Silverhawk Utilities Inc. Wastewater Treatment Facility

2019 Annual Report

Some Sections have been omitted due to proprietary information being contained within.

Submitted by:
Silverhawk Utilities Inc.

Submitted to:
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Environmental Protection Division

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Table 1 *- Abbreviations*

Abbreviation	Description
BC-MOE	British Columbia Ministry of Environment
BC-MSR	British Columbia Municipal Sewage Regulation
BOD_5	Biological Oxygen Demand (5- days)
CEUs	Continue Education Units
COD	Chemical Oxygen Demand
EP	Exfiltration Pond
FC	Fecal Coliforms
GW	Ground Water
LS	Lift Station
MBR	Membrane Bioreactor
MPN	Most Probable Number
MWR	Municipal Wastewater Regulation
PFD	Process Flow Diagram
SHU	Silverhawk Utilities Inc.
SSMR	Silver Star Mountain Resort
SW	Surface Water
TDP	Total Dissolved Phosphorous
TDS	Total Dissolved Solids
TF	Trickling Filter
TFEA	Trickling Filter Extended Aeration system
TKN	Total Kjeldahl Nitrogen
TN	Total Nitrogen
TP	Total Phosphorous
TSS	Total Suspended Solids
WWCS	Wastewater Collection System
WWTF	Wastewater Treatment Facility

Section 1.0 - Introduction

This is the Annual Report for the Wastewater Treatment Facility (WWTF) located at the Silver Star Mountain Resort (SSMR). The report provides details on the performance of the WWTF in 2019.

1.1 WWTF Background

Silverhawk Utilities Inc. (SHU) operates a certified Class III Wastewater Treatment Facility (WWTF) that's designed to treat domestic wastewater produced by the residents and visitors of the Silver Star Mountain Resort (SSMR). The resort is located approximately 20 km Northeast of Vernon, BC. This plant has been operated by SHU during the past 21 years and was upgraded to improve the performance of the treatment processes and the quality of the treated effluent which gets stored in the 20M storage pond then used for irrigation of neighboring grounds during the summer months.

One challenge with nutrient removal at the Silver Star plant had been the low water temperature when the flow peaks to its highest levels during the winter ski season at the resort. The ideal water temperature for a biological system to work very efficiently is around 25° C whereas the temperature of the incoming water at the Silver Star plant gets to as low as 6° C during the winter months. The main groups of nitrifying bacteria (Nitrosomonas [responsible for converting dissolved ammonia (NH4+) to Nitrite (NO2 -)] and Nitrobacters [responsible for converting Nitrite (NO2 -) to Nitrate (NO3 -) are very sensitive to variations in their environment, mainly temperature and dissolved oxygen. The optimum temperature for growth of these bacteria is in the range of 25 - 30 °C. At temperature of 18°C, the growth rate is decreased by 50%, and at temperatures in the range of 8 - 10 °C, the growth rate is decreased by 75%. At these low water temperatures of 6 - 12 °C in winter months, if the bacteria die, it may take several days to re-develop their community; i.e. it may take over 20 hours for the bacterial population to double, and of course, their efficiency is much lower.

Another challenge with nutrient removal at the Silver Star plant had been the low influent flow during the summer months. Wastewater contains food for the bacteria to keep them alive and functional. When the influent flow drops, the amount of food available for the bacteria decreases which ends up affecting the efficiency and performance of the plant.

Hence, an innovative model had to be utilized to deal with these challenges during the winter months when the influent flow is high but the water temperature is low, and during the summer months when the water temperature is fine but the influent flow is low. Several on-site experiments were conducted and based on the results of these experiments, a model was developed to treat the nutrients / pollutants at the extreme conditions. This model was monitored during the whole operation year in different seasons to ensure all the assumptions and expected results were met. The results have been consistently good and the potential pollutant in the effluent have consistently been below the allowable limits.

For a better understanding of main components of the SHU WWTF, most of the data presented in this report have been organized according to the following major areas:

- **Area 0 -** WWTF System
- **Area 1 -** Irrigation System
- **Area 2 -** Ground Water and Surface Water Systems

Section 2.0 - Facility Classification and Operator Certification

The SHU WWTF is registered and classified as a Class III facility. The SHU Wastewater Collection System (WWCS) is registered and classified as a Class I facility. Both SHU WWTF and WCS were operated in 2019 by *James Huffman*, *Keaton Brown*, *Cory Clement and Maxwell Dejong*.

2.1 James Huffman

James Huffman holds a Wastewater Treatment Plant Operator Level II Certificate and a Wastewater Collection System Operator Level I Certificate.

Figure 1 - *James Huffman's Municipal Wastewater Treatment Operator Certificate*

Figure 2 - *James Huffman's Municipal Wastewater Collection Operator Certificate*

2.2 Keaton Brown

Keaton Brown holds a Wastewater Treatment Plant Operator Level IV Certificate.

Figure 3 - *Keaton Brown's Municipal Wastewater Treatment Operator Certificate*

2.3 Cory Clement

Cory Clement holds a Wastewater Treatment Plant Operator Level III Certificate. Please note that Cory worked for Silverhawk Utilities until May 2019.

Figure 4 - *Cory Clement's Municipal Wastewater Treatment Operator Certificate*

2.4 Maxwell Dejong

Maxwell Dejong holds a Wastewater Treatment Plant Operator Level I Certificate. Please note that Maxwell Joined Silverhawk Utilities in August 2019.

***Figure 5** - Maxwell Dejong's Municipal Wastewater Treatment Operator Certificate*

Section 3.0 - Effects of Discharge on the Receiving Environment

3.1 WWTF System (Area 0)

The WWTF treated effluent quality is monitored on a regular basis to ensure that the WWTF processes are working efficiently to remove key contaminants. In 2019, COD, BOD_5 and TSS levels in the treated effluent were consistently in compliance with the MWR quality requirements. There was only one incident in 2019 in which the weekly average Total Nitrogen slightly exceeded the allowable discharge limit of 10 mg/L. This incident is discussed in Section 4.0 of this report.

The results of the routine effluent analysis performed between January and December of 2019 are included in Appendix C. Furthermore, the membranes were regularly inspected and maintained during this period to ensure proper performance. The inspection records are also included in Appendix C.

The WWTF treated effluent flows into the 20 Million Exfiltration Pond (20M EP). Water in the 20M EP percolates through to the ground, evaporates, or takes subsurface superficial water courses to feed the Vance Creek at the Northeast section of the 20M EP and the Coldstream Creek at the Southwest section of the 20M EP. During summer, the water in the 20M EP is reused for irrigation of landscapes in the surrounding areas. During the irrigation season the effluent is chlorinated to meet indirect water reuse standards. At the end of the irrigation season, the irrigated areas get assessed by a consulting agrologist to monitor the impact on the irrigated soil areas. The results of this assessment are summarized in section 3.2 following.

3.2 Irrigation System (Area 1)

As mentioned in the previous section, the quality of the treated effluent is regularly monitored. Given that the treated effluent in the 20M EP is the source of the irrigation water and in accordance with the Municipal Wastewater regulation (MWR), no extra monitoring is required for the irrigation water. Refer to Appendix C for the Effluent monitoring data. The reclaimed water monitoring data are included in Appendix F.

The quality of the effluent was consistently in compliance with the MWR monitoring requirements for Reclaimed Water with Lower Exposure Potential. The results of the effluent analysis during the irrigation season showed that the BOD_5 and TSS levels were always below the detection limits. The COD level during this period was consistently below 50 mg/L. The pH level in the treated effluent we between 6.5 and 7.6, which is appropriate for landscape irrigation. The results of the fecal coliform analysis performed during the irrigation period showed that the level was maintained below 6.0 CFU/100 mL. Please note that MWR has established the maximum Fecal Coliform limit for Reclaimed Water with Lower Exposure Potential at 1,000 CFU / 100mL.

An annual assessment to evaluate the effects of the irrigated effluent on the receiving lands and flora was performed on the irrigated areas. The monitoring report covers the evaluation of soil and vegetation conditions under the impact of nutrient and heavy metals. In the past few years these annual assessments have shown positive vegetation growth patterns and no evidence of negative impact of treated effluent on the receiving soil and vegetation.

The site monitoring report indicates that the irrigation of effluent on the site during 2019 appeared to be conducted in an environmentally safe manner. Some of the conclusions of this report are summarized below:

- Irrigation was not excessive during the period leading up to the shutdown of the system for winter; soils throughout the irrigated area were moist to wet but not saturated at the time of monitoring.
- The soil nutrient and quality assessment did not identify any areas of concern.
- Foliar testing did not identify any concerns.
- No site degradation due to irrigation was noted.

A sample from the 20M EP was also analyzed at the beginning of the irrigation season for total metals, Total Nitrogen, Fecal Coliform, TSS and Turbidity. The results of this analysis are included in Appendix G.

For more details on the results of the soil monitoring assessment, please refer to Appendix I for the complete site monitoring report.

3.3 Ground Water and Surface Water Systems (Area 2)

The ground water (GW) system consists of three GW monitoring wells (GW1, GW3, GW4) that surround the 20M EP, and a fourth one (GW5) located few meters at the Northwest side of the WWTF main building. The surface water monitoring system consists of two SW monitoring points (SW1 and SW2) downstream of GW1 on the Vance Creek, and four SW monitoring points (SW3, SW4, SW5 and SW6) downstream of GW3 on the Coldstream Creek. Refer to Figure 6 below for the locations of the GW and SW monitoring sites.

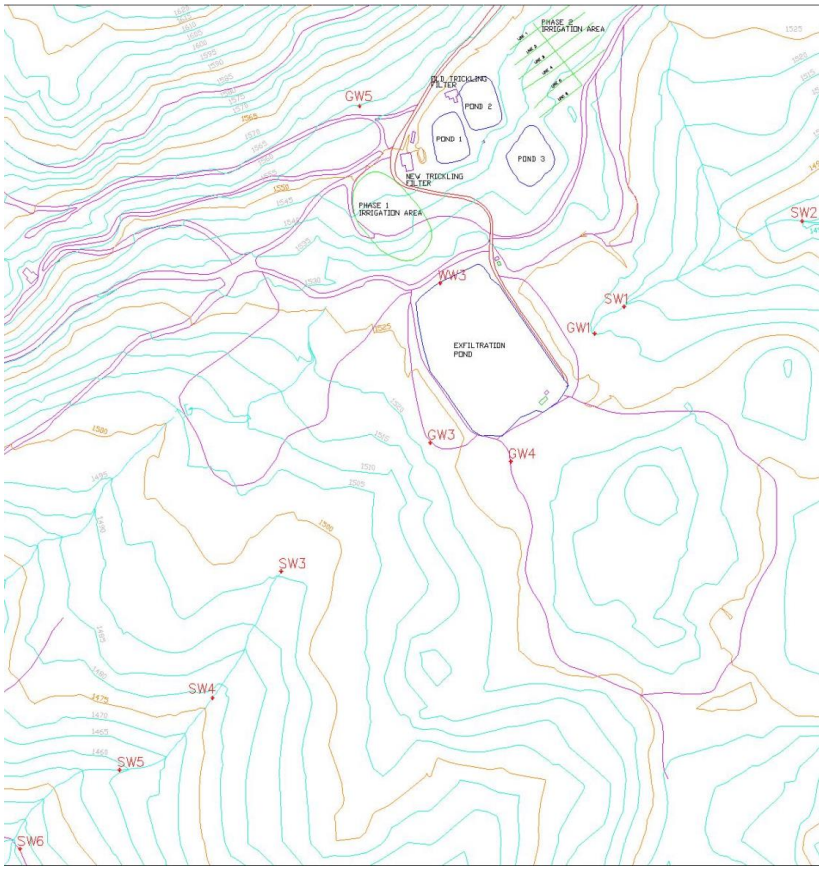


Figure 6 *- SW and GW Monitoring Sites Locations*

Historically, the ammonia levels in samples collected from GW1 (Vance Creek drainage) & GW3 (Coldstream Creek drainage) have been high. As it can be seen from the graph in Figure 7, the ammonia level in the 20M EP is consistently low. The ammonia level in the 20M EP has been this low since the second phase of upgrade was completed. This reduction in the ammonia levels should also be noticed in the ground waters. We will continue to monitor the ground waters to see if the ammonia levels in these waters are gradually decreasing. Given that the ammonia levels are consistently low in the plant's effluent, the effect on these ground waters can only be positive.

