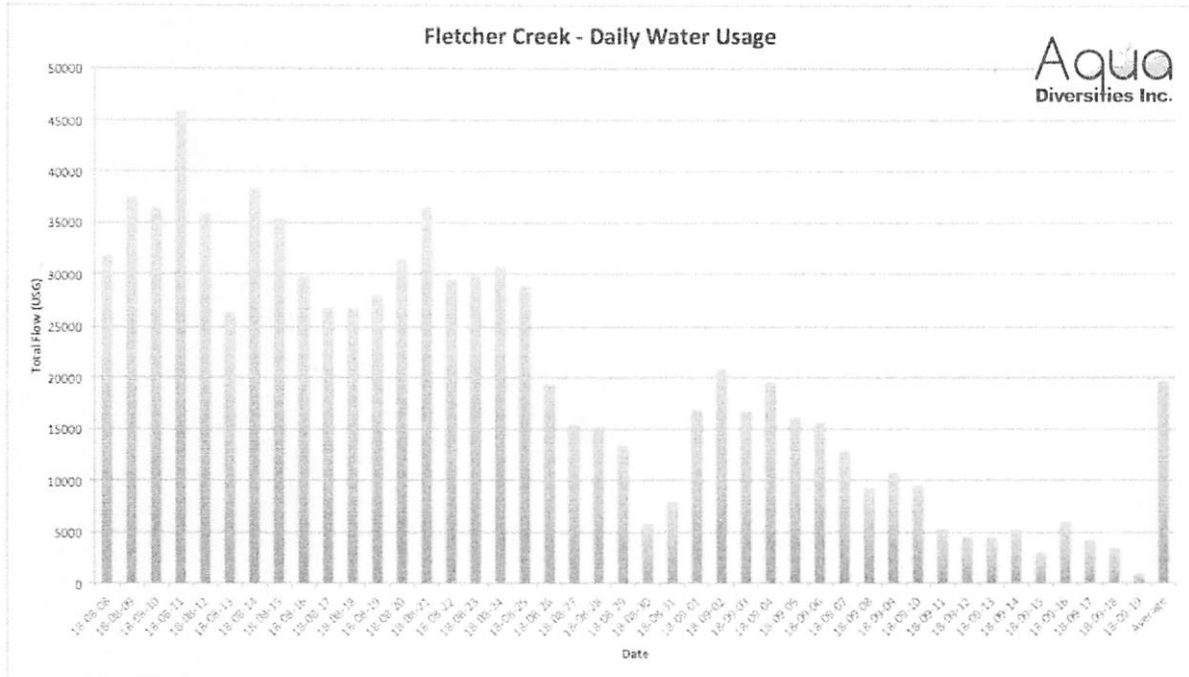
Regards

Kevin Jersey

FCID Board Member

Total Daily Flow Data

The graph below shows total daily flows that occurred in the FCID water system between August 8/18 and September 19/18.



The FCID currently has one water license (CO 57357) for local water works totalling 99,559.371 cubic metres per year, which equates to an average of 72,064.8 USG per day. The data recorded shows an average daily demand of 19,728 USG and a maximum day demand of 45,844 USG. Given the mix of hot and cool weather during the recording period, the assumption can be made that 19,728 USG is representative of the annual average daily demand.

Although both the recorded average daily demand and maximum day demand are below the volume of the water license, FCID members have observed insufficient water supply during summer months. There are other users on Fletcher Creek, including one user that is diverting water for a personal micro-hydro system. Kevin Jersey confirmed that the micro-hydro system is not used during periods of low creek flow.

The in-creek intake is a perforated manhole barrel that feeds two reservoir tanks. 9dot has communicated with Kevin Jersey to confirm the size of the current reservoir but this information is unknown at this time. There is currently a moratorium on new connections on the FCID water system due to the water shortages. 47 curb stops are currently installed on the FCID water system, but five of those properties are listed as "inactive" on the FCID provided site plan, which leaves 42 active users. Recommendations including potential reservoir sizing to reduce water shortages will be addressed in the *Design Brief* to be submitted for the FCID AGM.

