Sanitary Sewer System 2021 Annual Report

Town of Oliver

February 2022

Project No. 306-088-009

ENGINEERING ■ PLANNING ■ URBAN DESIGN ■ LAND SURVEYING

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Report Submission

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APPENDICES

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List of Acronyms

AC	Asbestos Cement
BOD_5	5-Day Biological Oxygen Demand
CPE	Chlorinated Polyethylene
EOCP	Environmental Operators Certification Program
FLNRO	Ministry of Forests, Lands, and Natural Resource Operations
GIS	Geographic Information Systems
HDPE	High Density Polyethylene
I&I (I/I)	Inflow and Infiltration
LS	Lift Station
LWMP	Liquid Waste Management Plan
MOE	Ministry of Environment and Climate Change Strategy
MPN	Most Probable Number
MSR	Municipal Sewage Regulation
MWR	Municipal Wastewater Regulation
OC	Operational Certificate
OCP	Official Community Plan
OIB	Osoyoos Indian Band
PVC	Polyvinyl Chloride
TRUE	TRUE Consulting
TSS	Total Suspended Solids
WMP	Waste Management Plan

Units of Measure

km	kilometre
L/d	Litres per day
L/m	Litres per minute
L/s	Litres per second
lpcd	Litres per capita per day
m	metre
m^3/day	cubic metre per day
mg/L	milligrams per Litre
mm	millimetre

1.0 Operational Data

The following report summarizes the operational data for the Town of Oliver's Sanitary Sewer System for 2021. The report is formatted from collection to disposal. Appendix A contains a complete copy of the Operational Certificate (OC) for the system PE 13717 issued by the Ministry of Environment (MOE) on December 14, 1995. When required, appropriate references will be made to the OC.

Section 1 of the OC outlines the specific authorized discharge requirements from the Oliver Wastewater Treatment Plant (WWTP) and are summarized as follows:

- The Town is authorized to discharge a maximum of 2,200m^3 per day from the aerated lagoons to the reclaimed wastewater storage reservoir, averaged on a daily basis.
- There is no maximum authorized discharge rate from the storage reservoir for beneficial use as irrigation water.
- The effluent discharged from the aerated lagoons to the storage reservoir must not exceed a 5-Day Biochemical Oxygen Demand[1] (BOD_5) of 45 mg/L, and a Total Suspended Solids (TSS) of 60 mg/L.
- A minimum reclaimed wastewater reservoir retention time of 60 days must be met prior to discharge of the reclaimed wastewater
- Reclaimed wastewater utilized for irrigation shall conform to the effluent irrigation guidelines developed by the BC Ministry of Health. Fecal Coliforms shall not exceed 200 MPN per 100 mL for agricultural, silvicultural, and low public use lands, and shall not exceed 2.2 MPN per 100 mL for high public use land.

To assist the reader in assessing the system operational data, the following drawings are included:

- Figure 1-1. Overall Plan - Reclaimed Water Supply System and Irrigation Areas
- Figure 1-2. Aerated Lagoon Treatment System

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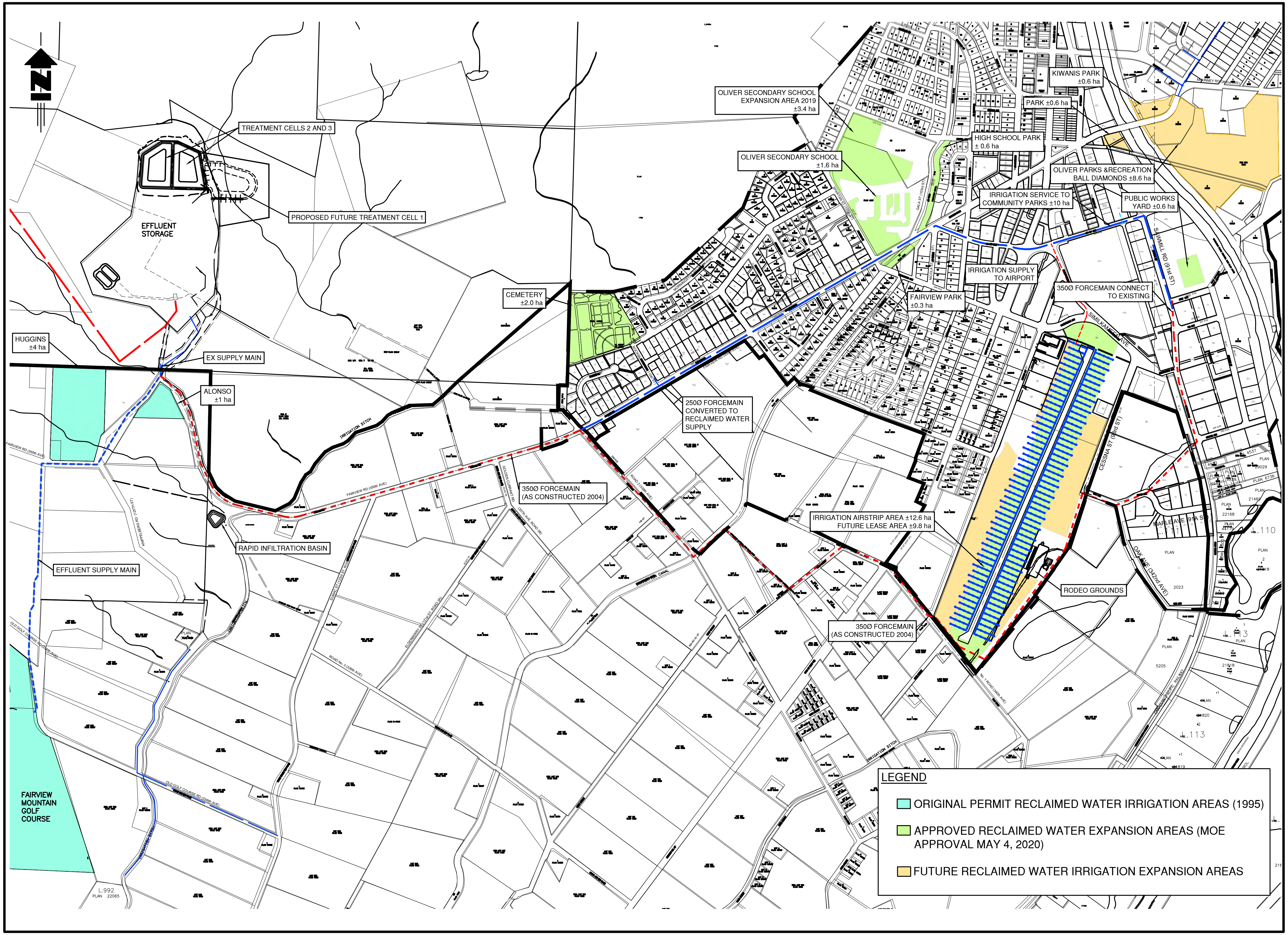
[1] As per the BC Municipal Wastewater Regulations, BOD_5 is described as the Carbonaceous Biological Oxygen Demand.



LEGEND

🟦 ORIGINAL PERMIT RECLAIMED WATER IRRIGATION AREAS (1995)

🟩 APPROVED RECLAIMED WATER EXPANSION AREAS (MOE APPROVAL MAY 4, 2020)

🟧 FUTURE RECLAIMED WATER IRRIGATION EXPANSION AREAS

No.	DATE	DESCRIPTION	BY	APP.

ISSUES / REVISIONS

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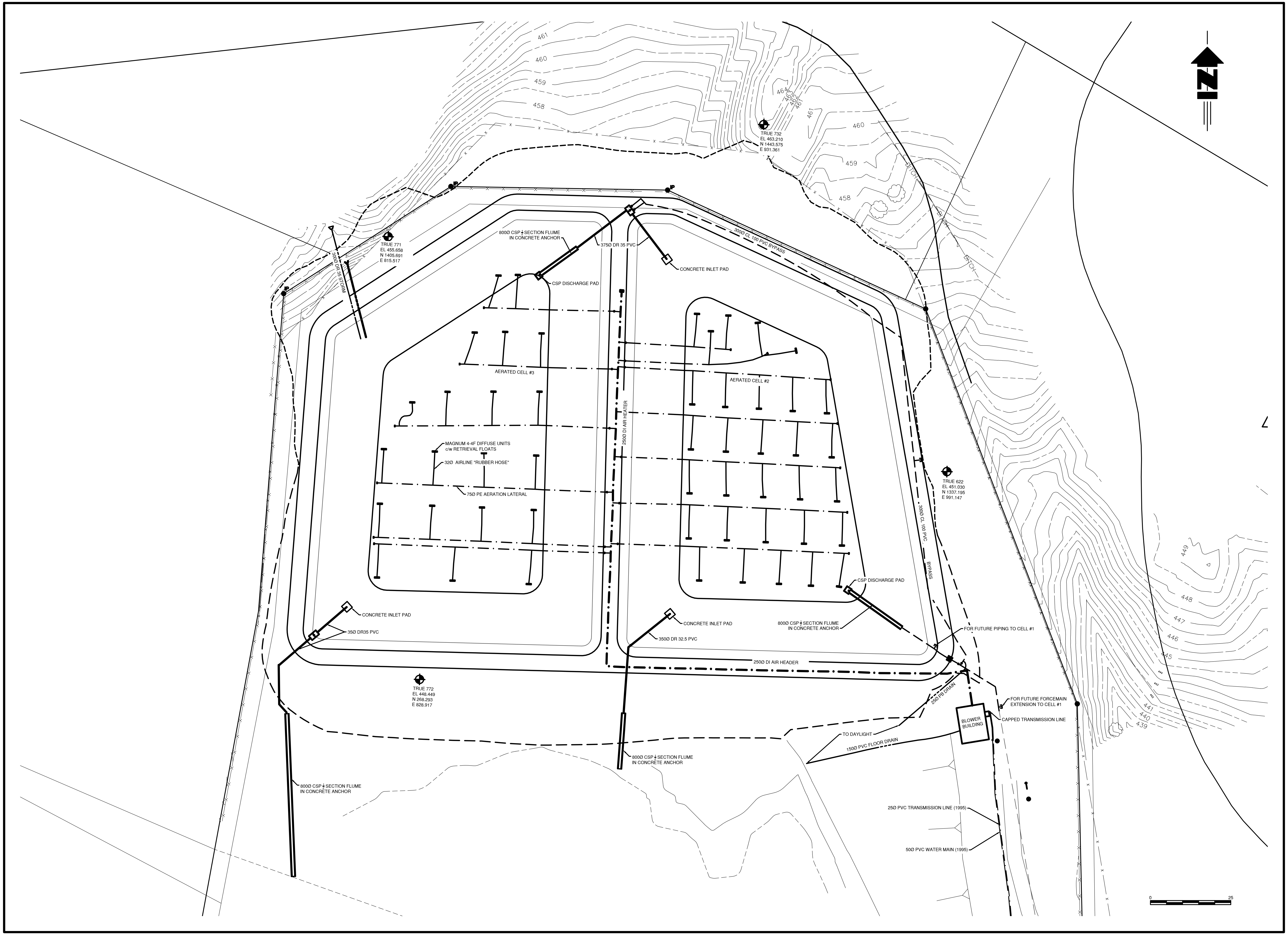
Town of Oliver
CANADA'S WINE CAPITAL

SANITARY SEWER ANNUAL REPORT

OVERALL PLAN RECLAIMED WATER SYPPLY SYSTEM AND IRRIGATION AREAS

SCALE N.T.S. (11x17)
DESIGN BY TRU
DRAWN BY NA
DATE FEBRUARY 2021
PROJECT REFERENCE No. 306-088-005
DRAWING No. **FIG 1-1**
SHEET 1 OF 1
ISSUE/REV.

FILE: r:\clients\300-399\306\306-088-008\03 drawings\cad\02 design drawings\306-088-007 report figures r1



No.	DATE	DESCRIPTION	BY	APPD.

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Town of Oliver
CANADA'S WINE CAPITAL

SANITARY SEWER ANNUAL REPORT

AREATED LAGOON TREATMENT SYSTEM LAYOUT AND INTERCELL PIPING

SCALE 1:500 (24x36)
DESIGN BY TRU
DRAWN BY NA
DATE JANUARY 2022
PROJECT REFERENCE No. 306-088-009
DRAWING No.
FIG 1-2
SHEET 1 OF 1
ISSUE/REV.

FILE: r:\clients\300-399\306\306-088-009\03 drawings\cad\02 design drawings\306-088-009 report figures ed

1.1 Influent

1.1.1 Influent Works (OC 6.4.2)

Influent from the sanitary sewer collection system is pumped through influent screens and piped into a two-cell flow equalization system ("equalization basins"). The original equalization basin was constructed in 1984 and lined with a Chlorinated Polyethylene (CPE) membrane. The second equalization basin was constructed in 2009 and lined with a 60mm HDPE membrane. These liners provide a transfer barrier for liquids from the basins to the native subsurface material. There is no piped interconnection between the Okanagan River and the equalization basins.

A detailed description of the collection system and treatment process can be found in the Town of Oliver's 2018 Sanitary Capital Plan prepared by TRUE Consulting (Appendix B). This Capital Plan includes an update to the Liquid Waste Management Plan. Further details can be found in the Oliver WWTP Operation and Maintenance Manual prepared by TRUE Consulting in February 2021.

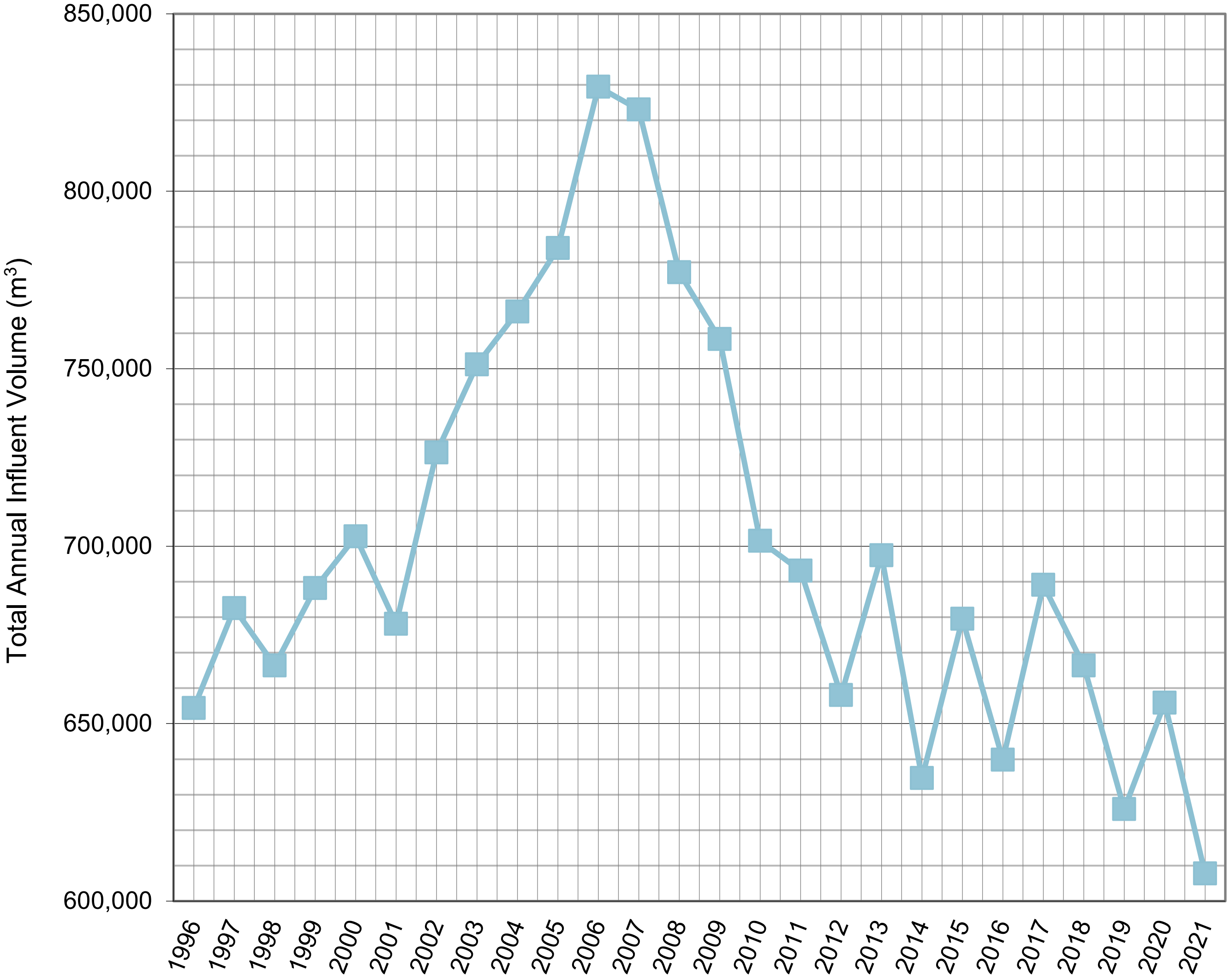
1.1.2 Influent Flow Data (OC 7.1.2 and 7.2.4.7)

Wastewater is pumped from the equalization basin to the aerated lagoons via the High Lift station. 2021 Daily flow data for the lift station is presented in Appendix C. The total volume pumped to the aerated lagoons in 2021 was 607,731 m^3, which equates to an average daily flow of 1,665 m^3/day. This is a decrease of 48,122 m^3 (7.3%) as compared to 2020. A summary of total influent inflows from the period 1996 to 2021 can be seen in Table 1-1 and Figure 1-3 below.

TABLE 1-1: ANNUAL TOTAL AND AVERAGE DAILY INFLUENT FLOW DATA

Year	Total Influent Volume (m^3)	Average Daily Flow (m^3/d)
1996	654,361	1,788
1997	682,480	1,870
1998	666,322	1,826
1999	688,193	1,885
2000	702,688	1,920
2001	678,052	1,858
2002	726,354	1,990
2003	751,139	2,058
2004	766,048	2,093
2005	783,947	2,148
2006	829,413	2,272
2007	823,011	2,255
2008	777,154	2,123
2009	758,308	2,078
2010	701,475	1,922
2011	693,045	1,899
2012	658,002	1,798
2013	697,377	1,911
2014	634,649	1,739
2015	679,542	1,862
2016	639,794	1,753
2017	689,098	1,888
2018	666,376	1,826
2019	625,911	1,715
2020	655,853	1,792
2021	607,731	1,665

Figure 1-3. Total Annual Influent Sewage Flows for 1996 to 2021



1.1.3 Influent Wastewater Sampling (OC 6.1 and 7.1.2)

Influent sampling data for total phosphorus and orthophosphate concentrations are presented in Table 1-2. The average total phosphorous and orthophosphate concentrations from March and September 2021 sampling were 6.18 and 1.99 mg/L respectively. The 2021 average concentrations are consistent with previous years.

TABLE 1-2. INFLUENT SAMPLING ANALYSIS

Year	Date	Total Phosphorus (mg/L)	Ortho Phosphate (mg/L)
1996	Mar. 22	5.44	
	Sep. 12	5.18	
1997	Mar. 19	5.87	
1998	Mar. 18	5.6	
	Sep. 9	5.89	
1999	Mar. 11	6.66	
	Sep. 23	4.89	
2000	Mar. 23	6.48	4.69
	Sep. 28	8.67	3.04
2001	Mar. 22	4.57	2.3
	Sep. 19	4.13	1.88
2002	Mar. 19	4.53	3.84
	Sep. 10	4.52	2.55
2003	Mar. 10	3.78	3.78
	Sep. 30	4.48	4.38
2004	Mar. 16	5.23	4.76
	Sep. 14	5.15	3.75
2005	Mar. 22	5.24	4.63
	Oct. 5	6.74	5.58
2006	Sep. 14	7.05	5.96
2007	Mar. 13	5.03	6.43*
	Sep. 11	6.03	5.03
2008	Sep. 3	7.44	3.3
2009	Mar. 5	8.18	3.84
	Sep. 1	5.31	1.38
2010	Mar. 9	4.26	0.558
	Sep. 2	3.36	2.16
2011	Mar. 8	4.9	0.316
	Sep. 8	11	0.859
2012	Mar. 1	6.16	2.23
	Sep. 11	7.76	3.72
2013	Mar. 7	5.75	2.57
	Sep. 11	4.62	1.89
2014	Mar. 5	4.28	0.82
	Sep. 17	3.82	not tested
2015	Mar. 11	5.36	2.66
	Sep. 16	4.55	2.96
2016	Mar. 7	4.17	1.21
	Sep. 6	2.35	0.36*
2017	Mar. 7	3.77	2.42
	Sep. 6	4.69	2.13
2018	Mar. 7	5.37	1.95
	Sep. 4	5.89	1.83
2019	Mar. 11	5.34	1.97
	Sep. 3	5.42	2.32
2020	Mar. 2	4.97	1.89
	Sep. 1	5.45	2.09
2021	Mar. 15	6.76	1.70
	Sep. 14	5.59	2.28
Average for Period of Record		**5.46**	**2.75**

* Suspected error

1.2 Wastewater Treatment (OC 6.2 and 7.1.2)

Effluent sampling results from the aerated lagoon system (Cell No. 3) prior to reservoir storage are tabulated in Table 1-3. All TSS and BOD_5 values were within the regulations for all sampling events. Additionally the Town has included $CBOD_5$ sampling analysis to comply with the MWR BOD_5 definition.

TABLE 1-3. CELL NO.3- EFFLUENT BOD_5, CBOD AND TSS

Date	BOD_5 (mg/L)	$CBOD_5$ (mg/L)	TSS (mg/L)
OC Limits	**45**		**60**
Jan-04 (2021)	33.5	16.7	25.6
Feb-02 (2021)	35.2	16.8	18.4
Mar-01 (2021)	35.7	N/A	38.8
Apr-06 (2021)		15.0	12.4
May-03 (2021)		11.6	27.6
Jun-07 (2021)		10.1	12.0
Jul-06 (2021)		7.0	8.0
Aug-03 (2021)		<4.8	11.7
Sep-07 (2021)		7.9	5.7
Oct-12 (2021)		5.1	5.6
Nov-01 (2021)		<4.7	12.4
Dec-13 (2021)		13.0	9.2

Due to a communication error between the Town and the Lab, BOD_5 was not calculated for samples taken for April to December. The Town has communicated this requirement to CARO for future analysis.

Historical data of BOD_5 and TSS is shown in Figure 1-4 below.

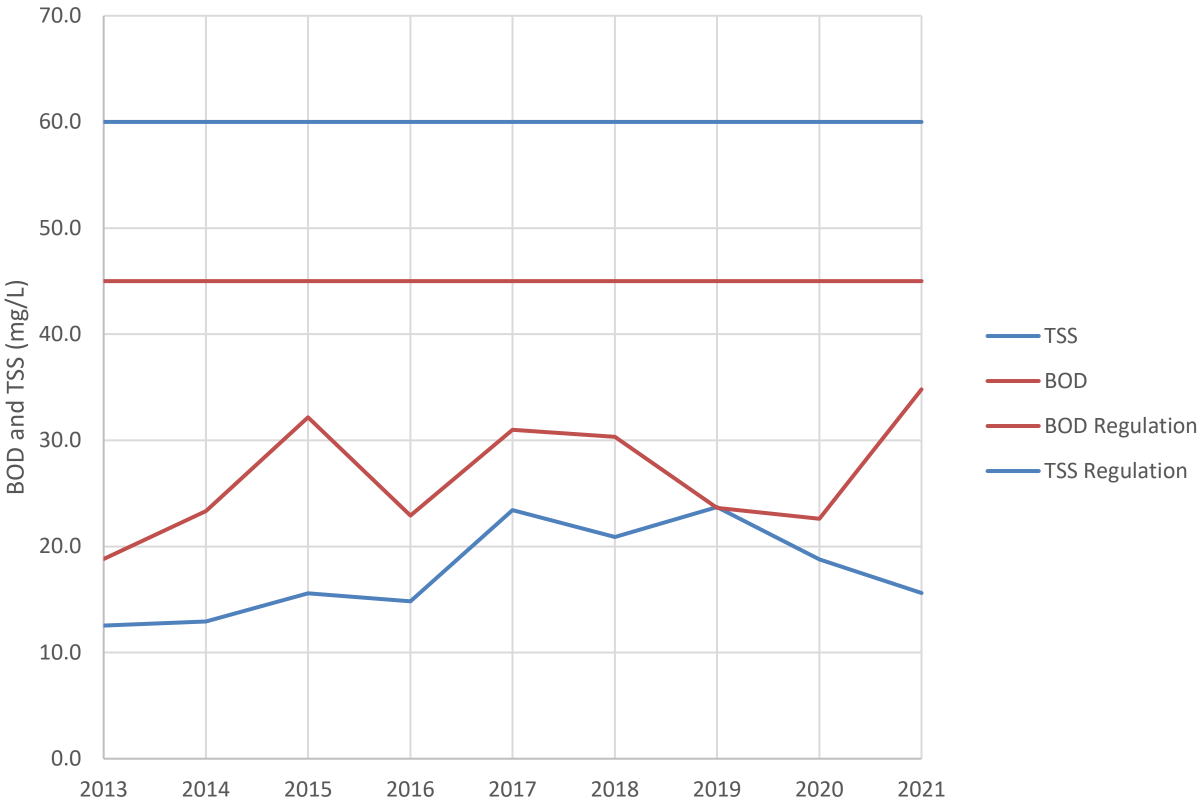


FIGURE 1-4. YEARLY AVERAGE TSS AND BOD_5 VALUES.

As seen above, the yearly average BOD_5 and TSS Data for the reclaimed water have been consistent, and well under the regulation limit.

As per PE-13717, semi-annual analysis of effluent must include:

- Total phosphorous, ortho-phosphorous, and total dissolved phosphorus (all expressed in mg/L P)
- Total nitrogen, ammonia nitrogen, nitrate, nitrite, nitrogen, and organic nitrogen (all expressed as mg/L N)

A summary of semi-annual sampling for total nitrogen, ammonia, and nitrate from 1997 – 2021 is presented in Table 1-4. The complete suite of semi-annual sampling and compliance testing requirements is included in Appendix C.

Sampling was conducted on March 15th and September 14th, 2021. The accepted range for total nitrogen in domestic wastewater is 20 to 50 mg/L. Total nitrogen was within this range for both samplings.

TABLE 1-4. CELL NO.3 EFFLUENT - NITROGEN

Year	September/October			March		
	Total Nitrogen (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)	Total Nitrogen (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)
1997	9.34	0.006	7.7	20.7	No Data	No Data
1998	10.8	0.005	8.89	25.1	No Data	No Data
1999	11.3	0.46	8.31	23.9	No Data	No Data
2000	No Data	0.48	9.77	29.1	No Data	No Data
2001	34.3	4.37	7.92	31.3	No Data	No Data
2002	17.7	0.013	16.3	23.6	No Data	No Data
2003	No Data	0.71	3.9	26.9	No Data	No Data
2004	9.8	8.46	0.29	17.2	No Data	No Data
2005	26.4	14.2	No Data	36.4	No Data	No Data
2006	12.1	0.78	5.97	No Data	No Data	No Data
2007	20	13.2	0.92	25.7	No Data	No Data
2008	10	9.55	0.297	24.1	No Data	No Data
2009	17	14	1	No Data	No Data	No Data
2010	16.3	8.44	3.6	27.8	No Data	No Data
2011	26	13.7	3.27	33.5	No Data	No Data
2012	5.28	1.95	2.17	32.2	No Data	No Data
2013	10.10	0.289	9.43	43.7	32.5	0.489
2014	No Data	No Data	No Data	32.8	31.2	0.046
2015	19.10	17.6	0.966	No Data	No Data	No Data
2016	12.80	1.82	5.33	33.2	31.2	1.05
2017	18.50	0.384	14.7	32	23.4	0.019
2018	11.9	0.916	8.2	32	31.1	0.282
2019	18.5	0.322	10.1	27.4	27.6	0.339
2020	21.9	15.6	2.36	35.3	25.2	1.2
2021	17.4	12.6	2.11	24.5	26	0.428

From 1997 to 2002, a significant proportion of ammonia and nitrogen was nitrified through the Town's aerated lagoon system. From 2003 to 2015, the Town accepted wastewater influent from Vincor (a local winemaker), which resulted in modest levels on nitrification. In January 2012, Vincor implemented a pre-treatment system, resulting in approximately a 90% reduction in BOD. This resulted in reduced loadings which in turn resulted in increased nitrification. As of July 1, 2015, Vincor has been disconnected from the Town's wastewater system.

1.3 Winter Effluent Storage Reservoir

Weekly storage reservoir level data for 2021 is presented in Appendix D. All elevations given are relative to geodetic datum. The elevation data has been converted to total volume in storage above the minimum 60-day storage level. The storage calibration curve is also included in Appendix D.

As per Section 1.1.1 of the OC, the Town is authorized to a maximum effluent discharge rate of 2,200 m^3 per day from the aerated lagoon sewage treatment system to the reclaimed wastewater storage reservoir, averaged on a monthly basis. A flow meter is located at the High Lift station, which pumps wastewater from the equalization basin to the aerated lagoons.

It is assumed that all effluent flows from aerated lagoon Cell No. 3 to the storage reservoir. The metered influent flow provides a conservative value for the discharge volume from Cell No. 3 to storage, as losses due to evaporation and seepage are not included. Monthly volumes are presented in Table 1-5 as follows:

TABLE 1-5. 2021 MONTHLY EFFLUENT DISCHARGE QUANTITIES

	Monthly m^3	Average m^3/day
January	49,284	1,590
February	44,846	1,602
March	48,897	1,577
April	48,020	1,601
May	54,213	1,749
June	55,313	1,844
July	57,934	1,869
August	52,039	1,679
September	50,787	1,693
October	51,359	1,657
November	46,729	1,558
December	48,310	1,558
Total	607,731	
Average		1,665

As shown in Table 1-5 there were no exceedances of the allowable discharge limit.

Annual operating data for the storage reservoir is summarized in Table 1-6. This includes a comparative summary from 2011 to 2021.

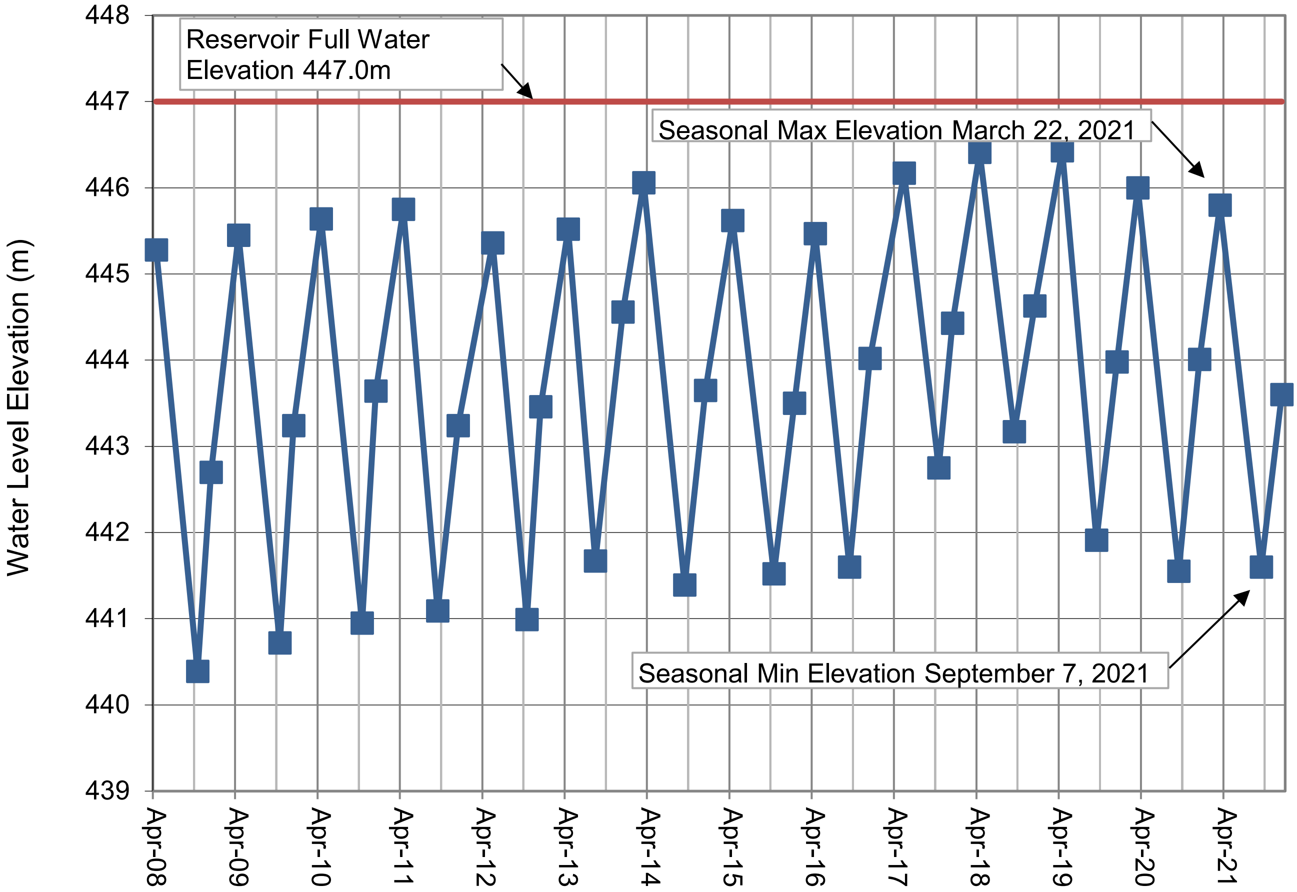
TABLE 1-6. EFFLUENT STORAGE RESERVOIR LEVEL DATA

Year	Date		Elevation (m)	Volume (m^3)
2011	Max.	11-Apr-11	445.75	357,000
	Min.	26-Sep-11	441.09	76,000
	End	31-Dec-11	443.24	197,000
2012	Max.	2-May-12	445.36	338,000
	Min.	10-Oct-12	440.99	72,000
	End	31-Dec-12	443.46	211,000
2013	Max.	25-Apr-13	445.52	355,000
	Min.	21-Aug-13	441.67	106,000
	End	31-Dec-13	444.56	284,000
2014	Max.	31-Mar-14	446.06	374,000
	Min.	15-Sep-14	441.39	92,000
	End	29-Dec-14	443.65	223,000
2015	Max.	7-Apr-15	445.62	351,000
	Min.	7-Oct-15	441.52	101,000
	End	4-Jan-16	443.5	214,000
2016	Max.	4-Apr-16	445.47	343,000
	Min.	19-Sep-16	441.60	105,000
	End	19-Dec-16	444.02	247,000
2017	Max.	22-May-17	446.17	379,000
	Min.	16-Oct-17	442.75	167,000
	End	18-Dec-17	444.43	275,000
2018	Max.	2-Apr-18	446.41	391,000
	Min.	10-Sep-18	443.17	193,000
	End	24-Dec-18	444.63	289,000
2019	Max.	8-Apr-19	446.43	397,000
	Min.	9-Sep-19	441.91	119,000
	End	23-Dec-19	443.98	245,000
2020	Max.	23-Mar-20	446	370,000
	Min.	14-Sep-20	441.55	102,000
	End	28-Dec-20	444.01	246,000
2021	Max.	22-Mar-21	445.8	360,000
	Min.	7-Sep-21	441.6	105,000
	End	20-Dec-21	443.6	221,000

Winter effluent storage reservoir year-end, maximum, and minimum operating elevations for the period 2008 to 2021 are illustrated graphically in Figure 1-5. Referring to this figure:

- The maximum elevation for 2021 (445.8 masl on March 22nd) is 0.20 metres below the maximum level for 2020.
- The 2021 year-end storage of 221,000 m^3 is 25,000 m^3 less than the available storage at the end of 2020.

FIGURE 1-5. EFFLUENT STORAGE RESERVOIR LEVELS - 2008 TO 2021



1.4 Reclaimed Water Quantities and Quality

1.4.1 Irrigation Plan (OC 1.8)

The Town of Oliver currently provides reclaimed water to the Fairview Mountain Golf Course, Alonso Property, Higgins Property, Fairview Park, Oliver Secondary School, Public Works, the Airstrip, and Cemetery for irrigation purposes. This area has expanded since that outlined in Site Plan A of the OC.

On December 13, 2018, the Town submitted an irrigation area expansion notification to the Ministry. An updated plan was submitted to the Ministry on February 25, 2020, to include expansion to the South Okanagan Secondary School irrigation system. These expansion areas were authorized by the Director on May 24, 2020, in accordance with Clause 1.8 of OC 13717 (see Appendix E)

1.4.2 Irrigation Volumes (OC 7.2.4.2 and 6.4)

Total reclaimed water usage is measured by a flow meter in the booster station located adjacent to the reclaimed water storage reservoir. Meters are also located at the Cemetery, Linear Park, the Airport, Public Works Yard, Alonso property, Southern Okanagan Secondary School, and Huggins Property for the purposes of measuring total reclaimed water use at each location.

The Town has been using reclaimed water to irrigate Fairview Park since 2016. In 2018, a water meter was installed. The water meter has not been operational since its installation, therefore specific data is not available. The consumption in Fairview Park has been combined with the consumption of the golf course as seen in Table 1-7 and Table 1-8.

TABLE 1-7. ANNUAL RECLAIMED WATER USE BY CUSTOMER

Location	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Fairview Mt. Golf Course & Fairview Park	297,875	248,521	316,368	346,520	322,048	311,899	281,186	329,226	418,594*	356,416
Airport	153,841	185,687	124,892	115,743	98,511	101,780	99,601	69,143		32,276
Cemetery	14,607	19,160	15,996	14,354	14,843	13,400	12,651	16,986	17,499	18,291
Gala Street Linear Park	6,622	8,051	8,749	7,647	8,360	1,030*	5,928	8,858	1,245	11,676
Public Works Yard	6,409	7,086	7,393	7,380	8,095	8,341	6,261	5,940	8,320	5,388
Alonso	7,015	6,715	3,893	3,851	2,364	2,498	1,794	9,240	6,012	0
Huggins	2,872	1,290	0	8,554	0	0	0	4,614	0	0
Southern Okanagan Secondary School	0	0	4,874	0	0	2	0	25,744	27,420	24,694
Infiltration Basin	0	0	0	0	0	23,322	38,391	16,858	11,117	2,256
Total Use	489,241	476,510	482,164	504,049	454,221	461,241	445,812	486,610	490,207	450,997

* The Airport flow meter was not working from May to September therefore the totals are grouped.

From flow data contained in Appendix D, reclaimed water quantities for each “user” is described as follows:

- **Lot 723, Plan 2361 - Fairview Mountain Golf Course and Fairview Park**

Total Usage	356,416 m^3
Crop Type	Turf and rough areas
Irrigated Area	57.6 ha
Irrigation Application Rate	0.62 m
Irrigation Period	April to October

- **Lot A, Plan 24065 - Oliver Cemetery**

Total Usage	18,291 m^3
Crop Type	Lawn, trees & shrubs
Irrigated Area	2.3 ha
Irrigation Application Rate	0.80 m
Irrigation Period	April to October

- **Gala Street Linear Park**

Total Usage	11,676 m^3
Crop Type	Lawn & trees
Irrigated Area	0.8 ha
Irrigation Application Rate	1.46 m
Irrigation Period	April and October

- **Lot A, Plan 38173 – Oliver Airport**

Total Usage	32,276 m^3
Crop Type	Forage Crops
Irrigated Area	12.6 ha
Irrigation Application Rate	0.26 m
Irrigation Period	June to September

Please note, records were only completed between June and September.

- **Lot A, Plan 33094 – Oliver Public Works Yard**

Total Usage	5,388 m^3
Crop Type	Lawn, landscaping, compost piles
Irrigated Area	0.6 ha
Irrigation Application Rate	N/A
Irrigation Period	April to October

The principal use of reclaimed water at the Public Works Yard is for composting operations, lawn care and landscaping. Because composting use is not separately metered, application rates for the lawn and landscaping areas cannot be calculated independently.

- **Lot A, Plan 37929 – Alonso (former Moir)**

Total Usage	0 m^3
Crop Type	Vineyard
Irrigated Area	approximately 1.0 ha
Irrigation Application Rate	0 m
Irrigation Period	April to October

- **Lot 3, Plan 5881 – Huggins**

Total Usage	0 m^3
Crop Type	Vineyard
Irrigated Area	approximately 3.7 ha
Irrigation Application Rate	0 m
Irrigation Period	April to October

- **South Okanagan Secondary School**

Total Usage	24,694 m^3
Crop Type	Lawn and Trees
Irrigated Area	approximately 5.4 ha
Irrigation Application Rate	0.46 m
Irrigation Period	April to October

Over the years of record, reclaimed water use on the Fairview Mountain Golf Course has varied significantly on a year-to-year basis. Table 1-8 has been prepared adding seasonal precipitation to reclaimed water usage to derive an annual total. A summary of seasonal precipitation from 1992 to 2021 can be found in Appendix F. The tabulation shows that the sum of seasonal precipitation and reclaimed water use for 2021 is 0.69 m applied. This is consistent with historical usage.

TABLE 1-8. ANNUAL TOTAL APPLICATION RATE AT THE FAIRVIEW MOUNTAIN GOLF COURSE

Year	Total Usage (m^3)	Application Rate (m)	Seasonal Precipitation (mm)	Total (m)
1995	413,000	0.92	124	1.04
1996	426,000	0.95	216	1.16
1997	345,000	0.77	324	1.09
1998	430,580	0.96	214	1.17
1999	342,424	0.76	162	0.92
2000	362,353	0.81	126	0.93
2001	376,353	0.84	178	1.01
2002	433,620	0.96	83	1.05
2003	401,022	0.89	94	0.98
2004	329,575	0.73	231	0.96
2005	373,292	0.83	131	0.96
2006	362,055	0.80	144	0.95
2007	414,225	0.92	88	1.01
2008	417,228	0.93	74	1.00
2009	358,375	0.80	161	0.96
2010	274,877	0.61	221	0.83
2011	290,036	0.64	151	0.80
2012	297,875	0.66	223	0.88
2013	248,521	0.55	180	0.73
2014	316,367	0.70	175	0.88
2015	346,520	0.77	136	0.91
2016	332,048	0.74	166	0.90
2017	311,899	0.69	133	0.83
2018	281,186	0.62	210	0.83
2019	329,226	0.73	127	0.86
2020	418,594	0.73	186	0.92
2021	356,416	0.62	67.9	0.69

1.4.3 Rapid Infiltration

The Town infiltrates reclaimed water to the rapid infiltration basins located south of the wastewater treatment facility (see Figure 1-1). These allow the Town to lower the water level of the storage reservoirs when needed. In 2021, the Town discharged 2,256 m^3 to the rapid infiltration basins.

The Town discharged minimal flows to the rapid infiltration basins as 2021 was a dry year. These flows were conveyed simply to flush the system, not to prevent reservoir overflow.

1.4.4 Hydraulic Balance (OC 7.2.4.1)

The annual overall system hydraulic balance (January 1st to December 31st) for the period 2009 to 2021 is summarized in Table 1-9.

TABLE 1-9. HYDRAULIC BALANCE DATA FOR 2012 TO 2021

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Volume in Storage on Jan. 1	167.0	200.0	223.0	197.0	211.0	284.0	223.0	214.0	247.0	275.0	289.0	245.0	246.0
(+) Total Influent	758.3	701.5	693.0	658.0	697.4	634.6	679.5	639.8	689.1	666.4	625.9	655.9	607.7
(-) Effluent Irrigation	520.5	519.8	470.9	489.2	476.5	482.2	504.0	454.2	437.9	407.4	469.8	479.1	448.7
(-) Rapid Infiltration	0	0	0	0	0	0	0	0	23.3	38.4	16.9	11.1	2.2
(-) Unaccounted Losses	206.8	159.7	248.1	154.8	147.9	213.5	184.0	152.6	199.9	206.6	183.3	16.6	181.7
Net Storage at Year-End (m^3)	198.0	222.0	197.1	211.0	284.0	223.0	214.0	247.0	275.0	289.0	245.0	246.0	221.0

*All volumes are shown in thousands of m^3

There is no freshwater contribution to the system. Unaccounted losses within the hydraulic balance include evaporation losses from the treatment lagoons and storage reservoir, seepage losses from both the treatment and storage cells, and flow meter inaccuracies. Unaccounted losses of 181,734 m^3 were calculated for 2021.

1.4.5 Irrigation Water Quality Data (OC 5.1 and 6.3)

Effluent quality for reclaimed water prior to irrigation is presented in Table 1-10. Section 5.1 of the OC requires that fecal coliforms do not exceed 200 MPN per 200 mL for agricultural, silvicultural, and low public use lands, or exceed 2.2 MPN per 100 mL for high use public land. As seen, results for the 2021 irrigation season are consistent with the OC requirements.

To provide background data to assist with future assessment studies, the Town of Oliver continued with an expanded monitoring programme to include phosphorus, nitrogen, chloride, and sodium through 2021. Data for these parameters are tabulated in Table 1-10.

TABLE 1-10. SUMMARY OF RECLAIMED WATER QUALITY DATA

	Date	Fecal Coliforms	Total Coliforms	Total P	Total N	Free CL Res
OC Limit		**#2.2 MPN/100 ml**	**n/a**	**n/a**	**n/a**	**n/a**
Unit		**MPN/100ml**	**MPN/100ml**	**mg/L**	**mg/L**	**mg/L**
April	12	<1.8	<1.8	4.76	24.1	0.29
May	7	<1	<1	3.75	24.5	0.34
June	14	<1	<1	3.11	22.3	0.49
July	13	<1	<1	2.65	15.6	0.55
August	10	<1	<1	2.82	12.3	0.42
September	14	<1	<1	5.34	12.6	0.34
October	20	<1	<1	6.17	17.9	0.23

* Note: The operational permit limit for fecal coliform in re-claimed water applied to agricultural land is 200 MPN per 100mL. Most of the re-claimed water in Oliver is applied on the Fairview Mountain Golf Course, which is classified as high public use, hence the lower limit of 2.2 MPN per 100 mL.

TABLE 1-11. HISTORICAL RECLAIMED WATER QUALITY DATA

Year	Seasonal Average Total Phosphorus (mg/L)	Seasonal Average Total Nitrogen (mg/L)	Seasonal Average Sodium (mg/L)
2000	2.92	12.5	
2001	2.46	14.1	
2002	2.75	13.4	
2003	1.2	6.8	114.3
2004	1.36	9.3	103.5
2005	2.87	11.9	94.4
2006	2.4	11.6	84.4
2007	3.91	11.9	84.2
2008	3.93	14.2	89.5
2009	3.27	12.1	93.7
2010	3.61	13.8	97.1
2011	3.88	16.9	111.2
2012	4.01	14.3	114.6
2013	4.77	19.4	112.6
2014	5.90	26.6	120.6
2015	4.04	20.3	112.3
2016	4.0	14.9	107.0
2017	4.5	16.9	108.0
2018	4.6	19.0	104.7
2019	4.6	18.6	112.5
2020	-	-	-
2021	4.1	18.5	96.9

As seen in Table 1-11, the average total phosphorus concentration in 2021 is consistent with values seen in previous years. The total nitrogen levels have decreased compared to 2014.

In 2021, sodium concentrations were consistent with the sampling between 2003 to 2019. Concerns regarding elevated sodium concentrations in the reclaimed water have been expressed by the Fairview Mountain Golf Course. Average seasonal sodium concentrations for the period 2003 to 2021 are illustrated graphically in Figure 1-6. As seen, concentrations were lowest between 2005 and 2010.

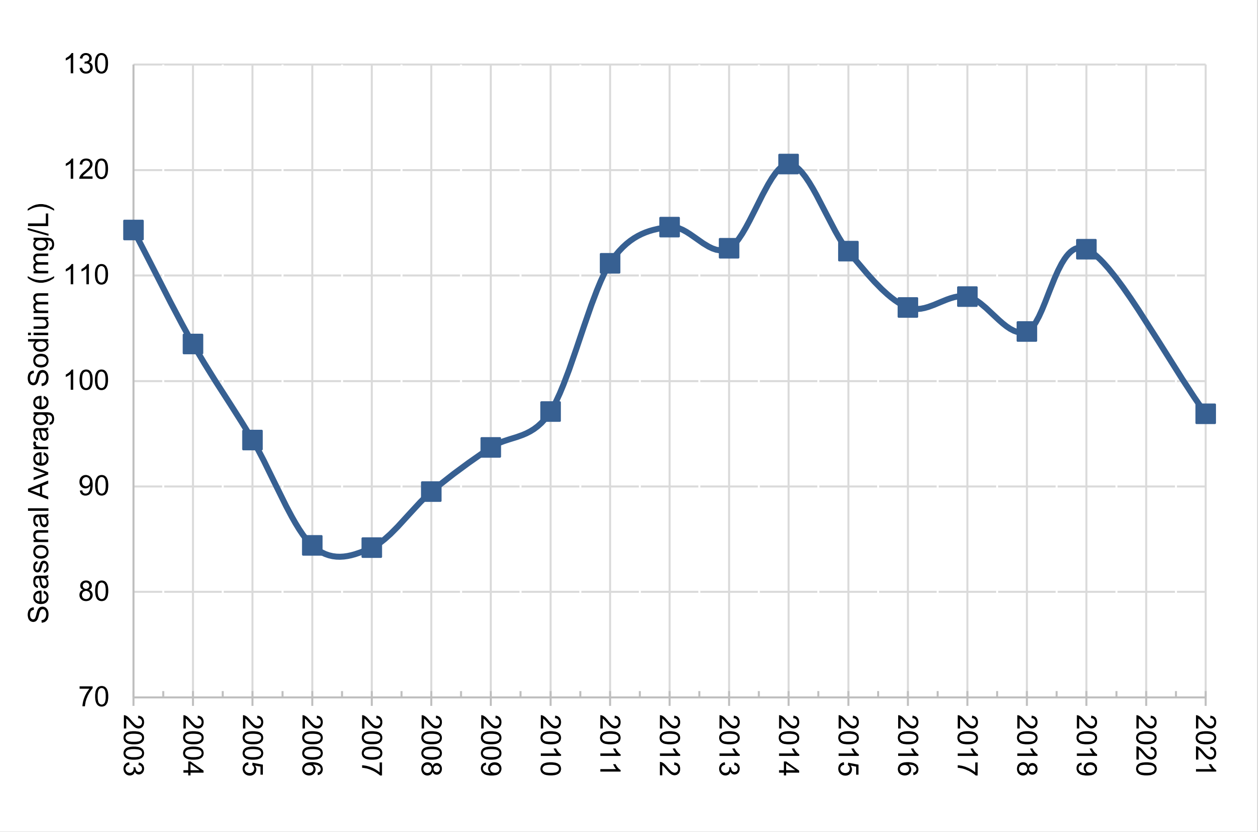


Figure 1-6. Average Seasonal Sodium Concentrations from 2003 to 2021

1.5 Summary of 2021 Operational Data

Operation of the Town of Oliver's wastewater collection, treatment, and reclaimed water system for 2021 is summarized as follows:

- Total influent quantities were 607,731 m^3, a decrease of 48,112 m^3, or 7.3% as compared to 2020. The 2021 annual influent quantity is comparable to previous years.
- Wastewater effluent quality for BOD_5 in the Town's aerated lagoons had no exceedances of the OC limit of 45mg/L. TSS values were also well under the OC limit of 60 mg/L.
- The maximum water level in the storage reservoir was 455.8 masl which equates to a volume of 360,000 m^3.
- Reclaimed water quality prior to irrigation use complied with the OC requirements.

2.0 Supplemental Information

2.1 Facility Classification and Operator Certification (OC 3.2 and 3.3)

The Town of Oliver Wastewater Treatment Facility (Facility No. 317) is classified as a Municipal Wastewater Treatment II (MWWT-II) under the Environmental Operations Certification Program.

In compliance with OC Section 3.3 operator certifications are summarized as follows:

TABLE 2-12. OPERATOR CERTIFICATIONS

Operator	ECOP Certification
Darren Bjornson	Wastewater Collection Level I
Hector Murillo	Wastewater Collection Level I
	Wastewater Treatment Level I
Keith Postnikoff	Wastewater Collection Level II
Ryan Seiling	Wastewater Collection Level I
	Wastewater Treatment Level I
Martin Schori	Wastewater Collection Level II
	Wastewater Treatment Level II
Adrian Zandvliet	Wastewater Collection Level I
	Wastewater Treatment Level I

2.2 Capital Improvements

Capital improvements and projects completed in 2021 included:

- Installation and Commissioning of 40 Hp Blower with VFD for aerated Cell No. 2 and 3.
- Phase 2 mainline sewer pipe upgrades for Station Street.
- Electrical Upgrade and improvements for MacPherson lift Station.
- Electrical Upgrade and improvements for Rockcliffe lift Station.
- Development of Reclaimed Water Monitoring Wells.
- Sawmill Road extension design Walnut Pl. to Oak Pl.
- Okanagan Street at Similkameen Ave. design.
- Rotary Beach pump replacement.

Capital Projects for 2022 Include:

- Cleaning and Development of MW-6 as per WWAL Report Recommendations.
- Okanagan Street at Similkameen Improvements.
- Rotary Beach Discharge Connection upgrades.

2.3 Influent Waste Bylaw (OC 3.6 and 7.2.4.4)

Sanitary Sewer System Use Bylaw No. 547 established regulations respecting the type, volume, and characteristics of wastewater discharged to the sanitary sewer system.

In January 2002, the Town of Oliver received an application from Vincor requesting approval to connect its winery located on the Osoyoos Indian Reserve, north of the Town boundaries, to the Town's sewerage system. This application relates to both process water and normal domestic sewage and was approved by the town.

Vincor was connected to the Town's sewerage system from October 2002 to July 01, 2015. During this period, Vincor's wastewater was sampled by the town at least twice per month to confirm compliance with the terms and conditions of the connection agreement and for invoicing purposes. Since 2015, there has been no influent received from Vincor.

2.3.1 Infiltration, Inflow, and Cross Connection Reduction (OC 7.2.4.3 and 7.2.4.4)

The Town of Oliver has an ongoing video camera inspection program for the sewer collections system. In addition, they have prepared a 2019 Sanitary Capital Plan. Within the report, SCADA data is analyzed for possible Inflow and Infiltration (I&I) from 2015 to present. This I&I analysis will allow for correlations between peak rain events, surface water diversions, and failures within the pipe infrastructure.

The Town regulates provisions to identify, eliminate, and prevent cross contamination with non-potable water sources through Bylaw No. 1043.

2.4 Sludge Management Plan (OC 3.8 and 7.2.4.6)

The Town's Sludge Management Plan was updated in February 2019 and is included in Appendix G. The Plan provides an overview of the system design, sludge characterization, sludge sampling and monitoring, sludge removal, and system recommendations.

Consistent with historical practices, the Town completed sludge depth and analytical sampling in Aerated Lagoon Cell No. 2 in 2021. The analytical data is provided in Appendix G.

2.5 Groundwater Monitoring Plan

In compliance with Section 6.8 of the OC, the Town of Oliver retained the services of Golder Associates to prepare a groundwater monitoring plan in 1997. A hydrogeological review of the Town's reclaimed wastewater irrigation groundwater monitoring program was completed by Western Water Associates Ltd. (WWAL) in January 2021.

A summary of all monitoring wells, their location, and name are provided in Table 2-13 below. Monitoring wells that were undertaken as 2021 capital projects have their completion date shown.

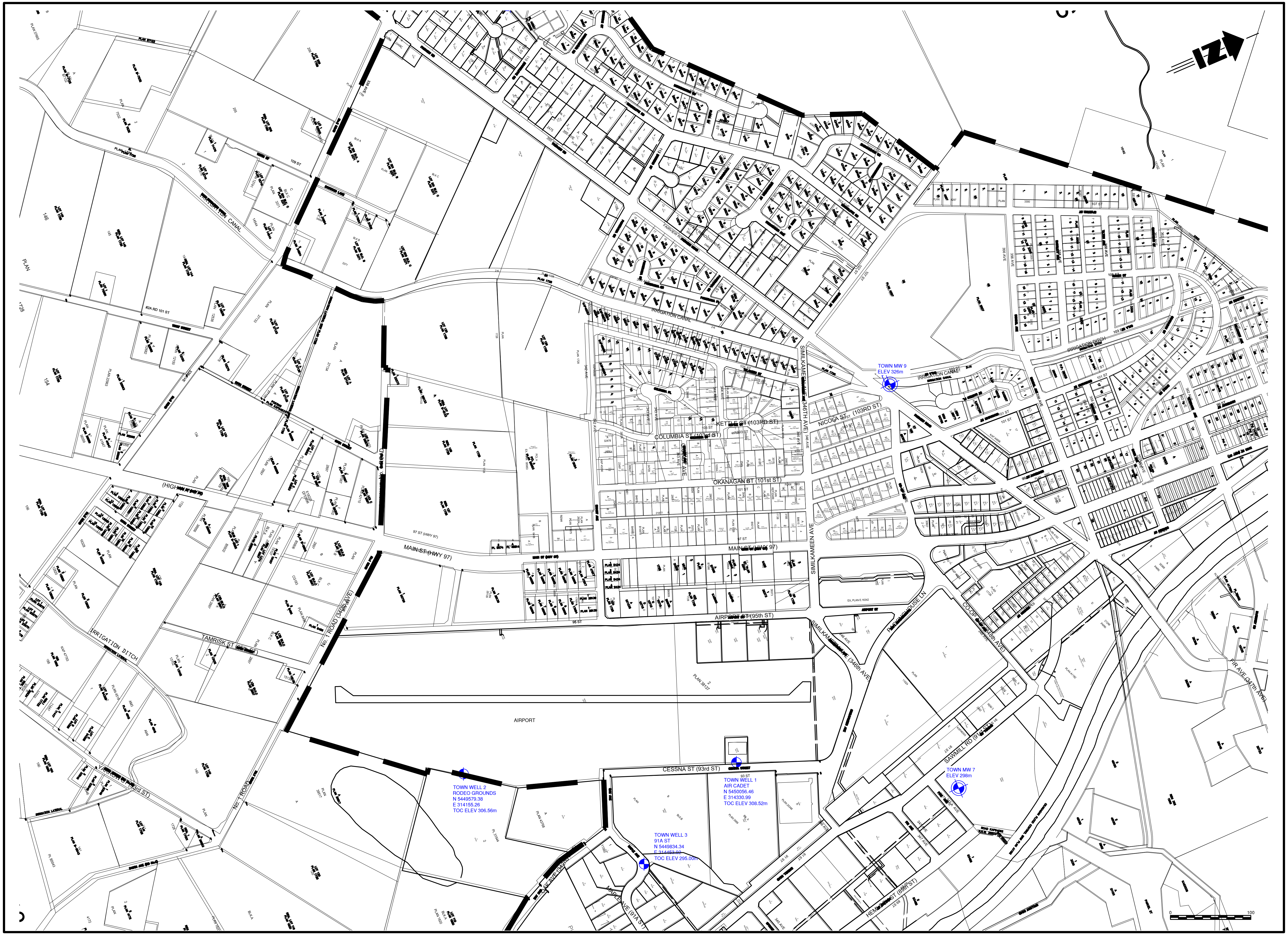
TABLE 2-13. SUMMARY OF MONITORING WELLS

Well Identification Number	Location/"Nick-name"	Completion Date
Well #1	"Air Cadet"	
Well #2	"Rodeo Grounds"	
Well #3	"91A Street"	
MW-1	Near Higgins/Alonso Property	
MW-2	Near Higgins/Alonso Property	
MW-3	Near Higgins/Alonso Property	
MW-4	"Sand Pit"	
MW-5	125th Street	
MW-6	Fairview Golf Course	
~~MW-7~~	~~Road No. 5 (abandoned)~~	
MW-7	South Side of Town Public Works Yard	4-May-21
MW-8	South end of Oliver Cemetery	5-May-21
MW-9	Gala Street Linear Park	6-May-21
MW-10	Road No. 5	7-May-21

Please note that the nomenclature of the wells has changed slightly due to the commissioning and decommissioning of monitoring wells in the area.

In May of 2021, WWAL retained Mud Bay Drilling to address the recommendations of the 2021 hydrogeological review. Four new monitoring wells were installed with three providing coverage for new areas receiving reclaimed wastewater for irrigation. The final well was installed as a replacement well for Town MW 7 located on Road No. 5. During well installation WWAL attempted to ‘bail-out’ and re-develop MW-6. Approximately 0.4 m of sediment was removed, and a water quality sample was obtained. Historically this well had been assumed dry. The full report can be seen in Appendix H.

Groundwater monitoring wells located throughout the Town are shown on Figure 2-7 and Figure 2-8.



ISSUES / REVISIONS

No.	DATE	DESCRIPTION	BY	APP'D

CONSULTANT SEAL

TRUE CONSULTING

201 - 2079 Falcon Road ■ Kamloops BC ■ V2C 4J2
tel 250.828.0881 ■ fax 250.828.0717
info@TRUE.bc.ca

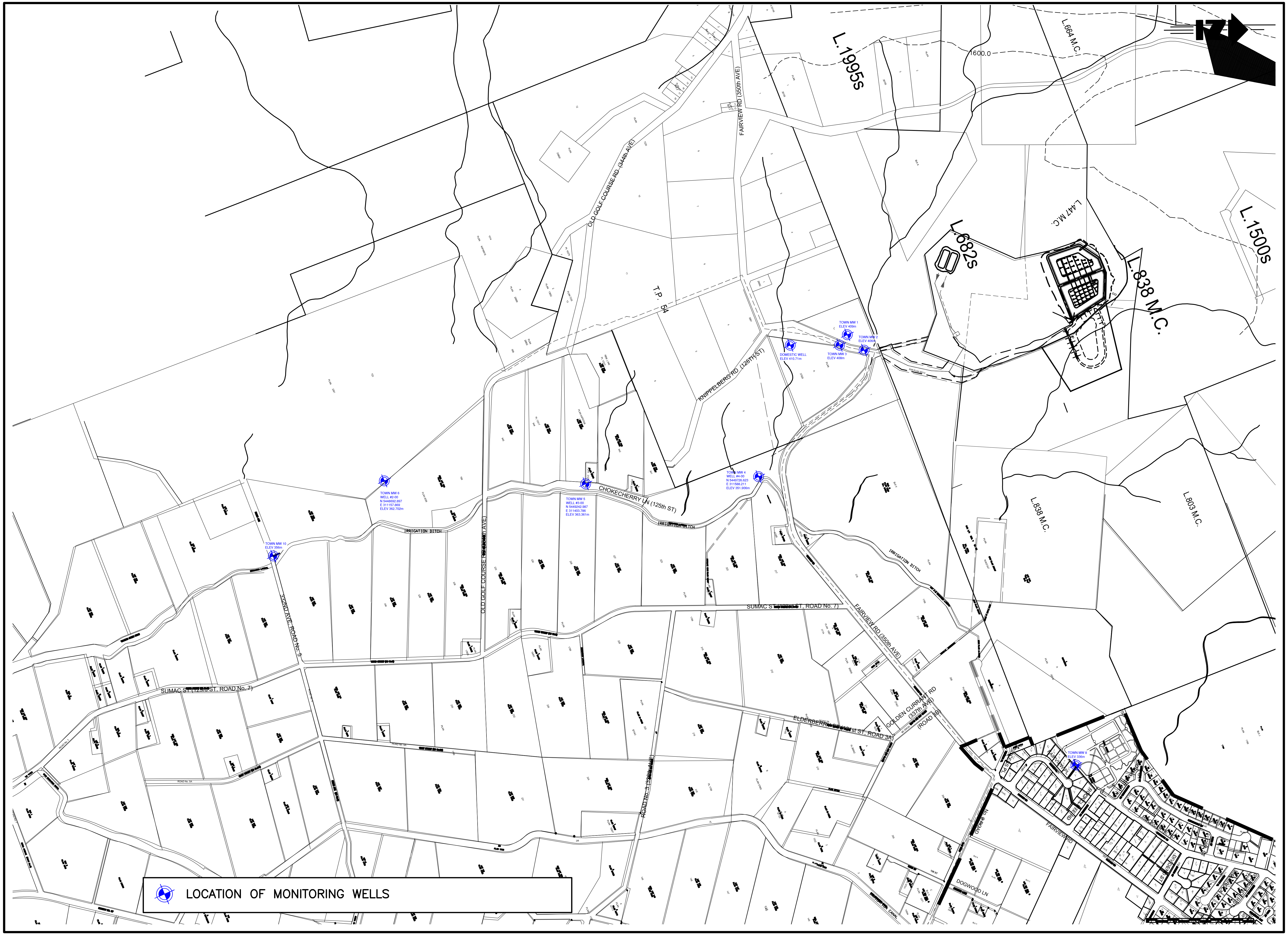
Town of Oliver
CANADA'S WINE CAPITAL

SANITARY SEWER ANNUAL REPORT

GROUNDWATER MONITORING WELLS NEAR AIRPORT

SCALE N.T.S (11x17)
DESIGN BY TRU
DRAWN BY ED
DATE JANUARY 2022
PROJECT REFERENCE No. 306-088-009
DRAWING No. FIG 2-7
SHEET 1 OF 1
ISSUE/REV.

FILE: r:\clients\300-399\306\306-088-009\03 drawings\cad\02 design drawings\306-088-009 report figures ed021622



No.	DATE	DESCRIPTION	BY	APP'D

ISSUES / REVISIONS

CONSULTANT SEAL

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Town of Oliver
CANADA'S WINE CAPITAL

SANITARY SEWER ANNUAL REPORT

GROUNDWATER MONITORING WELLS NEAR FAIRVIEW

SCALE N.T.S. (11x17)
DESIGN BY TRU
DRAWN BY ED
DATE JANUARY 2022
PROJECT REFERENCE No. 306-088-009
DRAWING No. **FIG 2-8**
SHEET 1 OF 1
ISSUE/REV.

FILE: r:\clients\300-399\306\306-088-009\03 drawings\cad\02 design drawings\306-088-009 report figures ed021622

2.5.1 Airport Monitoring Wells No. 1 to 3

There are a total of three monitoring wells at the airport site (Well #1, Well #2, Well #3). These wells are located down gradient from the reclaimed water use area. In 2011, the Town renamed streets. For clarity, historic street names are referenced in parenthesis in Figure 2-7 and Figure 2-8. Groundwater level data for these wells is summarized in Table 2-14.

As seen, the average groundwater table elevation in Wells 2 and 3 were comparable to previous years. The water levels in Well 1 were on average higher than previous years.

The water quality in these wells was generally within the expected values for the parameters measured. The ammonia values in Well 1 and 3 were slightly higher than other years. The hardness in Well 3 was also above previous years, however not as high as recorded in the years near 2010.

TABLE 2-14. HISTORICAL SUMMARY OF GROUNDWATER DEPTHS FOR AIRPORT MONITORING WELLS

Monitoring Well	Year	Minimum Level (mbtoc)	Maximum Level (mbtoc)	Average Level* (mbtoc)	Level Range (m)
Well #1 Air Cadet	2010	10.31	11.03	10.76	0.72
	2011	10.33	10.80	10.55	0.47
	2012	9.84	10.78	10.50	0.94
	2013	9.78	10.44	10.11	0.66
	2014	9.98	10.58	10.33	0.60
	2015	10.01	10.51	10.28	0.50
	2016	10.21	10.5	10.36	0.29
	2017	9.9	10.59	10.32	0.69
	2018	9.65	10.29	10.03	0.64
	2019	9.72	10.62	10.26	0.9
	2020	9.62	10.51	10.22	0.89
	2021	9.24	10.4	9.8	1.16
Well #2 Rodeo Grounds	2010	5.69	6.35	6.04	0.66
	2011	5.84	6.34	6.09	0.50
	2012	5.84	6.54	6.20	0.70
	2013	5.62	6.24	5.91	0.62
	2014	5.84	6.27	6.08	0.43
	2015	5.69	6.66	6.08	0.97
	2016	5.66	5.97	5.82	0.31
	2017	5.98	6.3	6.16	0.32
	2018	5.81	6.24	5.99	0.43
	2019	6.18	6.96	6.61	0.78
	2020	7.07	7.46	7.27	0.39
	2021	7.48	7.78	7.62	0.3
Well #3 91A St.	2010	1.45	1.64	1.54	0.19
	2011	1.31	1.55	1.46	0.24
	2012	1.38	1.54	1.46	0.16
	2013	1.20	1.39	1.27	0.19
	2014	1.11	1.65	1.37	0.54
	2015	1.21	1.66	1.41	0.45
	2016	1.13	1.43	1.28	0.30
	2017	1.06	1.38	1.23	0.32
	2018	0.87	1.51	1.2	0.64
	2019	1.24	1.78	1.45	0.54
	2020	1.18	1.72	1.44	0.54
	2021	1.2	2.1	1.7	0.9

Water quality analysis of these wells can be seen in Table 2-15.

Table 2-15. Historical Water Quality Data for Airport Monitoring Wells

Monitoring Well	Sample Date	Chloride	Ammonia	Nitrate + Nitrite	Total Hardness	Sodium
Well #1 Air Cadet	19-May-2010	13.5	0.06	12.7		
	7-Sep-2010	13.8	< 0.02	12	383	22.1
	28-Apr-2011	17.5	0.15	12.1	217	9.33
	28-Sep-2011	12.7	0.12	7.87	400	18.4
	24-Apr-2012	16.4	0.04	7.59	464	20.0
	16-Oct-2012		0.034	9.7	481	19.8
	9-Apr-2013		0.034	10.1	384	18.5
	9-Sep-2013		< 0.020	20.2	383	17
	16-Apr-2014		0.027	21.6	542	18.1
	4-Sep-2014	19.8	< 0.020	23.9	402	19.5
	14-Apr-2015	20.7	0.102	24.4	485	20.5
	16-Sep-2015	15.9	0.079	20.5	590	23.5
	-	-	-	-	-	-
	13-Sep-2016	13.7	0.032	15	386	19.1
	10-Apr-2017	14.2	0.033	12	388	19.5
	11-Sep-2017	10.4	<0.020	6.97	392	18
	14-May-2018	11.9	0.025	6.75	363	19.1
	10-Sep-2018	9.92	<0.020	7.97	344	16.8
	28-Oct-2019	9.77	0.023	12.6	388	19.6
	6-Apr-2020	10.3	<0.050	13	331	18.8
	1-Sep-2020	9.31	<0.050	11.1	378	19.4
	22-Apr-2021	8.83	<0.050	11	316	17.1
	13-Sep-2021	12.1	0.094	9.67	303	17.6
Well #2 Rodeo Grounds	19-May-2010	9.69	0.04	0.08		
	7-Sep-2010	8.93	< 0.02	0.26	686	22.3
	28-Apr-2011	11.9	0.05	0.05	531	9.13
	28-Sep-2011	9.33	0.02	2.18	491	16.1
	24-Apr-2012	10.6	0.01	0.749	572	17.4
	16-Oct-2012		0.021	0.263	661	17.8
	9-Apr-2013		0.047	0.121	384	18.4
	9-Sep-2013		0.023	0.115	889	18
	16-Apr-2014		0.024	0.123	392	15.9
	4-Sep-2014	8.47	0.02	0.584	370	15.9
	14-Apr-2015	9.05	0.094	0.865	494	18.5
	16-Sep-2015	6.56	0.037	0.3	1120	31.6
	-	-	-	-	-	-
	13-Sep-2016	6.54	0.032	0.628	1110	19.2
	10-Apr-2017	7.6	0.072	0.343	914	20.4
	11-Sep-2017	6.1	0.02	0.124	959	17.1
	14-May-2018	7.2	0.1	0.122	2550	20.3

	10-Sep-2018	7.07	0.037	0.138	2090	18.9
	28-Oct-2019	6.55	0.103	0.385	2440	20.8
	6-Apr-2020	6.44	0.101	0.212	394	17.2
	1-Sep-2020	6.86	0.081	0.173	1540	18.9
	22-Apr-2021	6.78	0.102	0.312	1410	17.5
	21-Sep-2021	9.24	0.081	0.045	1740	20.4
Well #3 91A St.	19-May-2010	12.2	0.06	< 0.02		
	7-Sep-2010	15.1	0.35	0.35	2300	37.7
	28-Apr-2011	23.1	0.04	0.44	633	15.3
	28-Sep-2011	18.5	0.1	0.32	1160	36.8
	24-Apr-2012	18.4	0.09	0.270	1470	36.9
	16-Oct-2012		0.04	0.033	924	31.6
	9-Apr-2013		0.049	0.074	834	23.9
	9-Sep-2013		0.07	0.101	1430	24.6
	16-Apr-2014		0.028	0.058	399	16.9
	4-Sep-2014	125	0.023	0.032	438	21.8
	14-Apr-2015	8.99	0.086	0.106	631	18.9
	16-Sep-2015	7.59	0.047	0.035	496	18.5
	-	-	-	-	-	-
	13-Sep-2016	8.01	0.032	0.214	389	17.2
	10-Apr-2017	8.07	0.059	0.334	366	16.7
	11-Sep-2017	7.64	<0.020	0.042	346	15.2
	14-May-2018	8.31	0.024	0.0507	381	15.4
	10-Sep-2018	8.05	0.031	0.739	355	14.4
	28-Oct-2019	7.87	0.121	0.349	360	16
	6-Apr-2020	8.03	0.095	0.315	371	16.3
	1-Sep-2020	8.47	<0.050	0.0929	443	16.5
	22-Apr-2021	8.68	<0.050	0.25	356	15.2
	21-Sep-2021	7.77	0.15	0.307	1120	15.1

2.5.2 Fairview Monitoring Wells

The Town of Oliver has seven groundwater monitoring wells downgradient of the Fairview area. Refer to Figure 2-7 and Figure 2-8 for their locations. A summary of sampling deficiencies is as follows:

- MW-1, MW-2, and MW-3 were not included in the 2021 data collection.
- The newly drilled monitoring well at the south end of the Cemetery (MW-8) was dry during the sampling event, therefore there is no water quality data available for this year.
- MW-6, located near the Fairview Golf Course, was sampled for the first time in many years, as historically it has been deemed dry

Historical data for groundwater level monitoring is presented in Table 2-16. The depths of all wells were comparable to previous years.

Historical data for groundwater quality analysis is presented in Table 2-17. The water quality of the wells was comparable to previous years, with the exception of the hardness in MW-4 during the September sampling event reaching a peak as compared to the past 5 years.

TABLE 2-16. HISTORICAL SUMMARY OF GROUNDWATER DEPTHS FOR FAIRVIEW MONITORING WELLS

Monitoring Well	Year	Minimum Level (mbtoc)	Maximum Level (mbtoc)	Average Level* (mbtoc)	Level Range (m)
Monitoring Well #4 Sand Pit	2010	8.28	10.61	9.32	2.33
	2011	8.36	11.24	9.74	2.88
	2012	8.48	10.85	9.79	2.37
	2013	8.21	10.64	8.89	2.43
	2014	7.43	9.62	8.57	2.19
	2015	8.08	10.20	8.92	2.12
	2016	7.79	8.98	8.38	1.19
	2017	6.24	8.33	7.71	2.09
	2018	1.99	8.13	6.75	6.14
	2019	7.81	9.4	8.47	1.59
	2020	7.8	10.43	9.03	2.63
	2021	8.35	10.75	9.3	2.4
Monitoring Well #5 125th Street	2010	8.26	11.97	10.20	3.71
	2011	5.38	9.69	8.12	4.31
	2012	6.41	9.54	8.48	3.13
	2013	5.59	9.23	7.95	3.64
	2014	8.13	9.77	9.04	1.64
	2015	-	-	-	-
	2016	4.57	9.90	7.70	5.33
	2017	4.56	10.57	7.93	6.01
	2018	5.28	9.09	7.78	3.81
	2019	7.89	9.66	9.01	1.77
	2020	7.36	10.1	9	2.74
	2021	7.1	9.6	8.8	2.5
Monitoring Well #6 Fairview Golf Course	2003-2019	*13.92 (Dry)*			
	2021	12.38	12.75	12.58	0.37
Monitoring Well #7 Public Works Yard	2021	2.76	3.01	2.91	0.25
Monitoring Well #8 Cemetery	2021	21.50	21.1 (dry)	21.2	0.40
Monitoring Well #9 Gala Linear Park	2021	25.80	27.70	26.4	1.90
Monitoring Well #10 Road No.5	2021	24.40	30.50	27.0	6.10

TABLE 2-17. HISTORICAL WATER QUALITY DATA FOR FAIRVIEW MONITORING WELLS

Monitoring Well	Sample Date	Chloride	Ammonia	Nitrate + Nitrite	Total Hardness	Sodium
Monitoring Well #4 Sand Pit	19-May-2010	137	0.02	2.43		
	7-Sep-2010	135	0.03	1.02	1310	128
	28-Apr-2011	135	0.08	2.95	1020	108
	24-Apr-2012	130	0.04	2.39	1110	101
	16-Oct-2012		0.034	0.691	1420	119
	9-Apr-2013		0.091	1.78	1070	118
	9-Sep-2013		0.156	2.06	1350	146
	16-Apr-2014		0.073	3.02	1050	115
	4-Sep-2014	125		1.68		127
	14-Apr-2015	141		3.56		120
	16-Sep-2015	135	0.023	1.53	1440	127
	-	-	-	-	-	-
	13-Sep-2016	129	0.021	1.63	1700	19.2
	10-Apr-2017	121	0.084	10.2	820	108
	11-Sep-2017	110	<0.020	3.05	387	11.5
	14-May-2018	111	0.035	4.12	725	100
	10-Sep-2018	96	0.043	2.99	838	87.1
	28-Oct-2019	103	0.222	16.9	704	93
	6-Apr-2020	119	0.091	8.03	659	92.2
	1-Sep-2020	101	0.072	1.11	1120	86.9
	22-Apr-2021	125	<0.050	4.19	782	81.7
	21-Sep-2021	101	0.073	0.967	2020	97.1
Monitoring Well #5 125th Street	19-May-2010	53.9	0.03	3.03		
	7-Sep-2010	37.3	0.03	1.03	467	29.2
	28-Apr-2011	26.3	0.04	2.1	639	41
	28-Sep-2011	38.5	0.35	2.75	423	48.7
	24-Apr-2012	48.8	1.9	3.19	460	22.4
	16-Oct-2012		0.025	2.94	446	19.3
	9-Apr-2013		0.036	1.11	381	15.9
	9-Sep-2013		0.071	0.652	398	12.4
	16-Apr-2014		0.022	0.577	465	13.1
	4-Sep-2014	14.7		0.683		14
	14-Apr-2015	16.7		1.31		14.7
	16-Sep-2015	27.7	< 0.020	0.794	456	31.6
	-	-	-	-	-	-
	13-Sep-2016	23.9	0.022	1.11	960	20.4
	10-Apr-2017	17	0.052	1.21	481	14.1

	11-Sep-2017	16.5	0.089	1.11	917	88.4
	14-May-2018	16	0.058	0.569	400	12.8
	10-Sep-2018	15.6	0.066	1.59	348	10.3
	28-Oct-2019	16.1	0.774	2.18	415	13.6
	6-Apr-2020	16.7	<0.050	1.6	409	14
	1-Sep-2020	17.7	<0.050	2.28	419	17.7
	22-Apr-2021	17.5	<0.050	1.69	386	16.5
	21-Sep-2021	16.4	0.073	1.6	374	15.1
Monitoring Well #6 Fairview Golf Course	21-Sep-2021	95.6	<0.050	2.33	396	96.9
Monitoring Well #7 Public Works Yard	21-Sep-2021	45.5	<0.050	2.28	311	35.7
Monitoring Well #9 Gala Linear Park	21-Sep-2021	165	<0.050	5.89	317	67.1
Monitoring Well #10 Road No. 5	21-Sep-2021	97.7	<0.050	3.21	493	18.4

Groundwater levels and water quality were generally consistent with previous years. To improve the groundwater monitoring programme, the following recommendations are made by TRUE Consulting and Western Water Associated Ltd.

- Finish cleaning out MW-6 and include it in the monthly groundwater level and semi-annual water quality sampling programme.
- Include MW-1, MW-2, and MW-3 in the monthly groundwater level and semi-annual water quality sampling.
- Complete meter readings at Fairview Park.
- Obtain monthly groundwater quality data at MW-4 for 1 year.
- Capture MW-4 transducer readings.
- Investigate possible point source of Nitrate at Well #1 (Air Cadet).

Additional commentary and analysis of 2021 hydrogeological data will be provided WWA by issuance of an independent submittal for annual reporting purposes.

2.6 Soils Assessment (OC 5.4, 5.5, and 6.9)

In accordance with Section 6.9 of the OC, a soils assessment of the irrigated areas was completed in June 2020 and is summarized herein. Soils were identified using a detailed soil survey of the central and southern Okanagan and Lower Similkameen Valley. This information was published in the *MOE Technical Report 18 Soils of the Okanagan and Similkameen Valleys, 1986.*

The conclusions found in the 2020 report prepared by Hugh Hamilton Associates are as follows.

- The schoolyard, cemetery, and park sites are all suitable for irrigation with reclaimed wastewater subject to the regulatory water quality requirements for reclaimed water.
- The airport lands east of the existing irrigated area will require special management;
  - This area has a limited irrigation season (June 15 to September 10).
  - Apply approximately ½ the rate outlined in the BC Agriculture Water Calculator.
  - Once vegetative cover improves and a layer of organic litter develops, the irrigation rates may be re-evaluated.
- Overall, the irrigation areas are capable of accepting reclaimed water for irrigation purposes.

For full report details please refer to Appendix K.

A summary of the soil classifications, characteristics, physical properties, and drainage for the reclaimed water irrigation areas is presented in Table 2-18. Detailed individual profile descriptions and an overview map of the soil parent materials is provided in Appendix K. As seen, all irrigated areas are well to rapidly drained except for the Public Works Yard. At this location, reclaimed water is used for compost operations and landscape irrigation, therefore it does not present an issue with respect to surface runoff or surfacing of reclaimed water.

TABLE 2-18. SOILS OVERVIEW - RECLAIMED WATER IRRIGATION AREAS

Irrigation Location	Soil Name	Soil Texture	Drainage	Coarse Fragment	Parent Material
Cemetery[1,2]	Ponderosa	Sandy Loam	Well-drained	65	FLUV
Oliver Secondary School[1,2]	Rutland	Sandy Loam	Rapidly-drained	63	GLFL
High School Park[1]	Rutland	Sandy Loam	Rapidly-drained	63	GLFL
Public Works Yard[1,2]	Cawston	Silt Loam	Rapidly-drained	15	FLUV
Airport[1]	Rutland	Sandy Loam	Rapidly-drained	63	GLFL
Oliver Community Park[3]	Kinney	Sandy Loam	Imperfect	-	FLUV
Alonso	Approved in Operational Certificate PE-13717				
Huggins	Approved in Operational Certificate PE-13717				
Fairview Mountain Golf Course	Approved in Operational Certificate PE-13717				

[1] Approved in Principle by the Ministry in August 2002.

[2] Previously irrigated with freshwater, simple replacement.

[3] Area considered for future reclaimed water irrigation

2.6.1 Soil Descriptions (OC 6.9)

Soil descriptions for each soil type are as follows:

Ponderosa Soils

Ponderosa soils only occur in the vicinity of Oliver. They have developed in a gravelly, moderately coarse textured fluvial veneer between 10 to 50 cm thick, overlying gravelly coarse textured fluvial fan deposits. Surface and subsurface textured are gravelly or very gravelly sandy loam or gravelly loam. Subsoils are very gravelly loamy sand. The soil drainage class is well to rapid.

Rutland Soils

Rutland soils occupy significant areas throughout the Okanagan Valley. The parent material is a moderately coarse textured veneer between 10 and 25cm thick, which overlies gravelly and stony, very coarse textured glaciofluvial deposits. Surface soil textures are dominantly sandy loam or loamy sand. Subsurface materials are gravelly sand or gravelly loamy sand. The soil drainage class is rapid.

Cawston Soils

Cawston soils occur on the Okanagan River floodplain. They have developed in medium textured recent fluvial deposits generally between 50 to 100 cm thick, overlying moderately coarse textured materials. Surface and subsurface textures are silt loam or loam. Subsoil textures are gravelly sandy loam or gravelly loamy sand. They are moderately pervious, have a high water holding capacity and slow surface runoff. The soil drainage class is dominantly poor, ranging to imperfect.

Kinney Soils

Kinney soils occur on the Okanagan River floodplain between Penticton and Osoyoos Lake. They have developed in a loamy fluvial veneer, usually between 30 and 80 cm thick, that overlies sandy floodplain deposits. Surface and subsurface textures are loam or sandy loam with a subsoil that is loamy sand or sand, occasionally containing thin silty lenses. They are imperfectly drained, moderately pervious and have moderate to low water holding capacity.

2.6.2 Surface Runoff (OC 5.4)

To date, the Town has not observed surface water runoff generated from reclaimed water irrigation use. As outlined in the soil profiles, the parent material at each irrigation area is generally well-drained. Runoff has also not been an operational issue due to the arid climate.

2.6.3 Surfacing Reclaimed Wastewater (OC 5.5)

The irrigation system is designed and managed to ensure that there is no surfacing of irrigation tail water downslope of the point of irrigation. A hydrogeological study of the rapid infiltration basin was completed by Golder Associated in 1998. The system capacity of 355 m^3/day was derived on the basis of the natural discharge capacity of the subsurface soils such that surfacing of effluent will not occur within 150m of the site.

APPENDIX A

Operational Certificate for PE 12717

Province of British Columbia

MINISTRY OF ENVIRONMENT, LANDS AND PARKS

BC Environment

Environmental Protection
#201-3547 Skaha Lake Rd.
Penticton, British Columbia
V2A 7K2
Telephone: (604) 490-8200
Fax: (604) 492-1314

Date: December 14, 1995

File: 76750-40/PE-13717 (01)

REGISTERED MAIL

The Corporation of the Town of Oliver
PO Box 638
Oliver BC VOH 1TO

Attention: Tom Szalay, Administrator

Enclosed is a copy of the Operational Certificate No. PE-13717 issued under the provisions of the Waste Management Act. This Operational Certificate supersedes Permit PE-00102 which is cancelled in accordance with Section 16(13) of the Waste Management Act. Your attention is respectfully directed to the terms and conditions outlined in the Operational Certificate. An annual Permit fee will be determined according to the Waste Management Permit Fee Regulation.

This Operational Certificate does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority shall rest with the Operational Certificate holder.

This Operational Certificate is issued pursuant to the provisions of the Waste Management Act to ensure compliance with Section 34(3) of that statute, which makes it an offence to discharge waste without proper authorization. It remains the responsibility of the Operational Certificate holder to ensure that all activities conducted under this authorization comply with any other applicable legislation which may be in force from time to time.

The administration of this Operational Certificate will be carried out by staff from our Regional Office located in Penticton, (telephone 490-8200). Plans, data and reports pertinent to the Operational Certificate are to be submitted to the Environmental Protection office, Suite 201, 3547 Skaha Lake Road, Penticton, British Columbia, V2A 7K2. - 30th Street, Vernon, British Columbia, V1T 9G3.

This decision may be appealed by any person(s) who considers themselves aggrieved by this decision, in accordance with Part 5 of the Waste Management Act. Written notice of intent to appeal must be received by the Regional Waste Manager within twenty-one (21) days of the date of notification of this decision.

Yours truly,

T.R. Forty, P.Eng.
Assistant Regional Waste Manager
Okanagan Sub-Region

Enclosure

PROVINCE OF
BRITISH COLUMBIA

Environmental Protection
#201 - 3547 Skaha Lake Road
Penticton
British Columbia, V2A 7K2
Telephone: (604) 490-8200

MINISTRY OF ENVIRONMENT,
LANDS AND PARKS

OPERATIONAL CERTIFICATE

PE 13717

Under the Provisions of the Waste Management Act

TOWN OF OLIVER
P.O. Box 638
Oliver, British Columbia
V0E 1T0

is authorized to discharge reclaimed wastewater to the ground by irrigation, from a municipal sewage collection and aerated lagoon sewage treatment facility located at Oliver, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the Waste Management Act and may result in prosecution.

1. SPECIFIC AUTHORIZED DISCHARGES AND RELATED REQUIREMENTS

The discharge of effluent to which this sub-section is applicable is from a municipal sewage treatment facility located approximately as shown on the attached Site Plan A and Site Plan B. The reference number (S.E.A.M. site number) for this discharge is E222150.

1.1 Discharge Quantity

1.1.1 The maximum authorized rate of effluent to be discharged from the aerated lagoon sewage treatment system to the reclaimed wastewater storage reservoir, averaged on a monthly basis:

1995 - 1950 m^3 per day
1996 - 2000 m^3 per day
1997 - 2050 m^3 per day
1998 - 2100 m^3 per day
1999 - 2150 m^3 per day
2000 - 2200 m^3 per day

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1.1.2 There is no maximum authorized rate of reclaimed wastewater to be discharged from the storage reservoir for beneficial use as irrigation water.

1.2 Discharge Quality

1.2.1 It is recommended that to ensure reclaimed wastewater is adequately renovated prior to irrigation, the characteristics of the effluent discharged from the aerated lagoon treatment system to the reclaimed wastewater storage reservoir not exceed:

5 Day Biochemical Oxygen Demand, 45 mg/L; and

Total Suspended Solids - 60 mg/L.

1.3 Permit Fee Calculations for Reclaimed Wastewater Discharge to Land

1.3.1 The characteristics of the reclaimed wastewater discharged from the storage reservoir and beneficially used for irrigation, for the purposes of permit fee calculations, the following discharge factors have been assumed:

5 Day Biochemical Oxygen Demand, 10 mg/L; and

Total Suspended Solids - 10 mg/L.