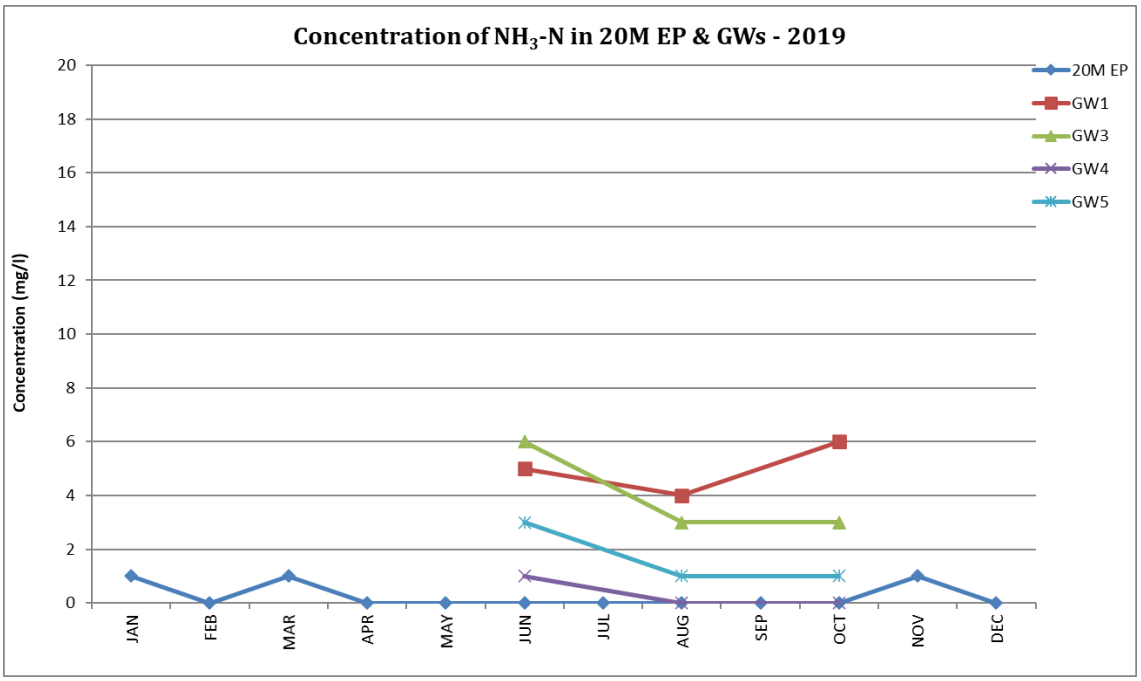


Figure 7 *- Ammonia Profile in the 20M EP & GW Monitoring Sites in 2019*

Although the plant's effluent quality is consistently below the quality limit, the GW & SW wells will be tested three times a year to monitor any change in their water composition. These tests will be performed once before the irrigation season starts (around 15th of June), another one will be done halfway through the irrigation season (around 15th of August), and the last one will be after the irrigation season is completed (around 15th of October).

Table 2 below illustrates the ammonia levels in the GW wells between 2010 - 2019. Since the most recent upgrade, both nitrate and ammonia levels have been consistently low. SHU will continue to monitor ammonia levels in the WWTF effluent, GW1 & GW3 in 2020 to see whether the ammonia level in these wells will substantially decrease.

***Table 2** - Ammonia Levels in GW System (2010 - 2019)*

NH_3 - N (mg/l)					
Year	**20M EP**	**GW1**	**GW3**	**GW4**	**GW5**
2010	1.05 - 39.8	5.34 – 9.38	7.86 – 10.5	<0.02 – 0.08	0.02 – 0.06
2011	0.66 - 17.9	6.42 – 9.27	6.46 – 8.97	<0.02 – 0.06	<0.02 – 0.21
2012	1.51 - 33	5.23 – 9.78	3.43 – 8.03	<0.02 – 0.041	<0.01 – 0.081
2013	0.516 - 37.6	5.74 – 12.6	6.7 – 8.79	0.021 – 0.131	0.025 – 0.187
2014	0.423 - 14.9	7.32 – 11.9	7.43 – 9.44	0.021 – 0.047	0.024 – 0.052
2015	0.077 - 4.32	6 – 12	7 – 11	0 - 0.027	0.024 - 1
2016	0.043 - 0.088	7 – 11	5 – 8	0	0 - 1
2017	0 - 2	4 – 8	5 – 7	0 - 2	0 - 1
2018	0 - 1	3 – 7	4 – 6	0	0 - 1
2019	0 - 1	4 – 6	3 – 6	0 - 1	1 - 3

Figure 8 below shows the ammonia profile in the effluent and in the 20M EP since 2010. In 2019, the plant continued to produce effluent with extremely low levels of ammonia.

The ammonia levels did not have the peaks and valleys seen in the previous years. The plant has been steadily producing effluent with extremely low values of ammonia and the same is expected in the future. The last plant upgrade established a controlled mechanism for maintaining a minimum level of nitrifying bacteria in the aerobic bioreactors. We can now ensure the ammonia is almost completely removed from the effluent before leaving the plant.

It is to be noted that the GW5 is located above the plant location and again, there is no negative contribution from the plant's effluent to this ground water.

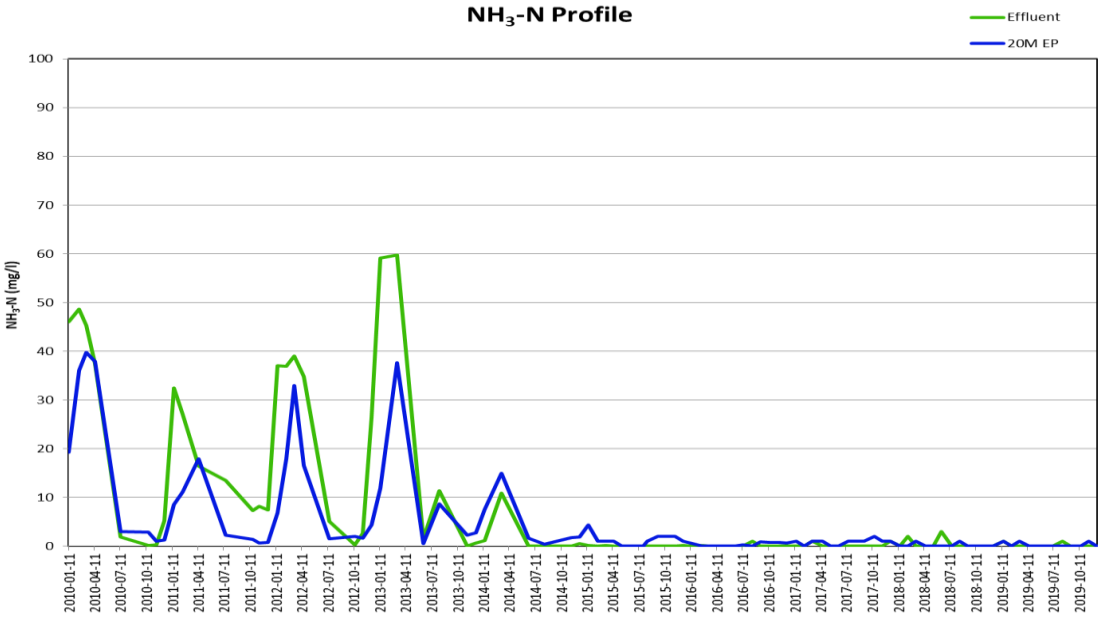


Figure 8 - *Ammonia Profile in the Effluent & 20M EP (2010 - 2019)*

Figure 9 shows a comparison between the nitrate levels of the 20M EP and the SWs. As it can be observed from the values in the graph, the nitrate level continued to be low in the SWs during 2019, and it should not rise going forward if the plant effluent was the source of nitrate in these surface waters.

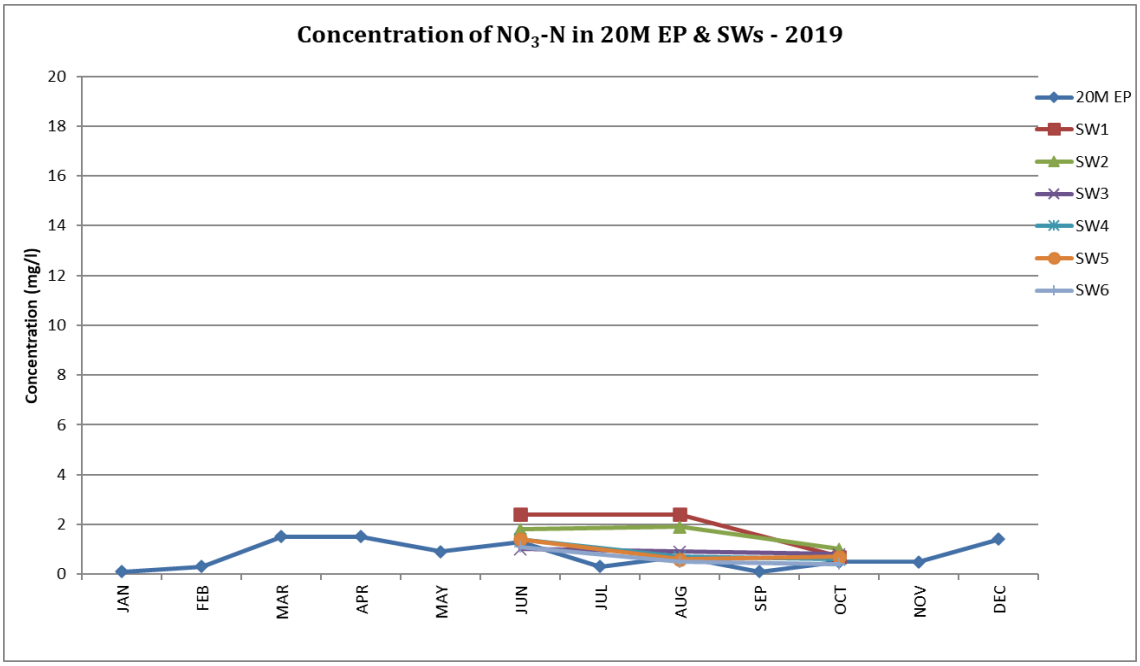


Figure 9 *- Nitrate Levels in the 20M EP versus the SW Monitoring Sites in 2019*

Due to much lower water temperatures in winter months and much lower water levels in the 20M EP, exfiltration may be reduced during these months. So, the best months to make a good judgment for contribution of plant effluent to GWs and SWs are between June and August when the pond is at its highest level and the water temperature is relatively high. If the concentrations of ammonia and nitrate have consistently been low in the 20M EP from January to June, and the concentrations of these analytes are still high in the GWs and SWs, then there have to be other sources that contribute to the high levels of nitrogen in these receiving waters.

Otherwise, if the contribution to the high levels in the GWs and SWs was solely from the WWTF, then the low concentrations of nitrate and ammonia in the plant's effluent should lower the levels of these analytes in both GWs & SWs.

Figure 10 below shows the sharp rise in the water level in the 20M EP between October and January. The level then continues to rise moderately until June. In June, the irrigation of the the neighboring grounds using the treated effluent from the pond begins. Moreover, the exfiltration rate significantly increases due to the higher temperatures. As a result, the level in the pond starts to drop as can be seen in Figure 10. In September, as the irrigation stops and the temperature drops, the level in the 20M EP starts to rise again.

Hence, the monitoring samples from the GWs and SWs will be scheduled to be taken and analyzed around mid-June, mid-August, and mid-October when the exfiltration rate is at its highest.

More results associated to the GW and SW monitoring in 2019 are presented in Appendix D of this report.

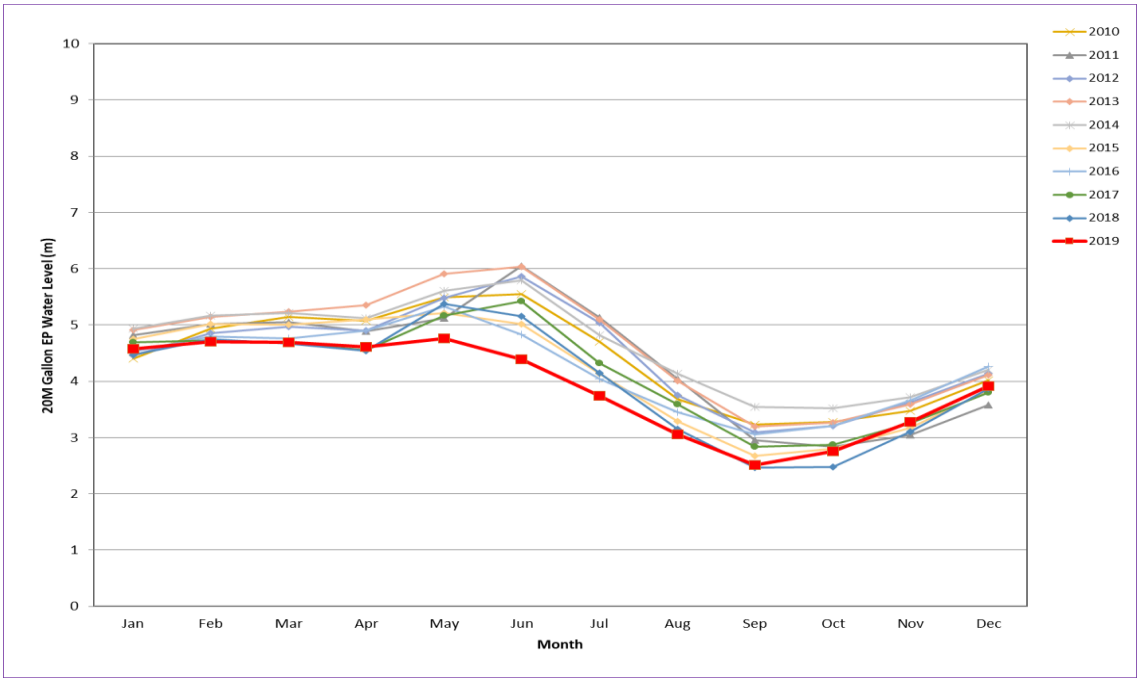


***Figure 10** - 20M EP Average Monthly Water Level (2010 - 2019)*

3.4 Vance Creek System

The Vance Creek System consists of two SW monitoring sites and three creek monitoring points:

- Surface Water #8 (SW8)
- Surface Water #9 (SW9)
- Vance Creek Upper (VCU)
- Vance Creek Lower (VCL)
- Vance Creek Tributary (VCT)

In 2010, these monitoring points were evaluated for Chloride, Ammonia, Nitrite, Nitrate, TKN, TN, pH, TP, TDP, TDS, TSS, Sulphate, FC and Sodium. Since then, there hasn't been any sampling or evaluation in this area based on recommendations made by Mike Reiner (BC-MOE).

