



Annual
Water
Report

2014



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1.0 Introduction

The Town of Oliver operates an extensive Municipal and Rural water system which consists of seven ground water well sites, two surface water sources, and three reservoirs. The water system covers the Town of Oliver itself and a substantial portion of area 'C' of the Regional District of Okanagan Similkameen. See Appendix A for details.

The Town provides domestic water to approximately 2,345 residential and 216 commercial/ industrial connections which are all metered now. Irrigation water is also provided to 614 connections irrigating approximately 5,200 acres of farmland with 1,025 acres of that pumping their own water from the Town's irrigation canal. 455 acres of non-farm land is also irrigated from this system. The change in the non-farm arable area from previous years is due to a change in the new Water Regulations Bylaw 1351 where customers previously received a half acre with the payment of their parcel tax.

2.0 History

The Liberal Premier of BC, "Honest" John Oliver, helped create, "The Soldiers' Settlement Plan", known as, "The Soldiers Land Act", following the First World War in 1918. This plan was implemented to provide immediate and long term economic opportunities to the soldiers by making land available to them at a reasonable cost.

The challenge for the government was to make the arid rangeland viable by constructing an irrigation system to create thousands of farmable acres. The irrigation project was named the South Okanagan Lands Irrigation Project.

The "ditch", as it is known, was completed in 1923 running 40 kilometres in length to transport irrigation water from one side of the valley to the other, transforming the arid desert into blossoming orchards and farms.

In 1963 the premier, W.A.C. Bennett, passed the responsibility for the irrigation system from the province to a committee of growers called the South Okanagan Land and Irrigation District (SOLID.) The system was operated by SOLID until 1989 when the Towns of Oliver and Osoyoos assumed control of the system.

On the dissolution of SOLID, in order to give rural water customers a continued voice in the operation of the local water system, two water councillor positions were created by bylaw to serve on Town council.

3.0 System Overview

As part of the water distribution system, the Town maintains approximately 143 kilometres of water main.

The distribution system is made up of AC, PVC, CI, HDPE material, with pipe sizes ranging from 50mm to 600mm diameter.

The age of the water mains range from new to approximately 49 years old. The age of the pipe does not necessarily reflect the need to replace it as the various material types and installation conditions make for different average life expectancies.

The majority of the Town's Rural water system is twinned with the exception of part of System 2 / Black Sage. There are currently no plans to complete twinning in System 2. The water system is still referred to by system numbers one through seven, however; the domestic water system is also referred to as Rural North (which includes System 1), Municipal, Rural South (which includes systems 4 through 7) and Black Sage (which includes System 2).

The Town uses ground water for all of its domestic water. As of 2014, with the completion of System 1 twinning, there are no customers receiving surface water in the summer months, leaving only irrigation customers on the canal water system.

Normal operating pressures range from 60psi to 120psi for standard pressurized services. Our irrigation system also has a number of low pressure users who pump out of the irrigation canal with their own pump houses.

3.1 Domestic System

The domestic water system storage capacity is 1,025,000 US gallons (3880 cubic metres) between four reservoirs. Existing Municipal reservoirs consist of a 360,000 US gallon (1360 cubic metre) reservoir and a newer (constructed in 2010) 500,000 US gallon (2470 cubic metre) reservoir. The other two reservoirs still in use are located in System 6a; Road 13 reservoir at 150,000 US gallons (cubic metres) and Hester Creek reservoir at 15,000 US gallons (cubic metres).

The rural area north of Town (System 1) has now been completely twinned. See "Capital Projects and Improvements" section for more detail.

A new domestic well north of Town is being developed near the existing well and will be called Buchanan domestic well. It will primarily supplement the existing domestic system Rural North. See "Capital Projects and Improvements" section for more detail.

CPR and Lions wells are no longer used because of the unacceptable uranium levels.

There are three wells at Tucelnuit, of which only #2 and #3 are used to supply the domestic system. Rockcliffe well is also a major supplier of domestic water to the Municipal system.

Airport Booster station is typically set to supply water from within the Municipal boundaries to the rural area south but can also be used to bring water from the rural area south to the Municipal system.

There are three Black Sage domestic wells accessed from the river dyke supplying the Black Sage area or System 2. They can also be used to supplement the rest of the rural domestic system south of Town.

Miller well is used to supply the Road 13 reservoir and supplement (up to 500 gallons per minute) the Black Sage or System 2 area during peak demand.

There is also a booster pump station (for system 6A) that helps elevate domestic water to an area including Road 13 and Pallay Drive.

3.2 Irrigation System

Surface water, specifically Okanagan River, is still the primary source for the irrigation water system, but also includes Buchanan well, Fairview well and Black Sage oxbow. The canal system runs from McIntyre Dam (where the diversion is complete with a fish screen) north of Town to Road 18 south of Town, where it continues past Road 22 as a piped system. The irrigation system in System 2B is supplied by the Black Sage oxbow, with the remainder of System 2 not being twinned. The Town maintains multiple water licences to allow these surface water diversions.

From the canal system, Mud Lake pump house is the first of five pump houses along the canal and serves the System 1 irrigation area north of Town.

A new well is being developed near the existing Buchanan well which will replace it and supplement the irrigation system in this area.

The second canal pump station along the system is Rockcliffe Irrigation in System 4, south of the Municipal boundaries. System 4 also includes a 25,000 US gallon (94 cubic metres) irrigation water reservoir.

The third canal pump station along the system is Fairview irrigation pump station in System 5. System 5 includes a 50,000 US gallon (189 cubic metres) irrigation water reservoir. There is also Fairview Irrigation well in System 5 which used to be part of the domestic water system but was switched over to the irrigation system when the nitrate levels exceeded the Canadian Drinking Water Standards. Its primary use now is to supply water in the shoulder seasons or low demand portions in the irrigation year but it can also help supplement peak demands.

Hester Creek irrigation pump station is located in System 6.

Mt Kobau irrigation pump station is the most southern in the water system, in System 7.

Only part of the Black Sage area has a separate irrigation system known as System 2B, while the rest of the area, known as System 2, irrigates with domestic ground water. The area that is twinned uses Black Sage pump station supplied by Black Sage oxbow for irrigation supply.

2014 irrigation season started on April 10th and ended October 7th. Crews began filling the canal and turning on spray fillers April 7th. The canal diversion was shut down on October 30th. All Town irrigation systems were shut down and winterized in October.

3.3 SCADA (Supervisory Control and Data Acquisition)

The Town utilizes a SCADA system to monitor and control many functions at a number of the pump stations and reservoirs. This system allows the Water Operators to monitor demand, reservoir levels and turn pumps on/ off. The Operator can change set points and monitor some aspects of the system remotely.

4.0 Routine Maintenance Program

Fire hydrants are inspected and flushed annually.

Water main flushing program is done annually. True Engineering has drafted a unidirectional flushing program for the domestic system within the Municipal boundaries.

The Town does not currently have a formalized valve exercising program but this would be included in the unidirectional flushing program for the domestic system within the Municipal boundaries.

Annual pump testing is completed on all pumps for preventative maintenance. The tests include load testing motors, checking bearings, inspection of motor controls and auxiliary equipment such as fans, sump pumps and heaters.

Most wells and pump stations are inspected daily. The reservoirs have intrusion alarms and are inspected monthly to ensure the site and structure are secure.