1.4 Authorized Works

The works authorized are: sewage collection system, sewage treatment plant concrete tankage for emergency containment, influent screen, flow equalization basin, pumping station, pressure forcemain to aerated lagoons, aerated lagoon treatment system, reclaimed wastewater storage reservoir sized to provide a minimum retention time of 60 days prior to spray irrigation, post storage chlorination, pressure forcemain to the golf course and related irrigation supply mains and sprinkler irrigation equipment, infiltration basin, and other related appurtenances, approximately as shown on the attached Site Plan A.

1.5 Source of Discharge

The source of discharge and sewage collection system services the Town of Oliver and surrounding area.

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1.6 Location of Works

The location of the sewage collection, flow equalization basin and effluent pumping station is: Block 47 of District Lot 2450s, Similkameen Division of Yale District.

The location of the effluent aerated lagoon treatment facilities, reclaimed wastewater storage reservoir, chlorination and withdrawal facilities is: District Lot 763s, and Block B, District Lot 682s, Similkameen Division of Yale District. The location of the potential infiltration basin sites: Block K, Plan 1789 (Town Sand Pit) and Lot 2, Plan 5881 (Town Gravel Pit).

1.7 Location of Discharge

The location where reclaimed wastewater may be irrigated is described generally as Oliver and the surrounding area.

1.8 Irrigation Plan

Submit for review, and obtain written authorization from the Regional Waste Manager, an "Irrigation Plan" of all new areas of land to be irrigated prior to commencement of irrigation with reclaimed wastewater. Areas for effluent irrigation are as indicated in the Oliver Waste Management Plan and as indicated on Site Plan A.

2. GENERAL REQUIREMENTS

2.1 Maintenance of Works, Emergency Procedures and Noncompliance Reporting

Inspect the pollution control works regularly and maintain them in good working order. In the event of an emergency or any condition which prevents continuing operation of the approved method of pollution control or results in noncompliance with the terms and conditions of this Operational Certificate, immediately notify the Regional Waste Manager and take appropriate remedial action.

2.2 Bypasses

The discharge of effluent which has bypassed the designated treatment works is prohibited, unless the consent of the Regional Waste Manager is obtained and confirmed in writing.

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2.3 Process Modifications

Notify the Regional Waste Manager, and his written consent obtained, prior to implementing changes to any process that may affect the quality and/or quantity of the discharge.

2.4 Alternate Water Supply

Provide alternate water supplies if any privately owned well is adversely affected by the land disposal scheme as determined by the Regional Waste Manager.

2.5 Plans - New Works

2.5.1 Plans of modifications and/or extensions to the existing works shall be signed and sealed by a Professional Engineer licensed to practise in the Province of British Columbia.

2.5.2 Copies of all "as-built" plans and drawings for the effluent treatment system, signed and sealed by a Professional Engineer licensed to practise in the Province of British Columbia, shall be submitted to the Regional Waste Manager on completion of construction.

2.5.3 Plans and specifications of any proposed new works, modifications or additions to the works authorized in this Operational Certificate, including the infiltration basin plans, and with the exception of the sewage collection system, shall be submitted to the Regional Waste Manager, and his written consent obtained before construction commences. The works shall be constructed in accordance with such plans.

2.5.4 Retain a copy of all "as-built", plans of modifications and/or extensions to the sewage collection system for perusal by the Regional Waste Manager, or his designate, upon request.

2.5.5 Plans for modifications of, and/or extensions to, the existing reclaimed wastewater irrigation system shall be approved by a person qualified in the design of irrigation systems.

2.5.6 Design and construct the irrigation works in accordance with best current agricultural practice and:

> The "Pollution Control Guidelines for Municipal Effluent Application to Land", dated January 1983, and any amendments thereto, issued by the Ministry of Environment of British Columbia.

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The "B.C. Sprinkler Irrigation Manual" 1989 issue, prepared by the B.C. Ministry of Agriculture and Fisheries.

The "Health and Safety Criteria for the Use of Reclaimed Wastewater", 1991, developed by the Ministry of Health and the Ministry of Environment.

3. GENERAL REQUIREMENTS - ALL DISCHARGES

3.1 Operation and Maintenance

Develop and maintain both an Operational and Maintenance Manual for the sewage collection, sewage treatment and reclaimed wastewater utilization. A copy of the Operational and Maintenance Manuals shall be retained at the treatment facility for inspection by the Regional Waste Manager or their designate.

3.2 Facility Classification

Maintain the wastewater treatment facility classification as authorized in Section 1.4 with the "British Columbia Water and Wastewater Operators Certification Program Society" (BCWWOCPS). The new aerated lagoon treatment facility is presently classified as a Level II facility.

3.3 Operator Certification

3.3.1 All operators in training (OIT) working at this Level II facility classified by the BCWWOCPS shall be required to successfully pass an OIT examination within three (3) months of commencement of employment at the facility. The OIT certificate shall be valid for fifteen (15) months from the date of issue. Prior to the expiry date of the OIT certificate, but not sooner than twelve (12) months from the date when the OIT commenced facility operation, the OIT shall successfully complete a Class I certification examination in order to continue to operate at the facility.

3.3.2 The facility is currently classified by the BCWWOCPS at Level II. Designate at least one operator to be the "Chief Operator" of the facility by **December 1, 1996**. The "Chief Operator" shall be certified at a Class II level, at a minimum.

After **December 1, 1996**, no person shall have "Direct Responsible Charge", as defined by the BCWWOCPS, of a municipal wastewater

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treatment facility classified at Level II or higher unless they possess a valid operator's certificate not more than one level below the classification level of the facility. **"Direct Responsible Charge" is the "Chief Operator" of the facility, the identifiable senior person who is in charge of the plant.**

3.3.3 Should the facility be reclassified by the BCWWOCPS at Level III, designate a "Chief Operator", certified at a Class III level by **December 1, 1998.**

3.3.4 Should the facility be reclassified by the BCWWOCPS at Level IV, designate a "Chief Operator", certified at a Class IV level by **December 1, 1998.**

3.4 Water Conservation

Establish a water conservation program to encourage a reduction in the volume of domestic and industrial wastewaters discharged to the sewage collection system.

3.5 Sewage Collection System - Groundwater Infiltration, Inflow and Cross Connections

Inspect and maintain the sewage collection system works so as to minimize the possibility of cross connections between the storm sewer and the sanitary sewer systems, to minimize infiltration of groundwater, to minimize inflow of water from basement sump pumps and roof drains, and minimize exfiltration of the collected sewage from the sewage collection system to the ground.

3.6 Influent Wastes Bylaw

Subject to being declared a Sewage Control Area under Section 17 of the Waste Management Act, and in order to minimize the potential effect of heavy metals or other toxic materials in the effluent and/or sludge, prepare, implement and/or amend an Influent Wastes Bylaw, Building Bylaw, or other similar bylaws, to regulate the input of such wastes to the sewage collection system. Devices to process household putrescible waste for disposal to the sewage collection system shall be prohibited.

3.7 Contingency Plan

Prepare a Contingency Plan that will address the appropriate course of action to be taken in any particular preconceived emergency situation. The Contingency Plan shall include chlorine leaks and any potential point of concern in the collection, treatment and disposal systems. Attention is to be given to public

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safety and the protection of the environment. The Contingency Plan is to be continually updated as necessary to reflect the current operation. A copy of the Contingency Plan shall be forwarded to the Regional Waste Manager on or before December 31, 1997.

3.8 Sludge Management Plan

The rationale of sludge management, including frequency of withdrawal of sludge from the sewage treatment plant and the location(s) used for disposal and/or utilization shall be developed into a Sludge Management Plan. The Sludge Management Plan shall be prepared and submitted to the Regional Waste Manager for approval on or before December 31, 1996.

3.9 Odours

Should odours become objectionable, additional works shall be provided when so directed in writing by the Regional Waste Manager.

3.10 Fencing

Erect a fence around the sewage treatment facility, storage reservoir and such other areas as required by the Regional Waste Manager. The height and type of fencing shall meet the approval of the Regional Waste Manager.

3.11 Surface Water Diversionary Works

Surface water shall be intercepted and diverted away from the effluent treatment facilities to the greatest extent possible.

3.12 Signage

3.12.1 A suitable sign erected at the main entrance to the site shall have the appropriate emergency phone numbers for use by the general public and others.

3.12.2 Prominent "NO TRESPASSING", signs shall be erected around agricultural and silvicultural sites irrigated with reclaimed wastewater, warning persons of the possible health hazard during the irrigation season and advising that the water used for irrigation is NOT POTABLE. The wording shall be in language or symbols readily comprehensible by the general public. eg. "NO TRESPASSING - RECLAIMED WASTEWATER - DO NOT DRINK"

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4. GENERAL REQUIREMENTS - EFFLUENT STORAGE RESERVOIR

4.1 Leakage

Operate and maintain the reclaimed wastewater storage reservoir to minimize fluid leakage. Leakage shall not aggravate or produce soil or bedrock instability or erosion elsewhere or contaminate ground or surface water.

5. GENERAL REQUIREMENTS - EFFLUENT IRRIGATION

5.1 Disinfection - Chlorination

5.1.1 Adequate chlorination shall be maintained and provide not less than one hour's contact time at average flow rates in the reclaimed wastewater discharging from the chlorination facility to the irrigation system.

5.1.2 Reclaimed wastewater utilized for irrigation shall conform to the effluent irrigation guidelines developed by the B.C. Ministry of Health. Fecal coliforms shall not exceed 200 MPN per 100 mL for agricultural, silvicultural and low public use lands, or exceed 2.2 MPN per 100 mL for high public use lands.

5.2 Annual Irrigation

5.2.1 The authorized discharge period for irrigation is during the period March 15 to October 31, inclusive.

5.2.2 With the written authorization of the Regional Waste Manager, the irrigation schedule may be extended on a weekly basis beyond these limits. Any extension will be considered only upon receipt of a substantiated written request.

5.3 Buffer Zones

5.3.1 The requirement for formal buffer zones surrounding lands irrigated with reclaimed wastewater is no longer in effect, however, a buffer zone may be specified by the Regional Waste Manager.

5.3.2 Reclaimed wastewater applied by irrigation shall not be applied to the ground any closer than 15 metres from the edge of flowing streams or bodies of water.

5.3.3 There shall be no reclaimed wastewater irrigated within 30 metres of any well or inground reservoir for domestic supply.

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5.4 Surface Runoff

There shall be no surface runoff of irrigated reclaimed wastewater from the irrigated lands.

5.5 Surfacing Reclaimed Wastewater

Irrigation shall be managed in such a fashion as to preclude surfacing of irrigation tail water down slope of the point of irrigation.

5.6 Spray Irrigation Drift

The reclaimed wastewater irrigation system shall be managed in such a fashion as to preclude aerosol drift from leaving the irrigated lands.

5.7 Irrigation Rates

5.7.1 Irrigation rates shall not exceed the rates given in "B.C. Sprinkler Irrigation Manual", dated 1989, prepared by the B.C. Ministry of Agriculture and Fisheries.

5.7.2 Soils of the irrigated lands shall be monitored to prevent saturation, erosion, and instability.

5.8 Agricultural Products Lag Time

5.8.1 A three day lag time is required before uninspected livestock intended for human consumption are permitted on areas irrigated with reclaimed wastewater. No lag time is required if livestock are subjected to the federal meat inspection program.

5.8.2 A six day lag time is required before dairy cattle are permitted in areas irrigated with reclaimed wastewater.

5.8.3 A three day lag time, after irrigation has ceased, is required before a crop intended for animal feed is harvested.

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6. MONITORING REQUIREMENTS

6.1 Influent Sampling Program - (Equalization Basin)

6.1.1 Install and maintain a suitable sampling facility at the equalization basin outlet, (S.E.A.M. site number E222152), and obtain a grab sample of the plant influent **semi-annually** (a proportional continuous sampler may be used).

6.1.2 Obtain analyses of the influent sample for the following:

total phosphorus and ortho phosphorus, expressed as P in mg/L;

6.2 Effluent Sampling Program - (Cell #3, prior to storage reservoir)

6.2.1 Install and maintain a suitable sampling facility on the outlet of the aerated treatment lagoon, Cell #3, (S.E.A.M. site number E222151), and obtain a grab sample of the effluent before it is discharged to the storage reservoir, for analysis by a suitably accredited laboratory, a proportional continuous sampler may be used, provided that prior written approval has been obtained from the Regional Waste Manager.

6.2.2 Obtain analyses of the effluent sample for the following:

total suspended solids (non-filterable residue), (**monthly** analysis), mg/L;

5-day biochemical oxygen demand, (**monthly** analysis), mg/L;

total phosphorus, ortho phosphorus and total dissolved phosphorus, (**quarterly analysis during 1996, and semi-annually** analysis, thereafter), all expressed as mg/L P; and

total nitrogen, ammonia nitrogen, nitrate nitrogen, nitrite nitrogen, and organic nitrogen, (**quarterly analysis during 1996, and semi-annually analysis thereafter**), all expressed as mg/L N.

6.2.3 Occasional full chemical analysis of the main cations and anions and other characteristics may be required at the discretion of the Regional Waste Manager.

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6.3 Effluent Irrigation Sampling Program - (Chlorine Contact Chamber, prior to Irrigation)

6.3.1 Install a suitable sampling facility after the chlorine contact chamber, prior to irrigating, (S.E.A.M. site number E222150) and obtain a grab sample of the reclaimed wastewater **during the irrigation season.**

6.3.2 Obtain analyses of the sample, parameters and frequency as follows:

faecal coliforms, M.P.N./100ml, on a **monthly** basis;

total coliforms, M.P.N./100ml, on a **monthly** basis;

total phosphorus, mg/L, on a **monthly** basis;

total nitrogen, mg/L, on a **monthly** basis; and

chlorine residual, mg/L, on a **weekly** basis.

6.3.3 Occasional full chemical analysis of the main cations and anions and other characteristics may be required at the discretion of the Regional Waste Manager.

6.4 Effluent Irrigation Monitoring Program

6.4.1 Provide and maintain a suitable flow measuring device to measure total volume of reclaimed wastewater irrigated annually and record the areas where it is utilized.

6.4.2 Provide and maintain a suitable flow measuring device to measure the amount of fresh water make-up from Okanagan River to the equalization basin in m^3/day, and totalize this make up water volume on an annual basis in m^3/year.

6.4.3 Provide and maintain a suitable flow measuring device and record once per day the reclaimed wastewater volume irrigated over a 24-hour period. Record the flows for each calendar month and for each calendar year.

6.5 Storage Reservoir Level Monitoring Program

6.5.1 Provide a suitable staff gauge or other similar device as approved by the Regional Waste Manager in the storage reservoir and take weekly measurements of the water level in the storage reservoir on a year round basis.

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

6.6 Sampling and Analytical Requirements

6.6.1 Proper care should be taken in sampling, storing and transporting the samples to adequately control temperature and avoid contamination, breakage, etc.

6.6.2 Occasional full chemical analysis of the main cations and anions and other characteristics may be required at the discretion of the Regional Waste Manager.

6.6.3 Analyses are to be carried out in accordance with procedures described in the second edition of "A Laboratory Manual for the Chemical Analysis of Waters, Wastewaters, Sediments and Biological Materials, (March 1994 Permittee Edition)", or by suitable alternative procedures as authorized by the Regional Waste Manager.

The above manual may be purchased from Queens Printer Publications Centre, 2nd Floor, 563 Superior Street, Victoria, B.C., V8V 4R6, 1-800-663-6105. The manual may also be reviewed at any Environmental Protection Program Office.

6.6.4 Sampling and flow measurement shall be carried out in accordance with the procedures described in "Field Criteria for Sampling Effluents and Receiving Waters", April 1989, 17 pp., or by other suitable alternative procedures as authorized by the Regional Waste Manager.

6.6.5 The Permittee is required to follow the terms and conditions of the Quality Assurance Regulation (EQDA). Ten percent of the samples collected shall be duplicated to provide data quality assurance. Quality control information generated by the Permittee lab while analyzing parameters required by this Permit shall also be provided with the data required to be reported.

6.7 Sludge Sampling and Monitoring Program

Develop and maintain a record keeping system for measuring and recording the depth of sludge collecting in the lagoons and volume of sludge removed from the treatment lagoons during desludging operations, the location where the sludge was discharged, and the amount of sludge discharged at each location. The Regional Waste Manager is to be notified in writing at least two weeks prior to the commencement of desludging operations. Analysis of the sludge may be required by the Regional Waste Manager.

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

6.8 Groundwater Monitoring Program

A Groundwater Monitoring Program, shall be submitted to the Regional Waste Manager. The Groundwater Monitoring Program shall be designed by a Professional Engineer or a Hydrogeological Technologist licensed to practice in the Province of British Columbia, to establish with acceptable scientific accuracy, the groundwater flow pattern and nutrient removal capability of the soil to ensure reasonable notice of impending high phosphorus or nitrate levels that may adversely affect surface water, groundwater or domestic waterwells. The sampling, measurement frequency and analyses shall be conducted in accordance with the Groundwater Monitoring Program upon its written authorization by the Regional Waste Manager. The Groundwater Monitoring Program to be submitted to the Regional Waste Manager by December 31, 1997.

6.9 Soils Assessment Program

A ground assessment of any new areas to be irrigated, as shown in the "Irrigation Plan", shall be performed by a suitably qualified professional, using best current climate and soils data to substantiate that the land is capable of accepting reclaimed wastewater for irrigation purposes. This assessment is to include any suggested restrictions or recommendations that the suitably qualified professional deems necessary. This Soils Assessment shall be submitted to the Regional Waste Manager for review prior to the initial commencement of irrigation annually. Further review and ongoing soils assessments may be required by the Regional Waste Manager.

7. <u>REPORTING</u>

7.1 General Reporting

7.1.1 Maintain the monitoring data required in Section 6 for inspection.

7.1.2 The influent/effluent water quality analyses and flow data is to be submitted to the Regional Waste Manager such that they are received by the Regional Waste Manager within 30 days of the results being sent out by the testing agency.

7.1.3 Monitoring data shall be submitted in an electronic and/or printed format satisfactory to the Regional Waste Manager.

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

7.2 Annual Reporting

7.2.1 Submit an Annual Report which includes a summary of the results of all sampling and monitoring programs as specified in this permit, data interpretation and trend analyses by a suitably qualified professional.

7.2.2 This report is to be in a format which is suitable for review by the public and/or other government agencies.

7.2.3 The first report is due on or before 60 days of the end of a calendar year for that year's monitoring. Raw data are to be attached as appendices to the report.

7.2.4 Maintain and submit records of the following as a part of the annual report:

7.2.4.1 Records of reclaimed wastewater balance, that is, the flows to and from the storage reservoir. This balance, must also include the freshwater make-up.

7.2.4.2 Records of the duration, intensity, property owner, acreage, location, and type of reclaimed wastewater irrigation.

7.2.4.3 Records of efforts to reduce infiltration, inflow and cross connections for inspection by the Regional Waste Manager or his designate.

7.2.4.4 Records of efforts to administer the Influent Wastes By-law(s) for inspection by the Regional Waste Manager or his designate. Include as an attachment, any amendments to the Influent Wastes By-law(s) that have been made during the past year.

7.2.4.5 Copy of the Contingency Plan.

7.2.4.6 Copy of the Sludge Management Plan.

7.2.4.7 Copy of the Annual Flow Summaries.

7.2.4.8 Copy of the Annual Irrigation Summaries.

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

APPENDIX A

Requirements of Reclaimed Wastewater Users

The holder of this Operational Certificate (The reclaimed wastewater supplier) shall be responsible for ensuring that the contractual agreement with the Reclaimed Wastewater User is in accordance with the Operational Certificate. A copy of this Appendix is to be provided to each user prior to the commencement of irrigation EACH YEAR.

1 GENERAL REQUIREMENTS

1.1 Plans - New Works

1.1.1 Plans for modifications and/or extensions to the existing reclaimed wastewater irrigation system shall be approved by a person qualified in the design of irrigation systems.

1.1.2 Design and construct the irrigation works in accordance with best current agricultural practice and the "Pollution Control Guidelines for Municipal Effluent Application to Land", dated January 1983, and any amendments thereto, issued by the Ministry of Environment of British Columbia, and also in accordance with the "B.C. Sprinkler Irrigation Manual", dated 1989, prepared by the B.C. Ministry of Agriculture and Fisheries.

1.2 Construction Criteria

1.2.1 All reclaimed water user valves, shall be of a type or secured in a manner that permits operation by only personnel authorized by each wastewater user. All piping, valves and outlets should be marked to differentiate reclaimed wastewater from domestic water. All reclaimed wastewater controllers, valves, etc., shall be affixed with reclaimed wastewater warning signs.

1.2.2 Use or installation of hose-bibbs on any irrigation system presently operating, or designated to operate with reclaimed wastewater, regardless of the hose-bibb construction or identification, is not permitted.

1.2.3 There shall be at least a 3 metre horizontal and a 0.3 metre vertical separation (with domestic water pipeline above the reclaimed water pipeline) between all pipelines transporting reclaimed water and those transporting domestic water.

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

1.2.4 There shall be no connection between a potable water supply, irrigation water or industrial well, and piping containing reclaimed wastewater, except through an air gap separation or reduced pressure principle device.

1.3 Fencing

The Reclaimed Wastewater User MAY be required by the Regional Waste Manager to erect a fence around the disposal area to restrict public access. The height and type of fencing shall meet the approval of the Regional Waste Manager.

1.4 Signage

1.4.1 Prominent "NO TRESPASSING", signs shall be erected around agricultural and silvicultural sites irrigated with reclaimed wastewater, warning persons of the possible health hazard during the irrigation season and advising that the water used for irrigation is NOT POTABLE. The wording shall be in language or symbols readily comprehensible by the general public. eg. "NO TRESPASSING - RECLAIMED WASTEWATER - DO NOT DRINK"

1.4.2 Warning signs shall be posted in sufficient numbers and size and at strategic locations to advise the public that reclaimed water is being used. Additional signage may be required as directed by the Regional Waste Manager.

2 GENERAL REQUIREMENTS - RECLAIMED WASTEWATER IRRIGATION

2.1 Buffer Zones

2.1.1 The requirement for formal buffer zones surrounding lands irrigated with reclaimed wastewater is no longer in effect, however, a buffer zone may be specified by the Regional Waste Manager.

2.1.2 Reclaimed wastewater applied by irrigation shall not be applied to the ground any closer than 15 metres from the edge of flowing streams or bodies of water.

2.1.3 There shall be no reclaimed wastewater irrigated within 30 metres of any well or inground reservoir for domestic supply.

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

2.2 Surface Runoff

2.2.1 There shall be no surface runoff of irrigated reclaimed wastewater from the irrigated lands.

2.2.2 The maximum ground slope shall not exceed 20% without the written consent of the Regional Waste Manager.

2.3 Surfacing Reclaimed Wastewater

2.3.1 Irrigation shall be managed in such a fashion as to preclude surfacing of irrigation tail water down slope of the point of irrigation.

2.3.2 Irrigation shall be managed as to prevent ponding.

2.4 Spray Irrigation Drift

2.4.1 Reclaimed wastewater shall be confined to the area designated and approved for reclamation. The reclaimed wastewater irrigation system shall be managed in such a fashion as to prevent aerosol drift from leaving the irrigated lands.

2.4.2 Precautions shall be taken to ensure that reclaimed water will not have contact with any facility or area not designated for reclamation, such as passing vehicles, buildings, domestic water facilities, fruit and vegetable gardens, or food handling facilities.

2.4.3 Drinking water facilities shall be protected from direct or wind blown reclaimed wastewater spray.

2.5 Irrigation Rates

2.5.1 Irrigation rates shall not exceed the rates given in "B.C. Sprinkler Irrigation Manual", dated 1989, prepared by the B.C. Ministry of Agriculture and Fisheries.

2.5.2 Soils of the irrigated lands shall be monitored periodically or as otherwise directed by the Regional Waste Manager or the Town of Oliver, to prevent saturation, erosion, and instability .

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

2.6 Agricultural Products Lag Time

2.6.1 A three day lag time is required before uninspected livestock intended for human consumption are permitted on areas irrigated with reclaimed wastewater. No lag time is required if livestock are subjected to the federal meat inspection program.

2.6.2 A six day lag time is required before dairy cattle are permitted in areas irrigated with reclaimed wastewater.

2.6.3 A three day lag time, after irrigation has ceased, is required before a crop intended for animal feed is harvested.

2.7 Insect and Vector Control

Adequate measures shall be taken to prevent the breeding of insects and other vectors of health significance, and the creation of odors, slimes or unsightly deposits.

2.8 Irrigation of Public Areas

2.8.1 Irrigation on golf courses or cemeteries shall only be practised when the public are not present.

2.8.2 Golf score cards shall indicate that reclaimed wastewater is used for irrigation on the golf course lands.

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

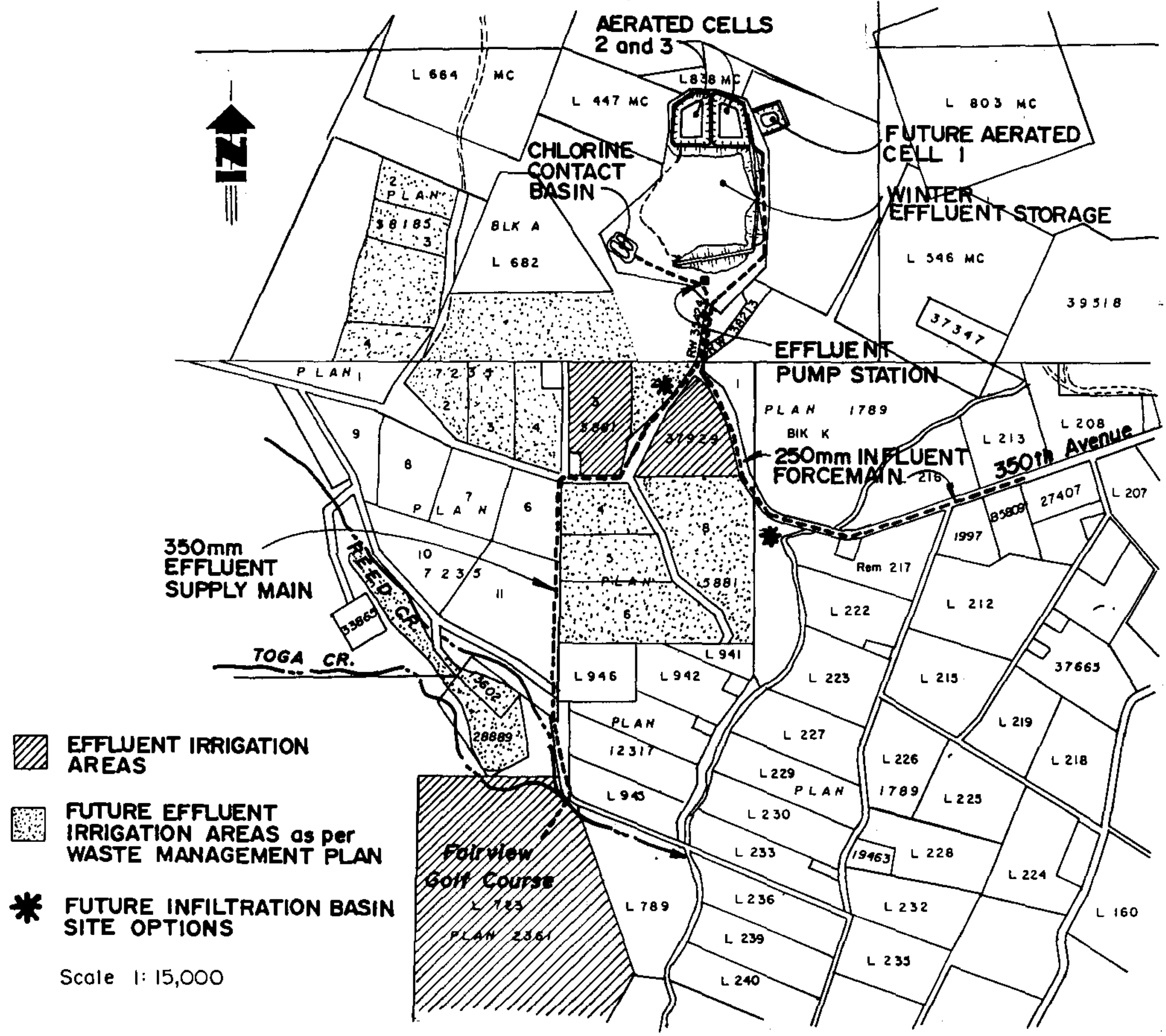
Province of British Columbia

Ministry of Environment, Lands and Parks

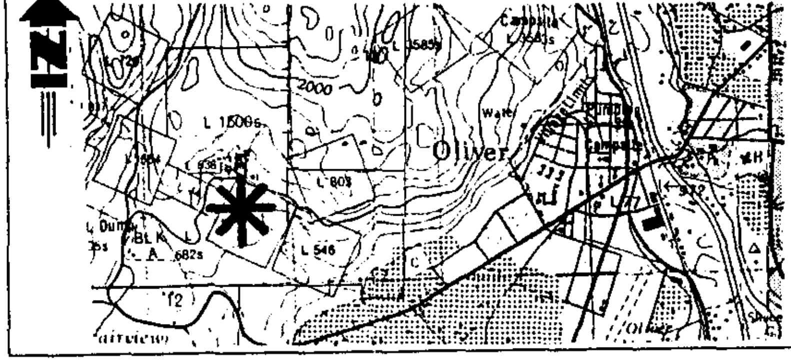
BC Environment

ENVIRONMENTAL PROTECTION DIVISION

SITE PLAN A



LOCATION MAP (1: 50,000)



(FOR OFFICE USE ONLY)

December 14, 1995
Date Issued

Date Amended

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

Page

Permit No./Approval No. PE 13717

APPENDIX B

2018 Sanitary Capital Plan

2018 Sanitary System Capital Plan

March 2019

Project No. 306-1751

ENGINEERING ■ PLANNING ■ URBAN DESIGN ■ LAND SURVEYING

Distribution List

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Revision Log

Revision #	*Revised by*	*Date*	*Issue / Revision Description*
0	A Schultz	2019-02-05	
1	A Schultz	2019-03-08	
2	D Grant	2019-12-04	Inclusion of FCM MAMP assistance statement

Report Submission

Report Prepared By:

Alyssa Schultz, EIT
Project Engineer

Report Reviewed By:

Steve Underwood, P. Eng.
Project Engineer

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Table of Contents

APPENDICES

List of Tables

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List of Acronyms

AC	Asbestos Cement
CPE	Chlorinated Polyethylene
FLNRO	Ministry of Forests, Lands, and Natural Resource Operations
GIS	Geographic Information Systems
HDPE	High Density Polyethylene
I&I (I/I)	Inflow and Infiltration
LS	Lift Station
LWMP	Liquid Waste Management Plan
MOE	Ministry of Environment and Climate Change Strategy
MSR	Municipal Sewage Regulation
MWR	Municipal Wastewater Regulation
OC	Operational Certificate
OCP	Official Community Plan
OIB	Osoyoos Indian Band
PCSWMM	Storm Water Management Model
PVC	Polyvinyl Chloride
SCADA	Supervisory Control and Data Acquisition
TRUE	TRUE Consulting
WMP	Waste Management Plan

Units of Measure

km	kilometre
L/d	Litres per day
L/m	Litres per minute
L/s	Litres per second
lpcd	Litres per capita per day
m	metre
m^3/day	cubic metre per day
mg/L	milligrams per Litre
mm	millimetre

Referenced Reports

TRUE Consulting Group (2002). *Town of Oliver 2002 Liquid Waste Management Plan Update.*

TRUE Consulting Group (2018). *Town of Oliver Wastewater Treatement System Capacity Improvements.*

Support from FCM

The preparation of this document was carried out with assistance from the Government of Canada and the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

1.0 Introduction

The purpose of this report is to evaluate the sanitary collection network and treatment system performance under existing and future conditions in order to develop a guide for staged system improvements and expansions. In addition, guideline recommendations from the Ministry of Environment and Climate Change (MOE) to review Liquid Waste Management Plans (LWMP) every 5 to 10 years has prompted an update to the Town's LWMP, which was most recently updated in 2002. This report serves as the 2018 LWMP Update. It includes revisions to the forecasted reclaimed water irrigation flow rates; review of all system works, summarizes upgrades to the Town's collection, treatment and reclaimed water system; and updates projected capital asset management costs.

The following general scope of work was completed:

- Reviewed the Town of Oliver's Liquid Waste Management Plan Update (2002)
- Reviewed historical population and generation rates in the Town in order to generate projected flows on a 20-year design horizon
- Developed a sanitary collection network model using PCSWMM including:
  - Reviewed record drawings and survey data to populate the model
  - Reviewed Official Community Plan (OCP) land use for existing and future conditions
- Reviewed available SCADA data for lift stations and the treatment system.
- Prepared a report to summarize the analysis and recommendations for replacement, rehabilitation, or improvements to infrastructure

2.0 Background

The Town's sanitary system is referred to in two distinct systems: the sanitary collection network and the treatment system. The sanitary collection network consists of gravity pipe, six lift stations, and their respective forcemains. The collection network converges at the Influent Lift Station where it then begins the treatment process at the screening station. All components beyond and including the screening station comprise the treatment system.

2.1 Sanitary Collection Network

The Town's sanitary collection network consists of approximately 41.5 kilometers of gravity mains, six lift stations, and 3 kilometers of force mains. As shown on Figure 2-1, the gravity network and lift stations convey all generated flows to the Influent Lift Station which pumps into the screening station (the first step in the treatment process). The network is generally separated into six areas, each of which supplies by gravity to one of the lift stations.

1. Influent Lift Station
2. McPherson Lift Station
3. Rockcliffe Lift Station
4. Rotary Beach Lift Station
5. Sawmill Road Lift Station
6. Scott Road Lift Station

The existing sanitary collection network is generally limited to within the Municipal boundary. However, there are some parcels outside the Municipality which are serviced or planned to be serviced in the future. These parcels are primarily on Osoyoos Indian Band (OIB) land. The installation year of infrastructure within the sanitary network ranges from the 1960s to present as there is ongoing development in the Town.

2.2 Treatment System

The original wastewater treatment system consisted of an equalization basin, wastewater pump station and activated sludge treatment system. These works were constructed pre-1985 and are located on the former treatment plant site adjacent to the Town's Public Works Yard at 5971 Sawmill Road. From 1962 to 1984 treated effluent was then discharged into the Okanagan River. In the mid 1980's the Town of Oliver adopted a plan for reuse of treated effluent in the Fairview area, thereby discontinuing direct discharge of treated effluent to the Okanagan River. A summary of system improvements and expansions from 1966 to present are listed in Section 2.2.8.

The existing treatment process now consists of an influent screening station, two equalization basins, a wastewater pump station and forcemain, an aerated lagoon treatment system, reservoir storage, and reclaimed water irrigation system. These system components are described in more detail below, and an overview of the wastewater treatment system can be seen in Figure 2-2, including site plans for the overall reclaimed water supply system and aerated lagoon areas.

2.2.1 Influent Screens

The first step in the treatment process is solids removal. This is achieved by pumping influent through rotating screens. These screens were part of the initial treatment system and are located on the former treatment plant site, adjacent to the Town’s Public Works Yard.

A real-time flow meter has operated at the screening station in recent years, however it only began storing historical sub-daily flow data on the SCADA system in December 2018. Sub-daily refers to data taken at shorter intervals (ie. Minutes or seconds) to record flow levels throughout the day. All other flow meters or flow totalizers in the system are located after the equalization basins, and therefore do not represent the actual sub-daily generated flows.

2.2.2 Equalization Basin

Following solids removal, effluent is piped into a two-cell flow equalization system. Construction of Cell 1 was prompted by unreliable electrical services in the South Okanagan in the early 1980’s. During this time, the Town experienced numerous, short duration interruptions in their electrical service on a daily basis throughout the summer months. In 1985, a design decision was made to construct a CPE-lined equalization basin (Cell 1) to store flows during short duration power failures rather than provide standby power. Since the early 1980’s, the electrical utility has undertaken major improvements to the electrical distribution system and short duration power failures are now infrequent.

Inflow to the equalization basins flows through concrete open channels that formerly comprised the aeration basins and sludge digestor. The decommissioned tankage has a total storage volume of 900 m^3 and can be used as emergency storage if required. Piping systems and valves remain in place, allowing for wastewater to be diverted to this tankage and then returned to the normal wastewater system if required.

In 1995, a floating surface aeration mixer was installed in Cell 1 for odor reduction. Cell 2 was constructed in 2009 as a result of energy incentives from Fortis BC to discharge during off-peak hours. Cell 2 is comprised of a 60 mil HDPE membrane lining and aerators, comparable to Cell 1. A site plan of the equalization basin is found in Figure 2-3.

2.2.3 Wastewater Pump Station and Forcemain

Following the equalization basins, the effluent is pumped from the High Lift Station through 3,400 m of 350 mm diameter PVC forcemain to a two-cell aerated treatment lagoon system. Pumping at the High Lift Station generally occurs in the evenings and on weekdays to optimize energy incentives offered by Fortis BC. The current forcemain was constructed in 2004., during which time the former 250 mm diameter forcemain was converted to a reclaimed water supply main.

2.2.4 Aerated Lagoon Treatment System

This two-cell aerated lagoon system is located off Fairview Road in the southeast area of the Town (see Figure 2-4) and was constructed in 1995 to replace the previous activated sludge plant. The aerated lagoon cells are designated as No. 2 and 3, with a third cell (No. 1) planned in the build out design (see Appendix A).

Air to the system is provided by two 40 Hp positive displacement blowers housed in a building located at the south east corner of aerated cell #2. Piping, electrical and space provisions have been made in the building for installation of two additional blower units. Figure 2-5 shows details of the Aeration Treatment System Layout and Intercell Piping.

2.2.5 Reservoir Storage

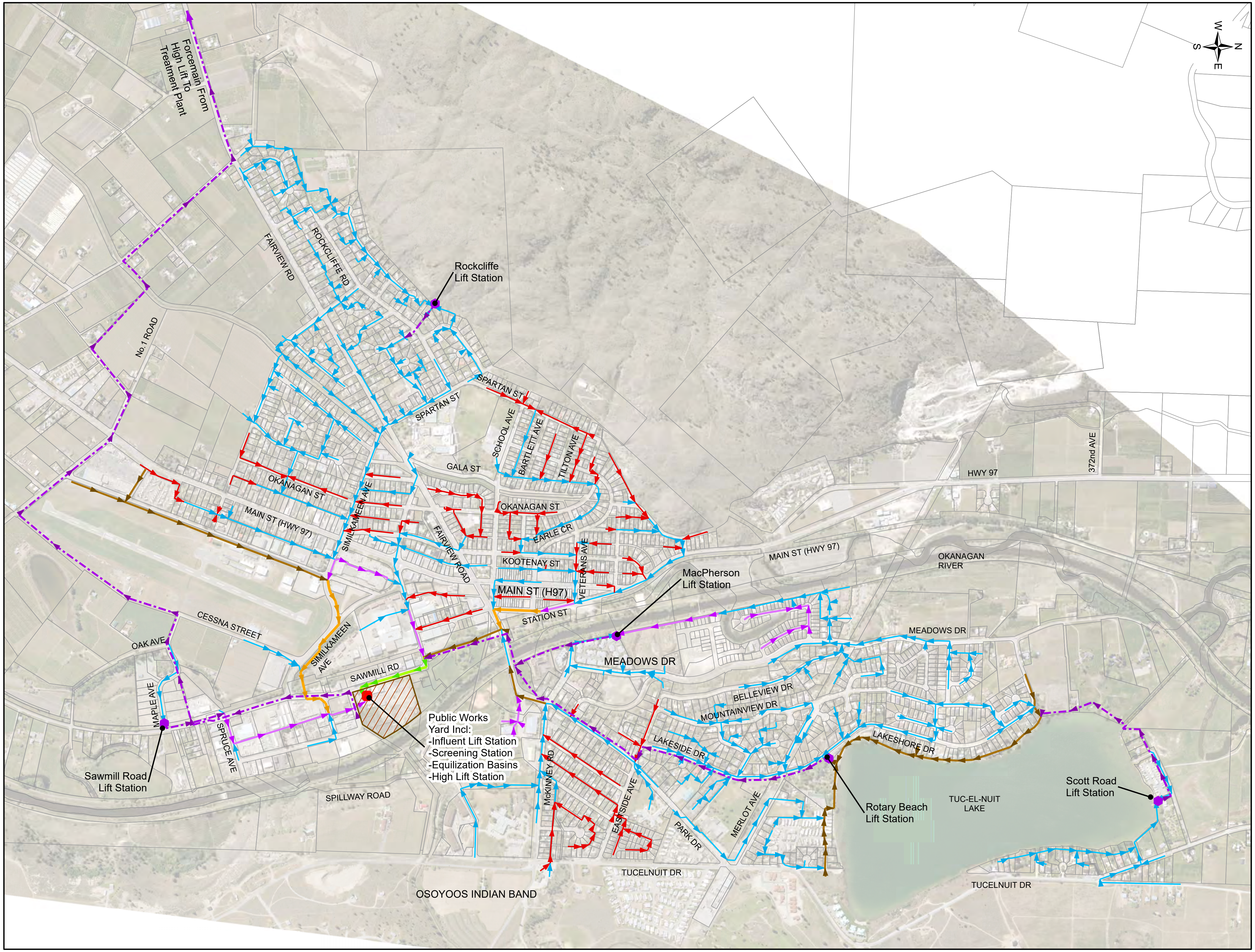
The winter effluent storage reservoir was constructed in 1984 and is comprised of two earth fill berms, which traverse the south and east side of a natural topographic depression. The maximum operating elevation of the reservoir is 447.0 m, at which point the surface area of the reservoir is 6.5 ha. Prior to distribution for irrigation use, effluent is pumped from reservoir storage to the chlorine contact basins.

2.2.6 Chlorine Contact Chambers

Following reservoir storage, the irrigation booster station pumps effluent from the winter storage reservoir to the chlorine contact basins. The booster station is equipped with two 50 Hp horizontal split case pumps, which have a combined operating capacity of 76 to 100 L/s (depending on the effluent elevation in the storage reservoir). Space and piping provisions have been made for a third pump. The Town utilizes chlorine gas in the booster station for effluent disinfection, followed by two CPE membrane-lined chlorine contact basins, each measuring 15m x 52m with a design operating depth of 2.6 m operate in series and provide a contact volume of 2180 m^3.

2.2.7 Reclaimed Water Irrigation

Reclaimed water supply and distribution was first constructed to the Fairview Mountain Golf Course in the 1980s. From 2004 to 2005, the reclaimed water distribution system was expanded to serve the seven additional sites including: the cemetery, Linear Park, Airport, Public Works Yard, Alonso, Huggins, and the Secondary School as shown on Figure 2-2. This distribution system uses the previous 250 mm diameter sanitary forcemain, now converted to reclaimed water supply. Flow meters measure reclaimed water usage at all sites except the Fairview Mountain Golf Course. Reclaimed water usage at the Fairview Mountain Golf Course has since been calculated as the total annual irrigation volume less all other metered usage.



BRITISH COLUMBIA

Town of Oliver

Sanitary Collection Network Layout

Legend

- ⇢ Forcemains
- ▨ Public Works
- ● Lift Stations
- ■ Influent Lift Station

Diameter (mm)

- → 150
- → 200
- → 250
- → 300
- → 375
- → 600
- ☐ Property Cadastre

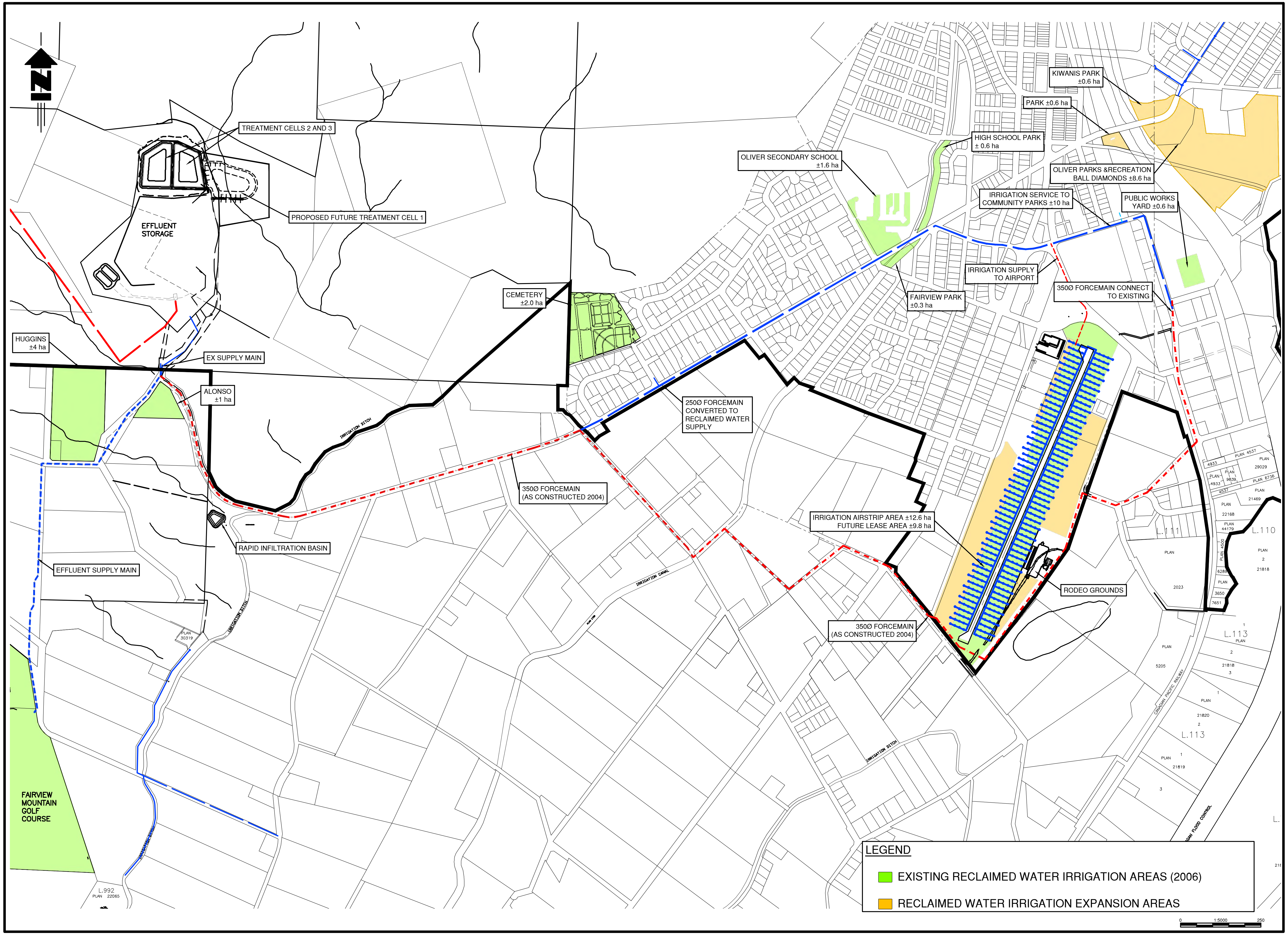
1:12,500

0 125 250 500 Meters

TRUE

Figure 2-1

R:\Clients\300-399\306\306-1751\03 Drawings\GIS\Maps\306-1751-001 Fig Sanitary Collection Layout.mxd



No.	DATE	DESCRIPTION	BY	APP'D

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING
201 - 2079 Falcon Road ■ Kamloops BC ■ V2C 4J2
tel 250.828.0881 ■ fax 250.828.0717
info@TRUE.bc.ca

BRITISH COLUMBIA Town of Oliver

2019 SANITARY CAPITAL PLAN

OVERALL PLAN RECLAIMED WATER SYPPLY SYSTEM AND IRRIGATION AREAS

SCALE N.T.S. (11X17)
DESIGN BY TRU
DRAWN BY NA
DATE JANUARY 2018
PROJECT REFERENCE No. 306-1751

DRAWING No.
FIG 2-2

SHEET OF 1

ISSUE/REV.

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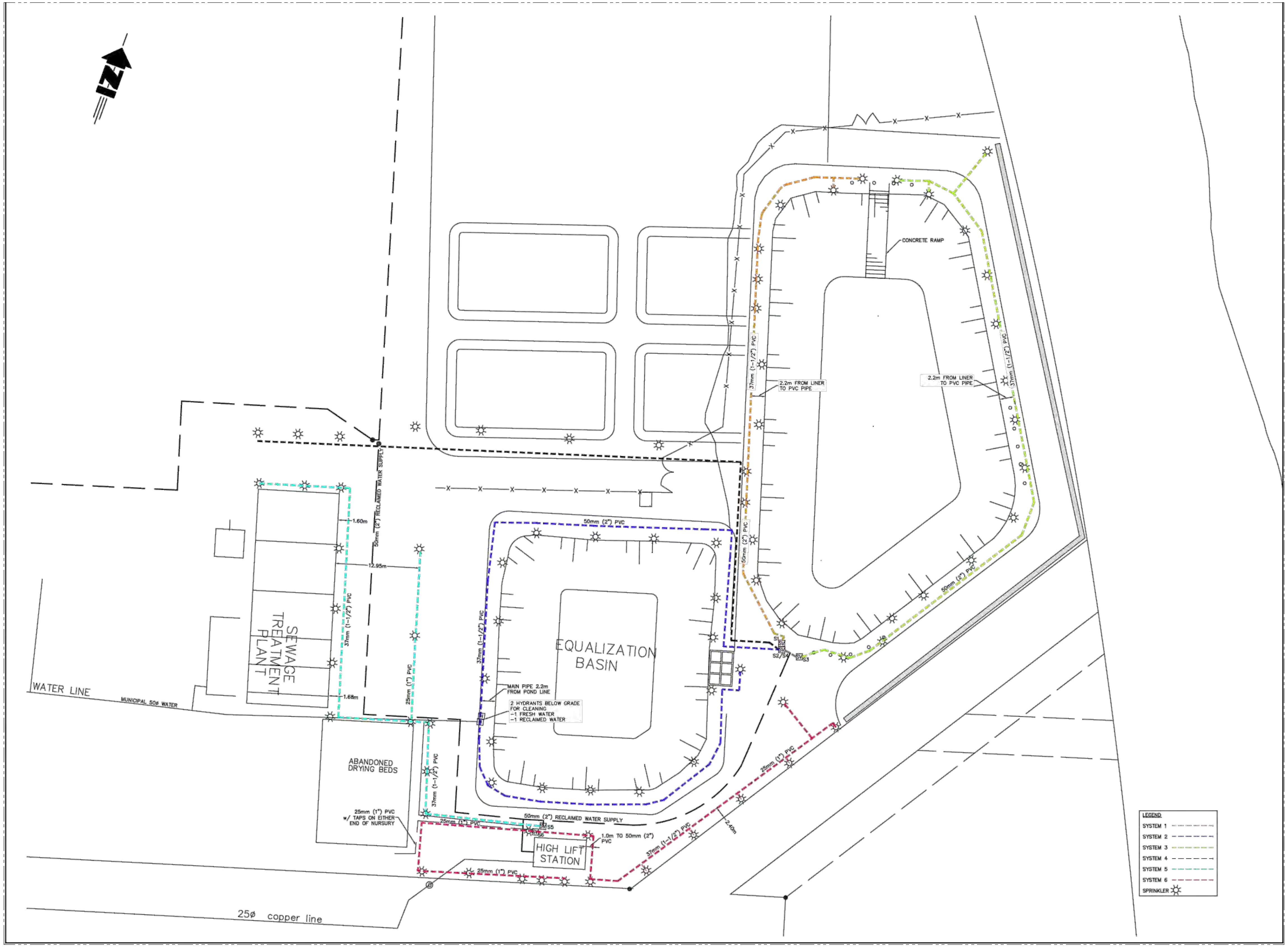

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info@TRUE.bc.ca

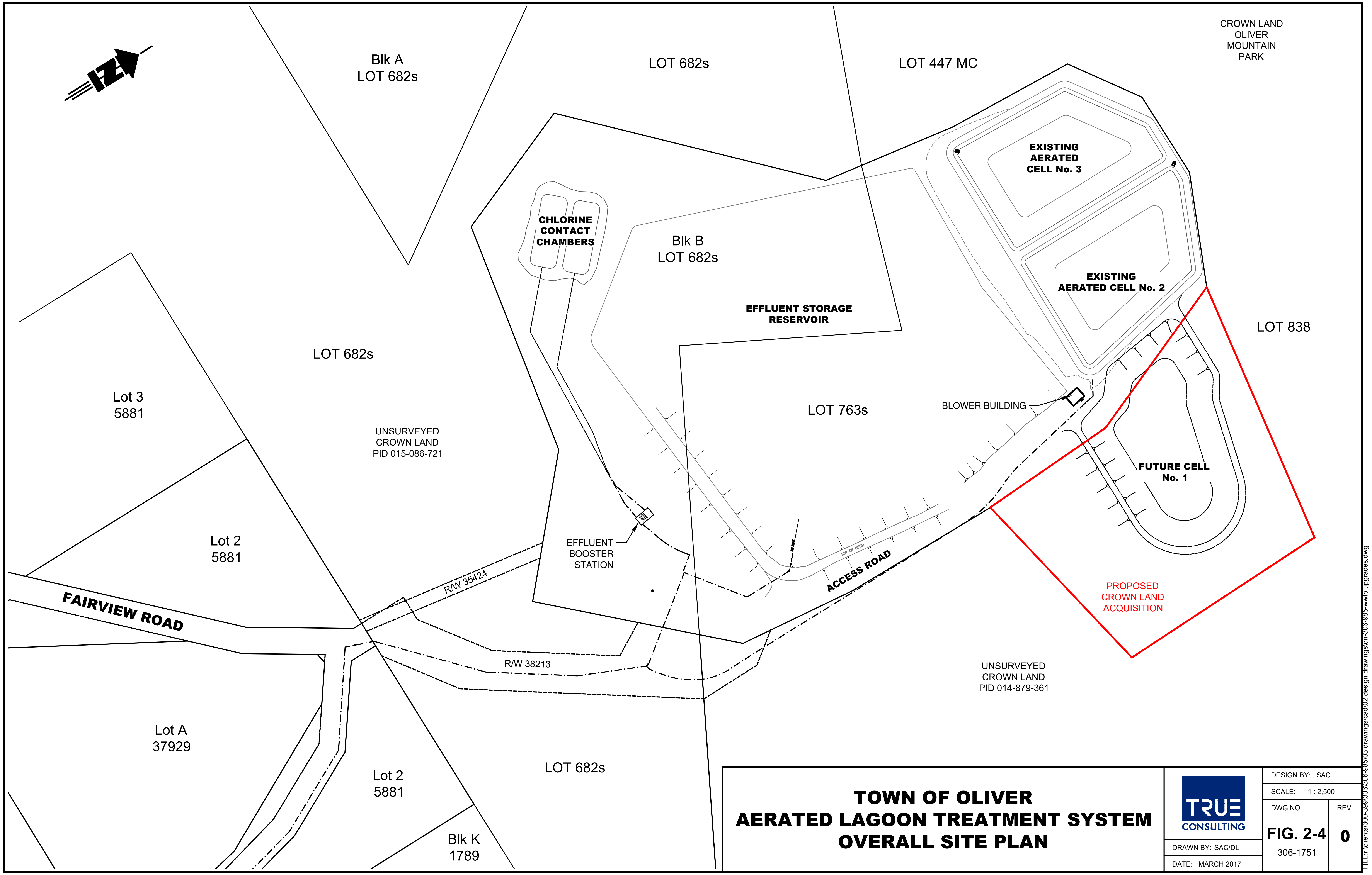
BRITISH COLUMBIA Town of Oliver

2019 SANITARY CAPITAL PLAN

EQUALIZATION BASIN OVERALL SITE PLAN

SCALE N.T.S. (11X17)
DESIGN BY TRU
DRAWN BY NA
DATE JANUARY 2018
PROJECT REFERENCE No. 306-1751
DRAWING No.
FIG 2-3
SHEET
OF
ISSUE/REV.

FILE: r:\clients\300-399\306\306-1751\03 drawings\cad\02 design drawings\306-1751 -march 7 2018

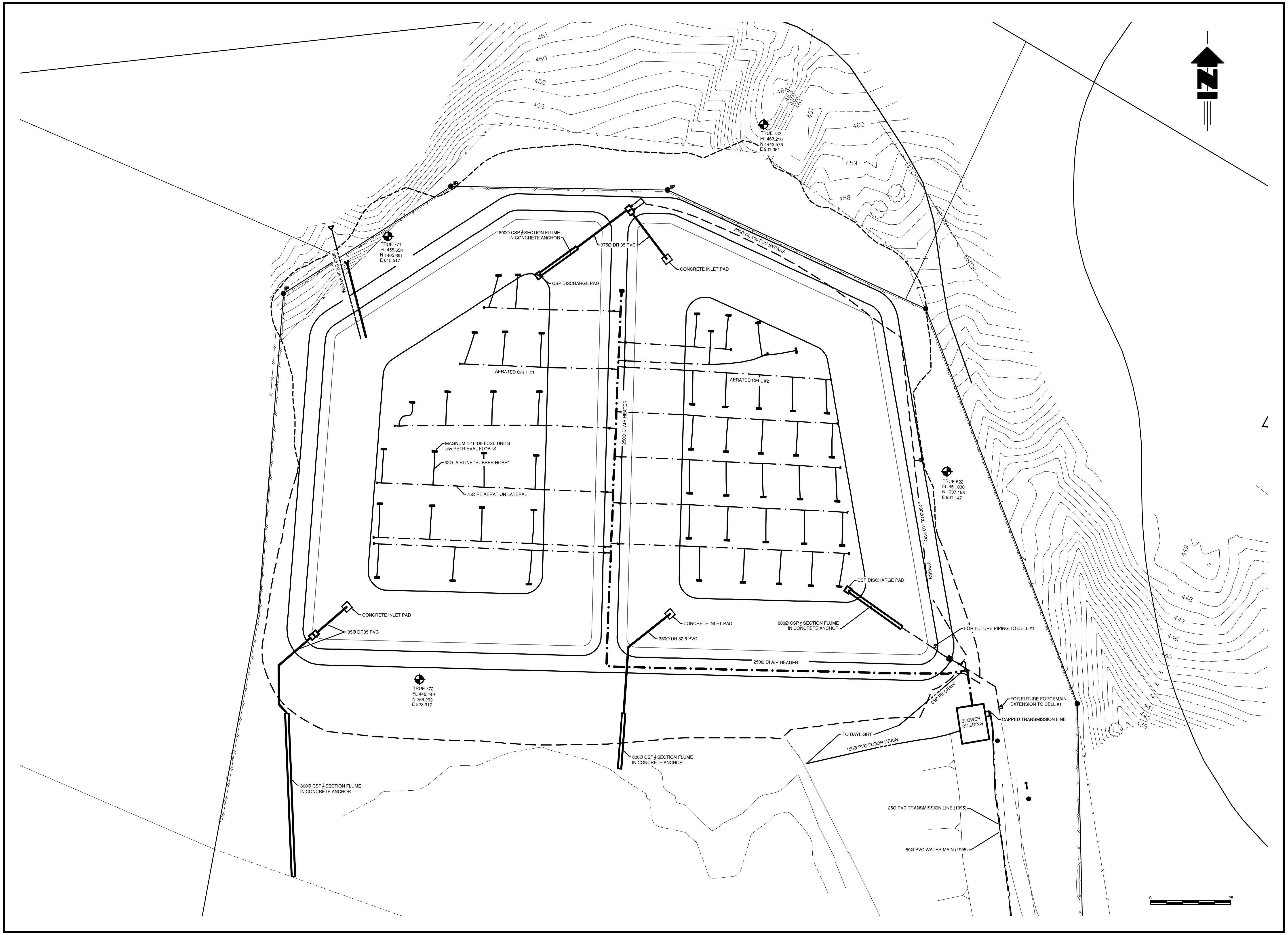


TOWN OF OLIVER
AERATED LAGOON TREATMENT SYSTEM
OVERALL SITE PLAN

TRUE CONSULTING

DESIGN BY: SAC
SCALE: 1 : 2,500
DWG NO.: FIG. 2-4
306-1751
REV: 0
DRAWN BY: SAC/DL
DATE: MARCH 2017

FILE:r:\clients\300-399\306\306-985\03 drawings\cad\02 design drawings\dn-306-985-wwtp upgrades.dwg



No.	DATE	DESCRIPTION	BY	APP'D

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING

201 - 2079 Falcon Road ■ Kamloops BC ■ V2C 4J2
tel 250.828.0881 ■ fax 250.828.0717
info@TRUE.bc.ca

BRITISH COLUMBIA
Town of Oliver

2019 SANITARY CAPITAL PLAN

AREATEION SYSTEM LAYOUT AND INTERCELL PIPING

SCALE	N.T.S. (11 X 17)
DESIGN BY	TRU
DRAWN BY	NA
DATE	JANUARY 2019
PROJECT REFERENCE No.	306-1751

DRAWING No.
FIG 2-5

SHEET 1 OF 1

ISSUE/REV.

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2.2.8 Chronological Summary of Improvements and Expansion of Sewerage Works

The Town completed their first Liquid Waste Management Plan (LWMP) in 1992, which provides a framework for collection, treatment, and disposal of wastewater. An update to the LWMP was completed in 2002, summarizing expansions and upgrades since publication of the 1992 LWMP. System improvements and expansions completed by the Town since 1966 are listed below in Table 2-1.

TABLE 2-1: CHRONOLOGICAL SUMMARY OF IMPROVEMENTS AND EXPANSIONS TO SEWERAGE WORKS

YEAR	IMPROVEMENTS AND EXPANSIONS
1966	- Sanitary sewage treatment system implementation. - Treated effluent discharged to Okanagan River.
1983	- Fairview Mountain Golf Course irrigation system constructed. - Authorization Permit No.:PE-00102
1985	- Construction of winter effluent storage and land disposal systems in the Fairview area. - Receipt of Authorization Permit No.: PE13717 - Discharge to Okanagan River discontinued. - Reclaimed water supply to Fairview Mountain Golf Course.
1992	- Adoption of Liquid Waste Management Plan - Additional lands suitable for irrigation identified.
1994	- Aerated lagoon earthworks.
1995	- Aeration system, Topping Lake manhole intake. - Blower building and appurtenances. - Operational Certificate No. PE-13717 Amended
1998	- Town initiated update of 1992 LWMP. - Rapid Infiltration Basins on Lot 2 Plan 5881.
1999	- High rate irrigation on Lots 5 and 6, Plan 5881. - Town advised that reclaimed water irrigation expansion in the Fairview area, consistent with the 1992 LWMP would not be approved.
2000	- Town initiated a second update of the LWMP, with the principle objective of identifying lands for expansion of the reclaimed water irrigation system.
2001	- Rapid Infiltration Basins on Lots 5 and 6 Plan 5881
2002	- LWMP Update reviewed and accepted.
2004	- Installation of 5020 metres of 350 mm ductile iron and PVC forcemain from the public works yard to the wastewater treatment site. - Reclaimed water supply main from 350th Ave to the cemetery. - Pressure reducing station at Oliver Secondary School. - Reclaimed water supply main from 348th Ave to the airport. - Public works yard reclaimed water service construction. - Airport reclaimed water irrigation system construction, including: pipes, fittings, sprinklers, control valves, etc. - Installation of flow meters at the airport, park adjacent to high school, cemetery and public works yard.

YEAR		IMPROVEMENTS AND EXPANSIONS
2005	-	Reclaimed water system extensions placed into service at the public works yard, Linear Park, cemetery and airport.
2009	-	Construction of raw wastewater equalization basin #2.
2010	-	Upgrading of the chlorine contact basins at the wastewater treatment facility and reclaimed watermain from the reclaimed water booster station to the chlorine contact basin.
2012	-	Installation of rotary drum screen #2.
2014	-	Construction of infiltration basin (Town sand pit).

3.0 Current and Projected Population

Population data has been updated since the 2002 LWMP Update. Using 2016 census information from Statistics Canada, projected growth rates for the short term and long term design horizons were revised.

3.1 Updated Population Data (1991-2016)

Updated population data is summarized in Table 3-1. This is compared to population estimates projected in the 2002 LWMP Update. To date, only agricultural properties in the North Tuc-El-Nuit Lake and 342nd area remain un-serviced by the Town's sanitary sewer system. Un-serviced properties within municipal boundaries represents approximately 2% of the Town's total population. For the purposes of this analysis, the Actual Population is derived from Statistics Canada and BC Stats.

TABLE 3-1 TOWN OF OLIVER POPULATION PROJECTIONS

YEAR	2002 LWMP ASSUMED POPULATION	ACTUAL POPULATION	ANNUAL AVERAGE POPULATION GROWTH RATE
1991		3,743	2.8%
**1996		4,285	-0.3%
**2001	4,867	4,224	0.7%
**2006	5,320	4,370	2.0%
*2011	5,687	4,824	0.4%
*2016	6,053	4,928	

*Source: Statistics Canada for Actual Population
**Source: BC Stats for Actual Population

3.2 Short and Long Term Population Projections

The average population growth rate from the 2001 to 2016 census is 1% annually. While BC Stats predicts population growth within the Regional District to be at a rate of 1% to 1.5%, this is mostly occurring in the City of Penticton and may not be an appropriate representation of the Region. The Town of Oliver Official Community Plan (OCP) anticipates a growth rate between -1% to 1% annually over the next 20 years. To provide a conservative estimate for analysis of the Town's sanitary system, a growth rate of 1% annually has been used for population projections within the Town of Oliver.

As shown in Table 3-2 below, the 10-year population projection (short term design horizon) is anticipated to reach a population of 5,550 and the 20-year population projection (long term design horizon) is expected to reach a population of 6,130. When compared to the 2002 LWMP Update, the actual 2018 population is approximately 1,200 fewer than previously projected.

TABLE 3-2: TOWN OF OLIVER SHORT TERM AND LONG TERM POPULATION PROJECTIONS

YEAR	2018 POPULATION PROJECTION	2002 LWMP POPULATION PROJECTIONS
2016	4,928	6,053
2017	4,977	6,127
2018	5,027	6,200
2028 (Short Term Horizon)	5,550	
2038 (Long Term Horizon)	6,130	

3.3 Land Use and Equivalent Population

In order to populate a hydraulic model of the collection network, parcel land-use was used to determine the generation rate of flow throughout the sanitary collection network. Detailed dwelling counts at existing conditions were not available from the town, therefore the OCP land-use and typical population densities were used to determine an equivalent population (see Table 3-3).

TABLE 3-3: OCP LAND USE AND POPULATION DENSITY

LAND USE	POPULATION DENSITY	
	PER HA	PER PARCEL
AGRICULTURAL		1
COMMERCIAL HWY	50	
COMMERCIAL TOURIST	50	
HIGH DENSITY RESIDENTIAL	80	
INDUSTRIAL	50	
INSTITUTIONAL	50	
LOW DENSITY RESIDENTIAL		1
MEDIUM DENSITY RESIDENTIAL	40	
OTHER LOTS		1
TOWN CENTRE	50	

Table 3-4 below shows the calculated equivalent populations for each land use category and the respective serviced area. Based on anticipated future development of undeveloped parcels, the same values were calculated for future conditions. The future equivalent population calculated referencing the OCP land use is consistent with the projected 20-year design horizon population at 1% annual population growth.

TABLE 3-4: OCP EQUIVALENT POPULATIONS

POPULATION DENSITY	EXISTING CONDITIONS		FUTURE CONDITIONS	
	EQUIVALENT POPULATION	AREA (HA)	EQUIVALENT POPULATION	AREA (HA)
AGRICULTURAL	2	0.8	2	0.8
COMMERCIAL HWY	477	9.5	1065	21.3
COMMERCIAL TOURIST	260	5.2	260	5.2
HIGH DENSITY RESIDENTIAL	760	9.5	1339	16.7
INDUSTRIAL	1560	31.2	1562	31.2
INSTITUTIONAL	1557	31.1	1557	31.1
LOW DENSITY RESIDENTIAL	1431	141.2	1463	155.3
MEDIUM DENSITY RESIDENTIAL	949	23.7	1319	33.0
OTHER LOTS	4	52.1	4	52.1
TOWN CENTRE	406	8.1	452	9.0
Total	**7406**	**312.5**	**9022**	**355.8**

4.0 Capacity Assessment of Treatment System

A capacity assessment for each component of the Town's treatment system is described below, including review of wastewater transmission, treatment and disposal. Population growth projections were integrated into the assessment, providing information on the service population capacity of each system component. This assessment was undertaken based on the 2002 LWMP Update and the OC No. PE-13717 for the system.

4.1 Wastewater Flows

4.1.1 Average Influent Flows

A comparison table of average daily and total annual influent flows are shown in Table 4-1. This table compares projections derived in the 2002 LWMP Update to actual data recorded by the Town. As seen, the average daily flow generated from recorded data in 2017 is significantly lower than the daily flow forecasted in the 2002 LWMP Update (1,888 m^3/day and 2,423 m^3/day respectively).

Table 4-1: Town of Oliver Sanitary Sewer Influent Flows from 2002-2017

	2002 LWMP			Actual			
Year	Population*	Annual Influent Volume (m^3)	Avg. Daily Flow (m^3/d)	Population	Annual Influent Volume (m^3)	Avg. Daily Flow (m^3/d)	Per Capita Flow (m^3/capita/day)
2002	4,984	744,295	2,039	4,253	726,354	1,990	0.47
2003	5,100	762,994	2,090	4,282	751,139	2,058	0.48
2004	5,173	774,771	2,123	4,312	766,048	2,099	0.49
2005	5,247	786,548	2,155	4,341	783,947	2,148	0.49
2006	5,320	798,326	2,187	4,370	829,413	2,272	0.52
2007	5,393	810,103	2,219	4,461	823,011	2,255	0.51
2008	5,467	821,880	2,252	4,552	777,154	2,129	0.47
2009	5,540	833,658	2,284	4,642	758,308	2,078	0.45
2010	5,613	845,435	2,316	4,733	701,475	1,922	0.41
2011	5,687	857,212	2,349	4,824	693,045	1,899	0.39
2012	5,760	868,990	2,381	4,845	658,002	1,803	0.37
2013	5,833	880,767	2,413	4,866	697,377	1,911	0.39
2014	5,907	892,544	2,445	4,886	634,649	1,739	0.36
2015	5,980	904,322	2,478	4,907	679,542	1,862	0.38
2016	6,053	916,099	2,510	4,928	639,794	1,753	0.36
2017	**6,127**	**927,876**	**2,542**	**4,977**	**689,098**	**1,888**	**0.38**

*Assumes 1.5% population growth rate from 2002 onwards.

The decrease in per capita sewage flows observed over the past twelve years can be attributed to legislation within the province related to low flow fixture installation, greater public awareness and conservation efforts, as well as disconnection of the Vincor winery. Future wastewater flows derived herein are based on a per capita contribution of 0.38 m^3/day and a population growth rate of 1% annually, as shown in Table 4-2.

TABLE 4-2: PROJECTED FUTURE INFLUENT FLOWS

YEAR	PROJECTED POPULATION	ANNUAL AVERAGE FLOW (M^3/D)	AVERAGE FLOW (L/S)
2017	4,977	1,888	21.9
2018	5,027	1,907	22.1
2023	5,283	2,004	23.2
2028	5,553	2,107	24.4
2033	5,836	2,214	25.6
2038	6,134	2,328	26.9
2043	6,446	2,446	28.3
2048	6,775	2,571	29.8
2053	7,121	2,703	31.3
2058	7,484	2,841	32.9
2063	7,866	2,986	34.6
2068	8,267	3,138	36.3
2073	8,689	3,299	38.2
2078	9,132	3,467	40.1
2083	9,598	3,644	42.2

4.1.2 Reservoir Operational Data

Effluent is stored in the Town's storage reservoir during the winter months (October to April). This equates to ± 240 days residence time in the reservoir, including a 60-day retention time, as per the requirements of the Town's OC. Reservoir operational data from 2002-2017 is presented in Table 4-3 on Page 17. The total storage utilized per capita ranges from 37-63 m^3 annually. Per capita storage from 2002 was excluded from this range, as the value appears to be a data anomaly. Variability in the rate of utilization can be attributed to climatic factors and user demand.

4.1.3 Annual Effluent Flows

The overall hydraulic balance of treated effluent from 2002 to 2017 is presented in Table 4-4 on Page 18. As seen, total influent volumes have decreased significantly since 2002 and the net effluent storage per capita has varied from year to year. Fluctuations in the reservoir storage requirements are related to seasonal weather variations and changes in user demand effecting irrigation demand. Unaccounted losses are comprised of seepage from the aerated lagoons and effluent storage reservoir, evaporative losses, and flow meter inaccuracies.

Table 4-3: Reservoir Storage and Irrigation Summary 2002-2017

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Volume in Storage on Jan. 1 (m^3)	82,000	90,000	213,000	272,000	205,000	197,000	170,000	167,000	200,000	223,000	197,000	211,000	284,000	223,000	214,000	247,000
Total Influent Volume (m^3)	726,354	751,139	766,048	783,947	829,413	823,011	777,154	758,308	701,475	693,045	658,002	697,377	634,649	679,542	639,794	689,098
Total Irrigation Volume (m^3)	433,620	401,022	329,575	620,982	636,315	649,220	606,744	520,530	519,803	470,917	489,241	476,510	482,164	504,049	454,221	437,919
Rapid Infiltration (m^3)	0	54,300	139,470	0	0	0	0	0	0	0	0	0	0	0	0	23,322
Unaccounted Losses (m^3)	284,734	172,817	238,003	229,965	199,098	200,791	173,410	206,778	159,672	248,128	154,761	147,867	213,485	184,493	152,573	199,857
Net Storage at Year-End (m^3)	90,000	213,000	272,000	205,000	199,000	170,000	167,000	198,000	222,000	197,000	211,000	284,000	223,000	214,000	247,000	275,000
Total Area Irrigated (m^2)	450,000	450,000	450,000	186,000	613,000	613,000	613,000	613,000	660,000	660,000	660,000	660,000	186,000	186,000	186,000	623,000
Storage Period (days)	147	153	231	189	189	177	199	180	198	168	161	118	168	183	168	147

Table 4-4: Winter Effluent Storage Operating Data

Year	Date		Elevation (m)	Storage Volume (m^3)	Storage Period (days)	Total Storage Used (m^3)	Total Storage per Capita (m^3/capita)
2002	Max.	22-Apr-02	443.73	228,000	147	90,000	21
	Min.	16-Sep-02	440.05	34,000			
2003	Max	22-Apr-03	443.96	240,000	153	213,000	50
	Min.	22-Sep-03	440.66	59,000			
2004	Max.	19-Apr-04	445.77	377,000	231	272,000	63
	Min.	06-Dec-04	444.22	260,500			
2005	Max.	18-Apr-05	446.4	390,000	189	205,000	47
	Min.	24-Oct-05	441.18	81,000			
2006	Max.	24-Apr-06	446.2	380,000	189	199,000	46
	Min.	30-Oct-06	440.81	67,000			
2007	Max.	30-Mar-07	446	370,000	177	170,000	38
	Min.	23-Sep-07	440.34	40,000			
2008	Max.	13-Apr-08	445.28	339,000	199	167,000	37
	Min.	29-Oct-08	440.39	49,000			
2009	Max.	14-Apr-09	445.45	344,000	180	198,000	43
	Min.	11-Oct-09	440.72	61,000			
2010	Max.	06-Apr-10	445.64	352,000	198	222,000	47
	Min.	21-Oct-10	440.95	71,000			
2011	Max.	11-Apr-11	445.75	357,000	168	197,000	41
	Min.	26-Sep-11	441.09	76,000			
2012	Max.	02-May-12	445.36	338,000	161	211,000	44
	Min.	10-Oct-12	440.99	72,000			
2013	Max.	25-Apr-13	445.52	355,000	118	284,000	58
	Min.	21-Aug-13	441.67	106,000			
2014	Max.	31-Mar-14	446.06	374,000	168	223,000	46
	Min.	15-Sep-14	441.39	92,000			
2015	Max.	07-Apr-15	445.62	351,000	183	214,000	44
	Min.	07-Oct-15	441.52	101,000			
2016	Max.	04-Apr-16	445.47	343,000	168	247,000	50
	Min.	19-Sep-16	441.60	105,000			
2017	Max.	22-May-17	446.17	379,000	147	275,000	55
	Min.	16-Oct-17	442.75	167,000			

Historically, reclaimed water usage has been measured by a flow meter located at the booster station (adjacent to the reclaimed water storage reservoir), the Alonso property and the Higgins property. In 2005, flow meters were installed at the cemetery, Linear Park, the airport, the school, and the public works yard. Reclaimed water usage at the Fairview Mountain Golf Course is calculated as the total annual irrigation volume less all other metered usage. Table 4-5 lists the sites currently serviced with reclaimed water irrigation and their total irrigated area.

TABLE 4-5: TOWN OF OLIVER IRRIGATION AREAS

LOCATION	AREA (M³)
Fairview Mountain Golf Course	450,000
Cemetery	23,000
103rd Street Linear Park	8,000
Airport	126,000
Public Works Yard	6,000
Alonso2	10,000
Huggins2	37,000
Secondary School	7,000
Total	**667,000**

4.2 Equalization Basin

Cell 1 has a total storage volume of 1,100 m^3 and was designed to include equalization storage (15% of average daily flow) and emergency storage (12 hours or 50% of average daily flow). A residence time of 0.67 days is used for storage capacity projections. This measurement is derived using a maximum storage period of 16 hours, as per peak electricity rate hours during the shoulder season (i.e. Mar.-Jun., Sept. and Oct.).

Cell 2 was constructed northeast of the existing equalization basin and provides operational storage of 2,300 m^3. A residence time of 0.67 days was again assumed for capacity projections. An overview of the equalization basin Cell 2 system expansion design and pre-design brief can be found in Appendix B. The total available storage of the two equalization basins, as well as the 900 m^3 of emergency storage described in Section 2.2.2, is summarized in Table 4-6.

TABLE 4-6: EQUALIZATION BASIN STORAGE CAPACITY

STORAGE AREA	TOTAL STORAGE VOLUME (M³)
Equalization Cell 1	1,100
Equalization Cell 2	2,300
Emergency Storage (in original treatment plant location)	900
Total Capacity	**4,300 m³**
Total Capacity excl. Emergency Storage	**3,400 m³**

The total design capacity of the two equalization basins is 3,400 m^3, excluding emergency storage. Table 4-7 forecasts storage requirements for operation using a 0.67 day residence time. Under this operational design, capacity is estimated to be reached in 2090. This projection assumes a 1.3 factor of safety, 1% population growth, 0.38 m^3/capita*day generation rate and 16-hour storage period. This capacity projection defines the point at which the system will no longer be able to store effluent to pump during off-peak hours.

Table 4-7: Equalization Basin Storage Capacity Projection

Year	Population (1% Growth Rate)	Flow (m^3/d)	Storage Required (m^3)
2017	4,977	1,888	1,636
2018	5,027	1,907	1,653
2019	5,077	1,926	1,669
2020	5,128	1,945	1,686
2025	5,389	2,045	1,772
2030	5,664	2,149	1,863
2035	5,953	2,259	1,958
2040	6,257	2,374	2,058
2045	6,576	2,496	2,163
2050	6,912	2,623	2,273
2055	7,264	2,757	2,389
2060	7,635	2,898	2,512
2065	8,024	3,046	2,640
2070	8,433	3,201	2,775
2075	8,864	3,365	2,916
2080	9,316	3,537	3,065
2085	9,791	3,717	3,222
2090	10,290	3,907	3,386
2091	10,393	3,946	3,420

4.3 High Lift Station

The SCADA system records the pump hours and number of starts at the High Lift Station, as well as the total daily flow using a flow totalizer. Based on this data, the operating capacity of the High Lift Station is approximately 30 L/s per pump. The Lift Station contains three pumps, one of which is reserved as a stand-by unit, meaning that the design capacity of the Lift Station is approximately 40 L/s (3,450 m^3/day).

As influent is stored in the equalization basins such that pumping can be done in off-peak hours, the capacity assessment of the High Lift Station is subject to average influent flows, rather than peak daily flows. Based on Table 4-7 above, the High Lift Station configuration is anticipated to meet the average daily flow pumping requirements until 2077, well past the long term design horizon (≥ 20 years).

4.4 Treatment

The two aerated lagoons in service have a combined capacity of approximately 75,800 m^3 and an operating depth of 5.3 m. Aeration is achieved through a submerged bottom fixed fine bubble diffuser system. A design summary was completed by TRUE in 2018 (see Appendix A) to establish the approximate timeline for construction of aerated lagoon No.1. Under existing conditions with lagoons fully de-sludged, it was determined that effluent BOD will exceed permitted concentrations in 2077, with a population of 9,080 people at 1% annual growth rate.

Under existing conditions where lagoons are not de-sludged, effluent BOD will exceed permitted concentrations in 2040, with a population of approximately 6,300 people. Under these assumptions, it is not anticipated that construction of the future aerated lagoon No. 1 will be required until 2040. This timeline will be dependent upon sludge accumulation, future desludging efforts and actual population growth rates.

A preliminary design for aerated lagoon No. 1 was completed by TRUE to determine the future Right of Way (ROW) area requirements for construction. In February 2017, a crown land tenure application was submitted to the Ministry of Forests, Lands, and Natural Resource Operations and Rural Development (FLNRORD) to obtain crown land necessary for the construction of aerated lagoon No.1. FLNRORD indicated the crown land tenure ROW necessary for the future construction of the lagoon could be incorporated into the Oliver Mountain assessment.

4.5 Winter Effluent Storage

The storage reservoir water elevation fluctuates between 439.00 m and 447.00 m, between which the total storage provided is estimated to be approximately 470,000 m^3. The lower elevation limit was generated based on a 60-day effluent residence time prior to discharge for irrigation.

The service capacity of the storage reservoir is dependent on climatic conditions both in the preceding irrigation season and the spring following the storage period. Construction of the infiltration basin in 2014 now assists the Town in addressing climatic variability. Winter storage requirements are derived from volume and flow data. A summary of winter effluent storage volumes from 2007-2017 is provided in Figure 4-1.

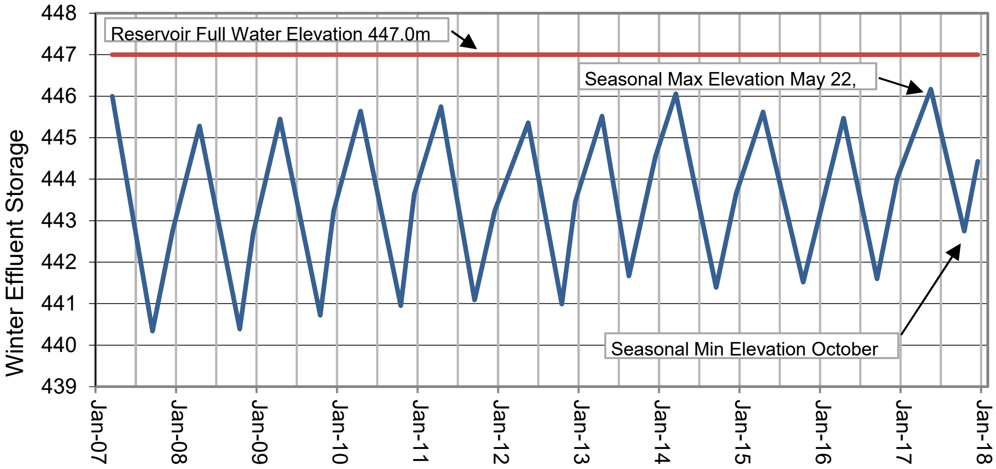


FIGURE 4-1: RESERVOIR WINTER EFFLUENT STORAGE ELEVATIONS (2005-2017)

A per capita storage requirement of 47 m^3/capita was averaged from 2003 to 2017. A multiplication factor of 1.2 was added to allow for a conservative estimate of future requirements. A 21 m^3/capita contribution provision was applied to meet the 60-day minimum retention time (as stated in the OC for PE 13717). This equates to a total requirement of 77 m^3/capita.

Measured storage requirements to date and projected requirements are presented in Table 4-8. Based on the above assumptions, the reservoir is anticipated to reach its design capacity in 2037 without any upgrades to the system or expansion of the reclaimed water irrigation area.

TABLE 4-8: RESERVOIR WINTER STORAGE REQUIREMENTS

YEAR	POPULATION (1% GROWTH)	VOLUME (M^3)
2018	5027	387,083
2019	5077	390,954
2020	5128	394,863
2021	5179	398,812
2022	5231	402,800
2023	5283	406,828
2024	5336	410,896
2025	5390	415,005
2026	5444	419,155
2027	5498	423,347
2028	5553	427,581
2029	5609	431,856
2030	5665	436,175
2031	5721	440,537
2032	5778	444,942
2033	5836	449,391
2034	5895	453,885
2035	5954	458,424
2036	6013	463,008
2037	6073	467,639

4.6 Reclaimed Water Irrigation

There are five reclaimed water supply mains: the original two to Fairview Golf Course and the old forcemain to the Public Works Yard were built in 1983. The other three mains were built in 2004. It is recommended that Town Operations maintain a record of leaks, repairs, or operational concerns on the original supply mains to ensure their condition is being monitored.

An irrigation area expansion plan was submitted to the MOE in December 2018. Following submission of the 2019 Liquid Waste Management Plan Update and Sanitary Sewer Annual Report, the MOE will proceed with an amendment of the Town's OC to be consistent with current reclaimed water irrigation areas.

5.0 Collection Network Hydraulic Model Results

The following sections summarizes the development, methodology, and results of the hydraulic model of the gravity collection network.

5.1 Wastewater Flows

5.1.1 Diurnal Curve

Historical SCADA data is available from the Town of Oliver for pump hours and number of starts at each Lift Station. Unfortunately, there are no flow meters throughout the collection network until the screening station which only recently began storing data in December 2018. In order to convert the pump hours to flow rate, a system curve analysis was conducted with pump specifications provided by Town staff.

Data from 2015-2018 was analyzed to determine the actual sub-daily flows for use in the hydraulic model. The selected diurnal curve is shown in Figure 5-1 for the Influent LS, which represents the Town's entire catchment. In 2016 and 2017, there was a distinct increase in flows between dry weather and freshet conditions at the Influent LS and MacPherson LS likely due to their catchments' proximity to the Okanagan River. The increased level of the Okanagan River follows a similar trend year-to-year compared to the increase in sewage flows in the spring. Therefore, Figure 5-1 shows diurnal curves for dry weather and freshet conditions.

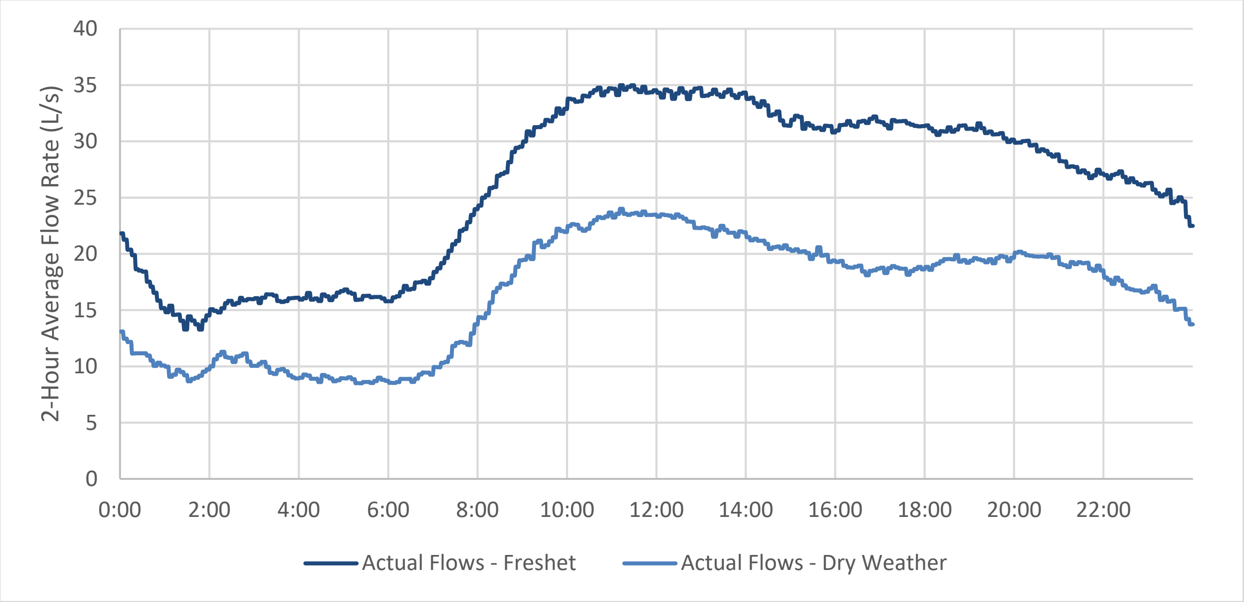


FIGURE 5-1: INFLUENT LIFT STATION DIURNAL CURVES – DRY WEATHER AND FRESHET

The average daily flow at the Influent LS has been determined as 17.5 L/s in the dry season, and 26.2 L/s during freshet. These values are consistent with the treatment facility's average annual flow of 21.9 L/s in 2017. During freshet, the Influent LS experienced 9.7 L/s of additional peak flow; while the McPherson LS experienced 1.1 L/s of additional peak flow.

5.1.2 Rain Event I&I

SCADA data was analyzed for possible Inflow and Infiltration (I&I) on all peak rain event days from 2015 to present. Peak rain events were determined using Osoyoos' daily precipitation data, which was checked against the Town of Oliver's daily recorded rainfall. This I&I analysis found no pattern of increased flows during peak rain events until two events in March 2018, in which the Influent LS experienced 16.7 L/s in additional peak flow.

This sudden change is I&I response may be the result of construction sites draining excess surface water into the sanitary system, which has been a concern for the Town in recent years. For the purpose of this analysis, a constant I&I design criteria of 8000 L/Ha/Day has been assigned.