3.5 Lumby/Coldstream System

The Lumby/Coldstream System consists of seven receiving environmental monitoring points:

- Noble Canyon Road (CC1)
- Coldstream Lumber (CC2)
- Coldstream Cemetery (CC3)
- Kirkland Drive (CC4)
- Trinity Valley Road (VC1)
- Trinity Valley Road (VC2)
- Vance Creek Ranch (VC3)

In 2010, these monitoring points were evaluated for Nitrite, Nitrate, TP, TKN, TN and FC. Since then, there hasn't been any sampling or evaluation in this area based on recommendations made by Mike Reiner (BC-MOE).

Section 4.0 - 2019 Incidents

4.1 High Total Nitrogen in Effluent

The following is a summary of the high Total Nitrogen (TN) incident that was encountered in 2019. It is to be noted that the average TN in the effluent in 2019 was 4.75 mg/L.

- **December 23 – December 29**: The concentration of TN in the effluent spiked on December 25th. The plant operators immediately attended to this problem and made operational adjustments to bring the TN level below the allowable discharge limit. The average TN of the composite samples taken during this week was 10.07mg/L. The TN level dropped below 10mg/L on December 29th, as can be seen in the effluent monitoring data.

  There was a power outage between December 20th - 21st which lasted over 12 hours. During this time, a large portion of the water in the aeration tank was siphoned into Cell 2 (Raw sewage storage Pond). This caused an interruption in the plant process and as a result, it took the operators a few hours to bring the plant back online after the power was restored. This incident contributed to the increase in the TN concentration in the effluent during that week. Refer to section 4.2 for details on this power outage incident.

The table below summarizes the TN concentrations during this period.

Week	Sample Date	Sample Type	TN (mg/L)	Weekly Average (mg/L)
Dec 23 – Dec 29	23-12-2019	Composite	7.2	**10.07**
	25-12-2019	Composite	11.2	
	27-12-2019	Composite	11.8	
	28-12-2019	Grab	15.21	-
	29-12-2019	Grab	8.5	
Dec 30 – Jan 5	30-12-2019	Composite	9.8	8.4 NOTE 2
	01-01-2020	Composite	9.9	
	03-01-2020	Composite	0.2 NOTE 1	
	03-01-2020	Grab	5.5 NOTE 1	
Jan 06 – Jan 12	06-01-2020	Composite	9.0	7.97
	08-01-2020	Composite	7.3	
	10-01-2020	Composite	7.6	
Jan 13 – Jan 19	13-01-2020	Composite	9.51	7.07
	15-01-2020	Composite	6.9	
	17-01-2020	Composite	4.8	

NOTE 1: The plant operators noticed that there was an error in the TN analysis because the concentration was too low. A grab sample was then analyzed and the TN concentration was 5.5 mg/L.

NOTE 2: Due to the error in the composite sample analysis, the result of the grab sample analysis was used in calculating the weekly average.

Please note that there were four times in 2019 during which the concentration of TN in one composite sample exceeded the allowable limit. However, the operators made the necessary adjustments to maintain the weekly average concentration below 10mg/L. Please refer to Appendix C for more details.

4.2 Power Outage

There were five power outage incidents that occurred in 2019. The following is a summary of these outages:

1- March 1st: Lasted for approximately 4 hours.
2- July 25th: Lasted for approximately 11 hours. This is the reason behind the reduced effluent flow reported on July 26th.
3- October 25th - 26th: Power was lost at 12:40pm on October 25th. Due to a storm in the Okanagan area, power was not restored until the next day at 2:40pm. The plant did not process any sewage during the power outage. This explains the low effluent flow reported on the 26th.
4- December 20th - 21th: Power was lost at 10:15pm on December 20th and was restored at 11:00am the next day. This caused an interruption in the plant process which affected the effluent's quality (Refer to incident in section 4.1).
5- December 31st - January 1st: Initially power was lost at 11:05pm and restored at 12:55am. The next outage was at 2:55am which was restored at 12:10pm on January 1st.

The excess raw sewage was stored in the grit channel and Cell2 during these power outage incidents. The excess sewage was then processed through the plant when the power was restored. No untreated spills or discharges to the environment occurred.

4.3 Broken Membrane Fibers

During the membrane inspection that took place on March 28th, the operators discovered that one of the Membrane modules had one broken fiber. The membrane was taken out of service to be repaired and the standby module was placed in service. A sample from the treated effluent was then sent to a CARO lab for Fecal Coliform analysis. The analysis showed that the level of Fecal Coliform in the treated effluent was below the detection limit. The membrane module was placed back in service on April 14th and has been running effectively since. Refer to the CARO lab analytical data in Appendix C for Fecal Coliform analysis results.

Section 5.0 - Planned Improvements of the WWTF for 2020

Currently, there aren't any planned improvements for 2020. The WWTF is capable of treating all the sewage coming from SS resort. In addition to that, the effluent quality has been consistently well below the allowable limits.

Section 6.0 - Source Control and Water Conservation

6.1 Education Programs

The Chief Operator of the plant, Jim Huffman, is continuously educating property owners, maintenance personnel and renters on the importance of regularly monitoring water consumption and complying with the sewer system dumping restrictions. Proper education is beneficial to both property owners and SHU because it reduces water usage fees and reduces the load on the treatment facility.

6.2 Manhole Construction and Maintenance

In the spring, when infiltration by runoff water is a concern, every SHU Wastewater Collection System sanitary manhole gets inspected and monitored. Ditching near the manholes is regularly checked and maintained to divert runoff, and the manholes are cleared of any debris to prevent blockages.

Section 7.0 - Reduce, Reuse and Recycle Initiatives

In 2001, Silverhawk initiated a consumption-based billing system that encourages customers to use less water and reduce their sewer bills. Moreover, SHU has implemented programs to reduce water waste. SHU has since been offering a service to inspect all water closets at hotels and rental units at the SSMR to identify leaks to the building owners.

7.1 Current Recycle Initiatives

SHU recycled approximately **29,655 m^3** of treated effluent as irrigated reclaimed water in 2019. The treated effluent was used to irrigate natural growth in Phase 1 and Phase 2 of the designated irrigation areas. Please refer to Appendix C for the effluent monitoring data and Appendix F for the reclaimed water quantity.

As development at SSMR continues, the volume of treated effluent will also increase; the intention is to recycle 100% of treated effluent resulting from any new development.

7.2 Future Recycle Initiatives

Future Golf Course (Phase 3):

The first step of this expansion was completed in 2008 with the laying of the main irrigation pipe from the treatment facility to the future golf course location. The treated effluent undergoes tertiary treatment through an MBR system in order to adhere to the BC-MOE standards for unrestricted public access irrigated lands. The discharged effluent through the MBR is free from bacteria, as the small pore size of the membrane filters bacteria, so no chlorine is needed to disinfect the effluent for pathogens.

Snowmaking:

SSMR had indicated a potential interest in using the treated effluent for snowmaking. SHU has a permit to do so and has not ruled out the possibility. The performance of the MBR system has been evaluated and it consistently meets the requirements for snowmaking for skiing because it falls within the unrestricted access category.

Section 8.0 - Historic and Projected Contributory Population and Plant Capacity

8.1 Commercial and Residential Flow Meter Readings

The annual water flow meter readings for both residential and commercial properties at SSMR are recorded to monitor water usage and predict the rate of increased demand on the wastewater collection and treatment facilities. The annual residential and commercial water usage data from 2010 to 2019 are graphed in Figure 11 and Figure 12, respectively.

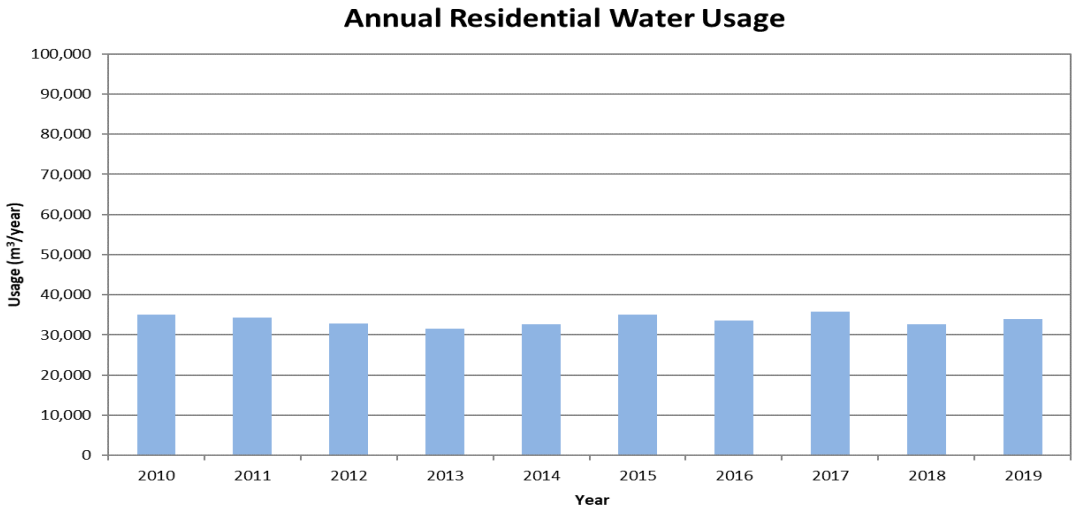


***Figure 11** - Annual Residential Water Usage (2010 - 2019)*

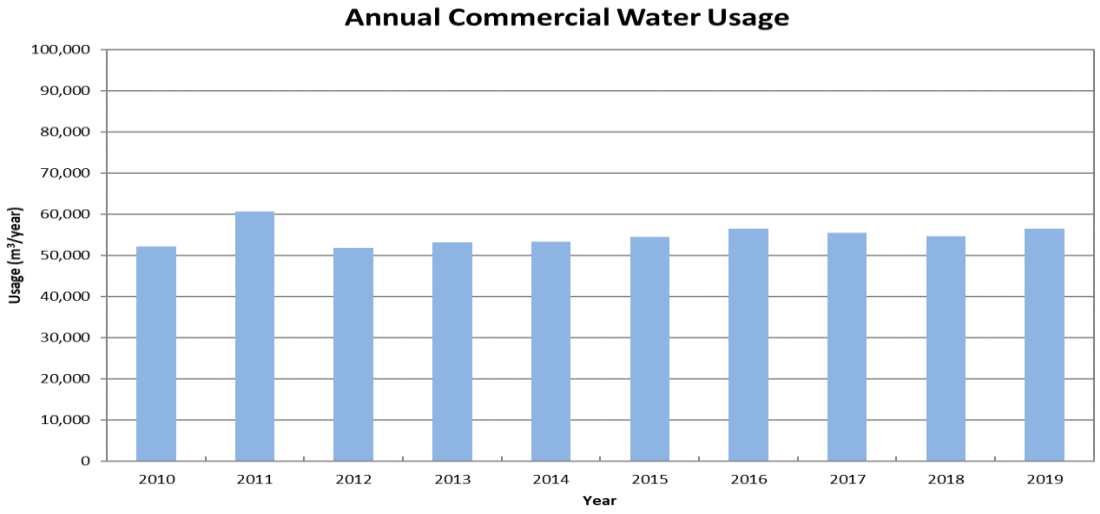


***Figure 12** - Annual Commercial Water Usage (2010 - 2019)*

8.2 Average and Peak Flow Calculations

The effluent flow volumes to the 20M EP were recorded daily throughout 2019. The recorded daily and monthly flows are listed in Tables 3, 4, 5 and 6**.** The WWTF processed **110,896 m^3** of effluent in 2019.

The average monthly flows between 2010 & 2019 are compared in Figure 13. With occupancy and development increasing, it is expected the flow to the plant to increases in the coming years.

Table 3 *- Daily and Monthly WWTF Flow (01/2019 - 03/2019)*

2019 (Jan - Mar) WWTF Monthly Flow Rates					
January, 2019		February, 2019		March, 2019	
Days	Flow Rate (m^3/d)	Days	Flow Rate (m^3/d)	Days	Flow Rate (m^3/d)
1	506	1	476	1	463
2	522	2	484	2	328
3	457	3	471	3	461
4	459	4	457	4	472
5	474	5	426	5	442
6	470	6	450	6	463
7	483	7	470	7	474
8	500	8	475	8	455
9	459	9	489	9	511
10	473	10	488	10	426
11	466	11	441	11	444
12	506	12	473	12	465
13	475	13	470	13	464
14	438	14	456	14	458
15	471	15	462	15	455
16	467	16	481	16	464
17	447	17	473	17	467
18	467	18	467	18	469
19	472	19	469	19	470
20	466	20	476	20	471
21	477	21	474	21	471
22	486	22	473	22	471
23	457	23	498	23	493
24	459	24	463	24	487
25	467	25	438	25	467
26	496	26	453	26	451
27	473	27	488	27	401
28	442	28	438	28	422
29	479	-	-	29	475
30	449	-	-	30	499
31	452	-	-	31	479
Total (m^3)	**14615**		**13079**		**14238**
Daily Average (m^3/d)	**471**		**467**		**459**
Weekends Average (m^3/d)	**479**		**481**		**462**

Table 4 *- Daily and Monthly WWTF Flow (04/2019 - 06/2019)*

2019 (Apr - Jun) WWTF Monthly Flow Rates					
April, 2019		May, 2019		June, 2019	
Days	Flow Rate (m^3/d)	Days	Flow Rate (m^3/d)	Days	Flow Rate (m^3/d)
1	451	1	186	1	243
2	474	2	198	2	203
3	476	3	192	3	244
4	473	4	238	4	231
5	481	5	230	5	231
6	351	6	228	6	222
7	376	7	238	7	234
8	323	8	218	8	222
9	349	9	366	9	183
10	353	10	359	10	153
11	225	11	340	11	154
12	187	12	354	12	157
13	178	13	293	13	151
14	146	14	288	14	159
15	158	15	303	15	148
16	163	16	354	16	164
17	158	17	349	17	148
18	177	18	361	18	153
19	225	19	349	19	151
20	220	20	331	20	147
21	194	21	362	21	182
22	222	22	354	22	171
23	281	23	363	23	189
24	258	24	360	24	182
25	263	25	357	25	188
26	241	26	361	26	157
27	227	27	368	27	157
28	209	28	365	28	184
29	204	29	358	29	210
30	189	30	270	30	226
-	-	31	230	-	-
Total (m^3)		**8232**		**9523**		**5544**
Daily Average (m^3/d)		**274**		**307**		**185**
Weekends Average (m^3/d)		**238**		**324**		**196**