Technical Memorandum – 01

Project:	Fletcher Creek Water Treatment System (Phase 1)
Document:	Technical Summary of Flow Data
Client:	Fletcher Creek Improvement District
Consultant:	9dot Engineering Inc.
Date:	November 26, 2018

Overview

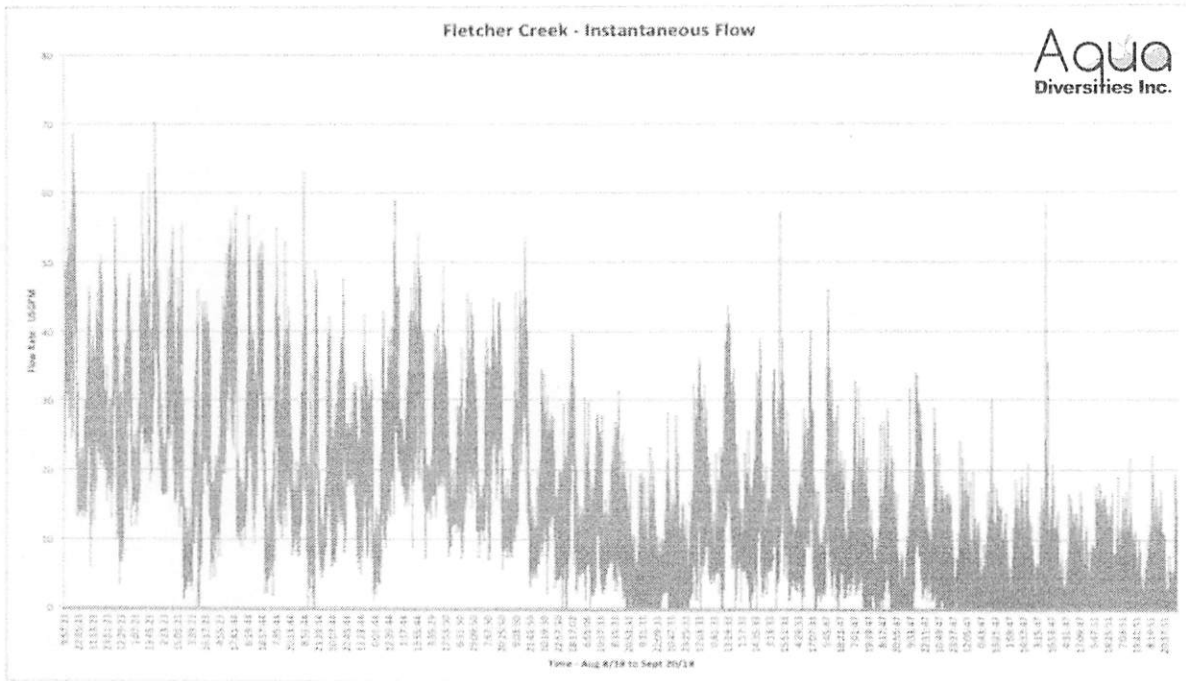
This document is a technical summary of the Fletcher Creek Improvement District (FCID) potable water flow data recorded from August 8, 2018 to September 19, 2018. The following information is included in this memo:

- Recorded instantaneous flow data and analysis;
- Recorded daily total flow data and analysis;
- Current water license information.

The analysis in this document is only related to the actual information collected. Further information including comparisons to the British Columbia Design Guidelines for Rural Residential Community Water Systems and design recommendations will be included in the *Design Brief* to be completed for FCID's annual general meeting in April 2019.

Instantaneous Flow Data

The graph below shows instantaneous flow rates occurring in the FCID water system between August 8/18 and September 19/18.



Peak flow occurred in late August when temperatures were in the range of 25 to 30 C. Flows as high as ~70 USGPM were recorded within the first few days of the meter being installed when irrigation was likely the highest. Temperatures cooled off throughout September and peak flows dropped to the 40-50 USGPM range with a few occurrences where demand reached close to 60 USGPM. The recorded flow rate matches instantaneous water demand as the flow meter was installed upstream of the first paying customer and downstream of the existing reservoir

It should be noted that there is one more property upstream of the flow meter location that is fed from the system. The property owner does not pay the FCID for water and instead has given the FCID an easement across their property to access the reservoir and intake. This is of particular interest when discussing potential treatment system location as a treatment system upstream of the first user would make access and power supply more difficult, and would complicate chlorine contact time.