5.0 Water Quality

Oliver has hard water which contains calcium and magnesium compounds. Hard water can cause pipes to fur up and scale to collect in kettles, electric irons, and washing machines, wearing them out sooner and making them less efficient. Many residents have purchased water softeners; the Town encourages the use of potassium chloride for the softening products.

In Town the average hardness is 235 mg/L or ppm between the Municipal wells but can vary depending on the source. The rural domestic water ranges from 159 at Black Sage #1 to 298 at Black Sage #3. The hardness in the water system fluctuates depending on which wells are being pumped and location.

5.1 Well Assessment/ Protection Plan

The Town received an Assessment of Groundwater Under the Direct Influence of Surface Water (GWUDI) report from Western Water Associates Ltd in 2012. The report indicates that Buchanan, Miller, Tucelnuit, and Black Sage #2 and #3 wells are low GWUDI risk while CPR, Lions and Black Sage #1 wells are moderate GWUDI risk requiring further sampling. Buchanan, CPR and Lions are no longer used in the domestic water system. Completion of a ground water protection plan is slated for 2015; see “Capital Projects and Improvements” section for more detail.

5.2 Disinfection

Chlorination occurs at all domestic pump houses. Black Sage received engineered chlorination facilities in 2014. See “Capital Projects and Improvements” section for more detail.

5.3 Monitoring Program

The Town of Oliver did not have to issue any water quality notices or advisories in 2014. An existing boil water notice for system 1 customers from 2013 was rescinded in January 2014.

5.3.1 Bacteriological

There are seven test stations located in the Municipal boundaries. The rural area north of Town has one test station and there are six testing sites (excluding wells) south of Town. See Appendix D for test site details.

As required in the Provincial Drinking Water Protection Act and Regulation, Municipal staff takes weekly water samples for bacteriological testing for Total Coliforms and e-Coli Bacteria at various sites throughout the system. There was no Total Coliform or e-Coli found in samples taken in 2014. See Appendix E for a summary of test results.

When any sample shows the presence of Total Coliform or e-Coli, the Interior Health Environmental Health Officer is consulted and standard protocol is to flush and resample the water immediately at the same location and resubmit for testing by the lab. We also complete in house presence/absence tests.

5.3.2 Nitrate / Nitrite Sampling

On approximately February 1, April 1, June 1, October 1, and December 1 of each year, samples are to be drawn from various wells and analysed for *Nitrates / Nitrites*. (Note: the intent is to sample for Nitrate / Nitrites every second month, however, the analysis for August will be included in the annual sample.) See Appendix F for results.

5.3.3 THM Sampling

THM testing was previously done at the beginning of August when Mud Lake pump station was supplying canal water to domestic customers in the summer months. This is no longer required now that the twinning is complete.

5.3.4 Annual Full Spectrum Sampling

On approximately August 1 of each year an annual sample will be drawn from two to three well site(s). The intent is that every source will be tested in a maximum five year rotation. They are to be analysed for the following:

General Parameters:

Fluoride	Nitrite	Hardness
PH	Colour	Sulphate
Chloride	Conductivity	Total Alkalinity
Nitrate (NO ₂)	Turbidity	Total Dissolved Solids

Metals:

Aluminium	Cobalt	Nickel
Arsenic (low level)	Copper	Potassium
Barium	Iron	Selenium (low level)
Boron	Lead (low level)	Silver
Cadmium	Magnesium	Sodium
Calcium	Manganese	Vanadium
Chromium	Molybdenum	Zinc

All of the data from the above analysis is recorded in a spreadsheet format, and includes comparisons of the results with the standards set in the “Canadian Drinking Water Guidelines”. See Appendix G for more details.

5.4 Turbidity Monitoring Program

As Mud Lake pump station no longer services domestic customers, turbidity is no longer monitored.

6.0 Water Use

The Town pumped 781,036,397 US gallons of ground water in 2014, and 3,427,418,855 US gallons of surface water. This represents an overall increase of 20% over 2013.

On the domestic water side, maximum daily water demand peaked at 3,035,436 US gallons on August 5th, while minimum daily demand occurred on January 5th at 572,305 US gallons. Domestic water use averaged 2,054,399 US gallons per day or 319 US gallons (1209 litres) per person based on a population of 6,432. (2011 BC Stats data of 4,824 for Oliver plus 643 Area C/OIB connections times 2.5 people.)

Figure 1 – Five Year Trend of Total Ground Water Pumped

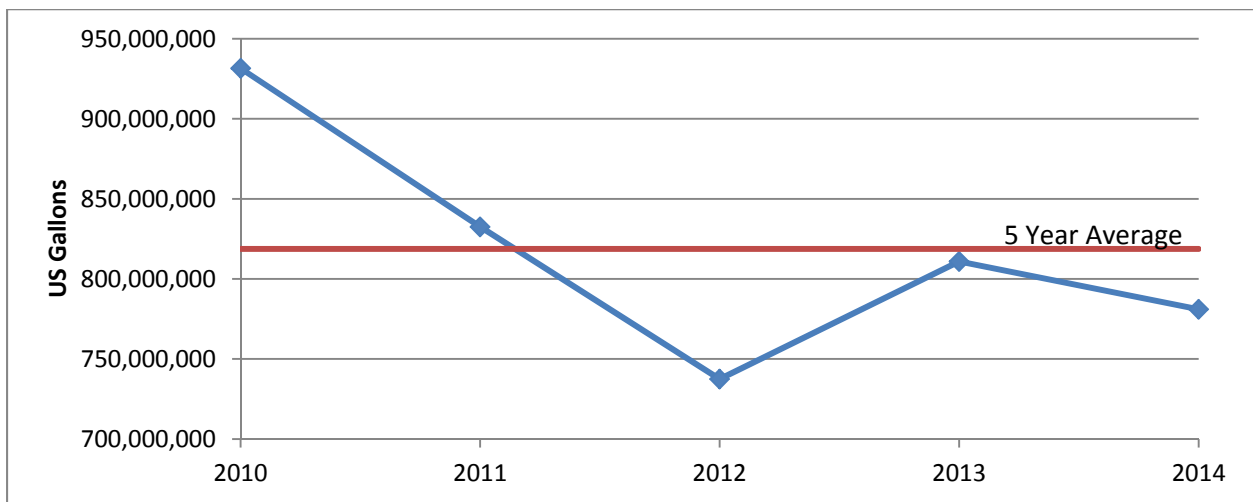
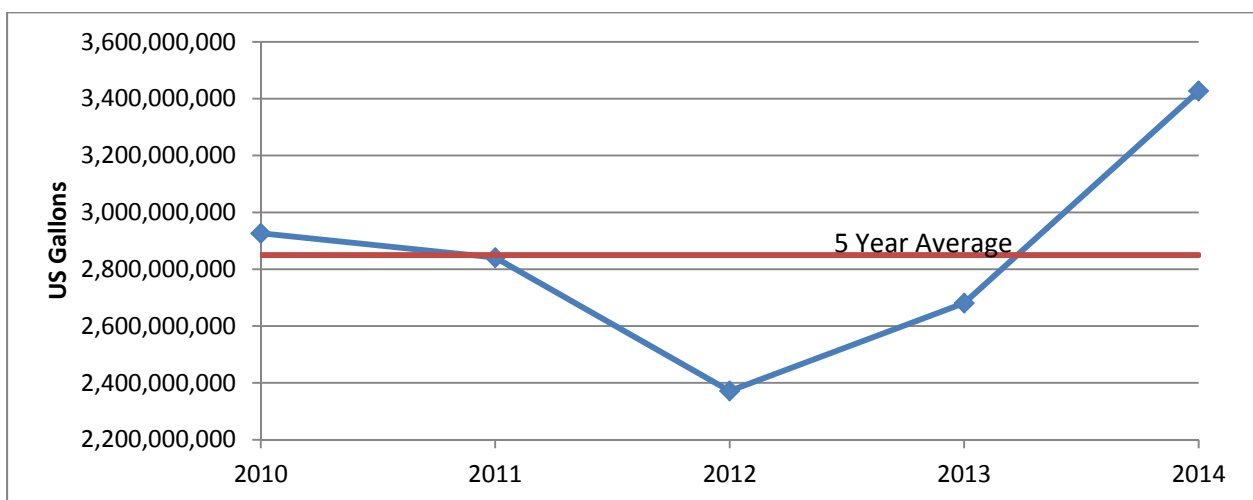