Table 5 *- Daily and Monthly WWTF Flow (07/2019 - 09/2019)*

2019 (Jul - Sep) WWTF Monthly Flow Rates					
July, 2019		August, 2019		September, 2019	
Days	Flow Rate (m^3/d)	Days	Flow Rate (m^3/d)	Days	Flow Rate (m^3/d)
1	292	1	274	1	277
2	373	2	247	2	256
3	330	3	292	3	198
4	344	4	267	4	155
5	335	5	265	5	160
6	266	6	269	6	167
7	272	7	265	7	145
8	266	8	248	8	188
9	268	9	224	9	219
10	273	10	238	10	221
11	268	11	280	11	199
12	273	12	251	12	228
13	267	13	230	13	231
14	281	14	208	14	233
15	266	15	211	15	231
16	271	16	271	16	227
17	269	17	231	17	188
18	272	18	249	18	187
19	271	19	223	19	185
20	280	20	203	20	187
21	273	21	233	21	169
22	266	22	230	22	165
23	276	23	236	23	175
24	213	24	245	24	151
25	270	25	275	25	145
26	169	26	259	26	161
27	275	27	265	27	152
28	272	28	223	28	180
29	256	29	220	29	200
30	270	30	221	30	174
31	272	31	243	-	-
Total (m^3)	**8549**		**7596**		**5754**
Daily Average (m^3/d)	**276**		**245**		**192**
Weekends Average (m^3/d)	**273**		**258**		**199**

Table 6 *- Daily and Monthly WWTF Flow (10/2019 - 12/2019)*

2019 (Oct - Dec) WWTF Monthly Flow Rates					
October, 2019		November, 2019		December, 2019	
Days	Flow Rate (m^3/d)	Days	Flow Rate (m^3/d)	Days	Flow Rate (m^3/d)
1	188	1	127	1	403
2	183	2	130	2	329
3	187	3	152	3	390
4	185	4	157	4	366
5	189	5	172	5	392
6	184	6	144	6	410
7	192	7	131	7	442
8	175	8	145	8	407
9	186	9	159	9	409
10	189	10	173	10	437
11	197	11	174	11	450
12	184	12	143	12	438
13	181	13	150	13	431
14	191	14	175	14	466
15	165	15	173	15	483
16	124	16	224	16	343
17	130	17	213	17	350
18	139	18	198	18	303
19	158	19	222	19	380
20	142	20	207	20	406
21	128	21	198	21	229
22	159	22	221	22	296
23	150	23	310	23	420
24	133	24	318	24	446
25	126	25	317	25	422
26	19	26	312	26	427
27	78	27	340	27	426
28	131	28	379	28	369
29	137	29	349	29	540
30	166	30	421	30	364
31	130	-	-	31	432
Total (m^3)	**4826**		**6534**		**12406**
Daily Average (m^3/d)	**156**		**218**		**400**
Weekends Average (m^3/d)	**142**		**233**		**404**

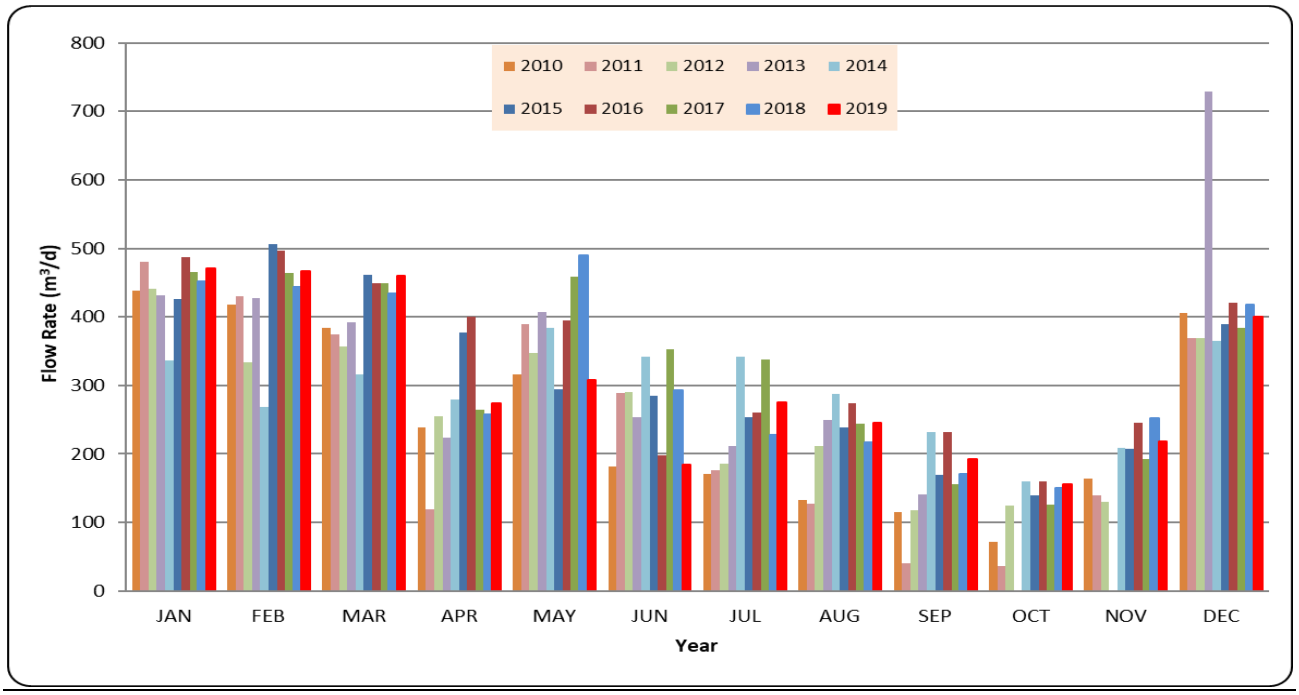


Figure 13 - *Average Monthly Wastewater Flow Rates (2010 - 2019)*

8.3 Projected Contributory Population and Plant Capacity

The 2019 residential, commercial, and new development pillow counts are summarized in Table 7.

Table 7 - *2019 Pillow Count*

	Pillow Count
Residential	6,615
Commercial	4,255.5
Total	**10,870.5**

The 2019 pillow count and planned future development pillow counts are compiled in Table 8.

Table 8 - *Current and Future Pillow Count*

	Pillow Count
Current	10,870.5
Planned future development	7,443.5
Total	**18,314**

In 2009 SHU adopted a revised pillow count calculation method that was repeated in 2010 through 2019. SHU observed that the original pillow count calculation method was not a realistic reflection of actual pillow counts at SSMR. To ensure that the wastewater collection and treatment systems have sufficient capacity to properly treat the wastewater, SHU felt it was necessary to develop a pillow count calculation method based on actual pillow count numbers collected at SSMR.

The new calculation method was developed directly from the average pillows counted per bedroom at a selection of residences and rental properties. The new and old pillow counts for resident styles are compared in Table 9 below.

***Table 9** - Pillow Count Calculation*

Residence Style	2009 Pillow Count	2010 - 2019 Pillow Count
Studio	2	4
1 bedroom	4	6
2 bedroom	6	8
3 bedroom	8	10
4 bedroom	9.5	14
5 bedroom	N/A	16

The new pillow count per zoning designation and commercial pillow counts are listed in Table 10 and Table 11 below.

***Table 10** - Pillow Count according to Zoning Designation*

Zoning Designation	Pillow Count
R1 Single dwelling	14
R2 Duplex (4 + 4 bedrooms)	28
R3 Medium density (3 bedrooms)	10
R4 Single dwelling and suite	22

Table 11 *- Commercial Pillow Count*

Commercial Service	Pillow Count
Restaurant & Bar	0.67 pillows / seat
Coffee shop	1.5 pillows / seat
Barber and Beauty salon	3 pillows / seat
Office space	1.5 pillows / 100ft^2

Adoption of the new pillow count method is important in ensuring the wastewater collection and treatment systems have sufficient capacity for the actual wastewater flow volumes at SSMR.

Plant Capacity:

The WWTF (excluding the storage ponds) is currently running at its maximum capacity during the peak season of December to January. During the last week of December and the first week of January, any excess flow over 24m^3/hr of raw sewage to the plant is stored in Cell 2 during the day, and from midnight to 7 am when the flow to the plant drops, a fully-automated transfer system pumps the water from Cell 2 back to the plant to process the excess water. The plant will continue to treat the excess sewage when the flow to the plant drops starting as early as February or later depending on the snow volumes and how busy the mountain is.

Capital Replacement Fund:

There is no capital replacement fund established.

Appendix A - Approved Monitoring Requirements

A.1 Introduction

Silverhawk Utilities submitted a request to the Ministry of Environment and Climate Change Strategy (ENV) in December 2016 to approve alternate monitoring requirements under Section 55(4) of the Municipal Wastewater Regulation (MWR). In November of 2017, ENV completed the review of these requests and approved alternate monitoring requirements.

A.2 Approval Conditions

The Approval of the alternate monitoring requirements was subject to the following conditions:

1- Silverhawk to use the weekly average concentration (average of three consecutive composite samples analyzed "in-house") of any of the parameters to determine if the regulatory standards have been exceeded and will immediately start investigating the cause of any exceedance and provide a solution to bring the facility into compliance. The parameter shall be monitored on a daily basis until compliance is achieved.

2- Silverhawk Utilities to Develop a "Trigger Response Plan" for scenarios when the "in-house" analysis indicate that the turbidity, TN or COD concentrations would exceed the maximum authorized discharge concentrations or indicate a process upset. The Plan should consider the following:
   a. Setting a COD concentration that correlates to BOD_5
   b. A response plan for the operators if turbidity, TN or COD approach or exceed authorized concentrations or indicate a process upset
   c. In the absence of more frequent Fecal Coliform analysis, develop a routine inspection and maintenance program that ensures the proper performance of the membrane filtration

3- At the beginning of the irrigation season, collect a sample from the 20M EP and analyze at a CALA certified lab for the following parameters:
   a. Dissolved metals, TSS, Turbidity, Total Nitrogen and Fecal Coliform

4- Re-instating quarterly submission of all in-house and CALA analysis identified above and as per Section 87 and 118 of the MWR

5- Continue to submit annual reports under Sections 66 and 67 of the MWR

6- Post annual reports on Silverhawk's website for the public to view

A.3 Actions Taken by Silverhawk Utilities

The following actions were taken by Silverhawk Utilities to satisfy the approval conditions:

1- Silverhawk was already monitoring the effluent three times per week and will continue to do so.
2- Silverhawk submitted a Trigger Response Plan to ENV on November 15th 2017 that addressed all the points identified by ENV. The plan is currently pending review and approval. However, as directed by ENV officer Trevor Hamelin, Silverhawk will follow the submitted Trigger Response Plan until it gets reviewed and approved by ENV.
3- Silverhawk will use COD of 100 mg/L as an indication of high BOD in the effluent. This correlation was established by historical data collected for COD and BOD_5, which were also shared with ENV.
4- A routine inspection and maintenance program for the membranes was implemented to ensure the proper performance of the membrane filtration.
5- Silverhawk was already analyzing a sample from the 20M EP at a CALA certified lab for Total Metals, TSS, Turbidity, Total Nitrogen and Fecal Coliform and will continue to do so.
6- Silverhawk has been submitting quarterly report since the approval of the alternative monitoring program.
7- The most recent annual report gets posted on Silverhawk's website every year.

The Approval letter that was issued by the Ministry of Environment and Climate Change Strategy is included in the following section. The revised monitoring schedule is summarized in Appendix B.

A.4 MOE Approval Letter

BRITISH COLUMBIA
Ministry of Environment and Climate Change Strategy

November 14, 2017 Authorization Number: 6738

VIA EMAIL: reza.shams@waterworks.ca, khaled.abdulrahman@waterworks.ca

Silverhawk Utilities Inc.
2024 12th Avenue,
Calgary AB T2N 1J7

Dear Registrant:

Re: Modification to General Monitoring Requirements under Section 55 of the Municipal Wastewater Regulation

This letter is to advise you that the Ministry of Environment and Climate Change Strategy (ENV) has completed the review of your December 2, 2016 request for the Director to approve alternate monitoring requirements under Section 55(4) of the Municipal Wastewater Regulation (MWR).

At present the Silverhawk Utilities Inc. (Silverhawk) facility is authorized to discharge a maximum of 544.8 m^3/day of Class C effluent to ground and for reclaimed water use (lower exposure potential for phase 1 and 2 and greater exposure potential for phase 3). On May 19, 2010 the Director imposed additional conditions that included: Weekly monitoring of Carbonaceous 5-day Biochemical Oxygen Demand (BOD_5), Total Suspended Solids (TSS) and all Nitrogen Parameters, set a total nitrogen (TN) limit of 10 mg/L and imposed the annual reporting condition under Section 66(1) of the MWR.