5.1.3 Land-Use Generation Rates

Using the equivalent population from the OCP land use described in Section 3.3 and an equivalent per capita flow rate in the dry season and during freshet, a generation rate was assigned to each OCP parcel under existing and future conditions. Table 5-1 below shows the estimated amount of flow that is contributed from each land use category. Under both existing and future conditions, the primary contributors are Industrial, Institutional, and Low Density Residential.

TABLE 5-1: GENERATION BASELINE FLOWS BY OCP LAND USE

OCP LAND USE	EXISTING – AVERAGE FLOW RATE (L/S)	FUTURE – AVERAGE FLOW RATE (L/S)
AGRICULTURAL	0.0	0.0
COMMERCIAL HWY	1.1	2.5
COMMERCIAL TOURIST	0.6	0.6
HIGH DENSITY RESIDENTIAL	1.8	3.2
INDUSTRIAL	3.7	3.7
INSTITUTIONAL	3.7	3.7
LOW DENSITY RESIDENTIAL	3.4	3.5
MEDIUM DENSITY RESIDENTIAL	2.2	3.1
OTHER LOTS	0.0	0.0
TOWN CENTRE	1.0	1.1
Total	**17.5**	**21.3**

5.1.4 Lift Stations & Force Mains

Through the pump curve analysis, the operating point of each pump was calculated and presented in Table 5-2. As mentioned, each lift station is designed with a stand-by pump such that the design capacity of each station assumes that one pump is offline.

TABLE 5-2: LIFT STATION ESTIMATED OPERATING POINTS AND AVERAGE DAILY FLOWS

LIFT STATION	# OF PUMPS	PUMP OPERATING POINT (L/S)	LIFT STATION DESIGN CAPACITY (L/S)
Influent Lift Station	3	35	70
McPherson	2	18.5	18.5
Rockcliffe	2	5.8	5.8
Rotary Beach	2	14.9	14.9
Sawmill Road	2	25.5	25.5
Scott Road	2	15	15

5.2 Model Development

A hydraulic model was developed using the latest version of PCSWMM in order to model all sanitary sewers and lift stations up to the Influent LS. The base data for the sanitary network was sourced from TRUE's GIS data of the Town's sanitary system. This GIS data included some general attributes (diameter, length, direction) of each conduit, but did not include any elevation data.

Manhole surface elevations were provided by Town staff from a survey conducted in 2018. The locations of surveyed manholes were compared to the GIS data and analyzed for data gaps. Invert elevations and other data gaps were first filled with information from record drawings as available; attributes such as diameter and direction of flow were also confirmed through record drawings. In the absence of record information, values were assumed based on surrounding information (e.g. inverts were interpolated based on available inverts nearby). All changes to the data set were tracked and coded so that staff could review and potentially update the base GIS data set.

Average daily flows were developed for all scenarios based on parcel area, generation rate, population densities and equivalent populations as detailed previously. The flows were spatially distributed through the model utilizing the spatial proximity of a parcel to the sanitary network. The model calculates the peak flow for each pipe segment by applying the diurnal curve to the average daily flow, routing the flows through the system, and applying a constant inflow for I&I and freshet flows.

5.3 Model Results

The model results have been summarized in Table 5-3 under the following four flow conditions:

TABLE 5-3: COLLECTION NETWORK HYDRAULIC MODEL SCENARIOS

CONDITIONS	SEASON	RAIN EVENT I&I (L/HA/DAY)	AVERAGE DAILY FLOW (L/S)	PEAK FLOW (L/S)	TOTAL DAILY VOLUME (M³)
Existing	Dry Weather	N/A	17.4	23.8	1,510
Existing	Freshet	8,000	37.5	66.5	3,240
Future	Dry Weather	N/A	21.3	29.6	1,840
Future	Freshet	8,000	41.2	71.0	3,560

5.3.1 Existing Conditions

The total daily flow under existing dry weather conditions reported in the model is 1,510 m³/day, with an average daily flow of 17.4 L/s and a peak daily flow of 23.8 L/s. Existing flows were also modelled in a wet weather scenario with a baseline I&I from freshet and I&I from a rain event during peak hours; the resulting total daily flow was 3,240 m³/day, with an average daily flow of 37.5 L/s and a peak daily flow of 66.5 L/s. Figure 5-2 below shows the modelled sub-daily data for inflow to the Influent LS under these existing conditions, overlaid with the actual diurnal curves for the Influent LS.

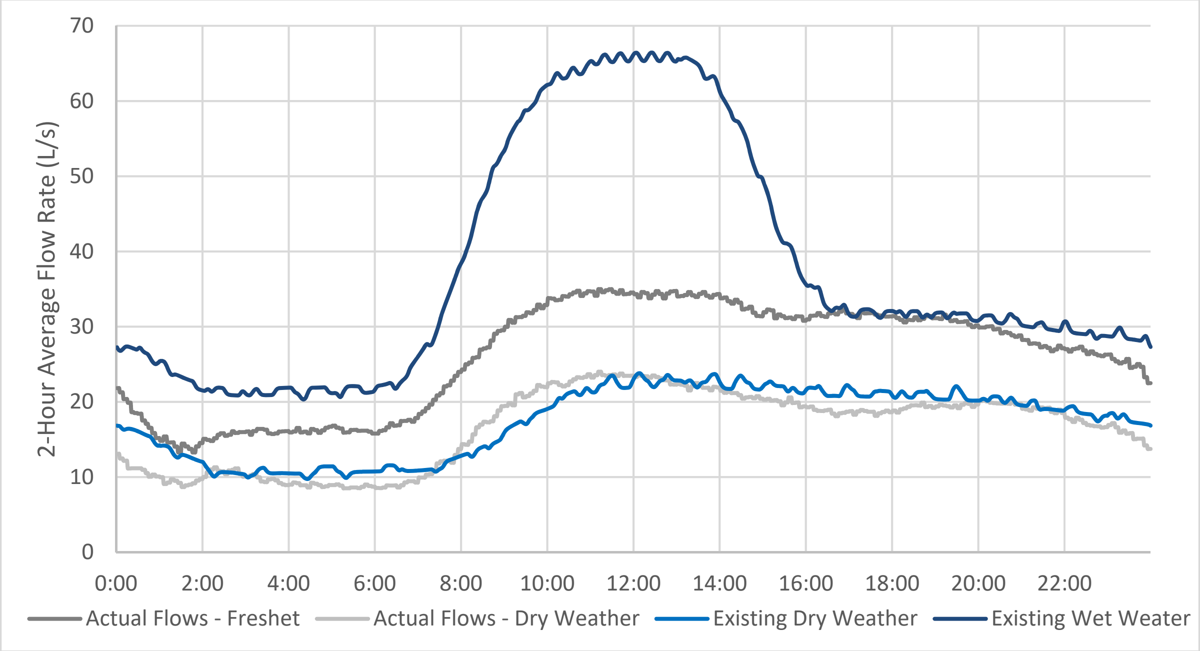
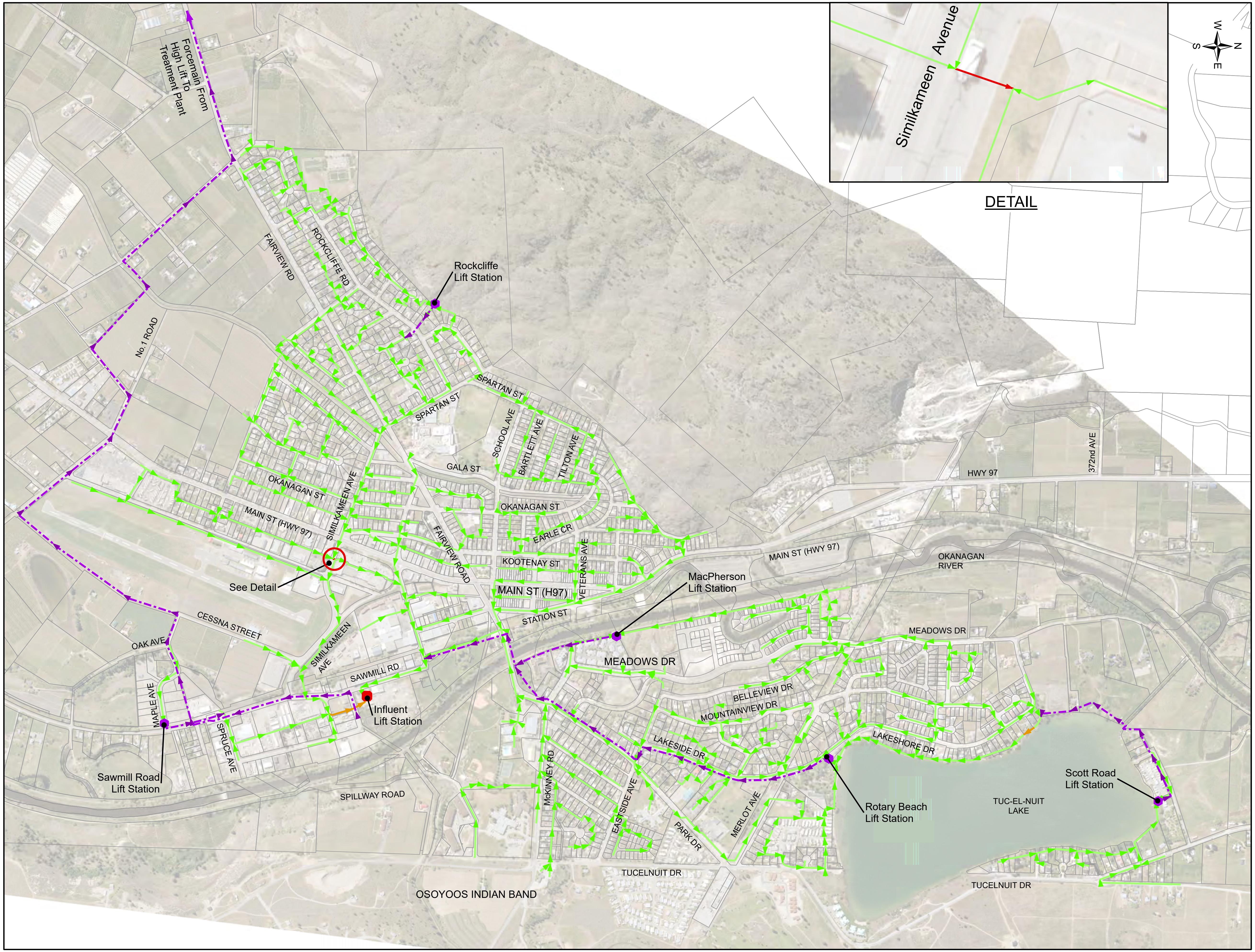


FIGURE 5-2: PCSWMM RESULTS AT INFLUENT LIFT STATION – EXISTING CONDITIONS



British Columbia Town of Oliver

Model Results- Existing and Future Wet Weather Conditions

Legend

- Forcemains
- ● Lift Stations
- 🟥 Influent Lift Station

Sanitary Mains

Max Flow / Full Flow

- < 0.50
- 0.50 - 0.66
- > 0.66
- ☐ Property Cadastre

1:12,500

0 125 250 500 Meters

TRUE

Figure 5-3

R:\Clients\300-399\306\306-1751\03 Drawings\GIS\Maps\306-1751-003 Fig Existing and Future Wet Conditions.mxd

During dry weather flows, there is no apparent surcharging of manholes or pipe, flooding, or pipe flowing above 2/3 of full flow. During wet weather conditions, there is one section of pipe operating above 2/3 of full flow, five sections above 1/2 of full flow, and no flooding or surcharging of manholes. Table 5-4 and Figure 5-3 (previous) summarize the pipe sections above 1/2 and 2/3 of full flow.

TABLE 5-4: PCSWMM RESULTS – EXISTING CONDITIONS - GRAVITY PIPE ABOVE 1/2 FULL FLOW

ID	INLET NODE	OUTLET NODE	DIAM (MM)	SLOPE (%)	LENGTH (M)	MAX/FULL FLOW RATIO	MAX DEPTH/ DIAMETER RATIO
C2	D-178	D-177	0.2	0. 2	8.5	1.09	0.58
C712	T-696	T-697	0.3	0.1	45.1	0.61	0.39
C12	D-152	D-101	0.25	0.6	17.6	0.57	0.57
C376	D-153	D-152	0.25	0.6	48.2	0.55	0.54
C377	D-155	D-154	0.25	0.6	11.5	0.55	0.53
C81	D-154	D-153	0.25	0.6	76.2	0.55	0.53

5.3.2 Future Conditions

The same dry weather and wet weather conditions were modelled for future generated flows for a 20-year design horizon. The total daily flow under future dry weather conditions reported in the model is 1,840 m³/day, with an average daily flow of 21.3 L/s and a peak daily flow of 29.6 L/s. Existing flows were also modelled in a wet weather scenario with a baseline I&I from freshet and I&I from a rain event during peak hours; the resulting total daily flow was 3,560 m³/day, with an average daily flow of 341.2 L/s and a peak daily flow of 71.0 L/s. Figure 5-4 below shows the modelled sub-daily data for inflow to the Influent LS under these future conditions, overlaid with the actual diurnal curves for the Influent LS.

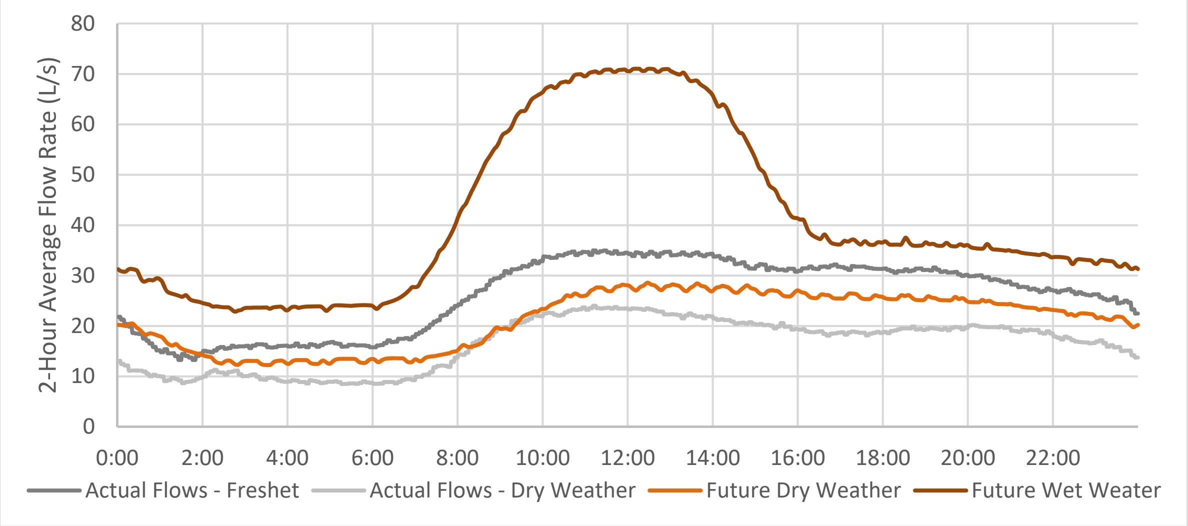


FIGURE 5-4: PCSWMM RESULTS AT INFLUENT LIFT STATION - FUTURE CONDITIONS

The results under future conditions are comparable to existing conditions: there is no surcharging or flooding of nodes, and the same sections of pipe operating above 1/2 and 2/3 of full flow under wet weather conditions.

5.3.3 Lift Station Performance

Table 5-5 below shows the peak inflows to each lift station under the maximum flow conditions (future wet weather), the operating capacity of each station based on the system curve analysis, and the surplus or deficit of capacity at peak flow.

TABLE 5-5: PCSWMM RESULTS – FUTURE WET WEATHER CONDITIONS - LIFT STATION CAPACITIES

LIFT STATION	LIFT STATION DESIGN CAPACITY (L/S)	PEAK INFLOW (L/S)	SURPLUS (+) / DEFICIT (-) IN CAPACITY (L/S)
Influent Lift Station	70	71.0	-1.0
McPherson	18.5	8.1	10.4
Rockcliffe	5.8	5.3	0.5
Rotary Beach	14.9	15.5	-0.6
Sawmill Road	25.5	1.1	24.4
Scott Road	15	1.8	13.1

Although Rotary Beach LS's capacity is exceeded in the model, Figure 5-5 below shows that the pump is able to continue pumping down the water level in the Lift Station at a slower rate. The Influent LS also has a deficit in capacity from peak flow and may not be capable of keeping up with the additional peaks in flow caused by the other lift stations.

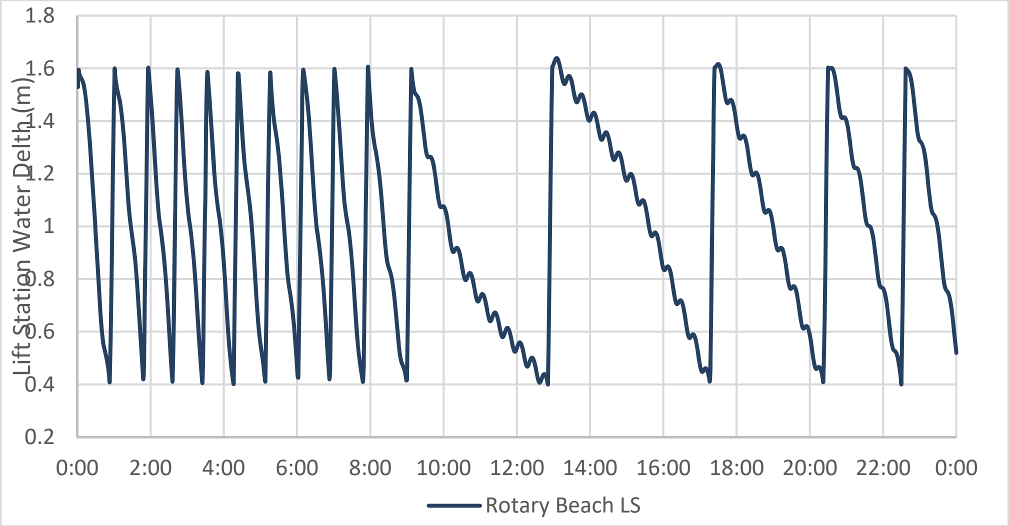


FIGURE 5-5: PCSWMM RESULTS – ROTARY BEACH LIFT STATION DEPTH

5.4 Asset Management

5.4.1 Collection Network

Developing a hydraulic model for the Town's sanitary collection network involved a systematic and in-depth review of the Town's sanitary manholes and linear assets. The data set has been improved based on the best available information and should be adopted as the Town's base data set to be maintained and improved upon over time.

The Town currently manages approximately 41.5 km of sanitary collection infrastructure including Polyvinyl Chloride (PVC), Vitrified Clay Tile (VCT), and Asbestos Cement (AC) pipe. Figure 5-6 provides a summary of the material types while Figure 5-7 provides and overview of materials for pipe segments in the system.

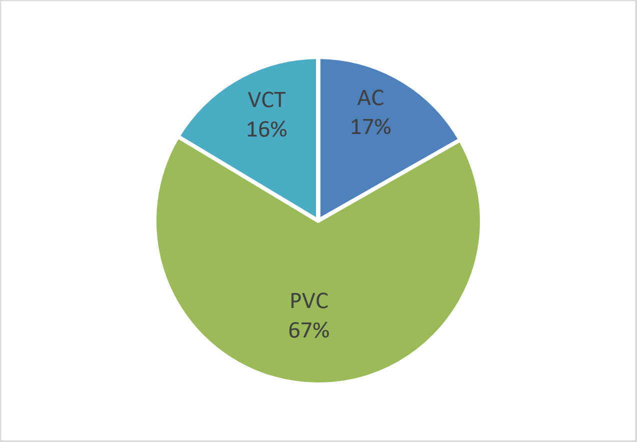


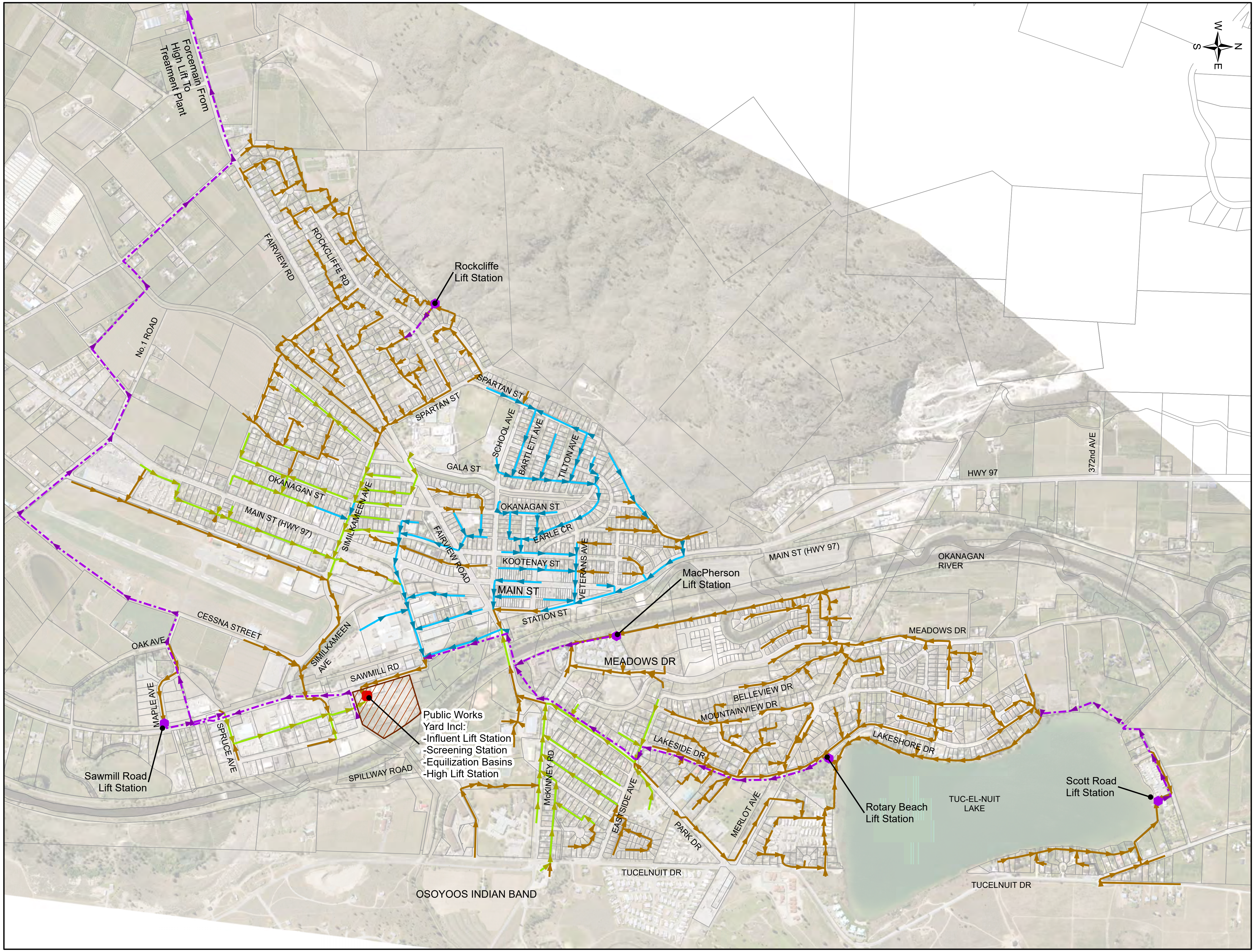
FIGURE 5-6: COLLECTION NETWORK PIPE MATERIAL PIE CHART

The outputs of a hydraulic model allow performance of the system to be incorporated into decision making for capital projects and assists with the prioritization of replacement projects. A simple risk model was developed to identify and prioritize replacement projects. The risk equation is:

Risk = Probability x Criticality

Probability was determined based on condition (if available) and remaining useful life which is a function of material and installation year. Condition inspections were conducted on many of the older VCT and AC pipes in 2016 and 2017. Criticality is based on size of pipe, contributing serviced area, and the max/full flow ratio from the model. In addition to compliance with the Sewerage System Regulation of BC, the Town of Oliver Subdivision and Development Servicing Standards outlines design standards for the sanitary sewer system including the maximum to full flow ratio is not to exceed 2/3 for pipe over 200 mm in diameter.

Once the risk score was determined, the assets were classified into high, medium, and low categories. Table 5-6 provides a breakdown of the risk categories.



BRITISH COLUMBIA
Town of Oliver

Asset Management Materials

Legend

▨ Public Works

● Lift Stations

🟥 Influent Lift Station

Forcemains

MATERIAL

AC

PVC

VCT

☐ Property Cadastre

1:12,500

0 125 250 500 Meters

TRUE

Figure 5-7

R:\Clients\300-399\306\306-1751\03 Drawings\GIS\Maps\306-1751-004 Fig Asset Management Material.mxd

TABLE 5-6: COLLECTION NETWORK - SUMMARY OF RISK SCORES

CATEGORY	LENGTH (M)	PERCENTAGE OF COLLECTION NETWORK
High	3,800	9%
Medium	4,700	11%
Low	33,000	80%

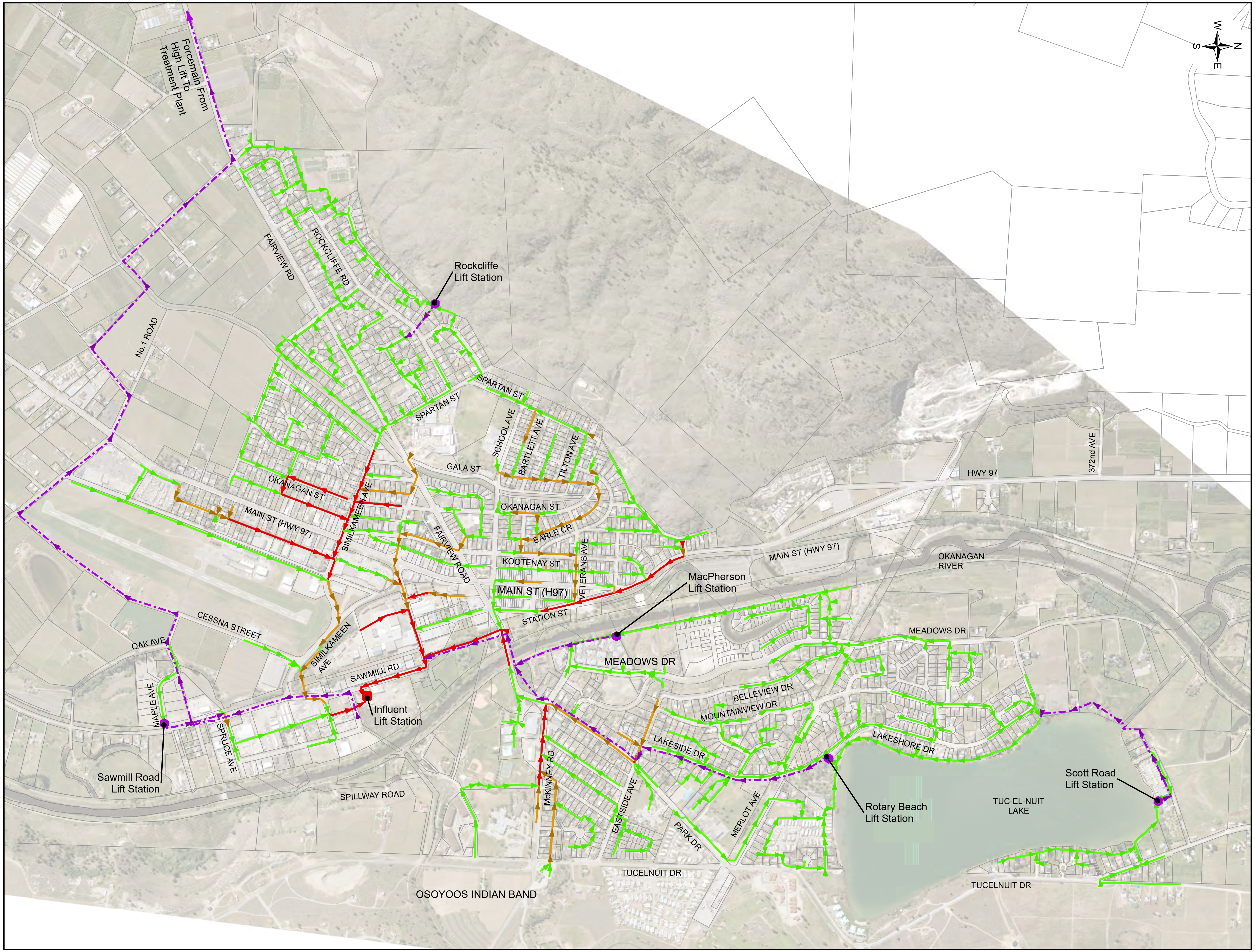
The dividing line between categories is rather arbitrary and was set based on experience with other municipalities. Figure 5-8 breaks out the risk categories by pipe material.

FIGURE 5-8: RISK SCORES BY PIPE MATERIAL

The AC and VCT pipe are largely classified as high and medium-risk due their age and estimated remaining useful life. However, the condition inspections from 2016 and 2017 show that some of the AC and VCT pipe is in good condition. PVC pipes are generally newer assets in the system and are classified as low risk. However, there are some segments of PVC near the Influent LS which have been flagged as high and medium risk due to their size and large contributing area. Figure 5-9 highlights the risk categories throughout the collection network.

5.4.2 Lift Stations & Forcemains

The Town keeps a record of lift station pump models and installation years as shown below in Table 5-7. Based on a 20-year useful life, three pumps should be assessed for replacement.



BRITISH COLUMBIA
Town of
Oliver

Asset Management Risk Categories

Legend

- Forcemains
- ● Lift Stations
- 🟥 Influent Lift Station

Sanitary Mains

RISK

- High
- Medium
- Low
- ☐ Property Cadastre

1:12,500

0 125 250 500
Meters

TRUE

Figure 5-9

R:\Clients\300-399\306\306-1751\03 Drawings\GIS\Maps\306-1751-005 Fig Asset Management Risk Categ.mxd

TABLE 5-7: ASSET MANAGEMENT - LIFT STATION PUMPS

LIFT STATION	ASSET	MANUFACTURER	MODEL #	INSTALL YEAR	USEFUL LIFE	USEFUL LIFE REMAINING	ANTICIPATED REPLACEMENT YEAR
Rotary Beach	Pump 1	Flygt	3153.185	2018	20	19	2038
	Pump 2	Flygt	3152.181	1993	20	-6	2013
Rockcliffe	Pump 1	Flygt	3127.180	1994	20	-5	2014
	Pump 2	Flygt	3127.180	1994	20	-5	2014
Scott Road	Pump 1	Flygt	3127.181	2010	20	11	2030
	Pump 2	Flygt	3127.181	2010	20	11	2030
Sawmill Road	Pump 1	Flygt	3085.183	2014	20	15	2034
	Pump 2	Flygt	3085.183	2014	20	15	2034
MacPherson	Pump 1	Flygt	3127.181HT	2013	20	14	2033
	Pump 2	Flygt	3127.160	2017	20	18	2037
Influent Lift	Pump 1	Flygt	3127.181	2013	20	14	2033
	Pump 2	Flygt	3127.181	2012	20	13	2032
	Pump 3	Flygt	3127.160	2015	20	16	2035

The forcemain asset information is summarized in Table 5-8 below. The forcemains were installed in the 1980s and 1990s using PVC.

TABLE 5-8: ASSET MANAGEMENT - FORCEMAINS

FORCEMAINS	LENGTH (M)	MATERIAL	DIAMETER (MM)	INSTALL YEAR	USEFUL LIFE	USEFUL LIFE REMAINING	ANTICIPATED REPLACEMENT YEAR
MacPherson Lift Station to 350th Ave Bridge	373	PVC	150	1983	80	44	2063
Junction by 350th Ave. Bridge to MH D-104	418	PVC	200	1983	80	44	2063
Rotary Beach Lift Station to 350th Ave Bridge	1298	PVC	150/250	1982	80	43	2062
Rockcliffe Lift Station to MH D-232	158	PVC	100	1994	80	55	2074
Scott Road Lift Station to MH T-751	720	PVC	150	1993	80	54	2073

6.0 System Upgrades

Based on these capacity assessments, a list of system upgrades has been developed for the collection network, lift stations, and treatment system. For the collection network, these projects are primarily based on available asset information; The first step in all recommended system upgrades is to verify the GIS information and determine the actual condition of these assets in order to avoid premature replacement. Alternatively, the Town may choose to undertake any of these projects outright based on its criticality to the system as risk of continued degradation may not be acceptable to the Town.

6.1 Collection Network

As discussed in Section 5.4, the risk model identified approximately 4 km of sanitary piping as high risk and therefore due for replacement or rehabilitation. The risk model is a prioritization tool to indicate which assets should be considered or investigated first.

The following list of projects has been developed assuming that all assets in the high-risk category need replacement or rehabilitation. These preliminary cost estimates will assist the Town in incorporating projects into their capital planning. Following further investigation into the high-risk assets, the Town may wish to reprioritize these projects if specific assets are found to be in satisfactory condition or the GIS information was incorrect.

TABLE 6-1: SANITARY COLLECTION NETWORK - SYSTEM UPGRADES

ID	PROJECT	EST. CAPITAL COST	EST. DCC ELIGIBILITY
S1	Fairview to Sawmill Road	$425,000	75%
S2	Main & Station Street (Hillside to Bank Ave)	$583,000	69%
S3	Similkameen Avenue (Tulameen to Airport)	$601,000	32%
S4	Okanagan Street at Similkameen	$564,000	0%
S5	Airport Street Alley (Skagit to Similkameen)	$313,000	0%
S6	McKinney Road (Coyote to Park)	$117,000	0%
S7	River Crossing at Fairview Road	$239,000	56%
S8	Co-op Road (Main to Sawmill)	$339,000	0%
S9	Fir Avenue to Influent Lift Station	$181,000	56%
	Total	**$3,362,000**	

A reasonable goal would be to replace or rehabilitate the high-risk assets within 10 years which equates to approximately 400 m of replacement each year. This replacement program covers approximately 10% of the sanitary collection network in the next 10 years. At this rate, the Town would replace the entire sanitary collection network in 100 years which exceeds the typical useful life of system components (approximately 80 years for PVC). Therefore, this program is just a start, and development of a long term replacement program will be vital to sustainably manage the sanitary collection network.

Project sheets containing additional information and detailed cost estimates for each project can be found in Appendix C.

6.2 Lift Stations

Pump Replacement – Rockcliffe Lift Station

Both pumps at the Rockcliffe LS are beyond their estimated useful life and should be assessed for replacement. Based on the results of the capacity assessment, replacing the pumps with new models of similar capacity will be adequate for future demand.

Capacity Assessment & Pump Replacement – Rotary Beach Lift Station

One pump at Rotary Beach LS is beyond its estimated useful life and should be assessed for replacement. While the collection network capacity assessment showed that Rotary Beach LS is nearing its capacity during peak I&I conditions, it is recommended to conduct a capacity assessment of the lift station to confirm the operating capacity. There are two forcemains available for the Rotary Beach LS to pump and Town staff believe that the station is currently pumping to the smaller of the two forcemains. Part of a capacity assessment of the LS would be to confirm which of the two historical forcemains is currently being used and determine options to increase capacity at the station. This will ensure that the replacement pump is adequate for future and peak I&I demand.

6.3 Treatment System

The service capacity of each component of the wastewater treatment system is a function of the useful life of the asset and the population which it can serve. The Town prepared a Wastewater Treatment Systems Capacity Improvement Design Brief in January 2019 to outline proposed upgrading works (see Appendix D). The recommendations are based on addressing deficiencies to the existing aerated lagoon treatment system, which is the only component of the treatment system forecasted to require upgrading within the next 15-years. The upgrades listed below have a combined capital cost estimate for $4,645,000. The detailed cost estimate can be found in Appendix D.

Middle Berm Stabilization

This project will involve stabilizing the saturated middle berm of aerated lagoons Cell No. 2 and 3. To rectify this issue, it is proposed to install two lock block walls along the length of this berm. These walls would be tied to each other with geogrid to provide stability and infilled. A secondary benefit of this berm stabilization would be that the existing lagoon capacity would increase due to the installation of a wall structure in place of the existing 3:1 lagoon slopes.

Aeration System Upgrades

Upgrades to the aeration system would include desludging of Cell No. 2, installation of a new aeration header and lateral pipes to each lagoon, provision for a new aeration system diffuser and installation of a new blower to the existing blower building. The new blower would act as the duty blower for the aeration system.

Installation of a 50 kW Photovoltaic System

It is proposed to utilize the aerated lagoon site as a location for renewable energy production as a means to offset emissions produced by the Town of Oliver. The Photovoltaic (PV) power will be connected to the system by means of a “grid-tie” inverter and metered by FortisBC under their net metering program.

7.0 Other Recommendations

In addition to the system upgrades summarized in Section 6, there are a number of additional areas of interest or concern which the Town may wish to investigate:

Electrical Systems Review

Aside from regular maintenance, the electrical systems in the lift stations and treatment system have not been upgraded since installation in the 1980s and 1990s. It is recommended that the Town review their electrical systems and determine if upgrades are required to maintain safe and reliable operations and meet future demand. Upgrades have already been identified by Town Operations staff to increase electrical service to 600V at the Scott Road and Rockcliffe Lift Stations.

Inflow & Infiltration

In order to further investigate the suspected I&I events in 2017 and 2018, the Town may wish to install portable flow monitors throughout the collection network to narrow down the problem areas. As part of the investigation into I&I, it is important to have accurate sub-daily precipitation data in order to identify a direct correlation between rainfall and increased flow. Therefore, it is recommended that the Town install a rain gauge and data collection system which would allow them to track sub-daily precipitation.

Winter Storage Options Assessment

Based on the capacity assessment of the treatment system, winter effluent storage will be the first limiting component in future development. Capacity of the current storage reservoir is estimated to be reached by 2037. It is recommended that the Town undertake an options assessment to begin long term planning to upgrade this facility.

SCADA System Review

A detailed review of the SCADA system is recommended to ensure that the Town is recording all necessary data in the correct format and timestep and identify any gaps in the data collection system. This review may result in recommendations to change, update, or add to the existing data collection systems.

APPENDIX A

Aerated Lagoon No. 1 – Design Summary

Internal Memorandum

To:	TRUE Staff	**From:**	Sean Curry, P. Eng.
Attn:	Staff on Oliver LWMP Update		
Date:	December 5, 2018	**File No:**	**306-985**

RE: Aerated Lagoon No. 1 – Design Summary

This memo is written to provide a summary of preliminary design considerations relating to the future construction of Aerated Lagoon No. 1 at the Town's wastewater treatment facility in the Fairview area.

Design considerations for this lagoon are based off of the Town's LWMP Update dated January 2002 (TRUE project number 306-083). In this report, the future Aerated Lagoon No. 1 design considerations were specified as follows:

- Capacity – minimum 20,000 m^3
- Interior slopes – 3:1
- Exterior slopes – 2:1
- Liquid depth – 5.25m
- Top of water level – 448.30m (match existing lagoons - see drawing 306-291) – topographic survey indicates that Aerated Lagoon No. 2 has a liquid elevation of 448.35m
- Bottom of water level – 443.00m (match existing lagoons - see drawing 306-291)
- Top of berm – 449.30m (i.e. 1.0m of freeboard)

In February 2017, a crown land tenure application was submitted to the Ministry of Forests, Lands, and Natural Resource Operations (MFLNRO) to obtain crown land necessary for the construction of Aerated Lagoon No. 1. This work was done in conjunction with another crown land tenure application submitted on behalf of the Town. Upon receipt, MFLNRO staff informed the author that an assessment relating to recreation and environmental protection of the Oliver Mountain area was currently being undertaken. Therefore, MFLNRO staff indicated that the required crown land tenure right-of-way necessary for the future construction of this lagoon should be incorporated into the Oliver Mountain assessment. Preliminary design for this lagoon was therefore authorized by Town staff to determine a required right-of-way area for construction of the future lagoon. This preliminary design is illustrated on the enclosed drawing 306-985-Fig 1.

It is important to note that the Town has no current plans for construction of the future Aerated Lagoon No. 1. The crown land tenure application process was started to ensure that land would be available when expansion of the wastewater treatment facility was deemed necessary. The 2002 LWMP Update indicated that construction of Aerated Lagoon No. 1 would provide service capacity for a population equivalent of about 11,000 persons while the existing system (i.e. 2 aerated lagoons in service with a combined capacity of about 75,800 m³) had a capacity for a service population of about 7,000 persons. The 2016 census population for the Town of Oliver was found to be 4,928 persons. Clearly, the existing system is adequate for the Town's current service population.

Based on the above, it is also important to provide an opinion on when the treatment objectives relating to the existing treatment system will exceed permitted maximum levels of 45 mg/L BOD and 60 mg/L of TSS. The following calculations are provided to indicate when these treatment objectives will be exceeded based on existing conditions (i.e. lagoons are not desludged) and ideal conditions (i.e. lagoons are fully desludged). Note that winter conditions govern and the Town's 2016 Annual Report indicated that average flow for this system is about 1,753 m³/d.

Existing Design Conditions (i.e. lagoons are fully desludged)

- Volume: Lagoon 2 has capacity of 37,600 m³ while lagoon 3 has capacity of 38,200 m³ resulting in a total design capacity of 75,800 m³
- Detention time = 75,800 m³ divided by 1,753 m³/day = 43.2 days
- 2016 Oliver census population = 4,928 persons
- Theoretical BOD = 0.17 lb/capita or 0.077 kg/capita x 4,928 persons = 379 kg/day BOD in
- Influent BOD concentration = BOD in divided by flow = 379 kg/day divided by 1,753 m³/day = 0.216 kg/m³ x 1×10^6 mg/kg divided by 1,000 L/m³ = 216 mg/L BOD in
- Theoretical reaction rate if wastewater temperature is assumed to be 5ºC during winter conditions = 0.162 day^{-1}
- Removal efficiency = 1 / (1 + reaction rate x detention time) = 12.5% remaining
- Wastewater treatment system Effluent BOD = removal efficiency x BOD in = 12.5% x 216 mg/L = 27.0 mg/L BOD
- Use solver to determine when effluent BOD will exceed 45 mg/L during winter conditions: found to be in 2077 with a population equivalent of about 9,080 persons (assumes 1% growth rate consistent with LWMP Update dated October 2017 306-1751). Refer to R:\Clients\300-399\306\306-985\04 Design\Aerated Lagoon No 1\Calculations.xlsx

Existing Conditions (i.e. lagoons are not desludged)

- Volume: As of 2011, Lagoon 2 had a sludge accumulation of 5,000 m³ while lagoon 3 had a sludge accumulation of 5,000 m³. Sludge accumulation is based off a survey conducted by Lambourne Environmental Ltd. in December 2011. This report can be found in R:\Clients\300-399\306\306-985\02 Correspondence\Grant Applications\2016 Clean Water and Wastewater Fund\CWWF 2016-Application No. 68\E Relevant Studies and Reports\Oliver survey report 2011.pdf
- Projected sludge accumulation is based off annual sludge accumulation between 1996 and 2011.
- Detention time = about 65,000 m³ divided by 1,753 m³/day = 37.1 days for 2016 conditions
- 2016 Oliver census population = 4,928 persons

- Theoretical BOD = 0.17 lb/capita or 0.077 kg/capita x 4,928 persons = 379 kg/day BOD in
- Influent BOD concentration = BOD in divided by flow = 379 kg/day divided by 1,753 m^3/day = 0.216 kg/m^3 x $1x10^6$ mg/kg divided by 1,000 L/m^3 = 216 mg/L BOD in
- Theoretical reaction rate if wastewater temperature is assumed to be 5ºC during winter conditions = 0.162 day^{-1}
- Removal efficiency = 1 / (1 + reaction rate x detention time) = 14.3% remaining
- Wastewater treatment system Effluent BOD = removal efficiency x BOD in = 14.3% x 216 mg/L = 30.8 mg/L BOD
- Use solver to determine when effluent BOD will exceed 45 mg/L during winter conditions: found to be in 2040 with a population equivalent of about 6,300 persons (assumes 1% growth rate consistent with LWMP Update dated October 2017 306-1751). Refer to R:\Clients\300-399\306\306-985\04 Design\Aerated Lagoon No 1\Calculations.xlsx

Based on the above, it can be assumed that the existing system has adequate capacity for the existing service population. Also, construction of the future Aerated Lagoon No. 1 will not be necessary until between 2040 and 2077 (depending upon sludge accumulation and future desludging efforts). A recommendation moving forward should be to fully desludge these lagoons on a regular basis to ensure that adequate treatment capacity is maintained. Desludging will allow the Town to defer capacity upgrades in the future.

Regards,

Sean Curry, P. Eng.

SAC/slf

enclosures: hand calculations and drawing 306-985-Figure 1 showing the preliminary design and right-of-way requirements for the future Aerated Lagoon No. 1

SECTION A - PROPOSED CELL #1 & DIVERSION DITCH

HORIZONTAL & VERTICAL
SCALE 1:500

CUT/FILL QUANTITIES

PROPOSED CELL #1 EARTHWORKS

24,000 m³ (CUT)
19,500 m³ (FILL)
NET 4,500 m³ (CUT)

NOT INCLUDING STRIPPING
APPROXIMATE VOLUME 3,900 m³ (CUT)

PROPOSED CELL #1 CAPACITY
26,000 m³

No.	DATE	DESCRIPTION	BY	APP'D
0	SEPT 07/2017	ISSUED FOR DISCUSSION	DF	SC

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING
201 - 2079 Falcon Road ▪ Kamloops BC ▪ V2C 4J2
tel 250.828.0881 ▪ fax 250.828.0717
info@TRUE.bc.ca

BRITISH COLUMBIA
Town of Oliver

AERATED LAGOON TREATMENT SYSTEM

PROPOSED CELL #1

SCALE 0 1:500 25

DESIGN BY	SU/SC
DRAWN BY	DF
DATE	SEPTEMBER, 2017
PROJECT REFERENCE No.	306-083 & 306-291

DRAWING No.
306-1751

FIG. 3-1

SHEET
1 OF 1

ISSUE/REV.
0

FILE: r:\clients\300-399\306\306-985\03 drawings\cad\02 design drawings\dn-306-985-oliver treatment

APPENDIX B

Equalization Basin Expansion – Predesign Brief

Equalization Basin Expansion

Predesign Brief

Prepared by:

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Ref: 306-081

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1.1 General Description – Town of Oliver Wastewater Treatment and Disposal Systems

Up to 1985, the Town of Oliver discharged treated wastewater from a secondary modified activated sludge treatment plant to the Okanagan River. To achieve compliance with initiatives of the Provincial government to reduce phosphorus loadings to Okanagan Valley watercourses, the Town of Oliver constructed effluent storage and effluent irrigation systems in the Fairview area in 1985. *Figure 2* is an overall plan of the Town of Oliver wastewater treatment, storage and related facilities and includes areas where the Town uses reclaimed water for irrigation purposes. In 1995, the Town constructed an aerated lagoon treatment system adjacent to the winter effluent storage reservoir and at that point, abandoned the secondary treatment plant at the public works yard.

The terminus of the Town's sewage collection remains at the Public Works yard. Wastewater is pumped through a rotating screen, piped to an equalization basin from where it is pumped to the Fairview area.

1.2 Waste Management Plan Update 2002

In 2002 the Town of Oliver completed a major revision and update of its Waste Management Plan focusing on the identification of additional lands for irrigation with reclaimed water. This update of the Waste Management Plan assessed several directions for expansion of the Town's reclaimed water irrigation supply system and concluded that the preferred option was the construction of supply mains to make reclaimed water available for irrigation purposes at Town/Public lands including the Airport, Cemetery, Public Works Yard, South Okanagan Secondary School, etc.

Once the preferred direction for irrigation area expansion was identified, the Waste Management Plan then assessed supply alternatives. The options were:

- construct new supply mains from the Fairview Area to the identified reclaimed water irrigation expansion areas.

or

- construct a new forcemain from the Public Works Yard to the Fairview area and use the existing forcemain constructed in 1985 as the reclaimed water supply main.

A major advantage of a new forcemain option was the opportunity for the Town to take advantage of, at that time, proposed time of use energy cost incentives to be offered by the electrical utility. The new forcemain option was recommended as the preferred option and the forcemain was constructed in 2004. Reclaimed water for irrigation purposes has been used at the cemetery, airport and public works yard in 2005 and 2006 supplied through the original forcemain.

1.3 Functional Description of the Existing Equalization Basin

The Town's existing equalization basin at the Public Works yard is a lagoon type structure, lined with a hypalon membrane and has an operating capacity of about 1100 cubic meters. In the early 1980's, the electrical service in the South Okanagan was very unreliable with numerous short duration interruptions in electrical service occurring on a daily basis through the summer months. In 1985, a design decision was made to construct an equalization basin to store flows during a short duration power failure rather than provide standby power which at that time may have started and stopped numerous times on a daily basis through the summer months. Since the early 1980's the electrical utility has undertaken major improvements to the Oliver and electrical distribution system and short duration power failures are now infrequent.

Consistent with its Waste Management Plan, the Town of Oliver has modified the controls of high lift station pumps to assess the practicality of fully complying with time of use operational restrictions and thereby achieve significantly reduced costs for electrical energy. The equalization basin's primary functional use has therefore changed from a facility to be used during power interruptions to a storage facility to take advantage of energy cost incentives. On a trail basis, the Town has successfully operating its 3 – 100 HP high lift pumps on a time of use basis through 2005 and 2006. Energy cost savings realized by the Town are of the order of $20,000 annually. The existing equalization basin is not of sufficient volume for the Town to continue to operate its high lift pumps on a time of use basis therefore the project proposal to construct a second equalization basin.

2.1 Time of Use Energy Cost Incentives

Time of use energy cost incentives are offered by Fortis Canada if the operation of the Town's high lift wastewater pump station can be limited to off peak periods. The off peak periods vary from summer to winter and are summarized as follows.

Winter – November, December, January, February
- off peak – Midnight to 7:00 AM – 7 hours
- peak – 7:00 AM to Noon – 5 hours
- off peak – Noon to 4:00 PM – 4 hours
- peak – 4:00 PM to 10:00 PM – 6 hours
- off peak – 10:00 PM to Midnight – 2 hours

Winter Maximum Storage Period – 6 hours

Summer – July, August
- off peak – Midnight to 10:00 AM – 10 hours
- peak – 10:00 AM to 9:00 PM – 11 hours
- off peak – 9:00 PM to Midnight – 3 hours

Summer Maximum Storage Period – 11 hours

Shoulder Seasons – March, April, May, June , September, October
- off peak – Midnight to 6:00 AM – 6 hours
- peak – 6:00 AM to 10:00 PM – 16 hours
- off peak – 10:00 PM to Midnight – 2 hours

Shoulder Season Maximum Storage Period – 16 hours

For the Town to take full advantage of the time of use energy incentives offered by Fortis, the design storage volume requirements to be provided in the equalization basins is determined by the shoulder season during which wastewater inflow has to be stored for a 16 hour period from 6:00 AM to 10:00 PM and pumped to the Town's treatment lagoon system over an 8 hour period from 10:00 PM to 6:00 AM.

2.2 Equalization Basin Sizing Criteria

Average daily sewage flows on a monthly basis measured at the Town's High Lift Station for the period 2003 to 2006 inclusive are presented in Table 2.1. The flow data illustrates some variation in average daily sewage flows between winter and summer with winter flows being about 93% of the annual average and summer flows being about 113% of the annual average. Higher flows during the summer months may be indicative of infiltration during freshet flows in the Okanagan River and tourism related summer period commercial uses.

Table 2.1
Town of Oliver
Summary of Monthly Sewer Flows

	2003 High Lift Station		2004 High Lift Station		2005 High Lift Station		2006 High Lift Station	
	Total Monthly m3/day	Monthly Average m3/day	Total Monthly m3/day	Monthly Average m3/day	Total Monthly m3/day	Monthly Average m3/day	Total Monthly m3/day	Monthly Average m3/day
Jan	60226	1943	61225	1975	63969	2064	65959	2128
Feb	53430	1908	56546	1950	57824	2065	60239	2151
Mar	58878	1899	60063	1938	62488	2016	66581	2148
Apr	59758	1992	59838	1995	63396	2113	63534	2118
May	61955	1999	62370	2012	65867	2125	72354	2334
Jun	61281	2043	61728	2058	68081	2269	77483	2583
Jul	68917	2223	70059	2260	73239	2363	78623	2536
Aug	69251	2234	73069	2357	73976	2386	76326	2462
Sep	65661	2189	67545	2251	64542	2151	68481	2283
Oct	67753	2186	68490	2209	65567	2115	69071	2228
Nov	61983	2066	62127	2071	61595	2053	64857	2162
Dec	62047	2002	62988	2032	63403	2045	65905	2126
Total	751139		766048		783947		829413	
Average	2052		2093		2147		2272	

For determination of the equalization volume requirements to enable the Town to take full advantage of the Fortis time of use energy incentives, the June 2006 shoulder season average daily sewage flow of 2583 m^3/day has been utilized. Equalization volume requirements are derived as follows:

- design shoulder season flow – 2583 m^{3}day
- shoulder season storage period – 16 hours
- storage volume – 16/24 x 2583 m^3 = 1722 m^3
- adjustment factor for flow variations – 30%
- storage volume – 1722 x 130% - 2238 m^3

- 2006 serviced population – 4200
- mid term horizon population as per the Waste Management Plan – 6200
- storage volume required to 6200 population horizon – 3300 m^3

The existing equalization provides approximately 1100 $m^3$of storage between normal low and high operating levels therefore the proposed expansion of the equalization basin has to provide a minimum of 2200 m^3 of operating storage.

2.3 Project Description

Proposed equalization basin number 2 is illustrated conceptually on drawing 306-1121-SK1. Equalization basin 2 is proposed to be located northeast of the existing basin generally occupying a vacant portion of the Public Works yard site between the Okanagan River flood control dyke and the existing basin and an area formerly used for sludge drying beds. When the Town completed the aerated lagoons in the Fairview area in 1995, the activated sludge treatment plant on the Public Works site was removed from service and the drying beds ancillary to the treatment plant were no longer required.

Referring to drawing 306-1121-SK1, the proposed equalization basin and related works are briefly described as follows.

- the equalization basin is proposed as a lagoon type structure with a 60 mil HDPE membrane lining comparable to the existing basin. At the average operating level, the basin measures approximately 30 m x 50 m.
- the proposed basin will have a floor, top of berm and operating elevations the same as the existing basin. It is therefore assumed that the two basins will be operated together, i.e. inflow directed to each basin through the existing diversion structure and withdrawn simultaneously from each basin through the same diversion structure.
- inlet and outlet piping connecting to chambers in the existing diversion structure intended for future extensions to a second equalization basin.
- two surface aerator/mixers to provide circulation in the basin and thereby minimize stagnant conditions that may result in odor problems.

As illustrated in drawing 306-1121-SK1 all proposed works associated with equalization basin 2 are within the Town's Public Works Yard.

2.4 Capital Cost Estimate

A preliminary capital cost estimate for Equalization Basin 2 is presented in the tabulation follows.

Preliminary Capital Cost Estimate
Equalization Cell No. 2

1. Strip Site	4500m^2 @ $2.00	$9,000
2. Excavation and Embankment	1000m^3 @ $8.00	$8,000
3. Import Fill	4000m^3 @ $15	$60,000
4. Sand Base for Liner	2800m^2 @ $6.00	$16,800
5. 60 Mil HDPE Liner	2800m^2 @ $30	$72,000
6. Site Piping		
6.1 Inlet Pipe	70 m @ $200	$14,000
6.2 Outlet Pipe	40 m @ $200	$8,000
6.3 Outlet Structure	allow	$5,000
6.4 375 Tee complete with Valves		$16,000
6.5 Modify Existing Diversion Structure complete with Slide Gates		$18,000
6.6 Piping in Abandoned STP	allow	$10,000
6.7 Abandoned STP to Diversion Structure	100m @ $250	$25,000
7. Mixers complete with Electrical	2 ea. @ $35,000	$70,000
8. Remove and Replace Liner in Existing Basin	1600m^2 @ $35	$56,000
	Subtotal Construction	$387,800
	Contingencies and Engineering (allow 25%)	$96,200
	Total Project	$484,000

APPENDIX C

Collection Network Upgrades – Project Sheets

Project: S1 – Fairview to Sawmill Road

Priority: 1

Trigger: Future Development

Type: Replacement/Upgrade

DCC: 75%

Location Map

Issue

This main is a very critical connection in the sanitary collection network, and services a corridor of future development. The 300 mm VCT pipe has surpassed its anticipated useful life.

Scope

Removal of approximately 315m of 300 mm VCT. Installation 315m of 600 mm PVC including reconnection of all existing services. New connections for future development are required.

DCC Justification

This project increases the capacity of the system for long term growth. DCC portion will be determined based on the change in cross sectional area of the upgrade:

$$DCC\,\% = 1 - \frac{\left(\frac{\pi (D_1)^2}{4}\right)}{\left(\frac{\pi (D_2)^2}{4}\right)} = 1 - \left(\frac{D_1}{D_2}\right)^2 = 1 - \left(\frac{0.3}{0.6}\right)^2 = 75\%$$

Time Frame

1-3 years

Cost Estimate

ITEM NO.	DESCRIPTION	UNIT	EST. QUANT.	UNIT PRICE	TOTAL PRICE
S1	**Fairview to Sawmill Road**				
1.1	Materials				
	600Ø PVC Sanitary Main - Supply and Install	m	315	$700	$220,500
	Lined Concrete Manhole - Supply and Install	ea	4	$8,000	$32,000
1.2	Service Connections				
	Tie into existing	ea	2	$5,000	$10,000
	Reconnect existing services	ea	1	$1,000	$1,000
	Connect New Services	ea	2	$2,000	$4,000
1.3	Other Construction				
	Asphalt Restoration	m²	800	$45	$36,000
	Bare Land Restoration	m²	460	$10	$4,600
	Curb and Gutter	m	8	$110	$880
	Sidewalk	m	8	$105	$840
	Traffic Control	L.S.		$5,000	$5,000
				Subtotal	**$315,000**
				Engineering & Contingency (35%)	$110,000
				TOTAL	**$425,000**

Project: S2 – Main & Station Street (Hillside to Bank)

Priority: 1

Type: Replacement/Upgrade

Trigger: Future Development

DCC: 69%

Location Map

Issue

This main is a key connection in the sanitary collection network, and services a corridor of future development. The existing VCT pipe has surpassed its anticipated useful life.

Scope

Replacement of approximately 475 m of 200 mm VCT and 25 m of 250 mm VCT with 500 m of 300 mm PVC, including reconnection of all existing services. New connections for future development are required.

DCC Justification

This project is driven by need for additional capacity due to planned development along this corridor. DCC portion will be determined based on the change in cross sectional area of the upgrade and length of each section of pipe where the area is changing of the upgrade:

$$DCC\ \% = 1 - \frac{\left(\left(\frac{\pi(D_{1.1})^2}{4}\right) * L_{1.1}\right) + \left(\left(\frac{\pi(D_{1.2})^2}{4}\right) * L_{1.2}\right)}{\left(\left(\frac{\pi(D_2)^2}{4}\right) * L_2\right)} = 1 - \frac{(D_{1.1}{}^2 * L_{1.1}) + (D_{1.2}{}^2 * L_{1.2})}{(D_2{}^2 * L_2)}$$

$$DCC\ \% = 1 - \frac{(0.2^2 * 25m) + (0.25^2 * 475m)}{(0.375^2 * 500m)} = 52\%$$

Time Frame

1-3 years

Cost Estimate

ITEM NO.	DESCRIPTION	UNIT	EST. QUANT.	UNIT PRICE	TOTAL PRICE
S2	**Main & Station Street (Hillside to Bank)**				
1.1	Materials				
	375Ø PVC Sanitary Main - Supply and Install	m	500	$480	$240,000
	Lined Concrete Manhole - Supply and Install	ea	8	$8,000	$64,000
1.2	Service Connections				
	Tie into existing	ea	6	$3,000	$18,000
	Reconnect existing services	ea	5	$1,000	$5,000
1.3	Other Construction				
	Asphalt Restoration	m²	2000	$45	$90,000
	Traffic Control	L.S.		$15,000	$15,000
				Subtotal	**$432,000**
				Engineering & Contingency (35%)	$151,000
				TOTAL	**$583,000**

Project: S3 – Similkameen Avenue (Tulameen to Airport)

Priority:	2	**Type:**	Replacement/Upgrade
Trigger:	Capacity/Aging Infrastructure	**DCC:**	32%

Location Map

Issue

This main is a key connection in the sanitary collection network. The existing AC and VCT pipe is beyond its anticipated useful life of 50 years, and inspections in 2016 and 2017 reported that the pipe has significant condition issues. This segment of pipe is also flagged in the hydraulic model as having capacity issues under current and future wet weather conditions.

Scope

Replace approximately 415m of 200 mm and 75m of 250 mm of VCT/AC with 415m of 300 mm PVC and 85 m of 375 mm PVC to tie into existing 375 mm.

DCC Justification

This project is driven by need for additional capacity. DCC portion will be determined based on the change in cross sectional area of the upgrade and length of each section of pipe where the area is changing:

$$DCC\,\% = 1 - \frac{\left(\left(\frac{\pi(D_{1.1})^2}{4}\right) * L_{1.1}\right) + \left(\left(\frac{\pi(D_{1.2})^2}{4}\right) * L_{1.2}\right)}{\left(\left(\frac{\pi(D_2)^2}{4}\right) * L_2\right)} = 1 - \frac{(D_{1.1}{}^2 * L_{1.1}) + (D_{1.2}{}^2 * L_{1.2})}{(D_2{}^2 * L_2)}$$

$$DCC\,\% = 1 - \frac{(0.2^2 * 415m) + (0.25^2 * 75m)}{(0.3^2 * 500m)} = 32\%$$

Time Frame

3-5 Years

Cost Estimate

ITEM NO.	DESCRIPTION	UNIT	EST. QUANT.	UNIT PRICE	TOTAL PRICE
S3	**Similkameen Avenue (Tulameen to Airport)**				
1.1	Materials				
	300Ø PVC Sanitary Main - Supply and Install	m	415	$400	$166,000
	375Ø PVC Sanitary Main - Supply and Install	m	85	$480	$40,800
	Lined Concrete Manhole - Supply and Install	ea	11	$8,000	$88,000
1.2	Service Connections				
	Tie into existing	ea	10	$3,000	$30,000
	Reconnect existing services	ea	13	$1,000	$13,000
1.3	Other Construction				
	Asphalt Restoration	m²	2000	$45	$90,000
	Curb and Gutter	m	8	$110	$880
	Sidewalk	m	8	$105	$840
	Traffic Control	L.S.		$15,000	$15,000
				Subtotal	**$445,000**
				Engineering & Contingency (35%)	$156,000
				TOTAL	**$601,000**

Project: P4 – Okanagan Street at Similkameen

Priority:	2	**Type:**	Replacement/Upgrade
Trigger:	Aging Infrastructure	**DCC:**	0%

Location Map

Issue

The existing AC and VCT pipe is beyond its anticipated useful life of 50 years, and inspections in 2016 and 2017 reported that the pipe has significant condition issues.

Scope

Replace approximately 385m of 150 mm AC and 315m of 200 mm AC and VCT with 700m of 200 mm PVC.

DCC Justification

This project would not qualify for DCC.

Time Frame

3-5 Years

TRUE

Cost Estimate

ITEM NO.	DESCRIPTION	UNIT	EST. QUANT.	UNIT PRICE	TOTAL PRICE
S4	**Okanagan Street at Similkameen**				
1.1	Materials				
	200Ø PVC Sanitary Main - Supply and Install	m	700	$240	$168,000
	Lined Concrete Manhole - Supply and Install	ea	8	$8,000	$64,000
1.2	Service Connections				
	Tie into existing	ea	4	$3,000	$12,000
	Reconnect existing services	ea	40	$1,000	$40,000
1.3	Other Construction				
	Asphalt Restoration	m²	2800	$45	$126,000
	Curb and Gutter	m	12	$110	$1,320
	Sidewalk	m	12	$105	$1,260
	Traffic Control	L.S.		$5,000	$5,000
				Subtotal	**$418,000**
				Engineering & Contingency (35%)	$146,000
				TOTAL	**$564,000**

Project: P5 – Airport Street Alley (Skagit to Similkameen)

Priority: 2

Type: Replacement/Upgrade

Trigger: Aging Infrastructure

DCC: 0%

Location

Issue

The existing AC pipe is beyond its anticipated useful life of 50 years, and inspections in 2016 and 2017 reported that the pipe has significant condition issues.

Scope

Replacement of approximately 400m of 200 mm AC with 200 mm PVC.

DCC Justification

This project would not qualify for DCC.

Time Frame

3-5 Years

Cost Estimate

ITEM NO.	DESCRIPTION	UNIT	EST. QUANT.	UNIT PRICE	TOTAL PRICE
S5	**Airport Street Alley (Skagit to Similkameen)**				
1.1	Materials				
	200Ø PVC Sanitary Main - Supply and Install	m	400	$240	$96,000
	Lined Concrete Manhole - Supply and Install	ea	4	$8,000	$32,000
1.2	Service Connections				
	Tie into existing	ea	2	$3,000	$6,000
	Reconnect existing services	ea	23	$1,000	$23,000
	Connect New Services	ea	0	$2,000	$0
1.3	Other Construction				
	Asphalt Restoration	m²	1600	$45	$72,000
	Curb and Gutter	m	4	$110	$440
	Sidewalk	m	4	$105	$420
	Traffic Control	L.S.		$2,500	$2,500
				Subtotal	**$232,000**
				Engineering & Contingency (35%)	$81,000
				TOTAL	**$313,000**

Project: P6 – McKinney Road (Coyote to Park)

Priority:	3	**Type:**	Rehabilitation
Trigger:	Aging Infrastructure	**DCC:**	0%

Location Map

Issue

The existing 200 mm AC pipe is beyond its anticipated useful life of 50 years. Inspections in 2016 and 2017 reported that the pipe is in acceptable condition given its age. Rehabilitation is intended to extend the useful life of these assets with decreased cost.

Scope

Trenchless rehabilitation of 285m of 200 mm AC pipe using cured-in-place lining.

DCC Justification

This project would not qualify for DCC.

Time Frame

5-10 Years

Cost Estimate

ITEM NO.	DESCRIPTION	UNIT	EST. QUANT.	UNIT PRICE	TOTAL PRICE
S6	**McKinney Road (Coyote to Park)**				
1.1	Materials				
	Trenchless Rehabilitation (cured-in-place lining)	m	285	$250	$71,250
1.2	Service Connections				
	Lining at Manholes	ea	5	$1,000	$5,000
	Lining at existing services	ea	1	$500	$500
1.3	Other Construction				
	Bypass Pumping	L.S.		$10,000	$10,000
				Subtotal	**$87,000**
				Engineering & Contingency (35%)	$30,000
				TOTAL	**$117,000**

Project: P7 – River Crossing at Fairview Road

Priority: 3 **Type:** Replacement/Upgrade

Trigger: Aging Infrastructure **DCC:** 56%

Location Map

Issue

This main is a very critical connection in the sanitary collection network. The existing 200 mm AC pipe is beyond its anticipated useful life of 50 years and is a high risk asset to the collection network.

Scope

Replace approximately 130m of 200 mm AC with 300 mm PVC.

DCC Justification

This project increases the capacity of the system for long term growth. DCC portion will be determined based on the change in cross sectional area of the upgrade:

$$DCC\ \% = 1 - \frac{\left(\frac{\pi(D_1)^2}{4}\right)}{\left(\frac{\pi(D_2)^2}{4}\right)} = 1 - \left(\frac{D_1}{D_2}\right)^2 = 1 - \left(\frac{0.2}{0.3}\right)^2 = 56\%$$

Time Frame

5-10 Years

Cost Estimate

ITEM NO.	DESCRIPTION	UNIT	EST. QUANT.	UNIT PRICE	TOTAL PRICE
S7	**River Crossing at Fairview Road**				
1.1	Materials				
	300Ø PVC Sanitary Main - Supply and Install	m	130	$400	$52,000
	Lined Concrete Manhole - Supply and Install	ea	2	$8,000	$16,000
	Hardware (incl. hangers, casing, spacers, fittings)	m	75	$1,000	$75,000
1.2	Service Connections				
	Tie into existing	ea	2	$3,000	$6,000
1.3	Other Construction				
	Asphalt Restoration	m²	260	$45	$11,700
	Curb and Gutter	m	8	$110	$880
	Sidewalk	m	8	$105	$840
	Traffic Control	L.S.		$15,000	$15,000
				Subtotal	**$177,000**
				Engineering & Contingency (35%)	$62,000
				TOTAL	**$239,000**

Project: P8 – Co-op Road (Main to Sawmill)

Priority:	3	**Type:**	Replacement/Upgrade
Trigger:	Aging Infrastructure	**DCC:**	0%

Location

Issue

This main is a key connection in the sanitary collection network. The existing VCT pipe is beyond its anticipated useful life of 50 years, and inspections in 2016 and 2017 reported that sections of the pipe have condition issues.

Scope

Replace approximately 85 m of 150 mm, 115 m of 200 mm, and 170 m of 250 mm of VCT with 270 m of 250 mm PVC.

DCC Justification

This project would not qualify for DCC.

Time Frame

5-10 Years

Cost Estimate

ITEM NO.	DESCRIPTION	UNIT	EST. QUANT.	UNIT PRICE	TOTAL PRICE
S8	**Co-op Road (Main to Sawmill)**				
1.1	Materials				
	250Ø PVC Sanitary Main - Supply and Install	m	270	$350	$94,500
	Lined Concrete Manhole - Supply and Install	ea	9	$8,000	$72,000
1.2	Service Connections				
	Tie into existing	ea	5	$5,000	$25,000
	Reconnect existing services	ea	5	$1,000	$5,000
1.3	Other Construction				
	Asphalt Restoration	m²	1080	$45	$48,600
	Curb and Gutter	m	4	$110	$440
	Sidewalk	m	4	$105	$420
	Traffic Control	L.S.		$5,000	$5,000
				Subtotal	**$251,000**
				Engineering & Contingency (35%)	$88,000
				TOTAL	**$339,000**

Project: P9 – Fir Avenue to Influent Lift Station

Priority: 3

Trigger: Aging Infrastructure

Type: Replacement/Upgrade

DCC: 56%

Location Map

Issue

This main is a very critical connection in the sanitary collection network. The existing 250 mm AC pipe has 10 years remaining in its anticipated useful life of 50 years.

Scope

Replace approximately 150m of 250 mm AC with 375 mm PVC and regrade to ensure adequate velocities to the Influent Lift Station.

DCC Justification

This project increases the capacity of the system for long term growth. DCC portion will be determined based on the change in cross sectional area of the upgrade:

$$DCC\ \% = 1 - \frac{\left(\frac{\pi(D_1)^2}{4}\right)}{\left(\frac{\pi(D_2)^2}{4}\right)} = 1 - \left(\frac{D_1}{D_2}\right)^2 = 1 - \left(\frac{0.25}{0.375}\right)^2 = 56\%$$

Time Frame

5-10 Years

Cost Estimate

ITEM NO.	DESCRIPTION	UNIT	EST. QUANT.	UNIT PRICE	TOTAL PRICE
S9	**Fir Avenue to Influent Lift Station**				
1.1	Materials				
	375Ø PVC Sanitary Main - Supply and Install	m	150	$480	$72,000
	Lined Concrete Manhole - Supply and Install	ea	4	$8,000	$32,000
1.2	Service Connections				
	Tie into existing	ea	2	$5,000	$10,000
	Reconnect existing services	ea	2	$1,000	$2,000
1.3	Other Construction				
	Asphalt Restoration	m²	120	$45	$5,400
	Bare Land Restoration	m²	480	$10	$4,800
	Curb and Gutter	m	12	$110	$1,320
	Sidewalk	m	12	$105	$1,260
	Traffic Control	L.S.		$5,000	$5,000
				Subtotal	**$134,000**
		Engineering & Contingency (35%)			$47,000
				TOTAL	**$181,000**

APPENDIX D

Wastewater Treatment System Capacity Improvements Design Brief

(*Report Appendix A Excluded)

Wastewater Treatment System Capacity Improvements

Design Brief

BRITISH COLUMBIA
Town of
Oliver

TRUE

January 2019

Project No. 306-1752

ENGINEERING ■ PLANNING ■ URBAN DESIGN ■ LAND SURVEYING

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0	SAC	Jan. 21, 2019	Final

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List of Acronyms

BOD	Biochemical Oxygen Demand
LWMP	Liquid Waste Management Plan
MCC	Motor Control Centre
MFLNRO	Ministry of Forests, Lands, and Natural Resource Operations
MOE	Ministry of Environment
OCP	Official Community Plan
PLC	Programmable Logic Controller
PV	Photovoltaic
SCADA	Supervisory Control and Data Acquisition
TRUE	TRUE Consulting
TSS	Total Suspended Solids

Units of Measure

hp	horsepower
kg	kilogram
kW	kilowatt
lb	pound
m^3	cubic metre
m^3/day	cubic metres per day
m	metre
mg	milligram
mg/L	milligrams per Litre
SCFM	standard cubic feet per minute

Referenced Reports

Golder Associates Ltd. "Pseudo-Static and Liquefaction Assessment – Oliver Effluent Reservoir Dams," <17 April 2018>

TRUE Consulting Ltd. Liquid Waste Management Plan (LWMP) Update. <January 2002>

TRUE Consulting Ltd. Sanitary Sewer System 2017 Annual Report. <18 July 2018>

1.0 Description of Existing Wastewater Treatment Works

The wastewater treatment facility for the Town of Oliver has been in operation since 1965. From 1965 to 1984, the Town operated a treatment plant for municipal wastewater and discharged treated effluent to the Okanagan River. In response to regulatory agency requirements for reduced phosphorus loadings to surface water courses in the Okanagan River Basin, the Town constructed effluent storage and land disposal systems in the Fairview area in 1983 and 1984. Discharge to the Okanagan River was discontinued. Finally, in 1995, a two-cell aerated lagoon system was constructed in the Fairview area.

Currently, the overall existing wastewater treatment system is comprised of influent screening, equalization storage, a high lift pump station, a two-cell aerated lagoon treatment system, winter effluent storage, chlorine contact system and reclaimed water irrigation.

This two-cell aerated lagoon system is located north and adjacent to the winter effluent storage reservoir. The aerated cells designated as Cell No. 2 and Cell No. 3 have been constructed as the second and third cells of an ultimate 3 cell system. Piping and other design provisions have been made for the third cell to be located immediately east of the existing lagoons. The capacity of the existing aerated lagoon system is as follows. Note that each cell has an operating depth of 5.3m.

- Cell No. 2 – 37,600 m^3
- Cell No. 3 – 38,200 m^3

Aeration is provided by a submerged bottom fixed fine bubble diffuser system. Air to the system is supplied by two 40 hp positive displacement Aerzen Model GM35S blowers housed in a building located at the south-east corner of Cell No. 2. Piping, electrical and space provisions have been made in the building for the installation of two additional blower units.

The treatment system effluent is regulated by Operational Certificate for PE 13717 issued by the Ministry of Environment (MOE). This operation certificate specifies the following limits:

- Discharge rate – 2,200 m^3/day
- 5 Day Biochemical Oxygen Demand – 45 mg/L
- Total Suspended Solids – 60 mg/L

A location and site plan of the aerated lagoon treatment system is provided in Appendix B.

1.1 Existing Flows Entering Aerated Lagoon System

The total volume pumped to the aerated lagoons in 2017 was 689,098 m³, as specified in the Town's Sanitary Sewer System 2017 Annual Report, which equates to an average daily flow of 1,888 m^3/day. This is an increase of 49,300 m^3 (7%) compared to 2016. For comparison, average day influent flows for the period 1996 to 2017 are illustrated in Figure 1-1 as follows. This figure also illustrates census population for the Town over that time period.

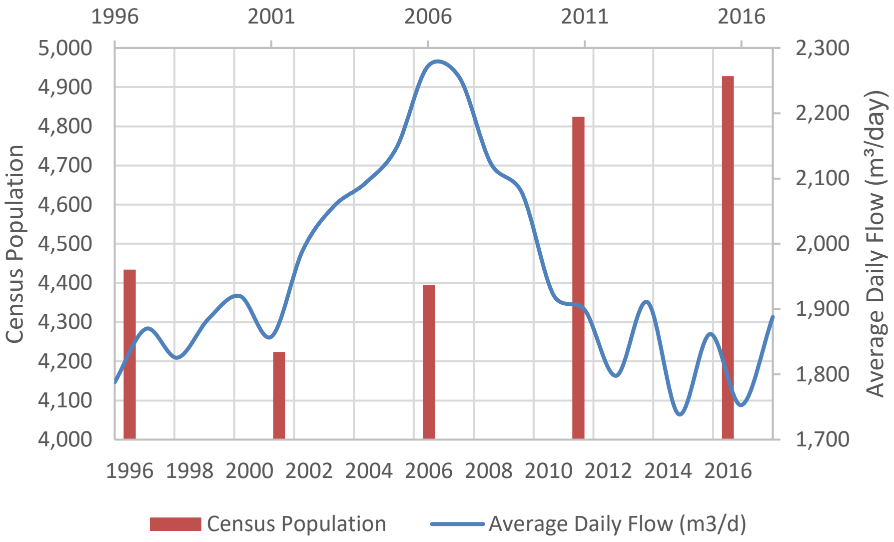


FIGURE 1-1: AVERAGE DAILY INFLUENT SEWAGE FLOWS AND CENSUS POPULATION FOR 1996 TO 2017

2.0 Wastewater Treatment System Deficiencies

The design average daily flow for the aerated lagoon system is 3,000 m^3/day with a detention time of 12 days for each cell. The Town's Liquid Waste Management Plan (LWMP) Update dated January 2002 noted that the upgrading works for the system would be necessary around 2020, at which time it was recommended that the Town proceed with the construction of a third aerated lagoon. This future lagoon (referred to as Cell No. 1) would be sized at 20,000 m^3.

It should be noted that growth projections from the Town's LWMP Update dated January 2002 have not yet been realized. Therefore, it is anticipated that the existing treatment works will be adequate past the 2020 upgrading date specified in that report, but this timeframe is limited by current and future sludge accumulation.

The Town's Sanitary Sewer System 2017 Annual Report reported multiple instances of BOD and TSS levels exceeding permitted levels. These exceedances have been attributed to sludge accumulation in the aerated lagoons. Based on these exceedances, the Town has begun the process of working towards providing additional capacity to this aerated lagoon system.

Other issues related to the aerated lagoon treatment system are summarized in the following sections.

2.1 Concerns Related to Proposed Cell No. 1 Location

In February 2017, a crown land tenure application was submitted to the Ministry of Forests, Lands, and Natural Resource Operations (MFLNRO) to obtain crown land necessary for the construction of Cell No. 1. Upon receipt of the crown land tenure application, MFLNRO staff informed the Town that an assessment relating to recreation and environmental protection of the Oliver Mountain area was currently being undertaken. MFLNRO also conducted a site visit and deemed the area to be "very" environmentally sensitive with significant concerns related to the following species:

- Lewis woodpecker
- Great Basin Spadefoot
- Behr's Hairstreak

On the basis of concerns raised by MFLNRO staff, it was recommended that the Town review other options for increasing the treatment capacity of the treatment works.

2.2 Sludge Accumulation

Sludge accumulation, specified in 2011 as approximately 5,000 m^3 in Cell No. 2 and 3,000 m^3 in Cell No. 3, has had the effect of reducing lagoon capacity and detention time. Therefore, sludge requires removal prior to treatment objectives being compromised due to reduced lagoon capacity. In this case, the Town of Oliver retained a sludge survey specialist in 2011 to conduct a review of sludge accumulation in the period since the lagoons were first constructed (summer 1995). The results of this survey indicated that sludge accumulation was far greater in Cell No. 2 than in Cell No. 3. This result is consistent with other municipalities experiences where sludge is found to accumulate near the inlet of the treatment system. After reviewing these findings, it was recommended that sludge removal from Cell No. 2 would represent a higher priority than Cell No. 3 recognizing that the sludge volume is greater as a percentage of the total volume. Also, detention time at the inlet to the treatment system is more important than detention time near the "end" of the treatment system. In the period since 2011, sludge accumulation has likely remained consistent.

2.3 Middle Berm Stability

The third significant issue with the existing treatment system relates to the instability of the earthen berm separating Cell No. 2 and Cell No. 3. The Town's Pseudo-Static and Liquefaction Assessment of the Town's effluent reservoir dams completed by Golder Associates Ltd. in April 2018 also noted that this berm would be likely to fail during a seismic event. This berm is known to be saturated and will likely fail if Cell No. 2 is drained and bypassed during sludge removal operations. Another complicating factor is that Cell No. 3 must also remain in service to ensure that operating permit effluent quality is achieved. Therefore, operating levels must be adequate to allow for treatment to occur. Since minimum operating levels must be provided, it will be necessary to stabilize the earthen berm.

2.4 Summary of Aerated Lagoon Deficiencies

Considering the above Sections 2.1 to 2.3, the following summary of deficiencies is presented. These deficiencies represent required high priority upgrades necessary for the Town to correct issues related with the aerated lagoon and achieve treatment objectives specified in Operational Certificate PE 13717.

- Exceedance of permitted effluent BOD and TSS levels.
  - Capacity improvements are required for treatment objectives to be achieved.
- Stability of middle berm.
  - Middle berm is saturated and requires upgrading. The existing two-cell aerated lagoon system does not provide redundancy since the middle berm cannot be relied upon.

As discussed in Section 2.1, the proposed location of Cell No. 1 does not appear to be viable. Therefore, the Town will be forced to consider alternative options for achieving treatment objectives in the future. Expansion of the existing lagoon footprint also does not appear to be a viable option. Therefore, upgrading of the aerated lagoon treatment works will be required.

3.0 Upgrading Objectives

The primary objective of the Wastewater Treatment System upgrading will be the resolution of deficiencies related to the existing aerated lagoon system. As previously discussed, these deficiencies are related to capacity and safety. Upgrading should also consider the potential of an expansion of the overall capacity to meet future requirements.

The following sections are presented to ensure that recommended upgrades are consistent with the Town's future capacity requirements. Therefore, expected flows arising from future population growth will be reviewed in detail.

3.1 Population Projections

The 2016 Town of Oliver census population was 4,928. The Town of Oliver Official Community Plan projects that the Town can anticipate a growth rate between -1% to 1% over the next 20 years. A growth rate of 1% per year is used for population projections within the Town of Oliver to provide a representative estimate for asset upgrades and replacement. A growth rate of 2% is also presented to provide a more conservative estimate.

TABLE 3-1: POPULATION PROJECTIONS BASED ON 2016 CENSUS

	Population Projection	
Year	***1% growth rate***	***2% growth rate***
2018	*5,027*	*5,127*
2028	*5,553*	*6,250*
2038	*6,134*	*7,619*
2048	*6,776*	*9,287*
2058	*7,485*	*11,321*
2068	*8,268*	*13,800*
2078	*9,133*	*16,822*

The following Figure 3-1 illustrates expected sewer influent flow associated with both specified growth rates. Note that future influent flow levels are based on 2016 average day flow conditions. The following figure shows that the two-cell aerated treatment system is expected to be adequate until between 2040 and 2070 depending upon future growth rates. This projection assumes that sludge accumulation does not affect treatment capacity.

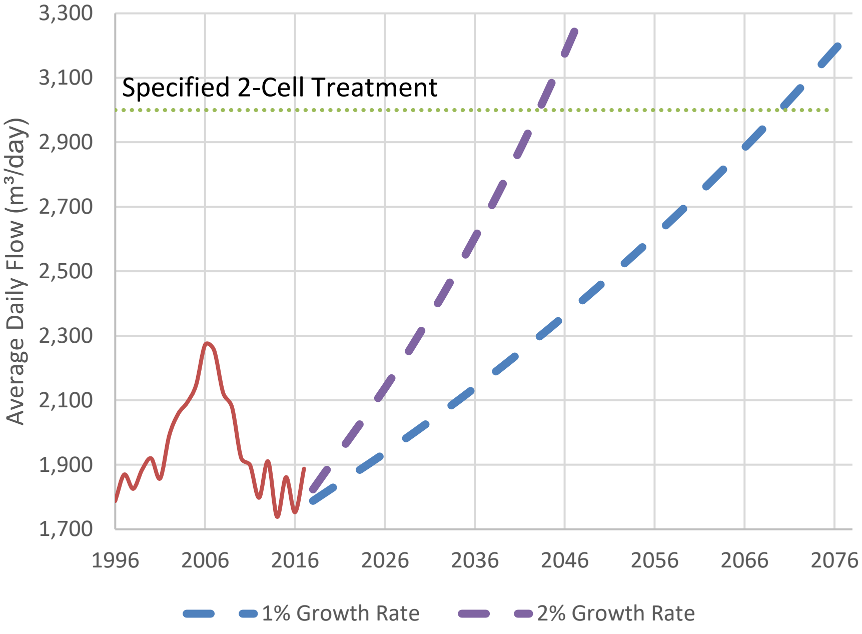


FIGURE 3-1: PROJECTED AVERAGE DAILY SEWAGE INFLUENT FLOWS

3.2 Design Capacity

This section is provided to determine when the treatment objectives relating to the existing treatment system will exceed permitted maximum levels of 45 mg/L BOD and 60 mg/L TSS. The following calculations are provided to indicate when these treatment objectives will be exceeded based on existing conditions (i.e. lagoons are not desludged) and ideal conditions (i.e. lagoons are fully desludged). Note that winter conditions govern and the Town’s 2016 Annual Report indicated that average flow for this system is about 1,753 m³/d.

Existing Design Conditions (i.e. lagoons are fully desludged)

- Volume: Cell No. 2 has capacity of 37,600 m³ while Cell No. 3 has capacity of 38,200 m³ resulting in a total design capacity of 75,800 m³
- Detention time = 75,800 m³ divided by 1,753 m³/day = 43.2 days
- 2016 Oliver census population = 4,928 persons
- Theoretical BOD = 0.17 lb/capita or 0.077 kg/capita x 4,928 persons = 379 kg/day BOD in
- Influent BOD concentration = BOD in divided by flow = 379 kg/day divided by 1,753 m³/day = 0.216 kg/m³ x $1x10^6$ mg/kg divided by 1,000 L/m³ = 216 mg/L BOD in
- Theoretical reaction rate if wastewater temperature is assumed to be 5ºC during winter conditions = 0.162 day^{-1}

- Removal efficiency = 1 / (1 + reaction rate x detention time) = 12.5% remaining
- Wastewater treatment system Effluent BOD = removal efficiency x BOD in = 12.5% x 216 mg/L = 27.0 mg/L BOD
- Exceedance of 45 mg/L during winter conditions:
  - found to be in 2077 with a population equivalent of about 9,080 persons (assumes 1% growth rate)
  - found to be in 2046 with a population equivalent of about 9,080 persons (assumes 2% growth rate)

Existing Conditions (i.e. lagoons are not desludged)

- Volume: As of 2011, Cell No. 2 had a sludge accumulation of 5,000 m³ while Cell No. 3 had a sludge accumulation of 3,000 m³.
- Projected sludge accumulation is based off annual sludge accumulation between 1996 and 2011.
- Detention time = about 65,000 m³ divided by 1,753 m³/day = 37.1 days for 2016 conditions
- 2016 Oliver census population = 4,928 persons
- Theoretical BOD = 0.17 lb/capita or 0.077 kg/capita x 4,928 persons = 379 kg/day BOD in
- Influent BOD concentration = BOD in divided by flow = 379 kg/day divided by 1,753 m³/day = 0.216 kg/m³ x $1x10^6$ mg/kg divided by 1,000 L/m³ = 216 mg/L BOD in
- Theoretical reaction rate if wastewater temperature is assumed to be 5ºC during winter conditions = 0.162 day^{-1}
- Removal efficiency = 1 / (1 + reaction rate x detention time) = 14.3% remaining
- Wastewater treatment system Effluent BOD = removal efficiency x BOD in = 14.3% x 216 mg/L = 30.8 mg/L BOD
- Exceedance of 45 mg/L during winter conditions:
  - found to be in 2040 with a population equivalent of about 6,270 persons (assumes 1% growth rate)
  - found to be in 2032 with a population equivalent of about 6,780 persons (assumes 2% growth rate)

Based on the above, it can be assumed that the existing system has adequate capacity for the existing service population. Also, additional lagoon capacity will not be necessary until between 2032 and 2077 (depending upon sludge accumulation and future desludging efforts). Desludging will therefore allow the Town to defer capacity upgrades in the future. This projection is approximately consistent with the findings presented in Section 3.1.

4.0 Proposed Upgrading Works

The upgrading works discussed in this section have been recommended on the basis of addressing deficiencies to the existing aerated lagoon treatment system. As discussed in Section 0, the Town's aerated lagoons have adequate capacity to achieve treatment objectives until at least 2032 providing that adequate desludging occurs on an ongoing basis. Therefore, upgrading works will mostly address deficiencies related to safety and operational issues, but will also consider capacity upgrades that will be necessary at some point in the future. A site plan of the proposed upgrades is provided in Appendix B.

The following sections summarize proposed upgrades to address aerated lagoon system deficiencies. Also note that a photovoltaic system has been recommended to offset a portion of greenhouse gas emissions associated with operating the aeriated lagoon system.