Figure 2 – Five Year Trend of Surface Water Pumped



7.0 Staff

According to EOCP (Environmental Operator Certification Program), Oliver's Water Distribution System is a Class III. Operations has six certified Water Distribution Operators; Two level I, three level II, and one level IV. One staff member has been water operator in training since April 2013 at Public Works with a view to succession planning.

All Operators are required to keep up their education and to maintain 2.4 certified education units (CEU's) every two years. Various accredited courses were put on at the Town regarding safe work practices.

8.0 Capital Projects & Improvements

8.1 Projects Completed in 2014

8.1.1 Phase 3 Twinning Project

A separate domestic water system for the Oliver rural Area supplied from groundwater was started in 2007. This was the third and final phase of the twinning projects and comprised of approximately 5 km of water distribution main and 46 domestic services, located in System 1, north of Town. These were the last customers receiving surface water for domestic purposes during the irrigation season, supplied by Mud Lake pump station. They will now receive domestic chlorinated groundwater from the Town's domestic water system. The Town has received grant money to help fund this project.

8.1.2 Black Sage Wells Chlorine Contact Time

Construction began in the winter of 2013 on an oversized (750mm Ductile Iron) pipe to allow adequate "chlorine contact time" for our domestic water customers in the Black Sage area, System 2 and 2b. This is to ensure that chlorine has enough time to kill bacteria before the drinking water reaches our first customers. Construction of an addition to the existing pumphouse for chlorination equipment was also included along with new controls and monitoring equipment on the SCADA system. These wells can also serve as back-up to the rest of the domestic water system (Road 13 Reservoir). The Town has received grant money to help fund this project.

8.1.3 Water line Upgrade in Alley behind Toasted Oak

The existing AC water main was upgraded with the sanitary sewer in the alley project. Multiple services were also replaced to property line.

8.1.4 Rockcliffe Irrigation Pumphouse Improvements

Electrical upgrades and improvements are slated at this pumphouse which will include new 'soft starts' installed on the pumps to replace the old equipment (which parts are no longer available for), instrumentation for the SCADA system with some wiring upgrades.

8.1.5 Flume 3 Irrigation Canal Upgrade

The flume was in desperate need of repair that was put off from 2012 because the bid costs received were over budget to complete the project. It was re-tendered in 2013 and work started in November. The flume received upgraded carrier beams to help with the structural component of our highest flume. It also received a new 40 mil linear low-density polyethylene liner (LLDPE) over the existing metal that carries the water to help with leaks. This work will extend the life of the structure which serves as a main component on the canal system.

8.2 Continuing Projects into 2015

8.2.1 Ground Water Protection Plan

As required by the Interior Health Authority and as a component of our multi-barrier approach to provide safe, reliable and sustainable drinking water, a plan and report will be prepared by a consultant. The report will lay out best management practices to protect the groundwater against contamination and will include risk characterization, stakeholder collaboration, establishment of achievable protection zones around each well head, and screening land-use planning tools. The Town has worked with a consultant in applying for grant money.

8.2.2 Buchanan Well Drilling (Domestic & Irrigation)

This work started in the winter of 2013 and involved drilling two wells, a 14" for domestic and a 10" for irrigation, which will replace the existing Buchanan well. One well will supplement the domestic water supply in System 1, north of Town and Municipal in-Town while the other will maintain the irrigation component of supplying irrigation water in the shoulder irrigation season and during peak demands.

A 350mm (14 inch) pipe was directionally drilled under the Okanagan River in 2014 from the east side to the west to complete System 1 domestic supply to the west side of Okanagan River.

2015 will see a pumphouse constructed to house the two wells along with a hypo-chlorine generation system for the domestic water. The Town has received funding to help towards the development of the wells.

8.2.3 Repair and Restore Section of Irrigation Canal

The canal was constructed over 90 years ago, upgrades and repairs are done before the beginning of each irrigation season. Annually a section of canal is restored. 2014 saw approximately 250 metres (800 feet) of wall and a small section of floor restored north of our Rockcliffe Irrigation pumphouse. In 2015 approximately 219 metres (719 feet) of canal, located near the Mud Lake pump house will be rehabilitated which involves pressure washing, new rebar along the floor and walls, shot-creting the walls, pouring concrete and re-finishing the canal floor.

8.3 Long-term Improvements Plans

The Town has a 5 year budgeted capital plan for known upgrades and new infrastructure or for projects. These projects include Canal rehabilitation on an annual basis along with:

2015

- a. Alley upgrades; Town Office to Kootenay Street including water main replacement
- b. Rockcliffe irrigation pumphouse control improvements
- c. SCADA system radio modem upgrades
- d. Mud Lake pump house electrical improvements
- e. Asset Management Plan

2016

- a. McGowan neighbourhood water main and service upgrades
- b. Haven Street water main upgrade
- c. Reservoir supply main repurposing
- d. Black Sage domestic variable frequency drive pump, 100HP
- e. Water main looping at head of lake
- f. Fairview irrigation pump house control & electrical upgrades

2017

- a. Centennial Park development
- b. Fairview pump house revolving screen and brushes
- c. Station Street upgrades
- d. Kobau irrigation pump house control and electrical upgrades

2018

- a. 6A Booster station SCADA addition

2019

- a. Miscellaneous undersized water main upgrades

9.0 Emergency Response Plan

The Town has an Emergency Response Plan pertaining to the water system. The Emergency Response Plan identifies a number of potential emergencies that could occur and provides a systematic approach on how the Town will deal with the emergency; the plan was last updated May 2012.

10.0 Cross Connection Control Program

Cross connection is an actual or potential connection between a potable water supply and a non-potable source, where it is possible for a contaminant to enter the drinking water supply. The Town's Cross Connection Control Program continues to work towards addressing the potential for the water system to be compromised by service connections which could introduce contaminated water into the domestic water system.