The MWR monitoring requirements for Class C effluent and reclaimed water meeting the lower exposure potential include:

Section 87, Table 8 (CLASS C)		**Section 118, Table 14 (lower exposure)**	
Flow	Daily	pH	Weekly
BOD_5 & TSS	Twice/month, composite	BOD_5 & TSS	Weekly
Fecal Coliforms	n/a	Fecal Coliforms	Weekly
Turbidity	n/a	Turbidity	N/A
Total Nitrogen and NO_3	Weekly (imposed on May 19, 2010)		

ENV has reviewed your request, annual reports and analytical data from December 2014 to May 2017. The analytical data indicated that BOD_5 and TSS was less than 10 mg/L and in compliance with Class C effluent standards. Meeting the TN requirement of 10 mg/L is difficult in colder climates and as a result Silverhawk has exceeded the TN limit of 10 mg/L periodically during the winter months, however, is compliant approximately 90 percent of the time.

Based on the review of the information available, I hereby **APPROVE** the following alternate monitoring requirements under Section 55(4) of the MWR with conditions.

The alternate monitoring requirements for sample collection and analysis at a laboratory certified under the Canadian Association for Laboratory Accreditation Inc. (CALA), as defined in Section 57(4) of MWR, is outlined below:

CLASS C Effluent Sampling Frequency*		**Lower Exposure Potential Sample Frequency***	
Flow	Daily	pH	Monthly (grab)
BOD_5 & TSS	Monthly (grab)	BOD_5 & TSS	Monthly (grab)
Fecal Coliforms	Monthly (grab)	Fecal Coliforms	Monthly (grab)
Turbidity	N/A	Turbidity	N/A
Total Nitrogen and NO_3	Monthly (grab)		

***Effluent samples must be collected before entering the 20 million gallon reservoir**.

Please Note, ENV understand that reclaimed water at this time is only utilized for irrigation. If in the future the reclaimed water is utilized for the purposes of snow making for skiing, the monitoring program must change to Greater Exposure Potential frequencies.

The Approval of the alternate monitoring requirements is subject to the following conditions:

1. Silverhawk must collect composite samples of the final treated effluent three times per week and analyze "in-house" for the following parameters: pH, chemical oxygen demand (COD), dissolved oxygen, Nitrate, Nitrite, Ammonia, TN, total phosphorus (TP), total dissolved phosphorus and turbidity.
2. Silverhawk will use the weekly average concentration (average of three consecutive composite samples analyzed "in-house") of any of the parameters to determine if the regulatory standards have been exceeded and will immediately start investigating the cause of any exceedance and provide a solution to bring the facility into compliance. The parameter will be monitored on a daily basis until compliance is achieved.
3. Develop a "Trigger Response Plan" (Plan) for scenarios when the "in-house" analysis indicates that the turbidity, TN or COD concentrations would exceed the maximum authorized discharge concentrations or indicate a process upset. The Plan must be

submitted to the Director for approval on or before 30 days from the date of this letter and should consider:

- Setting a COD concentration that correlates to BOD_5;
- A response plan for the operators if turbidity, TN or COD approach or exceed authorized concentrations or indicate a process upset; and
- In the absence of more frequent Fecal Coliform analysis, develop a routine inspection and maintenance program that ensure the proper performance of the membrane filtration.

4. At the beginning of the irrigation season, collect a samples from the 20 million gallon reservoir and analyse at a CALA certified lab for the following parameters: dissolved metals, TSS, turbidity, total nitrogen and fecal coliforms;
5. Re-instating quarterly submission of all in-house and CALA analysis identified above and as per Section 87 and 118 of the MWR;
6. Continue to submit annual reports under Sections 66 and 67 of the MWR;
7. Under Section 66(4) of the MWR, the Director is providing notice that Silverhawk must post annual reports to their website for the public to view.

This decision to specify more stringent standards or requirements under the Municipal Wastewater Regulation may be appealed to the Environmental Appeal Board in accordance with Part 8 of the *Environmental Management Act*. An appeal must be delivered within 30 days from the date that notice of this decision is given. For further information, please contact the Environmental Appeal Board at (250) 387-3464.

If you have any questions, please contact Trevor Hamelin at 604-582-5275 or trevor.hamelin@gov.bc.ca and include your authorization number.

Yours truly,

Stephanie Little
For Director, *Environmental Management Act*

Appendix B - Monitoring Schedule

B.1 Index for Monitoring Schedule

Al	Aluminum	**NO_2**	Nitrite
Ag	Silver	**NO_3**	Nitrate
As	Arsenic	**Pb**	Lead
B	Boron	**PO_4**	Phosphate
Ba	Barium	**SAR**	Sodium Absorption Ratio
Be	Beryllium	**Sb**	Antimony
Bi	Bismuth	**Se**	Selenium
BOD_5	Biological Oxygen Demand (5-day)	**Si**	Silicon
Ca	Calcium	**SO_4**	Sulfate
Cd	Cadmium	**Sn**	Tin
Cl	Chloride	**Sr**	Strontium
Co	Cobalt	**S**	Sulfur
COD	Chemical Oxygen Demand	**TA**	Total Alkalinity
Cr	Chromium	**TDP**	Total Dissolved Phosphorus
Cu	Copper	**TDS**	Total Dissolved Solids
DO	Dissolved Oxygen	**Te**	Tellurium
EC	Electrical Conductivity	**Tl**	Thallium
FC	Fecal Coliform	**Th**	Thorium
fCOD	Chemical Oxygen Demand (Filtered)	**Ti**	Titanium
Fe	Iron	**TKN**	Total Kjeldahl Nitrogen
Hg	Mercury	**TN**	Total Nitrogen
K	Potassium	**TP**	Total Phosphorus
Li	Lithium	**TSS**	Total Suspended Solids
Mg	Magnesium	**VSS**	Volatile Suspended Solids
Mn	Manganese	**U**	Uranium
Mo	Molybdenum	**V**	Vanadium
Na	Sodium	**VSS**	Volatile Suspended Solids
NH_3	Ammonia	**Zn**	Zinc
Ni	Nickel	**Zr**	Zirconium

B.2 Monitoring Schedule

In-House Monitoring Schedule

Location	Monitored Parameters	Sample Type	Frequency
Lift Station (Influent Tank)	DO, Temp, pH, COD, NH_3, NO_3, TSS, TP, TDP, TA	Composite Sample	3 Times a Week
	Flow	-	Daily
EQ Tank Feed Line	DO, Temp, pH	Grab Sample	3 Times a Week
	Flow	-	Daily
Internal Recycle Line	DO, Temp, pH, MLSS	Grab Sample	3 Times a Week
	Flow		Daily
Effluent (WW3) EMS# E228382	pH, COD, DO, NH_3, NO_3, NO_2, TN, TP, TDP, Turbidity, TA, Temp	Composite Sample	3 Times a Week
	Flow	-	Daily
20M EP EMS# E275065	pH, COD, NH_3, NO_2, NO_3, TSS, TP, TDP, TA, Turbidity	Grab Sample	Monthly
GW#1 - GW Well	COD, NH_3, NO_2, NO_3, TSS, TP, TDP, TA, Turbidity	Grab Sample	Once in June, Once in August & Once in October
GW#3 - GW Well		Grab Sample	
GW#4 - GW Well		Grab Sample	
GW#5 - GW Well		Grab Sample	
SW#1 - SW Well		Grab Sample	
SW#2 - SW Well		Grab Sample	
SW#3 - SW Well		Grab Sample	
SW#4 - SW Well		Grab Sample	
SW#5 - SW Well		Grab Sample	
SW#6 - SW Well		Grab Sample	
Phase 1	Flow	-	Daily During Irrigation Season
Phase 2	Flow	-	Daily During Irrigation Season

CALA Lab Monitoring Schedule

Location	Sample Parameters	Sample Type	Frequency
Effluent (WW3) EMS# E228382	BOD_5, COD, TSS, TKN, NH_3, NO_2, NO_3, TN, pH, Fecal Coliform	Grab Sample	Monthly
20M EP EMS# E275065	Fecal Coliform, Turbidity, TSS, TKN, NH_3, NO_2, NO_3, ON, TN, TP, TDP, Cl, SO_4 Total Hardness, Conductivity, Sodium Adsorption Ratio, Dissolved Metals (Al, Sb, As, Ba, Be, Bi, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Li, Mg, Mn, Mo, Ni, TP, K, Se, Si, Ag, Na, Sr, S, Te, Tl, Th, Sn, Ti, U, V, Zn, Zr)	Grab Sample	Once at the Beginning of Irrigation Season

Appendix C - Effluent Monitoring Data

C.1 Membrane Inspection Report

Inspection Date	Performed By	Comments / Observations
Jan 3/2019	Cory Clement Jim Huffman Keaton Brown	MBR units inspected. No Damage Observed. MBR # 1 placed into service. MBR # 3 is still in service. MBR # 2 removed from service & cleaned.
Jan 10/2019	Cory Clement Jim Huffman Keaton Brown	MBR units inspected. No Damage Observed. MBR # 2 placed into service. MBR # 1 is still in service. MBR # 3 removed from service & cleaned.
Jan 17/2019	Jim Huffman Keaton Brown	MBR units inspected. No Damage Observed. MBR # 3 placed into service. MBR # 2 is still in service. MBR # 1 removed from service & cleaned.
Jan 24/2019	Keaton Brown Cory Clement Jim Huffman	MBR units inspected. No Damage Observed. MBR # 1 placed into service. MBR # 3 is still in service. MBR # 2 removed from service & cleaned.
Jan 31/2019	KeatonBrown Cory Clement Jim Huffman	MBR units inspected. No Damage Observed. MBR # 2 placed into service. MBR # 1 is still in service. MBR # 3 removed from service & cleaned.
Feb 7/2019	Cory Clement Jim Huffman Keaton Brown	MBR units inspected. No Damage Observed. MBR # 3 placed into service. MBR # 2 is still in service. MBR # 1 removed from service & cleaned.
Feb 14/2019	Jim Huffman Cory Clement Keaton Brown	MBR units inspected. No Damage Observed. MBR # 1 placed into service. MBR # 3 is still in service. MBR # 2 removed from service & cleaned.
Feb 20/2019	Jim Huffman Cory Clement	MBR units inspected. No Damage Observed. MBR # 2 placed into service. MBR # 1 is still in service. MBR # 3 removed from service & cleaned.
Feb 28/2019	Keaton Brown Cory Clement	MBR units inspected. No Damage Observed. MBR # 3 placed into service. MBR # 2 is still in service. MBR # 1 removed from service & cleaned.
March 7/2019	Keaton Brown Cory Clement	MBR units inspected. No Damage Observed. MBR # 1 placed into service. MBR # 3 is still in service. MBR # 2 removed from service & cleaned.
March 12/2019	Jim Huffman Cory Clement	MBR units inspected. No Damage Observed. MBR # 2 placed into service. MBR # 1 is still in service. MBR # 3 removed from service & cleaned.
March 21/2019	Cory Clement Jim Huffman Keaton Brown	MBR units inspected. No Damage Observed. MBR # 3 placed into service. MBR # 2 is still in service. MBR # 1 removed from service & cleaned.
March 28/2019	Jim Huffman Keaton Brown Cory Clement	MBR units inspected. One broken fiber found on MBR # 2. Unit dismantled & fiber fixed & unit cleaned. MBR # 1 placed into service. MBR # 3 still in service.

Inspection Date	Performed By	Comments / Observations
April 4/2019	Cory Clement Jim Huffman Keaton Brown	MBR units inspected. No Damage Observed. MBR #1 is still in service. MBR #2 is now in service. MBR #3 removed from service & cleaned.
April 11/2019	Keaton Brown Jim Huffman Cory Clement	MBR units inspected. No Damage Observed. MBR #2 is still in service. MBR #3 is now in service. MBR #1 removed from service & cleaned.
April 18/2019	Jim Huffman Cory Clement Keaton Brown	MBR units inspected. No Damage Observed. MBR #3 is still in service. MBR #1 is now in service. MBR #2 removed from service & cleaned.
May 2/2019	Jim Huffman Cory Clement Keaton Brown	MBR units inspected. No Damage Observed. MBR #1 is still in service. MBR #2 is now in service. MBR #3 removed from service & cleaned.
May 30/2019	Jim Huffman Keaton Brown	MBR units inspected. No Damage Observed. MBR #2 is still in service. MBR #3 is now in service. MBR #1 removed from service & cleaned.
June 27/2019	Jim Huffman Keaton Brown	MBR units inspected. No Damage Observed. MBR #3 is still in service. MBR #1 is now in service. MBR #2 removed from service & cleaned.

MEMBANES INSPECTION REPORT

Inspection Date	Performed By	Comments / Observations
July 24/19	Jim Huffman Keaton Brown	MBR units inspected. No Damage Observed. MBR #1 is still in service. MBR #2 is now in service. MBR #3 removed from service & cleaned.
Aug 29/19	Jim Huffman Max DeJong	MBR units inspected. No Damage Observed. MBR #2 is still in service. MBR #3 is now in service. MBR #1 removed from service & cleaned.
Sept 26/19	Jim Huffman Max DeJong	MBR units inspected. No Damage Observed. MBR #3 is still in service. MBR #1 is now in service. MBR #2 removed from service & cleaned.

MEMBANES INSPECTION REPORT

Inspection Date	Performed By	Comments / Observations
Oct 30/2019	Jim Huffman Max Dejong	MBR units inspected. No Damage Observed. MBR #1 is still in service. MBR #2 is now in service. MBR #3 removed from service & cleaned.
Nov 28/19	Jim Huffman Max Dejong Keaton Brown	MBR units inspected. No Damage Observed. MBR #2 is still in service. MBR #3 is now in service. MBR #1 removed from service & cleaned.
Dec 5/19	Jim Huffman Max Dejong Keaton Brown	MBR units inspected. No Damage Observed. MBR #3 is still in service. MBR #1 is now in service. MBR #2 removed from service & cleaned.
Dec 12/19	Jim Huffman Max Dejong Keaton Brown	MBR units inspected. No Damage Observed. MBR #1 is still in service. MBR #2 is now in service. MBR #3 removed from service & cleaned.
Dec 19/19	Jim Huffman Max Dejong Keaton Brown	MBR units inspected. No Damage Observed. MBR #2 is still in service. MBR #3 is now in service. MBR #1 removed from service & cleaned.
Dec 26/19	Keaton Brown Max Dejong	MBR units inspected. No Damage Observed. MBR #3 is still in service. MBR #1 is now in service. MBR #2 removed from service & cleaned.