4.1 Middle Berm Stabilization

The initial component of the project would be to stabilize the existing middle berm. As previously discussed, this berm is known to be saturated and would likely fail if the water level of one of the lagoons was lowered independently of the other. Therefore, to rectify this issue, it is proposed that two lock block walls be installed along the length of this berm. These walls would be tied to each other with geogrid to provide stability and infilled. Since the existing aeration system header is installed within the existing berm, this project would necessitate the replacement of the lagoon aeration system. It should also be noted that the existing aeration system is reaching the end of its expected lifespan and therefore this project would allow for its replacement. A secondary benefit of this berm stabilization would be that the existing lagoon capacity would increase due to the installation of a wall structure in place of the existing 3:1 lagoon slopes.

4.2 Aeration System Upgrades

Following the proposed middle berm stabilization project, the following upgrades are proposed as a means to increase treatment capacity of the existing lagoon system.

- Desludging of Cell No. 2:
  - draining of liquid components from Cell No. 2 to Cell No. 3,
  - removal of the aeration system in both cells,
  - pumping of sludge from Cell No. 2 to a dewatering system which is to be located in a Town owned property approximately 850m away from the lagoon system,
- Aeration system upgrades:
  - Installation of a new aeration header and laterals pipes to each lagoon. Note that a floating aeration system is proposed to ease future operations and maintenance.

- Provision of new aeration system diffusers.
- Installation of a new blower in the existing blower building. The new blower will act as the duty blower for the aeration system and is proposed to be controlled by a dissolved oxygen sensor in the lagoon. Therefore, the level of dissolved oxygen in the treatment system will control the level of airflow from the proposed blower. This system is expected to result in a more efficient aeration system and help the Town of Oliver to reduce power consumption relating to wastewater treatment.

The aeration system would be designed to allow for future conversion of the treatment works to an intermittently decanted extended aeration system. This type of system would allow higher levels of BOD, TSS and ammonia removal while continuing to utilize the existing lagoon footprint. These future improvements would be installed on an as required timeline based on population growth of the Town of Oliver.

4.3 50 kW Photovoltaic System

The final portion of this project will be to utilize the aerated lagoon site as a location for renewable energy production as a means to offset emissions produced by the Town of Oliver. The Photovoltaic (PV) power will be connected to the system by means of a “grid-tie” inverter and metered by FortisBC under their net metering program. This means that the grid is used as the battery, and electricity can flow in both directions as required. This project would place Oliver as a leader in the province in terms of photovoltaic energy production at a time when renewable energy is as important as ever. It will also further local knowledge and expertise in the photovoltaic industry. The proposed solar array would be sized at 50 kW which will ensure that the project remains within FortisBC’s net metering limit per electrical service. Further, the anticipated consumption remains under the amount consumed at each location (another criteria of the FortisBC net metering program). The electricity usage at this site is by the municipality and is anticipated to remain stable long term.

5.0 Future Upgrades

As discussed in Section 4.2, the proposed upgrades would be designed to allow for future conversion of the treatment works to an intermittently decanted extended aeration system. This future upgrade will require the installation of the following additional components:

- Blowers – airflow requirement of 1,150 SCFM
- Floating aeration system (this would be included in the aeration system upgrades portion of the project – see Section 4.2)
- Lagoon baffle curtains
- Influent manifold
- PLC Control system and control valves
- Control probes and transducers

The above upgrades are expected to increase the lagoon reaction rate of the aerated lagoons. A projection of treatment levels associated with these future upgrades are summarized following:

- Discharge rate – 3,230 m^3/day
- 5 Day Biochemical Oxygen Demand – 20 mg/L
- Total Suspended Solids – 20 mg/L

The 2016 average daily flow equates to approximately 355 L/capita/day. Therefore, the peak flow able to be treated utilizing the future intermittently decanted extended aeration system is approximately equivalent to 9,100 people which is projected to occur in about 60 years assuming the OCP specified growth rate remains appropriate. It should also be noted that the assumed future treatment objectives of 20 mg/L for both BOD and TSS are higher than the existing Class 'C' effluent requirements currently specified in the Town's operational certificate. If the specified effluent requirements remain consistent with current conditions, the future design flow rate would increase accordingly.

6.0 Assessment Summary

The Town's aerated lagoon treatment works were constructed in 1995/1996 to treat wastewater effluent to at least 45 mg/L BOD and 60 mg/L TSS. In the period since the treatment system was constructed, various deficiencies have been identified relating to capacity and operation issues. Deficiencies associated with the aerated lagoon treatment system are:

- Exceedance of permitted effluent BOD and TSS levels.
  - Capacity improvements are required for treatment objectives to be achieved.
- Stability of middle berm.
  - Middle berm is saturated and requires upgrading. The existing two-cell aerated lagoon system does not provide redundancy since the middle berm cannot be relied upon.

Conceptually, upgrading works to address the above identified deficiencies would comprise:

- Middle berm stabilization
- Aeration system upgrades including desludging
- Allowances for future capacity upgrades

The project would also include a 50 kW photovoltaic system to reduce the carbon footprint of the Town's treatment system.

A capital cost estimate for the above upgrades of $4,645,000 is derived in the following Section 6.1.

Further to these proposed upgrades, a recommendation moving forward would be to desludge these lagoons on a regular basis to ensure that adequate treatment capacity is maintained. It should also be noted that a geotechnical investigation relating to the preferred method for stabilizing the middle berm would be required for this project. It is suggested that the Town proceed with this geotechnical investigation prior to commencement of the detailed design phase.

6.1 Capital Cost Estimate

A preliminary (Class D) capital cost estimate of expected costs associated with this project is provided following.

Table 6-1: Capital Cost Estimate

Part A - Middle Berm Stabilization			
A1.0	**Bulk excavation of existing middle berm to allow installation of proposed lock block walls**	22000 m³ @ $15 / m³	$330,000
A2.0	**Two lock block walls**	2000 m² @ $1000 / m²	$2,000,000
A3.0	**Infill between lock block walls**	4900 m³ @ $20 / m³	$98,000
A4.0	**LDPE membrane**	2000 m² @ $20 / m²	$40,000
	Subtotal: Part A - Middle Berm Stabilization		$2,468,000
Part B - Aeration System Upgrades			
B1.0	**Remove aeration system**	Allow	$10,000
B2.0	**phases to allow for dewatering of geotextile tubes)**		
2.1	Mobilization and demobilization	Allow	$20,000
2.2	Construct laydown area	Allow	$15,000
2.3	Supply only geotextile tubes	12 ea. @ $15000 ea.	$180,000
2.4	Temporary overland piping to laydown area	850 l.m. @ $50 / l.m.	$42,500
2.4	Pump sludge to geotextile tubes	12000 m³ @ $20 / m³	$240,000
2.5	Bottom area cleanup and leveling	Allow	$15,000
B3.0	**Aeration system**		
3.1	Aeration header	300 l.m. @ $150 / l.m.	$45,000
3.2	Aeration laterals (allow for floating system)	1000 l.m. @ $115 / l.m.	$115,000
3.3	Diffusers complete with rubber hose and connection to laterals	50 ea. @ $1500 ea.	$75,000
B4.0	**Supply and install 30hp blower complete with variable frequency drive**	L.S.	$55,000
B5.0	**Electrical and programming**	Allow	$30,000
	Subtotal: Part B - Aeration System Upgrades		$842,500
Part C - 50 kW Photovoltaic System			
C1.0	**Photovoltaic panels**	50000 W @ $1.5 / W	$75,000
C2.0	**Inverters**	50000 W @ $1.25 / W	$62,500
C3.0	**Installation**	50000 W @ $2.5 / W	$125,000
	Subtotal: Part C - 50 kW Photovoltaic System		$262,500
Summary			
	Subtotal: Part A - Middle Berm Stabilization		$2,468,000
	Subtotal: Part B - Aeration System Upgrades		$842,500
	Subtotal: Part C - 50 kW Photovoltaic System		$262,500
	Subtotal Parts A - C		$3,573,000
	Contingencies & Engineering (allow 30%)		$1,072,000
	TOTAL (not including GST)		$4,645,000

6.2 Lifecycle Expenditures

Consistent with the Guide to the Amortization of Tangible Capital Assets produced by the Local Government Infrastructure and Finance Division of the BC government in May 2008, the following expected lifespans are presented in relation to components of the Town's aerated treatment system.

TABLE 6-2: "PUBLISHED" EXPECTED LIFESPANS OF AERATED LAGOON TREATMENT ASSETS

Asset	***Expected Lifespan***
Aerators	*15 years*
Blowers	*10 years*
Lagoons	*50 years*

Both the original aerators and blowers that are in service at the Town's aerated lagoon treatment system are still in operation. Therefore, the "published" expected lifespan for these components can be expected to be conservative. A comparison of these "published" lifespans and "observed" lifespans is therefore provided following. In order to provide an expected lifecyle expenditure, the "observed" lifespans will be utilized.

TABLE 6-3: "OBSERVED" EXPECTED LIFESPANS OF AERATED LAGOON TREATMENT ASSETS

Asset	***Expected Lifespan***
Aerators	*25 years*
Blowers	*25 years*

It is anticipated that the proposed project will result in fully rehabilitated aerated lagoons and therefore it is anticipated that the aerated lagoons will have a new expected lifespan of at least 50 years. Lifecycle capital expenditures for the aerated lagoon system must then include replacement of aerators, replacement of blowers, and desludging operations to match the expected lifespan of the lagoon system. The period between desludging operations is expected to be 25 years which is approximately equivalent to the currently planned desludging operations and the initial lagoon construction date. A projection of these expenditures is presented following. Note that these projected expenditures are presented in 2019 dollars and should be adjusted utilizing the ENR cost index to account for future costs.

TABLE 6-4: PROJECTED LIFECYCLE EXPENDITURES

Asset	*Lifecycle Replacements and Unit Rate*	*Total Cost including 30% Contingency and Engineering*
Aeration System	*2 @ $75,000*	*$195,000*
Blowers	*2 @ $80,000*	*$208,000*
Desludging	*2 @ $512,500*	*$1,332,500*
Total Capital Expenditure Cost over 50 years		***$1,735,500***
	Cost per year	***$34,710***

6.3 Annual Operating Costs

Annual operating costs are expected to include aeration system maintenance requirements and energy costs associated with the blowers. A projection of these annual costs is presented following:

TABLE 6-5: ANNUAL OPERATING COSTS

Component	*Unit and Unit Cost*	*Cost*
Aeration System Maintenance	*50 hours @ $60 / hr*	*$3,000*
Blower Electrical Costs	*60,000 kWh @ 10.195 cents / kWh*	*$6,000*
	Total Annual Expenditures	***$9,000***

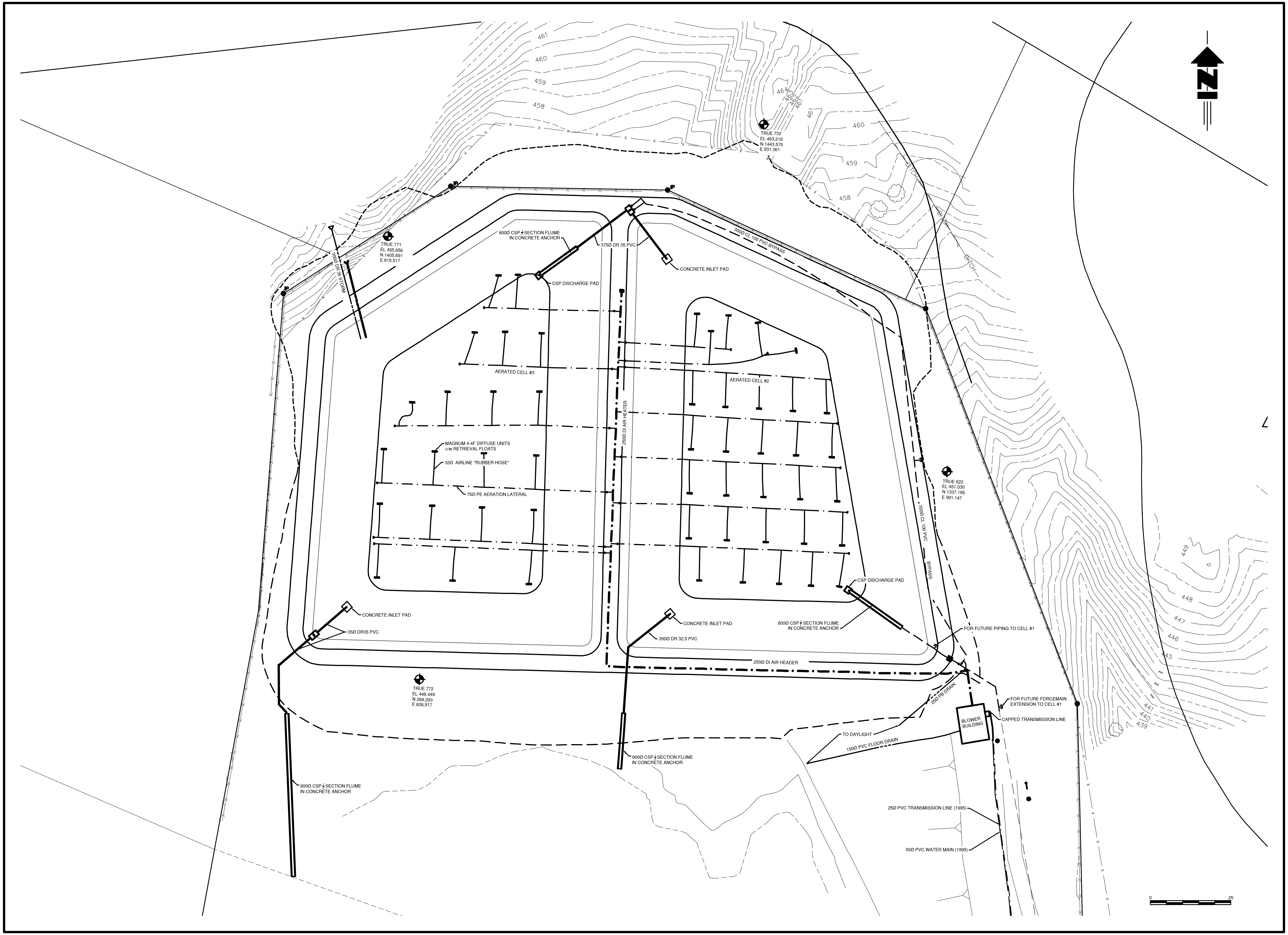
APPENDIX B

Figure 1-3 - Aerated Lagoon Treatment System Layout and Intercell Piping

306-985 Figure 1 - Proposed Cell No. 1

306-1752 Figure 1 - Overall Site Plan

306-1752 Figure 2 System Layout & Inter Cell Piping



No.	DATE	DESCRIPTION	BY	APP'D

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING

201 - 2079 Falcon Road ■ Kamloops BC ■ V2C 4J2
tel 250.828.0881 ■ fax 250.828.0717
info@TRUE.bc.ca

SANITARY SEWER ANNUAL REPORT

AREATED LAGOON TREATMENT SYSTEM LAYOUT AND INTERCELL PIPING

SCALE 1:500 (24x36)
DESIGN BY TRU
DRAWN BY NA
DATE JANUARY 2018
PROJECT REFERENCE No. 306-088-005
DRAWING No. FIG 1-3
SHEET 1 OF 1
ISSUE/REV.

FILE: r:\clients\300-399\306\306-088-005\03 drawings\cad\02 design drawings\306-088-005 report figures

SECTION A - PROPOSED CELL #1 & DIVERSION DITCH

HORIZONTAL & VERTICAL
SCALE 1:500

CUT/FILL QUANTITIES

PROPOSED CELL #1 EARTHWORKS

24,000 m³ (CUT)
19,500 m³ (FILL)
NET 4,500 m³ (CUT)

NOT INCLUDING STRIPPING
APPROXIMATE VOLUME 3,900 m³ (CUT)

PROPOSED CELL #1 CAPACITY
26,000 m³

No.	DATE	DESCRIPTION	BY	APP'D
0	SEPT 07/2017	ISSUED FOR DISCUSSION	DF	SC

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING
201 - 2079 Falcon Road ▪ Kamloops BC ▪ V2C 4J2
tel 250.828.0881 ▪ fax 250.828.0717
info@TRUE.bc.ca

BRITISH COLUMBIA Town of Oliver

AERATED LAGOON TREATMENT SYSTEM

PROPOSED CELL #1

SCALE 0 1:500 25

DESIGN BY	SU/SC
DRAWN BY	DF
DATE	SEPTEMBER, 2017
PROJECT REFERENCE No.	306-083 & 306-291

DRAWING No.
306-985
Fig. 1

SHEET
1 OF 1

ISSUE/REV.
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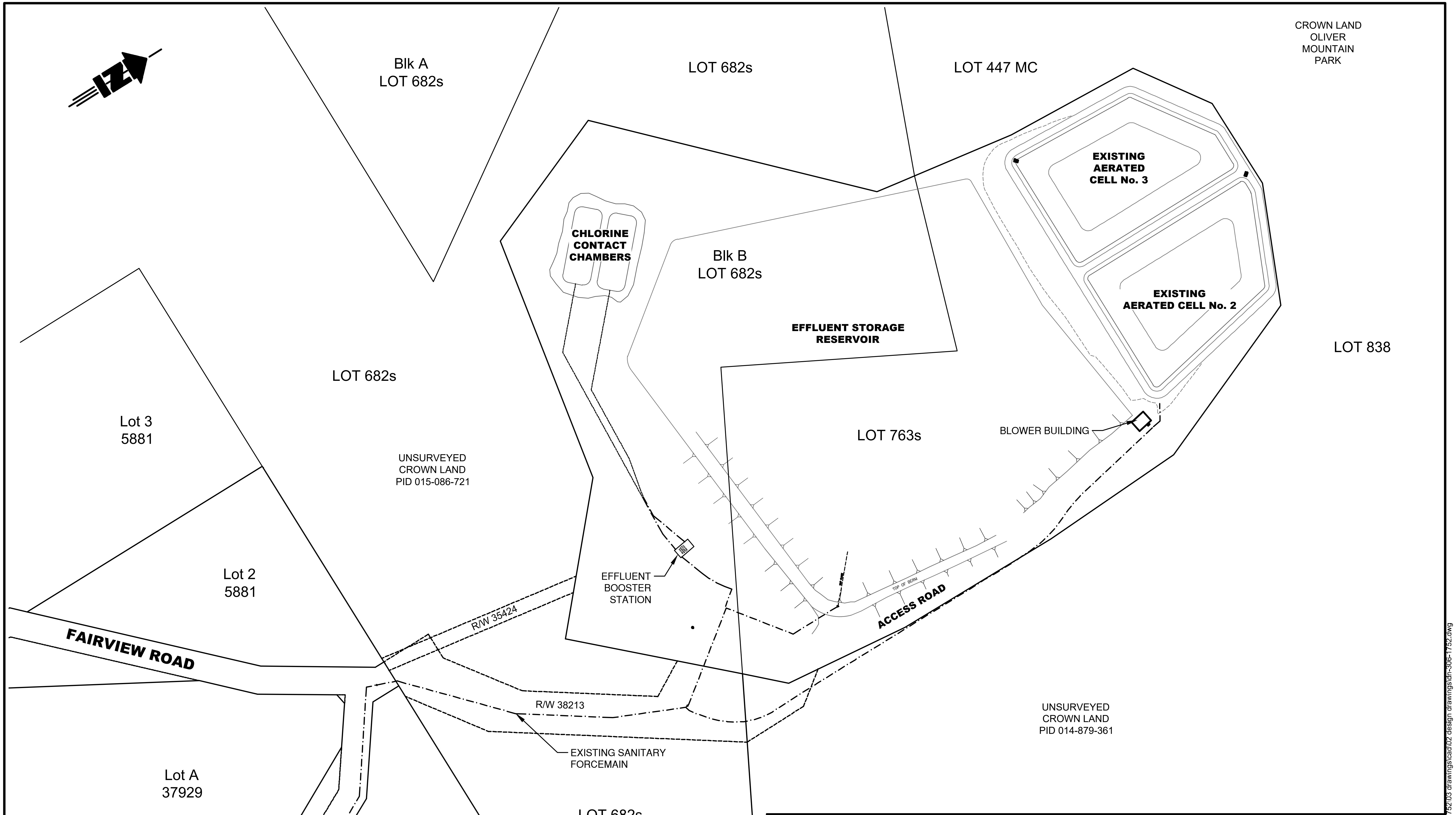

TOWN OF OLIVER
AERATED LAGOON TREATMENT SYSTEM
OVERALL SITE PLAN

TRUE CONSULTING

DRAWN BY: SAC/DL

DATE: JAN 2019

DESIGN BY: SAC

SCALE: 1 : 2,500

DWG NO.: Fig. 1 306-1752

REV: 0

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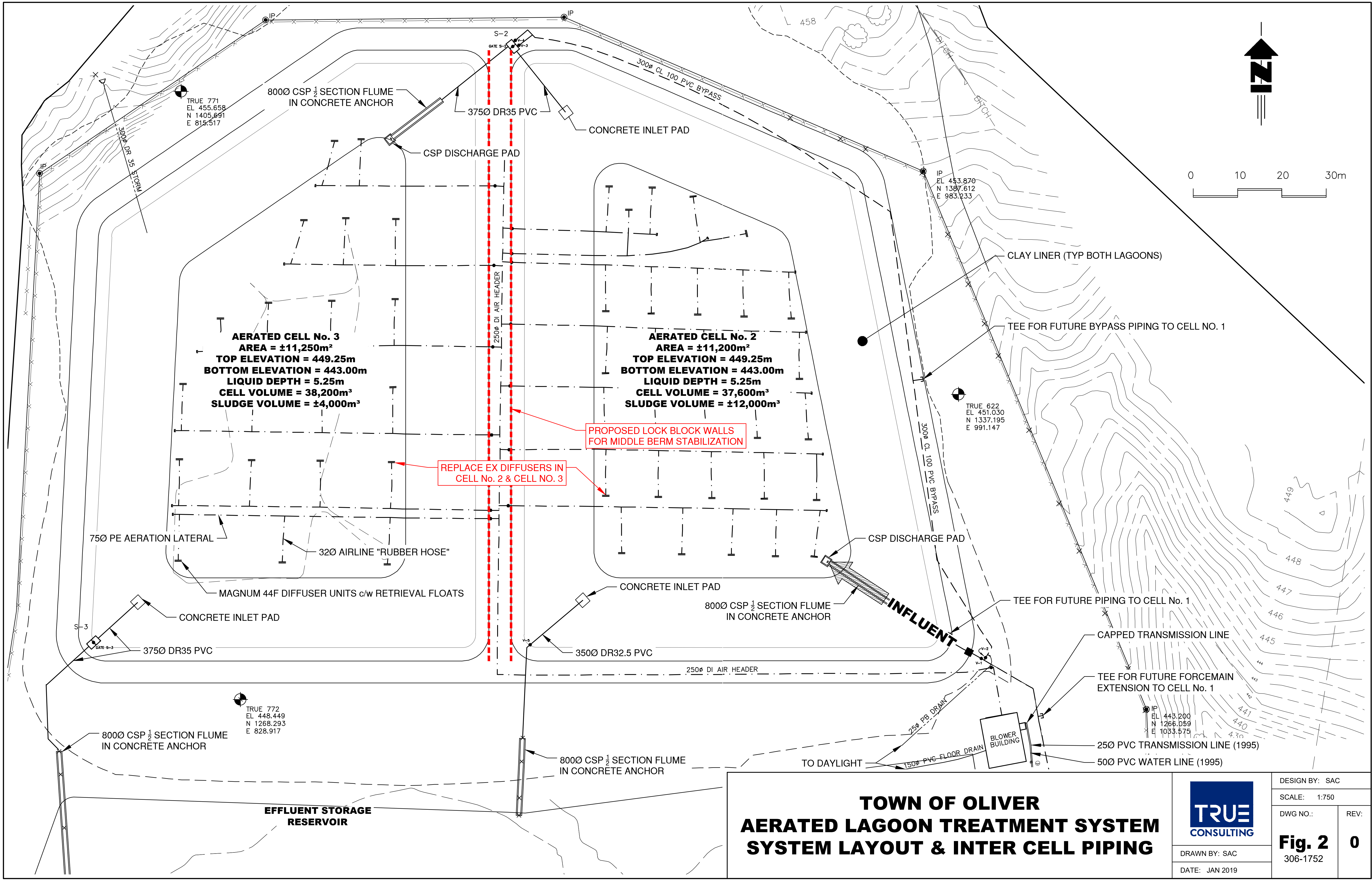

TOWN OF OLIVER
AERATED LAGOON TREATMENT SYSTEM
SYSTEM LAYOUT & INTER CELL PIPING

TRUE CONSULTING

DRAWN BY: SAC

DATE: JAN 2019

DESIGN BY: SAC

SCALE: 1:750

DWG NO.: Fig. 2
306-1752

REV: 0

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APPENDIX C

Influent and Effluent Sampling Data

TOWN OF OLIVER

PE - 13717 - Chlorine Contact Chamber Prior to Irrigation - EMS ID E222150

		Calculated Parameters	**General Parameters**	**Microbiological Parameters**		
	Date	**Total N**	**Total P**	**Total Coliforms**	**Fecal Coliforms**	**Free CL Res**
OC Limit		n/a	n/a	n/a	2.2 MPN/100 ml	n/a
Unit		mg/L	mg/L	MPN/100ml	MPN/100ml	mg/L
Frequency		monthly	monthly	monthly	monthly	weekly
April	12	24.1	4.76	<1.8	<1.8	0.29
May	7	24.5	3.75	<1	<1	0.34
June	14	22.3	3.11	<1	<1	0.49
July	13	15.6	2.65	<1	<1	0.55
August	10	12.3	2.82	<1	<1	0.42
September	14	12.6	5.34	<1	<1	0.34
October	20	17.9	6.17	<1	<1	0.23

* Note: The operational permit limit for fecal coliform in re-claimed water applied to agricultural land is 200 MPN per 100mL. Most of the re-claimed water in Oliver is applied on the Fairview Mountain Golf Course which is classified as high public use, hence the lower limit of 2.2 MPN per 100 mL.

Town of Oliver Sewer Flows - PE - 13717

	High Lift Station			Chlorine Booster Station				
January	Daily Flow m3/day	Total Monthly m3/day	Monthly Average m3/day	Irrigation m3/day (1)	Rapid Infiltration m3/day (2)	Total Daily m3/day (3)	Total Monthly m3/day	Monthly Average m3/day
1	1633.129							
2	2474.135							
3	1613.603							
4	526.2759							
5	1671.2							
6	1615.03							
7	1581.339							
8	1691.039							
9	2359.9							
10	1507.193							
11	606.7398							
12	1625.676							
13	1631.9							
14	1514.3							
15	1565.7							
16	2357.086							
17	1577.432							
18	588.1196							
19	1648.8							
20	1603.551							
21	1635.393							
22	1521.0							
23	2310.0							
24	1585.817							
25	600.6541							
26	1681.7							
27	1449.2							
28	1616.272							
29	1487.223							
30	2399.28							
31	1605.269							
		49284	1590	0.0	0		0.0	#DIV/0!
	OC Limit	n/a	2050m3/day				n/a	n/a

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2 & 3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

Town of Oliver Sewer Flows - PE - 13717

	High Lift Station			Chlorine Booster Station				
February	Daily Flow m3/day	Total Monthly m3/day	Monthly Average m3/day	Irrigation m3/day (1)	Rapid Infiltration m3/day (2)	Total Daily m3/day (3)	Total Monthly m3/day	Monthly Average m3/day
1	642.6							
2	1614.767834							
3	1646.869795							
4	1642.9521							
5	1639.306365							
6	2510.513117							
7	1547.189428							
8	661.3							
9	1681.3							
10	1640.8							
11	1622.8							
12	1485.530151							
13	2529.8							
14	1667.315318							
15	462.6179402							
16	1702.949687							
17	1652.33822							
18	1636.972996							
19	1598.6							
20	2416.659017							
21	1618.816837							
22	660.4640241							
23	1649.935529							
24	1672.0							
25	1636.392404							
26	1564.8							
27	2446.295473							
28	1594.541985							
29								
30								
31								
		44846	1602	0	0		0.0	#DIV/0!
	OC Limit	n/a	2050m3/day				n/a	n/a

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

(3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

Town of Oliver Sewer Flows - PE - 13717

	High Lift Station			Chlorine Booster Station				
March	Daily Flow m3/day	Total Monthly m3/day	Monthly Average m3/day	Irrigation m3/day (1)	Rapid Infiltration m3/day (2)	Total Daily m3/day (3)	Total Monthly m3/day	Monthly Average m3/day
1	636.9208					0.0		
2	1650.194					0.0		
3	1639.93					0.0		
4	1606.765					0.0		
5	1641.9					0.0		
6	2640.612					0.0		
7	1777.3					1.5		
8	540.2					0.0		
9	1682.9					0.0		
10	1655.9					0.1		
11	1677.1					2.0		
12	1649.519					0.0		
13	2345.0					0.0		
14	1726.933					0.0		
15	707.2821					0.0		
16	1671.2					0.0		
17	1581.2					0.0		
18	1543.123					0.0		
19	1615.762					0.0		
20	2333.44					0.0		
21	1604.928					0.0		
22	618.9775					13.4		
23	1640.539					1529.0		
24	1602.94					1088.9		
25	1644.105					0.0		
26	1594.878					0.0		
27	2372.4					755.6		
28	1666.4					0.0		
29	560.9912					11.2		
30	1709.4					815.7		
31	1558.408					903.7		
		48897	1577	0	0		5121.4	165
	OC Limit	n/a	2050m3/day				n/a	n/a

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

(3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

Town of Oliver Sewer Flows - PE - 13717

	High Lift Station			Chlorine Booster Station				
April	Daily Flow m3/day	Total Monthly m3/day	Monthly Average m3/day	Irrigation m3/day (1)	Rapid Infiltration m3/day (2)	Total Daily m3/day (3)	Total Monthly m3/day	Monthly Average m3/day
1	1597.375					1046.7		
2	1606.319					1040.3		
3	2414.26					746.9		
4	1661.2					955.7		
5	654.6266					947.5		
6	1790.2					996.8		
7	1567.118					1130.1		
8	1646.466					1193.2		
9	1649.4					1222.4		
10	2371.159					1132.7		
11	1678.77					750.6		
12	697.305					1978.8		
13	1685.0					2037.8		
14	1695.957					2202.4		
15	1718.12					2390.5		
16	1706.947					2144.1		
17	2259.7					2279.9		
18	1842.054					2646.2		
19	671.2253					2371.9		
20	1700.579					2476.8		
21	1684.617					2416.0		
22	1659.899					2378.6		
23	1981.966					2351.3		
24	2676.977					1191.9		
25	1640.578					0.3		
26	878.4399					779.9		
27	1399.012					611.0		
28	2048.899					715.9		
29	1259.582					7.5		
30	175.7944					1174.5		
31								
		48020	1601	0	0		43318.3	1444
	OC Limit	n/a	2050m3/day				n/a	n/a

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

(3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

Town of Oliver Sewer Flows - PE - 13717

	High Lift Station			Chlorine Booster Station				
May	Daily Flow m3/day	Total Monthly m3/day	Monthly Average m3/day	Irrigation m3/day (1)	Rapid Infiltration m3/day (2)	Total Daily m3/day (3)	Total Monthly m3/day	Monthly Average m3/day
1	2595.7					1072.9		
2	1741.738					1101.4		
3	826.7693					2098.3		
4	1665.1					1131.4		
5	1600.311					2297.7		
6	1653.55					1763.7		
7	1688.863					1975.5		
8	2541.2					1828.8		
9	2031.004					1775.8		
10	549.6					2170.8		
11	1667.064					2297.1		
12	1651.1					2112.5		
13	1658.1					2579.8		
14	1708.4					2848.7		
15	2671.9					3500.2		
16	1872.537					3284.8		
17	806.1					3626.0		
18	1685.4					3075.2		
19	1661.4					3220.1		
20	1752.9					2870.7		
21	1816.909					1995.2		
22	2836.205					855.9		
23	1806.9					1905.4		
24	751.3					2253.4		
25	1884.072					2842.8		
26	1845.877					3368.9		
27	1652.966					2950.4		
28	1778.5					3333.2		
29	2916.068					2367.6		
30	1971.661					3393.9		
31	923.9					4546.4		
		54213	1749	0	0		76444.6	2466
	OC Limit	n/a	2050m3/day				n/a	n/a

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

(3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

Town of Oliver Sewer Flows - PE - 13717

	High Lift Station			Chlorine Booster Station				
June	Daily Flow m3/day	Total Monthly m3/day	Monthly Average m3/day	Irrigation m3/day (1)	Rapid Infiltration m3/day (2)	Total Daily m3/day (3)	Total Monthly m3/day	Monthly Average m3/day
1	1694.282					3924.6		
2	1925.5					3271.5		
3	1896.807					3104.8		
4	1860.8					3692.9		
5	2659.77					2807.2		
6	2411.572					1254.2		
7	297.4					2461.7		
8	1753.8					963.2		
9	1710.309					2184.9		
10	1678.222					2123.0		
11	1544.5					2907.9		
12	2946.251					1717.1		
13	1613.322					1437.7		
14	1100.336					573.6		
15	1609.34					588.7		
16	1916.7					375.0		
17	1753.11					751.8		
18	1863.722					1469.7		
19	2791.833					1830.0		
20	1904.997					2187.2		
21	971.9					2813.3		
22	1707.225					2888.5		
23	1966.829					3591.3		
24	1954.1					3118.6		
25	2009.0					3864.7		
26	2844.225					3890.9		
27	1875.281					3625.3		
28	1076.9					4872.2		
29	2010.481					5767.9		
30	1964.453					5891.8		
31								
		55313	1844	0	0		79951.3	2665
	OC Limit	n/a	2050m3/day				n/a	n/a

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

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Town of Oliver Sewer Flows - PE - 13717

	High Lift Station			Chlorine Booster Station				
July	Daily Flow m3/day	Total Monthly m3/day	Monthly Average m3/day	Irrigation m3/day (1)	Rapid Infiltration m3/day (2)	Total Daily m3/day (3)	Total Monthly m3/day	Monthly Average m3/day
1	1781.3					4997.4		
2	1678.9					4970.7		
3	3290.197					4496.9		
4	1954.8					1410.8		
5	1077.961					3919.6		
6	1453.111					3369.2		
7	1974.546					2649.4		
8	1833.114					2378.9		
9	2030.6					2260.9		
10	2965.227					4897.1		
11	1967.023					4825.9		
12	945.7					4815.1		
13	1608.823					5711.1		
14	1612.388					5341.9		
15	1945.3					3708.8		
16	1718.086					4873.3		
17	3151.376					5419.2		
18	1901.091					3699.6		
19	865.6696					3755.2		
20	1594.0					3726.6		
21	1558.9					3579.3		
22	1943.6					3340.5		
23	1601.453					3698.1		
24	2998.91					4092.5		
25	1923.716					3884.4		
26	804.156					3796.0		
27	1523.5					3942.2		
28	1712.289					3846.6		
29	1988.9					3796.1		
30	1538.023					2727.2		
31	2991.5					3146.8		
		57934	1869	0	0		121077.3	3906
	OC Limit	n/a	2050m3/day				n/a	n/a

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

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Town of Oliver Sewer Flows - PE - 13717

	High Lift Station			Chlorine Booster Station				
August	Daily Flow m3/day	Total Monthly m3/day	Monthly Average m3/day	Irrigation m3/day (1)	Rapid Infiltration m3/day (2)	Total Daily m3/day (3)	Total Monthly m3/day	Monthly Average m3/day
1	1874.2					1057.5		
2	720.095					732.9		
3	1592.1					1745.0		
4	1577.778					2142.1		
5	1960.195					2176.0		
6	1618.8					2566.4		
7	2755.71					2924.1		
8	1855.862					1777.0		
9	826.4522					1420.9		
10	1571.356					2470.2		
11	1574.618					2895.4		
12	1594.9					3056.3		
13	2017.9					3354.0		
14	2618.949					2910.5		
15	1768.318					2929.3		
16	1085.532					2295.9		
17	1129.9					2622.9		
18	1687.0					2283.6		
19	1726.175					2414.3		
20	1546.114					2363.2		
21	2933.882					1533.8		
22	1717.288					759.4		
23	811.2724					1126.2		
24	1592.037					1545.7		
25	1499.846					1372.5		
26	1544.213					2668.2		
27	1933.9					2499.0		
28	2715.98					2793.0		
29	1912.538					2799.0		
30	765.6041					2469.5		
31	1510.1					2525.2		
		52039	1679	0	0		68228.9	2201
	OC Limit	n/a	2050m3/day				n/a	n/a

Notes:

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(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

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Town of Oliver Sewer Flows - PE - 13717

	High Lift Station			Chlorine Booster Station				
September	Daily Flow m3/day	Total Monthly m3/day	Monthly Average m3/day	Irrigation m3/day (1)	Rapid Infiltration m3/day (2)	Total Daily m3/day (3)	Total Monthly m3/day	Monthly Average m3/day
1	1796.107					2453.5		
2	1926.248					2286.6		
3	1616.2					1565.2		
4	2670.972					2259.9		
5	1702.046					2687.1		
6	854.8					1754.1		
7	1738.424					2091.2		
8	1951.7					2180.5		
9	1971.801					2408.2		
10	1748.882					1030.3		
11	2599.504					1888.2		
12	1749.725					955.8		
13	792.9					1313.6		
14	1583.6					937.2		
15	1556.1					743.7		
16	1736.799					1474.0		
17	1572.9					1438.4		
18	2604.212					365.1		
19	1771.696					349.2		
20	1088.158					0.0		
21	1536.837					1329.5		
22	1511.189					952.9		
23	1501.4					1066.6		
24	1634.898					711.0		
25	2445.177					957.8		
26	1711.8					359.9		
27	822.6					407.2		
28	1524.393					1479.7		
29	1565.737					363.6		
30	1500.411					750.6		
31								
		50787	1693	0	0		38560.5	1285
	OC Limit	n/a	2050m3/day				n/a	n/a

Notes:

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(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

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Town of Oliver Sewer Flows - PE - 13717

	High Lift Station			Chlorine Booster Station				
October	Daily Flow m3/day	Total Monthly m3/day	Monthly Average m3/day	Irrigation m3/day (1)	Rapid Infiltration m3/day (2)	Total Daily m3/day (3)	Total Monthly m3/day	Monthly Average m3/day
1	1498.7					1229.7		
2	2442.1					561.2		
3	1750.702					881.8		
4	757.9106					1031.0		
5	1573.8					956.8		
6	1508.733					958.3		
7	1530.876					817.3		
8	1575.663					923.9		
9	2450.478					1078.6		
10	1735.332					838.3		
11	631.3891					1478.9		
12	1508.227					1058.4		
13	1553.197					1421.3		
14	1498.8					294.5		
15	1554.554					790.2		
16	2535.9					581.3		
17	1652.698					625.7		
18	840.5504					780.2		
19	1516.947					862.6		
20	1509.9					408.2		
21	1556.777					0.0		
22	1707.162					0.0		
23	2614.89					353.0		
24	2359.047					0.0		
25	386.5					0.0		
26	1453.661					351.8		
27	1966.638					10.0		
28	1839.637					0.0		
29	1574.8					1.5		
30	2516.1					0.0		
31	1757.534					0.0		
		51359	1657	0	0		18294.4	590
	OC Limit	n/a	2050m3/day				n/a	n/a

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

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Town of Oliver Sewer Flows - PE - 13717

	High Lift Station			Chlorine Booster Station				
November	Daily Flow m3/day	Total Monthly m3/day	Monthly Average m3/day	Irrigation m3/day (1)	Rapid Infiltration m3/day (2)	Total Daily m3/day (3)	Total Monthly m3/day	Monthly Average m3/day
1	807.5							
2	1498.669							
3	1575.663							
4	1637.693							
5	1621.968							
6	2507.8							
7	1381.582							
8	1088.738							
9	1465.273							
10	1561.975							
11	1441.3							
12	1398.537							
13	2897.939							
14	1628.178							
15	685.3475							
16	1501.7							
17	1515.5							
18	1485.231							
19	1556.971							
20	2439.676							
21	1697.354							
22	687.444							
23	1578.7							
24	1555.027							
25	1573.8							
26	1571.143							
27	2448.205							
28	1719.903							
29	652.3							
30	1547.335							
31								
		46729	1558	0	0		0.0	#DIV/0!
	OC Limit	n/a	2050m3/day				n/a	n/a

Notes:

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(2 & 3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

Town of Oliver Sewer Flows - PE - 13717

	High Lift Station			Chlorine Booster Station				
December	Daily Flow m3/day	Total Monthly m3/day	Monthly Average m3/day	Irrigation m3/day (1)	Rapid Infiltration m3/day (2)	Total Daily m3/day (3)	Total Monthly m3/day	Monthly Average m3/day
1	1530.628							
2	1528.7							
3	1584.0							
4	2503.326							
5	1797.784							
6	600.8							
7	1615.9							
8	1575.902							
9	1540.424							
10	1542.5							
11	2439.374							
12	1708.081							
13	615.9055							
14	1556.959							
15	1565.4							
16	1512.63							
17	1582.104							
18	2582.432							
19	1628.57							
20	644.1							
21	1540.1							
22	1565.463							
23	1554.484							
24	1607.369							
25	2249.912							
26	1464.4							
27	605.9886							
28	1565.674							
29	1398.077							
30	1486.361							
31	1616.974							
		48310	1558	0	0		0.0	#DIV/0!
	OC Limit	n/a	2050m3/day				n/a	n/a

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2 & 3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

TOWN OF OLIVER
Summary of Monthly Sewer Flows

	High Lift Station		Chlorine Booster Station			
	Total Monthly m3/day	Monthly Average m3/day	Irrigation m3/day (1)	Rapid Infiltration m3/day (2)	Total Daily m3/day (3)	Monthly Average m3/day
Jan	49284	1590	0	0	0	#DIV/0!
Feb	44846	1602	0	0	0	#DIV/0!
Mar	48897	1577	0	0	5121.3592	165
Apr	48020	1601	0	0	43318.338	1444
May	54213	1749	0	0	76444.58	2466
Jun	55313	1844	0	0	79951.293	2665
Jul	57934	1869	0	0	121077.25	3906
Aug	52039	1679	0	0	68228.908	2201
Sep	50787	1693	0	0	38560.529	1285
Oct	51359	1657	0	0	18294.417	590
Nov	46729	1558	0	0	0	#DIV/0!
Dec	48310	1558	0	0	0	#DIV/0!
Total	607731		0	0	450996.67	
Average	1665				1236	

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site except during the non-irrigation season when the rapid infiltration readings are read from the meter located in the Chlorine Booster Station.

(3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

TOWN OF OLIVER
PE-13717 - Effluent Sampling - Cell #3, prior to storage reservoir - EMS ID E222151

	Date	BOD5 Carbonaceous	TSS	Nitrate	Nitrite	Phosphate	Nitrate & Nitrite	Nitrogen	Nitrogen	Ammonia	Kjeldahl	Phosphorus	Phosphorus
OC Limit			60 mg/L	(as N)	(as N)	(as P)	(as N)	(Total)	(Organic)	Total (as N)		Total (as P)	Total Dissolved
Units			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Frequency		monthly	monthly	semi-annually	semi-annually	semi-annually	semi-annually	semi-annually	semi-annually	semi-annually	semi-annually	semi-annually	semi-annually
January	4	16.7	25.6										
February	2	16.8	18.4										
March	1		38.8										
March	15*			0.428	0.039	4.06	0.467	24.50	<1.25	26.00	24.00	5.14	4.95
March	15*					1.70							6.76
April	6**	15	12.4										
May	3	11.6	27.6										
June	7	10.1	12.0										
July	6	7.0	8.0										
August	8	<4.8	11.7										
September	14			2.11	0.847	4.87	2.95	17.4	1.88	12.6	14.5	5.9	5.86
September	14					2.28							5.59
September	14	7.9	5.7										
October	19	5.1	5.6										
November	8	<4.7	12.4										
December													

PE - 13717 - Influent Sampling - Equalization Basin - EMS ID E222152
Influent Sampling

Semi- Annual

*Began lowering Cell 2 & 3 ponds on March 5, 2021
**Ponds still being lowered on April 6, 2021

APPENDIX D

Reclaimed Water Storage Reservoir Level and Flow Data & Volume Calibration Curve

TOWN OF OLIVER

RECLAIMED WATER USE BY CUSTOMER
(Readings in m3)

LOCATION	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
AIRPORT	221400.0	238400.0	203100.0	161600.0	131800.0	201050.0	147688.3	153841.2	185686.70	124891.7	115743.3	98510.9	101779.8	99601.3	69142.8	19567.0	32276.3
CEMETERY	14015	14125	17325	17000	18215	13311.2	16338.73	14607.36	19159.94	15996.1	14354.03	14843.27	13399.67	12651.17	16986.46	17498.75	18291.44
PUBLIC WORKS YARD	7720	12535	7580	5575	5795	6155.8	5163.96	6408.64	7085.72	7393.22	7380.1	8094.8	8340.74	6260.65	5939.63	8319.96	5387.7
103 STREET PARK	4555	9255	7090	5280	6345	5377.24	6232.1	6621.86	8051.37	8749.04	7647.12	8359.52	**1030.6***	5927.68	8858.46	1244.97	11676
SOSS										48457	4873.58	0	1.55	0	25743.75	27419.66	24693.89
ALONSO						3495.31	1670.9	7014.59	6714.65	3892.74	3850.51	2364.03	2498.39	1794.43	9240	6012.39	0
HUGGINS						15536.5	3787.05	2872.33	1290.33	meter off	8554.16	0	0	0	4614.7	0	0

Other Users Not Metered:

- Fairview Mountain Golf Course
- Fairview Park (new 2015)

TOWN OF OLIVER
STORAGE RESERVOIR
LEVEL DATA

DAY	JANUARY		FEBRUARY		MARCH		APRIL	
	ELEVATION	VOLUME IN STORAGE*	ELEVATION	VOLUME IN STORAGE*	ELEVATION	VOLUME IN STORAGE*	ELEVATION	VOLUME IN STORAGE*
1					445.26	333,000		
2								
3								
4								
5								
6							445.76	358,000
7								
8					445.47	343,000		
9								
10								
11								
12							445.74	357,000
13								
14								
15					445.69	354,000		
16								
17								
18								
19			445.07	320,000			445.57	348,000
20								
21								
22			445.13	323,000	445.80	360,000		
23			445.15	325,000				
24			445.16	326,000				
25								
26							445.54	347,000
27								
28								
29					445.76	358,000		
30								
31								

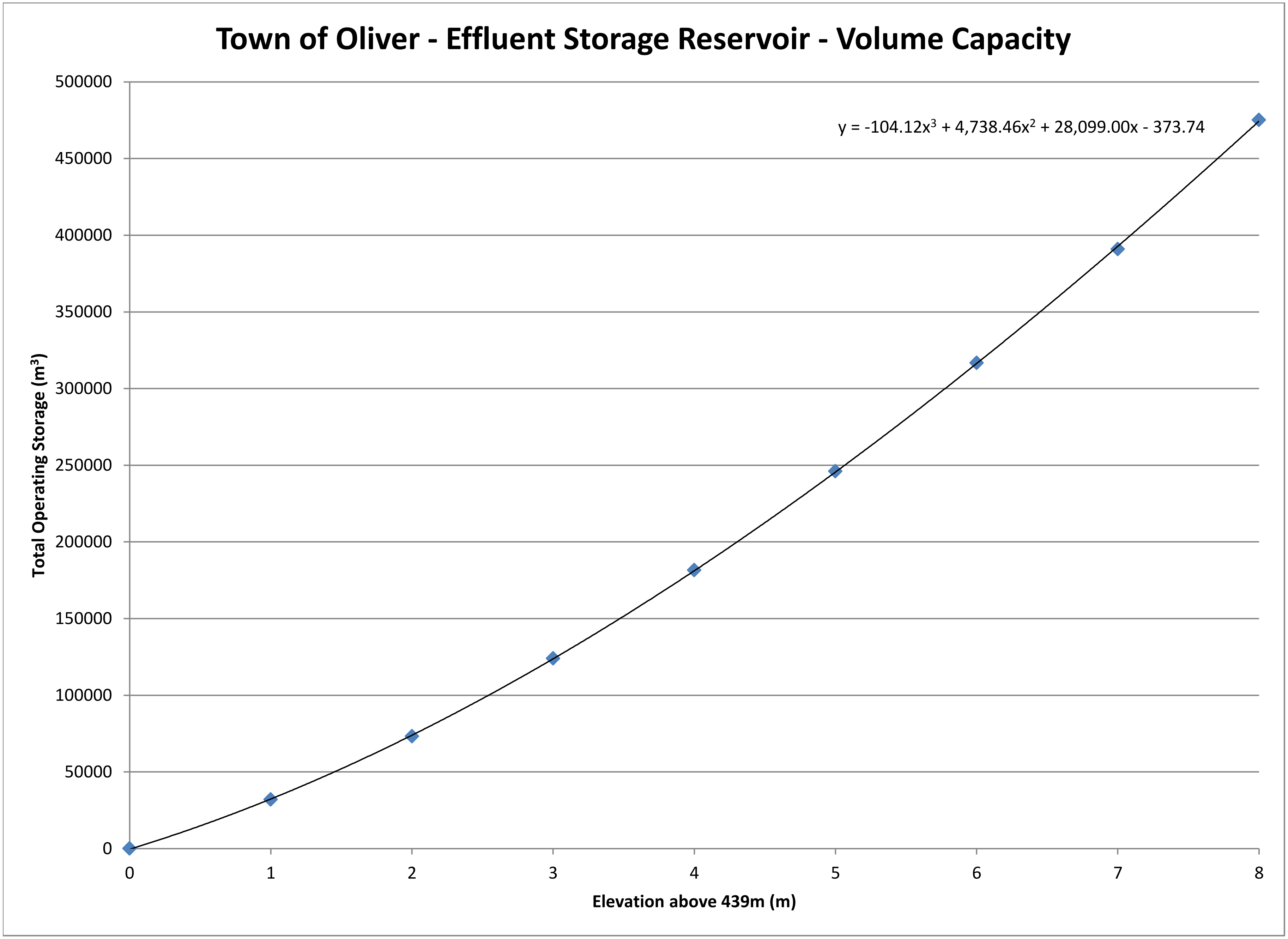
* Volume in Storage above Elevation 439.00
Elevation 439.00 is minimum 60 day average operating level

DAY	MAY		JUNE		JULY		AUGUST	
	ELEVATION	VOLUME IN STORAGE*	ELEVATION	VOLUME IN STORAGE*	ELEVATION	VOLUME IN STORAGE*	ELEVATION	VOLUME IN STORAGE*
1								
2								
3	445.52	346,000					442.31	140,000
4								
5					443.60	220		
6								
7			444.37	271,000				
8								
9							442.20	135,000
10	445.18	328,000						
11								
12					443.29	200,000		
13								
14			444.31	266,000				
15								
16							441.97	122,000
17	444.98	315,000						
18								
19					442.85	173,000		
20								
21			444.31	266,000				
22								
23							441.86	116,000
24								
25	444.79	299,000						
26								
27					442.46	151,000		
28			444.03	247,000				
29								
30								
31							441.72	110,000

* Volume in Storage above Elevation 439.00
Elevation 439.00 is minimum 60 day average operating level

DAY	SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	ELEVATION	VOLUME IN STORAGE*	ELEVATION	VOLUME IN STORAGE*	ELEVATION	VOLUME IN STORAGE*	ELEVATION	VOLUME IN STORAGE*
1					442.55	157,000	443.15	192,000
2								
3								
4			441.77	112,000				
5								
6								
7	441.60	105,000					443.30	201,000
8					442.67	163,000		
9								
10								
11								
12			441.82	114,000				
13	441.60	105,000					443.44	209,000
14								
15								
16								
17								
18			441.89	118,000				
19								
20	441.65	107,000					443.62	221,000
21								
22								
23								
24								
25			442.09	129,000				
26								
27	N/A							
28								
29								
30								
31								

* Volume in Storage above Elevation 439.00
Elevation 439.00 is minimum 60 day average operating level



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Town of Oliver - Effluent Storage Reservoir - Volume Capacity

Reservoir Elevation (m)	Elevation above 439m (m)	Measured Volume (m^3)	Calculated Volume (m^3)	% Difference from Measured
439	0	0	-374	N/A
440	1	32000	32360	1%
441	2	73300	73945	1%
442	3	124000	123758	0%
443	4	181600	181174	0%
444	5	246000	245568	0%
445	6	316800	316315	0%
446	7	391000	392791	0%
447	8	475200	474370	0%

APPENDIX E

Irrigation Plan

BRITISH
COLUMBIA

TOWN OF OLIVER
RECEIVED
AUG 1 9 2002

Reference: 66483

AUG 0 6 2002

Her Worship Mayor Linda Larson
and Councillors
Town of Oliver
PO Box 638
Oliver BC V0H 1T0

Dear Mayor Larson and Councillors:

I am pleased to inform you that the update to the Town of Oliver's Liquid Waste Management Plan (LWMP) is hereby approved in principle in accordance with section 18 of the *Waste Management Act.*

I recognize that your LWMP update was rather complicated and required the concerted efforts of your staff and your consultant to complete. I commend your efforts and those of your consultant and wish you well in the continued implementation of your LWMP.

The implementation and administration of the LWMP will require resolution of details involving financial, engineering, operational and administrative elements, and I request that you continue to work closely with ministry staff on plan implementation details. I am sending a copy of this letter to my colleague, the Minister of Community, Aboriginal and Women's Services (formerly Municipal Affairs), the Honourable George Abbott so that he is aware of my support for your funding request for the continued implementation of this plan.

Best regards,

Joyce Murray
Minister

cc: The Honourable George Abbott, Minister of Community, Aboriginal and Women's Services

FILE:
ROUTING: Vault file w/ WMP.
COMMENTS:
COPIES: TRO, BH
Reg Aug 26

Ministry of Water, Land and Air Protection

Office of the Minister

Mailing Address:
Parliament Buildings
Victoria BC V8V 1X4

December 13, 2018 Our File: 306-088-005

Ministry of Environment & Climate Change Strategy
102 Industrial Place
Penticton, B.C.
V2A 7C8

Attn: Regional Waste Manager

Dear Sir/Madam:

RE: *Town of Oliver – Update to Reclaimed Water Irrigation Plan - OC PE-13717*

The Town of Oliver requests approval from the Ministry for expansion of their reclaimed water irrigation system as authorized in Operational Certificate PE-13717. The current works authorized within this Operational Certificate are outlined in Site Plan A, dated December 14, 1995. The areas include:

Location	Legal Description
Fairview Mountain Golf Course	Lot 1, Plan KAP62023, DL2450S, SDYD
Alonso	Lot A, Plan KAP37929, Sec 12, Township 54, SDYD
Huggins	Lot 3, Plan KAP5881, Sec 12, Township 54, SDYD

The Town requests authorization for expansion of the irrigation system. The expansion areas are shown in Figure 1 enclosed herein. They are identified as Reclaimed Water Irrigation Expansion Areas (2006). Their location and legal descriptions of the expansion areas are as follows.

Location	Legal Description
High School Park	- Lot 2H, DL 2450S, SDYD, Townsite of Oliver - Southern portion of Block C, DL 2450S, SDYD, Irrigation Lateral SRW shown on PL 330, Lot 2G BLF52 on Oliver Townsite map
Fairview Park	- Lot 2J, DL 2450S, SDYD, Townsite of Oliver - Block 34, DL 2450S, SDYD, Townsite of Oliver, Incl Closed Rd PL B7567
Oliver Secondary School	Block 32, Plan KAP4297, DL 2450S, SDYD
Public Works	Lot 2, Plan KAP54258, DL 2450S, SDYD
Airstrip	Lot 2, Plan KAP38137, DL 2450S, SDYD
Cemetery	Lot 1, Plan KAP 24065, DL 2450S, SDYD, Portion L 203A

Total reclaimed water use is measured by a flow meter located at the booster station, adjacent to the reclaimed water storage reservoir. Meters have also been installed at the Cemetery, Airport, Public Works Yard, Alonso Property, Southern Okanagan Secondary School, High School Park and Huggins Property for the purposes of measuring total reclaimed water use at each location. There is no flow meter on the irrigation service to the Fairview Mountain Gold Course. Usage is calculated as the total annual irrigation, less all other metered usage. Annual reporting of the irrigated areas will be consistent with the reporting requirements as outlined in PE-13717 and include the total usage, crop type, irrigated area, irrigation application rate, and irrigation period.

Groundwater monitoring plans are established for the airport and Fairview Mountain Gold Course sites, the two largest users of reclaimed water. Sampling data is included in annual reporting.

As per the operational certificate, no reclaimed wastewater will be applied to the ground any closer than 15 metres from the edge of flowing streams or bodies of water. Additionally, no reclaimed wastewater is irrigated within 30 metres of any well or inground reservoir for domestic supply.

Should questions arise or for additional information, please do not hesitate to contact the undersigned.

Yours truly,

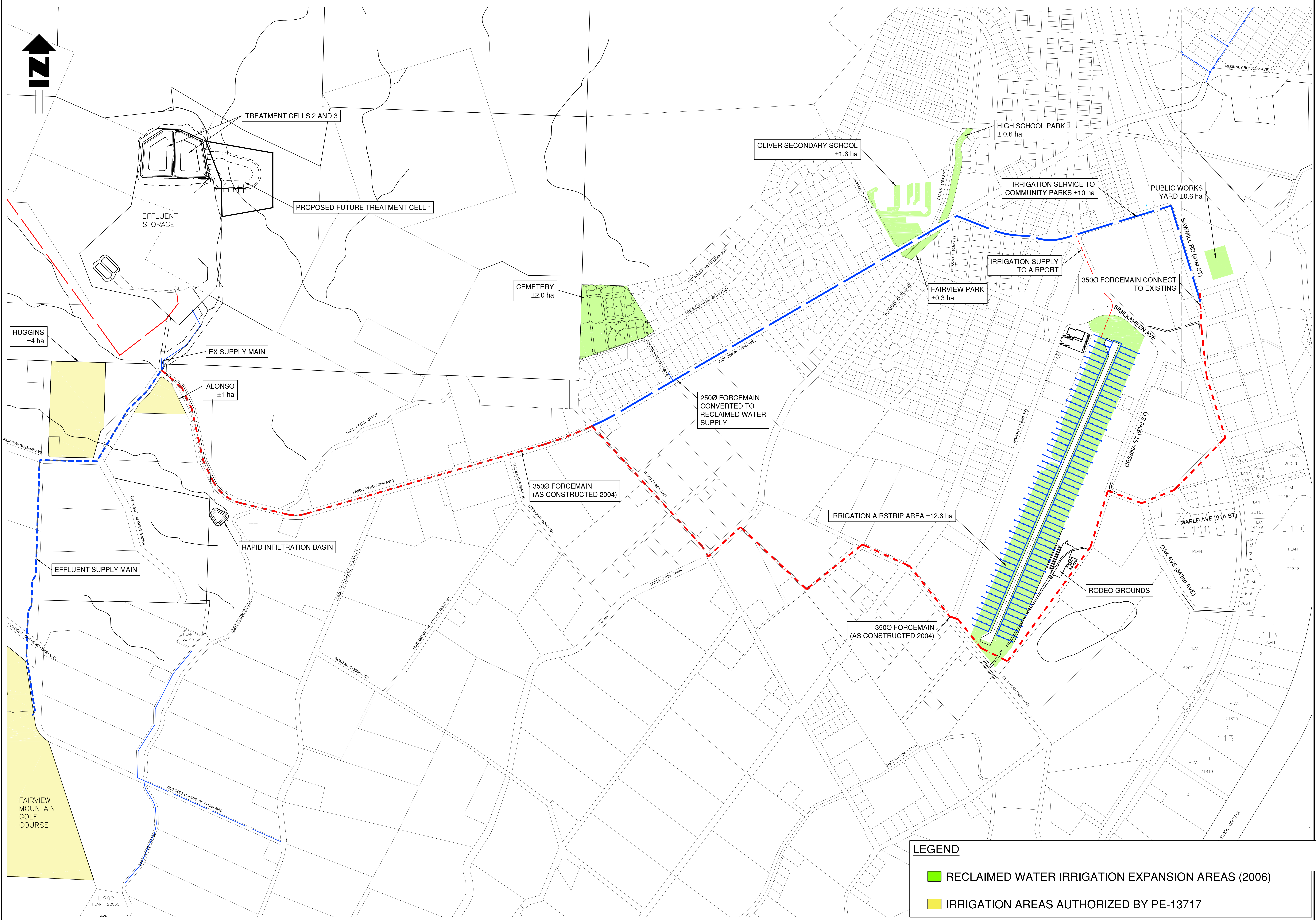
TRUE CONSULTING

Steve Underwood, P. Eng.

Enclosures

NA/

R:\Clients\300-399\306\306-088-005\02 Correspondence\Outgoing\To MoE\306-088-005-MoE-Oliver Treated Effluent Irrigation Area Expansion Notification-2018 12 13.docx



LEGEND

🟩 RECLAIMED WATER IRRIGATION EXPANSION AREAS (2006)

🟨 IRRIGATION AREAS AUTHORIZED BY PE-13717

No.	DATE	DESCRIPTION	BY	APP'D

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING

201 - 2079 Falcon Road ■ Kamloops BC ■ V2C 4J2
tel 250.828.0881 ■ fax 250.828.0717
info@TRUE.bc.ca

British Columbia Town of Oliver

SANITARY SEWER SYSTEM

OVERALL PLAN RECLAIMED WATER SYPPLY SYSTEM AND IRRIGATION AREAS

SCALE N.T.S. (11x17)

PROJECT REFERENCE No. 306-088-005

DRAWING No.

FIG 1

SHEET 1 OF 1

ISSUE/REV.

FILE: r:\clients\300-399\306\306-088-005\03
sign drawings\306-088-005 moe irrigation areas

TRUE

January 17, 2019

Our File: 306-088-005

Ministry of Environment & Climate Change Strategy
102 Industrial Place
Penticton, B.C.
V2A 7C8

Attn: Jen Pape, Environmental Protection Officer, Municipal Liquid Waste

Dear Ms. Pape:

RE: *Town of Oliver – Irrigation Area Expansion Notification - OC PE-13717*

In response to your email dated January 10, 2018, the following supplemental information is provided to support the Update to Reclaimed Water Irrigation Plan submitted to the Ministry on December 13, 2018.

1. The Town currently provides treated reclaimed water to the Alonso and Huggins vineyards for irrigation purposes. The Huggins service is turned off, but this service provides a backup source to the user in the event of a drought period. Both vineyards use drip irrigation to water crops. There are no supplemental food crops in the irrigation area.

2. The following drawings of the Town of Oliver Effluent Infiltration Basin are enclosed herein:
    a. General Location Map (Dwg. No. 306-1201-05)
    b. Effluent Infiltration Basin Plan and Profile (Dwg. No. 306-1322-03)

Should questions arise or for additional information, please do not hesitate to contact the undersigned.

Yours truly,

TRUE CONSULTING

Natalie Alteen

Natalie Alteen, EIT

Enclosures

NA

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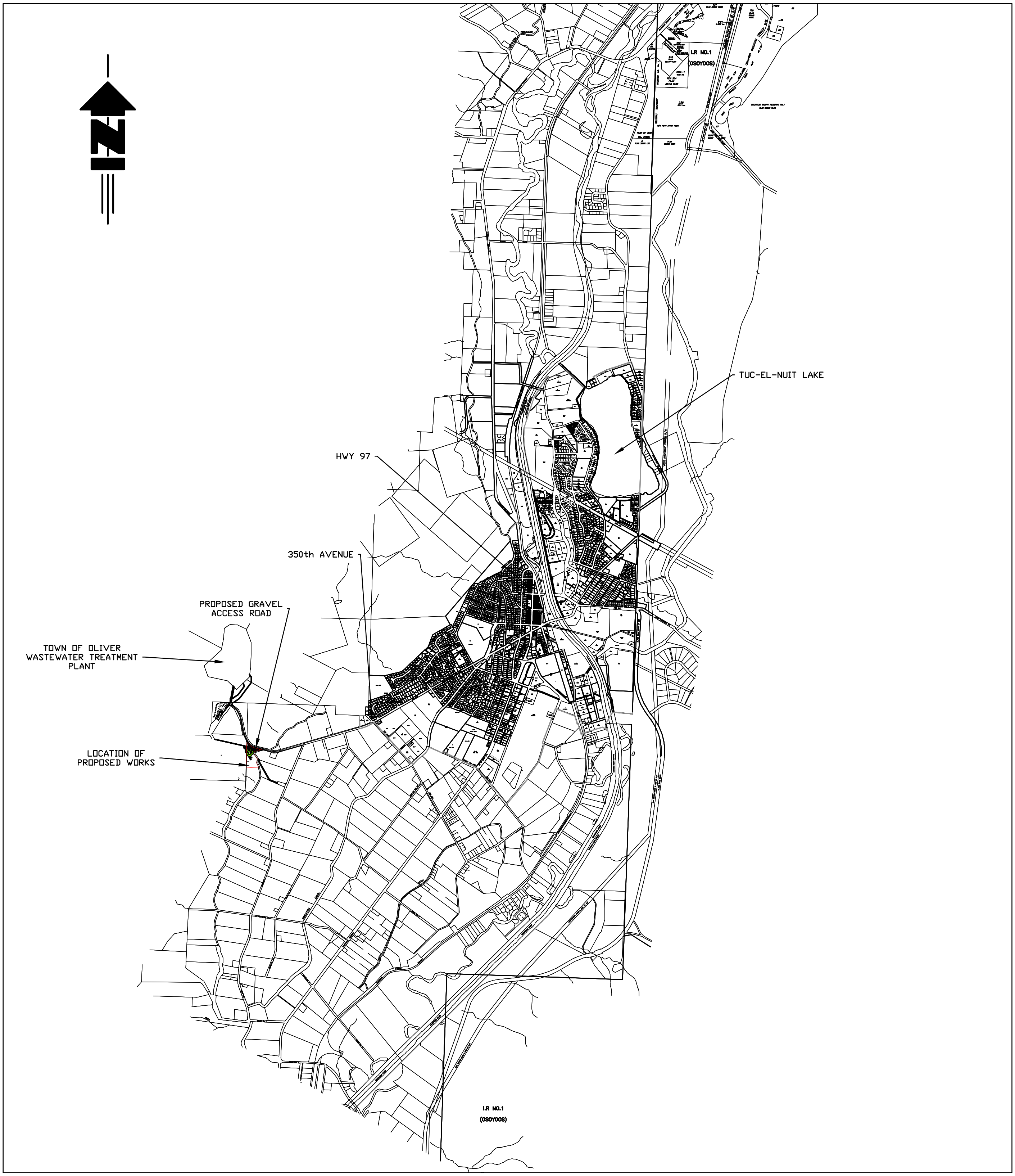

TOWN OF OLIVER

GENERAL LOCATION MAP

TRUE CONSULTING

DSGN. BY:	
SCALE:	1:50,000
DWG. NO.:	REV.:
306-1201-05	
DWN. BY:	KK
DATE:	NOV 2011

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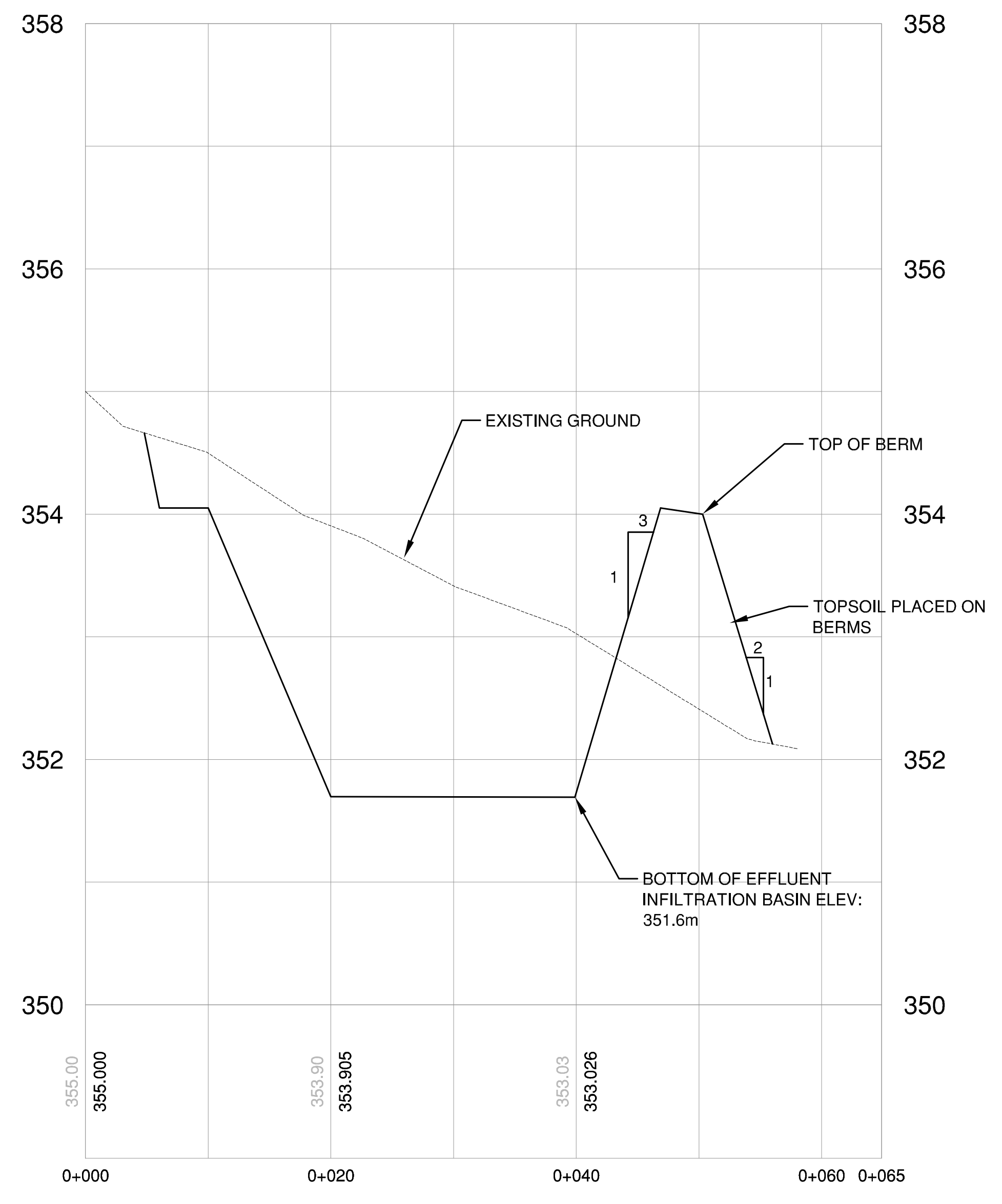
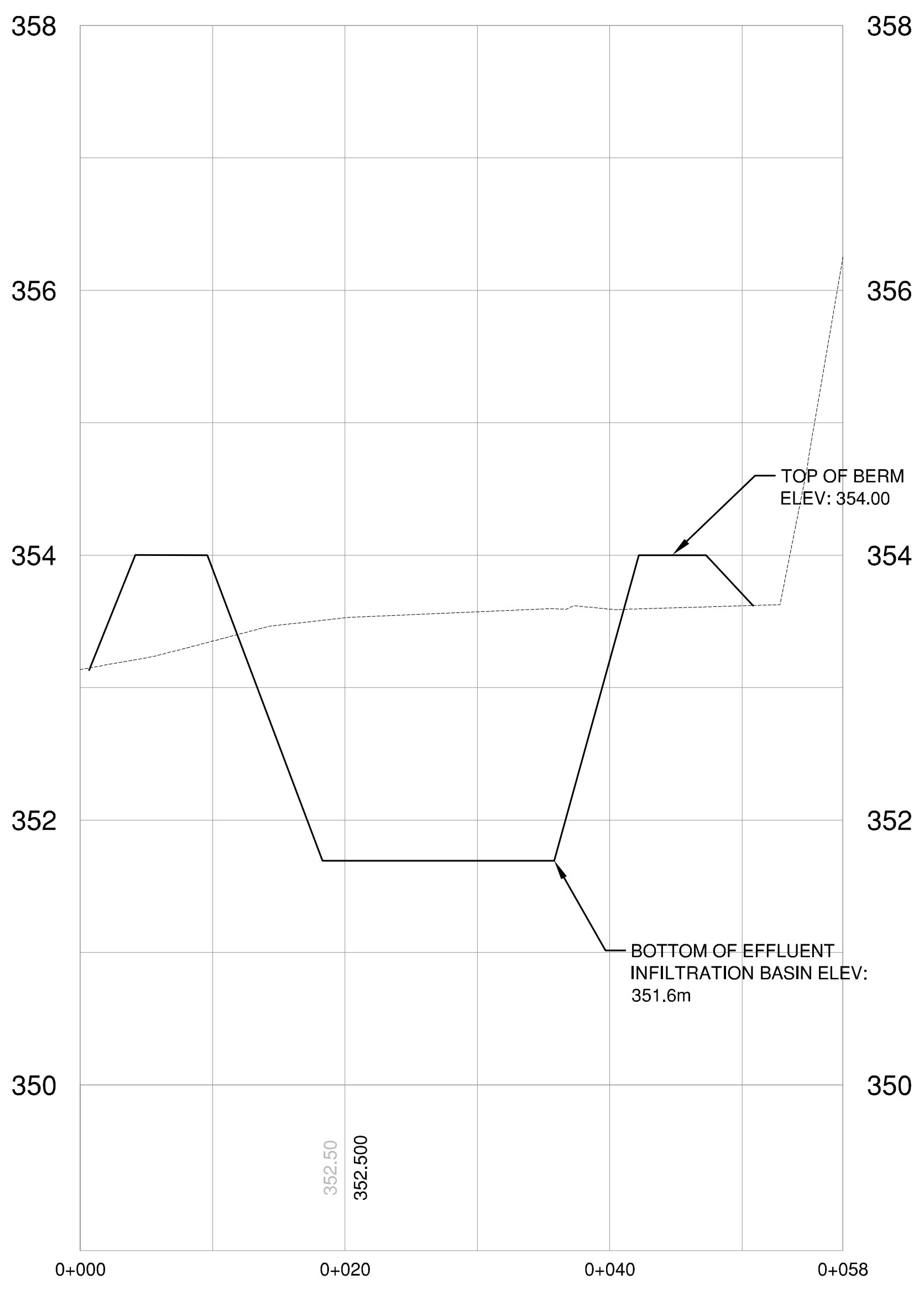


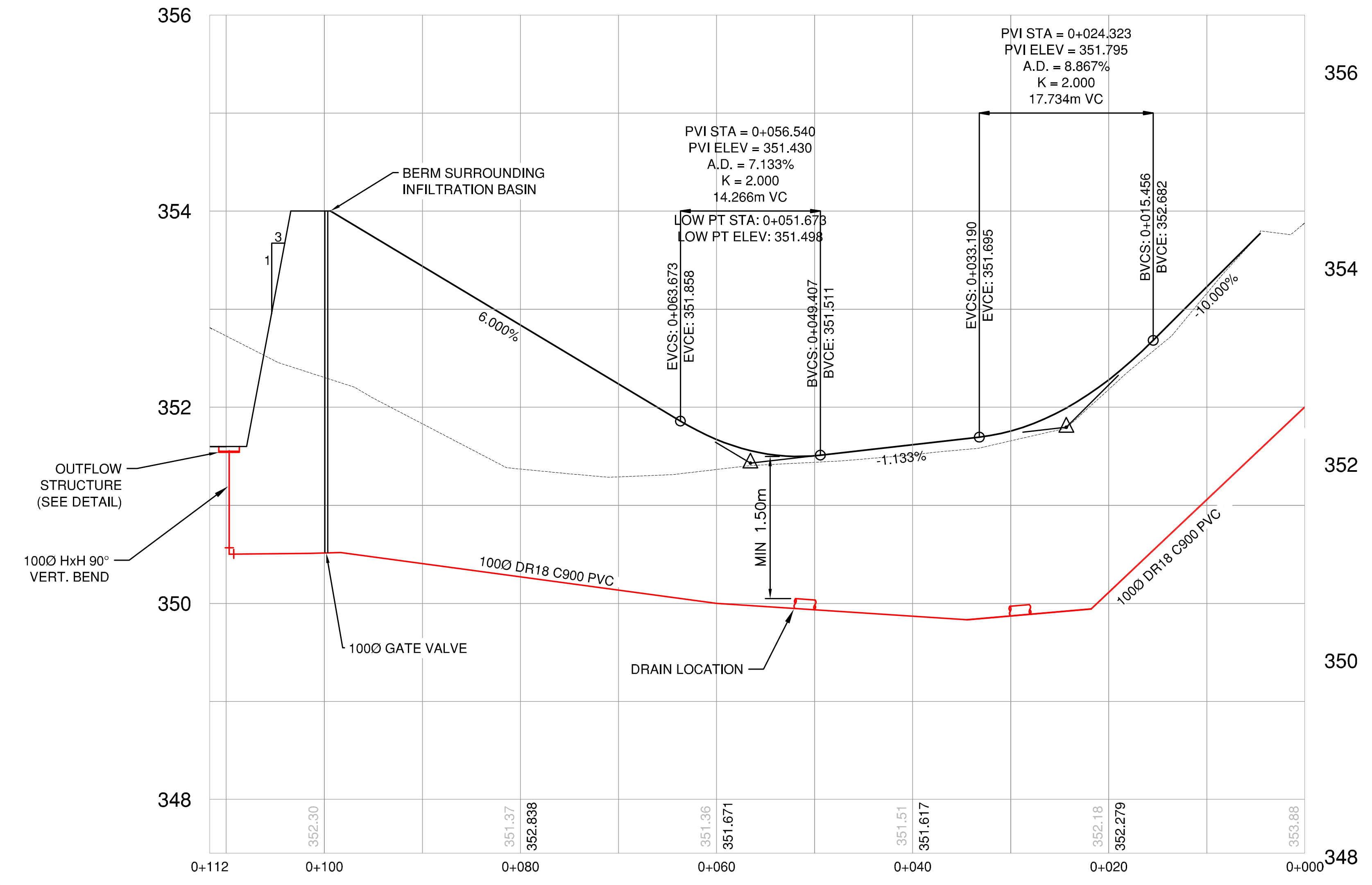
B - EFFLUENT INFILTRATION BASIN SECTION B-B

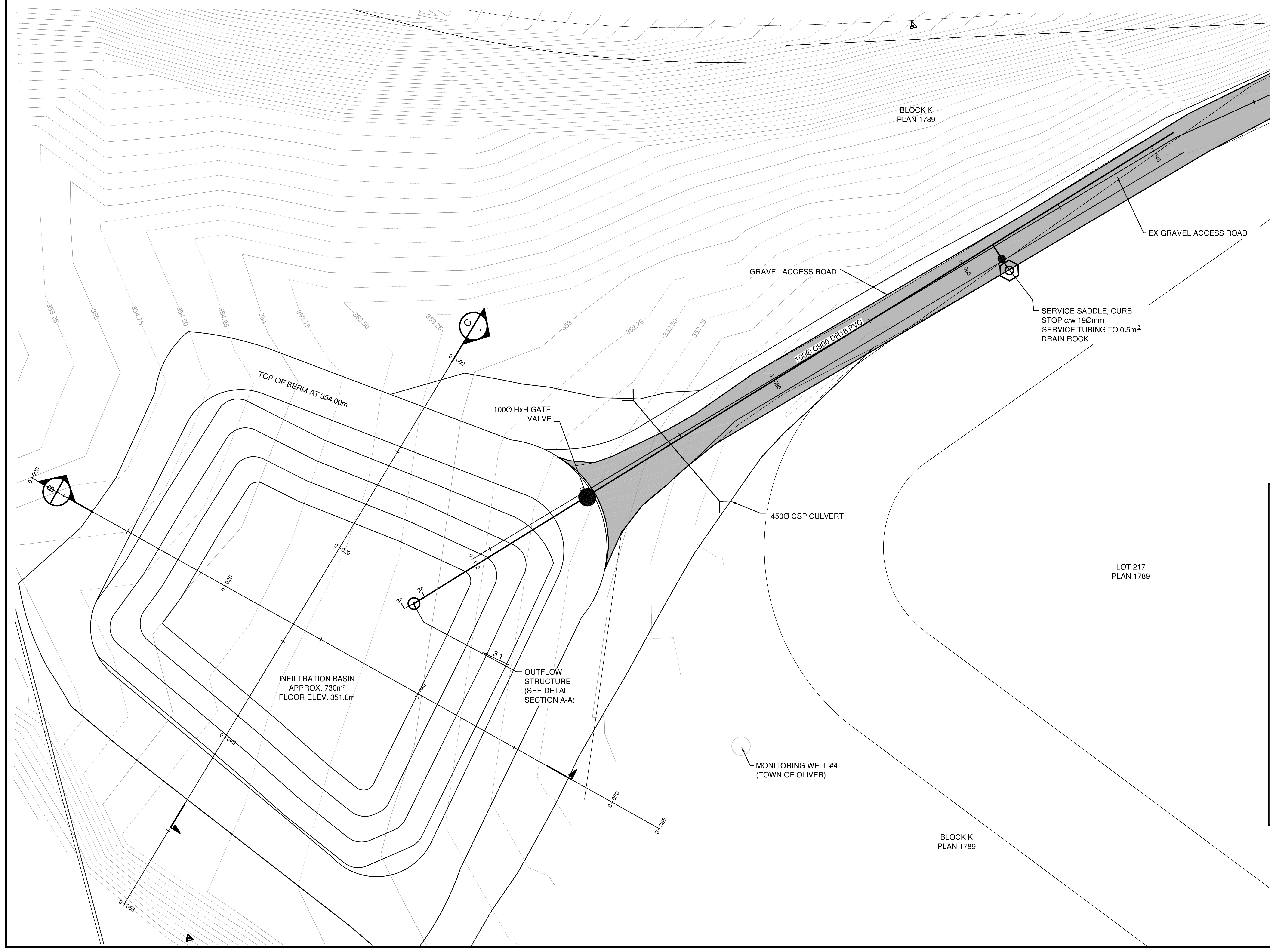
SCALE - 1:50

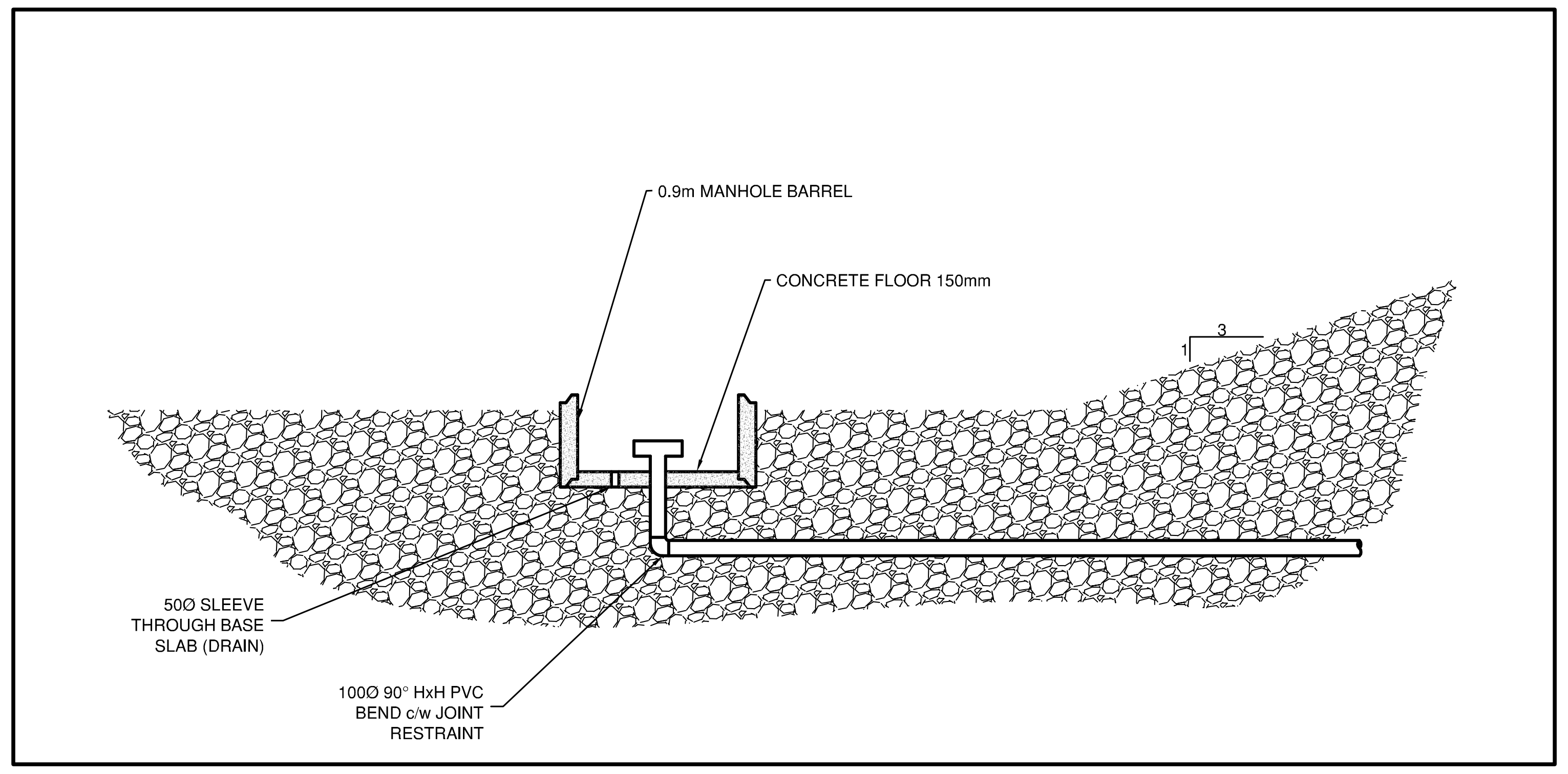


C - EFFLUENT INFILTRATION BASIN SECTION C-C

SCALE - 1:50







A - DETAIL A-A

SCALE - NTS

No.	DATE	DESCRIPTION	BY	APP'D
2	SEPT 25/14	RECORD DRAWING	SP	SU
1	SEPT 25/13	ISSUED FOR TENDER	SP	SU

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING

201 - 2079 Falcon Road ■ Kamloops BC ■ V2C 4J2
tel 250.828.0881 ■ fax 250.828.0717
info@TRUE.bc.ca

TOWN OF OLIVER

EFFLUENT INFILTRATION BASIN

PLAN AND PROFILE

SCALE	1:250 1:50
DESIGN BY	TRU/SU
DRAWN BY	WF/SP
DATE	SEPTEMBER 2013
PROJECT REFERENCE No.	306-1201

DRAWING No. 306-1322 03

SHEET 03 OF 03

REVISION 02

FILE: x:\project_drawings\306\306-1201\01_drawings\01_layout drawings\306-1201-asb

February 25, 2020 Our File: 306-088-007

Ministry of Environment and Climate Change Strategy
102 Industrial Place
Penticton, B.C.
V2A 7C8

Attn: Jen Pape, Environmental Protection Officer, Municipal Liquid Waste

Dear Ms. Pape:

RE: *Town of Oliver – Update to Reclaimed Water Irrigation Plan – OC-PE-13717*

The Town of Oliver submitted an approval request to the Ministry for expansion of their reclaimed water irrigation system as authorized in Operational Certificate ("OC") PE-13717 on December 13, 2018 (please see attached). This letter serves as a notification for additional expansion.

CURRENT WORK AUTHORIZED WITHIN PE-13717 (ISSUED: DECEMBER 14, 1995)

Works authorized within the OC, as described in Site Plan A of the permit, are outlined in the Table 1.

TABLE 1 AUTHORIZED WORKS WITHIN OC PE-13717 SITE PLAN A (DATED DECEMBER 14, 1995)

Location	Legal Description
Fairview Mountain Golf Course	Lot 1, Plan KAP62023, DL2450S, SDYD
Alonso	Lot A, Plan KAP37929, Sec 12, Township 54, SDYD
Huggins	Lot 3, Plan KAP5881, Sec 12, Township 54, SDYD

As described in the response letter submission to the Ministry on January 17, 2019 (please see attached), the Alonso and Huggins properties utilize reclaimed water irrigation for their vineyards. The Huggins service is turned off but provides a backup source to the user in the event of a drought period. Both vineyards utilize drip irrigation to water crops and there are no supplemental food crops in the irrigation area.

EXPANSION AREA NOTIFICATION (DECEMBER 13, 2018)

On December 13, 2018, the Town requested authorization for expansion of the irrigation system as described in Table 2. These areas are currently being irrigated.

…/2

TABLE 2 PROPSED EXPANSION AREA BY TOWN IN NOTIFICATION TO MINISTRY (DATED DECEMBER 13, 2018)

Location	Legal Description;
Gala Street Linear Park	Lot 2H, DL 2450S, SDYD, Townsite of Oliver; Southern portion of Block C, DL 2450S, SDYD, Irrigation Lateral SRW shown on PL 330, Lot 2G BLF52 on Oliver Townsite map
Fairview Park	Lot 2J, DL 2450S, SDYD, Townsite of Oliver; Block 34, DL 2450S, SDYD, Townsite of Oliver, Incl Closed Rd PL B7567
South Okanagan Secondary School	Block 32, Plan KAP4297, DL 2450S, SDYD; Block 48, Plan KAP2507, DL2450S, SDYD
Public Works	Lot 2, Plan KAP54258, DL 2450S, SDYD
Oliver Municipal Airport	Lot 2, Plan KAP38137, DL 2450S, SDYD
Cemetery	Lot 1, Plan KAP 24065, DL 2450S, SDYD, Portion L 203A

EXPANSION AREA NOTIFICATION

The Town wishes to notify the Ministry of an expansion to the South Okanagan Secondary School irrigation area. This irrigated area has increased from ± 1.6 ha to ± 5.4 ha as show on Figure 1-1 enclosed herein.