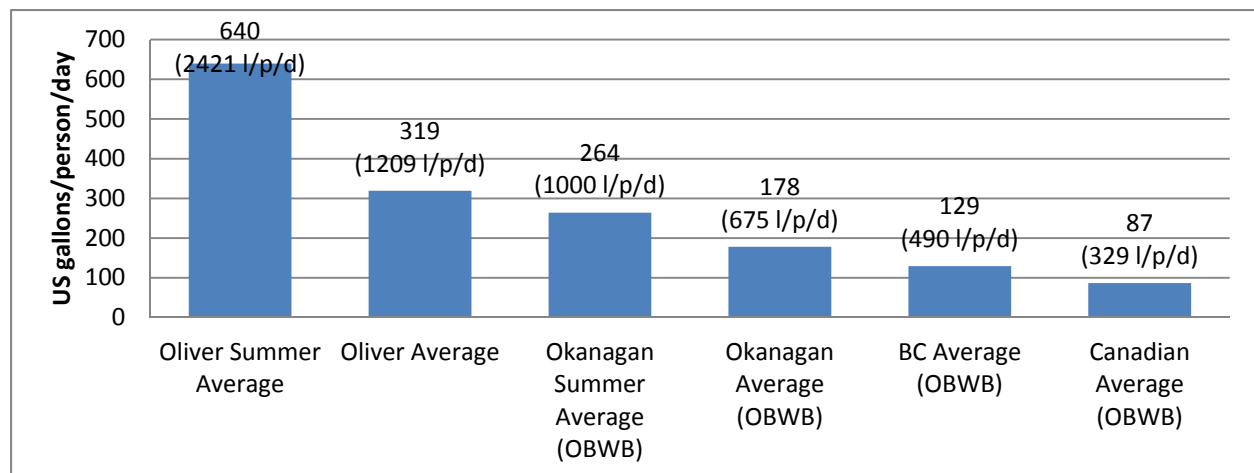
The program focuses on premise isolation for commercial and industrial customers. In 2014, there are 252 testable backflow assemblies in service (including agricultural devices) being tracked.

11.0 Water Conservation

The Town has worked towards providing public information and education for water conservation. As a contributing partner in the 'Make Water Work' campaign with the Okanagan Basin Water Board (OBWB) and its Okanagan WaterWise program, which is a valley wide awareness campaign, we were crowned as 'Make Water Work' champions for 2014, having the most pledges per capita to conserve water.

As demonstrated in Figure 1, under Water Consumption, domestic water consumption was down in 2014 but the Oliver area consumes significantly more water than the average Okanagan resident as shown on Figure 3.

Figure 3 – Water Consumption Comparison

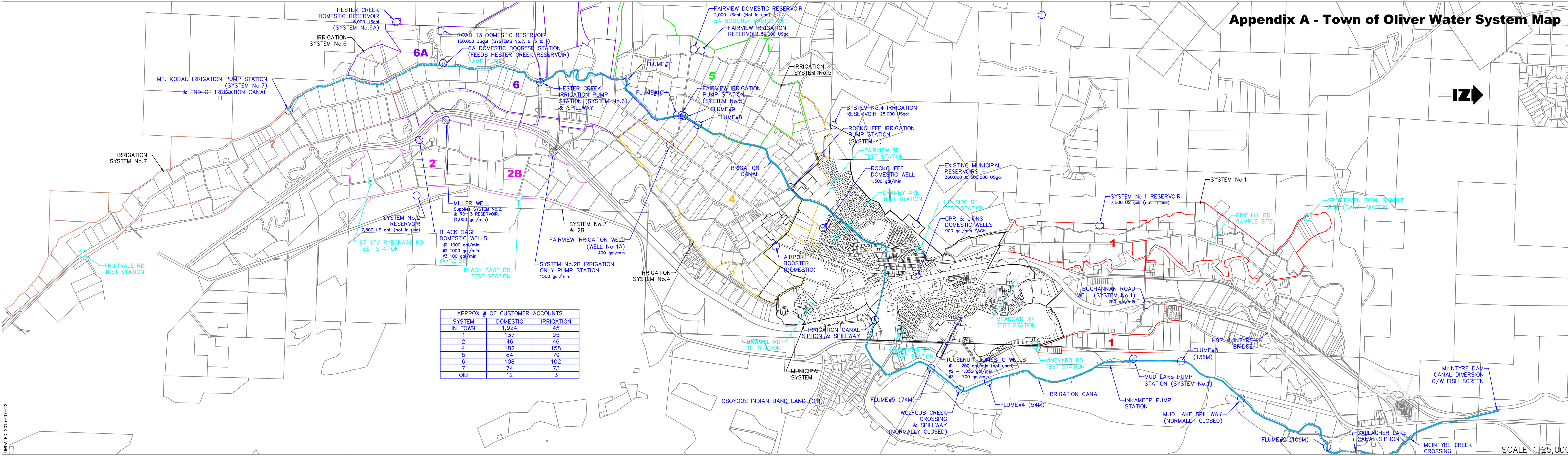


12.0 Conclusion

The Town of Oliver works hard to maintain water quality and quantity for their residents as well as numerous customers in Regional District area 'C'. Efforts are made to ensure appropriate water usage and educate the public whenever possible. Without these ongoing efforts, the area would not be the robust agricultural community that it is today.

If you have any comments regarding this report or other information that you would like to see included, please email works@oliver.ca or request a customer concern form at the Town Hall.

Appendix A - Town of Oliver Water System Map



APPROX # OF CUSTOMER ACCOUNTS		
SYSTEM IN TOWN	DOMESTIC	IRRIGATION
1	1,924	45
2	137	95
4	46	46
5	182	158
6	84	79
7	108	102
OIB	74	73
	12	3