C.2 In-House Lab Analytical Data

In-House Lab Results Summary - January 2019

EFFLUENT											
Date	Flow	DO	pH	COD	NH_3-N	NO_2-N	NO_3-N	TN	Turbidity	TP	Ortho-P
	m^3/d	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L
2019-01-01	506										
2019-01-02	522	5.8	7.2	26	0.0	0.008	10.4	10.41	0.24	4.60	3.00
2019-01-03	457										
2019-01-04	459	4.6	7.4	37	0.0	0.007	7.4	7.41	0.35	0.90	0.85
2019-01-05	474										
2019-01-06	470										
2019-01-07	483	5.7	7.2	30	0.0	0.004	5.3	5.30	0.29	0.17	0.17
2019-01-08	500										
2019-01-09	459	6.1	7.1	13	0.0	0.006	3.5	3.51	0.30	0.11	0.07
2019-01-10	473										
2019-01-11	466	5.4	7.1	9	0.0	0.004	4.1	4.10	0.29	0.22	0.20
2019-01-12	506										
2019-01-13	475										
2019-01-14	438	5.5	7.2	15	1.0	0.010	5.3	6.31	0.34		0.10
2019-01-15	471										
2019-01-16	467	5.2	7.2	44	0.0	0.006	2.6	2.61	0.29	0.40	0.38
2019-01-17	447										
2019-01-18	467	5.8	7.2	26	1.0	0.007	3.9	4.91	0.35	0.20	0.13
2019-01-19	472										
2019-01-20	466										
2019-01-21	477	5.7	7.1	13	0.0	0.002	5.7	5.70	0.32	0.61	0.58
2019-01-22	486										
2019-01-23	457	5.5	7.0	29	0.0	0.000	3.3	3.30	0.25	0.20	0.13
2019-01-24	459										
2019-01-25	467	5.9	7.3	17	0.0	0.005	4.8	4.81	0.29	0.88	0.83
2019-01-26	496										
2019-01-27	473										
2019-01-28	442	5.5	7.2	27	0.0	0.008	6.2	6.21	0.34	-	0.41
2019-01-29	479										
2019-01-30	449	5.8	7.2	27	0.0	0.005	2.6	2.61	0.38	0.12	0.10
2019-01-31	452										
Average	**471**	**5.6**	**7.2**	**24**	**0.2**	**0.006**	**5.0**	**5.17**	**0.31**	**0.76**	**0.53**
Maximum	**522**	**6.1**	**7.4**	**44**	**1.0**	**0.010**	**10.4**	**10.41**	**0.38**	**4.60**	**3.00**
Minimum	**438**	**4.6**	**7.0**	**9**	**0.0**	**0.000**	**2.6**	**2.61**	**0.24**	**0.11**	**0.07**

In-House Lab Results Summary - February 2019

EFFLUENT											
Date	Flow	DO	pH	COD	NH_3-N	NO_2-N	NO_3-N	TN	Turbidity	TP	Ortho-P
	m^3/d	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L
2019-02-01	476	5.5	7.2	30	0.0	0.004	3.5	3.50	0.24	0.20	0.04
2019-02-02	484										
2019-02-03	471										
2019-02-04	457	5.4	7.2	24	0.0	0.003	3.9	3.90	0.25	0.42	0.34
2019-02-05	426										
2019-02-06	450	6.2	7.0	27	0.0	0.002	2.4	2.40	0.25	0.20	0.20
2019-02-07	470										
2019-02-08	475	6.4	7.1	21	0.0	0.003	3.5	3.50	0.22	0.32	0.28
2019-02-09	489										
2019-02-10	488										
2019-02-11	441	5.6	7.3	30	1.0	0.007	4.6	5.61	0.21	1.63	1.58
2019-02-12	473										
2019-02-13	470	5.9	7.3	34	0.0	0.010	1.8	1.81	0.23	0.32	0.25
2019-02-14	456										
2019-02-15	462	6.1	7.3	35	0.0	0.012	2.5	2.51	0.23	0.42	0.28
2019-02-16	481										
2019-02-17	473										
2019-02-18	467	5.4	7.3	32	0.0	0.003	2.0	2.00	0.26	0.38	0.31
2019-02-19	469										
2019-02-20	476	5.1	7.1	22	0.0	0.000	1.2	1.20	0.21	0.18	0.09
2019-02-21	474										
2019-02-22	473	5.5	7.1	29	0.0	0.003	1.8	1.80	0.23	0.13	0.09
2019-02-23	498										
2019-02-24	463										
2019-02-25	438	5.7	7.1	24	0.0	0.008	2.5	2.51	0.38	0.24	0.12
2019-02-26	453										
2019-02-27	488	5.8	7.2	34	0.0	0.008	1.7	1.71	0.25	0.12	0.12
2019-02-28	438										
Average	**467**	**5.7**	**7.2**	**29**	**0.1**	**0.005**	**2.6**	**2.71**	**0.25**	**0.38**	**0.31**
Maximum	**498**	**6.4**	**7.3**	**35**	**1.0**	**0.012**	**4.6**	**5.61**	**0.38**	**1.63**	**1.58**
Minimum	**426**	**5.1**	**7.0**	**21**	**0.0**	**0.000**	**1.2**	**1.20**	**0.21**	**0.12**	**0.04**

In-House Lab Results Summary - March 2019

EFFLUENT											
Date	Flow	DO	pH	COD	NH_3-N	NO_2-N	NO_3-N	TN	Turbidity	TP	Ortho-P
	m^3/d	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L
2019-03-01	463	5.0	7.7	35	1.0	0.007	2.9	3.91	0.28	1.50	0.05
2019-03-02	328										
2019-03-03	461										
2019-03-04	472	5.9	7.2	42	0.0	0.005	2.8	2.81	0.30	1.08	0.96
2019-03-05	442										
2019-03-06	463	5.4	7.0	30	0.0	0.000	0.7	0.70	0.25	0.31	0.17
2019-03-07	474										
2019-03-08	455	5.5	7.1	37	0.0	0.002	0.5	0.50	0.24	0.26	0.19
2019-03-09	511										
2019-03-10	426										
2019-03-11	444	5.4	7.2	28	0.0	0.005	0.7	0.71	0.27	0.19	0.14
2019-03-12	465										
2019-03-13	464	6.5	7.3	32	0.0	0.009	0.8	0.81	0.34	0.24	0.11
2019-03-14	458										
2019-03-15	455	7.1	7.3	17	0.0	0.010	3.0	3.01	0.28	0.14	0.02
2019-03-16	464										
2019-03-17	467										
2019-03-18	469	6.4	7.2	22	0.0	0.000	3.7	3.70	0.30	1.08	0.93
2019-03-19	470										
2019-03-20	471	6.6	7.2	29	0.0	0.001	1.8	1.80	0.29	0.32	0.19
2019-03-21	471										
2019-03-22	471	6.4	7.0	32	0.0	0.006	2.8	2.81	0.27	0.17	0.06
2019-03-23	493										
2019-03-24	487										
2019-03-25	467	6.4	7.3	15	0.0	0.008	2.6	2.61	0.36	0.22	0.17
2019-03-26	451										
2019-03-27	401	7.5	7.4	15	0.0	0.008	2.7	2.71	0.38	0.23	0.06
2019-03-28	422										
2019-03-29	475	6.8	7.2	31	0.0	0.014	4.8	4.81	0.21	0.62	0.52
2019-03-30	499										
2019-03-31	479										
Average	**459**	**6.2**	**7.2**	**28**	**0.1**	**0.006**	**2.3**	**2.38**	**0.29**	**0.49**	**0.27**
Maximum	**511**	**7.5**	**7.7**	**42**	**1.0**	**0.014**	**4.8**	**4.81**	**0.38**	**1.50**	**0.96**
Minimum	**328**	**5.0**	**7.0**	**15**	**0.0**	**0.000**	**0.5**	**0.50**	**0.21**	**0.14**	**0.02**

In-House Lab Results Summary - April 2019

EFFLUENT											
Date	Flow	DO	pH	COD	NH_3-N	NO_2-N	NO_3-N	TN	Turbidity	TP	Ortho-P
	m^3/d	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L
2019-04-01	451	6.7	7.2	24	0.0	0.005	4.7	4.71	0.39	1.44	1.36
2019-04-02	474										
2019-04-03	476	6.7	7.1	54	0.0	0.001	1.0	1.00	0.23	0.22	0.12
2019-04-04	473										
2019-04-05	481	7.1	7.2	32	0.0	0.004	1.2	1.20	0.28	0.19	0.12
2019-04-06	351										
2019-04-07	376										
2019-04-08	323	6.6	7.3	21	1.0	0.087	1.0	2.09	0.21	1.61	1.49
2019-04-09	349										
2019-04-10	353	7.4	7.3	31	0.0	0.010	0.7	0.71	0.34	0.98	0.88
2019-04-11	225										
2019-04-12	187	8.6	7.4	28	0.0	0.014	1.0	1.01	0.21	1.06	1.05
2019-04-13	178										
2019-04-14	146										
2019-04-15	158	8.2	7.4	12	0.0	0.004	1.4	1.40	0.26	2.20	1.78
2019-04-16	163										
2019-04-17	158	8.2	7.2	19	0.0	0.006	1.1	1.11	0.23	2.90	2.25
2019-04-18	177										
2019-04-19	225	8.0	7.1	21	0.0	0.002	1.1	1.10	0.26	3.50	3.00
2019-04-20	220										
2019-04-21	194										
2019-04-22	222	7.8	7.3	12	0.0	0.038	0.8	0.84	0.18	2.80	2.10
2019-04-23	281										
2019-04-24	258	8.1	7.3	18	0.0	0.001	0.8	0.80	0.28	1.60	2.90
2019-04-25	263										
2019-04-26	241	8.2	7.3	21	0.0	0.007	1.2	1.21	0.17	0.70	2.30
2019-04-27	227										
2019-04-28	209										
2019-04-29	204	8.3	7.1	11	0.0	0.003	1.1	1.10	0.24	3.20	3.20
2019-04-30	189										
Average	**274**	**7.7**	**7.2**	**23**	**0.1**	**0.014**	**1.3**	**1.41**	**0.25**	**1.72**	**1.73**
Maximum	**481**	**8.6**	**7.4**	**54**	**1.0**	**0.087**	**4.7**	**4.71**	**0.39**	**3.50**	**3.20**
Minimum	**146**	**6.6**	**7.1**	**11**	**0.0**	**0.001**	**0.7**	**0.71**	**0.17**	**0.19**	**0.12**

In-House Lab Results Summary - May 2019

EFFLUENT											
Date	Flow	DO	pH	COD	NH_3-N	NO_2-N	NO_3-N	TN	Turbidity	TP	Ortho-P
	m^3/d	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L
2019-05-01	186	8.3	7.1	11	0.0	0.000	1.5	1.50	0.23	4.00	3.80
2019-05-02	198										
2019-05-03	192	8.7	7.2	25	0.0	0.005	1.5	1.51	0.23	4.00	4.00
2019-05-04	238										
2019-05-05	230										
2019-05-06	228	8.2	7.3	23	0.0	0.003	1.8	1.80	0.36	2.50	4.00
2019-05-07	238										
2019-05-08	218	8.6	7.3	13	0.0	0.010	2.1	2.11	0.26	4.85	4.35
2019-05-09	366										
2019-05-10	359	8.4	7.2	6	0.0	0.003	3.8	3.80	0.22	3.95	3.75
2019-05-11	340										
2019-05-12	354										
2019-05-13	293	8.6	7.2	0	0.0	0.009	6.2	6.21	0.27	3.30	3.15
2019-05-14	288										
2019-05-15	303	9.0	7.4	0	0.0	0.001	4.9	4.90	0.30	3.20	2.65
2019-05-16	354										
2019-05-17	349	8.6	7.5	7	0.0	0.005	4.0	4.01	0.26	3.25	2.80
2019-05-18	361										
2019-05-19	349										
2019-05-20	331	8.5	7.3	0	0.0	0.005	4.2	4.21	0.25	3.85	2.40
2019-05-21	362										
2019-05-22	354	8.4	7.4	22	0.0	0.005	5.0	5.01	0.26	4.55	4.40
2019-05-23	363										
2019-05-24	360	8.3	7.4	17	0.0	0.005	3.8	3.81	0.24	4.75	4.45
2019-05-25	357										
2019-05-26	361										
2019-05-27	368	8.1	7.2	20	0.0	0.004	4.6	4.60	0.25	8.20	7.10
2019-05-28	365										
2019-05-29	358	7.8	7.1	11	0.0	0.005	6.4	6.41	0.28	10.40	9.90
2019-05-30	270										
2019-05-31	230	8.2	7.5	17	0.0	0.003	5.9	5.90	0.32	12.80	11.50
Average	**307**	**8.4**	**7.3**	**12**	**0.0**	**0.005**	**4.0**	**3.98**	**0.27**	**5.26**	**4.88**
Maximum	**368**	**9.0**	**7.5**	**25**	**0.0**	**0.010**	**6.4**	**6.41**	**0.36**	**12.80**	**11.50**
Minimum	**186**	**7.8**	**7.1**	**0**	**0.0**	**0.000**	**1.5**	**1.50**	**0.22**	**2.50**	**2.40**