SYSTEM METERING

To date, total reclaimed water use is measured by a flow meter located at the booster station, adjacent to the reclaimed water storage reservoir. To measure total reclaimed water use at each location meters have been installed at the Cemetery, Oliver Municipal Airport, Public Works Yard, Alonso Property, Southern Okanagan Secondary School, Gala Street Linear Park, Huggins Property and most recently at Fairview Park.

There is no flow meter on the irrigation service to the Fairview Mountain Golf Course therefor usage is calculated as the total annual irrigation, less all other metered usage. Annual reporting of the irrigated areas is consistent with the reporting requirements as outlined in PE-13717 and include the total usage, crop type, irrigated area, irrigation application rate, and irrigation period.

GROUNDWATER MONITORING

Groundwater monitoring plans are established for the airport and Fairview Mountain Golf Course sites, the two largest users of reclaimed water. Sampling data is included in annual reporting.

As per the operational certificate, no reclaimed wastewater will be applied to the ground any closer than 15 metres from the edge of flowing streams or bodies of water. Additionally, no reclaimed wastewater is irrigated within 30 metres of any well or inground reservoir for domestic supply.

Should questions arise or for additional information, please do not hesitate to contact the undersigned.

Yours truly,

TRUE CONSULTING

Natalie Alteen

Natalie Alteen, EIT

Enclosures
NA/slf

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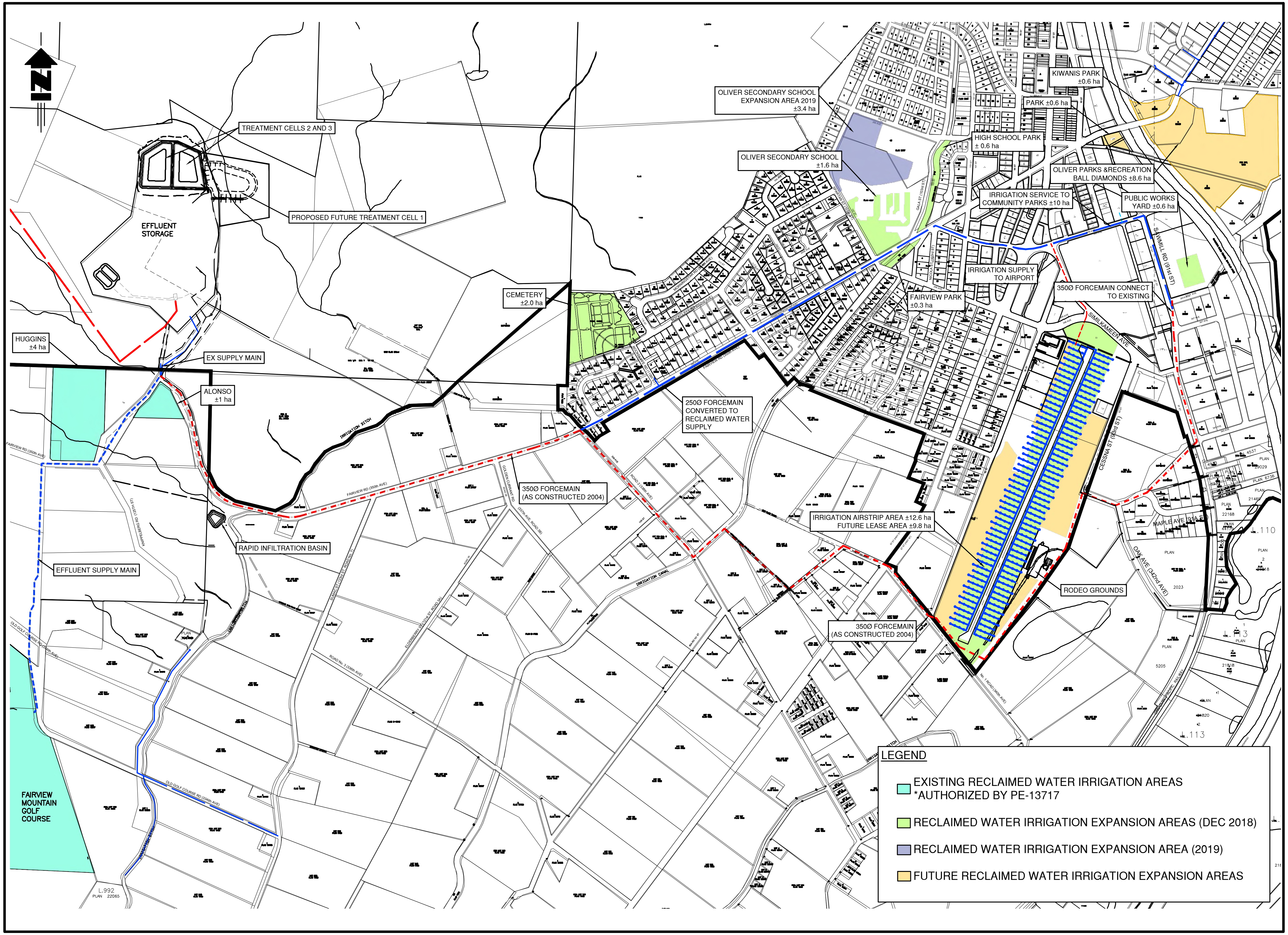


No.	DATE	DESCRIPTION	BY	APP'D

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING
201 - 2079 Falcon Road ▪ Kamloops BC ▪ V2C 4J2
tel 250.828.0881 ▪ fax 250.828.0717
info@TRUE.bc.ca

Town of Oliver
CANADA'S WINE CAPITAL

SANITARY SEWER ANNUAL REPORT

OVERALL PLAN RECLAIMED WATER SYPPLY SYSTEM AND IRRIGATION AREAS

SCALE N.T.S. (11x17)
DESIGN BY TRU
DRAWN BY NA
DATE JANUARY 2018
PROJECT REFERENCE No. 306-088-005
DRAWING No. **FIG 1-1**
SHEET 1 OF 1
ISSUE/REV.

FILE: r:\clients\300-399\306\306-088-007\03 drawings\cad\02 design drawings\306-088-007 report figures r1

December 13, 2018 Our File: 306-088-005

Ministry of Environment & Climate Change Strategy
102 Industrial Place
Penticton, B.C.
V2A 7C8

Attn: Regional Waste Manager

Dear Sir/Madam:

RE: *Town of Oliver – Update to Reclaimed Water Irrigation Plan - OC PE-13717*

The Town of Oliver requests approval from the Ministry for expansion of their reclaimed water irrigation system as authorized in Operational Certificate PE-13717. The current works authorized within this Operational Certificate are outlined in Site Plan A, dated December 14, 1995. The areas include:

Location	Legal Description
Fairview Mountain Golf Course	Lot 1, Plan KAP62023, DL2450S, SDYD
Alonso	Lot A, Plan KAP37929, Sec 12, Township 54, SDYD
Huggins	Lot 3, Plan KAP5881, Sec 12, Township 54, SDYD

The Town requests authorization for expansion of the irrigation system. The expansion areas are shown in Figure 1 enclosed herein. They are identified as Reclaimed Water Irrigation Expansion Areas (2006). Their location and legal descriptions of the expansion areas are as follows.

Location	Legal Description
High School Park	- Lot 2H, DL 2450S, SDYD, Townsite of Oliver - Southern portion of Block C, DL 2450S, SDYD, Irrigation Lateral SRW shown on PL 330, Lot 2G BLF52 on Oliver Townsite map
Fairview Park	- Lot 2J, DL 2450S, SDYD, Townsite of Oliver - Block 34, DL 2450S, SDYD, Townsite of Oliver, Incl Closed Rd PL B7567
Oliver Secondary School	Block 32, Plan KAP4297, DL 2450S, SDYD
Public Works	Lot 2, Plan KAP54258, DL 2450S, SDYD
Airstrip	Lot 2, Plan KAP38137, DL 2450S, SDYD
Cemetery	Lot 1, Plan KAP 24065, DL 2450S, SDYD, Portion L 203A

.../2

Total reclaimed water use is measured by a flow meter located at the booster station, adjacent to the reclaimed water storage reservoir. Meters have also been installed at the Cemetery, Airport, Public Works Yard, Alonso Property, Southern Okanagan Secondary School, High School Park and Huggins Property for the purposes of measuring total reclaimed water use at each location. There is no flow meter on the irrigation service to the Fairview Mountain Gold Course. Usage is calculated as the total annual irrigation, less all other metered usage. Annual reporting of the irrigated areas will be consistent with the reporting requirements as outlined in PE-13717 and include the total usage, crop type, irrigated area, irrigation application rate, and irrigation period.

Groundwater monitoring plans are established for the airport and Fairview Mountain Gold Course sites, the two largest users of reclaimed water. Sampling data is included in annual reporting.

As per the operational certificate, no reclaimed wastewater will be applied to the ground any closer than 15 metres from the edge of flowing streams or bodies of water. Additionally, no reclaimed wastewater is irrigated within 30 metres of any well or inground reservoir for domestic supply.

Should questions arise or for additional information, please do not hesitate to contact the undersigned.

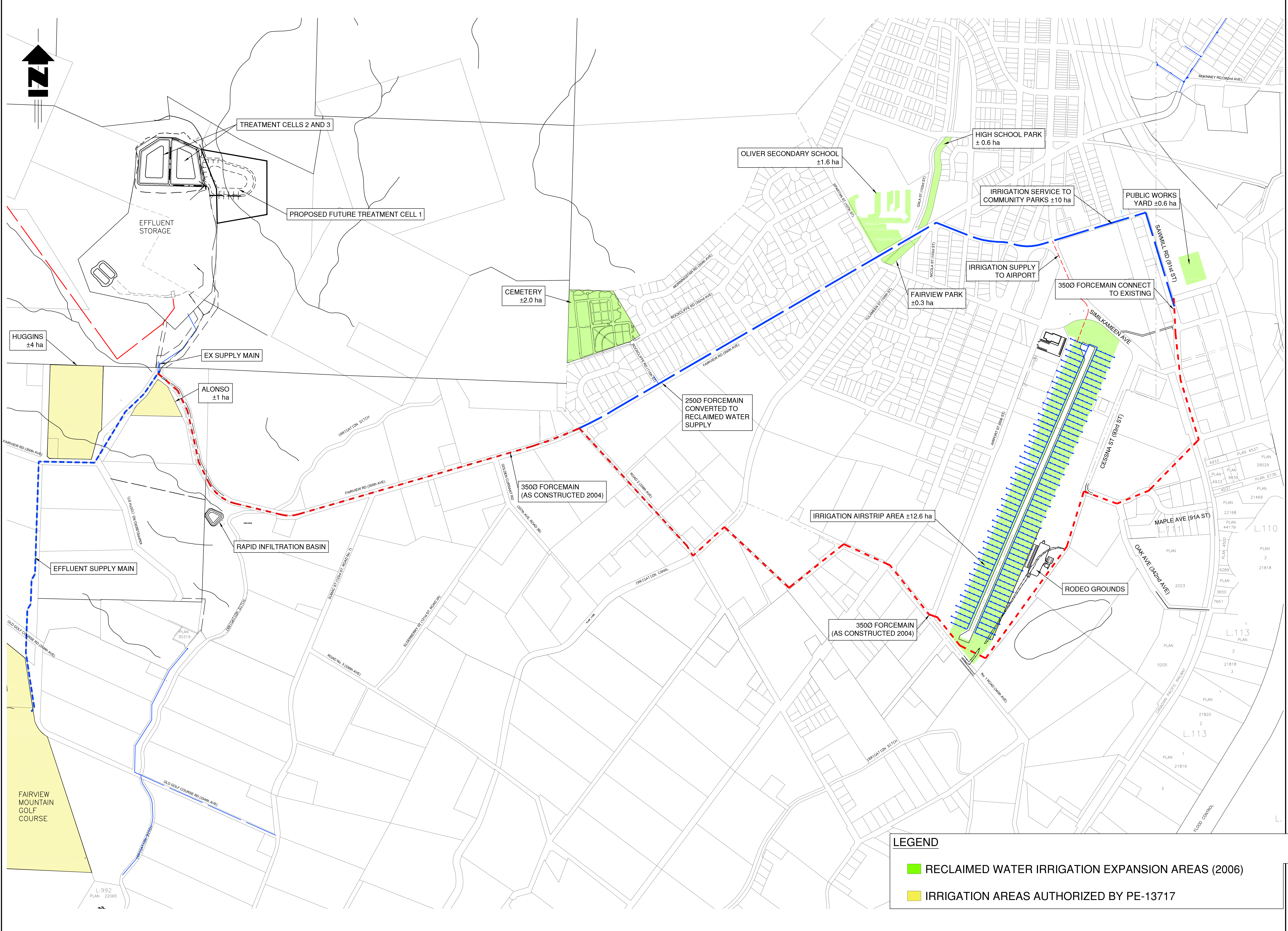
Yours truly,

TRUE CONSULTING

Steve Underwood, P. Eng.

Enclosures

NA/



LEGEND

🟩 RECLAIMED WATER IRRIGATION EXPANSION AREAS (2006)

🟨 IRRIGATION AREAS AUTHORIZED BY PE-13717

No.	DATE	DESCRIPTION	BY	APP'D

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING

201 - 2079 Falcon Road ■ Kamloops BC ■ V2C 4J2
tel 250.828.0881 ■ fax 250.828.0717
info@TRUE.bc.ca

BRITISH COLUMBIA
Town of Oliver

SANITARY SEWER SYSTEM

OVERALL PLAN RECLAIMED WATER SYPPLY SYSTEM AND IRRIGATION AREAS

SCALE N.T.S. (11x17)

PROJECT REFERENCE No. 306-088-005

DRAWING No.

FIG 1

SHEET 1 OF 1

ISSUE/REV.

FILE: r:\clients\300-399\306\306-088-005\03

sign drawings\306-088-005 moe irrigation areas

January 17, 2019 Our File: 306-088-005

Ministry of Environment & Climate Change Strategy
102 Industrial Place
Penticton, B.C.
V2A 7C8

Attn: Jen Pape, Environmental Protection Officer, Municipal Liquid Waste

Dear Ms. Pape:

RE: *Town of Oliver – Irrigation Area Expansion Notification - OC PE-13717*

In response to your email dated January 10, 2018, the following supplemental information is provided to support the Update to Reclaimed Water Irrigation Plan submitted to the Ministry on December 13, 2018.

1. The Town currently provides treated reclaimed water to the Alonso and Huggins vineyards for irrigation purposes. The Huggins service is turned off, but this service provides a backup source to the user in the event of a drought period. Both vineyards use drip irrigation to water crops. There are no supplemental food crops in the irrigation area.

2. The following drawings of the Town of Oliver Effluent Infiltration Basin are enclosed herein:
    a. General Location Map (Dwg. No. 306-1201-05)
    b. Effluent Infiltration Basin Plan and Profile (Dwg. No. 306-1322-03)

Should questions arise or for additional information, please do not hesitate to contact the undersigned.

Yours truly,

TRUE CONSULTING

Natalie Alteen

Natalie Alteen, EIT

Enclosures

NA

R:\Clients\300-399\306\306-088-005\02 Correspondence\Outgoing\To MoE\Irrigation Area Expansion Notification\306-088-005-MoE-Oliver Treated Effluent Irrigation Area Expansion Notification-2019 01 17.docx

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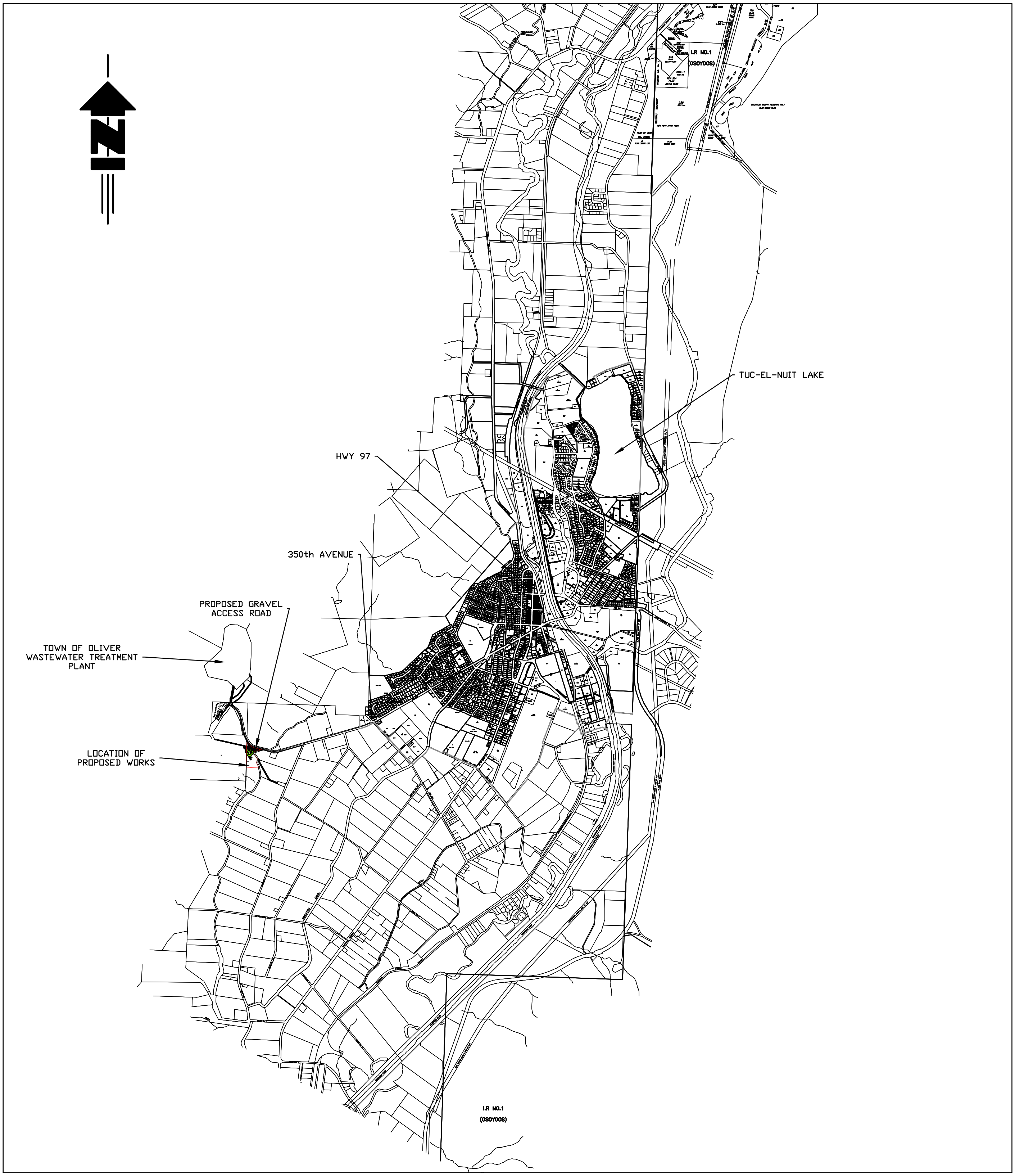

TOWN OF OLIVER

GENERAL LOCATION MAP

TRUE CONSULTING

DSGN. BY:
SCALE: 1:50,000
DWG. NO.: 306-1201-05
REV.:
DWN. BY: KK
DATE: NOV 2011

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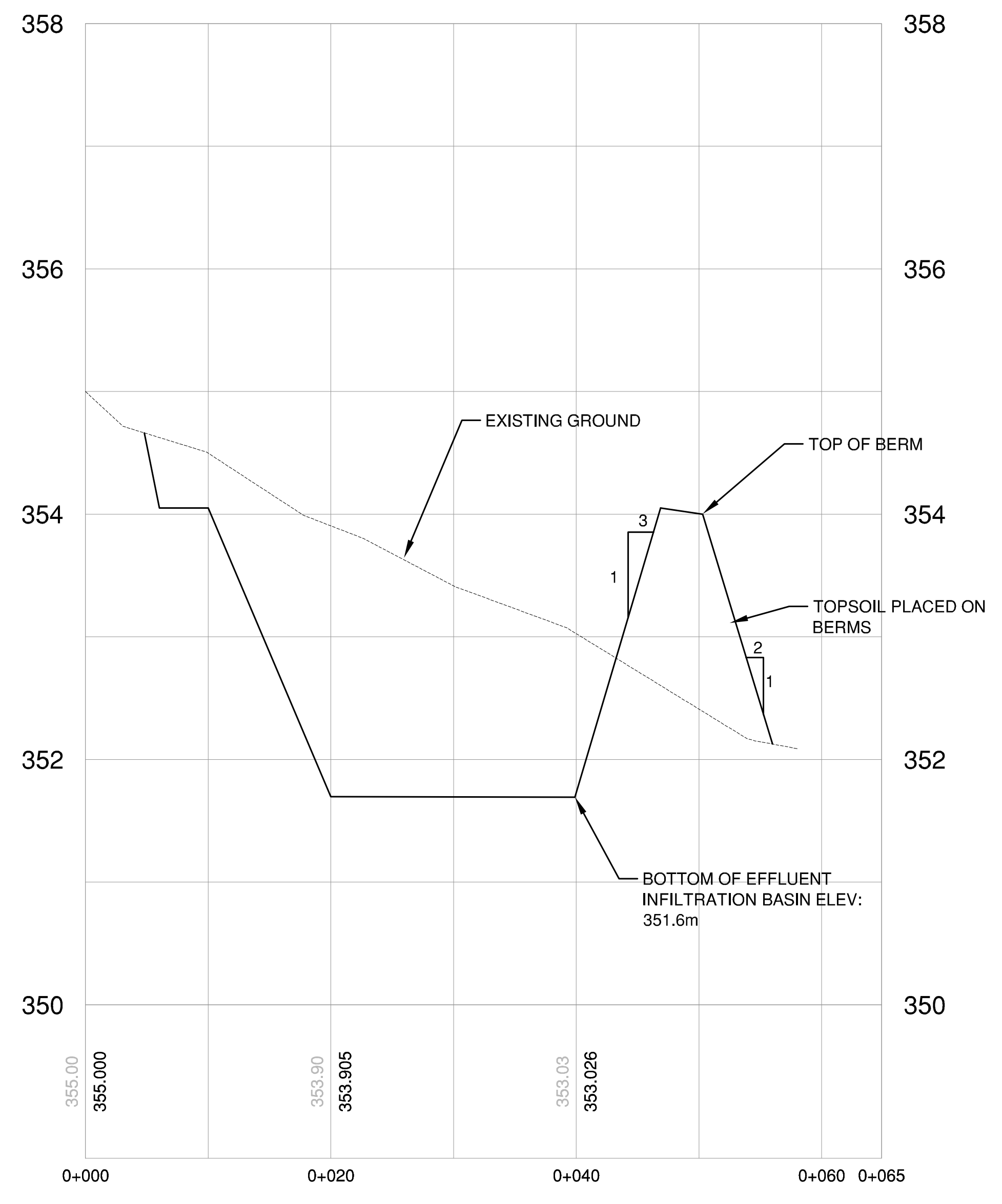

B EFFLUENT INFILTRATION BASIN SECTION B-B

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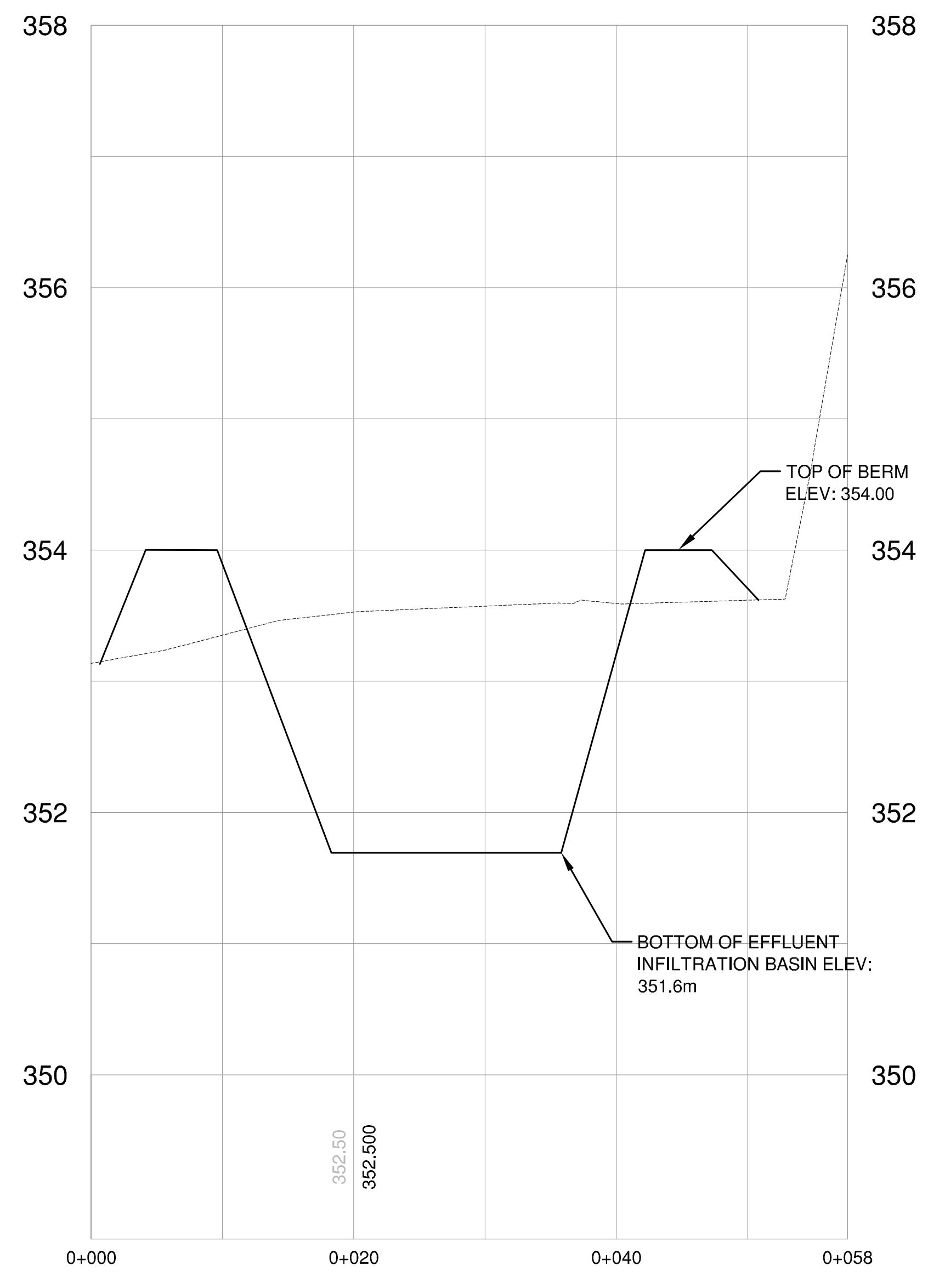
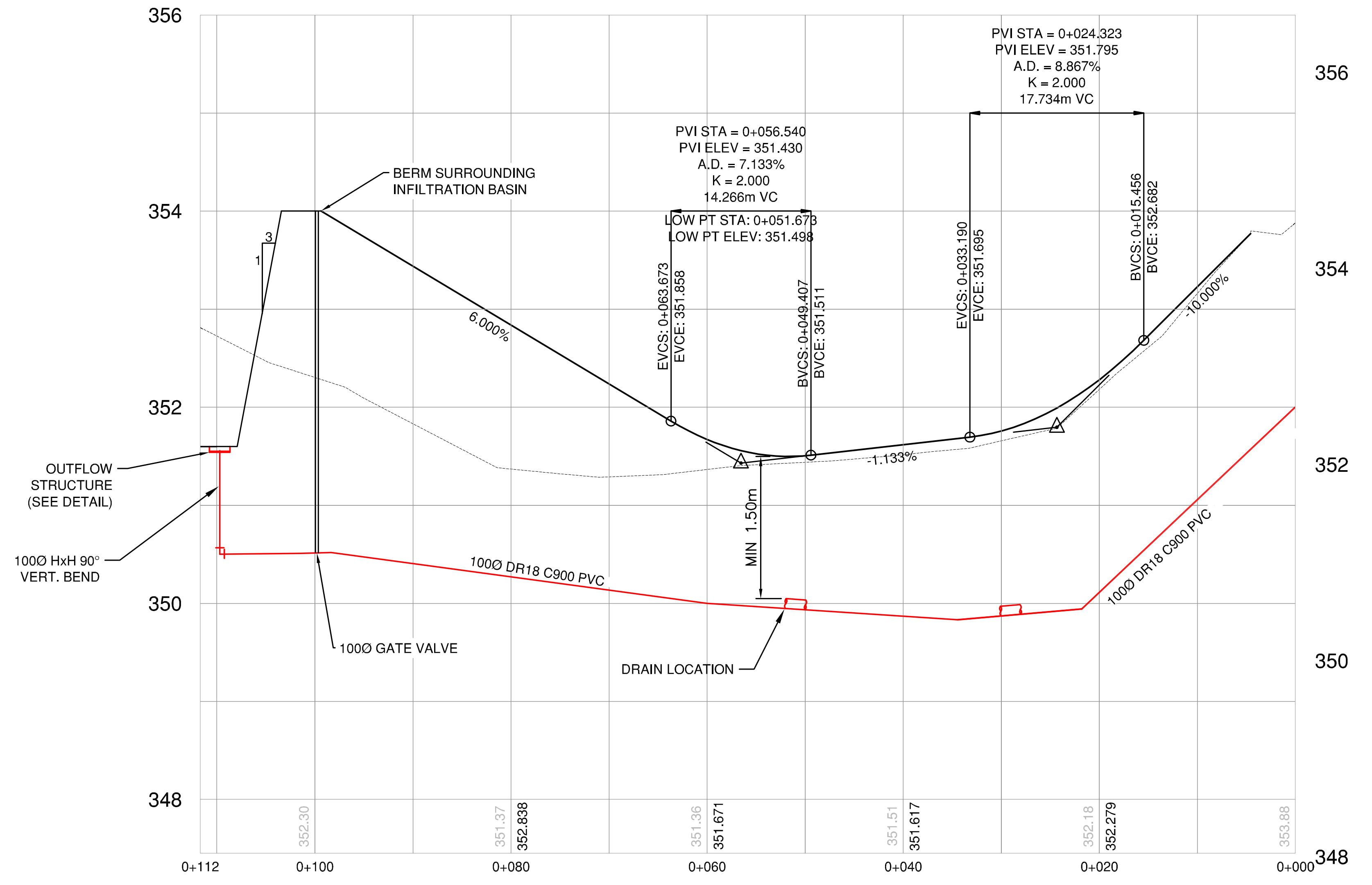
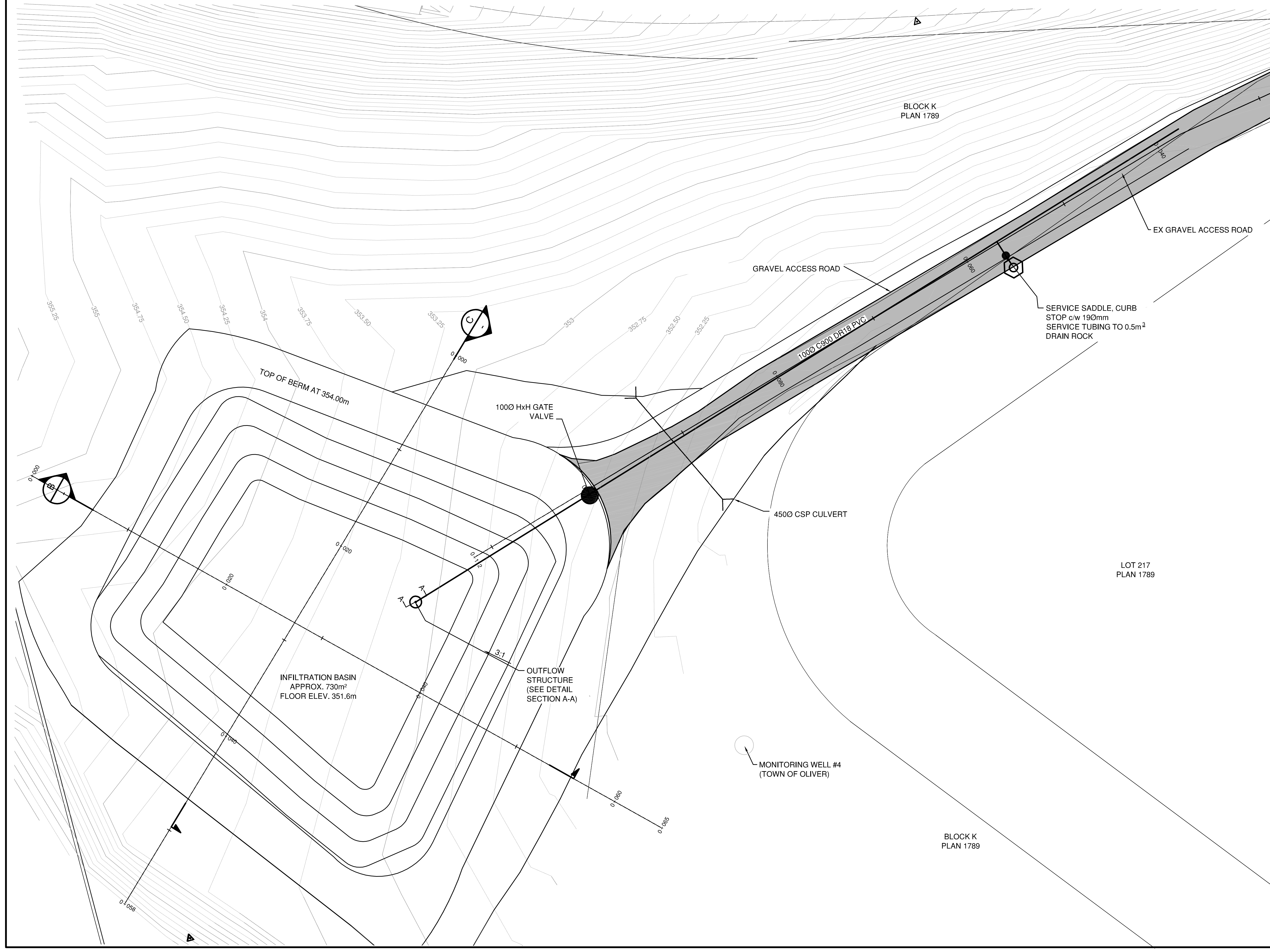
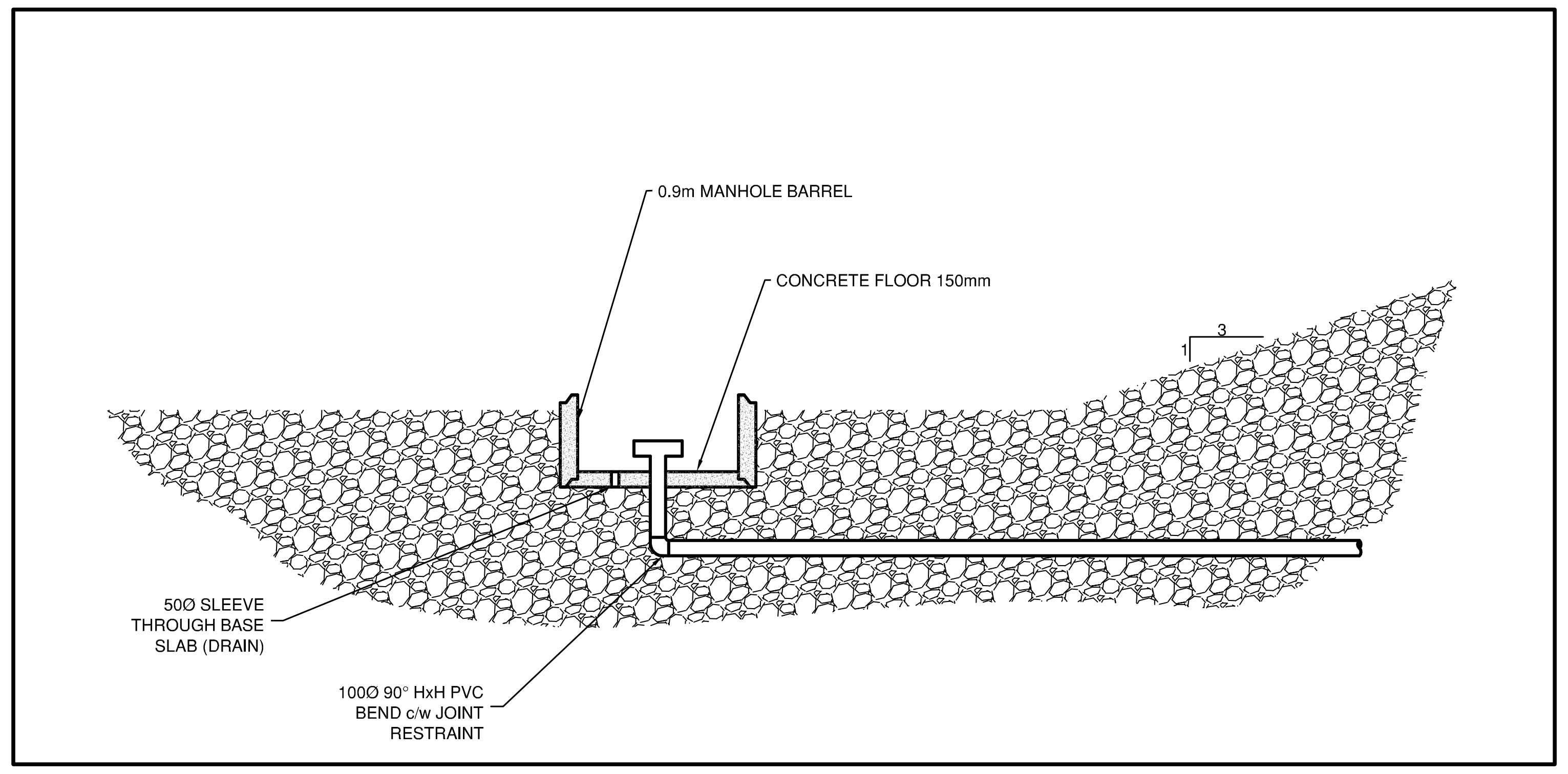


C EFFLUENT INFILTRATION BASIN SECTION C-C

SCALE - 1:50







A DETAIL A-A

SCALE - NTS

No.	DATE	DESCRIPTION	BY	APP'D
2	SEPT 25/14	RECORD DRAWING	SP	SU
1	SEPT 25/13	ISSUED FOR TENDER	SP	SU

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING

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info@TRUE.bc.ca

TOWN OF OLIVER

EFFLUENT INFILTRATION BASIN

PLAN AND PROFILE

SCALE	1:250 1:50
DESIGN BY	TRU/SU
DRAWN BY	WF/SP
DATE	SEPTEMBER 2013
PROJECT REFERENCE No.	306-1201

DRAWING No. 306-1322 03

SHEET 03 OF 03

REVISION 02

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APPENDIX F

Yearly Precipitation Data

Seasonal Precipitation Summary

Oliver STP

YEAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	SEASON TOTAL (mm)
1992	41.4	8.0	64.8	62.0	9.8	2.2	11.8	200.0
1993	50.6	34.5	48.0	67.9	39.5	18.4	14.8	273.7
1994	42.4	30.8	37.8	12.2	33.9	17.4	24.8	199.3
1995	17.5	17.9	37.6	10.2	22.6	7.5	10.6	123.9
1996	15.8	62.2	27.9	24.2	5.2	52.3	28.2	215.8
1997	35.3	41.8	87.9	47.6	18.5	63.4	29.0	323.5
1998	29.4	79.1	31.2	25.1	12.3	2.9	33.7	213.7
1999	20.1	28.9	40.3	15.5	44.1	1.2	11.7	161.8
2000	10.4	24.8	25.8	26.7	4.5	14.4	19.6	126.2
2001	37.6	16.4	39.4	32.2	15.0	13.6	24.1	178.3
2002	8.7	43.0	4.8	9.8	0.3	9.4	7.3	83.3
2003	29.4	18.4	12.9	0	0.0	11.4	21.7	93.8
2004	27.9	30.7	56.0	7.8	27.7	32.3	48.9	231.3
2005	12.4	41.1	48.4	2.9	1.3	2.9	22.4	131.4
2006	20.8	52.0	36.0	14.2	0.1	8.7	12.4	144.2
2007	4.9	3.2	24.1	29.0	2.8	12.2	11.6	87.8
2008	5.0	3.65	27.5	5.0	19.9	2.7	9.9	73.7
2009	4.8	26.8	13.4	28.6	27.8	20.2	39.5	161.1
2010	20.0	55.9	68.3	14.6	9.1	38.9	13.7	220.5
2011	12.5	69.6	24.4	18.7	0.0	3.4	22.4	151.0
2012	39.9	14.8	78.7	46	0.3	2	40.8	222.5
2013	16.5	30.5	35.0	8.6	36.6	47.5	5.6	180.3
2014	15.3	24.4	42.8	25	12.2	19.3	35.9	174.9
2015	2.2	54.4	13.2	17	19.9	3	26.3	136.0
2016	5.8	14.9	38.5	25.9	1.2	16.4	62.8	165.5
2017	40.5	61.2	21.2	0	0.0	4.8	5.3	133.0
2018	50.4	31.3	53.2	31.4	1.5	9.4	33.1	210.3
2019	8.0	3.7	6.9	10.4	6.1	80.9	11.1	127.1
2020	20.5	57.6	61.3	7.9	2.8	5.8	30.2	186.1
2021	1.8	2.0	17.6	4.6	2.9	7	32	67.9
Avg.	21.6	32.8	37.5	21.0	12.6	17.7	23.4	166.6

1992 to 1996 data from Environment Canada
1997 - present data compiled from Town of Oliver daily records

APPENDIX G

2019 Sludge Management Plan

Sludge Monitoring (Quality) Data

TOWN OF OLIVER
PE-13717 - Effluent Sludge - Cell #2

ANALYTICAL REPORT - Sampled on

			WALP Guidelines			
		CELL 2 EFF SLUDGE-1	Agricultural Low Grade	Agricultural High Grade	Retail Low Grade	Retail High Grade
Parameter	***Unit***					
Aluminum	ug/g					
Antimony	ug/g					
Arsenic	ug/g	10.3	75	75	75	75
Barium	ug/g					
Beryllium	ug/g					
Bismuth	ug/g					
Cadmium	ug/g	2.19	25	20	20	5-20
Calcium	ug/g					
Chromium	ug/g	41.9				
Cobalt	ug/g	3.33	150	150	150	150
Copper	ug/g	1710				
Iron	ug/g					
Lead	ug/g	47.7	1000	500	500	500
Magnesium	ug/g					
Manganese	ug/g					
Mercury	ug/g	4.12	10	5	5	5
Molybdenum	ug/g	23.2	20	20	20	20
Nickel	ug/g	22.7	200	180	180	180
Phosphorus	ug/g					
Potassium	ug/g					
Selenium	ug/g	13.4	14	14	14	14
Silver	ug/g					
Sodium	ug/g					
Strontium	ug/g					
Tellurium	ug/g					
Thallium	ug/g					
Tin	ug/g					
Titanium	ug/g					
Vanadium	ug/g					
Zinc	ug/g	1080	2500	1850	1850	1850
Zirconium	ug/g					

Total Solids	%	8.5
Volatile Solids	%	41.9

Sludge Management Plan

Town of Oliver

March 2019

Project No. 306-088-006

ENGINEERING ■ PLANNING ■ URBAN DESIGN ■ LAND SURVEYING

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Distribution List

# of Hard Copies	*PDF Required*	*Association / Company Name*
1	1	Town of Oliver
	1	Ministry of Environment
1	1	TRUE Consulting

Revision Log

Revision #	*Revised by*	*Date*	*Issue / Revision Description*

Report Submission

Report Prepared By:

Natleen

Natalie Alteen, EIT
Project Engineer

Report Reviewed By:

T. R. UNDERWOOD

TRUnderwood

Terry Underwood, P. Eng.
Project Engineer

Mar 13 /2019

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Table of Contents

APPENDICES

List of Figures

List of Acronyms

BC MOE	British Columbia Ministry of Environment,
OC	Operational Certificate
OCP	Official Community Plan
OMRR	Organic Matter Recycling Regulation
TRUE	TRUE Consulting

Units of Measure

ft	feet
km	kilometre
L/d	Litres per day
L/m	Litres per minute
L/s	Litres per second
lpcd	Litres per capita per day
m	metre
mg/L	milligrams per Litre
mm	millimetre
NTU	Nephelometric Turbidity Units
psi	pounds per square inch
USgpm	US gallons per minute

Referenced Reports

Lambourne Environmental	"Lagoon Survey Report for Town of Oliver Cells 1 & 2," December 2011
Canadian Council of Ministers of the Environment	"Guidance Document for the Beneficial Use of Municipal Biosolids, Municipal Sludge and Treated Septage," 2012
TRUE Consulting	"Sanitary Sewer System 2017 Annual Report," February 2018

1.0 Background

The wastewater treatment facility for the Town of Oliver has been in operation since 1965. From 1965 to 1984, the Town operated a treatment plant for municipal wastewater and discharged treated effluent to the Okanagan River. In response to regulatory agency requirements for reduced phosphorus loadings to surface water courses in the Okanagan River Basin, the Town constructed effluent storage and land disposal systems in the Fairview area in 1983 and 1984. Since 1985, the Town has utilized treated effluent in the Fairview area with the principle end user of treated effluent being the Fairview Mountain Golf Course. In 1995, a two-cell aerated lagoon system was constructed in the Fairview area (see Figure 1).

The existing treatment facility is comprised of influent screening, equalization storage, a two-cell aerated lagoon treatment system, winter effluent storage, chlorination contact chamber and reclaimed water irrigation.

In accordance with the Town of Oliver's Operation Certificate (OC) No. PE-13717 issued under the provisions of the Waste Management Act, the Town has prepared a Sludge Management Plan as it relates to the wastewater treatment facility. This document outlines the monitoring, management and beneficial use of the Town's municipal biosolids.

2.0 Characterization of Sludge

The Town of Oliver's wastewater collection system is generated primarily from residential and commercial buildings. The sludge is comprised of a mixture of fecal matter, organic and inorganic materials. Trace amounts of heavy metals, solvents, and petroleum products may enter the system as a result of municipal activities.

Source control initiative are imperative as they ensure the wastewater treatment facility functions properly, operator health and safety are protected, and the quality of treated effluent/biosolids is maintained. This mandate is included in the Town's Official Community Plan (OCP) Bylaw 1370, which prioritizes public awareness for potential groundwater contamination and health hazards related to the discharge of toxic substances into the municipal drainage system.

3.0 Sludge Sampling and Monitoring Program

3.1 System Design

Effluent is pumped from the equalization basins to the aerated lagoon Cells No. 2 and No.3 via the High Lift Station. Biological degradation and sedimentation of suspended solids is a primary function of the aerated lagoons system. Treatment is accomplished through the stabilization of organic wastes by bacteria and algae. Waste products include carbon dioxide (CO_2), ammonia and phosphates.

The aerated lagoon treatment system is comprised of two treatment cells, with aeration allowing for microbial degradation of organic material. Effluent enters Cell No.2 and then proceeds to secondary treatment in Cell No.3.

Cell No.2 provides primary digestion of influent. As such, sludge accumulates around the perimeter of the cell in the low current areas. This material sinks to the bottom of the cell, forming a sludge blanket. The capacity of Cells No.2 and No.3 are as follows. Each lagoon has a maximum operating depth of 5.3 m.

Cell No.2	**Cell No.3**
Surface Area at FWL 11,000 m^2	Surface Area at FWL 10,100 m^2
Storage Volume 37,600 m^3	Storage Volume 38,200 m^3

Anaerobic degradation occurs in areas with low dissolved oxygen and sunlight. Anaerobic bacteria produce water, carbon dioxide, nutrients, ammonia, alkalinity, hydrogen sulfide and methane as waste products.

On this basis, solids accumulations will occur in the aerated lagoons and require removal from the system. Excessive solids accumulations in the cells may result in odours, visible masses of floating solids on the lagoon surface, reduced detention time and degraded effluent quality.

The rate at which solids accumulate in the aerated cells and the point at which accumulations may significantly impair the operation of the system varies. Piping and other design provisions have been made for a future third cell construction east of the existing lagoons (see Figure 2).

Overall, the Operational Certificate for the system required the Town of Oliver to develop a strategy or plan to ultimately deal with sludge accumulations in the aerated cells. The OC specifies the following limits:

- Discharge rate – 2,200 m^3/day
- 5 Day Biochemical Oxygen Demand – 45 mg/L
- Total Suspended Solids – 60 mg/L

3.2 Theoretical Sludge Production Rates

Sludge accumulation rates within the system are dependent on the following variables:

- Amount of suspended solids entering the system in the raw sewage. Influent suspended solids to the treatment system are reduced as the influent is screened prior to entering the aerated lagoons.
- Operating temperature. As sludge accumulates on the floor of each cell, anaerobic digestion processes occur. This results in volatile solids removal and corresponding reductions in accumulated solids volume and mass. The digestion process is temperature dependent. Recognizing the geographic location of Oliver and generally “hot” summer weather conditions, anaerobic digestion processes on the floor of the cells represent a mechanism for significant sludge volume and mass reductions.
- Hydraulic load to the system and residence time.
- Sludge characteristics and compression. As sludge accumulates on the bottom of the lagoons, compression of the actual sludge mass will occur. This results in higher solids concentrations expressed as a % solids. Literature suggests that compression mechanisms are time and characteristic dependent.

Recognizing that influent is screened, there are favorable conditions for in-pond anaerobic digestion. The cells are adequately sized to allow for associated compression processes and there is no chemical addition to the system. Therefore, sludge accumulation within the lagoon cells is expected to be lower that other systems within the region.

A theoretical sludge accumulation rate calculation is presented herein. This rate is based on an assumed sludge production rate of 0.2 kg/kg of BOD removal. This sludge production rate is typical of extended aeration treatment plants in which digestion processes represent a mechanism for internal sludge quantity reductions:

Influent BOD Loading	180 mg/L
Average Influent Flow	2000 m^3/d
Total BOD Daily Loading	360 kg/d

Cell No. 2	Average BOD removal Cell #2- 70% of influent	250 kg/d
	Theoretical Sludge Production- 250 x 0.2	50 kg/d
	Sludge Volume/day= 50 kg @ 10% solids	0.50 m^3/d
	Sludge Volume/year	182 m^3/yr
Cell No. 3	Average BOD removal Cell #3- 70% of Cell #2 effluent	80 kg/d
	Theoretical Sludge Production- 80 x 0.2	16 kg/d
	Sludge Volume/day= 16 kg @ 10% solids	0.16 m^3/d
	Sludge Volume/year	60 m^3/yr

The preceding calculations suggest that the sludge accumulation rate in Cell No.2 will occur at a rate at least three times greater than Cell No.3. This has been shown in accumulation surveys and described in Section 4.0.

3.3 Monitoring Methods

Sludge accumulation are to be measured by direct and indirect monitoring as described herein.

3.3.1 Direct Monitoring

Direct sludge monitoring should be undertaken every two years. It is important that sampling is completed at the same time each year. In this manner, inaccuracies related to temperature dependent digestion process will be eliminated. September or October are suggested as the most appropriate periods to undertake a sludge accumulation survey.

The primary objective is to define the amount of sludge accumulation by probing the cell bottom and recording the apparent sludge thickness and location on a plan of the lagoon system. Each successive monitoring activity should attempt to probe approximately the same locations to assist in the determination of the accumulation rate.

Anticipated primary areas of sludge accumulation will be in the general vicinity of the inlet piping in the relatively quiescent areas between air diffusers. Sludge will generally not accumulate in the vicinity of the aerators.

The design depth of the lagoons (5.3m) will make in-cell measurements of sludge accumulation less than straightforward. Sludge accumulation measurements may be simplified to some extent by lowering the operating levels of Cells No.2 and No.3 by lowering the slide gate in hydraulic structure S-3. Lowering of operating levels should be undertaken on a gradual basis.

Any deviation from normal operation (i.e. lowering of operating levels) will require notification and approval of the Ministry of Environment.

3.3.2 Indirect Monitoring

Indirect Monitoring of sludge accumulation can be accomplished via analysis of treated effluent water quality. If treated effluent water quality exceeds the permitted discharge concentration limits, assessment of the sludge accumulation depth is triggered.

3.4 Sludge Sampling

Which final disposal method for sludge removed from the lagoons will be dependent on the characteristics of the sludge and require approval from the MOE. To enable evaluation of sludge disposal options and to support a proposal/plan submission for approval to the MOE, it is recommended that a minimum of two sludge samples be taken during accumulation surveys for physical and chemical analysis.

Samples may be obtained by a pipe-type probe or at depth samplers. Analysis of the sludge samples should include the following parameters:

% solids	
% volatile solids	
Fecal Coliform*	MPN/g*
Arsenic	(mg/kg)*
Cadmium	(mg/kg)
Chromium	
Cobalt	
Copper	(mg/kg)
Mercury	(mg/kg)
Molybdenum	(mg/kg)
Nickel	(mg/kg)
Lead	(mg/kg)
Selenium	(mg/kg)
Zinc	(mg/kg)

*On a dried weight basis

All parameters listed above should be analyzed during the initial phases of the sludge monitoring program. As data is compiled some parameters may be identified as not representing a concern, and in consultation with the MOE, the scope of the analysis accordingly reduced.

The chemical and physical characteristics of the final sludge product will be a major factor in determining the disposal method which will be acceptable to the MOE. The Town must follow the Organic Matter Recycle Regulation (OMRR) process and quality criteria for the desired end use of the bioldoids.

3.5 Sludge Removal

Sludge accumulation monitoring will provide data on when scheduling of sludge removal should be undertaken. Excessive sludge accumulations have the potential to significantly impact the performance of the system. Conditions that suggest accumulated sludge may be negatively impacting the system will be evident in the south-east corner area of Cell No 2, in the vicinity of the influent pipe. Indicators of excessive sludge accumulations in the area may include:

- Black color of wastewater
- Low dissolved oxygen concentrations
- Floating sludge masses
- Localized odours
- What appears to be “air bubbles” covering the lagoon surface during warm weather periods.

Sludge removal options which may be considered by the Town include the use of specialized equipment while the system is in operation, or alternatively draining of the cell for removal using excavation equipment. Equipment that can be utilized include: a float or barge mounted “dredge” type pump, floating discharge line, and on-shore portable sludge dewatering system.

The second approach involves cell draining and removal using excavation equipment. Utilization of this approach related to Cell No.2 is described herein.

3.5.1 Cell No.2 Draining Procedure

The procedure to drain Cell No.2 for sludge removal with a reduced water content is described as follows:

i. Lower the operating level of Cells No.2 and No.3 by gradually lowering the overflow weir gate in hydraulic structure S-3. This procedure should be undertaken over a 3 to 5 week period. When complete, the adjustable slide gate in hydraulic structure S-3 will be in the fully down position.

   IMPORTANT NOTE: Lowering of the operating level of the system is required to reduce the hydraulic head difference across the common berm between the cell to be drained and the cell remaining in operation. Failure to reduce the system operating level as described herein may result in localized instability and soil slumping at the toe of the slope of the common berm in the drained cell.

ii. The system should then be operated in the Cell No.2 bypass mode.

iii. The air supply to the aeration system in Cell No.2 should be shut off by closing isolation valves on the air header. Cautionary aspects related to the aeration system include:

   - Ensure air flow to diffuser units remining in service do not exceed the manufacturer’s recommended maximum per unit flow.
   - Confirm blower operation remains within the accepted operation range specified by the manufacturer.

   Operation of the aeration system with partial flow release to the pressure relief valve on the blower discharge piping may be necessary to maintain operation of the aeration system in Cell No.3 within ranges specified by both the blower and aeration system manufacturer.

iv. Reduce the operating level in Cell No.2 by opening valve V-5. Opening of valve V-5 will enable partial draining of Cell No.2, by gravity, to the winter effluent storage reservoir. Valve V-5 should be gradually opened such that the drop in liquid level in Cell No.2 does not exceed 150 mm per day.

v. Set up portable pumping equipment and completed draining of Cell No.2. Ideally, the discharge from the drainage pump will be directed into the Cell No.3 side chamber of hydraulic structure S-2. In this manner, contents from Cell No.2 will be provided treatment in Cell No.3 prior to discharge into the storage reservoir. Care should be given to ensure the discharge piping is securely fastened to hydraulic structure S-2.

CAUTION: During draining operation of Cell No.*2, simply pumping the contents across the common berm with the discharge piping laid on the berm is not recommended. The pump discharge, in this case, could result in serious erosion and localized instability of the exposed and/or submerged berm slope in Cell* No.*3.*

Locating the pump at the north end of Cell No.2 is recommended to minimize operational problems associated with sludge plugging the pump suction and/or sludge being drawn into the pump and simply relocated to Cell No.3.

vi. Upon completion of draining, allow the exposed sludge accumulation to air dry. The period necessary for air drying is difficult to estimate. An air-drying period of at least one month should be anticipated in the schedule planning of the desludging operation. The objective of the drying period is to reduce the water content of accumulated sludge, thereby making removal by excavation equipment more straightforward.

vii. Disconnect air feeder lines from laterals and remove from the lagoon. Temporary caps should be placed on cell lateral outlets to prevent sludge or other foreign material from entering the lateral piping.

CAUTION: Care is essential to ensure foreign material does not enter the lateral piping when the air feeder lines are removed. If foreign material ends up in the lateral piping, it will be carried after reassembly by air flowing into the diffusers, leading to clogging.

While the lagoon cell is drained, the aeration system should be thoroughly inspected and any corroded or “suspect” components replaced. Replacement of the air diffuser membranes and ropers to the retrieval floats is straightforward with the cell drained and should be scheduled to be done concurrent with the desludging operation.

viii. Remove accumulated sludge from Cell No.2. The most appropriate equipment required for the removal operation will be determined on-site based on the apparent water content of the material and the actual amount and location of the accumulations in the cell.

The preceding procedure would be followed in reverse to return the cell to service after de-sludging. In reassembling the aeration system, the manufacturer’s design details should be complied with in terms of connection fittings and anchor locations. It is important that the actual diffuser units be installed at the same level within tolerances recommended in the manufacturer’s Operation and Maintenance Manual. The lagoon cell should be filled to “just submerge” all aeration components at which time all laterals should be air tested by carefully partially opening (“cracking”) isolation valves on the air supply header.

CAUTION: The aeration system in Cell No.2 should not be returned to normal operation by opening of the isolation valve on the air header until the wastewater elevations in Cells No.2 and No.3 are equal.

3.6 Sludge Disposal

In British Columbia, the quality and beneficial use of biosolids for land application and composting is regulated under the Organic Matter Recycling Regulation (OMRR). This regulation applies to the construction and operation of composting facilities, as well as the production, distribution, storage, sale and use or land application of biosolids and compost.

When planning sludge removal operations, a written notification is to be provided to the Regional Waste Manager at least two weeks prior to the commencement of de-sludging operations. The notification should include the following requirements as outlined in the OMRR:

- An estimate of the total sludge volume based on monitoring data.
- Classification of the biosolids and an overview of the proposed treatment process.
- Analytical characterization derived from sampling data.
- A description of the proposed disposal method.

To a major extent, the analytical characterization of the sludge will determine what disposal options and sites will be acceptable to the Ministry. Compliance with pathogen and metal testing treatment objectives will be required. If the intended use is land application, a Land Application Plan (LAP) must be developed and signed by a Qualified Professional prior to any land application. Information required in this plan is set out in Schedule 7 of the OMRR.

Consistent with the strategy of the Town's wastewater treatment and disposal system, the objective of the sludge disposal method evaluation should be to provide the greatest flexibility possible for beneficial use. Options which may be considered consistent with this objective include:

3.6.1 Class A Biosolid

Composting to result in a Class A biosolid. These biolsolids must meet all of the following requirements:

- Schedule 1, Pathogen Reduction Processes;
- Schedule 2, Vector Attraction Reduction;
- Schedule 3, Pathogen Reduction Limits;
- Section 3 of Schedule 4, Quality Criteria;
- Schedule 5, Sampling and Analyses-Protocols and Frequency;
- Schedule 6, Record Keeping.

Class A biosolids can be applied in quantities greater than 5 cubic meters per year per parcel of land in accordance with the LAP and the soil substance concentrations specified in Schedule 10.1

of the OMRR. They must only be distributed in volumes that do not exceed 5 cubic meters per vehicle per day. If they are distributed in sealed bags for retail purposes, they are not to exceed 5 cubic meters, with no restrictions on the number of bags distributed per vehicle per day. They may be distributed in volumes greater than 5 cubic metres to composting facilities or biosolids growing medium facilities.

3.6.2 Class B Biosolids

Composting to result in a Class B biosolid. These biosolids must meet all of the following requirements:

- Schedule 1, Pathogen Reduction Processes;
- Schedule 2, Vector Attraction Reduction;
- Schedule 3, Pathogen Reduction Limits;
- Column 3 of Schedule 4, Quality Criteria;
- Schedule 5, Sampling and Analyses-Protocols and Frequency;
- Schedule 6, Record Keeping.

Class B biosolids must be applied to land in accordance with the LAP, the methodology specified in Schedule 8 and the soil substance concentrations specified in Schedule 10.1 of the OMRR. Class B biosolids may be distributed to composting facilities with no volume restrictions. They may be distributed to a biosolids growing medium facility with no volume restrictions if they meet the pathogen reduction and vector attraction requirements for Class A biosolids. They must not be applied to land in a watershed used as a permitted water supply under the Drinking Water Protection.

3.6.3 Biosolids Growing Medium

Biosolids that meet the requirements of all the following are biosolids growing medium:

- Column 2 of Schedule 4, Quality Criteria;
- Schedule 5, Sampling and Analyses-Protocols and Frequency;
- Schedule 6, Record-keeping;
- Schedule 11, Requirements for Biosolids Growing Medium.

Biosolids growing medium may be distributed with no volume restriction.

3.6.4 Disposal at the Sanitary Landfill

Sludge can be landfilled with other solid waste or used as a soil conditioner in final cover areas to enhance vegetation growth. Disposal at the landfill with sold waste should be considered as the least preferred option as no benefit is achieved and landfill “air space” is consumed. However, it should be recognized that the quality of the sludge may, in the final analysis, leave the landfill as the only feasible disposal option.

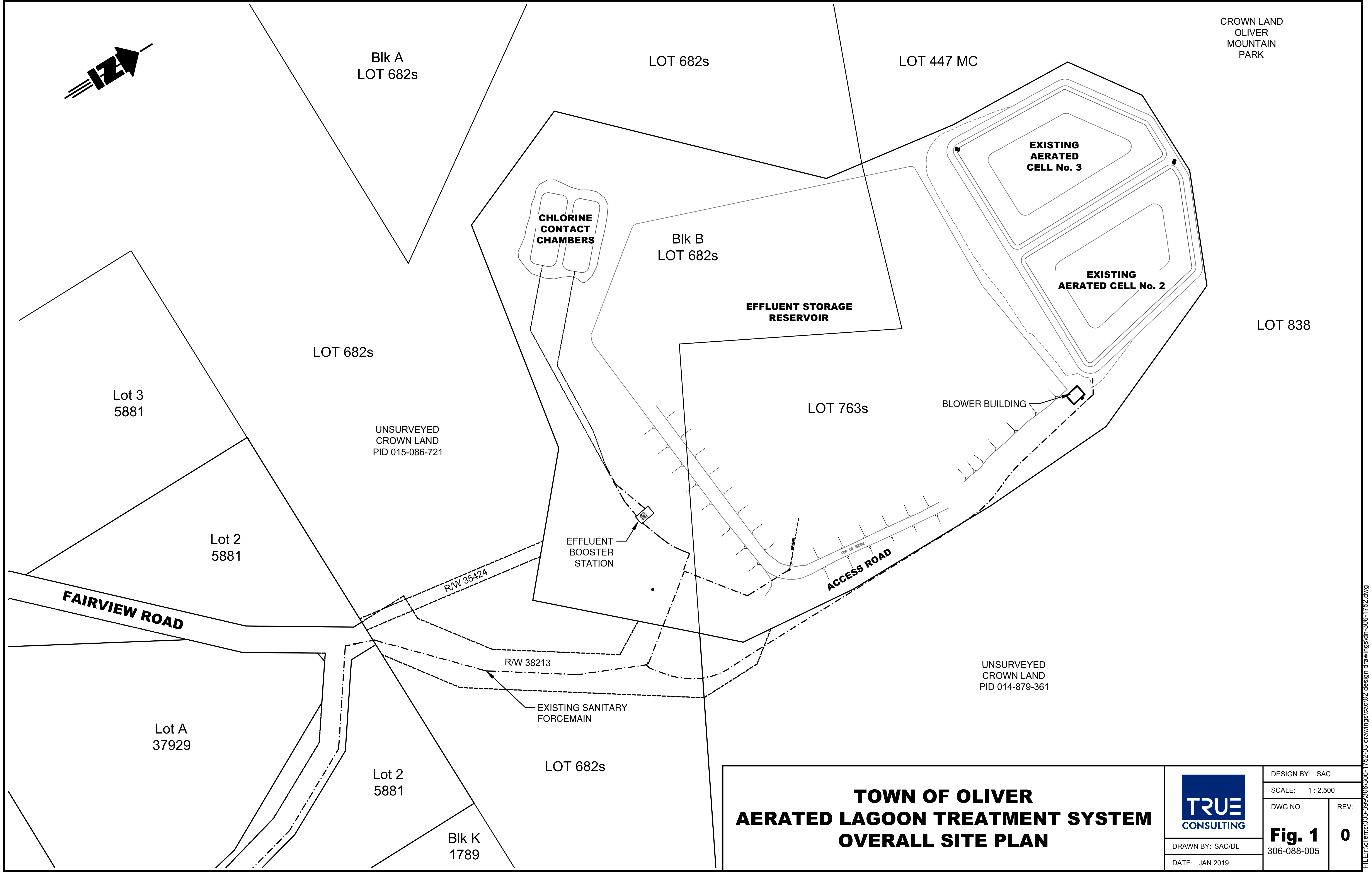
4.0 Recent Sampling

A sludge survey was completed by Lambourne Environmental in 2011 using a digital GPS and gridded sampling programme (see Appendix A). The dry down tell results for Cell No.2 range from 2.97 to 24.13 % solids, whereas Cell No.3 ranges from 3.82 to 7.12 % solids. As derived in theoretical calculations, Cell No.2 has an increased rate of sludge production due to the treatment system design.

The Town completed sludge sampling in 2017. Following sampling, Cell No.2 was lowered, and sludge was removed around the perimeter of the cell. Sludge accumulation sampling was again completed in 2018.

5.0 Recommendations

As the Town continues to advance their Sludge Management Plan, a reserve fund should be maintained for sludge removal and upgrading of the lagoons as required. Sludge sampling for thickness and density in Cell No.2 and No. 3 is to be completed every 2 years (at a minimum). Ongoing monitoring and maintenance will allow the Town to adapt to increases in population growth and reductions of water resources in a sustainable manner. Options for beneficial reuse of sludge should continue to be explored in the future.

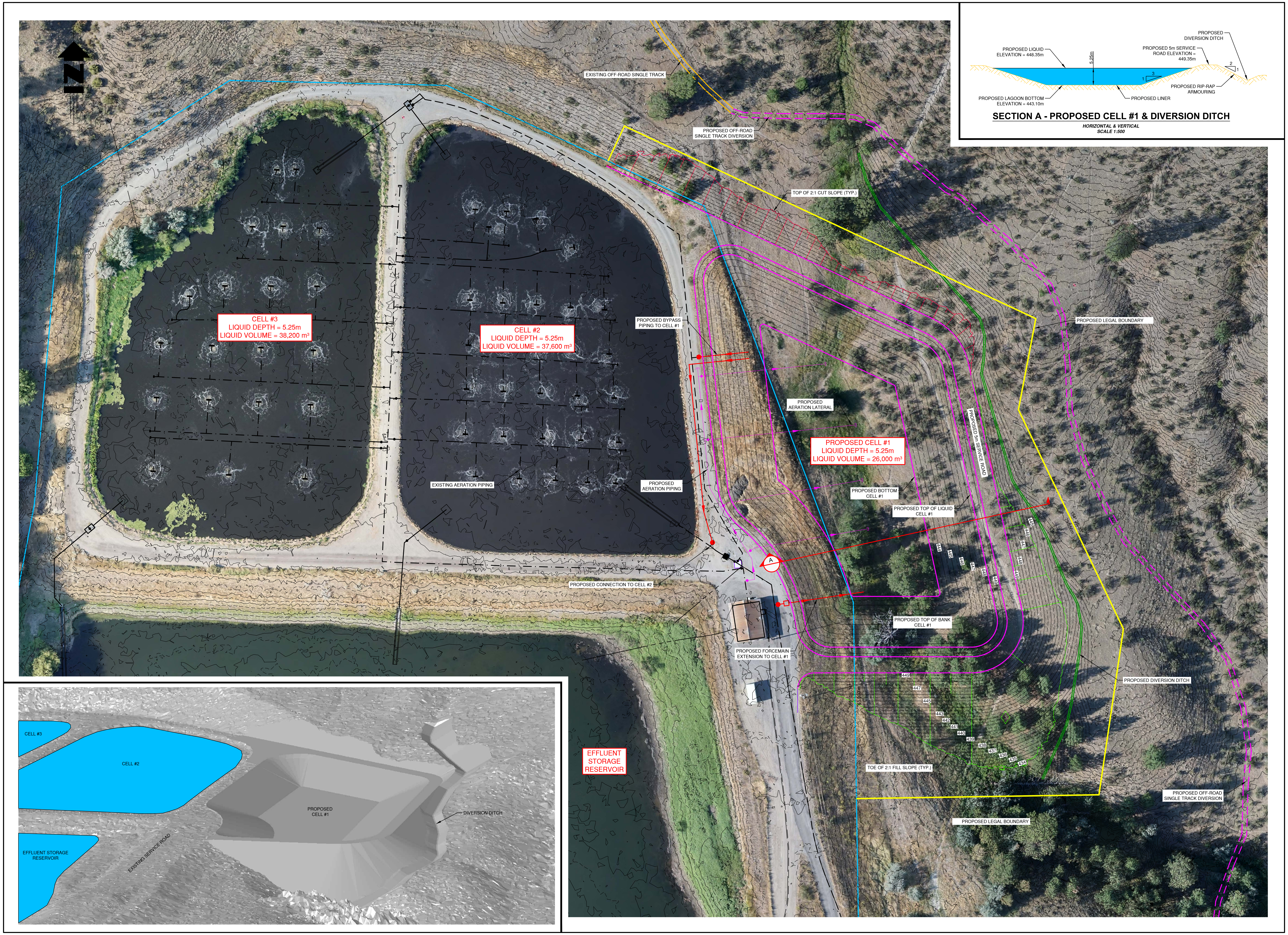


TOWN OF OLIVER
AERATED LAGOON TREATMENT SYSTEM
OVERALL SITE PLAN

TRUE CONSULTING

DESIGN BY: SAC
SCALE: 1 : 2,500
DWG NO.: **Fig. 1** 306-088-005
REV: **0**
DRAWN BY: SAC/DL
DATE: JAN 2019

FILE:r:\clients\300-399\306\306-1752\03 drawings\cad\02 design drawings\dn-306-1752.dwg



SECTION A - PROPOSED CELL #1 & DIVERSION DITCH

HORIZONTAL & VERTICAL
SCALE 1:500

CUT/FILL QUANTITIES

PROPOSED CELL #1 EARTHWORKS

24,000 m³ (CUT)
19,500 m³ (FILL)
NET 4,500 m³ (CUT)

NOT INCLUDING STRIPPING
APPROXIMATE VOLUME 3,900 m³ (CUT)

PROPOSED CELL #1 CAPACITY
26,000 m³

No.	DATE	DESCRIPTION	BY	APP'D
0	SEPT 07/2017	ISSUED FOR DISCUSSION	DF	SC

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING
201 - 2079 Falcon Road ■ Kamloops BC ■ V2C 4J2
tel 250.828.0881 ■ fax 250.828.0717
info@TRUE.bc.ca

BRITISH COLUMBIA
Town of Oliver

AERATED LAGOON TREATMENT SYSTEM

PROPOSED CELL #1

SCALE 0 1:500 25
DESIGN BY SU/SC
DRAWN BY DF
DATE SEPTEMBER, 2017
PROJECT REFERENCE No. 306-083 & 306-291
DRAWING No. 306-088-005
SHEET 1 OF 1
ISSUE/REV. 0

Fig. 2

FILE: r:\clients\300-399\306\306-985\03 drawings\cad\02 design drawings\dh-306-985-oliver treatment

APPENDIX A

Referenced Report

LAMBOURNE ENVIRONMENTAL Ltd.
51, 37337 Burnt Lake Trail, Red Deer County, AB T4S 2K5 Ph. (403)348-8298 Fax (403) 348-8290

December 15, 2011

Town of Oliver
35016 - 97 St.
PO Box 638
Oliver, BC
V0H 1T0
Attn: Shawn Goodsell

Re: Lagoon Survey Report for Town of Oliver, Cells 1 & 2

Dear Shawn,

Lambourne Environmental was contracted to conduct a sludge survey of cells 1 and 2 in Oliver. This survey was completed on November 17, 2011 and was conducted using a digital GPS system, with a boat being used to take the depth measurements and to gather samples from the lagoons. At the time of the survey, the lagoons were ice free and the aeration system had been turned off.

The calculation of volumes for the cells is shown in Table 1 below. The volume calculations were done using Carlson Civil 3D software. While collecting the samples for dry matter testing, it was difficult to find sludge in the second cell. The material in cell 2 was of low density and was found mostly along the east side of the cell. Several attempts to obtain samples in other areas of cell 2 yielded only gravel or stones and dark water. Cell 1 did contain some areas of accumulation and the sludge density varied considerably as seen in the dry down results obtained using our in-house single sample ovens. The majority of the sludge in cell 1 was around the perimeter of the cell indicating the aeration system is moving the material around and it is settling out in the low current area around the perimeter.

When calculating the dry tonnes, we typically see fairly consistent solids results. We take the average of the dry downs and multiply by the sludge volume to arrive at the dry tonnes. In this case, there were a few samples that showed significantly higher solids than the rest of the samples. We retested these samples on different dry down ovens to ensure consistent results. The average number used may skew the calculation of dry tonnes present, particularly in cell 1. The extent of the higher density material was not determined, but it may correspond to the location of the inlets to the cell or it could be material that has not been removed for some time. In the higher density samples, the biosolids did seem to contain a significant inorganic content of sand and grit.

Table 1

Cell #	Total Volume (m^3)	Biosolids Volume (m^3)	Average % solids	Calculated Dry Tonnes	Cell Depth (m)	Biosolids Height (m)
1	36,229	5,000	9.20%	460	5.6	0.1 – 1.95
2	36,278	3,000	5.13%	154	5.5	0 – 2.52
Total	72,507	8,000				

The following are the dry down test results from each cell.

Cell 1	
Sample #	% Solids
1-1	11.13
1-2	3.93
1-3	2.97
1-4	6.52
1-5	6.51
1-6	24.13

Cell 2	
Sample #	% Solids
2-1	7.12
2-2	3.82
2-3	4.99
2-4	4.59

I have also included the following drawing and data exhibits:

1. Cell 1 - Carlson drawing indicating the lagoon shape and points from where the depth measurements were taken.
2. Cell 1 - Table indicating the total depth measurements as well as the height of sludge in each location.
3. Cell 2 - Carlson drawing indicating the lagoon shape and points from where the depth measurements were taken.
4. Cell 2 - Table indicating the total depth measurements as well as the height of sludge in each location.
5. Cell 1 and 2 – Drawing indicating where the samples used for determining percent solids were collected from.

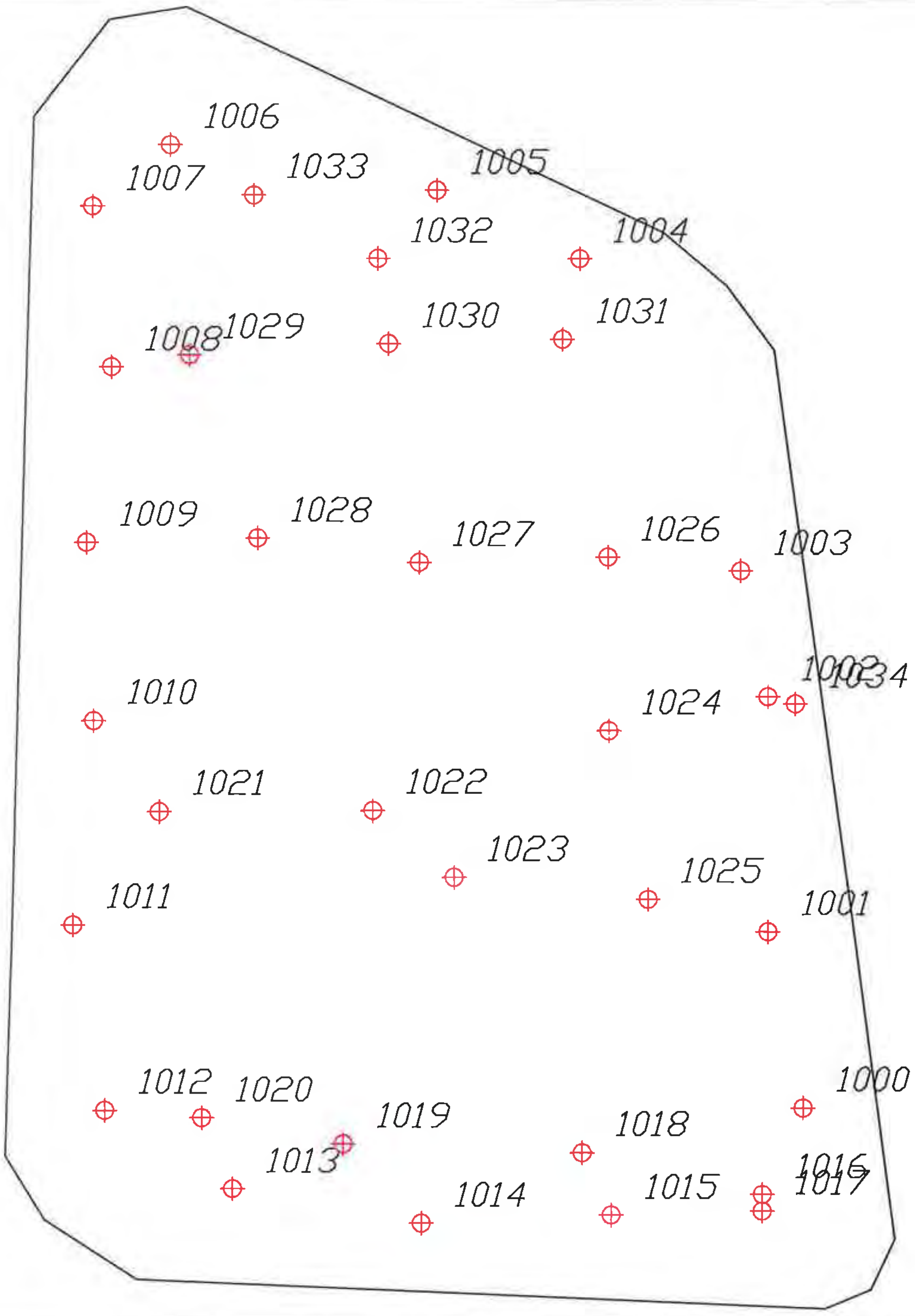
We appreciate the opportunity to work with you on this project. If there is any additional information you require, please let me know.

Yours truly,
Lambourne Environmental Ltd.

Blair Benn, P. Ag.
Vice-President

Encl.

Cc: True Consulting Group Ltd. – Kaitlin Klamut

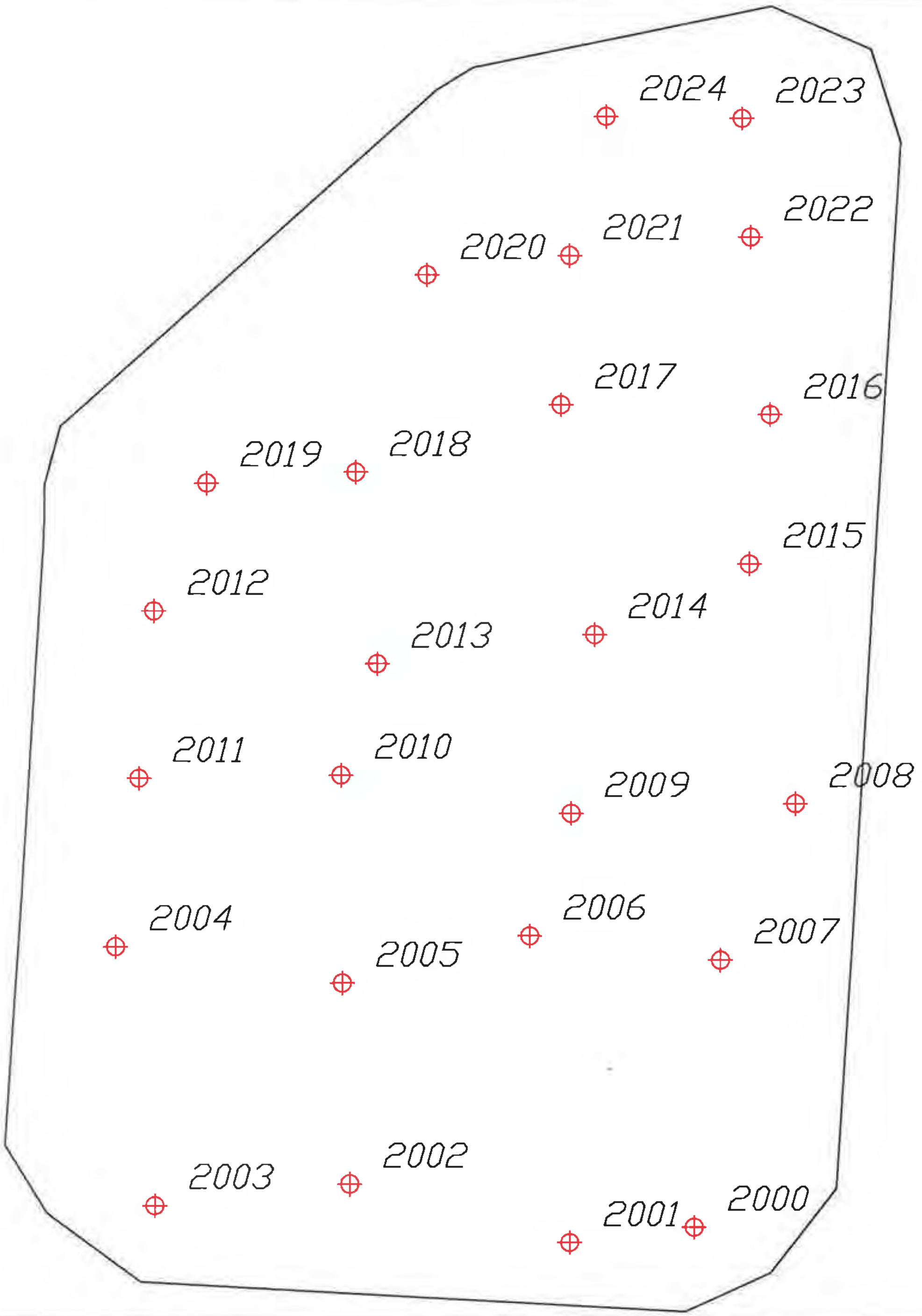


Survey Points

DRAWN **BB**	**DATE** **12/14/11**	**Lambourne** **Environmental**
APPROVED	**DATE**	
SCALE	**SHEET** **Cell 1**	**PROJECT NO.** **Oliver**

Oliver
Cell 1

Point #	Total Depth	Sludge Height
1000	2.64	1.54
1001	2.86	1.76
1002	1.87	0.67
1003	2.00	1.00
1004	1.60	0.60
1005	1.72	0.52
1006	2.76	1.86
1007	1.53	0.43
1008	2.18	0.88
1009	1.54	0.04
1010	2.06	1.36
1011	1.46	0.06
1012	2.12	0.12
1013	2.54	0.34
1014	1.71	0.01
1015	2.22	0.02
1016	2.72	0.62
1017	2.46	1.86
1018	4.18	0.18
1019	4.35	1.15
1020	4.37	0.87
1021	4.58	1.08
1022	5.50	0.00
1023	5.50	0.40
1024	5.67	0.67
1025	5.43	0.03
1026	5.61	0.01
1027	5.46	0.06
1028	5.42	0.02
1029	4.55	1.15
1030	5.45	0.05
1031	4.75	1.95
1032	5.13	0.03
1033	4.91	1.71
1034	0.97	0.47

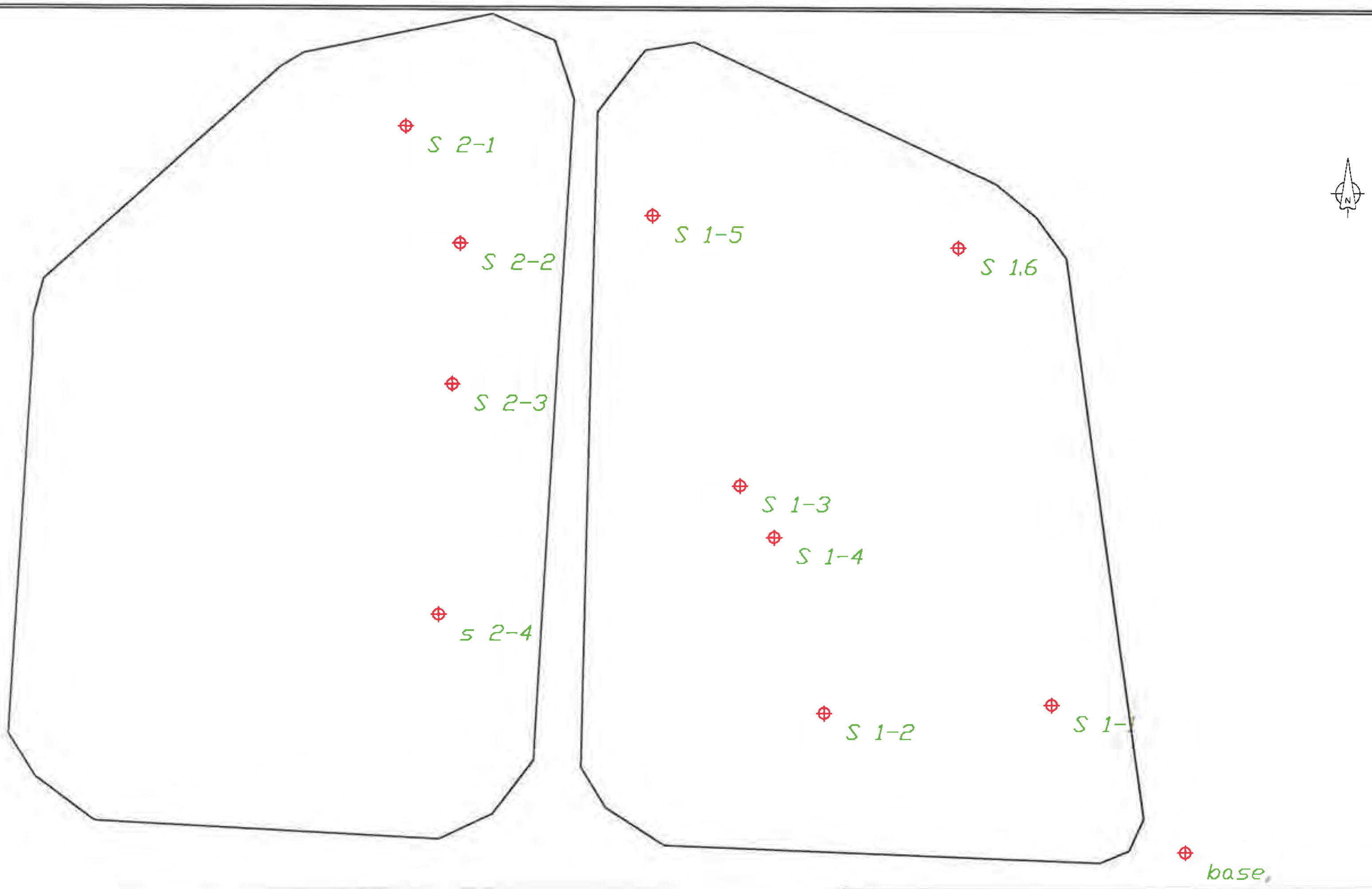


Survey Points

DRAWN **BB**	**DATE** **12/15/11**	**Lambourne** **Environmental**
APPROVED	**DATE**	
SCALE	**SHEET** **Cell 2**	**PROJECT NO.** **Oliver**

Oliver
Cell 2

Point #	Total Depth	Sludge Height
2000	1.53	0
2001	1.84	0
2002	3.78	0.68
2003	1.91	0
2004	3.23	0.03
2005	5.45	0.55
2006	5.53	0.63
2007	4.64	1.34
2008	2.08	0.00
2009	5.68	0.08
2010	5.54	0.04
2011	3.67	0.00
2012	3.58	0.58
2013	5.64	0.04
2014	5.67	0.37
2015	4.84	1.84
2016	3.64	0.54
2017	5.55	0.05
2018	4.81	0.00
2019	3.14	1.14
2020	1.70	0.00
2021	5.75	0.25
2022	4.72	2.52
2023	3.17	1.17
2024	3.32	0.42



Sample Points

DRAWN **BB**	**DATE** **12/15/11**	**Lambourne** **Environmental**
APPROVED	**DATE**	
SCALE	**SHEET** **Cell 1 & 2**	**PROJECT NO.** **Oliver**

APPENDIX H

2021 Western Water Associates Hydrogeological Review

western water
ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

January 28, 2021 WWAL Project: 20-046-01VR

Town of Oliver
c/o TRUE Consulting Ltd.
201-2079 Falcon Road,
Kamloops, B.C. V2C 4J2

Attn: Natalie Alteen, EIT

Re: Hydrogeological Review of the Town of Oliver Reclaimed Wastewater Irrigation Groundwater Monitoring Program

Western Water Associates Ltd. (WWAL) is pleased to provide this hydrogeological review of the Town of Oliver's (the Town) reclaimed wastewater irrigation groundwater monitoring program. The Town has been utilizing reclaimed wastewater to irrigate several properties since the mid 1980's and the wastewater treatment and reclaimed water irrigation is permitted by the Ministry of Environment (ENV) under Operational Certificate PE-13717 (last amended 1995).