SCALE 1:25,000

UPDATED 2015-07-22

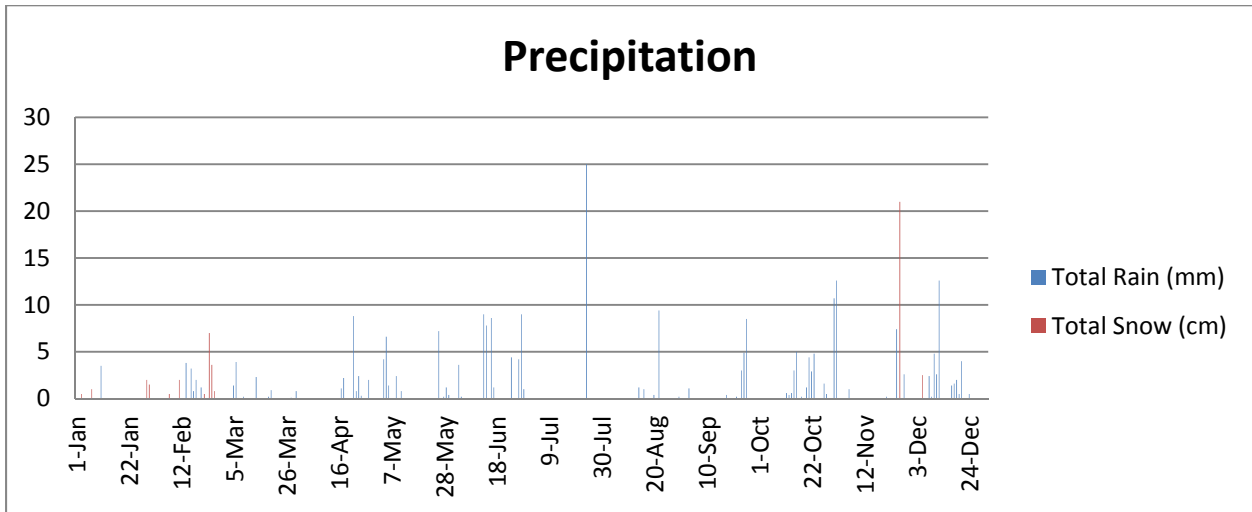
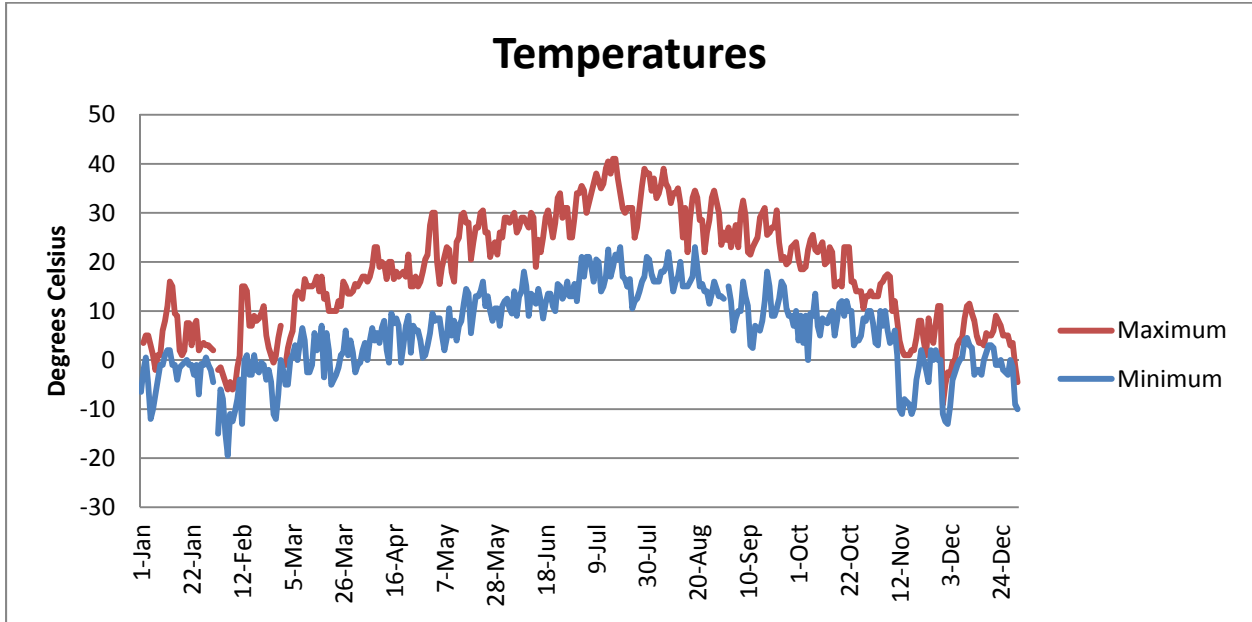
Appendix B – Water Use Data (US Gallons)

GROUND WATER SOURCES											
	Scada	Scada	Scada	Scada	Scada	TOTAL	Scada+Log	Log	Log	TOTAL	GRAND TOTALS
	CPR & LIONS PARK PS'S	ROCKCLIFFE DOMESTIC PS	TUCELNUIT PS 2	TUCELNUIT PS 3	MILLER RD RD 13		BLACK SAGE DOM PS	FAIRVIEW IRR WELL	BUCHANAN ROAD PS *		
MONTH	Mun	Mun	Mun	Mun	4,5,6,7		Sys 2	Sys 5A	Sys 1		
	used for DOMESTIC	used for DOMESTIC	used for DOMESTIC	used for DOMESTIC	used for DOMESTIC	used for DOMESTIC	used for BOTH	used for AGRICULTURAL	used for AGRICULTURAL	used for AGRICULTURAL	
January	0	8,698,818	5,462,724	10,038,002	0	24,199,544	0	0	0	0	24,199,544
February	0	9,596,083	1,911,672	10,038,071	21,700	21,567,526	0	0	0	0	21,567,526
March	0	830,385	15,685,281	7,766,662	14,000	24,296,328	0	448,000	0	448,000	24,744,328
April	0	17,394,117	10,166,968	2,824,999	5,990,400	36,376,485	7,846,370	7,277,000	2,947,000	10,224,000	54,446,855
May	0	19,408,088	24,439,203	3,421,091	7,028,100	54,296,482	34,651,930	548,000	872,000	1,420,000	90,368,412
June	0	33,278,069	18,730,820	2,073,138	7,148,100	61,230,126	38,915,529	0	310,000	310,000	100,455,656
July	0	33,617,007	31,691,621	12,518,015	147,371	77,974,014	54,843,293	8,000	333,000	341,000	133,158,307
August	0	28,956,868	21,314,040	16,627,815	8,324,800	75,223,523	47,015,842	0	1,323,000	1,323,000	123,562,365
September	0	22,513,046	16,120,550	9,708,583	6,248,300	54,590,478	32,791,379	0	781,000	781,000	88,162,857
October	0	14,418,973	3,273,914	11,393,399	6,684,900	35,771,187	19,444,823	6,452,000	10,451,000	16,903,000	72,119,009
November	0	8,632,754	6,815,275	3,853,141	5,526,400	24,827,571	0	0	0	0	24,827,571
December	0	10,809,998	8,433,814	4,749,526	0	23,993,338	0	0	0	0	23,993,338
					double-check:	514,346,601		double-check:		31,750,000	781,605,767
TOTALS	0	208,154,206	164,045,882	95,012,442	47,134,071	514,346,601	235,509,166	14,733,000	17,017,000	31,750,000	781,605,767
Max Flow	0	33,617,007	31,691,621	16,627,815	8,324,800	77,974,014	54,843,293	7,277,000	10,451,000	16,903,000	133,158,307
Min Flow	0	830,385	1,911,672	2,073,138	0	21,567,526	0	0	0	0	21,567,526
Avg Flow	0	17,346,184	13,670,490	7,917,704	3,927,839	42,862,217	19,625,764	1,227,750	1,418,083	2,645,833	65,133,814

*Meter only read on a periodic bass

SURFACE WATER SOURCES							
	Scada	Scada	Log	Scada	Scada	Log	TOTAL
	MUD LAKE PS	ROCKCLIFFE IRR PS	FAIRVIEW IRR PS	HESTER CREEK PS	MT KOBAU PS	BLK SAGE IRR PS	
MONTH	Sys 1	Sys 4	Sys 5	Sys 6	Sys 7	Sys 2B	
	used for AGRICULTURAL	used for AGRICULTURAL	used for AGRICULTURAL	used for AGRICULTURAL	used for AGRICULTURAL	used for AGRICULTURAL	used for AGRICULTURAL
January	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0
March	0	0	0	0	0	0	0
April	18,640,431	42,652,232	17,796,000	18,557,765	7,198,124	362,611	105,207,163
May	58,981,044	163,670,475	78,566,000	75,021,512	54,796,571	19,794,070	450,829,671
June	82,948,431	183,266,264	84,822,000	88,421,362	69,531,654	23,274,499	532,264,210
July	125,440,068	256,725,310	118,054,000	126,714,915	110,383,183	33,290,056	770,607,532
August	103,784,343	219,994,946	104,638,000	109,009,841	90,967,078	26,950,983	655,345,192
September	61,054,853	142,083,552	66,839,000	68,428,815	59,884,594	17,195,701	415,486,514
October	20,574,998	42,853,269	32,420,000	19,358,550	20,112,338	3,814,523	139,133,678
November	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0
						double-check:	3,068,873,960
TOTALS	471,424,168	1,051,246,047	503,135,000	505,512,759	412,873,543	124,682,443	2,597,449,792
Max Flow	125,440,068	256,725,310	118,054,000	126,714,915	110,383,183	33,290,056	770,607,532
Min Flow	0	0	0	0	0	0	0
Avg Flow	39,285,347	87,603,837	41,927,917	42,126,063	34,406,129	10,390,204	255,739,497