In-House Lab Results Summary - June 2019

EFFLUENT											
Date	Flow	DO	pH	COD	NH_3-N	NO_2-N	NO_3-N	TN	Turbidity	TP	Ortho-P
	m^3/d	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L
2019-06-01	243										
2019-06-02	203										
2019-06-03	244	7.9	7.5	44	0.0	0.008	7.3	7.31	0.45	12.60	12.00
2019-06-04	231										
2019-06-05	231	7.6	7.3	37	0.0	0.002	8.3	8.30	0.29	12.50	10.40
2019-06-06	222										
2019-06-07	234	8.1	7.3	11	0.0	0.002	8.3	8.30	0.44	12.60	12.20
2019-06-08	222										
2019-06-09	183										
2019-06-10	153	8.3	7.3	14	0.0	0.009	8.8	8.81	0.29	13.60	13.20
2019-06-11	154										
2019-06-12	157	7.8	7.0	20	0.0	0.005	8.8	8.81	0.29	12.50	11.90
2019-06-13	151										
2019-06-14	159	8.0	7.2	15	0.0	0.006	7.3	7.31	0.33	11.80	10.70
2019-06-15	148										
2019-06-16	164										
2019-06-17	148	8.1	7.2	34	0.0	0.005	4.5	4.51	0.40	10.00	9.70
2019-06-18	153										
2019-06-19	151	7.7	7.3	0	0.0	0.003	3.2	3.20	0.28	8.90	8.50
2019-06-20	147										
2019-06-21	182	8.0	7.4	14	0.0	0.003	1.3	1.30	0.29	8.15	7.50
2019-06-22	171										
2019-06-23	189										
2019-06-24	182	7.5	7.2	21	0.0	0.006	6.2	6.21	0.32	7.10	5.80
2019-06-25	188										
2019-06-26	157	7.7	7.3	5	0.0	0.012	7.7	7.71	0.26	7.15	6.20
2019-06-27	157										
2019-06-28	184	7.7	7.4	26	0.0	0.007	4.3	4.31	0.29	6.65	6.20
2019-06-29	210										
2019-06-30	226										
Average	**185**	**7.9**	**7.3**	**20**	**0.0**	**0.006**	**6.3**	**6.34**	**0.33**	**10.30**	**9.53**
Maximum	**244**	**8.3**	**7.5**	**44**	**0.0**	**0.012**	**8.8**	**8.81**	**0.45**	**13.60**	**13.20**
Minimum	**147**	**7.5**	**7.0**	**0**	**0.0**	**0.002**	**1.3**	**1.30**	**0.26**	**6.65**	**5.80**

In-House Lab Results Summary - July 2019

EFFLUENT											
Date	Flow	DO	pH	COD	NH_3-N	NO_2-N	NO_3-N	TN	Turbidity	TP	Ortho-P
	m^3/d	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L
2019-07-01	292	6.2	7.1	49	0.0	0.027	6.5	6.53	0.37	7.45	4.30
2019-07-02	373										
2019-07-03	330	6.2	7.2	12	1.0	0.000	6.1	7.10	0.33	5.95	5.10
2019-07-04	344										
2019-07-05	335	5.7	7.3	16	0.0	0.003	2.3	2.30	0.25	8.50	7.10
2019-07-06	266										
2019-07-07	272										
2019-07-08	266	6.3	7.2	20	0.0	0.006	4.3	4.31	0.32	8.50	7.40
2019-07-09	268										
2019-07-10	273	6.3	7.1	29	0.0	0.008	4.7	4.71	0.32	6.90	5.50
2019-07-11	268										
2019-07-12	273	5.8	7.3	22	0.0	0.005	4.5	4.51	0.29	6.45	4.80
2019-07-13	267										
2019-07-14	281										
2019-07-15	266	5.7	7.2	5	0.0	0.007	4.0	4.01	0.41	8.70	5.50
2019-07-16	271										
2019-07-17	269	6.1	7.3	5	0.0	0.006	2.7	2.71	0.30	5.50	4.10
2019-07-18	272										
2019-07-19	271	6.5	7.4	29	0.0	0.003	2.9	2.90	0.63	4.35	3.80
2019-07-20	280										
2019-07-21	273										
2019-07-22	266	6.1	7.3	14	0.0	0.002	2.9	2.90	0.31	4.35	2.90
2019-07-23	276										
2019-07-24	213	6.7	7.3	24	0.0	0.001	2.2	2.20	0.38	5.90	5.60
2019-07-25	270										
2019-07-26	169	4.5	7.2	0	1.0	0.005	2.4	3.41	0.34	6.95	6.45
2019-07-27	275										
2019-07-28	272										
2019-07-29	256	5.9	7.3	31	0.0	0.002	2.7	2.70	0.47	6.20	5.10
2019-07-30	270										
2019-07-31	272	6.0	7.2	32	0.0	0.004	3.1	3.10	0.31	7.00	6.00
Average	**276**	**6.0**	**7.2**	**21**	**0.1**	**0.006**	**3.7**	**3.81**	**0.36**	**6.62**	**5.26**
Maximum	**373**	**6.7**	**7.4**	**49**	**1.0**	**0.027**	**6.5**	**7.10**	**0.63**	**8.70**	**7.40**
Minimum	**169**	**4.5**	**7.1**	**0**	**0.0**	**0.000**	**2.2**	**2.20**	**0.25**	**4.35**	**2.90**

In-House Lab Results Summary - August 2019

EFFLUENT											
Date	Flow	DO	pH	COD	NH_3-N	NO_2-N	NO_3-N	TN	Turbidity	TP	Ortho-P
	m^3/d	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L
2019-08-01	274										
2019-08-02	247	5.9	7.3	10	0.0	0.002	2.4	2.40	0.42	8.80	6.80
2019-08-03	292										
2019-08-04	267										
2019-08-05	265	6.1	7.3	31	0.0	0.005	4.5	4.51	0.33	9.20	9.20
2019-08-06	269										
2019-08-07	265	5.8	7.2	18	0.0	0.006	4.0	4.01	0.38	6.70	6.60
2019-08-08	248										
2019-08-09	224	6.2	7.3	11	0.0	0.001	2.3	2.30	0.30	5.30	5.10
2019-08-10	238										
2019-08-11	280										
2019-08-12	251	6.2	7.3	2	0.0	0.006	3.0	3.01	0.26	4.70	3.90
2019-08-13	230										
2019-08-14	208	7.0	7.2	34	1.0	0.009	3.3	4.31	0.23	5.10	4.00
2019-08-15	211										
2019-08-16	271	6.3	7.3	26	0.0	0.012	2.0	2.01	0.34	4.60	0.00
2019-08-17	231										
2019-08-18	249										
2019-08-19	223	6.9	7.3	0	0.0	0.007	2.7	2.71	0.27	6.60	6.40
2019-08-20	203										
2019-08-21	233	2.3	7.0	4	0.0	0.006	2.7	2.71	0.31	6.50	6.35
2019-08-22	230										
2019-08-23	236	6.7	7.3	13	0.0	0.011	3.0	3.01	0.32	6.10	6.05
2019-08-24	245										
2019-08-25	275										
2019-08-26	259	6.7	6.5	36	0.0	0.004	2.9	2.90	0.30	5.10	3.90
2019-08-27	265										
2019-08-28	223	7.2	7.4	36	0.0	0.007	2.5	2.51	0.29	4.00	3.00
2019-08-29	220										
2019-08-30	221	6.8	7.4	18	0.0	0.011	1.6	1.61	0.37	5.50	5.50
2019-08-31	243										
Average	**245**	**6.2**	**7.2**	**18**	**0.1**	**0.007**	**2.8**	**2.92**	**0.32**	**6.02**	**5.14**
Maximum	**292**	**7.2**	**7.4**	**36**	**1.0**	**0.012**	**4.5**	**4.51**	**0.42**	**9.20**	**9.20**
Minimum	**203**	**2.3**	**6.5**	**0**	**0.0**	**0.001**	**1.6**	**1.61**	**0.23**	**4.00**	**0.00**

In-House Lab Results Summary - September 2019

EFFLUENT											
Date	Flow	DO	pH	COD	NH_3-N	NO_2-N	NO_3-N	TN	Turbidity	TP	Ortho-P
	m^3/d	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L
2019-09-01	277										
2019-09-02	256	6.6	7.2	16	0.0	0.009	3.4	3.41	0.47	6.30	5.90
2019-09-03	198										
2019-09-04	155	7.0	7.6	29	0.0	0.006	2.8	2.81	0.55	5.10	4.20
2019-09-05	160										
2019-09-06	167	7.2	7.5	17	0.0	0.006	2.4	2.41	0.31	6.90	6.50
2019-09-07	145										
2019-09-08	188										
2019-09-09	219	6.8	7.4	25	0.0	0.005	4.1	4.11	0.43	7.70	6.30
2019-09-10	221										
2019-09-11	199	7.6	7.4	35	0.0	0.005	3.5	3.51	0.29	6.40	5.50
2019-09-12	228										
2019-09-13	231	7.6	7.3	22	0.0	0.007	4.4	4.41	0.34	5.90	5.10
2019-09-14	233										
2019-09-15	231										
2019-09-16	227	7.0	7.3	24	1.0	0.004	9.3	10.30	0.34	6.80	4.30
2019-09-17	188										
2019-09-18	187	6.8	7.5	22	0.0	0.030	5.5	5.53	0.44	7.27	6.40
2019-09-19	185										
2019-09-20	187	7.3	7.2	39	0.0	0.000	3.9	3.90	0.50	7.75	6.00
2019-09-21	169										
2019-09-22	165										
2019-09-23	175	7.3	7.5	29	0.0	0.000	7.4	7.40	0.41	7.70	
2019-09-24	151										
2019-09-25	145	7.9	7.3	36	0.0	0.003	8.7	8.70	0.34	7.70	6.90
2019-09-26	161										
2019-09-27	152	8.1	7.3	40	0.0	0.004	5.9	5.90	0.39	6.30	5.60
2019-09-28	180										
2019-09-29	200										
2019-09-30	174	7.6	7.4	36	0.0	0.000	4.8	4.80	0.63	6.90	5.50
Average	**192**	**7.3**	**7.4**	**28**	**0.1**	**0.006**	**5.1**	**5.17**	**0.42**	**6.82**	**5.68**
Maximum	**277**	**8.1**	**7.6**	**40**	**1.0**	**0.030**	**9.3**	**10.30**	**0.63**	**7.75**	**6.90**
Minimum	**145**	**6.6**	**7.2**	**16**	**0.0**	**0.000**	**2.4**	**2.41**	**0.29**	**5.10**	**4.20**

In-House Lab Results Summary - October 2019

EFFLUENT											
Date	Flow	DO	pH	COD	NH_3-N	NO_2-N	NO_3-N	TN	Turbidity	TP	Ortho-P
	m^3/d	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L
2019-10-01	188										
2019-10-02	183	7.9	7.9	7	0.0	0.001	5.9	5.90	0.39	6.25	5.60
2019-10-03	187										
2019-10-04	185	8.0	7.4	23	3.0	0.003	5.4	8.40	0.48	5.80	5.55
2019-10-05	189										
2019-10-06	184										
2019-10-07	192	8.3	7.3	22	0.0	0.008	6.0	6.01	0.32	5.30	4.60
2019-10-08	175										
2019-10-09	186	8.2	7.3	11	0.0	0.008	6.0	6.01	0.20	6.20	5.70
2019-10-10	189										
2019-10-11	197	8.2	7.3	16	0.0	0.007	7.1	7.11	0.19	6.20	6.20
2019-10-12	184										
2019-10-13	181										
2019-10-14	191	8.2	7.3	23	0.0	0.007	9.1	9.11	0.33	7.40	7.00
2019-10-15	165										
2019-10-16	124	8.2	7.2	27	0.0	0.004	8.4	8.40	0.30	8.20	7.80
2019-10-17	130										
2019-10-18	139	8.2	7.2	34	0.0	0.003	2.2	2.20	0.32	8.55	8.50
2019-10-19	158										
2019-10-20	142										
2019-10-21	128	8.6	7.3	25	0.0	0.005	3.6	3.61	0.44	5.80	4.30
2019-10-22	159										
2019-10-23	150	8.5	7.6	15	0.0	0.015	6.4	6.42	0.62	5.10	4.70
2019-10-24	133										
2019-10-25	126	8.0	7.3	37	1.0	0.006	5.2	6.21	0.51	4.55	4.20
2019-10-26	19										
2019-10-27	78										
2019-10-28	131	8.2	7.5	21	0.0	0.004	4.2	4.20	0.30	5.55	5.30
2019-10-29	137										
2019-10-30	166	8.4	7.2	9	0.0	0.005	7.2	7.21	0.25	4.85	4.85
2019-10-31	130										
Average	**156**	**8.2**	**7.4**	**21**	**0.3**	**0.006**	**5.9**	**6.21**	**0.36**	**6.13**	**5.72**
Maximum	**197**	**8.6**	**7.9**	**37**	**3.0**	**0.015**	**9.1**	**9.11**	**0.62**	**8.55**	**8.50**
Minimum	**19**	**7.9**	**7.2**	**7**	**0.0**	**0.001**	**2.2**	**2.20**	**0.19**	**4.55**	**4.20**