1.0 PROJECT BACKGROUND

The Town of Oliver collects wastewater from the community and pumps it to two aerated lagoons for treatment. The operational certificate requires that effluent in the treatment lagoons meet 45 mg/L BOD_5 and 60 mg/L Total Suspended Solids (TSS) criteria before the treated effluent is transferred to a storage lagoon. The results of monthly sampling provided in previous annual monitoring reports indicates that these criteria are typically met.

Between 1997 and 2019, annual effluent flows into the treatment lagoons ranged from 625,911 m^3 to 829,413 m^3.

Treated wastewater is stored over the winter in the storage lagoon. In the spring through fall, the stored treated wastewater is disinfected and beneficially reused as reclaimed irrigation water at several properties inside and outside the Town of Oliver boundary, and this has been occurring since the mid-1980s. Properties originally permitted to be irrigated with reclaimed under PE-13717 water include the Fairview Mountain Golf Course, the Huggins and Alonso properties.

Over time, the Town has expanded irrigation to additional lands, and plans to further expand this land base in the future (see attached figures). Over the years irrigation was expanded to include:

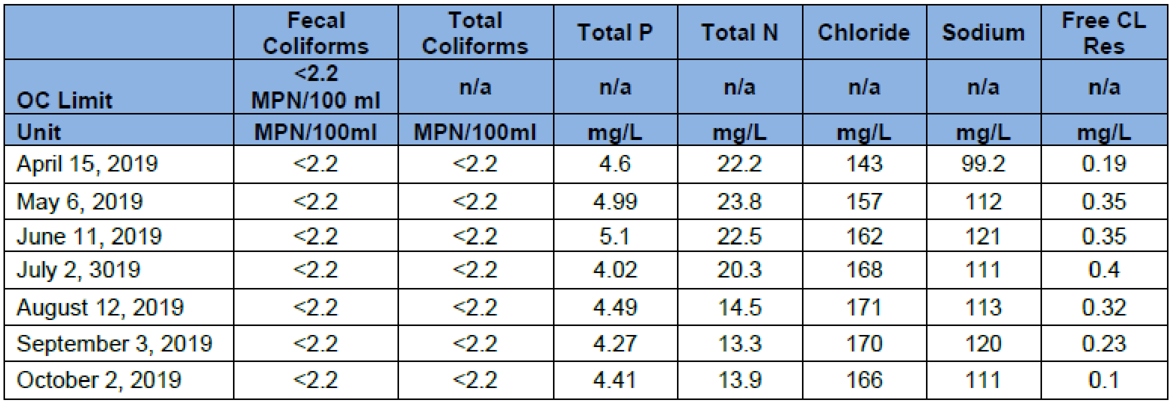
- Fairview Park,
- Gala Street Linear Park,
- South Okanagan Secondary School,
- the Town's Public Works Yard,
- lands surrounding the Oliver Municipal Airport, and
- the Cemetery.

The Town received Ministry approval by letter to irrigate the above-listed areas in May 2020. Future expansion of the irrigated area at the airport is proposed, as is irrigation of the Oliver Parks and Recreation Ball Diamonds, Kiwanis Park and another small park, all along or east of the Okanagan River. TRUE Consulting's Figure 1-1 (attached) illustrates the illustrates where and how irrigation has expanded to over time.

Total annual reclaimed water use for irrigation has been fairly constant between 2011 and 2019, ranging from approximately 407,000 m^3 to 504,000 m^3. The Fairview Mountain Golf Course is the largest consumer of reclaimed irrigation water, using 50-70% of the total volume in a given year. The airport is the second largest consumer of reclaimed water using approximately 15-25% of the annual total.

Table 1-10 below summarizes 2019 reclaimed water quality testing results which provide an indication of the water quality being used for irrigation.

TABLE 1-10: SUMMARY OF RECLAIMED WATER QUALITY DATA



	Fecal Coliforms	Total Coliforms	Total P	Total N	Chloride	Sodium	Free CL Res
OC Limit	<2.2 MPN/100 ml	n/a	n/a	n/a	n/a	n/a	n/a
Unit	MPN/100ml	MPN/100ml	mg/L	mg/L	mg/L	mg/L	mg/L
April 15, 2019	<2.2	<2.2	4.6	22.2	143	99.2	0.19
May 6, 2019	<2.2	<2.2	4.99	23.8	157	112	0.35
June 11, 2019	<2.2	<2.2	5.1	22.5	162	121	0.35
July 2, 3019	<2.2	<2.2	4.02	20.3	168	111	0.4
August 12, 2019	<2.2	<2.2	4.49	14.5	171	113	0.32
September 3, 2019	<2.2	<2.2	4.27	13.3	170	120	0.23
October 2, 2019	<2.2	<2.2	4.41	13.9	166	111	0.1

Data Source: TRUE 2020.

In addition to reclaimed wastewater irrigation, the Town constructed a Rapid Infiltration Basin and has the ability to discharge treated wastewater to ground. The RIB is utilized to maintain appropriate water levels in the storage lagoon to accommodate wastewater inflows during the non-irrigation season. From 2017 to 2019, between 16,858 m^3/yr and 38,391 m^3/yr of reclaimed water has been infiltrated into the RIB.

WWAL was requested to complete this hydrogeological review of the current groundwater monitoring program and to make recommendations for modifications to the monitoring plan to reflect the newly permitted and future irrigation areas. In concert with this hydrogeological review, WWAL coordinated and participated in a soil investigation and reclaimed water irrigation suitability assessment of the new irrigation areas (Hamilton and Associates 2020).

2.0 SCOPE OF WORK

WWAL's work program was outlined in our accepted proposal P20-077 dated May 7, 2020. We completed the following scope of work for this assessment:

- Reviewed pertinent background information on the wastewater system. This included Operational Certificate PE-13717, several annual sanitary sewer system monitoring reports prepared by TRUE Consulting (2015 – 2020), previous hydrogeological reports (Golder 1998a and b), well logs for monitoring wells, and the results of the current groundwater monitoring program.
- Reviewed available information on area geology and hydrogeology, including aquifer mapping, data from provincial groundwater observation wells in the area, and well logs for reported water wells in the area.
- Completed a site visit to view the monitoring well sites, the location of the rapid infiltration facility and the new irrigation areas.
- Compiled water level and water quality data from annual monitoring reports, and created time series plots for water levels and key indicators of wastewater influence in groundwater.
- Prepared this report outlining the results of our assessment including recommendations to modify or update the annual monitoring program.

3.0 SITE DESCRIPTION, PHYSIOGRAPHY AND GEOLOGY

3.1 Site Description

Oliver, B.C. is located in the South Okanagan valley, straddling the Okanagan River between Vaseux Lake to the north and Osoyoos Lake to the south. The largest surface water bodies in the Oliver area are the Okanagan River and Tugulnuit Lake. The Okanagan River flows north-south through Oliver and Tugulnuit Lake is located in the northeast of the Town. Highway 97 transects the Town, roughly following the Okanagan River. Oliver is bounded by mountainous terrain to its east and west with land in the area generally sloping towards the river valley bottom. Elevations in the Town of Oliver range from approximately 600 m above sea level (asl) in upland areas to 300 m asl in the valley bottom.

The bulk of the Town's wastewater treatment and storage infrastructure, including the aerated treatment lagoons, effluent storage reservoir and RIB are located in the Fairview area to the west of the Town boundary (Figure 1). Currently permitted, newly permitted and future irrigation areas are shown on TRUE's Figure 1.1 and other figures provided as an attachment. A summary of each irrigation area is provided below.

Fairview Mountain Golf Course:

The Fairview Mountain Golf Course is located along the hillside southwest of the Town boundary and approximately 1 km south of the aerated lagoons and effluent storage reservoir. An area of approximately 45 ha is irrigated with reclaimed water at the golf course and irrigation volumes range from approximately 250,000 m^3 to 350,000 m^3 per year. Land to the north, south and west of the golf course is largely undeveloped rocky/forested hillside with land to the east being agricultural in use.

Huggins Property:

The Huggins irrigation area is a 3.7 ha vineyard located along Fairview Road south of the aerated lagoons and effluent storage. Service to the Huggins property is currently turned off with reclaimed water being used to meet irrigation demands in case of drought. The Town's WWTP is located to the north of the Huggins property, to the east is the Alonso property and areas to the west and south area largely undeveloped with some agricultural land use to the south.

Alonso Property:

The Alonso property is located on Fairview Road directly to the east of the Huggins vineyard. The Town's WWTP is located to the north of the Alonso Property and undeveloped land followed by agricultural land borders the property to the east and south. The irrigated lands at the Alonso property encompass a 1 ha vineyard that receives approximately 1,600 m^3 to 9,200 m^3 of reclaimed water annually during the irrigation season. The RIB is located approximately 100 m southeast of the Huggins vineyard.

Fairview Park:

Fairview park is located within the Town of Oliver, just south of South Okanagan Secondary School. 0.3 ha of land are irrigated at Fairview park and reclaimed water flows are not yet metered in this location.

Gala Street Linear Park:

Gala Street Linear park is located along Gala Street to the east of South Okanagan Secondary School. To the north, east and south Gala Street Linear Park is bordered by residential areas. Gala Street Linear Park receives approximately 6,200 m^3 to 8,900 m^3 of reclaimed water via spray irrigation annually over an area of 0.8ha.

South Okanagan Secondary School:

South Okanagan Secondary School is located at 6140 Gala Street. Land use surrounding the school is largely residential. 5.4 ha of land are irrigated at South Okanagan Secondary School, receiving 25,700 m^3 of reclaimed water for irrigation in 2019.

Cemetery:

The Cemetery is located along the Town's west boundary, is bordered by agricultural land and a gravel pit to the west, the Town to the east and south and undeveloped hillslopes to the north. An area of 0.74 ha is irrigated with reclaimed water at the cemetery, receiving on the order of 13,400 m^3 to 17,000 m^3 of reclaimed water annually.

Public Works Yard:

The Town's Public Works Yard is located to the northeast of the airport along the west shore of the Okanagan River at 5971 Sawmill Road. Approximately 5,100 m^3 to 8,300 m^3 of reclaimed water are applied to an area of 0.6 ha annually. In addition to utilizing reclaimed water for irrigation at the Public Works Yards, reclaimed water is applied to compost piles.

Oliver Community Parks and Recreation Ball Diamonds/Kiwanis Park:

These parks cover an area of 8.6 ha along the east shore of the Okanagan River and is bordered by Fairview Road to its northwest. Kiwanis Park (0.6 ha) is located to the north of Fairview Road and another small section of park (0.6 ha) is located across the Okanagan River. The Oliver Community Park area is not yet irrigated with reclaimed water but is proposed as a future expansion area.

Oliver Municipal Airport:

The Oliver Municipal airport is located southeast of the Town's core and to the west of the Okanagan River. Currently 12.6 ha of land are irrigated with reclaimed water at the airport with the irrigation area being proposed to be expanded by an additional 9.8 ha. The airport receives approximately 69,000 m^3 to 186,000 m^3 of reclaimed water yearly. To the east and south west the airport is bordered by agricultural land and by commercial properties to the north and west.

3.2 Geological Setting

In northern and southern areas, including the southern extent of the airport, Oliver is underlain by metamorphic rocks of the Grand Forks Gneiss/Monashee Complex from the Proterozoic era (2500-570 million years before present). Bedrock of this complex includes quartz-biotite gneiss, quartzite, marble and amphibolite. In areas underlying the aerated lagoon, RIB and Fairview Mountain Golf Course, bedrock is mapped as metamorphic rocks of the Kobau Group described as schist, chlorite schist, quartzite, amphibolite and minor marble, Carboniferous to Permian in age (362.5 to 245 million years before present). The remainder of Oliver, mainly the Town centre as well as areas to the east and west of the Town centre, are underlain by bedrock of the Okanagan Batholith Group. Rocks of the Okanagan Batholith Group are described as granodioritic intrusive rocks from the Middle Jurassic, 178-157.1 million years before present (ENV, 2020).

Surficial geology in the Okanagan Valley was extensively mapped and described by Hugh Nasmith in Bulletin No. 46 *Late Glacial History and Surficial Deposits of the Okanagan Valley British Columbia* (1962). Surficial geology in the upland areas underlying in the Fairview Mountain Golf Course and RIB is characterized by outwash terrace deposits consisting of stratified glacial drift material deposited from meltwater streams and lakes during glacial retreat. The remainder of the upland areas are mapped as raised alluvial fans, terraces and deltas. Modern day Okanagan River floodplain deposits are found along the Okanagan River. Surficial geology underlying the town centre to the west of the Okanagan River is characterized by raised alluvial fans and deltas.

4.0 HYDROGEOLOGICAL SETTING

There are four provincially-mapped aquifers underlying the Oliver area, of which three are present beneath some or all of the irrigation areas (ENV, 2020). The mapped aquifers include Aquifers 254 IIA, 255 IA, 256 IIA and 1108 IIA, select details for which are provided in Table 4.1. The extent of these aquifers is shown on Figure 2. The two primary aquifers over which the bulk of reclaimed water irrigation occurs are Aquifer 256 and 254.

Table 4.1 Mapped Aquifers in the Oliver Area

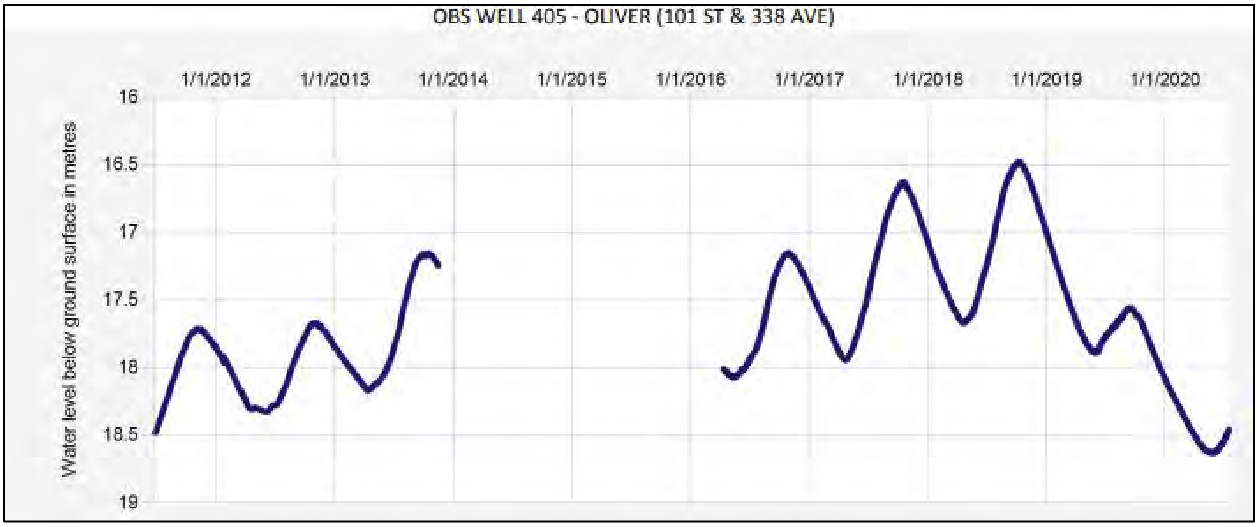
Aquifer Number	Aquifer Type	Description	Vulnerability	Productivity	Demand	Irrigated Areas Overlying
254 IIA	Sand And Gravel	Unconfined valley bottom alluvial aquifer, generally east of Highway 97 extending from Tugulnuit Lake to Osoyoos Lake	High	High	Moderate	• Airport • Public Works Yard • Oliver community Park
255 IA	Sand And Gravel	Unconfined valley bottom alluvial aquifer, extending from Tugulnuit Lake north to Vaseaux Lake	High	Moderate	High	
256 IIA	Sand And Gravel	Predominantly confined aquifer system comprised of alluvial or colluvial deposits, occupying the terraces and hillsides west of Highway 97	Low	Low	Moderate	• Fairview Mountain GC • Allonso/Huggins • S. Okanagan Secondary School • Fairview Park • Gala Linear Park • Cemetery • RIBs
1108 IIA	Bedrock	Predominantly unconfined fractured crystalline bedrock aquifer, underlies the Oliver Town core and mountainous areas to the west.	High	Low	Low	A bedrock aquifer underlies all areas receiving reclaimed water, but overburden aquifers overly bedrock in most areas.

The mapped overburden aquifers (Aquifers 254 IIA, 255 IA, 256 IIA) form an unconfined to semi-confined valley bottom aquifer system along the Okanagan River receiving recharge from upland bedrock areas, Vaseux Lake, the Okanagan River and irrigation. Elevated nitrate levels have long been reported in the aquifer system (Hodge 1992) and are likely caused by agricultural activity (Geller, D. and B. Manwell, 2016). Groundwater flow direction in Aquifers 254 IIA and 255 IA is inferred to follow the Okanagan River southwards towards Osoyoos Lake. In Aquifer 256 IIA groundwater flow is inferred to be eastwards towards the Okanagan River from upland areas, with Aquifer 256 discharging into the valley bottom Aquifer 254 system.

The Town of Oliver relies on a network of groundwater supply wells to provide potable water to the community. In addition to supplying potable water the Town supplies irrigation water to approximately 5,200 acres of farmland and 455 acres of non-farmland. The majority of irrigation water is sourced from surface water with a small portion being provided by groundwater. The potable water supply well located closest to the irrigation areas is the Rockcliffe Well (WTN82376), approximately 400 m west of the airport. The Town's Fairview irrigation well is located approximately 1,300 m east of the golf course. The location of the Town's municipal supply wells (within the extent of the map area) are shown on Figure 1.

Provincial observation well # 405 (OW 405) is located approximately 770 m west of the southern extent of the airport. OW405 is completed in Aquifer 256 IIA and water levels for OW405 are available from 2011 on, although a data gap exists from November 2013 to April 2016. Water level data for OW 405 (Figure 4.1), indicates annual water level fluctuations in the aquifer are on the order of 0.3 m to 1.3 m, with highest water levels being observed in the fall (October or November) and lowest levels occurring in the spring (April, May). The annual water level trend in Aquifer 256 differs from that of other monitoring wells in the interior completed in sand and gravel aquifers, where annual groundwater highs typically occur in the late spring/early summer and are typically associated with freshet induced recharge to aquifers. Higher aquifer levels in the fall indicate that Aquifer 256 is likely receiving recharge from irrigation return flows as the high water levels correspond with the end of the typical irrigation season (May to October). Aquifer levels appear to have been stable or slightly increasing from 2011 to 2018. Recent data suggests that aquifer levels are declining with the lowest aquifer levels on record being observed in early 2020.

Figure 4.1 Water Levels in Observation Well 405 (July 2011 – July 2020)



5.0 CURRENT GROUNDWATER MONITORING AND SAMPLING PROGRAM

The current groundwater monitoring program includes seven monitoring wells (Figure 1), of which five intercept groundwater and can be sampled.

Four of the monitoring wells are located in the Fairview area and were constructed in 2000. Town MWs 5, 6 and 7 are located east of the Fairview Golf Course and Town MW4 is located further north, in close proximity to the currently used RIB. Town MW4 and MW5 reportedly always contain water, while MW6 has reportedly been dry since 2003 and MW 7 has reportedly been dry since 2006. Well logs for the monitoring wells in the Fairview area indicate that the area is underlain by sand and gravel with varying silt content followed by clayey silt. These monitoring wells are typically completed with screens just above the clayey silt, but some of the screens are located within the clayey silt and do not contain groundwater.

Three monitoring wells (referred to as Wells #1, #2 and #3) located east of the airport are inferred to have been constructed in 2005 around the time reclaimed water irrigation began at the airport. No well logs are available for these wells, however these wells consistently intercept groundwater and are sampled.

Table 5.1 provides a summary of construction details for the wells in the current monitoring program.

Table 5.1 Summary of Monitoring Well Construction Details

Well ID	Well Depth m (ft)	Screened Interval m (ft) bgs	Diameter mm (in)	Top of Casing Elevation m asl	Location
Well #1 (Air Cadet)	10.52 (34.5) btoc	unknown	50 (2)	308.52	East (Downgradient) of Airport
Well #2 (Rodeo Grounds)	8.08 (26.5) btoc	unknown	50 (2)	306.56	East (Downgradient) of Airport
Well #3 (91A Street)	4.1 (13.5) btoc	unknown	50 (2)	295	East (Downgradient) of Airport
Town MW4 (near RIB)	10.98 (36) btoc		50 (2)	351.906	Downgradient of RIB
Town MW5 (125th Street)	13.25 (43.5) btoc		50 (2)	363.361	Assumed Background
Town MW6	18.29 (60) bgs	13.29-18.29 (43.6-60)	50 (2)	362.702	Downgradient of Golf Course
Town MW7 (Road No. 5)	25.91 (85) bgs	20.91-25.91 (68.6-85)	50 (2)	362.859	Downgradient of Golf Course

In addition to the above, the Town has three monitoring wells located between the Huggins and Alonso properties, just south of the wastewater treatment and storage lagoons. These wells were installed in 1997 as part of hydrogeological investigation supporting the design and commissioning of a RIB in the area (this RIB was only used for a few years in the late 1990s and early 2000s and is no longer in use). These three wells are not currently monitored.

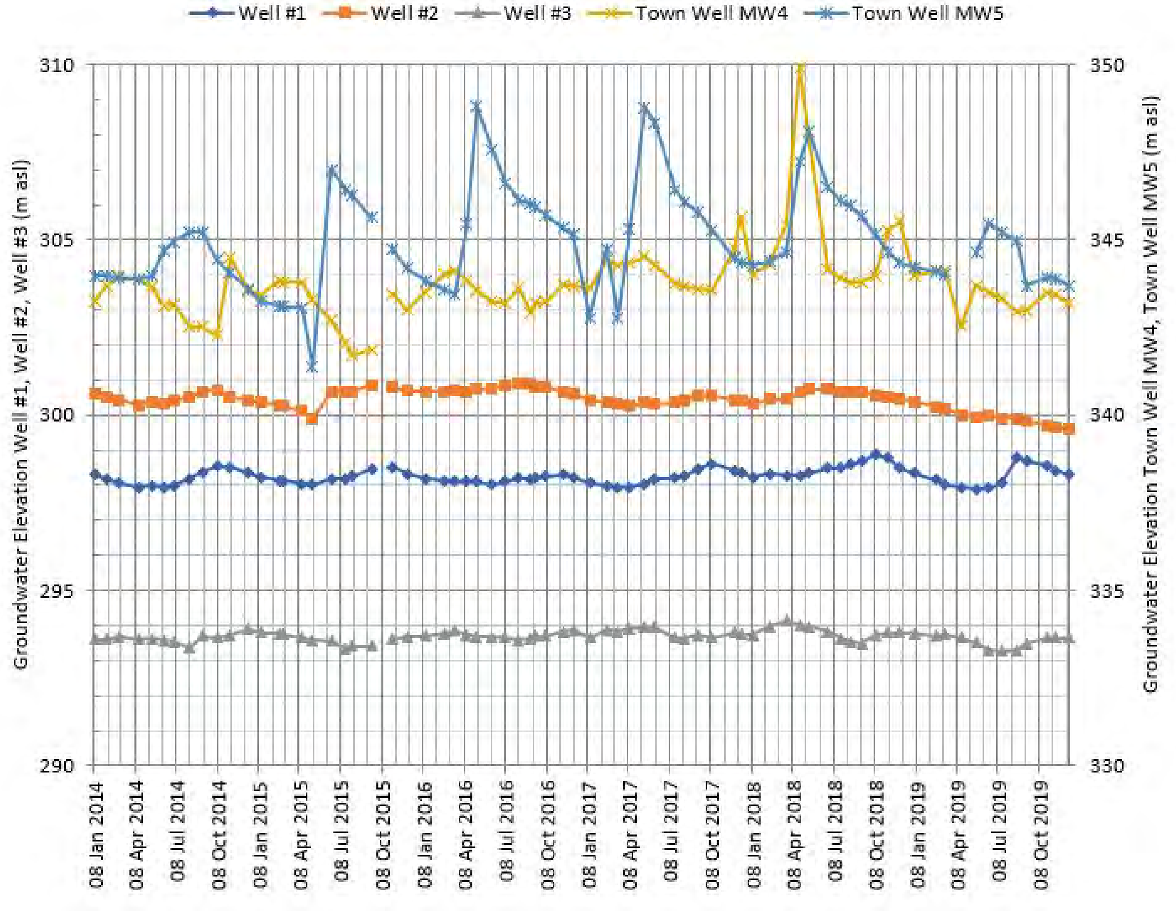
The current monitoring program sees groundwater levels measured in each of the seven active wells monthly, and water quality samples collected biannually in April and September. Monitoring wells are sampled for the following parameters:

- Nitrogen species (nitrate, nitrite, ammonia)
- Total and dissolved phosphorous
- Chloride, sodium, calcium and magnesium
- Hardness
- conductivity

6.0 HISTORICAL GROUNDWATER LEVEL DATA

WWAL was provided monitoring well water level data collected from 2014 to 2019. Annual Sanitary Sewer Systems Reports prepared by TRUE indicate that Town MW6 has been dry since at least 2003 and Town MW7 was first noted to be dry in 2006 (TRUE, 2020). Monitoring well logs indicated that Town MW's 4, 5 and 7 are screened either above or across the clayey silt unit whereas Town MW6 is screened within the clay unit which could be the reason for this well being dry. Figure 6.1 illustrates water levels in the monitoring wells from 2014 to 2019.

Figure 6.1 Groundwater Elevation Oliver Spray Irrigation Monitoring Wells



The monitoring wells near the airport (Wells #1 to #3, completed in Aquifer 254) show a different pattern of water level fluctuations than Town MW4 and MW5, which are completed in Aquifer 256. Wells #1 to #3 fluctuate on the order of 0.5 to 1 m annually and are relatively stable. Water levels in Well #1, Well #2 and Well #3 appear to be at their highest near the end of the irrigation season suggesting that irrigation return flows are contributing recharge to the aquifer.

Water levels in Town MW4 and MW5 display greater fluctuations in water levels when compared to the monitoring wells installed near the airport. MW5, the assumed program background well, shows the most annual fluctuation, on the order of 3 to 6 m. Seasonal peaks tend to occur in May or June. This contrasts with the pattern observed at provincial observation well #405 (discussed in Section 4), where seasonal highs occur in October, presumably in response to irrigation return flows. Town MW5 is located hydraulically upgradient of most of the irrigated areas and the pattern of fluctuation is more indicative of the typical freshet influenced aquifer recharge response observed in the Okanagan.

Town MW4 displays less seasonal fluctuation than Town MW5 but still more than the wells near the airport. A noticeable spike in water levels is evident in May 2018, and is assumed to be the result of use of the RIB at that time. As water level measurements are only collected monthly, the full impact of use of the RIB (which may only occur for a week or two) is likely not being captured.

7.0 HISTORICAL GROUNDWATER QUALITY DATA

The current groundwater monitoring program assesses impacts of reclaimed water disposal on the receiving environment in locations downgradient of the two areas receiving the greatest amounts of reclaimed irrigation water (Fairview Mountain Golf Course and Airport) along with impacts of effluent infiltration through the RIB. Environmental receptors of concern include aquifers downgradient of the irrigation areas and RIB where wells may be used, as well as downgradient aquatic receiving environments, mainly the Okanagan River. Aside from groundwater being utilized for drinking water the area south of Oliver is largely agricultural in use, therefore groundwater may also be used for irrigation and livestock watering.

Considering the above receptors of concern, water quality results were compared to the B.C. Contaminated Sites Regulation, Schedule 3.2, Generic Numerical Water Standards for Drinking Water (CSR DW), Aquatic Life (CSR AW), Livestock Watering (LW) and Irrigation (IW) (ENV, 1997).

Water quality results for parameters sampled at the monitored wells are discussed in the sections below along with time series plots, illustrating concentrations of each parameter over time.

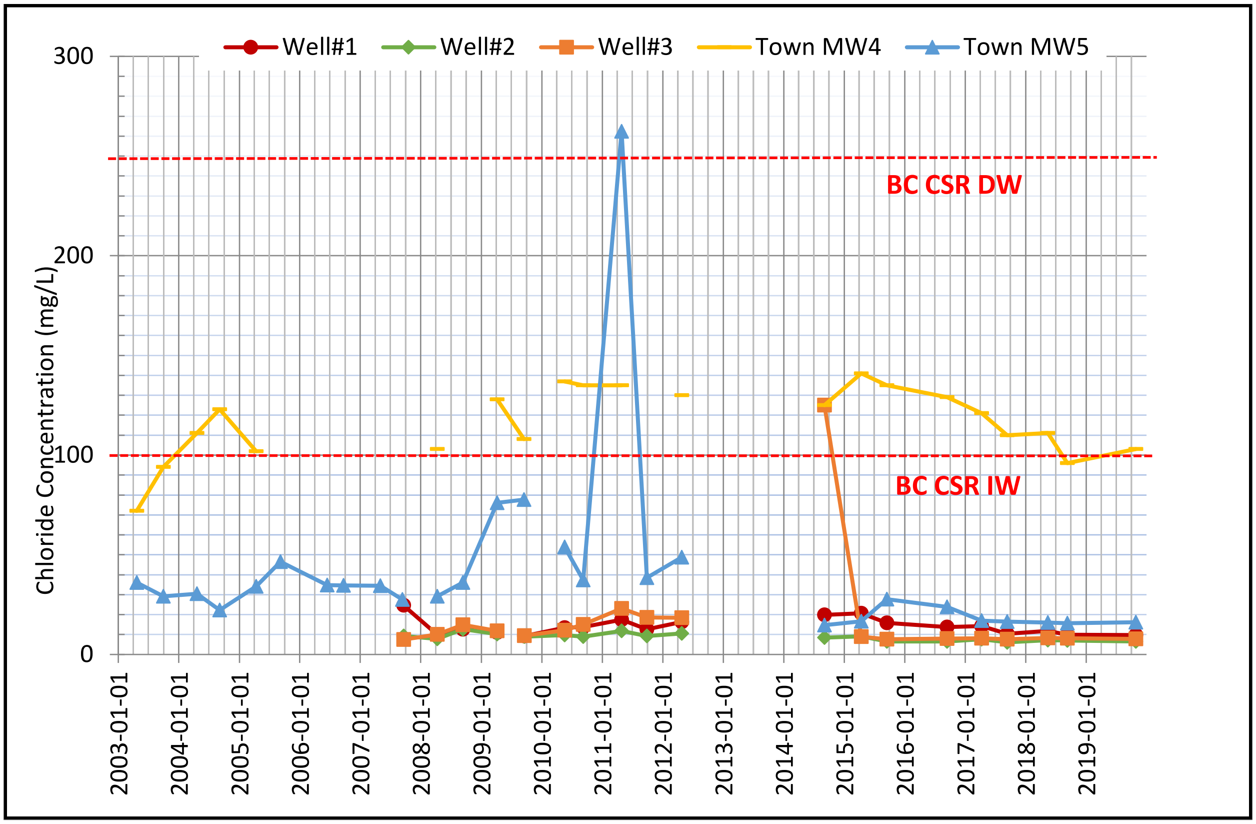
7.1 Chloride

Chloride is regarded as a conservative ion, meaning it does not biogeochemically degrade and is indicative of the degree of anthropogenic input. While chloride is typically present in low concentrations in freshwater aquifer systems, elevated chloride can be due to anthropogenic activities such as reclaimed water irrigation, wastewater effluent disposal to ground, road salting, industrial processes, and agricultural activity. Figure 5.1 illustrates a time series plot of chloride concentrations in monitoring well samples. For context, chloride concentrations in the reclaimed water used for irrigation in 2019 was in the 140 to 170 mg/L range.

Overall chloride levels in Well #1, Well #2 and Well #3 appear relatively stable in recent years and are generally found below 30 mg/L with the exception of a spike in chloride at Well #3 in September 2014. Town MW4 generally displays the highest chloride concentrations out of all monitored wells, which is likely associated with the downgradient location of Town MW4 with respect to the RIB and surrounding agricultural activity.

Town MW5 is used as a background well as reclaimed water irrigation is no longer practiced upgradient of this well. Over the last 5 years chloride concentrations in Town MW5 were relatively stable and similar to concentrations at wells #1-3. Prior to 2012, when irrigation with reclaimed water was presumably occurring upslope, chloride concentrations were higher.

Figure 7.1 Chloride Time Series Plot



7.2 Sodium

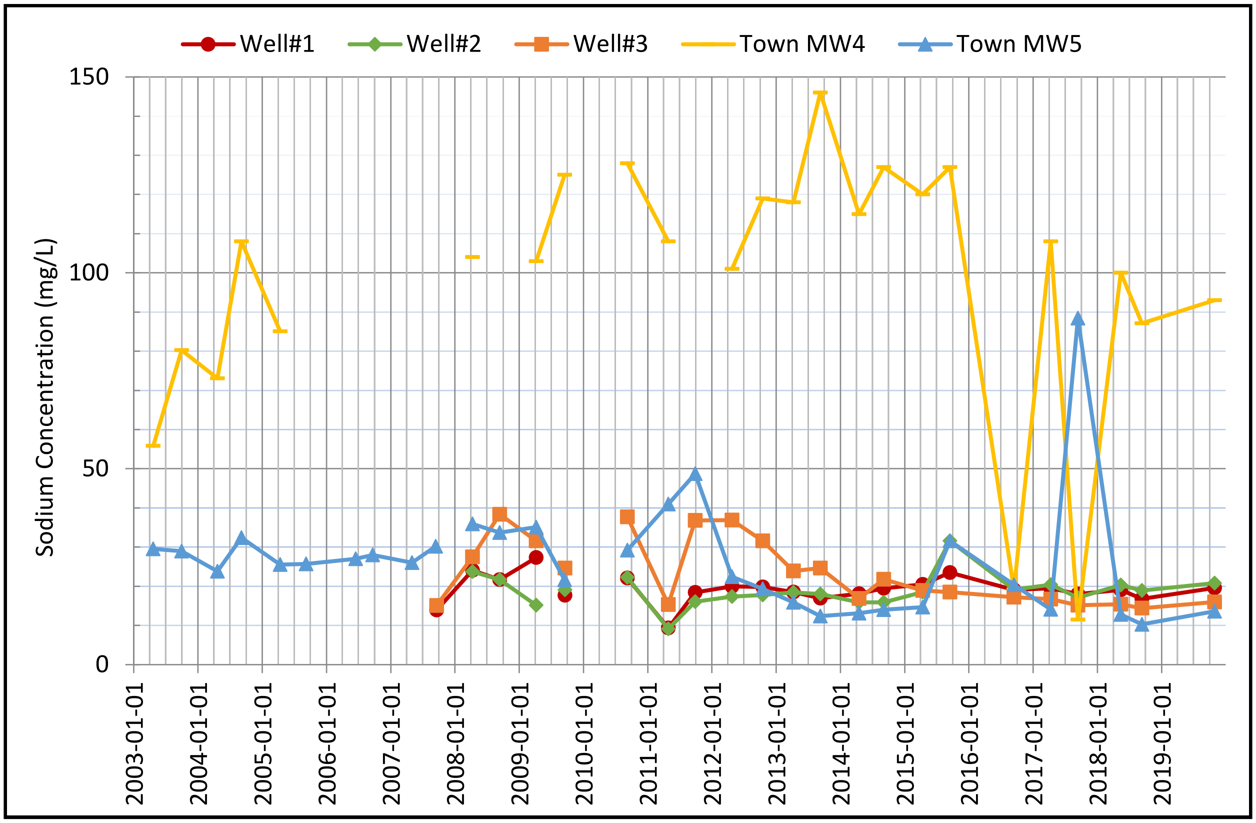
The presence of sodium above background concentrations can indicate wastewater impacts on groundwater. Sodium can also be present due to anthropogenic activities such as road salting, industrial effluents, home water softener use, and agricultural activity.

Sodium concentrations in Well #1, Well #2 and Well #3 remained relatively stable since 2014, showing some moderate fluctuations prior to 2014

Town MW4 displays the highest sodium concentrations and sizeable fluctuations in sodium concentrations. Sodium levels in Town MW4 declined rapidly in the fall of 2016 after which spikes in concentrations were observed in samples collected in the spring. These observed spikes are likely the result of reclaimed water infiltration through the RIB as the RIB was in use during the winters of 2017, 2018 and 2019. MW4 and the RIB are located within a draw, which may also convey waters impacted by upgradient agricultural activities towards the area.

Town MW5 shows relatively large variations in sodium concentrations, with concentrations generally being below Town MW4 and in the same range as the airport monitoring wells.

Figure 7.2 Total Sodium Time Series Plot



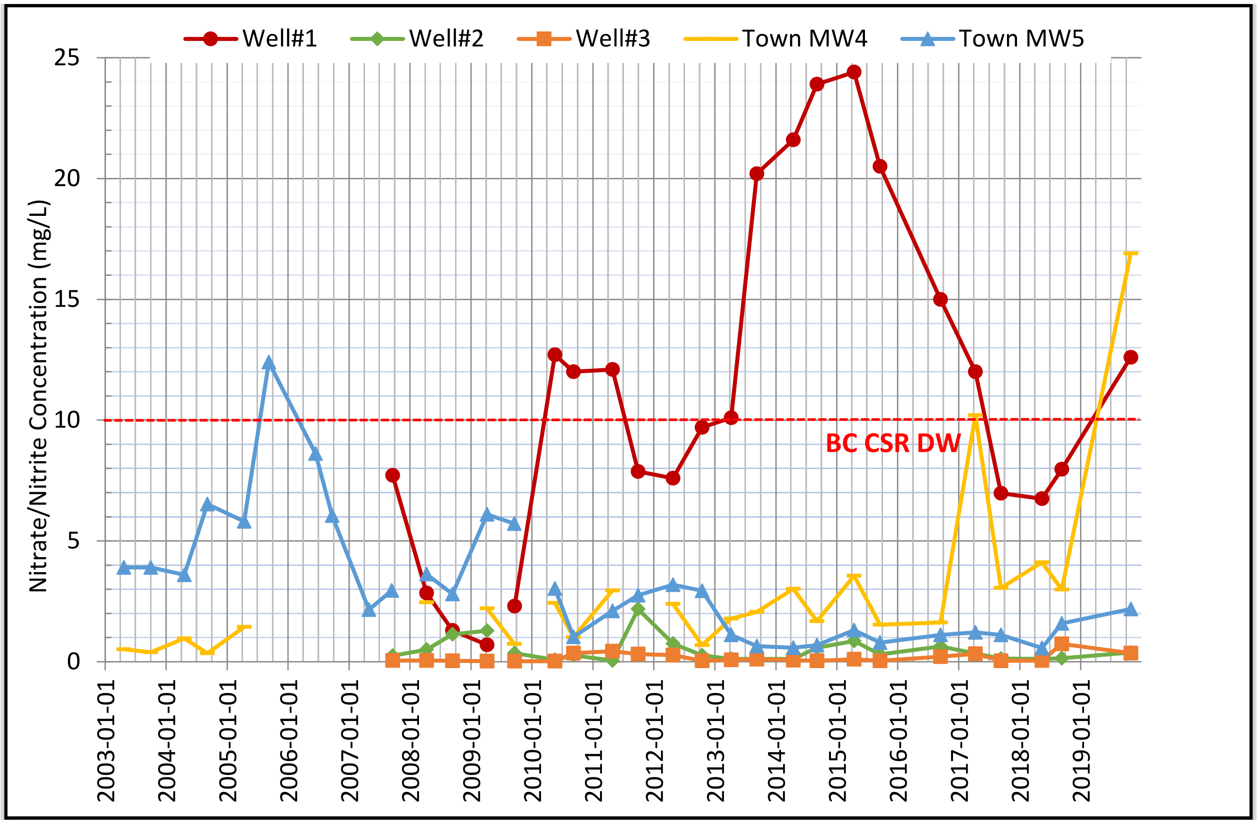
7.3 Nitrate/Nitrite

Nitrate rarely occurs naturally in water and generally occurs in water due to anthropogenic activities. Nitrate concentrations greater than 3 mg/L are considered by the Province to reflect human impacts (ENV, 2007). The most common anthropogenic sources of nitrates include agricultural activities, wastewater disposal to ground, and discharge from industrial processes and mining (blast residuals from ammonium-nitrate or other explosives). Nitrite is an unstable form of nitrogen that rapidly oxidizes to nitrate or reduces to nitrogen gas, as such nitrite is typically found at low concentrations in the environment (ENV, 1998).

Overall, Well #1 displays the highest nitrate/nitrite levels with concentrations frequently exceeding the BC CSR DW standard. Nitrate/nitrite concentrations appear to have peaked in Well #1 in 2015 at close to 25 mg/L, decreasing until late 2018, then rising again. The concentration and pattern of nitrate concentrations in Well #1 is anomalous, and suggests there may be another point source of nitrate being added to the aquifer near this location. Nitrate/nitrite concentrations in Well #2 and Well #3 have remained relatively stable and mostly below 1 mg/L.

An increasing trend in nitrate/nitrite concentrations is apparent in Town MW4 with the sample collected in the fall of 2019 exceeding the BC CSR DW standard. Again, water quality in Town MW4 appears to be influenced by the RIB. Nitrate and nitrite concentrations in Town MW5 show a decreasing trend although some impact is still evident and likely due to agricultural activity in the surrounding area.

Figure 7.3 Nitrate/Nitrite Time Series Plot



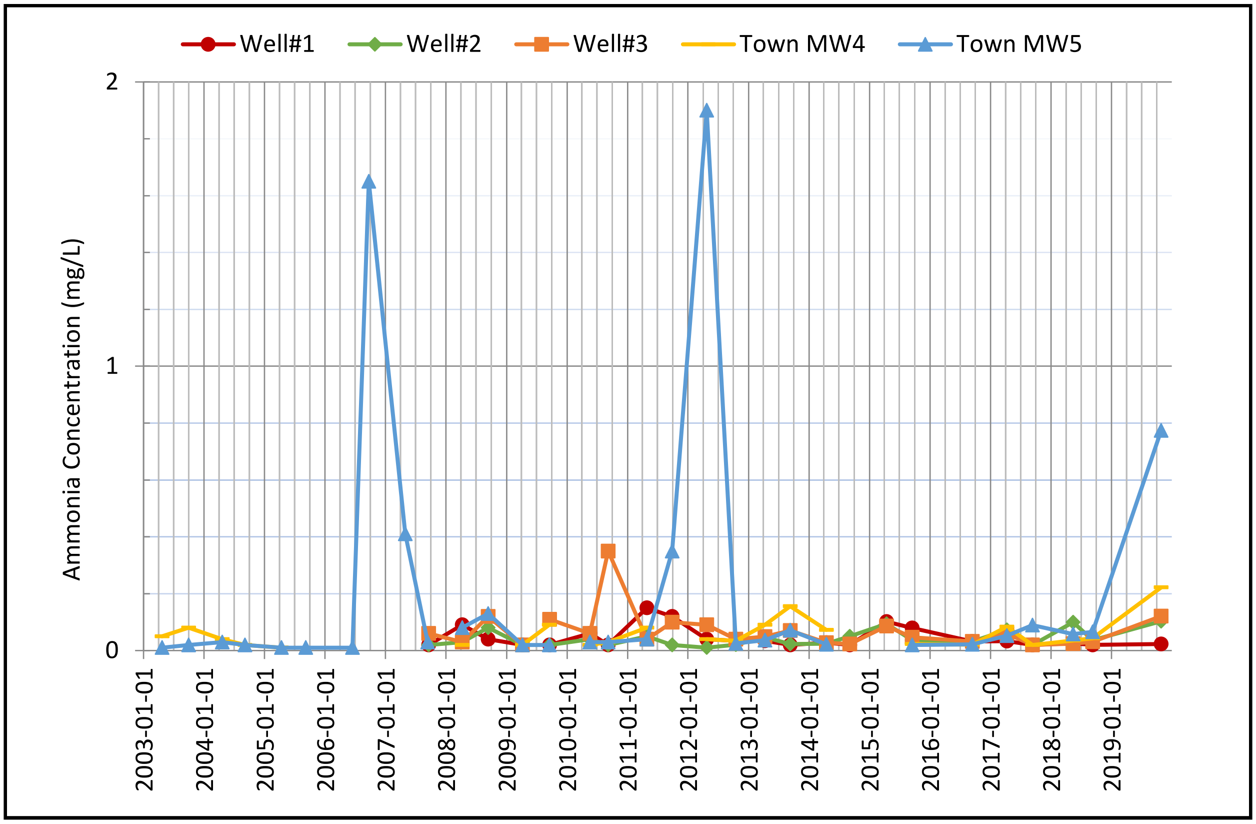
7.4 Ammonia

Ammonia is the primary form of nitrogen in raw wastewater but is quickly converted to nitrite and eventually nitrate during wastewater treatment (MoE 1998). When ammonia or nitrite are present in groundwater, it indicates that the source of nitrogen is close by, and that the nitrification process was not completed prior to nitrogen reaching the groundwater table. Anthropogenic sources of ammonia include wastewater effluent, agriculture and urban development, industrial effluents, and mining (blast residuals).

Ammonia concentrations in all wells except MW5 have been relatively stable since 2011. Several spikes in ammonia concentration in MW5 have occurred which do not correspond to spikes at other locations and is considered anomalous. The ammonia data indicate a point source other than the reclaimed irrigation water may be impacting MW5.

The ammonia concentration in most monitoring wells trended upward in the fall sample collected in 2019.

Figure 7.4 Ammonia Time Series Plot



8.0 CONCLUSIONS

Based on our assessment, we provide the following conclusions:

C1 The current groundwater monitoring program includes seven monitoring wells, three downgradient of the airport (Well #1, Well #2, Well #3), two downgradient of the Fairview Mountain Golf Course (MW6 and MW7), one downgradient of the RIB (MW4) and one background well (MW5). Water levels in the monitoring wells are checked monthly and samples are collected from the monitoring wells semi-annually, usually in the spring and fall.

C2 MW6 and MW7 which are intended to monitor impacts from irrigation of the Fairview Mountain Golf Course have been dry for more than a decade, so no monitoring of the impacts of golf course irrigation is currently completed.

C3 The monitoring wells near the airport (Well #1, #2 and #3) are completed in valley bottom Aquifer 254, while the remaining wells which are completed at higher elevation in the Fairview area are completed in Aquifer 256. The pattern of groundwater level fluctuation in these two groups of monitoring wells are different and evident in the data being collected. Airport monitoring wells show a small magnitude of seasonal fluctuation on the order of 0.5 to 1.0 m, with peaks occurring in the fall suggesting the influence of irrigation recharge. MW5, the assumed program background well, shows the highest magnitude of fluctuation in the 3 – 6 m range, with peaks in the spring typical of an aquifer response to freshet induced recharge. MW4, located immediately downgradient of the RIB shows moderate seasonal fluctuations of 2 – 3 m and the data indicate groundwater level spikes occur in response to loading of the RIB, which is to be expected.

C4 Water quality results from the groundwater monitoring program indicate the following:

- Water quality in MW4 shows elevated sodium, chloride and nitrate/nitrite concentrations, with the most recent nitrate sample collected being 17 mg/L, above the drinking water quality guideline of 10 mg/L. MW4 is located immediately downgradient of the RIB, and in a draw leading from the Alonso and Huggins properties located upslope. MW4 is impacted by the RIB and likely upslope land uses, and a plume of nitrate-impacted groundwater is expected to migrate away from the area following loading of the RIB. The geometry and extent of that plume is not known. It is likely that the current monitoring program does not capture the full range of impacts from use of the RIB, as the RIB is typically loaded continuously for a period weeks while water levels are measured monthly and water quality samples are only collected biannually.
- Town MW5, which is utilized as the program background well shows water quality impacts. Of note are recurring spikes in ammonia concentrations at levels not seen in other monitoring wells. As lands near MW5 are not currently irrigated with reclaimed water, the observed water quality impacts may be due to other point sources.
- Well #2 and Well #3 located downgradient of the airport generally display the lowest impacts on groundwater quality, with concentrations of chloride, sodium, nitrate and ammonia at what are likely background levels for Aquifer 254. Well #1 is an exception, as it is characterized by very high nitrate concentrations often above 10 mg/L, and reaching as high as 25 mg/L in 2015. The data suggest a point source of nitrate in the area other than the reclaimed water may be impacting groundwater at Well #1. The Air Cadet building is located very close to Well #1, and we noted a vineyard and BC Tree Fruits facility across the street to the east.

C5 The current reclaimed water irrigation monitoring program appears to adequately assess impacts of the reclaimed water irrigation and disposal system downgradient of the airport, however the data for Well #1 indicates a significant impact to groundwater and warrants additional investigation.

Town MW4 is well sited to monitor impacts from reclaimed water infiltration at the RIB, however the frequency of monitoring at this well is not sufficient to adequately characterize the impact to groundwater.

Town MW5, the program background well, displays some indication of impacts to groundwater, even though reclaimed water irrigation no longer occurs upslope.

Lastly, as the two wells sited to assess impacts from irrigation of the Fairview Mountain Golf Course have been dry since at least 2007, the impacts of golf course irrigation are not being assed in the current program.

7. RECOMMENDATIONS

R1 WWAL recommends continued monthly monitoring of water levels and bi-annual sampling at Wells #1, #2, #3 and Town MW5.

R2 We recommend an increased level of monitoring at Town MW4 located near the RIB. We recommend that a transducer be installed in this well to better characterize the effect on water levels when the RIB is utilized. We also recommend that for one full year, groundwater quality samples from Town MW4 be collected monthly.

R3 We recommend incorporating the three wells between the Huggins and Alonso properties into the monitoring program for 1 year if the wells are still present. Groundwater levels should be measured monthly and water quality samples collected biannually on the same schedule as the other wells. After reviewing the results of the one year of monitoring, it may be found that one of these wells would serve as a better program background well.

R4 Well #1 located near the Air Cadet building near the airport shows significant nitrate impacts, the source of which is not known and is inconsistent with the data obtained from the other airport monitoring wells which demonstrate little impact. The source of this nitrate contamination should be investigated. Possible sources include the nearby vineyard, BC Tree Fruits facility, possible septic field for the Air Cadet building, or leaking wastewater or reclaimed irrigation water mains. Depending on the results of this investigation, additional monitoring wells in the area may be required to further investigate the source of the nitrate in groundwater.

R5 Several additional monitoring wells are required to adequately monitor the "new" areas receiving or slated to receive reclaimed irrigation water, and to monitor impacts from the current largest consumer of reclaimed water, the Fairview Mountain Golf Course. The following monitoring wells are recommended:

1. One monitoring well in the Gala Street Liner Park, sited to monitor the impacts of irrigation in the park and at the Secondary School.
2. One monitoring well in the southern end of Oliver Community park.
3. One monitoring well in the southern end of the Public Works Yard.
4. One monitoring well along the southern property boundary of the cemetery. The need for this well can be discussed further, as there may be public opposition to drilling in a cemetery. In addition, a monitoring well at this location may be influenced by the cemetery as well as the reclaimed water irrigation.

5. Two monitoring wells east of the Fairview Mountain Golf Course to replace MW6 and MW7.

Ideally these monitoring wells would be installed before the April 2021 sampling event, and after installation, would be monitored and sampled at the same frequency as the other monitoring wells.

R6 After the new wells have been monitored for one year, the data should be compiled, reviewed and interpreted by a hydrogeologist. Modifications to the monitoring plan can be made after that.

Table 8.1 Summary of Recommended Modifications to Groundwater Monitoring Program

Recommendation	Details
Increased level of Monitoring at MW4	Install a transducer, or increase the frequency of manual water level measurements to weekly. Increase the frequency of water quality sampling to monthly for one year.
Incorporate the existing three monitoring wells near the Alonso and Huggins Property into the monitoring program for one year.	Monitor/sample on the same schedule as the other wells in the program
Install one monitoring well in the Gala Street Liner Park, sited to monitor the impacts of irrigation in the park and at the Secondary School.	Monitor/sample on the same schedule as the other wells in the program
Install one monitoring well in the southern end of Oliver Community park.	Monitor/sample on the same schedule as the other wells in the program
Install one monitoring well in the southern end of the Public Works Yard.	Monitor/sample on the same schedule as the other wells in the program
Install one monitoring well along the southern property boundary of the cemetery. POSSIBLE	Monitor/sample on the same schedule as the other wells in the program
Install two monitoring wells east of the Fairview Mountain Golf Course to replace MW6 and MW7.	Monitor/sample on the same schedule as the other wells in the program

9.0 COST ESTIMATES

WWAL has prepared a high-level cost estimate to complete the above recommended tasks. Table 9.1 below summarized the estimates by task.

Table 9.1: Cost estimates to complete recommended tasks.

Contractor	Cost Estimate
Environmental Drilling Contractor – 6 monitoring wells	$25,000
WWAL – Core well installation program: Confirmation of well sites, utility locates. Field oversight of monitoring well drilling. Well development and initial sampling. Provide well logs and a map.	$10,000
WWAL – Expanded program. Purchase and install recommended transducer in Town MW4 near RIB. Investigate source of high nitrate in Air Cadet well (Well #1). Compile and review data collected during 2021 and make recommendation for refinement of monitoring program moving forward.	$10,000

Notes:

1) Costs in Table 9.1 do not include costs for monthly water level sampling and bi-annual sampling of the existing and proposed expanded monitoring well network. This routine monitoring is currently completed by Town public works staff. WWAL costs do include initial development and sampling (April 2021) of the recommended new monitoring wells (up to 6).
2) Costs to install six new monitoring wells based on a quote from Mud Bay Drilling (attached). We suggest adding a $5,000 contingency to this estimate to account for variability in well depths.

10.0 CLOSURE

We trust this letter provides the information you require. If you have any questions or would like to discuss these findings further, do not hesitate to contact the undersigned.

WESTERN WATER ASSOCIATES LTD.

Lisa Gardiner

Lisa Gardiner, P.Eng.
Environmental Engineer

PROFESSIONAL GEOSCIENTIST
PROVINCE OF BRITISH COLUMBIA
R. M. RHODES
#32839
28-Jan-2021

Ryan Rhodes P.Geo.
Hydrogeologist

Attachments:
Figures 1 and 2; Mud Bay Drilling Quote

11.0 REFERENCES

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2. The scope and the period of service provided by Western Water Associates Ltd are subject to restrictions and limitations outlined in subsequent numbered limitations.
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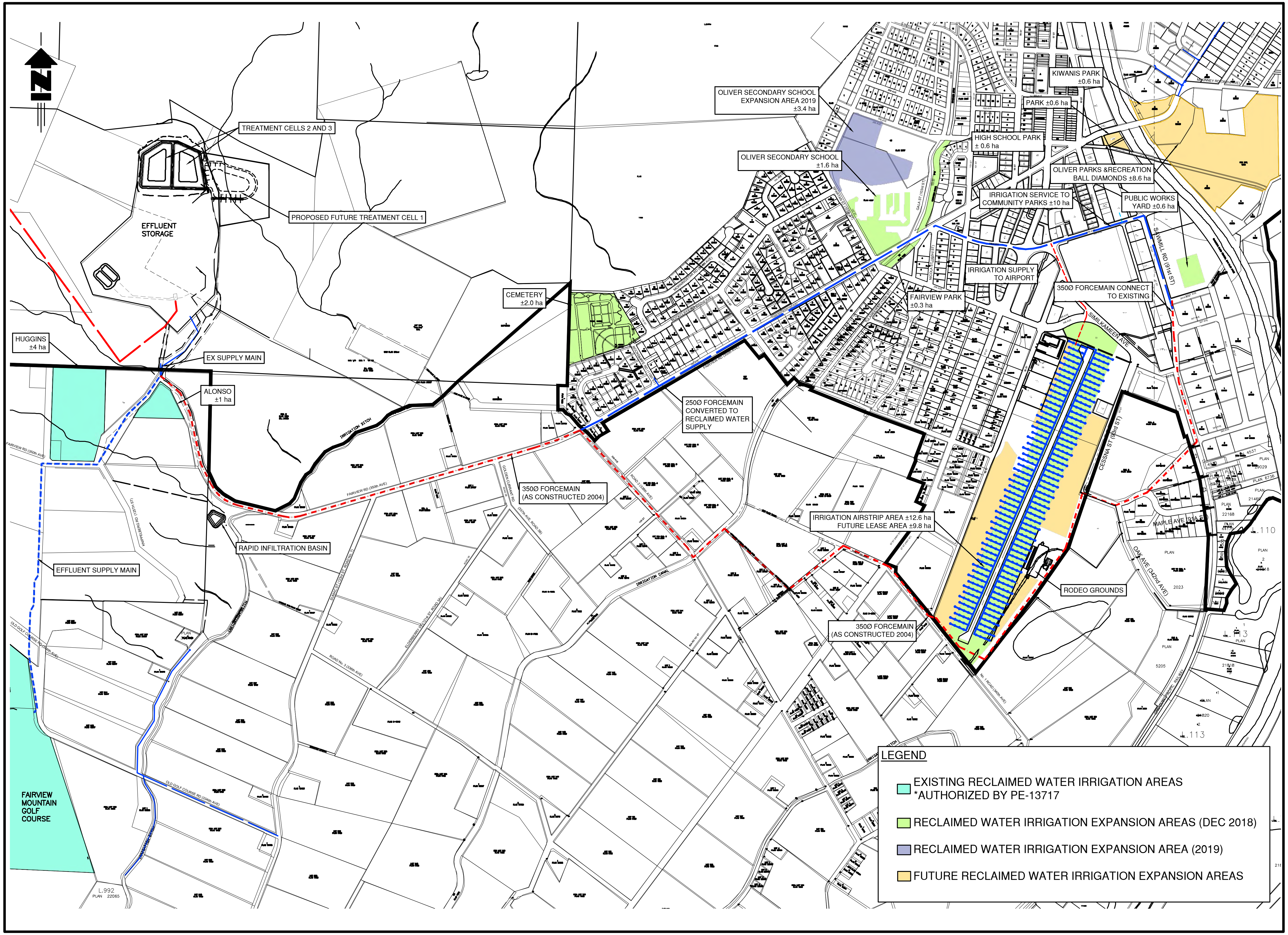


LEGEND

🟦 EXISTING RECLAIMED WATER IRRIGATION AREAS
*AUTHORIZED BY PE-13717

🟩 RECLAIMED WATER IRRIGATION EXPANSION AREAS (DEC 2018)

🟪 RECLAIMED WATER IRRIGATION EXPANSION AREA (2019)

🟨 FUTURE RECLAIMED WATER IRRIGATION EXPANSION AREAS

No.	DATE	DESCRIPTION	BY	APP'D

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING
201 - 2079 Falcon Road ▪ Kamloops BC ▪ V2C 4J2
tel 250.828.0881 ▪ fax 250.828.0717
info@TRUE.bc.ca

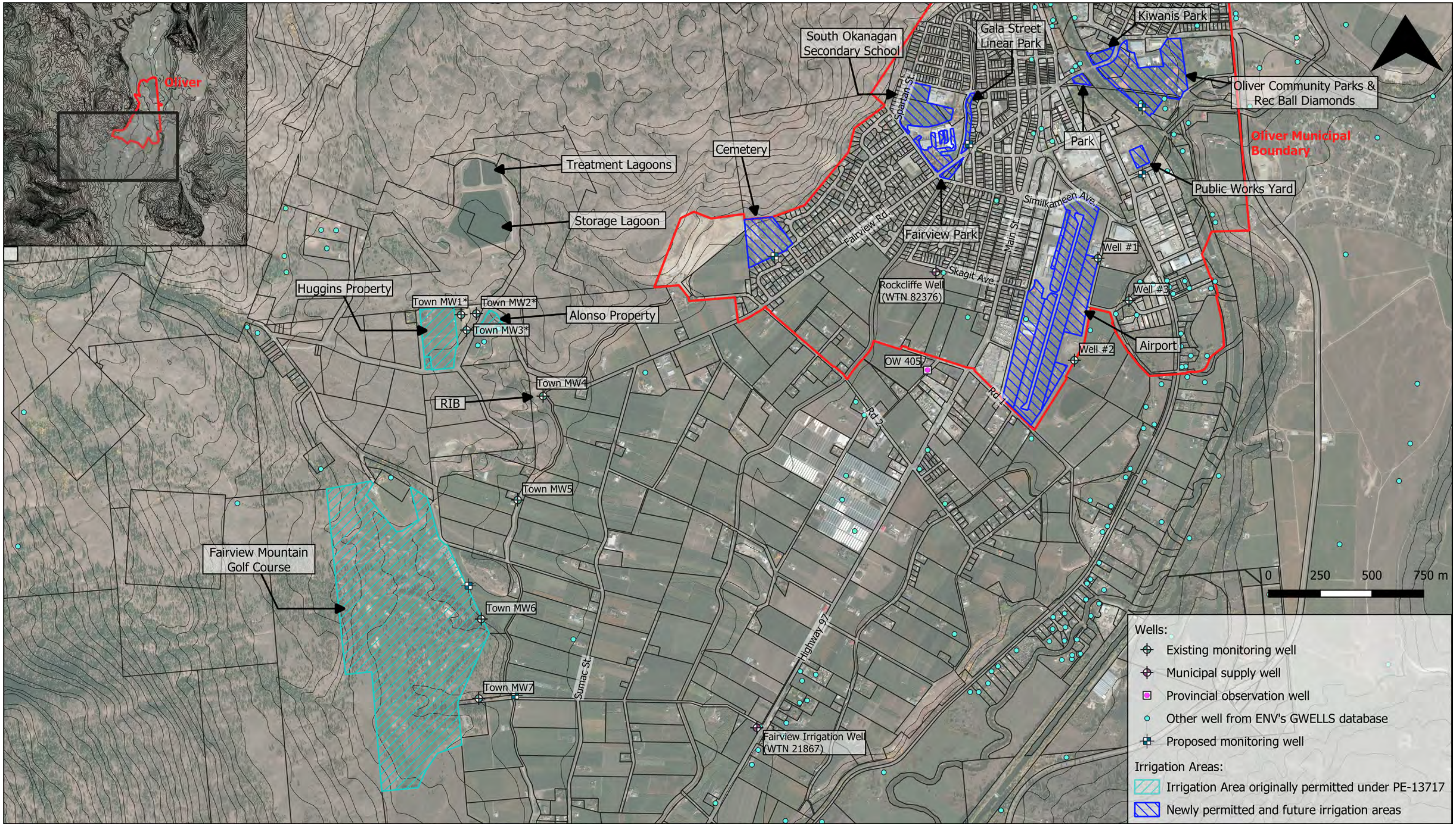
Town of Oliver
CANADA'S WINE CAPITAL

SANITARY SEWER ANNUAL REPORT

OVERALL PLAN RECLAIMED WATER SYPPLY SYSTEM AND IRRIGATION AREAS

SCALE N.T.S. (11x17)
DESIGN BY TRU
DRAWN BY NA
DATE JANUARY 2018
PROJECT REFERENCE No. 306-088-005
DRAWING No. **FIG 1-1**
SHEET 1 OF 1
ISSUE/REV.

FILE: r:\clients\300-399\306\306-088-007\03 drawings\cad\02 design drawings\306-088-007 report figures r1



Oliver Reclaimed Water Irrigation Review

western water ASSOCIATES LTD

TITLE **Figure 1** Monitoring Well Locations and Reclaimed Water Irrigation Areas

DRAWN Tim Sivak

DATE January 28, 2021

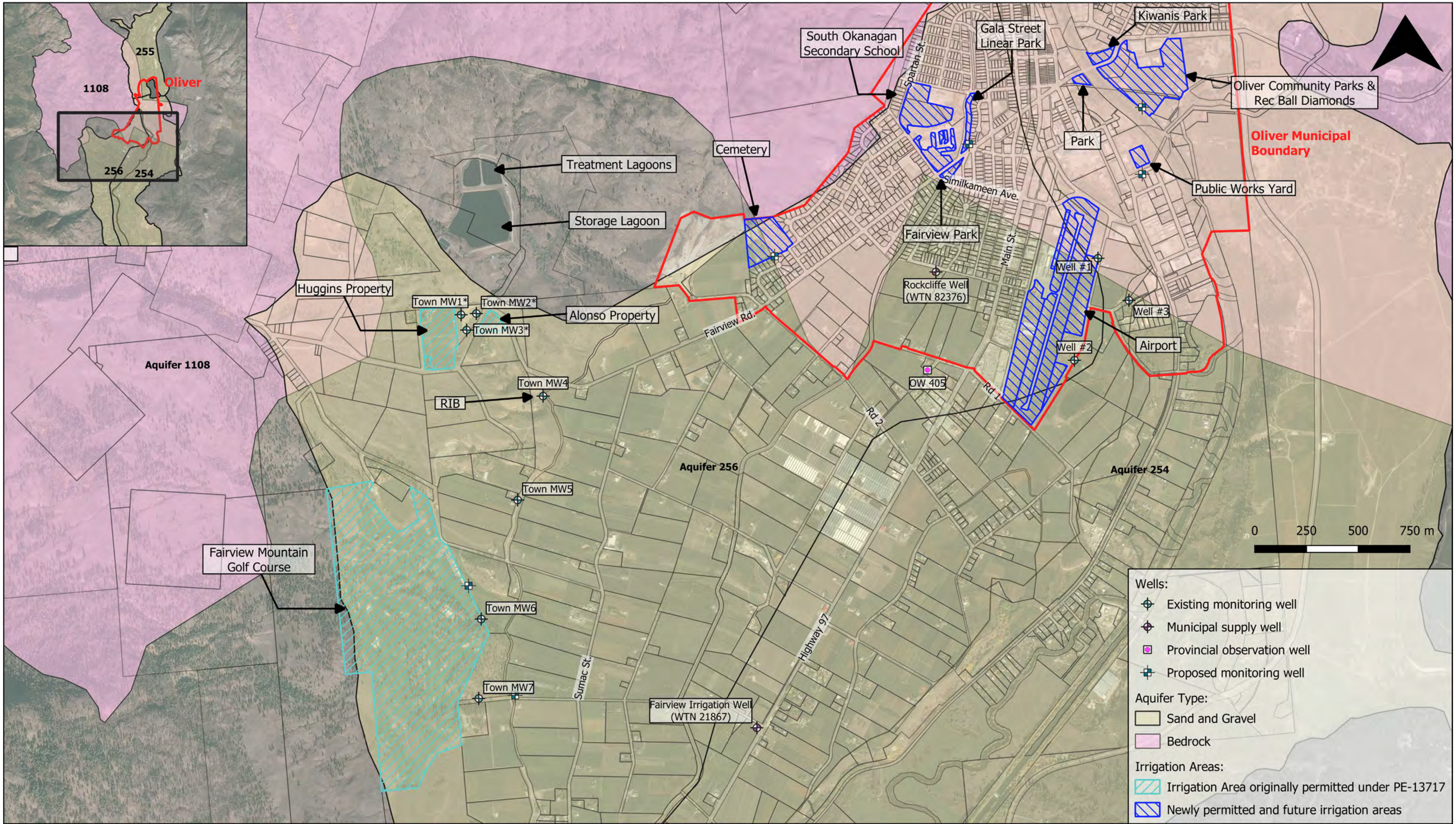
CLIENT TRUE Consulting Ltd.

REVIEWED

PROJECT NO. 20-046-01VR

REVISION NO. E

Data Sources: Base plan from publicly available data sources.
Contour interval: 20 m
Map Projection: NAD83 BC Albers (EPSG 3005)
Other notes: Current and future spray irrigation areas from TRUE Consulting Ltd.
*location is approximate



Oliver Reclaimed Water Irrigation Review

western water ASSOCIATES LTD

TITLE **Figure 2** Mapped Aquifers in the Oliver Area

DRAWN Tim Sivak	DATE January 29, 2021	CLIENT TRUE Consulting Ltd.
REVIEWED	PROJECT NO. 20-046-01VR	REVISION NO. B

Data Sources: Base plan from publicly available data sources.
Contour interval: -
Map Projection: NAD83 BC Albers (EPSG 3005)
Other notes: Current and future spray irrigation areas from TRUE Consulting Ltd.
*location is approximate.

9015B Jim Bailey Road
Kelowna, BC V4V 2W4

T: 250-765-2210
F: 604-888-4206

info@mudbaydrilling.com
mudbaydrilling.com

Contact: Ryan Rhodes
Company: Western Water Associates
Address: 106-5145 26th St
Vernon, BC, V1T 8G4
Phone: 250-541-1030
Email: ryan@westernwater.ca
Date: Wednesday, August 26, 2020
Site: Oliver

Estimate Number: 20-1207497
Revision Number: 20-1207497.2
Prepared By: BSEY
Proposed Rig: Sonic DB320

Scope

2 mw's to 80' and 4 mw's to 40'

Item	Description	Rate	Unit	Qty	Extended
Mobilization	Equipment and crew	$800.00	Lump sum	1	$800.00
Drilling, sampling, and Installations	All operations on site	$475.00	Hours	29	$13,775.00
Overtime	Over 8 hours on site	$75.00	Hours	5	$375.00
Crew travel	Crew only to / from site	$185.00	Hours	2	$370.00
Living allowance		$750.00	Shift	2	$1,500.00
Support unit		$350.00	Shift	3	$1,050.00
Bit and casing Wear		$45.00	Meter	54.88	$2,469.60
PVC screen	2" SCHD40	$21.00	Meter	18.3	$384.30
PVC blank	2" SCHD40	$14.00	Meter	27.43	$384.02
PVC fittings	J-Plug and sand point	$41.00	Set	6	$246.00
Silica sand		$16.00	Bags	36	$576.00
Bentonite chips		$21.00	Bags	44	$924.00
Concrete		$16.00	Bags	6	$96.00
45 gal. Drums with lids		$70.00	Each	10	$700.00
Well covers	Flush mount or stick-up	$145.00	Each	6	$870.00
Core boxes	10' per box	$60.00	Each		$0.00
				Total (CAD $):	**$ 24,519.92**

Notes and Assumptions

- Client is responsible for all locates and permits
- ConeTec and Mud Bay will not be responsible for damage to any underground utilities
- Client will provide suitable access for truck mounted equipment and transport truck and trailers
- Water must be available on site, or provisions made for prior to mobilization
- No allowances made for insitu testing or sampling
- No allowances made for disposal of cuttings or waste
- Client will be responsible for creating and submitting well closure reports
- Assumes secure site for overnight equipment parking
- Based on 10 hour work days + daily crew travel
- Weekend or night work premium will apply if required
- Traffic control and flaggers will be provided by the client if required

APPENDIX I

2021 Western Water Associates Well Installation Report

Town of Oliver Monitoring Well Installation

TECHNICAL MEMORANDUM

TO:	Shawn Goodsell (Town of Oliver), Natalie Alteen, P.Eng. (TRUE)	**DATE:**	26-Aug-2021
FR:	Morgan Jackson, B.Sc. and Ryan Rhodes, P.Geo, (WWAL)	**REFERENCE:**	20-046-02VR

RE: MONITORING WELL INTALLATION, DEVELOPMENT AND SAMPLING – TOWN OF OLIVER RECLAIMED WASTEWATER IRRIGATION SYSTEM ENVIRONMENTAL MONITORING PROGRAM, OLIVER, B.C.

INTRODUCTION

Western Water Associates Ltd. (WWAL) is pleased to provide this brief Technical Memorandum to the Town of Oliver (the Town) and TRUE Consulting Ltd. documenting the installation of new and replacement monitoring wells for the Town's reclaimed wastewater environmental monitoring program.

In 2020, WWAL completed a review of the Town's environmental monitoring program (WWAL 2021), which is a requirement of the Town's reclaimed wastewater system Operational Certificate PE-13717. Over time, the Town of Oliver has expanded the areas receiving reclaimed wastewater for irrigation, but the monitoring network had not been updated in concert so new monitoring wells to increase coverage of irrigated areas was recommended. In addition, two wells in the existing network were reportedly dry for the past decade, and we recommended those be replaced.

In total, four wells were completed in 2021. Drilling was completed in early May 2021. After drilling and installation, monitoring wells were developed, purged and sampled by WWAL for wastewater indicator parameters. In addition, WWAL was able to rehabilitate one of the original monitoring wells (Town MW6) to make it suitable for continued sampling.

MONITORING WELL DRILLING PROGRAM

WWAL installed four monitoring wells between May 4 and 7, 2021. Three of the monitoring wells were installed to provide coverage to newer areas receiving reclaimed water for irrigation that were not being monitored:

- MW8 – south side of the Town Public Works Yard
- MW9 - south end of the Oliver Cemetery
- MW10 – Gala Street linear park, east of the South Okanagan Secondary School.

The fourth monitoring well (MW-11) is located near the west end of 332nd Avenue, and was installed as a replacement for pre-existing monitoring well Town MW7, which has been dry since at least 2006.

All four monitoring wells were drilled by Mud Bay Drilling of Surrey, B.C. with a rubber tracked Sonic DB320 drill rig. The wells were completed to depths of between 6.6 m to 29.7 m (22 ft to 97.5 ft) below ground surface (bgs) into unconsolidated sediments. The wells are 50 mm (2 inches) in diameter and are equipped with a J-Plug cap and a 10 slot screen of 1.5 m or 3 m (5 ft or 10 ft) in length. A 10-20 filter sand pack was installed in the annulus surrounding the well screens and a bentonite seal was installed as appropriate within the annular space, above the screened interval, and at surface. Three wells are completed flush with ground surface and one well (MW-11) was completed with an above ground steel protector. The well covers or monuments for all four wells were cemented in place. All four monitoring wells comply with the requirements of the *B.C. Groundwater Protection Regulation*. Well logs are provided as an attachment and Table 1 summarizes select well details. Figure 1 depicts the location of all new and existing monitoring wells included in the groundwater monitoring program.

Table 1 – Summary of Select Monitoring Well Details

Well Identification	Completion Date	Well Completion Depth (mbtoc)	Well Surface Completion	Screened Interval (mbgs)	Aquifer Lithology	Water Level May 19, 2021 (mbtoc)
MW-8	May 4, 2021	6.52	Flush Mount	5.2 – 6.7	Sand & Gravel	2.35
MW-9	May 5, 2021	21.1	Flush Mount	18.2 – 21.2	Sand & Gravel some fines at depth	dry
MW-10	May 6, 2021	27.1	Flush Mount	25.7 – 27.2	Sand & Gravel some fines at depth	24.54
MW-11	May 7, 2021	30.6	Above Ground Monument	27.1 – 29.7	Sand and Silt	24.32

Note: mbtoc- meters below top of casing; mbgs- meters below ground surface.

Well lithology was logged by WWAL field staff during drilling. Lithology observed in monitoring wells was relatively similar, consisting of sand, gravel or sand and gravel. At wells MW-9, MW-10 and MW-11 some finer sediments (silt and/or clay seams) were observed at depths ranging from 15 m to 26 m (48 ft to 88 ft). Lithology in the new monitoring wells is similar to reported lithology in existing monitoring wells included the program. Detailed well logs with lithology are included as an attachment.

MONITORING WELL DEVELOPMENT AND SAMPLING METHODS

The monitoring wells were developed by surging with a Waterra surge block, tubing and foot valve until approximately ten times the well volume was removed and water removed was relatively clear. The monitoring wells were disinfected with chlorine bleach approximately 4 to 7 hours prior to sample collection. The bleach was agitated using a bailer dedicated to that well and water was purged into a bucket away from the well head. Groundwater quality samples were collected within 3 to 5 hours of well development when the water ran relatively clear and no longer smelled of chlorine. WWAL field staff noted slight turbidity in water samples collected at the wells, which is common in newly installed wells and is expected to dimmish over time with additional sampling. The samples were labelled and stored in an ice-filled cooler, then transported to CARO Analytical, in Kelowna B.C. for chemical analyses within 24-hours of sample collection.

Monitoring well MW-9 has remained dry since installation and could not be developed or sampled at this time.

During an initial site visit in March 2021, WWAL staff found approximately 1 m of water in pre-existing monitoring well Town MW-6, which had previously been considered dry. Further, the well depth was measured to be approximately 4 m (13 ft) shallower than reported on the well log; we interpreted this to mean that fine sediments had accumulated in the bottom of the well over time. WWAL field staff attempted to bail out and re-develop MW-6 on two occasions using a small pump and waterra tubing/foot valve. This resulted in the removal of 0.4 m of sediment from the well.

WATER QUALITY SAMPLING RESULTS

Table 2 below summarizes the water quality results from monitoring wells MW-8, MW-10, and MW-11 collected on May 19, 2021. Water quality samples were also collected from pre-existing monitoring well Town MW-6 on May 19, 2021 as this well had recently been re-developed and had not been sampled since it was reported dry in 2003. A copy of the laboratory water quality results are attached to this report.

Reclaimed wastewater associated parameters chloride, nitrate, and sodium are slightly at all sampled locations, however, all below applicable Canadian Drinking Water Quality Guidelines (GCDWQ). Nitrate is elevated at MW-10 and MW-11 and to a lesser extent at MW-6 at 4.63 mg/L, 3.13 mg/L and 1.99 mg/L, respectively. Total coliform bacteria was not detected at any of the newly installed monitoring well but was detected a 5 MPN/100 mL at MW-6. *E.coli* bacteria were not detected at any of the sampled locations.

A duplicate sample was collected at monitoring well MW-11 during the sampling event on May 19, 2021 for QA/QC purposes. The Relative Percent Difference (RPD) of each of the sampled parameters with results above detection limits was calculated. Most parameters indicated RPD values lower than 10%, with the majority of the parameters falling below 5%. The RPD for total dissolved phosphorus was 28% and total kjeldahl nitrogen (TKN) was above 50%. WWAL asked the laboratory to re-analyze the samples for dissolved phosphorus and TKN to establish if there was laboratory error introduced during the previous analysis. The RPD for the re-run samples were 21.6 % (dissolved phosphorus) and 49.1 % (TKN). Caro Laboratory staff indicated that one of the samples was slightly more turbid, which likely caused the discrepancy between sample concentration values. Overall, we deem the sampling methodology used and results obtained to be acceptable. In the future, best efforts should be made to collect samples with as low turbidity as possible.

Table 2 – Summary of Water Quality Results

Field Parameter	Units	GCDWQ	MW-6 (pre-existing well)	MW-8	MW-10	MW-11
pH	pH units	7.0 - 10.5	7.8	7.83	8.11	7.0
Electrical Conductivity	µS/cm	None	980	849	788	1031
Temperature	°C	AO≤ 15°C	13.1	11.9	12.4	14.0
Oxidation Reduction Potential	RmV	None	710	74	151	719
Laboratory Parameter						
Chloride	mg/L	AO≤250	91.6	83.3	90.9	157
Total Dissolved Phosphorus	mg/L	None	0.0557	0.117	0.0239	0.0264
Total Phosphorus (as P)	mg/L	None	0.251	0.185	0.0497	0.088
Ammonia	mg/L	None	0.067	<0.050	<0.050	<0.050
Nitrate as N	mg/L	MAC=10	1.99	0.945	4.63	3.13
Nitrite as N	mg/L	MAC=1	<0.010	<0.010	<0.010	<0.010
Nitrate as N + Nitrite as N	mg/L	None	1.99	0.945	4.63	3.14
Total Nitrogen	mg/L	None	2.62	1.24	4.91	3.38
Total Kjeldahl Nitrogen	mg/L	None	0.625	0.292	0.282	0.241
Conductivity	µS/cm	None	1060	905	978	1220
pH	pH units	7.0 - 10.5	7.02	6.94	7.31	7.04
Hardness	mg/L	None	345	312	343	470
Calcium (total)	mg/L	None	80.7	89.4	82.5	111
Magnesium (total)	mg/L	None	34.7	21.4	33.2	46.7
Sodium (total)	mg/L	AO≤200	109	83.2	36.7	78.7
Total Coliform	MPN /100 mL	MAC = None Detected	**5**	<1	<1	<1
E. coli	MPN/100 mL	MAC = None Detected	<1	<1	<1	<1

Note: bolded orange values indicated exceedance of health based MAC guidelines;

CONCLUSIONS AND RECOMMENDATIONS

WWAL oversaw the installation of four monitoring wells for inclusion in the Oliver reclaimed wastewater irrigation system groundwater monitoring program. After installation, WWAL developed the wells to make them suitable for ongoing sampling, and collected initial water quality samples from three of the monitoring wells (MW-8, MW-10, MW11) and one pre-existing monitoring well MW-6 (not sampled since at least 2003). Monitoring well MW-9 has been dry since installation and could not be developed and sampled at this time.

We recommend the following:

R1 Incorporate the four new monitoring wells into the environmental monitoring program. Continue to complete monthly water level measurements of all wells and biannual sampling.

R2 Rehabilitated monitoring well Town MW-6 has a fairly limited water column and was observed to recharge slowly after being purged. Much of the screened interval of the well is filled with sediment, making this well more prone to producing turbid water during sampling. While most of the program monitoring wells are purged and sampled with waterra tubing and foot valves, we recommend Town MW-6 be purged and sampled with a bailer. This well should be first purged and then sampled on the following day. Care should be taken to lower and remove the bailer slowly when sampling to obtain the clearest samples possible.

Further, MW-6 should be disinfected with bleach approximately 24 hours prior to purging and collecting water samples during the next sampling event to eliminate total coliform bacteria found to be present after the recent sampling.

R. M. RHODES
#32839
26-Aug-2021

Morgan Jackson, B.Sc.
Environmental Scientist

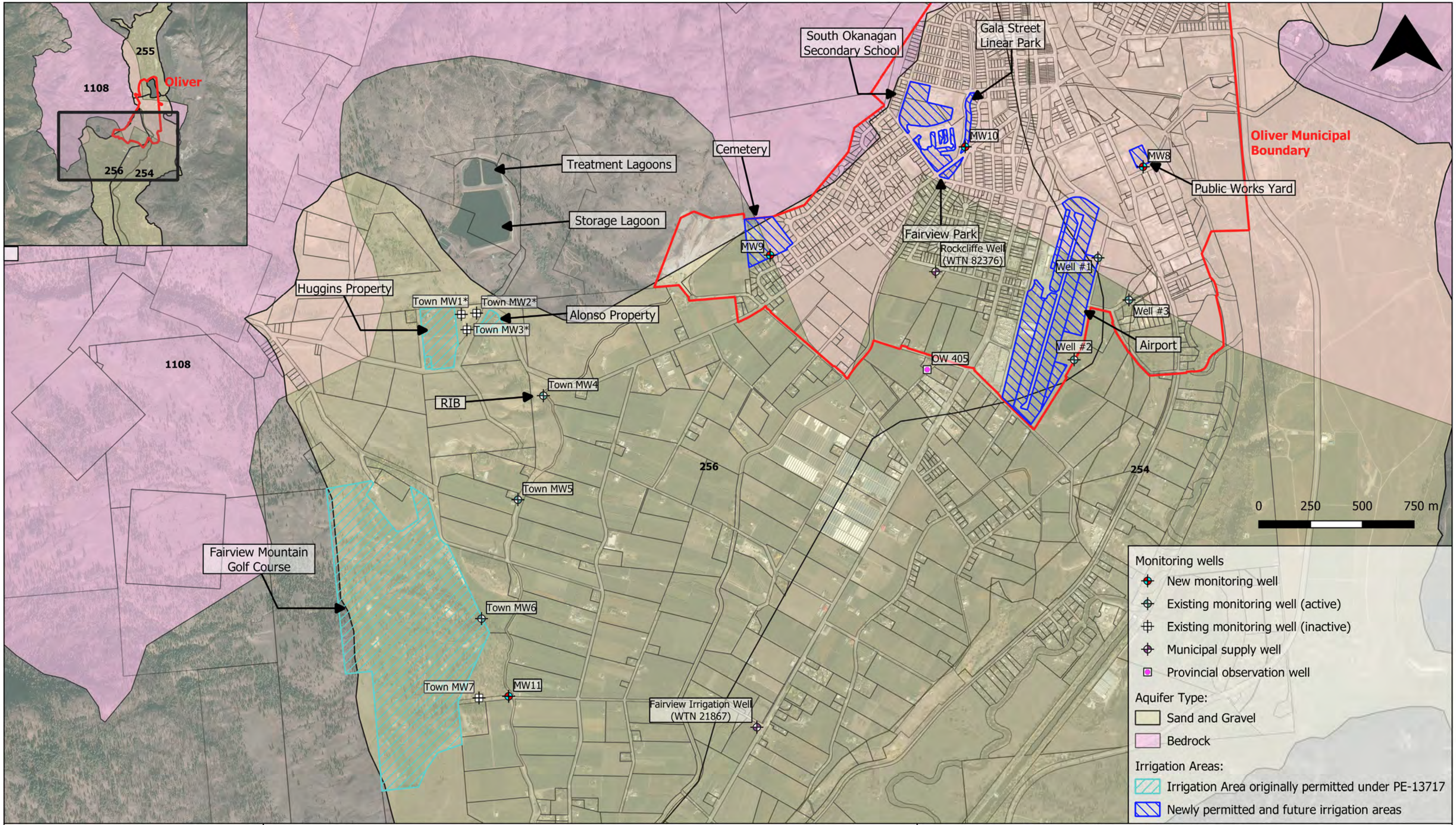
Ryan Rhodes, P.Geo.
Hydrogeologist

Attachments:

Figure 1 – Location of Oliver Reclaimed Water Environmental Monitoring Wells
Well Logs
Laboratory Analytical Reports

REFERENCES

Western Water Associates Ltd. 2021. Hydrogeological Review of the Town of Oliver Reclaimed Wastewater Irrigation Groundwater Monitoring Program. Report prepared for the Town of Oliver and TRUE Consulting Ltd., January 28, 2021.



Oliver Reclaimed Water Irrigation Review	TITLE **Figure 1** Town of Oliver Reclaimed Wastewater Irrigation Monitoring Wells		
western water ASSOCIATES LTD	DRAWN Tim Sivak	DATE August 25, 2021	CLIENT TRUE Consulting Ltd.
	REVIEWED	PROJECT NO. 20-046-02VR	REVISION NO. A

Data Sources: Base plan from publicly available data sources.
Contour interval: -
Map Projection: NAD83 BC Albers (EPSG 3005)
Other notes: Current and future spray irrigation areas from TRUE Consulting Ltd.
*location is approximate.

western water
ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

MONITORING WELL LOG MW-8

SHEET 1 of 1

MONITORING WELL ID: MW-8

DATE DRILLED: May 4, 2021

PROJECT: Town of Oliver Monitoring Well Installation

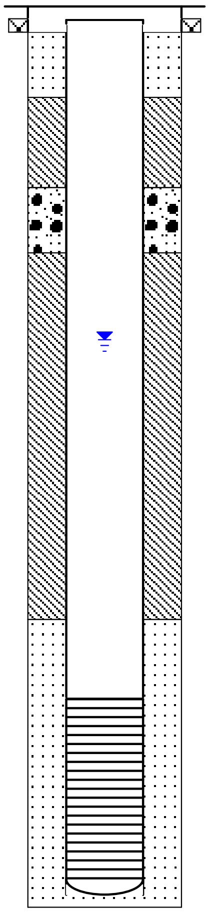
SITE LOCATION: Public Works Yard

CLIENT: Town of Oliver

PROJECT NUMBER: 20-046-02VR

DEPTH (m)	LITHOLOGY DESCRIPTION
	Ground Surface
0	SAND and GRAVEL, with some cobbles, coarse grained sand, small to large sub-rounded gravel, loose, poorly sorted, dry, brown.
1	
	SAND with some silt, minor clay, fine grained sand, loose, poorly sorted, dry, brown to grey. Organics (wood flecks) and mottling 2.3 m to 3 m.
2	
3	
	SAND and SILT, fine grained sand, loose, poorly sorted, moist to wet at 5.2 m, dark grey
4	
5	
	SAND and GRAVEL coarse and medium grained sand, small to large rounded gravel, loose, wet, brown.
6	
	SANDY SILT, with clay seams, loose, wet, dark grey. Clay seams at approximately 6.7 m and 8.2 m, hard, dry, 1 -2.5 inches in thickness.
7	
8	
9	

WELL CONSTUCTION



WELL COMPLETION DETAILS

Flushmount box, cemented in place

0.1 m - 5.2 m below ground surface (bgs) Blank 2 inch diameter PVC with J-plug cap

0.2 m - 0.3 m bgs 10-20 Filter sand

0.3 m - 1.2 m Surface seal, Enviroplug medium bentonite chips

1.2 m - 1.8 m bgs Sand and Crush

Water level 2.45 m (8.0 ft) below top of casing (btoc)

1.8 m - 4.6 m bgs Bentonite chips

4.6 m - 5.2 m bgs 10- 20 Filter sand

5.2 m - 6.7 m bgs 2 inch diameter 10 slot PVC screen 1.5 m (5 ft) length with bottom plug

Total Well Depth 6.52 m (21.4 ft) btoc

COORDINATES: 11U 314598.0 m E 5450466.0 m N

ELEVATION: 298 m asl **(gps)**

STATIC WATER LEVEL: 2.45 m btoc

DRILLING CONTRACTOR: Mud Bay Drilling Ltd.