Appendix C – Climate data



Appendix D – Test sites

Bacteriological Sampling Sites:

Municipal System

Name of Site	Civic Address	Description of Sample Port
Fairview TS	Across from 1080 Fairview Road	Test Station
Tucelnuit TS	7084 Tucelnuit Drive	Test Station
Meadows TS	7030 Meadows Drive	Test Station
Hillside TS	6521 Hillside Street	Test Station
Wolfcub TS	892 McKinney Road (in back alley)	Test Station
Sawmill TS	5829 Sawmill Road	Test Station
Granby TS	652 Granby Avenue	Test Station
Reservoir	6450 Spartan Street	
Tucelnuit #2 (raw water)	Lakeside Drive and Merlot Avenue	Discharge manifold valve
Tucelnuit #2 (raw water)	Merlot Avenue at Lakeside Drive	Discharge manifold valve
Rockcliffe well (raw water)	Skagit Avenue at Columbia Street	Discharge manifold valve

Rural North

Sys. No.	Name of Site	Civic Address	Description of Sample Port
1	Sportsmens*	352 Sportsmens Bowl Road	Blow-off Stand Pipe
1	Pinehill Rd	7548 Highway 97	Test Station

*Only utilized until twinning completed.

Rural South

Sys. No.	Name of Site	Civic Address	Description of Sample Port
2	Ryegrass TS	4480 Ryegrass Road	Test Station
2	Blacksage TS	Black Sage Rd / Orchard Grove Ln	Test Station
2	Black Sage Well #1 (125 HP)	Parcel A, Plan 37485 (87th Street)	Discharge manifold valve
2	Black Sage Well #2 (100 HP)	Parcel A, Plan 37485 (87th Street)	Discharge manifold valve
2	Black Sage Well #3 (15 HP)	Parcel A, Plan 37485 (87th Street)	Discharge manifold valve
2	Miller Well	East end of Miller Road ROW	Discharge manifold valve
4	Snowbrush TS	Across from 5519 Snowbrush Street	Test Station
5	5A Booster Station	Road 5 / Lot 992 Plan 22065	Suction manifold valve
6	6A Booster Station	Road 13 / Mariposa Road (Canal)	Pump bleed-off valve
7	Fruitvale TS	3598 Fruitvale Way	Test Station

Appendix E – Chlorine residual and coliform sampling results (Target 0.2 to 1.50 Chlorine Residual)

DATE	RURAL NORTH				BLACK SAGE				RURAL SOUTH														MUNICIPAL					
	System #1				System #2				System #4				System #5				System #6				System #7							
	Surface Water Source				Groundwater Source				Ground Water Source				Groundwater Source				Groundwater Source				Groundwater Source				Groundwater Source			
	Chlorine Residual	Sample Location	Coliform		Chlorine Residual	Sample Location	Coliform		Chlorine Residual	Sample Location	Coliform		Chlorine Residual	Sample Location	Coliform		Chlorine Residual	Sample Location	Coliform		Chlorine Residual	Sample Location	Coliform		Chlorine Residual	Sample Location	Coliform	
Jan 6th	0.25	Sportman Bowl	<1	<1								0.23	5A Booster	<1	<1									n/a	Rockcliffe Well	<1	<1	
Jan 13th	0.08	Sportman Bowl	<1	<1												0.12	6A Booster	<1	<1					0.14	Hillside TS	<1	<1	
Jan 20th												0.15	5A Booster	<1	<1									0.17	Meadows TS	<1	<1	
Jan 28th																0.15	6A Booster	<1	<1					0.26	Vineyard TS	<1	<1	
Feb 3rd												0.30	5A Booster	<1	<1									0.24	Wolfcub TS	<1	<1	
Feb 11th																0.23	6A Booster	<1	<1					0.25	Fairview TS	<1	<1	
Feb 17th												0.08	5A Booster	<1	<1									0.20	Hillside TS	<1	<1	
Feb 24th																0.24	6A Booster	<1	<1									
Feb 25th																								0.22	Vineyard TS	<1	<1	
Mar 3rd												0.14	5A Booster	<1	<1									0.26	Wolfcub TS	<1	<1	
Mar 10th																0.19	6A Booster	<1	<1					0.21	Meadows TS	<1	<1	
Mar 17th												0.14	5A Booster	<1	<1									0.14	Sawmill TS	<1	<1	
Mar 24th																0.12	6A Booster	<1	<1					0.22	Fairview TS	<1	<1	
Mar 31st												0.14	5A Booster	<1	<1									0.10	Hillside TS	<1	<1	
April 7th	Twinning Complete															0.09	6A Booster	<1	<1					0.22	Meadows TS	<1	<1	
April 14th					-	Black Sage TS	<1	<1				0.13	5A Booster	<1	<1									0.05	Vineyard TS	<1	<1	
April 22nd					0.27	Ryegrass TS	<1	<1								0.09	6A Booster	<1	<1					0.11	Wolfcub TS	<1	<1	
																							n/a	Rockcliffe Well	<1	<1		
Apr 28th					0.92	Black Sage TS	<1	<1	0.12	Snowbrush TS	<1	<1												0.10	Sawmill TS	<1	<1	
					n/a	Miller Rd Well	<1	<1																				
May 5th					0.48	Ryegrass TS	<1	<1												0.13	Fruitvale TS	<1	<1	0.25	Fairview TS	<1	<1	
					n/a	Black Sage Well	<1	<1																				
May 12th					0.24	Black Sage TS	<1	<1				0.10	5A Booster	<1	<1									0.15	Hillside TS	<1	<1	
May 20th					0.38	Ryegrass TS	<1	<1								0.11	6A Booster	<1	<1					0.21	Meadows TS	<1	<1	
May 26th									0.17	Snowbrush TS	<1	<1												0.15	Vineyard TS	<1	<1	
																								0.33	Tucelnut TS	<1	<1	
June 2nd					0.23	Ryegrass TS	<1	<1				0.14	5A Booster	<1	<1									0.38	Wolfcub TS	<1	<1	
June 9th					0.16	Ryegrass TS	<1	<1												0.11	Fruitvale TS	<1	<1	0.12	Sawmill TS	<1	<1	
					n/a	Black Sage Well	<1	<1																				
June 16th	0.14	Loose Bay	<1	<1	0.37	Black Sage TS	<1	<1								0.13	6A Booster	<1	<1					0.32	Fairview TS	<1	<1	
June 23rd	0.14	Loose Bay	<1	<1	0.32	Ryegrass TS	<1	<1				0.17	5A Booster	<1	<1									0.21	Hillside TS	<1	<1	
					n/a	Miller Well	<1	<1																				