The flow data does show no flow on numerous occasions, particularly once temperatures dropped and irrigation would have been reduced or stopped. Kevin Jersey (FCID) observed flow occurring overnight and brought up concerns about leakage in the system. The numerous zero-flow readings shown above indicate leakage is not a major concern. The overnight flow in late August and early September is in the 5-15 USGPM range and can be attributed to overnight irrigation.

Technical Memorandum – 02

Project:	Fletcher Creek Water Treatment System (Phase 1)
Document:	Water Quality Analysis
Client:	Fletcher Creek Improvement District
Consultant:	9dot Engineering Inc.
Date:	December 12, 2018

Overview

This document provides an analysis of the Fletcher Creek Improvement District (FCID) potable water quality data. FCID is currently on a Boil Water Advisory.

As part of Phase 1-Field Investigation & Data Collection, Aqua Diversities Inc. collected raw water samples on Wednesday August 8, 2018. Samples were sent to CARO analytical lab for Comprehensive chemical analysis and bacteriological testing.

Sample results were analysed and compared to historical source water quality data (2009/2012). The source water quality test results and the Guidelines for Canadian Drinking water Quality (CGDWQ) are presented in *Table 1- FCID Water Quality Data Summary*. Note that, in November the FCID Board passed a resolution to undertake monthly bacteriological testing, November sample results are included in the attached summary table.

Fletcher Creek Water Quality Analysis

- There was presence of total coliforms, and presence of *E.Coli* in the August 2018 and November 2018 samples.
- TOC was 1.23mg/L in the August 2018 sample indicating presence of Natural Organic Matter.
- Turbidity was higher in July 2012 than in August 2018 (within CGDWQ). This could indicate increased suspended solids from spring freshet when surface water sources are known to exceed 1 NTU or a rain event that spiked turbidity.

Source Challenges

Bacteriological

Coliform bacteria are used as indicator organisms for the bacteriological quality of water. Total coliforms are bacteria that can be found throughout the natural environment. Fecal Coliform (*E.coli*) are a subset of the coliform group that reside in the intestinal tract of warm blooded animals, including humans. Fecal coliforms and *E. coli* contamination is often present in surface water sources and can pose a risk to

human health in addition to them also indicating that other disease-causing organisms such as virus or protozoa may also be present.

A multi-barrier treatment approach that removes these pathogens is necessary to achieve the GCDWQ and meet the IHA drinking water guidelines.

Total Organic Carbon (TOC)

TOC is a measure of the amount of organic matter in the water body. Total organic carbon and dissolved organic carbon can typically be correlated with colour and chlorination by-product formation. TOC values are typically higher during spring freshet. Removal of TOC is important in order to reduce the formation of trihalomethanes as well as prevent turbidity from colour. TOC is an indicator of dissolved Natural Organic Matter.

Natural Organic Matter (NOM)

NOM typically are present in surface water sources and is in both dissolved and suspended states and typically results from decaying vegetation in the water source. Typical drinking water treatment systems may not remove dissolved NOM as the dissolved solids pass through the physical filtration process. Dissolved NOM can increase colour and subsequently increase Turbidity over 1 NTU which exceeds the Canadian Drinking Water Guideline and subsequently reduce Ultraviolet Transmittance (UVT) below the industry standard NSF Validated UV set-point.

There are no mineral or radiological parameters in the Fletcher Creek Source that require specific treatment. The highlighted cell (Aluminum) exceeds the Aesthetic Objective guideline only.