TOTAL DEPTH: 6.52 m btoc

DRILLING METHOD: Sonic rubber track rig

Drawn By: MJ

Reviewed By: RR

Logged By: MJ

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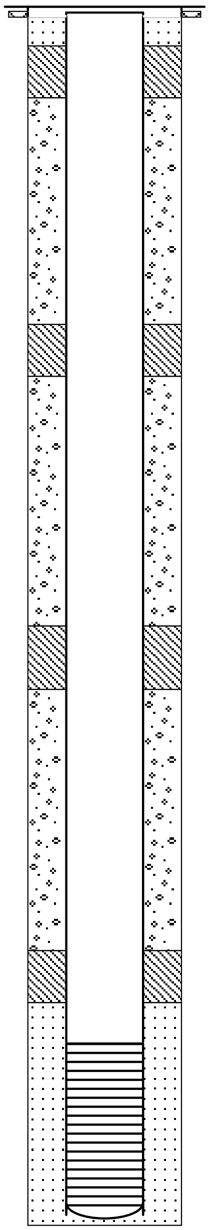
Consultants in Hydrogeology and Water Resources Management

MONITORING WELL LOG MW-9

SHEET 1 of 1

MONITORING WELL ID: MW-9
PROJECT: Town of Oliver Monitoring Well Installation
CLIENT: Town of Oliver

DATE DRILLED: May 5, 2021
SITE LOCATION: Cemetary
PROJECT NUMBER: 20-046-02VR

DEPTH (m)	LITHOLOGY DESCRIPTION	WELL CONSTUCTION	WELL COMPLETION DETAILS
	Ground Surface		**Flushmount box, cemented in place**
0	SAND and GRAVEL, medium and coarse grained sand, small to large rounded to sub-rounded gravel, loose, poorly sorted, dry, brown.		**0.1 m - 18.1 m below ground surface (bgs) Blank 2 inch diameter PVC with J-plug cap** **0.2 m - 0.6 m bgs 10-20 Filter sand** **0.6 m - 1.5 m bgs Surface seal, Enviroplug medium bentonite chips**
1			
2			
3			
4			
5			
6			
7			
8			
9	GRAVEL with some SAND, fine grained sand, small to large rounded to sub-rounded gravel, loose, poorly sorted, dry, brown.		**1.5 m - 17.4 m bgs Alternating layers of 1 m bentonite seal with 4.5 m of natural sluff**
10			
11			
12	SAND with GRAVEL coarse and medium grained sand, small to large rounded to sub-rounded gravel, loose, wet, brown. Mottling at 13.7 m (45 ft), approximately 1 cm thick.		
13			
14			
15			
16			
17			
18			**17.4 m - 21.2 m bgs 10-20 Filter sand**
19			**18.1 m -21.2 m bgs 2 inch diameter 10 slot PVC screen 3 m (10 ft) length with bottom plug**
20	SAND, with some silty clay chunks, fine and medium grained sand, loose, wet, brown.		
21			**Total Well Depth 21.1 m (69.2 ft) below top of casing (btoc)**
22			

COORDINATES: 11U 3142761.6 m E 5450263.7 m N

ELEVATION: 336 m asl **(gps)**

STATIC WATER LEVEL: Dry

DRILLING CONTRACTOR: Mud Bay Drilling Ltd.

TOTAL DEPTH: 21.1 m btoc

DRILLING METHOD: Sonic rubber track rig

Drawn By: MJ	Reviewed By: RR	Logged By: MJ

western water ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

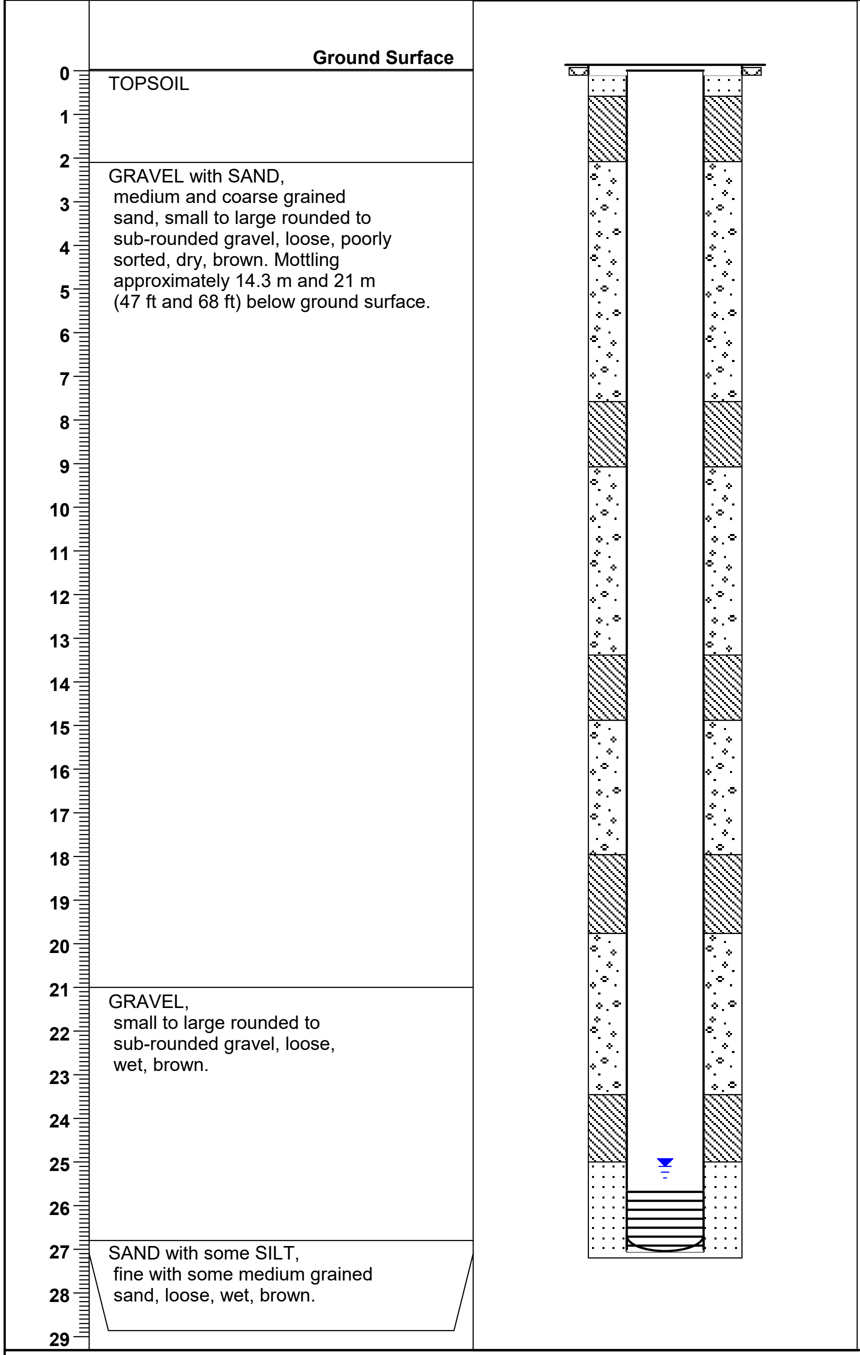
MONITORING WELL LOG MW-10

SHEET 1 of 1

MONITORING WELL ID: MW-10
PROJECT: Town of Oliver Monitoring Well Installation
CLIENT: Town of Oliver

DATE DRILLED: May 6, 2021
SITE LOCATION: Gala St. Linear Park
PROJECT NUMBER: 20-046-02VR

DEPTH (m)	**LITHOLOGY DESCRIPTION**	**WELL CONSTUCTION**	**WELL COMPLETION DETAILS**



TOPSOIL

GRAVEL with SAND, medium and coarse grained sand, small to large rounded to sub-rounded gravel, loose, poorly sorted, dry, brown. Mottling approximately 14.3 m and 21 m (47 ft and 68 ft) below ground surface.

GRAVEL, small to large rounded to sub-rounded gravel, loose, wet, brown.

SAND with some SILT, fine with some medium grained sand, loose, wet, brown.

Flushmount box, cemented in place

0.1 m - 25.7 m bgs Blank 2 inch diameter PVC with J-plug cap

0.2 m - 0.6 m bgs 10-20 Filter sand

0.6 m - 2.1 m bgs Suface seal, Enviroplug medium bentonite chips

2.1 m - 25 m bgs Alternating layers of appoximately 1 m bentonite seal with 4.5 m of natural sluff

Water level 25.1 m (82.3 ft) below top of casing (btoc) (May 6, 2021)

25 m - 27.2 m bgs 10-20 Filter sand

25.7 m - 27.2 m bgs 2 inch diameter 10 slot PVC screen 1.5 m (5 ft) length with bottom plug

Total Well Depth 27.1 m btoc

COORDINATES: 11U 313762.5 m E 5450678.4 m N

ELEVATION: 326 m asl **(gps)**

STATIC WATER LEVEL: 25.1 m btoc

DRILLING CONTRACTOR: Mud Bay Drilling Ltd.

TOTAL DEPTH: 27.1 m btoc

DRILLING METHOD: Sonic rubber track rig

Drawn By: MJ	Reviewed By: RR	Logged By: MJ

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Consultants in Hydrogeology and Water Resources Management

MONITORING WELL LOG MW-11

SHEET 1 of 1

MONITORING WELL ID: MW-11
PROJECT: Town of Oliver Monitoring Well Installation
CLIENT: Town of Oliver

DATE DRILLED: May 6-7, 2021
SITE LOCATION: West end 332 Ave
PROJECT NUMBER: 20-046-02VR

DEPTH (m)	LITHOLOGY DESCRIPTION	WELL CONSTUCTION	WELL COMPLETION DETAILS

Ground Surface

SAND with GRAVEL, fine and medium grained sand, small to large rounded to sub-rounded gravel, loose, poorly sorted, dry, brown.

SAND, with Silt lenses, fine and medium grained sand, loose, poorly sorted, dry, grey.

SAND with GRAVEL, fine and medium grained sand, small to large rounded to sub-rounded gravel, loose, poorly sorted, dry, brown.

SAND, fine grained, loose, well sorted, dry, brown.

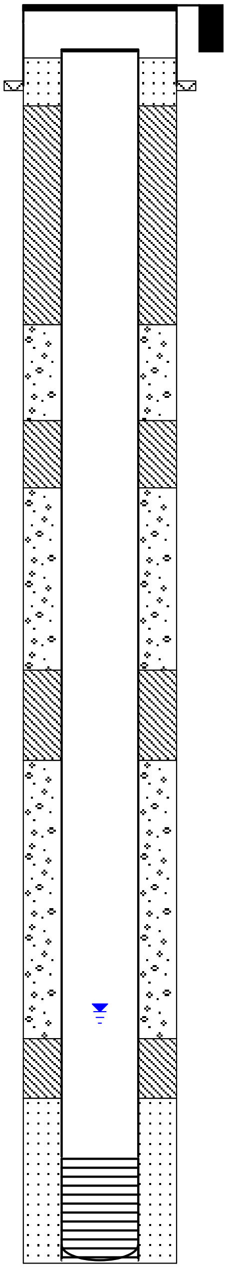
SAND with GRAVEL, fine and medium grained sand, small to large rounded to sub-rounded gravel, loose, poorly sorted, dry, brown.

SAND, with compact Silt and Clay lenses, fine and medium grained sand, loose, poorly sorted, dry, grey.

SAND with GRAVEL, fine and medium grained sand, small to large rounded to sub-rounded gravel, loose, poorly sorted, dry, brown.

SAND, with compact Silt and Clay lenses, fine and medium grained sand, loose, poorly sorted, dry, grey.

SAND and SILT, fine grained sand, loose, poorly sorted, moist, brown. Increased moisture at 19.2 m, 20.7 m and21 m (63 ft, 68 ft and 69 ft) bgs. Mottling throughout.



Well stick-up 0.86 m above ground surface (ags)

0.86 m ags - 27.1 m below ground surface (bgs) Blank 2 inch diameter PVC with J-plug cap. Above ground lockabel monument casing, cemented in place

0.7 m ags - 0.6 m bgs 10-20 Filter sand

0.6 m - 6.1 m bgs Surface seal, Enviroplug medium bentonite chips

6.1 m - 25.6 m bgs Alternating layers of approximately 1 m bentonite seal with 4.5 m of natural sluff

Water level 25.1 m (82.3 ft) below top of casing (btoc) (May 6, 2021)

25.6 m - 29.7 m bgs 10-20 Filter Sand

27.1 m - 29.7 m bgs 2 inch diameter 10 slot PVC screen 3 m (10 ft) length with bottom plug

Total Well Depth 30.6 m btoc

COORDINATES: 11U 311235.0 m E 5448302.0 m N

ELEVATION: 356 m asl **(gps)**

STATIC WATER LEVEL: 24.3 m btoc

DRILLING CONTRACTOR: Mud Bay Drilling Ltd.

TOTAL DEPTH: 30.6 m btoc

DRILLING METHOD: Sonic rubber track rig

Drawn By: MJ

Reviewed By: RR

Logged By: MJ

CERTIFICATE OF ANALYSIS

REPORTED TO Western Water Associates Ltd
106 - 5145 26th Street
Vernon, BC V1T 8G4

ATTENTION Morgan Jackson

PO NUMBER
PROJECT 20-046-02VR
PROJECT INFO

WORK ORDER 21E2339

RECEIVED / TEMP 2021-05-20 09:52 / 11.0°C
REPORTED 2021-06-23 08:49
COC NUMBER B099390

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

Note: Sample ID "duplicate" is a duplicate for MW11. Samples with Laboratory ID's ending in "RE1" were rerun at the request of WWAL to evaluate QA/QC.

If you have any questions or concerns, please contact me at *bwhitehead@caro.ca*

Authorized By:

Brent Whitehead
Client Scientist - Team Lead

TEST RESULTS

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
MW-8 (21E2339-01) | Matrix: Water | Sampled: 2021-05-19 07:30						
Anions						
Chloride	**83.3**	AO ≤ 250	0.10	mg/L	2021-05-21	
Nitrate (as N)	**0.945**	MAC = 10	0.010	mg/L	2021-05-21	
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-05-21	
Calculated Parameters						
Hardness, Total (as CaCO3)	**312**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	**0.945**	10	0.0100	mg/L	N/A	
Nitrogen, Total	**1.24**	N/A	0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2021-05-25	
Conductivity (EC)	**905**	N/A	2.0	µS/cm	2021-05-26	
Nitrogen, Total Kjeldahl	**0.292**	N/A	0.050	mg/L	2021-05-28	
pH	**6.94**	7.0-10.5	0.10	pH units	2021-05-26	HT2
Phosphorus, Total (as P)	**0.185**	N/A	0.0050	mg/L	2021-05-27	
Phosphorus, Total Dissolved	**0.117**	N/A	0.0050	mg/L	2021-05-27	
Microbiological Parameters						
Coliforms, Total	< 1	MAC = 0	1	MPN/100 mL	2021-05-20	HT1
E. coli	< 1	MAC = 0	1	MPN/100 mL	2021-05-20	HT1
Total Metals						
Calcium, total	**89.4**	None Required	0.20	mg/L	2021-05-27	
Magnesium, total	**21.4**	None Required	0.010	mg/L	2021-05-27	
Sodium, total	**83.2**	AO ≤ 200	0.10	mg/L	2021-05-27	
MW-10 (21E2339-02) | Matrix: Water | Sampled: 2021-05-19 08:00						
Anions						
Chloride	**90.9**	AO ≤ 250	0.10	mg/L	2021-05-21	
Nitrate (as N)	**4.63**	MAC = 10	0.010	mg/L	2021-05-21	
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-05-21	
Calculated Parameters						
Hardness, Total (as CaCO3)	**343**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	**4.63**	10	0.0100	mg/L	N/A	
Nitrogen, Total	**4.91**	N/A	0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2021-05-25	
Conductivity (EC)	**978**	N/A	2.0	µS/cm	2021-05-26	
Nitrogen, Total Kjeldahl	**0.282**	N/A	0.050	mg/L	2021-05-28	
pH	**7.31**	7.0-10.5	0.10	pH units	2021-05-26	HT2
Phosphorus, Total (as P)	**0.0497**	N/A	0.0050	mg/L	2021-05-27	
Phosphorus, Total Dissolved	**0.0239**	N/A	0.0050	mg/L	2021-05-27	

TEST RESULTS

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Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
MW-10 (21E2339-02) | Matrix: Water | Sampled: 2021-05-19 08:00, Continued						
Microbiological Parameters						
Coliforms, Total	< 1	MAC = 0	1	MPN/100 mL	2021-05-20	HT1
E. coli	< 1	MAC = 0	1	MPN/100 mL	2021-05-20	HT1
Total Metals						
Calcium, total	**82.5**	None Required	0.20	mg/L	2021-05-27	
Magnesium, total	**33.2**	None Required	0.010	mg/L	2021-05-27	
Sodium, total	**36.7**	AO ≤ 200	0.10	mg/L	2021-05-27	
MW-11 (21E2339-03) | Matrix: Water | Sampled: 2021-05-19 08:50						
Anions						
Chloride	**157**	AO ≤ 250	0.10	mg/L	2021-05-21	
Nitrate (as N)	**3.13**	MAC = 10	0.010	mg/L	2021-05-21	
Nitrite (as N)	**0.010**	MAC = 1	0.010	mg/L	2021-05-21	
Calculated Parameters						
Hardness, Total (as CaCO3)	**470**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	**3.14**	10	0.0100	mg/L	N/A	
Nitrogen, Total	**3.38**	N/A	0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2021-05-25	
Conductivity (EC)	**1220**	N/A	2.0	µS/cm	2021-05-26	
Nitrogen, Total Kjeldahl	**0.241**	N/A	0.050	mg/L	2021-05-28	
pH	**7.04**	7.0-10.5	0.10	pH units	2021-05-26	HT2
Phosphorus, Total (as P)	**0.0880**	N/A	0.0050	mg/L	2021-05-27	
Phosphorus, Total Dissolved	**0.0264**	N/A	0.0050	mg/L	2021-05-27	
Microbiological Parameters						
Coliforms, Total	< 1	MAC = 0	1	MPN/100 mL	2021-05-20	HT1
E. coli	< 1	MAC = 0	1	MPN/100 mL	2021-05-20	HT1
Total Metals						
Calcium, total	**111**	None Required	0.20	mg/L	2021-05-27	
Magnesium, total	**46.7**	None Required	0.010	mg/L	2021-05-27	
Sodium, total	**78.7**	AO ≤ 200	0.10	mg/L	2021-05-27	
MW-11 (21E2339-03RE1) | Matrix: Water | Sampled: 2021-05-19 08:50						
General Parameters						
Nitrogen, Total Kjeldahl	**0.267**	N/A	0.050	mg/L	2021-06-21	HT1
Phosphorus, Total Dissolved	**0.0273**	N/A	0.0050	mg/L	2021-06-18	HT1

Duplicate (21E2339-04) | Matrix: Water | Sampled: 2021-05-19

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Anions						
Chloride	**150**	AO ≤ 250	0.10	mg/L	2021-05-21	
Nitrate (as N)	**3.04**	MAC = 10	0.010	mg/L	2021-05-21	
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-05-21	
Calculated Parameters						
Hardness, Total (as CaCO3)	**493**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	**3.04**	10	0.0100	mg/L	N/A	
Nitrogen, Total	**3.50**	N/A	0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2021-05-25	
Conductivity (EC)	**1200**	N/A	2.0	µS/cm	2021-05-26	
Nitrogen, Total Kjeldahl	**0.454**	N/A	0.050	mg/L	2021-05-28	
pH	**7.10**	7.0-10.5	0.10	pH units	2021-05-26	HT2
Phosphorus, Total (as P)	**0.0861**	N/A	0.0050	mg/L	2021-05-27	
Phosphorus, Total Dissolved	**0.0338**	N/A	0.0050	mg/L	2021-05-27	
Total Metals						
Calcium, total	**114**	None Required	0.20	mg/L	2021-05-27	
Magnesium, total	**50.3**	None Required	0.010	mg/L	2021-05-27	
Sodium, total	**83.8**	AO ≤ 200	0.10	mg/L	2021-05-27	

Duplicate (21E2339-04RE1) | Matrix: Water | Sampled: 2021-05-19

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
General Parameters						
Nitrogen, Total Kjeldahl	**0.398**	N/A	0.050	mg/L	2021-06-21	HT1
Phosphorus, Total Dissolved	**0.0332**	N/A	0.0050	mg/L	2021-06-18	HT1

MW-6 (21E2339-05) | Matrix: Water | Sampled: 2021-05-19 07:00

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Anions						
Chloride	**91.6**	AO ≤ 250	0.10	mg/L	2021-05-21	
Nitrate (as N)	**1.99**	MAC = 10	0.010	mg/L	2021-05-21	
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-05-21	
Calculated Parameters						
Hardness, Total (as CaCO3)	**345**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	**1.99**	10	0.0100	mg/L	N/A	
Nitrogen, Total	**2.62**	N/A	0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	**0.067**	None Required	0.050	mg/L	2021-05-25	
Conductivity (EC)	**1060**	N/A	2.0	µS/cm	2021-05-26	
Nitrogen, Total Kjeldahl	**0.625**	N/A	0.050	mg/L	2021-05-28	

TEST RESULTS

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Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
MW-6 (21E2339-05) | Matrix: Water | Sampled: 2021-05-19 07:00, Continued						
General Parameters, Continued						
pH	**7.02**	7.0-10.5	0.10	pH units	2021-05-26	HT2
Phosphorus, Total (as P)	**0.251**	N/A	0.0050	mg/L	2021-05-27	
Phosphorus, Total Dissolved	**0.0557**	N/A	0.0050	mg/L	2021-05-27	
Microbiological Parameters						
Coliforms, Total	**5**	MAC = 0	1	MPN/100 mL	2021-05-20	HT1
E. coli	< 1	MAC = 0	1	MPN/100 mL	2021-05-20	HT1
Total Metals						
Calcium, total	**80.7**	None Required	0.20	mg/L	2021-05-27	
Magnesium, total	**34.7**	None Required	0.010	mg/L	2021-05-27	
Sodium, total	**109**	AO ≤ 200	0.10	mg/L	2021-05-27	

Sample Qualifiers:

HT1	The sample was prepared and/or analyzed past the recommended holding time.
HT2	The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

APPENDIX 1: SUPPORTING INFORMATION

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Conductivity in Water	SM 2510 B (2017)	Conductivity Meter	✓	Kelowna
E. coli in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Hardness in Water	SM 2340 B* (2017)	Calculation: 2.497 [total Ca] + 4.118 [total Mg] (Est)	✓	N/A
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	✓	Kelowna
Phosphorus, Total Dissolved in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Total Metals in Water	EPA 200.2 / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
AO	Aesthetic Objective
MAC	Maximum Acceptable Concentration (health based)
mg/L	Milligrams per litre
MPN/100 mL	Most Probable Number per 100 millilitres
pH units	pH < 7 = acidic, ph > 7 = basic
µS/cm	Microsiemens per centimetre
EPA	United States Environmental Protection Agency Test Methods
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

Guidelines Referenced in this Report:

BC CSR Schedule 3.2 Drinking Water
Guidelines for Canadian Drinking Water Quality (Health Canada, June 2019)

Note: In some cases, the values displayed on the report represent the lowest guideline and are to be verified by the end user

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Western Water Associates Ltd	**WORK ORDER**	21E2339
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General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued or once samples expire, whichever comes first. Longer hold is possible if agreed to in writing.

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager:bwhitehead@caro.ca

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline(s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.

APPENDIX 2: QUALITY CONTROL RESULTS

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The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in “batches” and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup)**: An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS)**: A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS)**: A second aliquot of sample is fortified with with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM)**: A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B1E2150										
Blank (B1E2150-BLK1)				Prepared: 2021-05-21, Analyzed: 2021-05-21						
Chloride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Blank (B1E2150-BLK2)				Prepared: 2021-05-21, Analyzed: 2021-05-21						
Chloride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
LCS (B1E2150-BS1)				Prepared: 2021-05-21, Analyzed: 2021-05-21						
Chloride	15.8	0.10	mg/L	16.0		99	90-110			
Nitrate (as N)	4.00	0.010	mg/L	4.00		100	90-110			
Nitrite (as N)	2.00	0.010	mg/L	2.00		100	85-115			
LCS (B1E2150-BS2)				Prepared: 2021-05-21, Analyzed: 2021-05-21						
Chloride	16.1	0.10	mg/L	16.0		100	90-110			
Nitrate (as N)	4.01	0.010	mg/L	4.00		100	90-110			
Nitrite (as N)	2.11	0.010	mg/L	2.00		106	85-115			
General Parameters, Batch B1E2319										
Blank (B1E2319-BLK1)				Prepared: 2021-05-25, Analyzed: 2021-05-25						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
Blank (B1E2319-BLK2)				Prepared: 2021-05-25, Analyzed: 2021-05-25						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
Blank (B1E2319-BLK3)				Prepared: 2021-05-25, Analyzed: 2021-05-25						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
Blank (B1E2319-BLK4)				Prepared: 2021-05-25, Analyzed: 2021-05-25						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							
Blank (B1E2319-BLK5)				Prepared: 2021-05-25, Analyzed: 2021-05-25						
Ammonia, Total (as N)	< 0.050	0.050	mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B1E2319, Continued										
LCS (B1E2319-BS1)				Prepared: 2021-05-25, Analyzed: 2021-05-25						
Ammonia, Total (as N)	1.04	0.050	mg/L	1.00		104	90-115			
LCS (B1E2319-BS2)				Prepared: 2021-05-25, Analyzed: 2021-05-25						
Ammonia, Total (as N)	0.980	0.050	mg/L	1.00		98	90-115			
LCS (B1E2319-BS3)				Prepared: 2021-05-25, Analyzed: 2021-05-25						
Ammonia, Total (as N)	0.943	0.050	mg/L	1.00		94	90-115			
LCS (B1E2319-BS4)				Prepared: 2021-05-25, Analyzed: 2021-05-25						
Ammonia, Total (as N)	0.963	0.050	mg/L	1.00		96	90-115			
LCS (B1E2319-BS5)				Prepared: 2021-05-25, Analyzed: 2021-05-25						
Ammonia, Total (as N)	1.08	0.050	mg/L	1.00		108	90-115			
Duplicate (B1E2319-DUP4)	**Source: 21E2339-01**			Prepared: 2021-05-25, Analyzed: 2021-05-25						
Ammonia, Total (as N)	< 0.050	0.050	mg/L		< 0.050				15	
Matrix Spike (B1E2319-MS4)	**Source: 21E2339-01**			Prepared: 2021-05-25, Analyzed: 2021-05-25						
Ammonia, Total (as N)	0.204	0.050	mg/L	0.250	< 0.050	82	75-125			
General Parameters, Batch B1E2448										
Blank (B1E2448-BLK1)				Prepared: 2021-05-26, Analyzed: 2021-05-26						
Conductivity (EC)	< 2.0	2.0	µS/cm							
LCS (B1E2448-BS1)				Prepared: 2021-05-26, Analyzed: 2021-05-26						
Conductivity (EC)	1410	2.0	µS/cm	1410		100	95-105			
Reference (B1E2448-SRM1)				Prepared: 2021-05-26, Analyzed: 2021-05-26						
pH	7.00	0.10	pH units	7.01		100	98-102			
General Parameters, Batch B1E2546										
Blank (B1E2546-BLK1)				Prepared: 2021-05-26, Analyzed: 2021-05-27						
Phosphorus, Total (as P)	< 0.0050	0.0050	mg/L							
Phosphorus, Total Dissolved	< 0.0050	0.0050	mg/L							
Blank (B1E2546-BLK2)				Prepared: 2021-05-26, Analyzed: 2021-05-27						
Phosphorus, Total (as P)	< 0.0050	0.0050	mg/L							
Phosphorus, Total Dissolved	< 0.0050	0.0050	mg/L							
LCS (B1E2546-BS1)				Prepared: 2021-05-26, Analyzed: 2021-05-27						
Phosphorus, Total (as P)	0.100	0.0050	mg/L	0.100		100	85-115			
Phosphorus, Total Dissolved	0.100	0.0050	mg/L	0.100		100	85-115			
LCS (B1E2546-BS2)				Prepared: 2021-05-26, Analyzed: 2021-05-27						
Phosphorus, Total (as P)	0.0967	0.0050	mg/L	0.100		97	85-115			
Phosphorus, Total Dissolved	0.0967	0.0050	mg/L	0.100		97	85-115			
General Parameters, Batch B1E2548										
Blank (B1E2548-BLK1)				Prepared: 2021-05-26, Analyzed: 2021-05-28						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
Blank (B1E2548-BLK2)				Prepared: 2021-05-26, Analyzed: 2021-05-28						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B1E2548, Continued										
LCS (B1E2548-BS1)				Prepared: 2021-05-26, Analyzed: 2021-05-28						
Nitrogen, Total Kjeldahl	1.01	0.050	mg/L	1.00		101	85-115			
LCS (B1E2548-BS2)				Prepared: 2021-05-26, Analyzed: 2021-05-28						
Nitrogen, Total Kjeldahl	0.998	0.050	mg/L	1.00		100	85-115			
General Parameters, Batch B1F2166										
Blank (B1F2166-BLK1)				Prepared: 2021-06-18, Analyzed: 2021-06-21						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
Blank (B1F2166-BLK2)				Prepared: 2021-06-18, Analyzed: 2021-06-21						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
LCS (B1F2166-BS1)				Prepared: 2021-06-18, Analyzed: 2021-06-21						
Nitrogen, Total Kjeldahl	1.03	0.050	mg/L	1.00		103	85-115			
LCS (B1F2166-BS2)				Prepared: 2021-06-18, Analyzed: 2021-06-21						
Nitrogen, Total Kjeldahl	1.03	0.050	mg/L	1.00		103	85-115			
Microbiological Parameters, Batch B1E2012										
Blank (B1E2012-BLK1)				Prepared: 2021-05-20, Analyzed: 2021-05-20						
Coliforms, Total	< 1	1	MPN/100 mL							
E. coli	< 1	1	MPN/100 mL							
Blank (B1E2012-BLK2)				Prepared: 2021-05-20, Analyzed: 2021-05-20						
E. coli	< 1	1	MPN/100 mL							
Blank (B1E2012-BLK3)				Prepared: 2021-05-20, Analyzed: 2021-05-20						
Coliforms, Total	< 1	1	MPN/100 mL							
E. coli	< 1	1	MPN/100 mL							
Blank (B1E2012-BLK4)				Prepared: 2021-05-20, Analyzed: 2021-05-20						
E. coli	< 1	1	MPN/100 mL							
Total Metals, Batch B1E2552										
Blank (B1E2552-BLK1)				Prepared: 2021-05-26, Analyzed: 2021-05-27						
Calcium, total	< 0.20	0.20	mg/L							
Magnesium, total	< 0.010	0.010	mg/L							
Sodium, total	< 0.10	0.10	mg/L							
LCS (B1E2552-BS1)				Prepared: 2021-05-26, Analyzed: 2021-05-27						
Calcium, total	2.06	0.20	mg/L	2.02		102	80-120			
Magnesium, total	2.22	0.010	mg/L	2.02		110	80-120			
Sodium, total	2.22	0.10	mg/L	2.02		110	80-120			
Reference (B1E2552-SRM1)				Prepared: 2021-05-26, Analyzed: 2021-05-27						
Calcium, total	9.98	0.20	mg/L	10.7		93	70-130			
Magnesium, total	3.65	0.010	mg/L	3.59		102	70-130			
Sodium, total	8.88	0.10	mg/L	8.71		102	70-130			

CARO Analytical Services **Client** Western Water Associates Ltd
FINAL Analytical Testing Report **Attention** Morgan Jackson
Work Order: 21E2339 **Project** 20-046-02VR
Report Date: 2021-06-23 08:49:58 **Project Info** [none]

Note: This is not the original data. Please refer to PDF / Hardcopy report.

												Sample Re-Analysis		
LAB ID						21E2339-05	21E2339-01	21E2339-02	21E2339-03	21E2339-04		21E2339-03RE1	21E2339-04RE1	
CLIENT ID						MW-6	MW-8	MW-10	MW-11	Duplicate (MW11)	Relative Percent Difference (%)	MW-11	Duplicate (MW11)	Relative Percent Difference (%)
DATE SAMPLED						2021-05-19	2021-05-19	2021-05-19	2021-05-19	2021-05-19		2021-05-19	2021-05-19	
DATE RECEIVED						2021-05-20	2021-05-20	2021-05-20	2021-05-20	2021-05-20				
MATRIX						Water	Water	Water	Water	Water		Water	Water	
General Method	**Analyte**	**Units**	**RL**	**Std (CDWQG)**	**Std (CSR2DW)**									
Anions	Chloride	mg/L	1	AO<=250	250	91.6	83.3	90.9	157	150	4.5%			
Anions	Nitrate (as N)	mg/L	0.01	MAC=10	10	1.99	0.945	4.63	3.13	3.04	2.9%			
Anions	Nitrite (as N)	mg/L	0.01	MAC=1	10	<0.010	<0.010	<0.010	0.01	<0.010	NA			
Calculated Parameters	Hardness, Total (as CaCO3)	mg/L	0.5	None Required	N/A	345	312	343	470	493	4.9%			
Calculated Parameters	Nitrate+Nitrite (as N)	mg/L	0.01	N/A	10	1.99	0.945	4.63	3.14	3.04	3.2%			
Calculated Parameters	Nitrogen, Total	mg/L	0.05	N/A	N/A	2.62	1.24	4.91	3.38	3.5	3.6%			
General Parameters	Ammonia, Total (as N)	mg/L	0.05	None Required	N/A	0.067	<0.050	<0.050	<0.050	<0.050	NA			
General Parameters	Nitrogen, Total Kjeldahl	mg/L	0.05	N/A	N/A	0.625	0.292	0.282	0.241	0.454	88.4%	0.267	0.398	49.1%
General Parameters	Phosphorus, Total (as P)	mg/L	0.005	N/A	N/A	0.251	0.185	0.0497	0.088	0.0861	2.2%			
General Parameters	Phosphorus, Total Dissolved	mg/L	0.005	N/A	N/A	0.0557	0.117	0.0239	0.0264	0.0338	28.0%	0.0273	0.0332	21.6%
General Parameters	pH	pH units	0.1	7.0-10.5	N/A	7.02	6.94	7.31	7.04	7.1	0.9%			
General Parameters	Conductivity (EC)	uS/cm	2	N/A	N/A	1060	905	978	1220	1200	1.6%			
Microbiological Parameters	Coliforms, Total	MPN/100 mL	1	MAC = 0	N/A	5	<1	<1	<1		NA			
Microbiological Parameters	E. coli	MPN/100 mL	1	MAC = 0	N/A	<1	<1	<1	<1		NA			
Total Metals	Calcium, total	mg/L	0.2	None Required	N/A	80.7	89.4	82.5	111	114	2.7%			
Total Metals	Magnesium, total	mg/L	0.01	None Required	N/A	34.7	21.4	33.2	46.7	50.3	7.7%			
Total Metals	Sodium, total	mg/L	0.1	AO<=200	200	109	83.2	36.7	78.7	83.8	6.5%			

CDWQG - Guidelines for Canadian Drinking Water Quality (Health Canada, June 2019)
CSR2DW - BC CSR Schedule 3.2 Drinking Water

RPD values >25% flagged.

APPENDIX J

2021 Groundwater Monitoring Data

GROUNDWATER MONITORING WELL #1 (AIR CADET)

	Anions			Calculated Parameters		General Parameters					Total Metals		
Sample Date	Chloride	Nitrate (as N)	Nitrite (as N)	Hardness Total (as CaCO3)	Nitrate+Nitrite (as N)	Ammonia Total (as N)	BOD 5-day Carbonaceous	Conductivity (EC)	Phosphorus Total (as P)	Phosphorus Total Dissolved	Calcium Total	Magnesium Total	Sodium Total
22-Apr	8.83	11.0	<0.010	316	11.0	<0.050	<9.2	652	0.059	0.0396	94	19.5	17.1
13-Sep	12.1	9.67	<0.010	303	9.67	0.094	<5.0	679	0.0485	0.0374	92.6	17.4	17.6

GROUND WATER MONITORING WELL #2 (RODEO GROUNDS)

	Anions			Calculated Parameters		General Parameters					Total Metals		
Sample Date	Chloride	Nitrate (as N)	Nitrite (as N)	Hardness Total (as CaCO3)	Nitrate+Nitrite (as N)	Ammonia Total (as N)	BOD 5-day Carbonaceous	Conductivity (EC)	Phosphorus Total (as P)	Phosphorus Total Dissolved	Calcium Total	Magnesium Total	Sodium Total
22-Apr	6.78	0.312	<0.010	1410	0.312	0.102	<9.2	446	53.80	<0.0050	492	44.7	17.5
21-Sep	9.24	0.045	<0.010	1740	0.0449	0.081	<5.0	760	0.423	0.009	490	124.0	20.4

GROUND WATER MONITORING WELL #3 (MAPLE AVENUE)

	Anions			Calculated Parameters		General Parameters					Total Metals		
Sample Date	Chloride	Nitrate (as N)	Nitrite (as N)	Hardness Total (as CaCO3)	Nitrate+Nitrite (as N)	Ammonia Total (as N)	BOD 5-day Carbonaceous	Conductivity (EC)	Phosphorus Total (as P)	Phosphorus Total Dissolved	Calcium Total	Magnesium Total	Sodium Total
22-Apr	8.68	0.250	<0.010	356	0.250	<0.050	<9.2	645	0.832	0.0059	86.7	33.8	15.2
21-Sep	7.77	0.286	0.021	1120	0.307	0.150	21.4	582	1.63	0.0082	366	50.1	15.1

GROUND WATER MONITORING WELL #4 (SAND PIT)

	Anions			Calculated Parameters		General Parameters					Total Metals		
Sample Date	Chloride	Nitrate (as N)	Nitrite (as N)	Hardness Total (as CaCO3)	Nitrate+Nitrite (as N)	Ammonia Total (as N)	BOD 5-day Carbonaceous	Conductivity (EC)	Phosphorus Total (as P)	Phosphorus Total Dissolved	Calcium Total	Magnesium Total	Sodium Total
22-Apr	125	4.19	<0.010	782	4.19	<0.050		1540	2.18	0.114	203	67	81.7
21-Sep	101	0.943	0.024	2020	0.967	0.073	11.4	17.3	2.42	0.125	598	129	97.1

*** Test results high due to draining effluent water two weeks before testing into the infiltration to lower Topping Lake

GROUND WATER MONITORING WELL #5 (Choke Cherry)

	Anions			Calculated Parameters		General Parameters					Total Metals		
Sample Date	Chloride	Nitrate (as N)	Nitrite (as N)	Hardness Total (as CaCO3)	Nitrate+Nitrite (as N)	Ammonia Total (as N)	BOD 5-day Carbonaceous	Conductivity (EC)	Phosphorus Total (as P)	Phosphorus Total Dissolved	Calcium Total	Magnesium Total	Sodium Total
22-Apr	17.5	1.69	<0.010	386	1.69	<0.050		709	0.0503	0.0124	113	25.3	16.5
21-Sep	16.4	1.60	<0.010	374	1.60	0.073	<5.0	735	0.0716	0.0273	101	23.1	15.1

Fairview Golf Course

	Anions			Calculated Parameters		General Parameters					Total Metals		
Sample Date	Chloride	Nitrate (as N)	Nitrite (as N)	Hardness Total (as CaCO3)	Nitrate+Nitrite (as N)	Ammonia Total (as N)	BOD 5-day Carbonaceous	Conductivity (EC)	Phosphorus Total (as P)	Phosphorus Total Dissolved	Calcium Total	Magnesium Total	Sodium Total
N/A													
21-Sep	95.6	2.31	0.029	396	2.33	<0.05	<5	1110	0.0768	0.67	81	46.9	96.9

Public Works Yard

	Anions			Calculated Parameters		General Parameters					Total Metals		
Sample Date	Chloride	Nitrate (as N)	Nitrite (as N)	Hardness Total (as CaCO3)	Nitrate+Nitrite (as N)	Ammonia Total (as N)	BOD 5-day Carbonaceous	Conductivity (EC)	Phosphorus Total (as P)	Phosphorus Total Dissolved	Calcium Total	Magnesium Total	Sodium Total
N/A													
21-Sep	45.5	2.28	<0.010	311	2.28	<0.050	<5	737	0.126	0.103	83	25.1	35.7

Linear Park

	Anions			Calculated Parameters		General Parameters					Total Metals		
Sample Date	Chloride	Nitrate (as N)	Nitrite (as N)	Hardness Total (as CaCO3)	Nitrate+Nitrite (as N)	Ammonia Total (as N)	BOD 5-day Carbonaceous	Conductivity (EC)	Phosphorus Total (as P)	Phosphorus Total Dissolved	Calcium Total	Magnesium Total	Sodium Total
N/A													
21-Sep	165	5.88	0.01	317	5.89	<0.50	<5	1030	0.488	0.017	76.4	30.6	67.1

End of Road 5

	Anions			Calculated Parameters		General Parameters					Total Metals		
Sample Date	Chloride	Nitrate (as N)	Nitrite (as N)	Hardness Total (as CaCO3)	Nitrate+Nitrite (as N)	Ammonia Total (as N)	BOD 5-day Carbonaceous	Conductivity (EC)	Phosphorus Total (as P)	Phosphorus Total Dissolved	Calcium Total	Magnesium Total	Sodium Total
N/A													
21-Sep	97.7	3.21	<0.010	493	3.21	<0.05	<5	1020	0.0126	0.0126	103	56.9	18.4

TOWN OF OLIVER

GROUND WATER MONITORING WELL READINGS

(Note: The value recorded indicates the measurement from the top of casing to the water level expressed in meters.)

Month	Day	Air Cadet (Well #1)	Rodeo Grounds (Well #2)	Maple Ave (Well #3)	Test Well #2 (Corner 350th/T.L.)	Test Well #4 (Sand Pit)	Test Well #5	Test Well #6 (Golf Course)	Test Well #7 Public Works Yard	Test Well #8 Cemetery	Test Well #9 Linear Park	Test Well #10 End of Road 5
January	5	10.05	7.48	1.36	fenced off	8.88	9			N/A	N/A	N/A
February	9	10.01	7.5	1.2	fenced off	8.35	9.23			N/A	N/A	N/A
March	11	9.86	7.5	1.32	fenced off	8.38	9.36			N/A	N/A	N/A
April	13	9.7	7.55	1.42	fenced off	8.42	9.38			N/A	N/A	N/A
May	7	9.7	7.54	1.44	fenced off	8.67	8.52			N/A	N/A	N/A
June	29	9.38	7.62	1.79	fenced off	9.9	7.78	14.35 (dry)	2.76	21.06 Dry/bttm	27.69 (no water)	24.37
July	23	9.24	7.66	2	fenced off	10.94 (dry)	7.93	12.60 (bottom)	2.9	21.06 Dry	26.33	30.84 Dry
August	12	9.27	7.65	2.1	fenced off	10.75	7.1	12.53	2.93	21.11 Dry/bttm	26.48	30.50 Dry/bttm
September	13	9.89	7.68	2.11	fenced off	10.67	8.58	12.38	2.92	21.5 Dry	26.3	24.42 Water
October	25	10.01	7.72	1.86	fenced off	9.81	9.17	12.5	2.86	21.11	26.13	24.45
November	19	10.25	7.72	1.7	fenced off	9.05	9.49	12.73	2.97	21.45 Dry	25.9	24.56
December	13	10.4	7.78	1.7	fenced off	10.90 (dry)	9.61	12.75	3.01	21.33 Dry	25.8	30.48 Dry

Golder Associates Ltd.

243-1889 Springfield Road
Kelowna, British Columbia, Canada V1Y 5V5
Telephone (250) 860-8424
Fax (250) 860-9874

REPORT ON

DEVELOPMENT OF GROUNDWATER MONITORING PROGRAM SPRAY IRRIGATION AND RAPID INFILTRATION SYSTEMS

TOWN OF OLIVER, B.C.

Submitted to:

Town of Oliver
35016 - 97th Street
Oliver, B.C.
V0H 1T0

DISTRIBUTION:

3 copies -	Town of Oliver Oliver, B.C.
1 copy -	True Engineering Kamloops, B.C.
2 copies -	Golder Associates Ltd. Kelowna, B.C.

February 12, 1998

972-4198a

Golder Associates Ltd.

243-1889 Springfield Road
Kelowna, British Columbia, Canada V1Y 5V5
Telephone (250) 860-8424
Fax (250) 860-9874

Golder Associates

February 12, 1998

Our Ref.: 972-4198a

Town of Oliver
35016 - 97th Street
Oliver, B.C.
VOH 1T0

Attention: Mr. Bruce Hamilton

RE: DEVELOPMENT OF GROUNDWATER MONITORING PROGRAM SPRAY IRRIGATION AND RAPID INFILTRATION SYSTEMS TOWN OF OLIVER, BRITISH COLUMBIA

Dear Mr. Underwood:

Golder Associates Ltd. (Golder) is pleased to provide this report, presenting the development of a groundwater monitoring program for the Town of Oliver. The purpose of the development of a groundwater monitoring program was to address the Town's Operational Certificate, such that the groundwater flow pattern in the area of the Town of Oliver's surplus treated effluent spray system and rapid infiltration system could be determined, and that the effects of these disposal systems on local groundwater quality could be determined.

1.0 BACKGROUND

According to TRUE Engineering Ltd., the Town of Oliver had an estimated effluent surplus volume of approximately 120,000 m^3 in storage in 1997. The effluent surplus was generated as a result of a decrease in the volume of treated effluent used for irrigation purposes at the Fairview Mountain Golf Course during the summer of 1996 and 1997. In order to resolve the additional effluent surplus issue, the Town of Oliver proceeded with a short term disposal plan involving the following: 1) the rapid infiltration using an infiltration basin located on Lot 2, Plan 5881, and 2) a high rate irrigation system located on Lots 4 and 5 of Plan 5881. In addition, the continued irrigation of the Fairview Mountain Golf Course using surplus treated effluent was conducted. The locations of the Fairview Mountain Golf Course, Lot 4 and 5 of Plan 5881 and Lot 2 of Plan 5881 are shown on Figure 1 and 2.

The spray irrigation system has been in use at the Fairview Mountain Golf Course since approximately 1983, during which time surplus treated effluent has been used by the golf course for irrigation purposes on an as-needed basis. The high rate irrigation system, located on Lots 4 and 5 of Plan 5881, has been operated by the Town of Oliver between August 19 and November 15, 1997, during which time surplus treated effluent was sprayed onto portions of the property. It is understood that the Town of Oliver proposes to change the high rate irrigation system to a conventional irrigation system in the future, disposing of surplus treated effluent of Lots 4 and 5, the northern portion of Lot 6 and the western portion of Lot 8, Plan 5881. In addition to the spray irrigation systems, the Town of Oliver had proposed to dispose of up to 600 m^3/d of surplus treated effluent within an infiltration basin system located on Lot 2 of Plan 5881. It is understood that the use of the high rate irrigation system and the infiltration basin to dispose of surplus treated effluent will only be used on a short-term, as-needed basis, in the event that the effluent storage lagoon exceeds its storage capacity.

Golder has recently conducted a hydrogeological investigation regarding the potential maximum volume of surplus treated effluent that could be discharged to the infiltration basin located on Lot 2, Plan 5881, the results of which are presented in our February, 1998 report (Ref. No. 972-4198A). During the course of the hydrogeological investigation, three monitoring wells (MW 1, MW 2 and MW 3) were drilled and installed at selected locations downgradient of the infiltration basin for future groundwater monitoring (Figure 2).

2.0 METHODOLOGY

In order to develop a comprehensive groundwater monitoring plan for the Town of Oliver, a site reconnaissance was conducted on September 16, 1997, during which time the various disposal methods for the surplus treated effluent (the spray irrigation at the Fairview Mountain Golf Course and Lots 4 and 5, Plan 5881 and the use of the infiltration basin) were examined. In addition, a review of BCE's water well logs was conducted for the area of the Fairview Mountain Golf Course, Lots 4 and 5 of Plan 5881 (high rate irrigation system) and Lot 2 of Plan 5881 (infiltration basin). All available water well logs are shown in Appendix I.

3.0 RESULTS

3.1 Review of Available Well Water Records

Two available water-well records were obtained from the Groundwater Section of the Ministry of Environment, in Victoria, B.C. for the area surrounding the Fairview Mountain Golf Course, Lots 4 and 5 of Plan 5881 (high rate irrigation) and Lot 2 of Plan 5881 (infiltration basin) (Appendix I). One water well was noted approximately 170 m east of the Fairview Mountain Golf Course (see W1 on Figure 2). The water well log indicated that well W1 encountered approximately 0.6 m of topsoil, followed by a layer of fine sand to approximately 13.7 m below ground surface. This was underlain by a gravel deposit to a depth of approximately 36.6 m, at which depth the well was terminated. Groundwater was not encountered in well W1.

The second water well is located approximately 150 m to the south of the infiltration basin (Lot 2, Plan 5881) (see W2 on Figure 2). According to the well log, well W2 encountered approximately 7.3 m of sand and gravel, at which depth bedrock was encountered. Well W2 was terminated within the bedrock at a depth of 123.4 m below ground surface. Groundwater was encountered at MW 2 at approximately 16.7 m below ground surface. According to Mrs. Moir, the property owner, well W2 is used for domestic purposes.

3.2 Site Reconnaissance

During the site reconnaissance of the area of the Fairview Mountain Golf Course, Lots 4 and 5 of Plan 5881 (high rate irrigation system) and Lot 2 of Plan 5881 (infiltration basin), one additional water well was noted in the area to the north of the golf course (W3 Figure 2). A log for this well was not found in our review of BCE's water well records. However, according to a Town of Oliver employee, the water well belongs to Mr. Bill Eggert. Mr. Eggert was contacted and stated that there are actually two wells on his property (W3 and W4). Well W3 was originally drilled in 1979 to a depth of approximately 67 m as a test hole. According to Mr. Eggert, well W3 was redrilled and cased in 1987 to approximately 12.2 m below ground surface. Soil conditions encountered at well W3 consisted of 1.2 m of clay and gravel, followed by a clay and sand deposit to a depth of 4.9 m below ground surface. This deposit was underlain by a fine sand, with some gravel seams to a depth of 10.4m. The sand deposit was underlain with a thin silty clay deposit to a depth of 11.3 m. This was underlain by broken rock, till and bedrock. Well W3 was terminated at a depth of 12.5 m below ground surface within the bedrock. The recorded static water level within this well was 9.8 m on August 13, 1987, however, it is unknown at what depth groundwater was encountered. According to Mr. Eggert, well W3 has never been used. Well W4 is used for domestic purposes and is approximately 6 m in depth. The soil conditions encountered during the installation of W4 are unknown, however, it is located near Reed's Creek.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The review of available water well information in the area of the Fairview Mountain Golf Course, Lots 4 and 5 of Plan 5881 and Lot 2 of Plan 59881, indicated that there are only four existing water wells in the general area, with three wells in the area of the golf course (W1, W3 and W4) and one well located in the area of the infiltration basin (W2) (Figure 2). Based on a review of the available water well logs, only well W1 appears to be unsuitable for groundwater sampling, as the well is reportedly dry.

In order to evaluate the effects that the disposal of surplus treated effluent has on the local groundwater quality, it is recommended that a groundwater monitoring network be installed in the three areas of effluent disposal (Fairview Mountain Golf Course, Lots 4 and 5 of Plan 5881 and Lot 2 of Plan 5881). Based on a review of available information, it appears that there are an inadequate number of existing monitoring wells in the area of the golf course and the high-rate irrigation area to monitor downgradient groundwater quality. It is therefore recommended that two groundwater monitoring wells be installed in the area downgradient of the Fairview Mountain Golf Course and that one groundwater monitoring well be installed downgradient of Lots 4 and 5 of Plan 5881, at the locations shown on Figure 2. As it is understood that the high-rate irrigation system on Lots 4 and 5, Plan 5881 may eventually change to a conventional irrigation system disposing of surplus treated effluent on Lots 4, 5, 6 (northern portion) and 8 (western portion) of Plan 5881, the proposed monitoring well location for this general area has been chosen to accommodate this change.

Upon completion of the drilling and installation of the three proposed monitoring wells it is recommended that groundwater be collected for chemical analyses. In addition, it is recommended domestic well W4, located side/downgradient of the Fairview Mountain Golf Course and MW 2 and domestic well W2, located in the area of the infiltration basin also be sampled. The following sampling frequency is recommended for the various disposal areas:

- Fairview Mountain Golf Course: As the spray irrigation system at the golf course is used yearly on an as-needed basis (primarily in the summer months), it is recommended that groundwater be sampled from the two proposed monitoring well locations and domestic well W4 two times prior to the start of the irrigation season at the golf course (February and May), in order to collect background groundwater quality information, and on a semi-annual basis (August and December) thereafter.

- High-Rate Irrigation System: It is recommended that groundwater be collected from the proposed monitoring well location downgradient of Lots 4 and 5, Plan 5881 and from domestic well W2 two times prior to using of the irrigation system in 1998, in order to collect background groundwater quality information, and on a semi-annual basis thereafter. The actual months samples should be collected is dependent on the months that the irrigation system is used. As the use of the high-rate irrigation system in this area is intended to be on a short-term, as-needed basis, should the disposal of surplus treated effluent on Lots 4, 5, 6 and 8 not occur during subsequent years, groundwater sampling from these monitoring wells need not be conducted.

- Infiltration Basin: It is recommended that groundwater be collected from monitoring well MW 2 and domestic well W2 two times prior to using the infiltration basin in 1998, in order to collect background groundwater quality information, and on a semi-annual basis thereafter. The actual months groundwater sampling should be conducted is dependent on the months that the infiltration basin is used. As the use of the infiltration basin system is intended to be on a short-term, as-needed basis, should the disposal of surplus treated effluent into the basin not occur during any subsequent years, groundwater sampling from these monitoring wells need not be conducted.

It should be noted that domestic well W2 has been included in the monitoring program for both the high-rate irrigation system and the infiltration basin system. Should neither the high rate irrigation system nor the infiltration basin system be used during a subsequent year, the sampling of domestic well W2 would not be required. However, should one or both of these systems be in operation during a given year, it is recommended that well W2 be sampled according to the frequency outlined above.

All collected groundwater samples should be submitted for the analyses of the following parameters: conductivity, pH, chloride, nitrate, nitrite, ammonia, total nitrogen, dissolved phosphorous, ortho-phosphate, and total and fecal coliform. In addition, water levels within all monitoring wells should be measured during the sampling events. Discharge rates/volumes into the infiltration basin and the high-rate irrigation system should be monitored on a daily basis during operation. It is further recommended that the results of the groundwater monitoring program be reviewed by a qualified hydrogeologist on an annual basis.

5.0 CLOSURE

We trust the foregoing provides you with the information that you require at this time. Should you have any questions, please do not hesitate to contact the undersigned at your earliest convenience.

Yours truly,

GOLDER ASSOCIATES LTD.

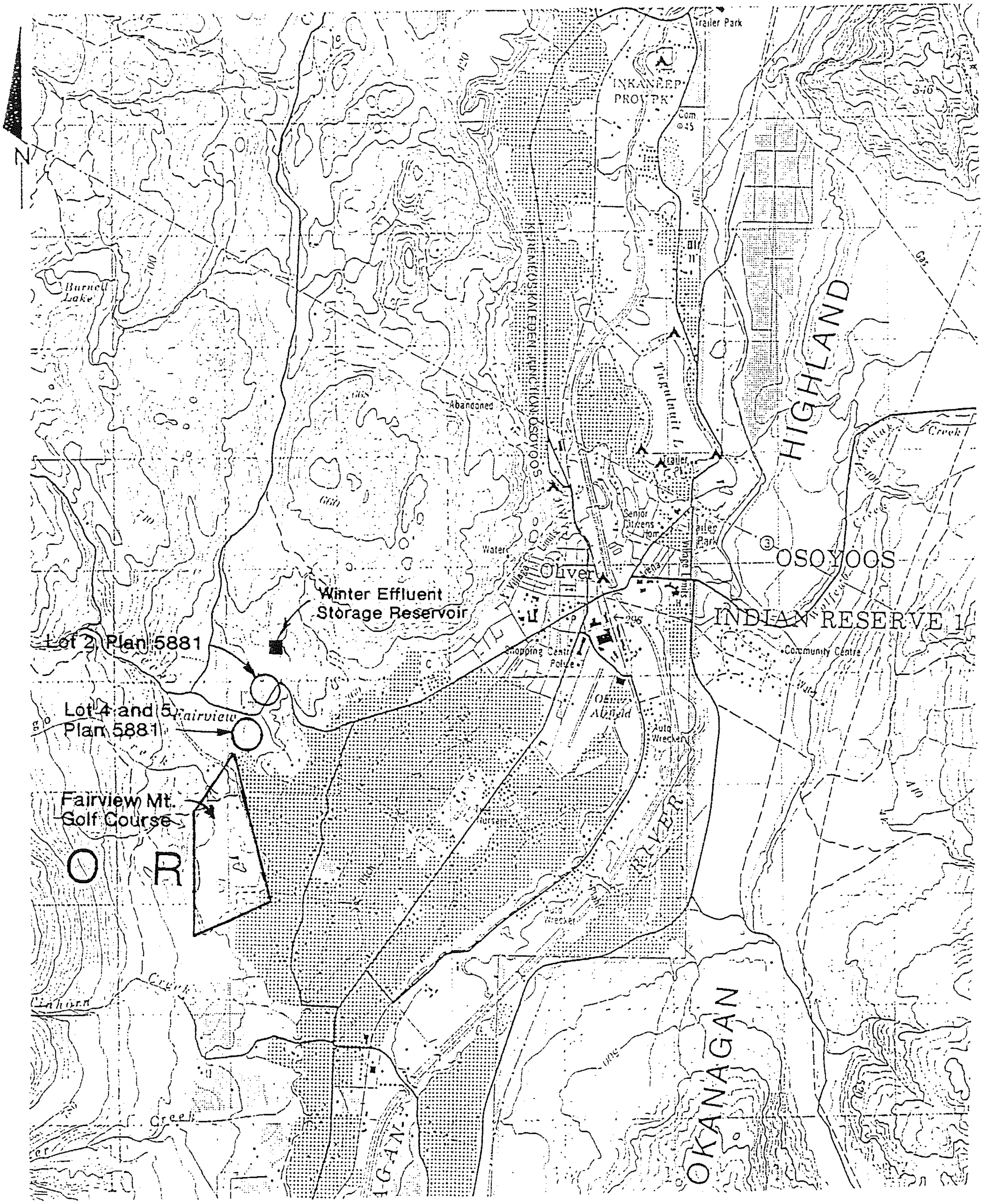
Jacqueline Foley, M.Sc.
Hydrogeologist

B. Carlsen, P. Eng.
Principal, Office Manager

MS/JDF/SO/BC/pjc
Encl.
n:\1997.100\972-4198\gwrpt.doc

KEY PLAN

Figure 1



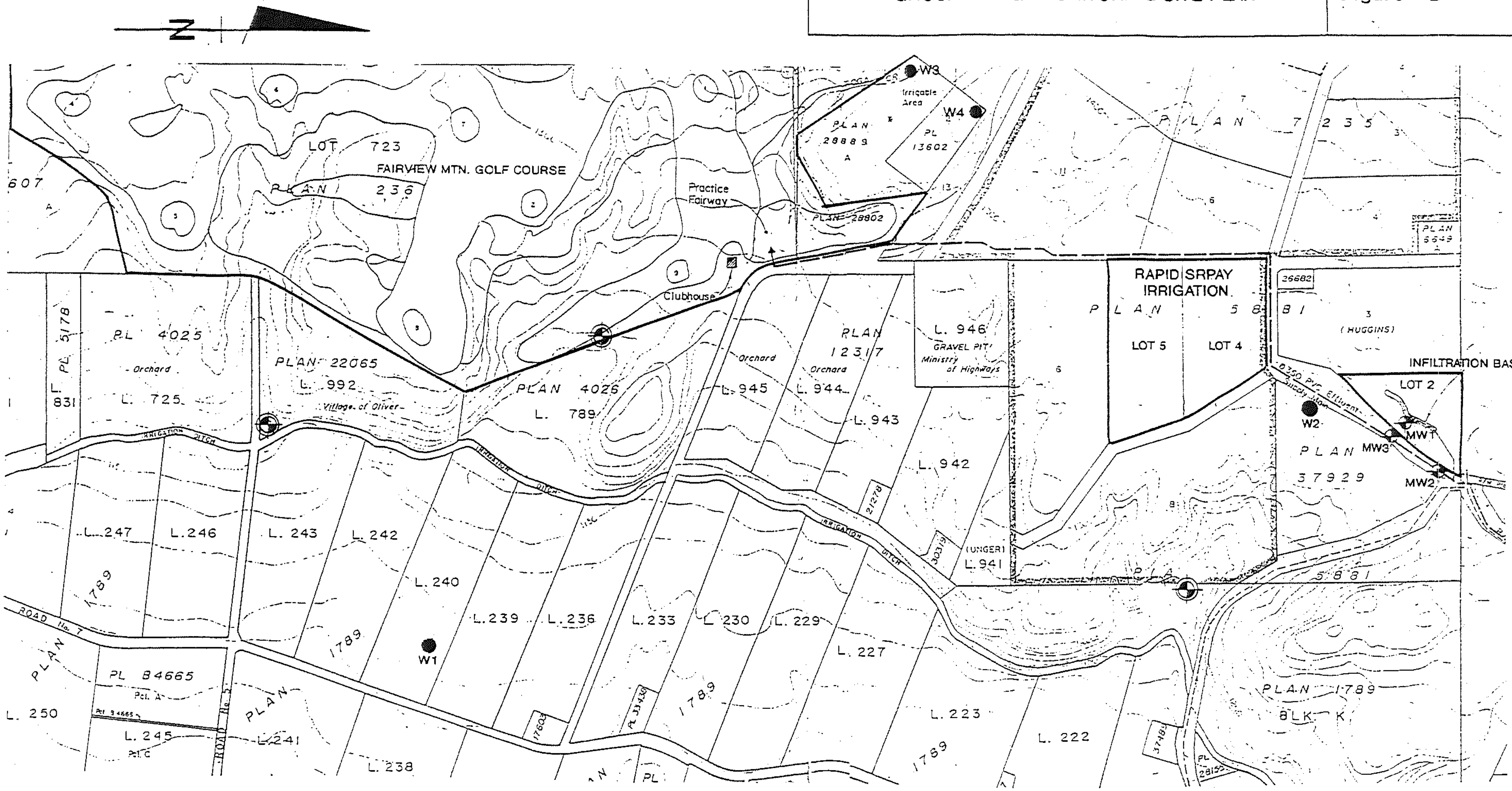
Reference Map: Keremeos 82

SCALE 1:50,000

Golder Associates

PROJECT No. 972-4198A DRAWN LR REVIEWED JF DATE Oct/97

GROUNDWATER MONITORING SITE PLAN	Figure 2



LEGEND

MW1 Approximate location of existing monitoring well

W1 ● Approximate location of water well

Approximate location of proposed monitoring well

Drawing courtesy of True Engineering

Approximate Scale: 1:6300

Golder Associates

PROJECT: 972-4198 a	DRAWN BY: MS	DATE: DEC./1997	REVIEWED: JDF

APPENDIX K

Soils Classification and Description

Hamilton & Associates
3909 16th Street
Vernon, BC, V1T 7N5

June 23, 2020

Town of Oliver
c/o Western Water Associates Ltd.
#106-5145 26 Street,
Vernon, BC V1T 8G4

RE: OPERATIONAL CERTIFICATE NUMBER PE-13717
SOIL ASSESSMENT PROGRAM – NEW RECLAIMED WATER IRRIGATION AREAS

Attention: Ryan Rhodes, P.Geo.

1. INTRODUCTION

The Town of Oliver (the Town) currently discharges the reclaimed municipal wastewater from its wastewater treatment facility (WWTF) to ground by irrigation under the authorization of Operational Certificate (OC) PE-13717. The Town wishes to expand the area that is authorized for irrigation with reclaimed municipal wastewater and will therefore require an amendment to the OC. Hugh Hamilton, P.Ag., of Hamilton and Associates was retained by Western Water Associates Ltd., on behalf of the Town, to complete a soil assessment to determine whether the lands on planned new irrigation areas are capable of accepting reclaimed wastewater for irrigation purpose. The requirements for the soils assessment are specified in Section 6.9 of the OC.

The assessment was completed through a combination of a review of background information (including soil maps and reports, climate data, land use zoning maps, and aerial photographs), a field reconnaissance completed on June 3, 2020, and data analyses and interpretation. Additional information on methods is contained in Section 4.

2. DESCRIPTION OF THE PLANNED NEW IRRIGATION AREAS

Four irrigation areas are to be added to the approved land base for reclaimed water irrigation:

- The playing fields and park land located between Oliver Elementary School and South Okanagan High School (Figure 1 – maps and photos are at end of report). All of this parcel is currently covered with turfgrass and is irrigated with an underground sprinkler system (Photo 1). There are mature trees around the edges of the fields.
- Oliver Cemetery (Figure 2). The cemetery grounds are primarily vegetated with turfgrass (Photos 3 and 4) and are irrigated with underground sprinklers. Trees (mostly cedar) are planted around the property boundary, and there are some deciduous tree among the monuments.
- Oliver Community Park located immediately east of the Okanagan River on Fairview Road (Figure 3). The park includes three baseball/softball fields, a lawn bowling green, and areas for walking and sitting. The ground cover is turfgrass and there are a number of mature trees in the

areas outside the ball fields and on the small area on the north side of Fairview Road (Photo 5). The park is irrigated with an underground sprinkler system.

- Oliver Municipal Airport (Map 4). The new irrigation area is the strip of industrial-zoned land on the east side of the runway (Photo 7). The fields surrounding the runway to the west are already authorized for reclaimed water irrigation. The new irrigation area is mostly unoccupied although some parts are used for storage and there is one building. It appears that the topsoil was stripped from parts of the site and transported off-site. Vegetation cover is limited (about 25-50% on average) and includes alfalfa, agronomic and native grasses, and invasive species (see Section 4). It is not currently irrigated.

3. EXISTING SOILS, LAND USE AND EXPOSURE POTENTIAL

Soil information for the subject property was obtained from the BC Soil Information Finder Tool (SIFT). Figures 1 to 4 show the spatial distribution of soil types on the planned irrigation sites, and the soil properties are summarized in Table 1. Soils at the school and airport sites are mapped by BC as 100% Rutland soils, which are classified as Orthic Dark Brown Chernozems, developed on glacio-fluvial deposits. They typically are gravelly with a sandy or sandy loam surface texture (Photo 2). Soils at the cemetery are Ponderosa soils developed on alluvial fan deposits with a fluvial veneer. They are classified as Rego Dark Brown Chernozems and are also gravelly within sandy loam. The soils in the park have been developed on fluvial and floodplain deposits. About 90% of the irrigated area is classified as Kinney soils and are Gleyed Regosols (signifying that they are relatively young and that the soil profile is routinely saturated for an extended period). The northwest part of the park as mapped as Cawston soils, a Rego Gleysol (indicating somewhat greater soil profile development but also routinely saturated). The Kinney soils have a sandy loam or loam texture with some silt lenses, while the Cawston soil is a silt loam (Photo 6).

Because the sites are all located within the municipal boundaries, there are no published agricultural capability maps. All of the sites are located outside of the BC Agricultural Land Reserve.

The school grounds are used by the school students of sports and general play when school is in session, and by the public for recreation without restriction at all other times. The cemetery is open to the public and family visits every day during specified hours. Oliver Community Park is always open to public use. The airport lands are located behind a locked gate, so public access is unlikely. Based on the definitions in the BC Reclaimed Water Guidelines (BC Ministry of Environment 2013), the school grounds, park and cemetery would be considered “High Exposure Potential” while the airport is “Low Exposure Potential”. The school, park and cemetery also would be considered “high public use lands” as per Section 5.1.2 of the OC, while the airport is “low public use lands”. The treatment standard for use of reclaimed water on these sites varies slightly between the regulatory documents (Table 2). The OC requirements are understood to take precedence over the other documents, although Section 5.1.2 says that irrigation shall conform to guidelines developed by BC, so the Reclaimed Water guidelines should also apply (note that it sets limits for *E. coli*, not fecal coliforms).

Table 1 – Soils on the Planned Irrigation Sites

Soil Name	**Rutland**	**Kinney**	**Cawston**	**Ponderosa**
Sites where present	**Airport** (AP), **Schools** (SC)	**Oliver Community Park** (PK)	**Oliver Community Park**	**Cemetery** (CM)
Approximate coverage on sites	AP-100%, SC-100%	PK – 90%	PK- 10%	CM - 100%
Classification	Orthic Dark Brown Chernozem	Gleyed Regosol	Rego Humic Gleysol	Rego Dark Brown Chernozem
Parent material	Sandy veneer over glacial-fluvial deposits	Loamy fluvial veneer over sandy floodplain deposits	Fluvial deposits	Fluvial veneer over fluvial fan deposits
Texture	Sandy loam, loamy sand	Sandy loam/loam with some silt lenses	Silt loam or loam	Gravelly/very gravelly sandy loam or gravelly loam
Drainage	Rapid	Imperfect	Poor to imperfect	Well to rapid
Water holding capacity	Low	Moderate to low	High	Low
Major soil limitations for crops	Stoniness, low available moisture holding capacity, low natural fertility	High water tables near Okanagan River; moderate salinity	Short duration fluctuating groundwater table in sandy & gravelly subsoils during spring freshet	Stoniness; susceptible to soil acidification after several years or irrigation & fertilization

Sources: Government of British Columbia. (2019); Wittneben (1986); Gough et al. (1994).

Table 2
Standards for bacteriological quality of reclaimed water for irrigation

Regulatory Document	School grounds, cemetery & park	Airport
Operational Certificate PE-13717	Maximum 2.2 MPN/100 mL fecal coliforms	Maximum 200 MPN/100 mL fecal coliforms
Reclaimed Water Guideline (BC MoE 2013)	1 CFU/100 mL or 2 MPN/ 100 mL *E. coli*	Not specified
Municipal Wastewater Regulation	Median <1 CFU/100 mL or <2.2 MPN fecal coliforms; maximum 14 CFU/100 mL	Median <200 CFU/100 mL fecal coliforms; maximum 1,000 CFU/100 mL

4. RESULTS OF THE ASSESSMENT

4.1 Soil Properties

The field assessment took place on June 3, 2020. The weather was clear and sunny although there had been some rainfall over the previous several days. The field work was completed by Hugh Hamilton, P.Ag. with the assistance of Ryan Rhodes, P.Geo., of Western Water. At each site, several boreholes were completed with a hand auger to a depth of between approximately 0.3 and 0.7 metres. The characteristics of the soil at each location were noted including the thickness of the upper (A or Ap) horizon, presence/depth of roots, soil texture (by hand), soil colour, presence/absence of mottles (iron staining), and the amount of gravel (based on the Soil Classification Working Group, 1998). In most cases it was not possible to auger beyond about 0.5 m depth because of the amount of gravel in the soil. In addition to the boreholes, we noted the vegetation cover and general drainage patterns, and looked for evidence of water ponding or running off the sites from previous irrigation or rainfall.

The soil properties observed in the field were consistent with the existing BC mapping, indicating that the published soil information (SIFT) can be relied upon for irrigation planning. The key exception is the land on the airport site where the topsoil (likely the Ap horizon[1] or the combined A and B horizons appear to have been stripped off in places, exposing the underlying gravelly BC or C horizon that is characteristic of the Rutland soil (Wittneben 1986). This was confirmed by digging a soil pit or the west side of the fence in the alfalfa field that surrounds the runway, where a dark brown Ap horizon (~0.3 m thick) was present (Photo 8). At the airport site there is considerable gravel exposed on the surface among pockets of thin sandy soil. The vegetation cover is sparse (Photos 7, 9 and 10).

The soils in Oliver Community Park were moist but not saturated at the time of the site visit, and no free water was encountered in any of the auger holes. At depths beyond about 0.15 m the soils were grey-brown in colour with faint mottling, indicating periodic saturation and reducing conditions. These properties may reflect conditions prior to creation of the park and construction of the dike along the Okanagan River. However, a high water table is likely during spring freshet when the river level is high.

---

[1] The "p" in the Ap soil horizon descriptor represent the plow layer, where previous cultivation has typically blended the natural A and part of the natural B horizons.

4.2 Capability for Irrigation

Table 3 shows the monthly average irrigation demand for the soils on the planned irrigation sites. These estimates were generated using the BC Irrigation Calculator[2] for the soil textures confirmed in the field. At the school, cemetery, and park sites the crop is grass, while the crop at the airport was assumed to be alfalfa, like the neighbouring field (alfalfa is currently sporadically present on the new fields – Photo 10). Sprinkler was selected as the irrigation method except at the airport, where a solid set gun was assumed (consistent with the method used on the fields around the runway). The irrigation demand values in Table 3 are presented as cubic metres per hectare per day for the specified month as well as a total volume per hectare for the core May 1 to September 30 irrigation season.

Based on the soil assessment and the irrigation capacity calculations, the school, cemetery, and park sites are all suitable for irrigation with reclaimed water, subject to the regulatory requirements for reclaimed water and assuming best practices are followed for irrigation on public lands (Section 4.3).

It is important to note that the irrigation demand values shown are estimates of average rates based on modelling data and should be used for guidance only. Specific sites may be capable of using more or less water in any specific year depending on the weather. Except for the new areas at the airport, the other sites are currently irrigated, and the Town of Oliver and School Board operators have considerable experience managing the irrigation regime on their sites. In general, the irrigation volumes should be managed to optimize crop growth while meeting the regulations and best practices for the use of reclaimed water. Additional guidance on irrigation operations is provided in the next section.

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[2] On-line at: http://bcwatercalculator.ca/agriculture/irrigation

Table 3
Estimated Average Irrigation Rate by land parcel

Site	**Community Park – N. Part**	**Community Park – Middle Part**	**Community Park – S. Part**	**Airport***	**Cemetery**	**Schools – N. Side**	**Schools – S. Side**
PID	001486683	006278159	026967201	007629583	n/a	001486683	010562401
Dominant Soil	Cawston	Kinney	Kinney	Rutland	Ponderosa	Rutland	Rutland
Irrigation Period**	Apr 27 – Oct 1	Apr 27 – Oct 1	Apr 27 – Oct 1	Apr 26 – Oct 1	Apr 27 – Oct 1	Apr 29 – Oct 1	Apr 29 – Oct 1
VOLUME PER HECTARE	**m^3/ha/day**	**m^3/ha/day**	**m^3/ha/day**	**m^3/ha/day**	**m^3/ha/day**	**m^3/ha/day**	**m^3/ha/day**
April	0.68	0.88	0.85	*0.88*	zero	1.75	0.00
May	32	42	42	*56*	35	42	37
June	56	72	72	*96*	77	72	71
July	71	91	91	*121*	99	91	90
August	59	75	75	*100*	82	75	75
September	37	48	48	*64*	52	48	48
October	53	67	68	*90*	75	67	67
TOTAL MAY-SEPT (m^3/ha)	**7,833**	**10,042**	**10,042**	***13,407***	**10,575**	**10,043**	**9,822**

*Airport values in Italics would apply if the topsoil were intact. Values shown are not appropriate under current conditions and should not be used. See text Section 4.3 for recommendations.

**Irrigation period is from the BC Agriculture Water Calculator. Note that irrigation typically occurs on few days in both April and October. The total volume per hectare for the core May 1 to September 30 irrigation season is intended to provide guidance for irrigation planning purposes.

4.3 Operational Considerations

Irrigation must follow the conditions specified in the OC. Following are the key clauses that apply to new reclaimed water irrigation on the four sites:

- Section 5.1.2 - Disinfection must meet the requirements of the OC (≤2.2 MPN/100 mL fecal coliforms) and the Reclaimed Water Guideline ≤1 CFU/100 mL or ≤2 MPN/ 100 mL *E. coli)*.
- Section 5.2 – The irrigation period is March 15 to October 31.
- Section 5.3 – No reclaimed water shall be applied within 15 m of a stream (e.g. Okanagan River at the park site) or waterbody, or within 30 m of a well used for domestic supply.
- Sections 5.4 and 5.5 – No surface runoff of irrigated runoff shall occur, and no water should emerge from slopes located downgradient of the irrigated areas (known as tail water).
- Section 4.5 – Spray irrigation water must not drift in the air off-site, e.g. as an aerosol.
- Section 5.7.2 – Irrigation should not cause the soils to become saturated or cause soil erosion or instability.

Section 5.7.1 of the OC states that the irrigation rates should follow the 1989 BC Sprinkler Irrigation Manual. That manual was published before the province developed its current irrigation demand models or the BC Agriculture Water Calculator. The irrigation rates shown above in Table 3 are preferred over the single value given for Oliver in the 1989 manual because they are customized for each soil polygon.

In addition, the following practices from the BC Reclaimed Water Guideline (p. 20) should be followed at the **school, cemetery, and park sites**.

- No direct contact shall occur between the reclaimed water and any person while irrigation is underway.
- Residual chlorine should be present in the reclaimed water at the point of use at a concentration of at least 0.5 mg/L.
- There should be signs indicating that reclaimed water is used for irrigation (as per OC Section 3.12.1).
- The movement of irrigation water below the rooting zone to groundwater must be minimized.
- Periodic sampling (i.e. annually) and testing of the reclaimed water for metals and ions (specifically sodium and chloride) should take place, with the results compared to the applicable BC and Canadian water quality guidelines. This is in addition to the testing for BOD, TSS and nutrients under the OC.

At the **airport**, special irrigation management is necessary because of the lack of topsoil and the sparse vegetative cover on the site, which could result in excessive volumes of reclaimed water moving to groundwater rather than being evapotranspired. Irrigation of this site should begin in a limited fashion until it can be demonstrated that irrigation can meet the same guidelines and standards for the other sites, as listed above. The recommended approach is as follows:

- Irrigation of the site should not start before June 15 and should finish by September 10.

- Start with about one-half the prescribed monthly rate from the BC calculator (Table 3; e.g. maximum 60 m^3/ha/day in July). Monitor the to see if the alfalfa and grasses on-site respond with increased growth and expanded surface coverage.
- If feasible, apply a layer (approximately 10 cm) of soil, compost or biosolids before beginning irrigation in the first year. This is to improve water and nutrient retention and to promote vegetative growth. This could begin with a pilot test program on several plots (e.g. three 20 m × 20 m plots) to fine-tune the methodology.
- All other conditions in the OC and the Reclaimed Water Guideline must also apply.

If the vegetation cover becomes better established and an organic litter layer builds up on the surface, the length of the irrigation season and the irrigation rate may be increased at the new airport site until they approach the guidelines for a Rutland soil.

5. CONCLUSIONS AND RECOMMENDATIONS

To conclude, the schoolyard, cemetery, and park sites are all suitable for irrigation with reclaimed water, subject to the regulatory requirements for reclaimed water and assuming best practices are followed for irrigation on public lands (as listed in Section 4.3). The airport lands located east of the existing irrigated lands will require special management if they are to be irrigated with reclaimed water, due to the lack of topsoil and the sparse vegetation. Irrigation can proceed within a limited season only (June 15 to September 10), initially using rates that are about one-half of the BC Agriculture Water Calculator. If the vegetative cover improves and a layer of organic litter develops on the surface, then the schedule and irrigation rates may be re-evaluated. If possible, a layer of soil, biosolids or compost should be applied prior to irrigation to improve water and nutrient retention.

6. CLOSURE

This report was prepared exercising the standard of care, skill and diligence which is reasonably expected within the agrology profession involved in the assignment, in the location of the assignment, as measured by professional standards applicable during the performance of the services. No other warranty or guarantee, expressed, implied or statutory, is made or intended by this report.

I trust this completes this assignment to your satisfaction. Please contact the undersigned at (250) 938-3408 if you have any questions or require additional information.

Sincerely,
Hamilton and Associates

Hugh Hamilton, Ph.D., P.Ag.
Senior Scientist

BRITISH COLUMBIA
B.C.I.A.
Hugh Hamilton, P. Ag.
311
INSTITUTE OF AGROLOGISTS

Attachments: Figures 1-4 and Photographs.

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Gough, N., G. Hughes-Games, and D. Nikkel. 1994. Soil Management Handbook for the Okanagan and Similkameen Valleys. 1st Edition. B.C. Ministry of Agriculture, Fisheries and Food.

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Wittneben, U. 1986. Soils of the Okanagan and Similkameen Valley. Report no. 52, BC Soil Survey. Ministry of Environment. Victoria. 229 pp.

PHOTOGRAPHS

Photo 1. Sports field with turfgrass cover between elementary and high schools.

Photo 2: Typical surface soil (~4-20 cm below surface) at school site.

Photo 3: Lawn area along cemetery boundary, currently irrigated.

Photo 4: Cemetery overview showing unirrigated and irrigated (background) areas.

Photo 5: Oliver Community Park from dike looking northeast.

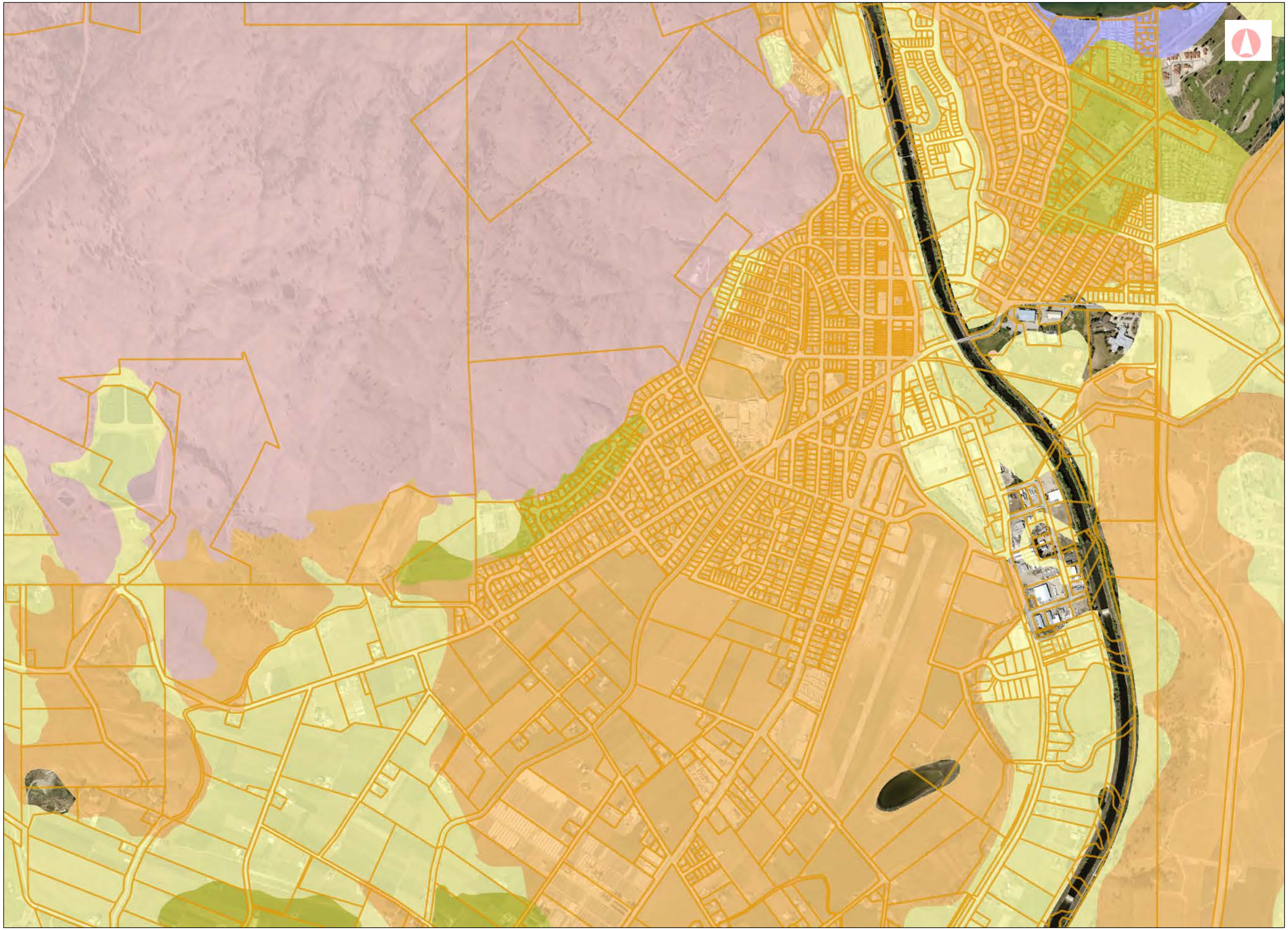
Photo 6: Example of silty soil in north part of Oliver Community Park

Photo 7: Proposed new irrigation area at airport. Note exposed sub-soil and relatively spare vegetative cover [Land on right side of photo may receive some irrigation water from fields near runway (yellow flowers)].

Photo 8: Surface soil in irrigated fields. Note intact dark upper horizon and presence of gravel throughout.

Photo 9: Soil pit on proposed irrigation area at airport. At this location, a residual A/Ap horizon is present. Note fine roots in upper 10 cm.

Photo 10: Ground surface at new airport irrigation area where topsoil may have been partially removed. Note how alfalfa plants are green as their roots obtain moisture from deep within soil.



BRITISH COLUMBIA

iMapBC Mapping

Legend

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Soil Polygons - Parent Mate

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Datum:	NAD83
Projection:	WGS_1984_Web_Mercator_Auxiliary_Sphere

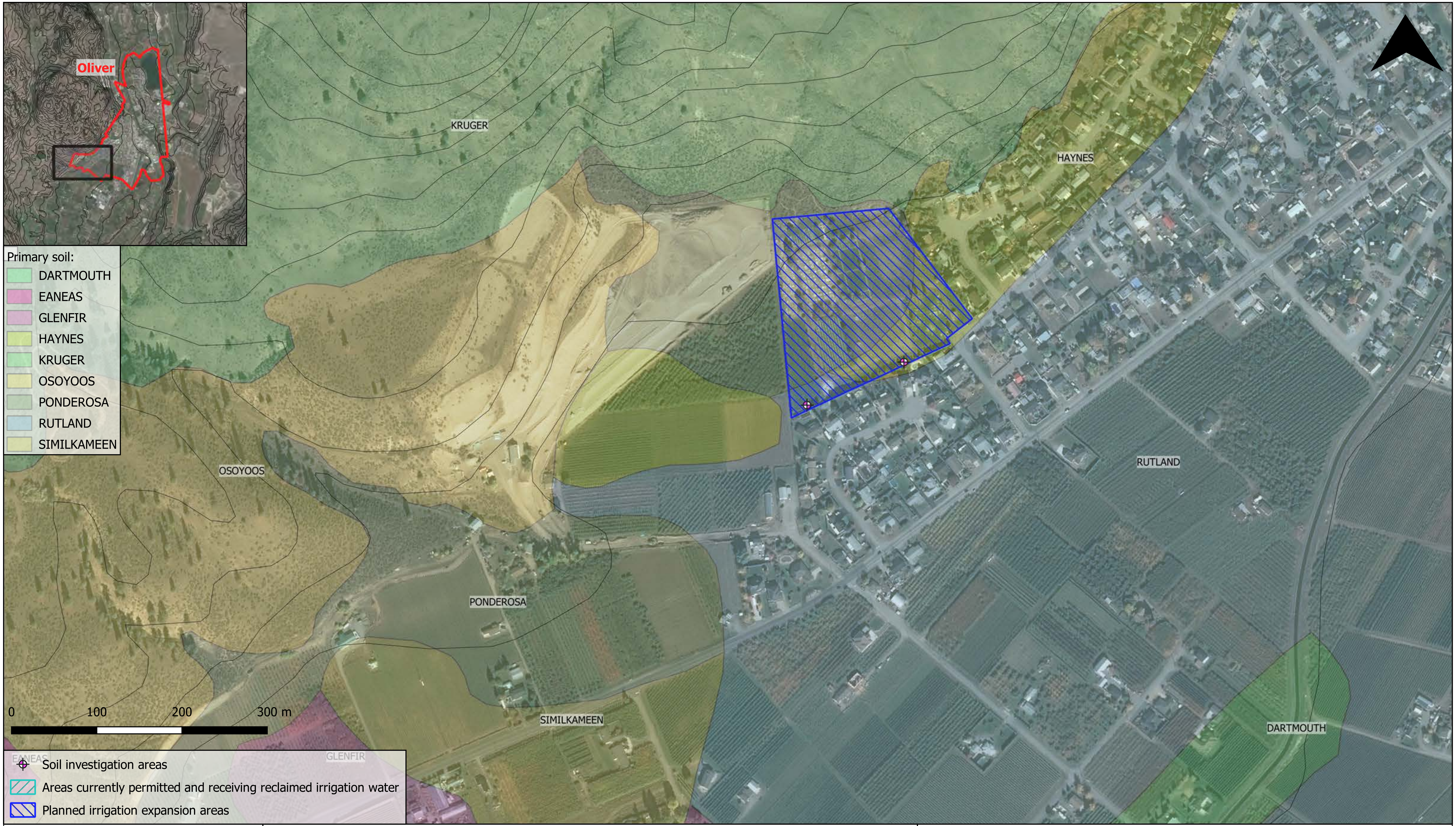
Key Map of British Columbia

Oliver Spray Irrigation Review

western water
ASSOCIATES LTD

TITLE **Figure 1:** School Area		
DRAWN Tim Sivak	DATE June 29, 2020	CLIENT TRUE Consulting Ltd.
REVIEWED Ryan Rhodes	PROJECT NO. 20-046-01VR	REVISION NO. C

Data Sources:	Base plan from publicly available data sources. Soils mapping from National Soils Database.
Contour interval:	20 m
Map Projection:	NAD83 BC Albers (ESPG 3005)
Other notes:	Soil investigation areas recorded with handheld GPS. Current and future spray irrigation areas from TRUE Consulting Ltd.