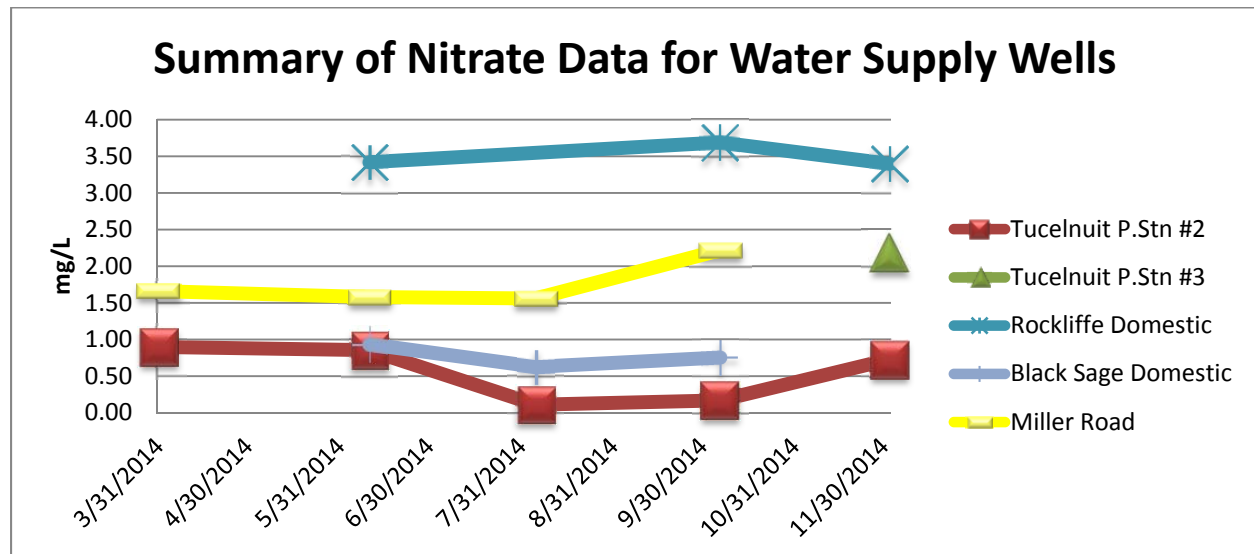
	RURAL NORTH				BLACK SAGE				RURAL SOUTH														MUNICIPAL					
	System #1				System #2				System #4				System #5				System #6				System #7							
	Surface Water Source				Groundwater Source				Ground Water Source				Groundwater Source				Groundwater Source				Groundwater Source							
	Chlorine	Sample	Coliform		Chlorine	Sample	Coliform		Chlorine	Sample	Coliform		Chlorine	Sample	Coliform		Chlorine	Sample	Coliform		Chlorine	Sample	Coliform					
DATE	Residual	Location	Total	Ecoli	Residual	Location	Total	Ecoli	Residual	Location	Total	Ecoli	Residual	Location	Total	Ecoli	Residual	Location	Total	Ecoli	Residual	Location	Total	Ecoli				
July 2nd					0.13	Black Sage TS	<1	<1	0.34	Snowbrush TS	<1	<1									0.38	Meadows TS	<1	<1				
July 7th					0.14	Ryegrass TS	<1	<1									0.15	Fruitvale TS	<1	<1	0.20	Vineyard TS	<1	<1				
July 14th					0.05	Black Sage TS	<1	<1					0.10	5A Booster	<1	<1					0.17	Wolfcub TS	<1	<1				
July 21st					0.24	Ryegrass TS	<1	<1									0.08	6A Booster	<1	<1								
July 28th					0.12	Black Sage TS	<1	<1	0.27	Snowbrush TS	<1	<1									0.25	Sawmill TS	<1	<1				
August 5th	0.11	Pinehill Rd	<1	<1	0.13	Black Sage TS	<1	<1									0.12	Fruitvale TS	<1	<1	0.10	Meadows TS	<1	<1				
August 11th	0.35	Pinehill Rd	<1	<1	0.30	Black Sage TS	<1	<1									0.32	6A Booster	<1	<1								
August 18th	0.14	Pinehill Rd	<1	<1	0.26	Black Sage TS	<1	<1					0.09	5A Booster	<1	<1					0.15	Hillside TS	<1	<1				
August 25th	0.18	Pinehill Rd	<1	<1	0.24	Ryegrass TS	<1	<1	0.12	Snowbrush TS	<1	<1									0.20	Meadows TS	<1	<1				
Sept 2nd	0.22	Pinehill Rd	<1	<1	0.23	Ryegrass TS	<1	<1					0.18	5A Booster	<1	<1					0.35	Vineyard TS	<1	<1				
					n/a	Miller Well	<1	<1																				
Sept 8th	0.12	Pinehill Rd	<1	<1	0.16	Black Sage TS	<1	<1													0.20	Wolfcub TS	<1	<1				
Sept 15th	0.19	Pinehill Rd	<1	<1	0.13	Ryegrass TS	<1	<1												-	Fruitvale TS	<1	<1	0.11	Sawmill TS	<1	<1	
Sept 24th	0.14	Pinehill Rd	<1	<1	0.18	Black Sage TS	<1	<1	0.11	Snowbrush TS	<1	<1									0.15	Fairview TS	<1	<1				
Sept 29th	0.19	Pinehill Rd	<1	<1	0.16	Ryegrass TS	<1	<1	0.20	Snowbrush TS	<1	<1									0.19	Hillside TS	<1	<1				
Oct 6th	0.10	Pinehill Rd	<1	<1	0.12	Ryegrass TS	<1	<1									0.18	Fruitvale TS	<1	<1	0.20	Meadows TS	<1	<1				
Oct 14th	0.14	Pinehill Rd	<1	<1	0.07	Black Sage TS	<1	<1	0.09	Snowbrush TS	<1	<1									0.19	Vineyard TS	<1	<1				
Oct 20th	0.05	Pinehill Rd	<1	<1	0.05	Ryegrass TS	<1	<1									0.27	6A Booster	<1	<1								
Oct 27th	0.13	Pinehill Rd	<1	<1	0.40	Black Sage TS	<1	<1					0.03	5A Booster	<1	<1					0.11	Sawmill TS	<1	<1				
Nov 3rd	0.18	Pinehill Rd	<1	<1													0.07	Fruitvale TS	<1	<1	0.08	Fairview TS	<1	<1				
Nov 12th	0.08	Pinehill Rd	<1	<1													0.18	6A Booster	<1	<1	0.11	Hillside TS	<1	<1				
Nov 17th									0.15	Snowbrush TS	<1	<1									0.12	Meadows TS	<1	<1				
Nov 24th													0.16	5A Booster	<1	<1					0.28	Vineyard TS	<1	<1				
Dec 1st																	0.05	6A Booster	<1	<1								
Dec 8th	0.16	Pinehill Rd	<1	<1									0.20	5A Booster	<1	<1					0.05	Sawmill TS	<1	<1				
Dec 15th									0.24	Snowbrush TS	<1	<1									0.40	Granby PITS	<1	<1				
Dec 22nd																	-	6A Booster	<1	<1								
Dec 29th													0.12	5A Booster	<1	<1					0.24	Hillside TS	<1	<1				

Appendix F – Nitrate, and THM sampling results

Nitrates:

Date	Tucelnuit P.Stn #2	Tucelnuit P.Stn #3	Rockliffe Domestic	Black Sage Domestic	Miller Road
3/31/2014	0.90				1.66
6/10/2014	0.86		3.42	0.94	1.58
8/5/2014				0.63	
8/5/2014	0.11				1.56
10/6/2014	0.17		3.69	0.75	2.22
12/2/2014	0.73	2.19	3.40		