Table 1- FCID Water Quality Data Summary

Analyte	Units	MRL	Std (CGDWQ)	Sample Date			
				24-Nov-09	11-Jul-12	8-Aug-18	05-Nov-18
Chloride	mg/L	0.1	AO<=250	0.14	<0.10	<0.10	
Fluoride	mg/L	0.1	MAC=1.5	<0.10	<0.10	<0.10	
Nitrate (as N)	mg/L	0.01	MAC=10	0.09	0.012	0.02	
Nitrite (as N)	mg/L	0.01	MAC=1			<0.010	
Sulfate	mg/L	1	AO<=500	11.3	2.9	6.7	
Temperature, at pH	°C		N/A			23	
Colour, True	CU	5	AO<=15	<5	<5	<5.0	
Alkalinity, Total (as CaCO3)	mg/L	2	N/A	131	60	101	
Alkalinity, Phenolphthalein (as CaCO3)	mg/L	2	N/A			<1.0	
Alkalinity, Bicarbonate (as CaCO3)	mg/L	2	N/A			101	
Alkalinity, Carbonate (as CaCO3)	mg/L	2	N/A			<1.0	
Alkalinity, Hydroxide (as CaCO3)	mg/L	2	N/A			<1.0	
Cyanide, Total	mg/L	0.002	MAC=0.2	<0.01	<0.010	<0.0020	
Turbidity	NTU	0.1	AO<1.0	<0.1	2.6	0.21	
pH	pH units	0.01	7-10.5	8.19	7.91	7.91	
Conductivity (EC)	uS/cm	2	N/A	261	120	207	
Carbon, Total Organic	mg/L	0.5	N/A			1.23	
Chemical Oxygen Demand	mg/L	20	N/A			<20	
Langelier Index	-	-5	N/A			-0.03	
Hardness, Total (as CaCO3)	mg/L	0.5	N/A	130	49.6	98.5	
Solids, Total Dissolved (calc)	mg/L	1	N/A	155		105	
Aluminum, total	mg/L	0.005	AO<0.1	0.006	0.173	0.0132	
Antimony, total	mg/L	0.0001	MAC=0.006	<0.0001	0.0001	<0.00020	
Arsenic, total	mg/L	0.0005	MAC=0.01	<0.0005	<0.0005	<0.00050	
Barium, total	mg/L	0.005	MAC=1	0.0123	0.007	0.0111	
Boron, total	mg/L	0.004	MAC=5	<0.002	0.004	0.0093	
Cadmium, total	mg/L	0.00001	MAC=0.005	<0.00001	0.00002	0.000016	
Calcium, total	mg/L	0.2	N/A	41.1	14.9	30.2	
Chromium, total	mg/L	0.0005	MAC=0.05	<0.0005	0.0029	<0.00050	
Cobalt, total	mg/L	0.0001	N/A	<0.00005	0.00027	<0.00010	
Copper, total	mg/L	0.0002	AO<=1	0.0372	0.0004	<0.00040	
Iron, total	mg/L	0.01	AO<=0.3	0.04	0.24	0.018	
Lead, total	mg/L	0.0001	MAC=0.01	0.0001	0.0001	0.00024	
Magnesium, total	mg/L	0.01	N/A	6.59	3.01	5.59	
Manganese, total	mg/L	0.0002	AO<=0.05	<0.0002	0.0063	0.00094	
Mercury, total	mg/L	0.00002	MAC=0.001	<0.00005	<0.00002	<0.000010	
Molybdenum, total	mg/L	0.0001	N/A	0.0006	0.0005	0.0007	
Nickel, total	mg/L	0.0002	N/A	0.0009	0.0036	<0.00040	
Potassium, total	mg/L	0.02	N/A	0.66	0.3	0.48	
Selenium, total	mg/L	0.0005	MAC=0.05	0.0007	<0.0005	0.00079	
Silicon	mg/L	0.2	N/A	1.9	2.2		
Sodium, total	mg/L	0.02	AO<=200	0.96		0.65	
Strontium, total	mg/L	0.001	N/A	0.242		0.19	
Uranium, total	mg/L	0.00002	MAC=0.02	0.00087	0.00038	0.000682	
Zinc, total	mg/L	0.004	AO<=5	0.002	<0.004	<0.0040	
Coliforms, Total	CFU/100 mL	1	MAC = None Detected			>= 33	120
E. coli	CFU/100 mL	1	MAC = None Detected			>= 1	> 1
Background Colonies	CFU/100 mL	200	N/A			> 200	> 1
UV Transmittance @ 254nm				96.8	94.1		