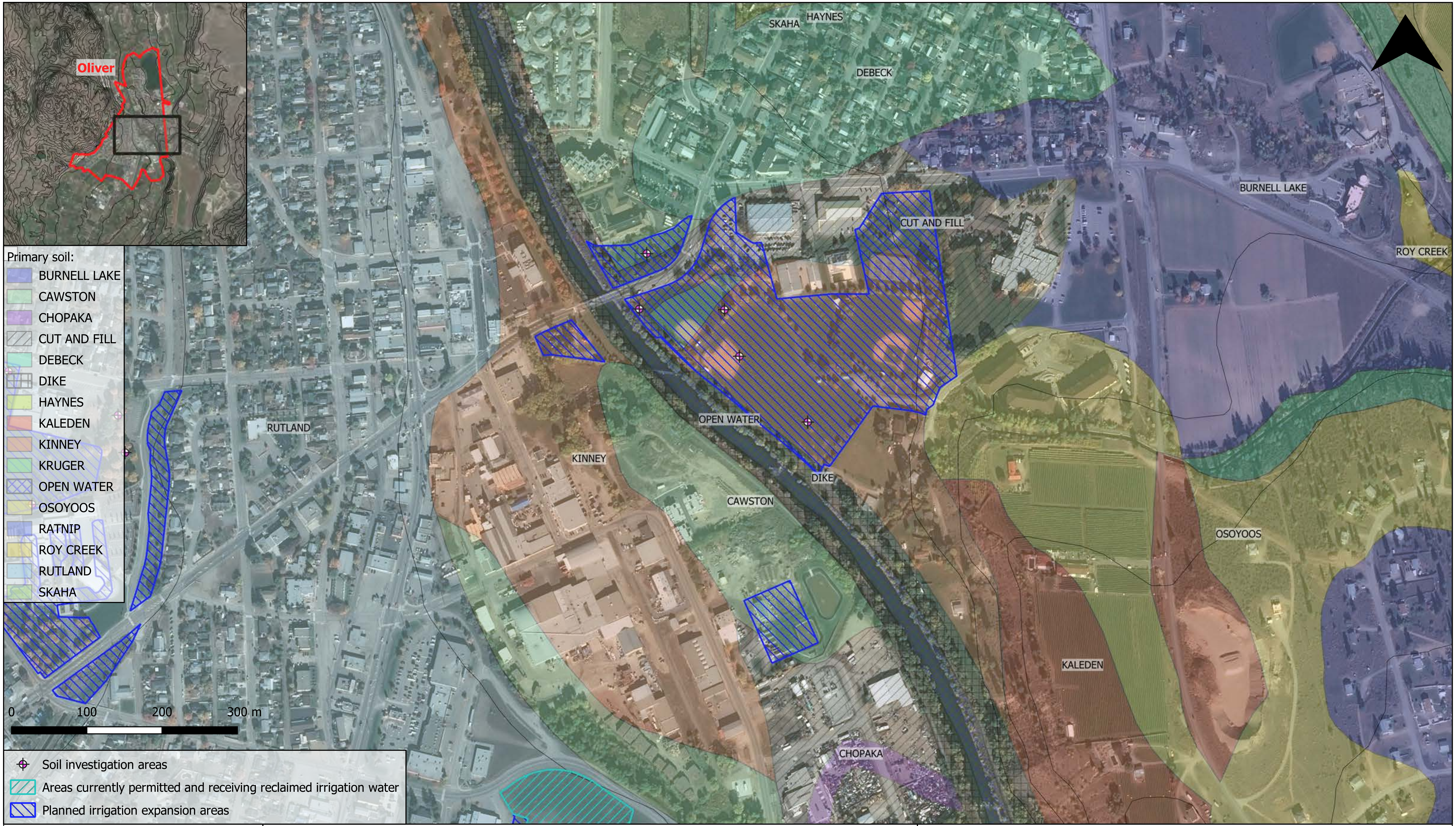
Oliver Spray Irrigation Review

western water
ASSOCIATES LTD

TITLE
Figure 2: Oliver Cemetery Area

DRAWN Tim Sivak	DATE June 29, 2020	CLIENT TRUE Consulting Ltd.
REVIEWED Ryan Rhodes	PROJECT NO. 20-046-01VR	REVISION NO. C

Data Sources: Base plan from publicly available data sources. Soils mapping from National Soils Database.
Contour interval: 20 m
Map Projection: NAD83 BC Albers (ESPG 3005)
Other notes: Soil investigation areas recorded with handheld GPS. Current and future spray irrigation areas from TRUE Consulting Ltd.



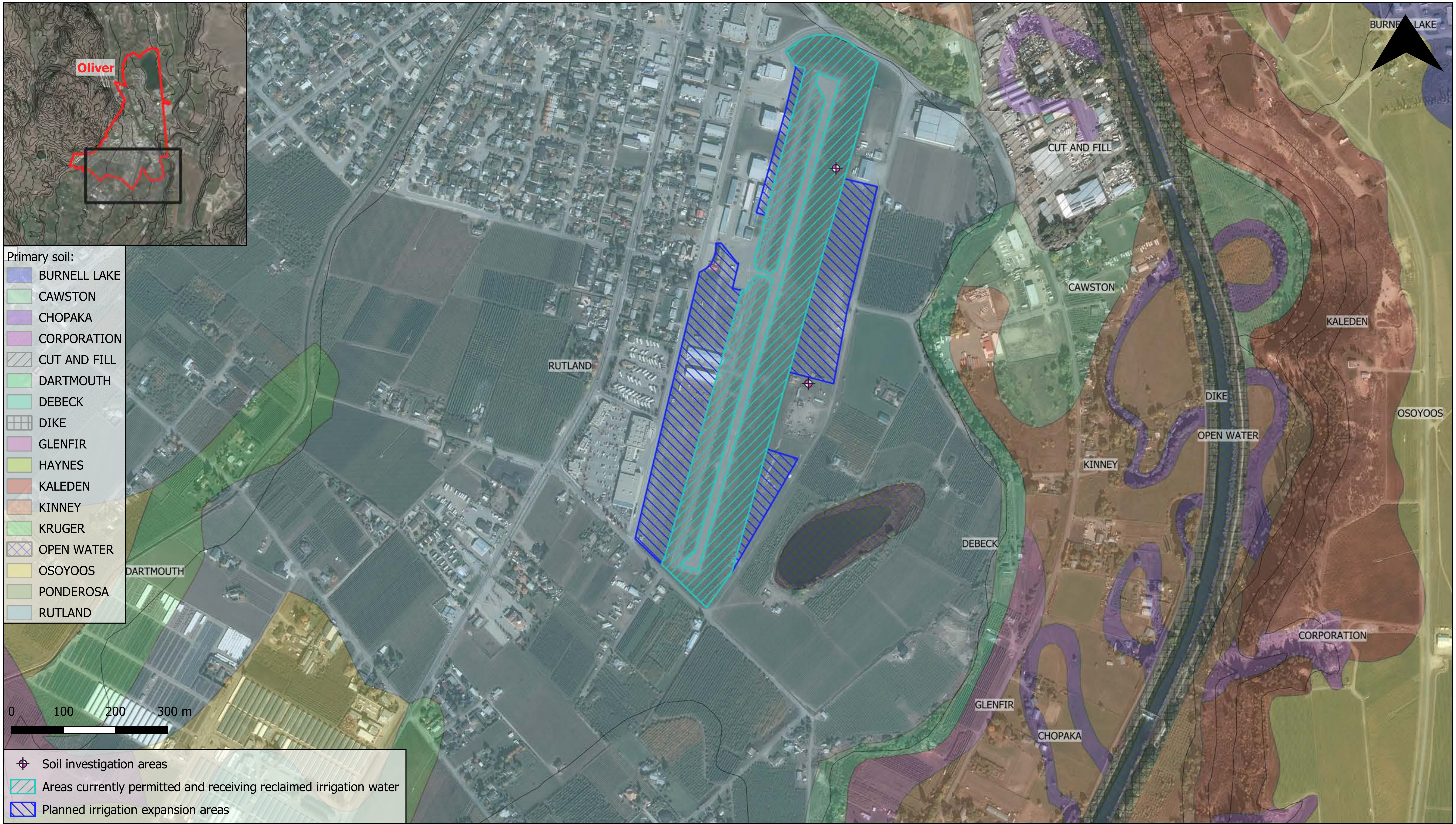
Oliver Spray Irrigation Review

western water
ASSOCIATES LTD

TITLE **Figure 3:** Oliver Community Park & Area

DRAWN Tim Sivak
DATE June 29, 2020
CLIENT TRUE Consulting Ltd.
REVIEWED Ryan Rhodes
PROJECT NO. 20-046-01VR
REVISION NO. C

Data Sources: Base plan from publicly available data sources. Soils mapping from National Soils Database.
Contour interval: 20 m
Map Projection: NAD83 BC Albers (ESPG 3005)
Other notes: Soil investigation areas recorded with handheld GPS. Current and future spray irrigation areas from TRUE Consulting Ltd.



Oliver Spray Irrigation Review

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TITLE
Figure 4: Aiport Area

DRAWN Tim Sivak
DATE June 29, 2020
CLIENT TRUE Consulting Ltd.
REVIEWED Ryan Rhodes
PROJECT NO. 20-046-01VR
REVISION NO. C

Data Sources: Base plan from publicly available data sources. Soils mapping from National Soils Database.
Contour interval: 20 m
Map Projection: NAD83 BC Albers (ESPG 3005)
Other notes: Soil investigation areas recorded with handheld GPS. Current and future spray irrigation areas from TRUE Consulting Ltd.

RUTLAND SOILS (R)

GENERAL COMMENTS

Rutland soils occupy significant areas throughout the Okanagan Valley portion of the map area and also near Keremeos in the Similkameen Valley. Topography is usually level to gently sloping although some terrace scarps are extremely sloping. Soils commonly associated with Rutland soils include Faulder, Dartmouth, Keremos, Oyama and Skaha.

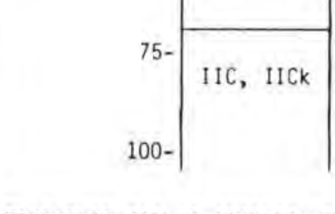
The parent material of Rutland soils is a moderately coarse textured veneer between 10 and 25 cm thick which overlies gravelly and stony, very coarse textured glaciofluvial deposits. Surface soil textures are dominantly sandy loam or loamy sand while subsurface and subsoil textures are gravelly sand or gravelly loamy sand. Stones and cobbles are also common. Rutland soils are classifed as Orthic Dark Brown. They are rapidly drained, rapidly pervious, have slow surface runoff and low water holding capacity.

A very gently sloping area of undeveloped Rutland soils northeast of Oliver.

The main agricultural limitations are gravelly and stony textures, rapid permeability and low water holding capacity. Tree fruits and grapes are presently grown in most cultivated and irrigated areas. Typical native vegetation consists of a variety of grasses, sagebrush, rabbitbrush and scattered Ponderosa pine.

Rutland soils are well suited for urban and related uses. They are rapidly drained, have high bearing capacity and generally level topography. The depth of topsoil is shallow. Effluent from septic field installations may be incompletely filtered by the very gravelly, coarse-textured subsoil.

GENERALIZED RUTLAND SOIL PROFILE



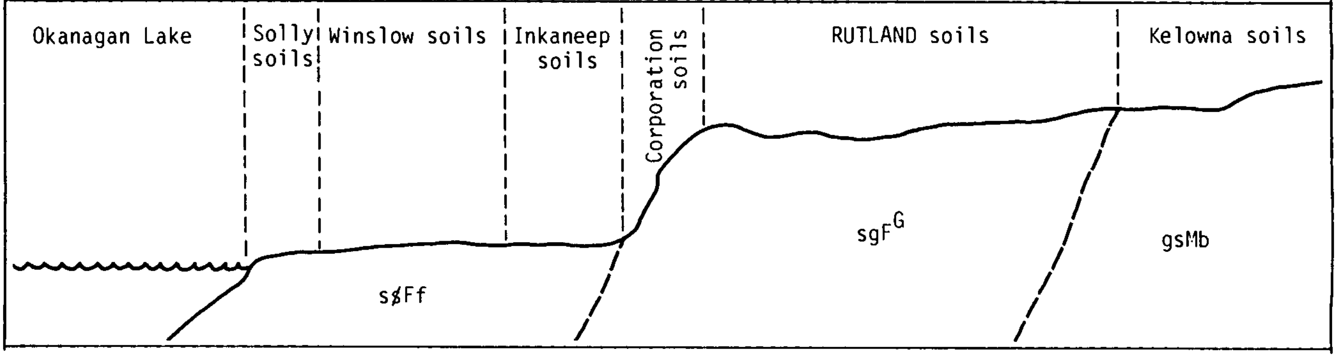
Dark grayish brown or brown (10YR 4/2.5), sandy loam or loamy sand; weak, fine subangular blocky structure; soft consistence.

Brown (10YR 5/3), very gravelly sand or very gravelly loamy sand; weak, very fine subangular blocky structure; soft consistence.

Light gray to brownish-yellow (10YR 7/1-6/6), very gravelly sand; single-grain; loose consistence; weakly calcareous in upper part, grading to moderately calcareous at depth.

TAXONOMIC SOIL CLASSIFICATION: Orthic Dark Brown

RUTLAND SOIL LANDSCAPE CROSS SECTION



SOIL CHARACTERISTICS

DEPTH TO BEDROCK (m)	: >2
PARENT MATERIAL	: fluvioglacial deposits
DEPTH TO FREE LIME (cm)	: >80
SURFACE STONINESS CLASS	: 1-4
DEPTH TO WATERTABLE (m)	: >2
PERVIOUSNESS CLASS	: rapid
SOIL DRAINAGE CLASS	: rapid
DEPTH TO ROOT RESTRICTION (cm)	: none, other than that due to gravelly and strong subsurface textures
TOPOGRAPHY	: mostly nearly level to gentle slopes; some terrace scarps may be extremely sloping

PHYSICAL SOIL PROPERTIES	SOIL DEPTH	
	0-20 cm	>20 cm
UNIFIED TEXTURE SYMBOL	SM	GW-GP
AASHO TEXTURE SYMBOL	A-2-4	A-1
LIQUID LIMIT	NP	NP
PLASTICITY INDEX	NP	NP
SHEAR STRENGTH	medium	high
SOIL TEXTURE	sandy loam, loamy sand	gravelly loamy sand, very gravelly sand
PERMEABILITY	rapid	very rapid
AWSC	low	very low
COARSE >7.5 cm (%)	0-5	10-30
FRAGMENTS <7.5 cm (%)	0-10	30-80
PASSING # 4	60-100	50-80
SIEVES (%) # 40	40-80	1-5
#200	10-40	<4

CHEMICAL SOIL PROPERTIES	SOIL DEPTH	
	0-20 cm	>20 cm
SOIL REACTION (pH) 1:1 H_2O	6.6-7.4	7.2-8.0
1:2 0.01M $CaCl_2$	6.1-6.8	6.8-7.5
SALINITY CLASS	non-saline	non-saline
ORGANIC CARBON	moderate	very low
NITROGEN	low	very low
EXCHANGE CAPACITY	medium	low to very low
EXCHANGEABLE CATIONS - Ca	high	high
- Mg	high	high
- Na	very low	medium
- K	high	low
BASE SATURATION (%)	90-100	100
PHOSPHOROUS	medium	variable
SULFUR	low	low

KINNEY SOILS (KY)

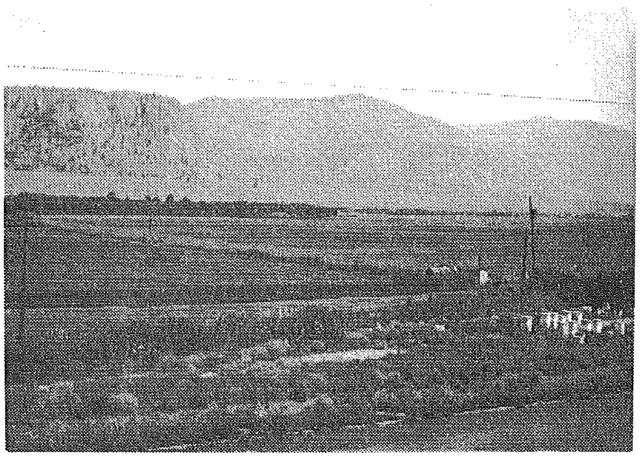
GENERAL COMMENTS

Kinney soils occur on the Okanagan River floodplain between Penticton and Osoyoos Lake. They occupy the slightly higher-lying, nearly level to very gently slopes in association with Chopaka, Cawston and Strutt soils.

Kinney soils have developed in a loamy fluvial veneer, usually between 30 and 80 cm thick, that overlies sandy floodplain deposits. Surface and subsurface textures are sandy loam or loam; the subsoil is loamy sand or sand and sometimes contains thin silty lenses. These Gleyed Regosol soils are imperfectly drained, moderately pervious and have moderate to low water holding capacity. Periodic water tables fluctuate with the level of the Okanagan River.

The main agricultural limitations of Kinney soils are moderately high water tables in late spring and in some areas, moderate salinity in the surface and potential for flooding. Cultivated areas are used for pasture and hay production. Natural vegetation occurs in a few areas and consists of black cottonwood, aspen, willow and scattered Ponderosa pine on slightly elevated dryer sites.

Urban uses of Kinney soils are restricted by periodic high water tables and potential for flooding.



Kinney soils occupy the higher areas on the gently undulating central portion of the photo.

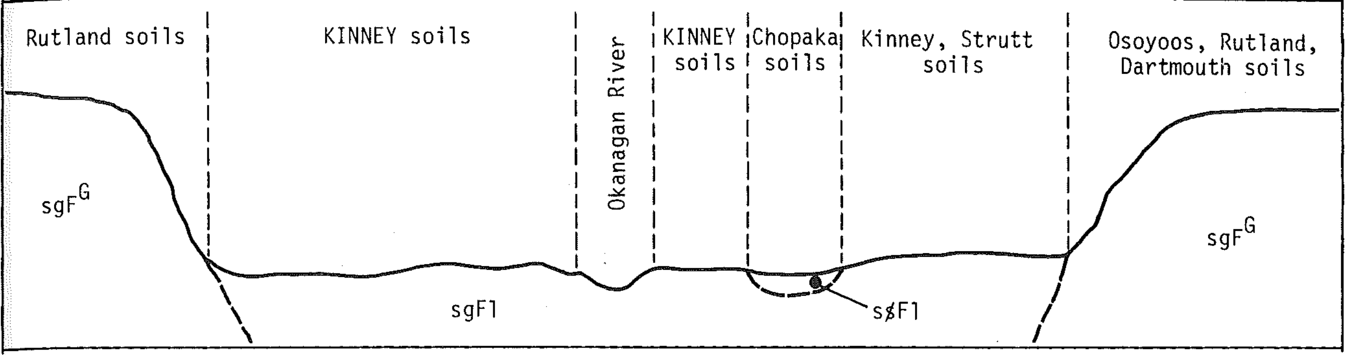
GENERALIZED KINNEY SOIL PROFILE

DEPTH (cm)

0- 25-	Ap,AC	Dark gray or gray (10YR 4.5/1.5), loam or sandy loam; moderate to strong, fine, pseudo-platy structure breaking to moderate to strong, very fine, angular blocky peds; slightly hard consistence; lower part weakly calcareous; sometimes slightly to moderately saline.
50- 75-	Cgj	Pale brown (10YR 6/3), sandy loam; massive, breaking to moderate to strong, medium, angular blocky peds; slightly hard to hard consistence; common, fine, distinct, brownish-yellow (10YR 6/6) mottles.
100-	IICg	Light gray (10YR 6/1), loamy sand or sand; very weak, very fine, subangular blocky structure; very friable consistence; many, medium, distinct, strong brown (7.5YR 5/6) mottles.

TAXONOMIC SOIL CLASSIFICATION: Gleyed Regosol

KINNEY SOIL LANDSCAPE CROSS SECTION



SOIL CHARACTERISTICS

DEPTH TO BEDROCK (m) : >2
PARENT MATERIAL : recent fluvial floodplain deposits
DEPTH TO FREE LIME (cm) : surface is sometimes weakly calcareous, subsoil is generally lime free
SURFACE STONINESS CLASS : 0
DEPTH TO WATERTABLE (m) : fluctuates from about 25 cm to over 1.5 m
PERVIOUSNESS CLASS : moderate
SOIL DRAINAGE CLASS : imperfect
DEPTH TO ROOT RESTRICTION (cm) : 100; water table
TOPOGRAPHY : nearly level and very gentle slopes

PHYSICAL SOIL PROPERTIES	SOIL DEPTH	
	0-100 cm	>100 cm
UNIFIED TEXTURE SYMBOL	ML	SM-SP
AASHO TEXTURE SYMBOL	A-4	A-2-4; A-2
LIQUID LIMIT	10-25 or NP	10-25 or NP
PLASTICITY INDEX	0.1-5 or NP	0.1-5 or NP
SHEAR STRENGTH	medium	medium
SOIL TEXTURE	sandy loam, loam	loamy sand or sand
PERMEABILITY	moderate	rapid
AWSC	moderate	low
COARSE >7.5 cm (%)	0	0
FRAGMENTS <7.5 cm (%)	0	0-5
PASSING # 4	100	100
SIEVES (%) # 40	70-100	60-70
#200	40-70	30-40

CHEMICAL SOIL PROPERTIES	SOIL DEPTH	
	0-100 cm	>100 cm
SOIL REACTION (pH) 1:1 H_2O	7.5-8.4	7.0-7.5
1:2 0.01M $CaCl_2$	7.1-8.0	6.6-7.0
SALINITY CLASS	non to moderately saline	non-saline
ORGANIC CARBON	moderate to low	very low
NITROGEN	low	very low
EXCHANGE CAPACITY	medium	low to very low
EXCHANGEABLE CATIONS - Ca	high	high
- Mg	high	low to medium
- Na	high	low
- K	high	low
BASE SATURATION (%)	100	100
PHOSPHOROUS	variable	very low
SULFUR	high	low to medium

CAWSTON SOILS (CA)

GENERAL COMMENTS

Cawston soils occur on the floodplain of the Similkameen River near Keremeos and Cawston and on the Okanagan River floodplain between Osoyoos Lake and Penticton. These Rego Humic Gleysol soils occupy slightly depressional to very gently sloping lower fluvial terraces, usually in association with Kinney, Chopaka, Gillanders and Keremeos soils.

Cawston soils have developed in medium textured recent fluvial deposits generally between 50 and 100 cm thick overlying moderately coarse textured materials. Surface and subsurface textures are silt loam or loam. Subsoil texture are usually gravelly sandy loam or gravelly loamy sand. The soils are poorly to imperfectly drained. They are moderately pervious, have a high water holding capacity and slow surface runoff.

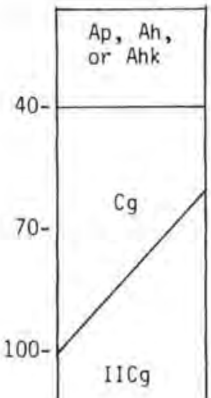
Cawston soils in association with Chopaka and Keremeos soils occupy the gently undulating middle portion of the photo.

Cawston soils are suited for most agricultural crops, particularly if artificial drainage is installed. Most areas are now cleared and cultivated. The more poorly drained areas are mostly used for forage production while the somewhat higher-lying, imperfectly drained areas are used for tree fruits, forages and vegetables. The few, uncleared areas support grasses, cattails, reeds and black cottonwood.

Cawston soils are constrained for urban and similar uses by moderately high water tables which impede basement and other excavations and restrict the operation of septic tank disposal fields.

GENERALIZED CAWSTON SOIL PROFILE

DEPTH (cm)



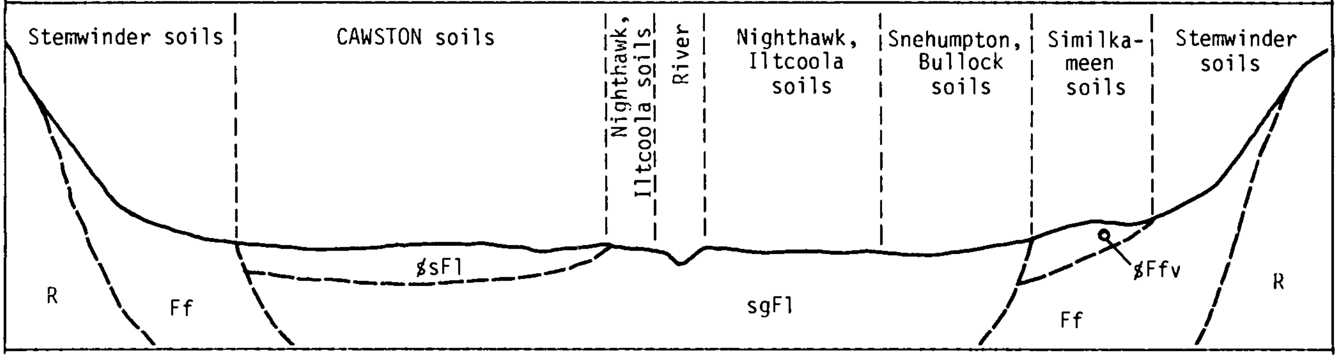
Dark grayish brown (10YR 4/2) to very dark grayish brown (10YR 3/2), silt loam or loam; weak to moderate, very fine subangular blocky structure; very friable consistence; weakly to moderately calcareous; none or few, fine, faint mottles.

Dark grayish brown or very dark grayish brown (10YR 3.5/2), sandy loam to silt loam; weak, fine pseudo-subangular blocky structure; very friable consistence; few, fine, faint mottles.

Dark brown (10YR 3/3) or brown (10YR 4/3), gravelly sandy loam to very gravelly loamy sand; weak, medium, pseudo-angular blocky structure or single-grain; loose or very friable consistence; few, coarse, prominent mottles.

TAXONOMIC SOIL CLASSIFICATION: Rego Humic Gleysol

CAWSTON SOIL LANDSCAPE CROSS SECTION



SOIL CHARACTERISTICS

DEPTH TO BEDROCK (m) : >2
PARENT MATERIAL : recent fluvial floodplain deposits
DEPTH TO FREE LIME (cm) : weakly to moderately calcareous in surface layer
SURFACE STONINESS CLASS : 0
DEPTH TO WATERTABLE (m) : fluctuating, ranges from 50 cm to >1 m.
PERVIOUSNESS CLASS : moderate
SOIL DRAINAGE CLASS : dominantly poor, ranging to imperfect
DEPTH TO ROOT RESTRICTION (cm) : 80; water table
TOPOGRAPHY : nearly level and very gentle slopes

PHYSICAL SOIL PROPERTIES	SOIL DEPTH		
	0-40 cm	40-80 cm	>80 cm
UNIFIED TEXTURE SYMBOL	ML-CL	SM-ML	GP, GM
AASHO TEXTURE SYMBOL	A-6; A-4	A-6; A-4; A-2-4	A-1
LIQUID LIMIT	30-35	25-35	NP
PLASTICITY INDEX	1-15	1-12	NP
SHEAR STRENGTH	medium to low	low to medium	high
SOIL TEXTURE	loam, silt loam	silt loam to sandy loam	very gravelly loamy sand, gravelly sandy loam
PERMEABILITY	moderate	moderate	rapid
AWSC	moderate	moderate to low	very low
COARSE >7.5 cm (%)	0	0	5-10
FRAGMENTS <7.5 cm (%)	0	0-5	35-60
PASSING # 4	100	100	5-10
SIEVES # 40	60-80	60-80	<5
#200	40-60	50-70	<2

CHEMICAL SOIL PROPERTIES	SOIL DEPTH		
	0-40 cm	40-80 cm	>80 cm
SOIL REACTION (pH) 1:1 H_2O	7.9-8.0	7.7-8.0	7.8-8.4
1:2 0.01M $CaCl_2$	7.6-8.0	7.4-7.6	7.6-8.0
SALINITY CLASS	non to very weakly saline	non-saline	non-saline
ORGANIC CARBON	moderate	very low	very low
NITROGEN	medium to high	very low	very low
EXCHANGE CAPACITY	high	medium	low to very low
EXCHANGEABLE CATIONS - Ca	high	high	high
- Mg	high	medium to high	low
- Na	low	low	low
- K	high	moderately high	low
BASE SATURATION (%)	100	100	100
PHOSPHOROUS	very low	very low	very low
SULFUR	moderately high	moderately high	moderately high

PONDEROSA SOILS (PO)

GENERAL COMMENTS

Ponderosa soils occur only in the vicinity of Oliver. They occupy nearly level to moderately sloping areas in association with Rutland, Glenfir, Ratnip and Burnell Lake soils.

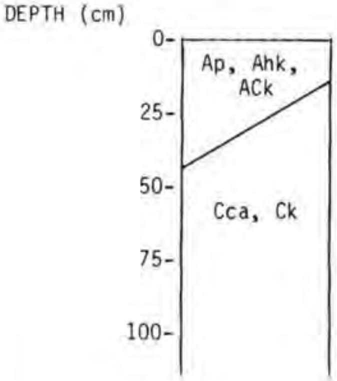
Ponderosa soils have developed in a gravelly, moderately coarse textured fluvial veneer between 10 and 50 cm thick, overlying gravelly coarse textured fluvial fan deposits. Surface and subsurface textures are gravelly or very gravelly sandy loam or gravelly loam; subsoils are very gravelly loamy sand. These Rego Dark Brown: calcareous phase soils are well to rapidly drained, rapidly pervious and have low water holding capacity.

Almost all areas of Ponderosa soils are cleared, cultivated and planted to tree fruits and vineyards. Small, scattered, uncleared areas located on steep slopes support scattered Ponderosa pine, sagebrush and grass in the understory.

Except for a few steeply sloping areas, Ponderosa soils are moderately well suited for most urban and related uses. Incomplete septic tank effluent filtration may occur in the coarse-textured subsoils.

A typical view of moderately sloping Ponderosa soils near Oliver.

GENERALIZED PONDEROSA SOIL PROFILE

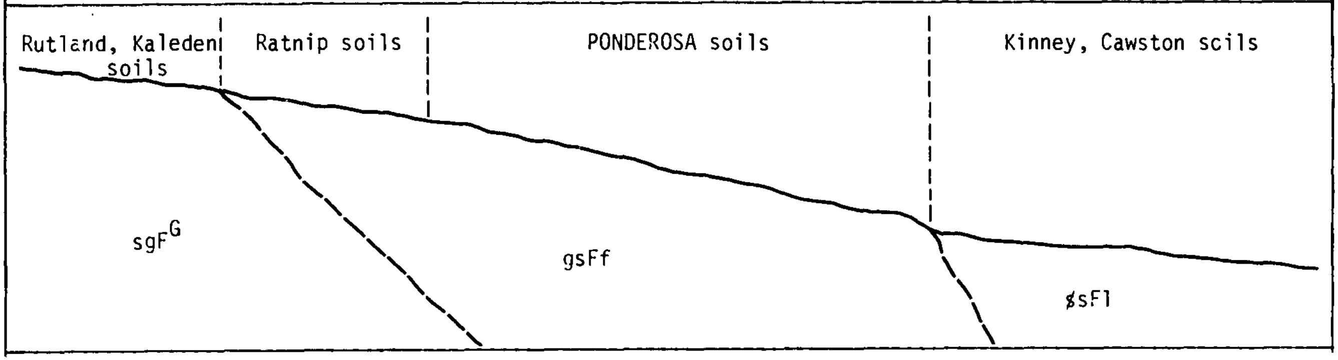


Dark grayish brown (10YR 4.5/2.5), gravelly sandy loam; weak, fine to very fine, granular structure; very friable consistence; moderately calcareous.

Pale brown (10YR 5.5/3 - 6/3.5), very gravelly loamy sand; weak, fine subangular blocky structure; very friable to firm consistence; strongly calcareous.

TAXONOMIC SOIL CLASSIFICATION: Rego Dark Brown: calcareous phase

PONDEROSA SOIL LANDSCAPE CROSS SECTION



SOIL CHARACTERISTICS

DEPTH TO BEDROCK (m) : >2
PARENT MATERIAL : fluvial fan deposits
DEPTH TO FREE LIME (cm) : calcareous to surface
SURFACE STONINESS CLASS : 0-3
DEPTH TO WATERTABLE (m) : >2
PERVIOUSNESS CLASS : rapid
SOIL DRAINAGE CLASS : well to rapid
DEPTH TO ROOT RESTRICTION (cm) : none
TOPOGRAPHY : nearly level to moderate slopes

PHYSICAL SOIL PROPERTIES	SOIL DEPTH	
	0-50 cm	>50 cm
UNIFIED TEXTURE SYMBOL	GM-GC	GM-GP
AASHO TEXTURE SYMBOL	A-1	A-1
LIQUID LIMIT	15-25 or NP	NP
PLASTICITY INDEX	0.1-5 or NP	NP
SHEAR STRENGTH	high to medium	high to medium
SOIL TEXTURE	very gravelly sandy loam to gravelly loam	very gravelly loamy sand
PERMEABILITY	rapid	very rapid
AWSC	moderate to low	low
COARSE >7.5 cm (%)	5-15	20-40
FRAGMENTS <7.5 cm (%)	20-75	30-60
PASSING # 4	50-80	30-50
SIEVES (%) # 40	20-30	5-20
#200	5-10	<2

CHEMICAL SOIL PROPERTIES	SOIL DEPTH	
	0-50 cm	>50 cm
SOIL REACTION (pH) 1:1 H_2O	7.8-8.1	8.0-8.5
1:2 0.01M $CaCl_2$	7.4-7.6	7.5-7.8
SALINITY CLASS	non-saline	non-saline
ORGANIC CARBON	moderate	low
NITROGEN	low to very low	very low
EXCHANGE CAPACITY	low	low to very low
EXCHANGEABLE CATIONS - Ca	high	high
- Mg	low	medium to high
- Na	very low	very low
- K	medium	moderately high
BASE SATURATION (%)	100	100
PHOSPHOROUS	very low	very low
SULFUR	low	medium

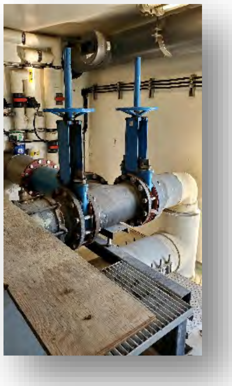
APPENDIX L

Oliver Sanitary Sewer System Contingency Plans

Sanitary Sewer System Contingency Plans

Town of Oliver

INCORPORATED 75 YEARS | 1945-2020
Town of Oliver
CANADA'S WINE CAPITAL



TRUE

April 2020

Project No. 306-089

ENGINEERING ■ PLANNING ■ URBAN DESIGN ■ LAND SURVEYING

201-2079 Falcon Rd | Kamloops BC | V2C 4J2 | www.true.bc.ca | tel 250.828.0881 | fax 250.828.0717

Distribution List

# of Hard Copies	*PDF Required*	*Association / Company Name*
	1	Ministry of Environment
2	1	Town of Oliver
1	1	TRUE Consulting

Revision Log

Revision #	*Revised by*	*Date*	*Issue / Revision Description*

Report Submission

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April 21 2020

Steve Underwood, P. Eng.
Project Engineer

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Executive Summary

Enclosed herein are Contingency Plans for system works associated with the Town of Oliver's Sanitary Sewer Treatment System operated under Operational Certificate PE 13717. Per Section 3.7 of the Operational Certificate. This plan addresses the appropriate course of action to be taken in any particular preconceived emergency situation. This plan includes chlorine leaks and any potential point of concern to the collection, treatment and disposal systems.

Attention is given to public safety and the protection of the environment. This plan should be continually updated to reflect the most current operation. Revisions to the Contingency Plan are to be forwarded to the Regional Waste Manager.

This document has been prepared by the Town of Oliver's Operations Department and TRUE Consulting.

1.0 Berm or Dam Failure at the Wastewater Treatment Plant

In the event of a berm or dam failure at the wastewater treatment plant, the following contingency plan is to be put into action.

At the time that a berm or dam failure at the wastewater treatment plant is discovered, the following procedures will be followed:

1. Assess the extent of the damage, leak or failure.
2. Do not disturb any physical evidence that may exist.
3. Arrange for any temporary measures that may be required such as supporting, ditching, damming, etc.
4. Notify the Director of Operations.
5. Notify the RCMP if the damage is the result of accident, vandalism or criminal activity.
6. Summon a qualified Geo-Technical Engineer to review the design drawings and provide recommendations.
7. Notify the CAO, Mayor, and Council.
8. Notify the appropriate insurance company for the Town (ie. liability or boiler and machinery insurance).

Considerations:

- Is there any immediate down slope risk to life or property? If so, notify the effected parties immediately.
- Given the location of the leak, does the O & M Manual refer to any alternate operating modes that will minimize the leak or risk of total failure? (ie. Lowering the level in the aeration cells.) If so, follow the instructions in the O & M Manual carefully.

2.0 Blower Failure at Aerated Lagoons

In the event of a blower failure, the following contingency plan is to be put into action.

At the time that a blower failure at the aerated lagoons is discovered, the following procedures will be followed:

1. Refer to O & M Manual.
2. Assess whether or not the blower(s) can be restarted.
3. Summon Sewer Operators as required.
4. Take dissolved oxygen (DO) readings in the aeration cells. Begin to monitor and record any reduction in the DO readings.

Considerations:

- Consider how many units are operating or failed vs. how many are required to maintain the DO. ie. Is there standby capacity available? Are any of the blowers operable?
- Assess the DO readings and evaluate how long it may take before degradation of the effluent quality may be noted. Seek professional assistance with this if required.
- Assess whether or not the blower unit or motor will require work at an off-site repair shop. If so, make necessary arrangements to confirm that those repair shops will provide an expedited emergency level of service. eg. AC Motor Electric or Mearl's Machine.
- Does it appear that the failure will cause degradation of the effluent quality? If so, take the following steps:
    - Consider how a temporary aerating system can be devised using gas powered compressors and PVC pipe.
    - Notify the Ministry of Environment.

3.0 Chlorine Leak

In the event of a chlorine leak, the following contingency plan is to be put into action.

At the time that a chlorine leak is discovered, the following procedures will be followed:

1. Notify their Supervisor (Director of Operations) and/or the Public Works Office by the fastest means possible. The Director of Operations will then notify the CAO and Mayor and Council.
2. The employee who has received training in the emergency and handling procedures of chlorine will take charge of the situation until such time that a more trained and qualified person arrives at the scene who may then take charge.

The person taking charge will:

1. Stay calm and assess the situation.
2. Establish 2-way communication between the scene and the Public Works office via cell phone or 2-way radio. If a municipal 2-way radio is not at the scene, request the Public Works office to have one sent to the scene immediately. If there is no one available at the Public Works office, contact the Municipal Hall.
3. Direct the Public Works Clerk to stay at the radio and the phone until the emergency is over.
4. Based on the training of the person in charge and his assessment of the emergency, he will instruct the Public Works Clerk to summon the people and agencies listed below as required by the severity of the situation. The phone numbers of these people have been posted beside the radio base station at the Municipal Hall and the base station at the Fire Hall.
5. Evacuate the lower areas and down wind of the chlorine leak.
6. Erect barricades to roadways surrounding the chlorine leak, lower areas and down wind of the chlorine leak.

AGENCIES THAT WILL ASSIST IN A CHLORINE EMERGENCY

a)	Oliver Fire Department	911
b)	Police and ambulance	911 or 250-498-3422
c)	**Provincial Emergency Program***	**1-800-663-3456**
d)	Brenntag Canada Inc. Emergency #	1-604-685-5036 (24/7)
e)	Transport Canada Emergency #	1-613-996-6666

***Provincial Emergency Program must be notified**

NOTE: SCBA's are maintained by the Oliver Fire Department and available at all times when responding to an emergency situation.

4.0 Effluent Forcemain Leak

In the event of an effluent force main leak the following contingency plan will be put into action.

At the time that an effluent force main leak is discovered, the following procedures will be followed:

1. Turn off and lock out all pumps in the High Lift Pump Station.
2. Isolate main line valves, where appropriate.
3. Assess whether or not the failure has resulted in any damage to the environment or property damage. If so, make the necessary arrangements to minimize the damage.
4. Barricade any unsafe areas.
5. Refer to the O & M Manual for more information.
6. Summon Public Works staff and contractors to make repairs.
7. Assess how long the repair time will be and whether or not there is sufficient standby storage capacity in the equalization basin and abandoned concrete holding cells.

Considerations:

- Is traffic control required?
- Has the break occurred within a Provincial road? If so, notify the Ministry of Highways or Highway Maintenance Contractor.
- Has there been damage to the environment? If so, contact the following:
    - Director of Operations.
    - Provincial Emergency Program.
    - Regional Waste Manager.
- Is the available standby storage capacity sufficient to accept the influent flow for the duration of the pipeline repair? If not, consider the following:
    - Will it be necessary to notify the public requesting them to minimize discharge into the sewer system?
    - Will hydro vac tank trucks be required? If so, make standby arrangements.
    - Will arrangements be necessary with neighboring municipalities to accept sewage transported by truck?

4.1 Reclaimed Effluent Forcemain Conversion to Effluent Forcemain

If the storage capacity is not sufficient and the repair will take an extended period of time. The reclaimed effluent forcemain can be used to bypass the break. The following is the start up procedure:

1. Close reclaimed water service valves at:

   Check Box

   - 1.1 Public Works Yard ☐
   - 1.2 Airport Irrigation ☐
   - 1.3 Oliver Secondary ☐
   - 1.4 Oliver Cemetery ☐
   - 1.5 Alonso Vineyard ☐
   - 1.6 Fairview Golf Course ☐
2. Open normally closed valve in street adjacent to the High Lift Station and close corresponding normally open valve. Valves show on TRUE record drawing 306-961-14 (Detail C).
3. Open PRV bypass valve and close PRV isolation valve at Fairview Park. Valve shown on TRUE record drawings 306-961-17 and 306-961-16.
4. Open normally closed interconnect valve at Topping lake access and close corresponding normally open valve. Valve shown on TRUE record drawing 306-961-01 (Detail A).
5. Restart High Lift Station. Monitor discharge pressure. Note: Flow rate will be reduced. The station will need to run outside of normal operation hours.
6. When repair is complete, reverse the above valve sequence. Rinse line with treated effluent through blow-off at High Lift to Equalization Basins. Re-open reclaimed water service supplies.

5.0 Extended Power Outage (Over ½ Hour)

In the event of an extended power outage over ½ hour, the following contingency plan is to be put into action.

At the time that an extended power outage is discovered, the following procedures will be followed:

1. Attempt to contact Fortis at 1-866-436-7847, to find out if they have been advised how long the outage will be?
2. Evaluate how the outage may impact the operation of all components of the Sanitary Sewer System.
3. Check to see if generator is operating in Sewer Treatment Plant.

Considerations:

- Will it be necessary to take action to prevent property damage or damage to the environment? If so, review the emergency procedure for that particular component of the system.
- Use generator for lift stations, start Rockcliffe and then check the rest of the lift stations.
- Will hydro vac tank trucks be required? If so, make standby arrangements.
- Will arrangements be necessary with neighboring municipalities to accept sewage transported by truck?
- The stationary generator located in the Sewer Treatment Plant (STP) building will power the STP, sewer screen, washer compactor, lights, and the influent lift station in the event of a power outage.

6.0 Influent Lift Station Failure

In the event of an influent lift station failure, the following contingency plan is to be put into action.

At the time that the influent lift station failure is discovered, the following procedures will be followed:

1. Check to see if the back-up generator is operating.
2. Assess whether or not the failure has resulted in any damage to the environment or property damage. If so, make the necessary arrangements to minimize the damage.
3. Assess the cause of the failure. Is it electrical or mechanical in nature?
4. Assess whether or not there is any information in the O & M Manual that would provide any insight into the problem.
5. Assess whether or not the station can be restarted.
6. Summon Public Works staff, Electrical Contractor and /or power utility for assistance as required.

Considerations:

- Is the failure due to loss of power from the power utility? If so, is the standby generator operating?
- Will it be necessary to notify the public requesting them to minimize discharge into the sewer system?
- Will hydro vac tank trucks be required? If so, make standby arrangements.
- Will arrangements be necessary with neighboring municipalities to accept sewage transported by truck?

Note: Electric Motor & Pump Service in Kelowna maintains a broad inventory of Flygt Pumps for emergency purposes (1-888-837-3677).

7.0 Neighbourhood Lift Station Pump Failure

In the event of a neighborhood lift pump station failure, the following contingency plan is to be put into action.

At the time that a neighborhood lift pump station failure is discovered, the following procedures will be followed:

1. If no power contact another Operator and get standby generator on site.
2. Assess whether or not the failure has resulted in any damage to the environment or property. If so, make the necessary arrangements to minimize the damage.
3. Assess the cause of the failure. Is it electrical or mechanical in nature?
4. Assess whether or not there is any information in the O & M Manual that would provide any insight into the problem.
5. Assess whether or not the station can be restarted.
6. Summon Public Works staff and /or contractors or the power utility for assistance as required.

Considerations:

- Has there been any damage to the environment? If so, notify the Director of Operations and advise that the Provincial Emergency Program ("PEP") and the Ministry of Environment
- Has there been any property damage? If so, notify the Director of Operations (or alternate) to deal with potential liability issues.
- Is there power to the lift station? If not, is it a localized or an area wide outage? Who needs to be summoned to restore the power supply?
- Attempt to contact Fortis at 1-866-436-7847, to find out if they have been advised how long the outage will be?
- What is the rate of flow coming into the pump station?
- How much storage capacity can be utilized in the collection system before damage to the environment or property damage may result?
- As a temporary measure, should the water supply to the neighborhood be temporarily turned off in order to limit the amount of in-flow into the station?
- Will hydro vac trucks / tank trucks be required to haul sewage? If so, make the appropriate arrangements.

8.0 Reclaimed Water Supply Main Leak

In the event of a reclaimed water supply main leak, the following contingency plan is to be put into action.

At the time that a reclaimed water supply main leak is discovered, the following procedures will be followed:

1. Isolate the break.
2. Isolate the main line valves.
3. Barricade any unsafe areas.
4. Summon Public Works staff and / or contractors to make repairs.
5. Notify all large reclaimed irrigation customers if the break occurs during the irrigation season.

Considerations:

- Is traffic control required?
- Has the break occurred within a Provincial road? If so, notify the Ministry of Highways or Argo Road Maintenance.
- Is there property damage? If so, notify the Director of Operations or alternate.
- Will the break disrupt water supply to any fire hydrants beyond the end of the workday? If so, notify the Fire Department and the owners of any private fire hydrants so that they can notify their insurance company. ie. Fairview Mountain Golf Course and South Okanagan Secondary School (SOSS).

9.0 Major Gravity Main Collapse

In the event of a collapse or a major joint separation, the following contingency plan is to be put into action.

At the time that an effluent force main leak is discovered, the following procedures will be followed:

1. Summon Public Works staff to access the situation and turn plug affected main.
2. Summon a hydro vac truck to remove buildup of sanitary flow before the plugged affected area.
3. Assess whether or not the failure has resulted in any damage to the environment or property damage. If so, make the necessary arrangements to minimize the damage.
4. Barricade any unsafe areas.
5. Assess how to set up by-pass pumping into the next manhole down the main flow that is damaged.
6. Summon Public Works staff and contractors to make repairs.

Considerations:

- Is traffic control required?
- Has the break occurred within a Provincial road? If so, notify the Ministry of Highways or Argo Road Maintenance.
- Has there been damage to the environment? If so, contact the following:
    - Director of Operations.
    - Provincial Emergency Program.
    - Regional Waste Manager.

10.0 High Lift Station Electrical Fire

In the event of a collapse or a major joint separation, the following contingency plan is to be put into action.

At the time that the High Lift Station Electrical Fire is discovered, the following procedures will be followed:

1. Summon the power utility to disconnect the power and summon the Fire Department to extinguish the fire.
2. If the power is disconnected then the fire can be extinguished.
3. Assess whether or not the electrical fire has resulted in any damage to the environment or property damage. If so, make the necessary arrangements to minimize the damage.
4. Summon an electrical contractor to assess the cause of the electrical fire and to repair the High lift Station.
5. Assess whether or not there is any information in the O & M Manual that would provide any insight into the problem.
6. Assess whether or not the station can be restarted.
7. Summon Public Works staff and/or contractors or the power utility for assistance as required.

Considerations:

- Has there been any damage to the environment? If so, notify the Director of Operations and advise that the Provincial Emergency Program ("PEP") and the Ministry of Environment
- Has there been any property damage? If so, notify the Director of Operations (or alternate) to deal with potential liability issues.
- Is there power to the lift station? If not, is it a localized or an area wide outage? Who needs to be summoned to restore the power supply?
- What is the rate of flow coming into the pump station?
- How much storage capacity can be utilized in the collection system before damage to the environment or property may result?
- As a temporary measure, should the water supply to the neighborhoods be temporarily turned off in order to limit the amount of in-flow into the station?
- Will hydro vac trucks / tank trucks be required to haul sewage? If so, make the appropriate arrangements.
- Will arrangements be necessary with neighboring municipalities to accept sewage transported by truck?

11.0 Influent Screen Failure

In the event of an Influent Screen Failure at the wastewater treatment plant, the following contingency plan is to be put into action.

At the time that the Influent Screen Failure at the wastewater treatment plant is discovered, the following procedures will be followed:

1. Summon Public Works to switch the Influent Screen to the back-up Drum Screen.
2. Check to see if the back-up generator is operating.
3. If both screens happen to be broken, a 6" self-priming pump would be required outside the Main Influent Lift Station in the manhole outside, upstream and bypass the Main Influent Station and pumped directly into the Equalization Basin #1.
4. Assess whether the Influent Screens can be repaired and schedule a trash bin to be emptied every two (2) weeks as a minimum.
5. Assess whether or not there is any information in the O & M Manual that would provide any insight into the problem.
6. Flushing device will clean screens, ensure after screen replacement that the flushing device is operational
7. Summon Public Works staff and contractors to make repairs.

Considerations:

- Has there been any damage to the environment? If so, notify the Director of Operations and advise that the Provincial Emergency Program ("PEP") and the Ministry of Environment
- Has there been any property damage? If so, notify the Director of Operations (or alternate) to deal with potential liability issues.
- Is there power to the Influent Screen? If not, is it a localized or an area wide outage? Who needs to be summoned to restore the power supply?
- What is the rate of flow coming into the Wastewater Treatment Plant?
- How much storage capacity can be utilized in the collection system before damage to the environment or property damage may result?

12.0 Contact Pond Failure

In the event of a Contact Pond Failure at Topping Lake, the following contingency plan is to be put into action.

At the time that the Contact Pond Failure at Topping Lake is discovered, the following procedures will be followed:

1. Assess the extent of the damage, leak or failure.
2. Do not disturb any physical evidence that may exist.
3. Arrange for any temporary measures that may be required such as supporting, ditching, damming, etc.
4. Notify the Director of Operations.
5. Notify the RCMP if the damage is the result of accident, vandalism or criminal activity.
6. Summon a qualified Geo-Technical Engineer to review the design drawings and provide recommendations.
7. Notify the CAO, Mayor, and Council.
8. Notify the appropriate insurance company for the Town (ie. liability or boiler and machinery insurance).

Considerations:

- Is there any immediate down slope risk to life or property? If so, notify the effected parties immediately.
- Given the location of the leak, does the O & M Manual refer to any alternate operating modes that will minimize the leak or risk of total failure? (ie. Lowering the level in the Contact Ponds.) If so, follow the instructions in the O & M Manual carefully.

13.0 Topping Lake Aeration Building Failure

In the event of Topping Lake Pump House Failure, the following contingency plan is to be put into action.

At the time Topping Lake Pump House Failure at Topping Lake is discovered, the following procedures will be followed:

1. Assess whether or not the failure has resulted in any damage to the environment or property damage. If so, make the necessary arrangements to minimize the damage.
2. Assess the cause of the failure. Is it electrical or mechanical in nature?
3. Assess whether or not there is any information in the O & M Manual that would provide any insight into the problem.
4. Assess whether or not the blower(s) can be restarted.
5. Take dissolved oxygen (DO) readings in the aeration cells. Begin to monitor and record any reduction in the DO readings.
6. Assess whether or not the station can be restarted.
7. Summon Public Works staff, electrical contractor and/or power utility for assistance as required.

Considerations:

- Is the failure due to loss of power from the power utility?
- Will it be necessary to notify the public requesting them to minimize discharge into the sewer system?
- Will hydro vac trucks / tank trucks be required? If so, make standby arrangements.
- Will arrangements be necessary with neighboring municipalities to accept sewage transported by truck?

Note: Electric Motor & Pump Service in Kelowna maintains a broad inventory of Flygt Pumps for emergency purposes (1-888-837-3677).

14.0 High Lift Diversion Structure Failure

In the event of the Diversion Structure Failure, the following contingency plan is to be put into action.

At the time of the Diversion Structure Failure at wastewater treatment plant is discovered, the following procedures will be followed:

1. Assess the extent of the damage, leak, collapse or failure.
2. Do not disturb any physical evidence that may exist.
3. Arrange for any temporary measures that may be required such as supporting, damming, or by-pass pumping, etc.
4. Notify the Director of Operations.
5. Notify the RCMP if the damage is the result of accident, vandalism or criminal activity.
6. Summon a qualified Geo-Technical Engineer to review the design drawings and provide recommendations.
7. Notify the CAO, Mayor, and Council.
8. Notify the appropriate insurance company for the Town (ie. liability or boiler and machinery insurance).

Considerations:

- Does the O & M Manual refer to any alternate operating modes that will minimize the leak or risk of total failure? (ie. Bypass pumping intot he Equalization Basins.) If so, follow the instructions in the O & M Manual carefully.
- Will it be necessary to notify the public requesting them to minimize discharge into the sewer system?
- Will hydro vac trucks / tank trucks be required? If so, make standby arrangements.
- Will arrangements be necessary with neighboring municipalities to accept sewage transported by truck?

15.0 Equalization Basins Failure

In the event of an Equalization Basin Failure at wastewater treatment plant, the following contingency plan is to be put into action.

At the time that the Equalization Basin Failure at wastewater treatment plant is discovered, the following procedures will be followed:

1. Assess the extent of the damage, leak or failure.
2. Do not disturb any physical evidence that may exist.
3. Arrange for any temporary measures that may be required such as supporting, ditching, damming, etc.
4. Assess whether or not the failure has resulted in any damage to the environment or property damage. If so, make the necessary arrangements to minimize the damage.
5. Notify the Director of Operations.
6. Notify the RCMP if the damage is the result of accident, vandalism or criminal activity.
7. Summon a qualified Geo-Technical Engineer to review the design drawings and provide recommendations.
8. Notify the CAO, Mayor, and Council.
9. Notify the appropriate insurance company for the Town (ie. liability or boiler and machinery insurance).
10. Assess how long the repair time will be and whether or not there is sufficient standby storage capacity in the equalization basin and abandoned concrete cells.

Considerations:

- Is there any immediate down slope risk to life or property? If so, notify the effected parties immediately.
- Given the location of the leak, does the O & M Manual refer to any alternate operating modes that will minimize the leak or risk of total failure? (ie. Lowering the level in the Equalization Basins.) If so, follow the instructions in the O & M Manual carefully.
- Has there been damage to the environment? If so, contact the following:
    - Director of Operations.
    - Provincial Emergency Program.
    - Regional Waste Manager.
- Is the available standby storage capacity sufficient to accept the influent flow for the duration of the Equalization Basin repair? If not, consider the following:
    - Will it be necessary to notify the public requesting them to minimize discharge into the sewer system?
    - Will hydro vac trucks / tank trucks be required? If so, make standby arrangements.

- Will arrangements be necessary with neighboring municipalities to accept sewage transported by truck?

APPENDIX A

Operation Certificate PE 13717

Province of British Columbia

MINISTRY OF
ENVIRONMENT,
LANDS AND PARKS

BC Environment

Environmental Protection
#201-3547 Skaha Lake Rd.
Penticton, British Columbia
V2A 7K2
Telephone: (604) 490-8200
Fax: (604) 492-1314

Date: December 14, 1995

File: 76750-40/PE-13717 (01)

REGISTERED MAIL

The Corporation of the Town of Oliver
PO Box 638
Oliver BC VOH 1TO

Attention: Tom Szalay, Administrator

Enclosed is a copy of the Operational Certificate No. PE-13717 issued under the provisions of the Waste Management Act. This Operational Certificate supersedes Permit PE-00102 which is cancelled in accordance with Section 16(13) of the Waste Management Act. Your attention is respectfully directed to the terms and conditions outlined in the Operational Certificate. An annual Permit fee will be determined according to the Waste Management Permit Fee Regulation.

This Operational Certificate does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority shall rest with the Operational Certificate holder.

This Operational Certificate is issued pursuant to the provisions of the Waste Management Act to ensure compliance with Section 34(3) of that statute, which makes it an offence to discharge waste without proper authorization. It remains the responsibility of the Operational Certificate holder to ensure that all activities conducted under this authorization comply with any other applicable legislation which may be in force from time to time.

The administration of this Operational Certificate will be carried out by staff from our Regional Office located in Penticton, (telephone 490-8200). Plans, data and reports pertinent to the Operational Certificate are to be submitted to the Environmental Protection office, Suite 201, 3547 Skaha Lake Road, Penticton, British Columbia, V2A 7K2. - 30th Street, Vernon, British Columbia, V1T 9G3.

This decision may be appealed by any person(s) who considers themselves aggrieved by this decision, in accordance with Part 5 of the Waste Management Act. Written notice of intent to appeal must be received by the Regional Waste Manager within twenty-one (21) days of the date of notification of this decision.

Yours truly,

T.R. Forty, P.Eng.
Assistant Regional Waste Manager
Okanagan Sub-Region

Enclosure

PROVINCE OF
BRITISH COLUMBIA

Environmental Protection
#201 - 3547 Skaha Lake Road
Penticton
British Columbia, V2A 7K2
Telephone: (604) 490-8200

MINISTRY OF ENVIRONMENT,
LANDS AND PARKS

OPERATIONAL CERTIFICATE

PE 13717

Under the Provisions of the Waste Management Act

TOWN OF OLIVER

P.O. Box 638

Oliver, British Columbia

V0E 1T0

is authorized to discharge reclaimed wastewater to the ground by irrigation, from a municipal sewage collection and aerated lagoon sewage treatment facility located at Oliver, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the Waste Management Act and may result in prosecution.

1. SPECIFIC AUTHORIZED DISCHARGES AND RELATED REQUIREMENTS

The discharge of effluent to which this sub-section is applicable is from a municipal sewage treatment facility located approximately as shown on the attached Site Plan A and Site Plan B. The reference number (S.E.A.M. site number) for this discharge is E222150.

1.1 Discharge Quantity

1.1.1 The maximum authorized rate of effluent to be discharged from the aerated lagoon sewage treatment system to the reclaimed wastewater storage reservoir, averaged on a monthly basis:

1995 - 1950 m^3 per day
1996 - 2000 m^3 per day
1997 - 2050 m^3 per day
1998 - 2100 m^3 per day
1999 - 2150 m^3 per day
2000 - 2200 m^3 per day

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1.1.2 There is no maximum authorized rate of reclaimed wastewater to be discharged from the storage reservoir for beneficial use as irrigation water.

1.2 Discharge Quality

1.2.1 It is recommended that to ensure reclaimed wastewater is adequately renovated prior to irrigation, the characteristics of the effluent discharged from the aerated lagoon treatment system to the reclaimed wastewater storage reservoir not exceed:

5 Day Biochemical Oxygen Demand, 45 mg/L; and

Total Suspended Solids - 60 mg/L.

1.3 Permit Fee Calculations for Reclaimed Wastewater Discharge to Land

1.3.1 The characteristics of the reclaimed wastewater discharged from the storage reservoir and beneficially used for irrigation, for the purposes of permit fee calculations, the following discharge factors have been assumed:

5 Day Biochemical Oxygen Demand, 10 mg/L; and

Total Suspended Solids - 10 mg/L.

1.4 Authorized Works

The works authorized are: sewage collection system, sewage treatment plant concrete tankage for emergency containment, influent screen, flow equalization basin, pumping station, pressure forcemain to aerated lagoons, aerated lagoon treatment system, reclaimed wastewater storage reservoir sized to provide a minimum retention time of 60 days prior to spray irrigation, post storage chlorination, pressure forcemain to the golf course and related irrigation supply mains and sprinkler irrigation equipment, infiltration basin, and other related appurtenances, approximately as shown on the attached Site Plan A.

1.5 Source of Discharge

The source of discharge and sewage collection system services the Town of Oliver and surrounding area.

1.6 Location of Works

The location of the sewage collection, flow equalization basin and effluent pumping station is: Block 47 of District Lot 2450s, Similkameen Division of Yale District.

The location of the effluent aerated lagoon treatment facilities, reclaimed wastewater storage reservoir, chlorination and withdrawal facilities is: District Lot 763s, and Block B, District Lot 682s, Similkameen Division of Yale District. The location of the potential infiltration basin sites: Block K, Plan 1789 (Town Sand Pit) and Lot 2, Plan 5881 (Town Gravel Pit).

1.7 Location of Discharge

The location where reclaimed wastewater may be irrigated is described generally as Oliver and the surrounding area.

1.8 Irrigation Plan

Submit for review, and obtain written authorization from the Regional Waste Manager, an "Irrigation Plan" of all new areas of land to be irrigated prior to commencement of irrigation with reclaimed wastewater. Areas for effluent irrigation are as indicated in the Oliver Waste Management Plan and as indicated on Site Plan A.

2. GENERAL REQUIREMENTS

2.1 Maintenance of Works, Emergency Procedures and Noncompliance Reporting

Inspect the pollution control works regularly and maintain them in good working order. In the event of an emergency or any condition which prevents continuing operation of the approved method of pollution control or results in noncompliance with the terms and conditions of this Operational Certificate, immediately notify the Regional Waste Manager and take appropriate remedial action.

2.2 Bypasses

The discharge of effluent which has bypassed the designated treatment works is prohibited, unless the consent of the Regional Waste Manager is obtained and confirmed in writing.

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2.3 Process Modifications

Notify the Regional Waste Manager, and his written consent obtained, prior to implementing changes to any process that may affect the quality and/or quantity of the discharge.

2.4 Alternate Water Supply

Provide alternate water supplies if any privately owned well is adversely affected by the land disposal scheme as determined by the Regional Waste Manager.

2.5 Plans - New Works

2.5.1 Plans of modifications and/or extensions to the existing works shall be signed and sealed by a Professional Engineer licensed to practise in the Province of British Columbia.

2.5.2 Copies of all "as-built" plans and drawings for the effluent treatment system, signed and sealed by a Professional Engineer licensed to practise in the Province of British Columbia, shall be submitted to the Regional Waste Manager on completion of construction.

2.5.3 Plans and specifications of any proposed new works, modifications or additions to the works authorized in this Operational Certificate, including the infiltration basin plans, and with the exception of the sewage collection system, shall be submitted to the Regional Waste Manager, and his written consent obtained before construction commences. The works shall be constructed in accordance with such plans.

2.5.4 Retain a copy of all "as-built", plans of modifications and/or extensions to the sewage collection system for perusal by the Regional Waste Manager, or his designate, upon request.

2.5.5 Plans for modifications of, and/or extensions to, the existing reclaimed wastewater irrigation system shall be approved by a person qualified in the design of irrigation systems.

2.5.6 Design and construct the irrigation works in accordance with best current agricultural practice and:

> The "Pollution Control Guidelines for Municipal Effluent Application to Land", dated January 1983, and any amendments thereto, issued by the Ministry of Environment of British Columbia.

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The "B.C. Sprinkler Irrigation Manual" 1989 issue, prepared by the B.C. Ministry of Agriculture and Fisheries.

The "Health and Safety Criteria for the Use of Reclaimed Wastewater", 1991, developed by the Ministry of Health and the Ministry of Environment.

3. GENERAL REQUIREMENTS - ALL DISCHARGES

3.1 Operation and Maintenance

Develop and maintain both an Operational and Maintenance Manual for the sewage collection, sewage treatment and reclaimed wastewater utilization. A copy of the Operational and Maintenance Manuals shall be retained at the treatment facility for inspection by the Regional Waste Manager or their designate.

3.2 Facility Classification

Maintain the wastewater treatment facility classification as authorized in Section 1.4 with the "British Columbia Water and Wastewater Operators Certification Program Society" (BCWWOCPS). The new aerated lagoon treatment facility is presently classified as a Level II facility.

3.3 Operator Certification

3.3.1 All operators in training (OIT) working at this Level II facility classified by the BCWWOCPS shall be required to successfully pass an OIT examination within three (3) months of commencement of employment at the facility. The OIT certificate shall be valid for fifteen (15) months from the date of issue. Prior to the expiry date of the OIT certificate, but not sooner than twelve (12) months from the date when the OIT commenced facility operation, the OIT shall successfully complete a Class I certification examination in order to continue to operate at the facility.

3.3.2 The facility is currently classified by the BCWWOCPS at Level II. Designate at least one operator to be the "Chief Operator" of the facility by **December 1, 1996**. The "Chief Operator" shall be certified at a Class II level, at a minimum.

After **December 1, 1996**, no person shall have "Direct Responsible Charge", as defined by the BCWWOCPS, of a municipal wastewater

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treatment facility classified at Level II or higher unless they possess a valid operator's certificate not more than one level below the classification level of the facility. **"Direct Responsible Charge" is the "Chief Operator" of the facility, the identifiable senior person who is in charge of the plant.**

3.3.3 Should the facility be reclassified by the BCWWOCPS at Level III, designate a "Chief Operator", certified at a Class III level by **December 1, 1998.**

3.3.4 Should the facility be reclassified by the BCWWOCPS at Level IV, designate a "Chief Operator", certified at a Class IV level by **December 1, 1998.**

3.4 Water Conservation

Establish a water conservation program to encourage a reduction in the volume of domestic and industrial wastewaters discharged to the sewage collection system.

3.5 Sewage Collection System - Groundwater Infiltration, Inflow and Cross Connections

Inspect and maintain the sewage collection system works so as to minimize the possibility of cross connections between the storm sewer and the sanitary sewer systems, to minimize infiltration of groundwater, to minimize inflow of water from basement sump pumps and roof drains, and minimize exfiltration of the collected sewage from the sewage collection system to the ground.

3.6 Influent Wastes Bylaw

Subject to being declared a Sewage Control Area under Section 17 of the Waste Management Act, and in order to minimize the potential effect of heavy metals or other toxic materials in the effluent and/or sludge, prepare, implement and/or amend an Influent Wastes Bylaw, Building Bylaw, or other similar bylaws, to regulate the input of such wastes to the sewage collection system. Devices to process household putrescible waste for disposal to the sewage collection system shall be prohibited.

3.7 Contingency Plan

Prepare a Contingency Plan that will address the appropriate course of action to be taken in any particular preconceived emergency situation. The Contingency Plan shall include chlorine leaks and any potential point of concern in the collection, treatment and disposal systems. Attention is to be given to public

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safety and the protection of the environment. The Contingency Plan is to be continually updated as necessary to reflect the current operation. A copy of the Contingency Plan shall be forwarded to the Regional Waste Manager on or before December 31, 1997.

3.8 Sludge Management Plan

The rationale of sludge management, including frequency of withdrawal of sludge from the sewage treatment plant and the location(s) used for disposal and/or utilization shall be developed into a Sludge Management Plan. The Sludge Management Plan shall be prepared and submitted to the Regional Waste Manager for approval on or before December 31, 1996.

3.9 Odours

Should odours become objectionable, additional works shall be provided when so directed in writing by the Regional Waste Manager.

3.10 Fencing

Erect a fence around the sewage treatment facility, storage reservoir and such other areas as required by the Regional Waste Manager. The height and type of fencing shall meet the approval of the Regional Waste Manager.

3.11 Surface Water Diversionary Works

Surface water shall be intercepted and diverted away from the effluent treatment facilities to the greatest extent possible.

3.12 Signage

3.12.1 A suitable sign erected at the main entrance to the site shall have the appropriate emergency phone numbers for use by the general public and others.

3.12.2 Prominent "NO TRESPASSING", signs shall be erected around agricultural and silvicultural sites irrigated with reclaimed wastewater, warning persons of the possible health hazard during the irrigation season and advising that the water used for irrigation is NOT POTABLE. The wording shall be in language or symbols readily comprehensible by the general public. eg. "NO TRESPASSING - RECLAIMED WASTEWATER - DO NOT DRINK"

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4. GENERAL REQUIREMENTS - EFFLUENT STORAGE RESERVOIR

4.1 Leakage

Operate and maintain the reclaimed wastewater storage reservoir to minimize fluid leakage. Leakage shall not aggravate or produce soil or bedrock instability or erosion elsewhere or contaminate ground or surface water.

5. GENERAL REQUIREMENTS - EFFLUENT IRRIGATION

5.1 Disinfection - Chlorination

5.1.1 Adequate chlorination shall be maintained and provide not less than one hour's contact time at average flow rates in the reclaimed wastewater discharging from the chlorination facility to the irrigation system.

5.1.2 Reclaimed wastewater utilized for irrigation shall conform to the effluent irrigation guidelines developed by the B.C. Ministry of Health. Fecal coliforms shall not exceed 200 MPN per 100 mL for agricultural, silvicultural and low public use lands, or exceed 2.2 MPN per 100 mL for high public use lands.

5.2 Annual Irrigation

5.2.1 The authorized discharge period for irrigation is during the period March 15 to October 31, inclusive.

5.2.2 With the written authorization of the Regional Waste Manager, the irrigation schedule may be extended on a weekly basis beyond these limits. Any extension will be considered only upon receipt of a substantiated written request.

5.3 Buffer Zones

5.3.1 The requirement for formal buffer zones surrounding lands irrigated with reclaimed wastewater is no longer in effect, however, a buffer zone may be specified by the Regional Waste Manager.

5.3.2 Reclaimed wastewater applied by irrigation shall not be applied to the ground any closer than 15 metres from the edge of flowing streams or bodies of water.

5.3.3 There shall be no reclaimed wastewater irrigated within 30 metres of any well or inground reservoir for domestic supply.

5.4 Surface Runoff

There shall be no surface runoff of irrigated reclaimed wastewater from the irrigated lands.

5.5 Surfacing Reclaimed Wastewater

Irrigation shall be managed in such a fashion as to preclude surfacing of irrigation tail water down slope of the point of irrigation.

5.6 Spray Irrigation Drift

The reclaimed wastewater irrigation system shall be managed in such a fashion as to preclude aerosol drift from leaving the irrigated lands.

5.7 Irrigation Rates

5.7.1 Irrigation rates shall not exceed the rates given in "B.C. Sprinkler Irrigation Manual", dated 1989, prepared by the B.C. Ministry of Agriculture and Fisheries.

5.7.2 Soils of the irrigated lands shall be monitored to prevent saturation, erosion, and instability.

5.8 Agricultural Products Lag Time

5.8.1 A three day lag time is required before uninspected livestock intended for human consumption are permitted on areas irrigated with reclaimed wastewater. No lag time is required if livestock are subjected to the federal meat inspection program.

5.8.2 A six day lag time is required before dairy cattle are permitted in areas irrigated with reclaimed wastewater.

5.8.3 A three day lag time, after irrigation has ceased, is required before a crop intended for animal feed is harvested.

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6. MONITORING REQUIREMENTS

6.1 Influent Sampling Program - (Equalization Basin)

6.1.1 Install and maintain a suitable sampling facility at the equalization basin outlet, (S.E.A.M. site number E222152), and obtain a grab sample of the plant influent **semi-annually** (a proportional continuous sampler may be used).

6.1.2 Obtain analyses of the influent sample for the following:

total phosphorus and ortho phosphorus, expressed as P in mg/L;

6.2 Effluent Sampling Program - (Cell #3, prior to storage reservoir)

6.2.1 Install and maintain a suitable sampling facility on the outlet of the aerated treatment lagoon, Cell #3, (S.E.A.M. site number E222151), and obtain a grab sample of the effluent before it is discharged to the storage reservoir, for analysis by a suitably accredited laboratory, a proportional continuous sampler may be used, provided that prior written approval has been obtained from the Regional Waste Manager.

6.2.2 Obtain analyses of the effluent sample for the following:

total suspended solids (non-filterable residue), (**monthly** analysis), mg/L;

5-day biochemical oxygen demand, (**monthly** analysis), mg/L;

total phosphorus, ortho phosphorus and total dissolved phosphorus, (**quarterly analysis during 1996, and semi-annually** analysis, thereafter), all expressed as mg/L P; and

total nitrogen, ammonia nitrogen, nitrate nitrogen, nitrite nitrogen, and organic nitrogen, (**quarterly analysis during 1996, and semi-annually analysis thereafter**), all expressed as mg/L N.

6.2.3 Occasional full chemical analysis of the main cations and anions and other characteristics may be required at the discretion of the Regional Waste Manager.

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6.3 Effluent Irrigation Sampling Program - (Chlorine Contact Chamber, prior to Irrigation)

6.3.1 Install a suitable sampling facility after the chlorine contact chamber, prior to irrigating, (S.E.A.M. site number E222150) and obtain a grab sample of the reclaimed wastewater **during the irrigation season.**

6.3.2 Obtain analyses of the sample, parameters and frequency as follows:

faecal coliforms, M.P.N./100ml, on a **monthly** basis;

total coliforms, M.P.N./100ml, on a **monthly** basis;

total phosphorus, mg/L, on a **monthly** basis;

total nitrogen, mg/L, on a **monthly** basis; and

chlorine residual, mg/L, on a **weekly** basis.

6.3.3 Occasional full chemical analysis of the main cations and anions and other characteristics may be required at the discretion of the Regional Waste Manager.

6.4 Effluent Irrigation Monitoring Program

6.4.1 Provide and maintain a suitable flow measuring device to measure total volume of reclaimed wastewater irrigated annually and record the areas where it is utilized.

6.4.2 Provide and maintain a suitable flow measuring device to measure the amount of fresh water make-up from Okanagan River to the equalization basin in m^3/day, and totalize this make up water volume on an annual basis in m^3/year.

6.4.3 Provide and maintain a suitable flow measuring device and record once per day the reclaimed wastewater volume irrigated over a 24-hour period. Record the flows for each calendar month and for each calendar year.

6.5 Storage Reservoir Level Monitoring Program

6.5.1 Provide a suitable staff gauge or other similar device as approved by the Regional Waste Manager in the storage reservoir and take weekly measurements of the water level in the storage reservoir on a year round basis.

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Assistant Regional Waste Manager

6.6 Sampling and Analytical Requirements

6.6.1 Proper care should be taken in sampling, storing and transporting the samples to adequately control temperature and avoid contamination, breakage, etc.

6.6.2 Occasional full chemical analysis of the main cations and anions and other characteristics may be required at the discretion of the Regional Waste Manager.

6.6.3 Analyses are to be carried out in accordance with procedures described in the second edition of "A Laboratory Manual for the Chemical Analysis of Waters, Wastewaters, Sediments and Biological Materials, (March 1994 Permittee Edition)", or by suitable alternative procedures as authorized by the Regional Waste Manager.

The above manual may be purchased from Queens Printer Publications Centre, 2nd Floor, 563 Superior Street, Victoria, B.C., V8V 4R6, 1-800-663-6105. The manual may also be reviewed at any Environmental Protection Program Office.

6.6.4 Sampling and flow measurement shall be carried out in accordance with the procedures described in "Field Criteria for Sampling Effluents and Receiving Waters", April 1989, 17 pp., or by other suitable alternative procedures as authorized by the Regional Waste Manager.

6.6.5 The Permittee is required to follow the terms and conditions of the Quality Assurance Regulation (EQDA). Ten percent of the samples collected shall be duplicated to provide data quality assurance. Quality control information generated by the Permittee lab while analyzing parameters required by this Permit shall also be provided with the data required to be reported.

6.7 Sludge Sampling and Monitoring Program

Develop and maintain a record keeping system for measuring and recording the depth of sludge collecting in the lagoons and volume of sludge removed from the treatment lagoons during desludging operations, the location where the sludge was discharged, and the amount of sludge discharged at each location. The Regional Waste Manager is to be notified in writing at least two weeks prior to the commencement of desludging operations. Analysis of the sludge may be required by the Regional Waste Manager.

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

6.8 Groundwater Monitoring Program

A Groundwater Monitoring Program, shall be submitted to the Regional Waste Manager. The Groundwater Monitoring Program shall be designed by a Professional Engineer or a Hydrogeological Technologist licensed to practice in the Province of British Columbia, to establish with acceptable scientific accuracy, the groundwater flow pattern and nutrient removal capability of the soil to ensure reasonable notice of impending high phosphorus or nitrate levels that may adversely affect surface water, groundwater or domestic waterwells. The sampling, measurement frequency and analyses shall be conducted in accordance with the Groundwater Monitoring Program upon its written authorization by the Regional Waste Manager. The Groundwater Monitoring Program to be submitted to the Regional Waste Manager by December 31, 1997.

6.9 Soils Assessment Program

A ground assessment of any new areas to be irrigated, as shown in the "Irrigation Plan", shall be performed by a suitably qualified professional, using best current climate and soils data to substantiate that the land is capable of accepting reclaimed wastewater for irrigation purposes. This assessment is to include any suggested restrictions or recommendations that the suitably qualified professional deems necessary. This Soils Assessment shall be submitted to the Regional Waste Manager for review prior to the initial commencement of irrigation annually. Further review and ongoing soils assessments may be required by the Regional Waste Manager.

7. REPORTING

7.1 General Reporting

7.1.1 Maintain the monitoring data required in Section 6 for inspection.

7.1.2 The influent/effluent water quality analyses and flow data is to be submitted to the Regional Waste Manager such that they are received by the Regional Waste Manager within 30 days of the results being sent out by the testing agency.

7.1.3 Monitoring data shall be submitted in an electronic and/or printed format satisfactory to the Regional Waste Manager.

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Assistant Regional Waste Manager

7.2 Annual Reporting

7.2.1 Submit an Annual Report which includes a summary of the results of all sampling and monitoring programs as specified in this permit, data interpretation and trend analyses by a suitably qualified professional.

7.2.2 This report is to be in a format which is suitable for review by the public and/or other government agencies.

7.2.3 The first report is due on or before 60 days of the end of a calendar year for that year's monitoring. Raw data are to be attached as appendices to the report.

7.2.4 Maintain and submit records of the following as a part of the annual report:

7.2.4.1 Records of reclaimed wastewater balance, that is, the flows to and from the storage reservoir. This balance, must also include the freshwater make-up.

7.2.4.2 Records of the duration, intensity, property owner, acreage, location, and type of reclaimed wastewater irrigation.

7.2.4.3 Records of efforts to reduce infiltration, inflow and cross connections for inspection by the Regional Waste Manager or his designate.

7.2.4.4 Records of efforts to administer the Influent Wastes By-law(s) for inspection by the Regional Waste Manager or his designate. Include as an attachment, any amendments to the Influent Wastes By-law(s) that have been made during the past year.

7.2.4.5 Copy of the Contingency Plan.

7.2.4.6 Copy of the Sludge Management Plan.

7.2.4.7 Copy of the Annual Flow Summaries.

7.2.4.8 Copy of the Annual Irrigation Summaries.

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

APPENDIX A

Requirements of Reclaimed Wastewater Users

The holder of this Operational Certificate (The reclaimed wastewater supplier) shall be responsible for ensuring that the contractual agreement with the Reclaimed Wastewater User is in accordance with the Operational Certificate. A copy of this Appendix is to be provided to each user prior to the commencement of irrigation EACH YEAR.

1 GENERAL REQUIREMENTS

1.1 Plans - New Works

1.1.1 Plans for modifications and/or extensions to the existing reclaimed wastewater irrigation system shall be approved by a person qualified in the design of irrigation systems.

1.1.2 Design and construct the irrigation works in accordance with best current agricultural practice and the "Pollution Control Guidelines for Municipal Effluent Application to Land", dated January 1983, and any amendments thereto, issued by the Ministry of Environment of British Columbia, and also in accordance with the "B.C. Sprinkler Irrigation Manual", dated 1989, prepared by the B.C. Ministry of Agriculture and Fisheries.

1.2 Construction Criteria

1.2.1 All reclaimed water user valves, shall be of a type or secured in a manner that permits operation by only personnel authorized by each wastewater user. All piping, valves and outlets should be marked to differentiate reclaimed wastewater from domestic water. All reclaimed wastewater controllers, valves, etc., shall be affixed with reclaimed wastewater warning signs.

1.2.2 Use or installation of hose-bibbs on any irrigation system presently operating, or designated to operate with reclaimed wastewater, regardless of the hose-bibb construction or identification, is not permitted.

1.2.3 There shall be at least a 3 metre horizontal and a 0.3 metre vertical separation (with domestic water pipeline above the reclaimed water pipeline) between all pipelines transporting reclaimed water and those transporting domestic water.

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1.2.4 There shall be no connection between a potable water supply, irrigation water or industrial well, and piping containing reclaimed wastewater, except through an air gap separation or reduced pressure principle device.

1.3 Fencing

The Reclaimed Wastewater User MAY be required by the Regional Waste Manager to erect a fence around the disposal area to restrict public access. The height and type of fencing shall meet the approval of the Regional Waste Manager.

1.4 Signage

1.4.1 Prominent "NO TRESPASSING", signs shall be erected around agricultural and silvicultural sites irrigated with reclaimed wastewater, warning persons of the possible health hazard during the irrigation season and advising that the water used for irrigation is NOT POTABLE. The wording shall be in language or symbols readily comprehensible by the general public. eg. "NO TRESPASSING - RECLAIMED WASTEWATER - DO NOT DRINK"

1.4.2 Warning signs shall be posted in sufficient numbers and size and at strategic locations to advise the public that reclaimed water is being used. Additional signage may be required as directed by the Regional Waste Manager.

2 GENERAL REQUIREMENTS - RECLAIMED WASTEWATER IRRIGATION

2.1 Buffer Zones

2.1.1 The requirement for formal buffer zones surrounding lands irrigated with reclaimed wastewater is no longer in effect, however, a buffer zone may be specified by the Regional Waste Manager.

2.1.2 Reclaimed wastewater applied by irrigation shall not be applied to the ground any closer than 15 metres from the edge of flowing streams or bodies of water.

2.1.3 There shall be no reclaimed wastewater irrigated within 30 metres of any well or inground reservoir for domestic supply.

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2.2 Surface Runoff

2.2.1 There shall be no surface runoff of irrigated reclaimed wastewater from the irrigated lands.

2.2.2 The maximum ground slope shall not exceed 20% without the written consent of the Regional Waste Manager.

2.3 Surfacing Reclaimed Wastewater

2.3.1 Irrigation shall be managed in such a fashion as to preclude surfacing of irrigation tail water down slope of the point of irrigation.

2.3.2 Irrigation shall be managed as to prevent ponding.

2.4 Spray Irrigation Drift

2.4.1 Reclaimed wastewater shall be confined to the area designated and approved for reclamation. The reclaimed wastewater irrigation system shall be managed in such a fashion as to prevent aerosol drift from leaving the irrigated lands.

2.4.2 Precautions shall be taken to ensure that reclaimed water will not have contact with any facility or area not designated for reclamation, such as passing vehicles, buildings, domestic water facilities, fruit and vegetable gardens, or food handling facilities.

2.4.3 Drinking water facilities shall be protected from direct or wind blown reclaimed wastewater spray.

2.5 Irrigation Rates

2.5.1 Irrigation rates shall not exceed the rates given in "B.C. Sprinkler Irrigation Manual", dated 1989, prepared by the B.C. Ministry of Agriculture and Fisheries.

2.5.2 Soils of the irrigated lands shall be monitored periodically or as otherwise directed by the Regional Waste Manager or the Town of Oliver, to prevent saturation, erosion, and instability .

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2.6 Agricultural Products Lag Time

2.6.1 A three day lag time is required before uninspected livestock intended for human consumption are permitted on areas irrigated with reclaimed wastewater. No lag time is required if livestock are subjected to the federal meat inspection program.

2.6.2 A six day lag time is required before dairy cattle are permitted in areas irrigated with reclaimed wastewater.

2.6.3 A three day lag time, after irrigation has ceased, is required before a crop intended for animal feed is harvested.

2.7 Insect and Vector Control

Adequate measures shall be taken to prevent the breeding of insects and other vectors of health significance, and the creation of odors, slimes or unsightly deposits.

2.8 Irrigation of Public Areas

2.8.1 Irrigation on golf courses or cemeteries shall only be practised when the public are not present.

2.8.2 Golf score cards shall indicate that reclaimed wastewater is used for irrigation on the golf course lands.

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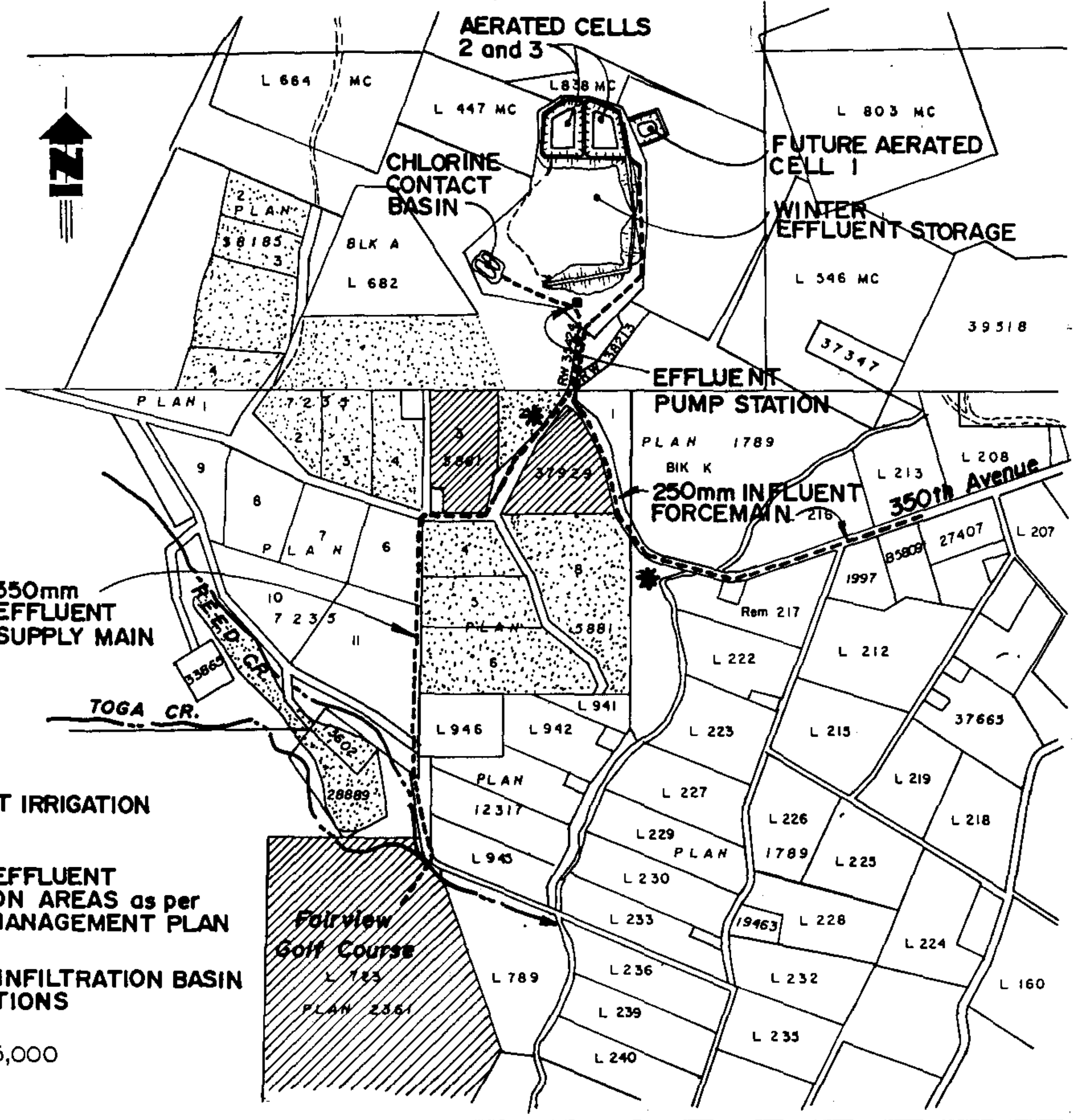
Assistant Regional Waste Manager

Province of
British Columbia
Ministry of Environment,
Lands and Parks

BC Environment

ENVIRONMENTAL PROTECTION DIVISION

SITE PLAN A



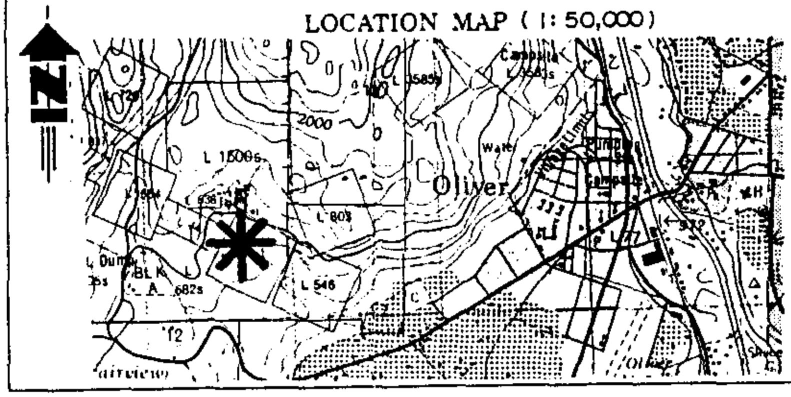
▨ EFFLUENT IRRIGATION AREAS

░ FUTURE EFFLUENT IRRIGATION AREAS as per WASTE MANAGEMENT PLAN

✱ FUTURE INFILTRATION BASIN SITE OPTIONS

Scale 1: 15,000

LOCATION MAP (1: 50,000)



(FOR OFFICE USE ONLY)

December 14, 1995
Date Issued

Date Amended

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

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