*Maximum acceptable concentration per Canadian Drinking Water Guidelines is 10



Appendix G – Full spectrum analysis results

Parameter	Guide-line	Unit	In Town			Rural South			
			Rockcliffe Well	Tucelnuit #2	Tucelnuit #3	Black Sage #1	Black Sage #2	Black Sage #3	Miller Road
			Domestic	Domestic	Domestic	Domestic & Irrigation	Domestic & Irrigation	Domestic & Irrigation	Domestic
			July 29, 2013	October 6, 2014	July 29, 2013	August 1, 2012	August 1, 2012	August 5, 2014	July 29, 2013
Alkalinity, Total as CaCO3	-	mg/L	243	155	197	149	180	230	234
Chloride	≤250	mg/L	14.7	4.14	14.3	5.37	6.9	6.25	8.34
Fluoride	1.5	mg/L	0.34	0.41	0.36	0.12	0.11	0.18	0.3
Nitrogen, Nitrate as N	10	mg/L	3.75	0.169	1.78	0.379	0.824	0.627	1.42
Nitrogen, Nitrite as N	1	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Sulfate	≤500	mg/L	54.7	32	50.8	nt	nt	76.1	66.4
Colour, True	≤15	TCU	<5	<5	<5	<5	<5	<5	<5
Solids, Total Dissolved	≤500	mg/L	376	255	310	211	274	365	346
Turbidity	Varies	NTU	<0.1	<0.1	<0.1	nt	nt	<0.1	<0.1
pH	6.5 to 8.5	pH	7.92	7.89	8.03	7.86	7.92	7.89	7.95
Conductivity (EC)	-	uS/cm	633	364	530	378	456	590	595
Hardness, Total (as CaCO3)	-	mg/L	303	158	241	159	204	298	295
Nitrogen, Nitrate+Nitrite as N	-	mg/L	3.75	0.169	1.78	nt	nt	0.627	1.42
Aluminum	≤0.1	mg/L	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005
Antimony	0.006	mg/L	0.0002	0.0002	<0.0001	nt	nt	0.0004	0.0001
Arsenic	0.01	mg/L	0.0018	0.0032	0.0033	0.0008	0.0008	0.0029	0.0033
Barium	1	mg/L	0.058	0.053	0.076	0.039	0.046	0.049	0.081
Beryllium	-	mg/L	<0.0001	<0.0001	<0.0001	nt	nt	<0.0001	<0.0001
Bismuth	-	mg/L	<0.0001	<0.0001	<0.0001	nt	nt	<0.0001	<0.0001
Boron	5	mg/L	0.077	0.021	0.04	0.032	0.049	0.061	0.077
Cadmium	0.005	mg/L	0.00002	0.00001	<0.00001	0.00006	0.00003	0.00026	0.00002
Calcium	-	mg/L	82.4	41.3	67.3	37.9	48	70.9	68.9
Chromium	0.05	mg/L	0.0006	<0.0005	0.0006	<0.0005	<0.0005	<0.0005	<0.0005
Cobalt	-	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Copper	≤1	mg/L	0.002	0.0104	0.0035	0.0258	0.011	0.0320	0.0051
Iron	≤0.3	mg/L	<0.01	<0.01	<0.01	<0.01	0.01	0.03	<0.01
Lead	0.01	mg/L	<0.0001	0.0003	<0.0001	0.0018	0.0016	0.0043	0.0006
Lithium	-	mg/L	0.0086	0.0057	0.0081	nt	nt	0.0056	0.0065
Magnesium	-	mg/L	23.6	13.3	17.7	15.7	20.4	29.3	29.8
Manganese	≤0.05	mg/L	<0.0002	0.0015	<0.0002	0.0196	0.0053	0.0003	0.0866
Mercury	0.001	mg/L	<0.00002	<0.00002	<0.00002	nt	nt	nt	<0.00002
Molybdenum	-	mg/L	0.005	0.0056	0.0036	0.0068	0.0049	0.0114	0.0052
Nickel	-	mg/L	0.0005	<0.0002	0.0003	0.0009	0.0006	0.0008	0.0007
Phosphorus	-	mg/L	<0.020	0.036	0.042	nt	nt	0.053	<0.020
Potassium	-	mg/L	5.27	3.63	4.55	3.55	4.14	5.44	5.35
Selenium	0.01	mg/L	0.0022	0.001	0.0046	<0.0005	0.001	0.0017	0.0036
Silicon	-	mg/L	9.8	10.5	11.4	nt	nt	11.8	10.6
Silver	-	mg/L	<0.00005	0.0001	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Sodium	≤200	mg/L	17.4	13.7	21.5	13.8	16	21.3	15.4
Strontium	-	mg/L	0.872	0.543	0.772	nt	nt	0.840	0.838
Sulfur	-	mg/L	17	9	16	nt	nt	26	21
Tellurium	-	mg/L	<0.0002	<0.0002	<0.0002	nt	nt	<0.0002	<0.0002
Thallium	-	mg/L	0.00002	<0.00002	<0.00002	nt	nt	<0.00002	<0.00002
Thorium	-	mg/L	<0.0001	<0.0001	<0.0001	nt	nt	<0.0001	<0.0001
Tin	-	mg/L	<0.0002	<0.0002	<0.0002	nt	nt	<0.0002	<0.0002
Titanium	-	mg/L	<0.005	<0.005	<0.005	nt	nt	<0.005	<0.005
Uranium	0.02	mg/L	0.0106	0.00321	0.00754	0.00311	0.00546	0.00613	0.00619
Vanadium	-	mg/L	<0.001	0.002	0.001	0.002	0.002	0.003	<0.001
Zinc	≤5	mg/L	<0.004	0.004	<0.004	0.036	0.013	0.149	0.014
Zirconium	-	mg/L	<0.0001	0.0002	<0.0001	nt	nt	<0.0001	<0.0001

Appendix H – Well details

Groundwater Source	Depth (m)	Diameter (cm)	Pump rate (US gpm)	Notes
Buchanan domestic well				Under development to supply domestic water primarily to System No. 1
New Buchanan irrigation well				Under development to supply irrigation water to System No. 1 in the shoulder seasons.
Buchanan irrigation well (old)	34.75	20.32	250	Currently used to supply System No.1 in the shoulder seasons. Will be decommissioned when the new wells come on line.
Tucelnuit domestic well #1	14.02	20.32	n/a	Not in use, no pumps.
Tucelnuit domestic well #2	14.32	30.48	1,050	
Tucelnuit domestic well #3	13.72	25.40	700	
Lions Park domestic well	25.90	15.24	900	Not used because of uranium levels.
CPR domestic well	15.20	15.24	900	Rarely used because of uranium levels.
Centennial Park	25.90	15.24	n/a	Not in use, no pumphouse. Hydrocarbons.
Rockcliffe domestic well	24.4	40.64	1,500	
Fairview Irrigation well	42.67	20.32	400	Was removed from the domestic system when nitrate levels became too high. Is used to supplement the irrigation system.
Miller domestic well	17.98	30.48	1,000	Supplies System 2 and Road 13 Reservoir. High manganese levels.
Black Sage domestic well #1	33.53	40.64	1,000	
Black Sage domestic well #2	33.53	40.64	1,000	
Black Sage domestic well #3	33.22	20.32	100	