In-House Lab Results Summary - November 2019

EFFLUENT											
Date	Flow	DO	pH	COD	NH_3-N	NO_2-N	NO_3-N	TN	Turbidity	TP	Ortho-P
	m^3/d	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L
2019-11-01	127	8.5	7.2	22	0.0	0.007	8.3	8.31	0.43	6.10	5.70
2019-11-02	130										
2019-11-03	152										
2019-11-04	157	8.7	7.7	17	1.0	0.015	5.4	6.42	0.51	3.70	3.60
2019-11-05	172										
2019-11-06	144	8.6	7.7	5	0.0	0.028	7.2	7.23	0.47	4.50	4.40
2019-11-07	131										
2019-11-08	145	8.6	7.9	12	0.0	0.007	7.9	7.91	0.44	4.30	2.10
2019-11-09	159										
2019-11-10	173										
2019-11-11	174	7.7	7.2	15	0.0	0.022	8.8	8.82	0.44	4.20	3.90
2019-11-12	143										
2019-11-13	150	8.2	7.0	0	0.0	0.302	11.1	11.40	0.36	3.70	3.55
2019-11-14	175										
2019-11-15	173	7.6	7.0	16	0.0	0.882	7.6	8.48	0.27	6.80	6.20
2019-11-16	224										
2019-11-17	213										
2019-11-18	198	7.6	7.6	10	0.0	0.023	5.8	5.82	0.44	4.05	2.40
2019-11-19	222										
2019-11-20	207	6.9	7.1	25	0.0	0.089	9.4	9.49	0.38	3.00	2.00
2019-11-21	198										
2019-11-22	221	7.3	7.1	47	0.0	0.186	6.6	6.79	0.50	4.15	3.80
2019-11-23	310										
2019-11-24	318										
2019-11-25	317	6.2	6.9	0	0.0	0.005	6.6	6.61	0.39	3.40	3.05
2019-11-26	312										
2019-11-27	340	6.5	6.9	27	0.0	0.002	6.3	6.30	0.39	3.40	3.05
2019-11-28	379										
2019-11-29	349	6.3	6.8	4	0.0	0.004	7.1	7.10	0.31	3.30	3.25
2019-11-30	421										
Average	**218**	**7.6**	**7.2**	**15**	**0.1**	**0.121**	**7.5**	**7.74**	**0.41**	**4.20**	**3.62**
Maximum	**421**	**8.7**	**7.9**	**47**	**1.0**	**0.882**	**11.1**	**11.40**	**0.51**	**6.80**	**6.20**
Minimum	**127**	**6.2**	**6.8**	**0**	**0.0**	**0.002**	**5.4**	**5.82**	**0.27**	**3.00**	**2.00**

In-House Lab Results Summary - December 2019

EFFLUENT											
Date	Flow	DO	pH	COD	NH_3-N	NO_2-N	NO_3-N	TN	Turbidity	TP	Ortho-P
	m^3/d	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L
2019-12-01	403										
2019-12-02	329	6.3	7.0	115	0.0	0.004	9.3	9.30	0.43	3.80	3.20
2019-12-03	390										
2019-12-04	366	5.2	7.4	55	1.0	0.002	3.8	4.80	0.36	2.45	2.00
2019-12-05	392										
2019-12-06	410	5.8	6.9	24	0.0	0.000	3.9	3.90	0.42	3.05	3.00
2019-12-07	442										
2019-12-08	407										
2019-12-09	409	5.3	6.9	34	0.0	0.004	6.1	6.10	0.26	3.40	3.20
2019-12-10	437										
2019-12-11	450	5.9	6.8	9	0.0	0.003	5.8	5.80	0.22	3.80	3.35
2019-12-12	438										
2019-12-13	431	6.3	6.8	23	1.0	0.002	7.9	8.90	0.27	7.00	6.60
2019-12-14	466										
2019-12-15	483										
2019-12-16	343	5.4	6.9	38	1.0	0.007	10.5	11.51	0.36	7.50	6.70
2019-12-17	350										
2019-12-18	303	7.2	7.2	25	1.0	0.000	5.8	6.80	0.28	6.80	5.30
2019-12-19	380										
2019-12-20	406	6.6	7.0	34	1.0	0.003	8.0	9.00	0.32	3.90	3.60
2019-12-21	229										
2019-12-22	296										
2019-12-23	420	6.7	6.7	28	0.0	0.002	7.2	7.20	0.32	5.60	4.95
2019-12-24	446										
2019-12-25	422	6.8	6.7	17	0.0	0.010	11.2	11.21	0.26	3.90	3.55
2019-12-26	427										
2019-12-27	426	5.8	6.8	15	0.0	0.002	11.8	11.80	0.29	5.00	4.65
2019-12-28	369				4.0	0.011	11.2	15.21			
2019-12-29	540				0.0	0.000	8.5	8.50			
2019-12-30	364	5.8	6.8	45	0.0	0.004	9.8	9.80	0.35	4.20	3.70
2019-12-31	432										
Average	**400**	**6.1**	**6.9**	**36**	**0.6**	**0.004**	**8.1**	**8.66**	**0.32**	**4.65**	**4.14**
Maximum	**540**	**7.2**	**7.4**	**115**	**4.0**	**0.011**	**11.8**	**15.21**	**0.43**	**7.50**	**6.70**
Minimum	**229**	**5.2**	**6.7**	**9**	**0.0**	**0.000**	**3.8**	**3.90**	**0.22**	**2.45**	**2.00**

C.3 CARO Lab Analytical Data

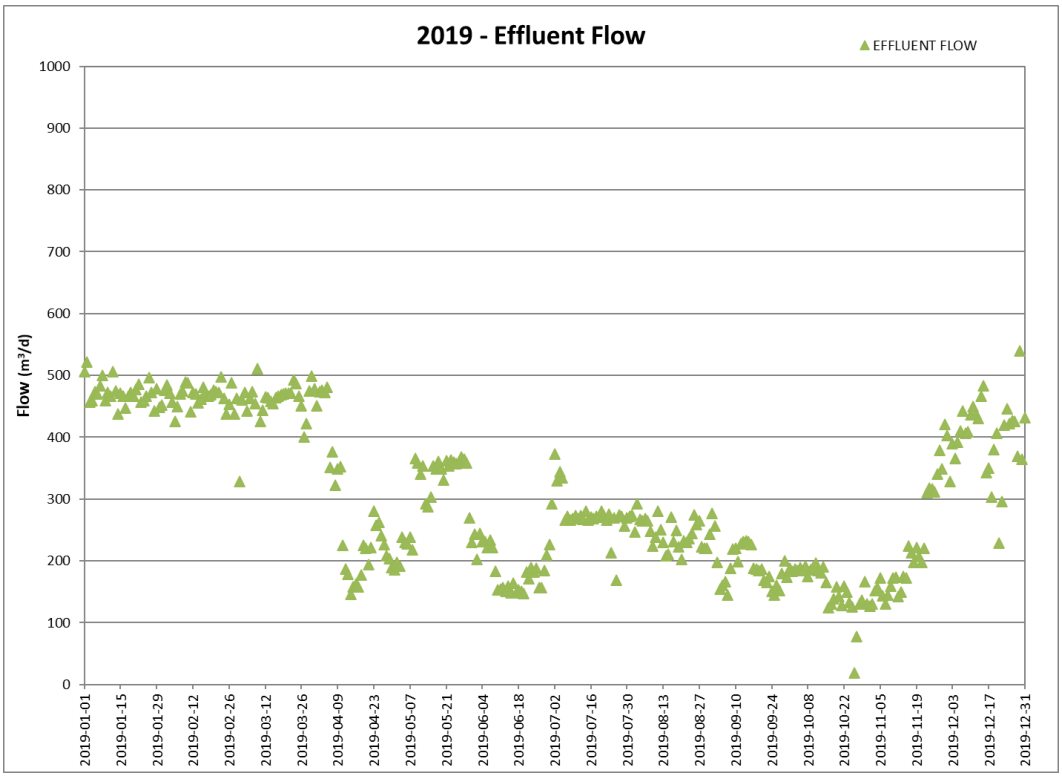
Note: CARO is a CALA certified Lab. The CARO lab Reports are included in Appendix H.

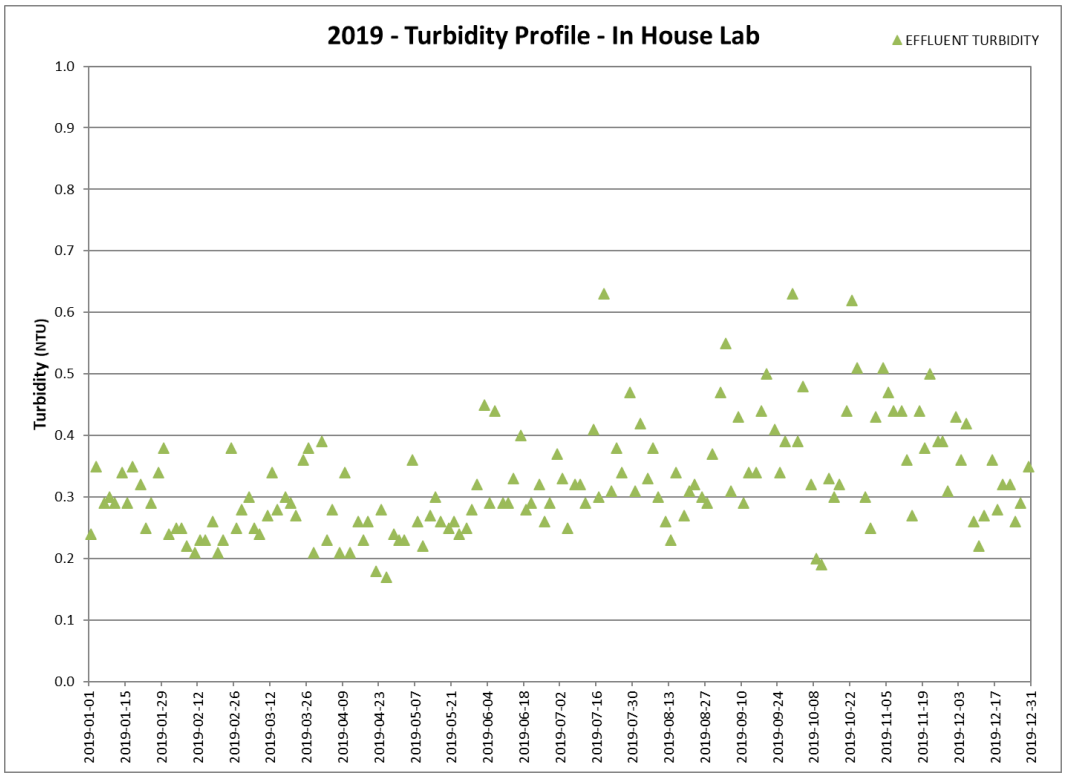
CALA Lab Results Summary (CARO Analytical Services)

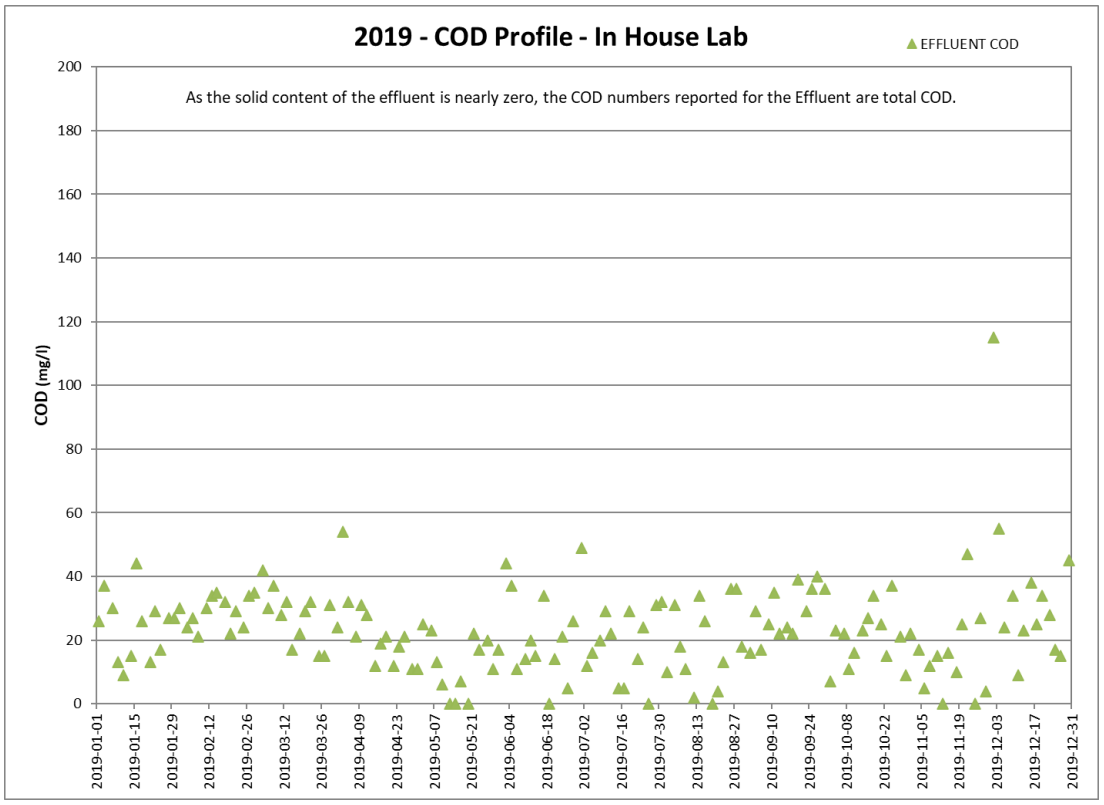
EFFLUENT											
Date	pH	NH_3-N	NO_2-N	NO_3-N	NO_X-N	TKN	TN	COD	BOD_5	TSS	Fecal Coliform NOTE 2
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	CFU/100mL
2019-01-16	7.96	0.050	< 0.010	1.40	1.40	1.4	2.8	22	< 8.7	< 3.3	17.0
2019-02-13	8.00	0.113	< 0.010	1.45	1.45	1.2	2.7	29	< 6.3	< 3.3	5.0
2019-03-13	7.91	0.045	0.082	0.32	0.40	1.10	1.5	30	6	< 2.0	2.0
2019-04-01											< 1
2019-04-17	7.96	0.098	0.018	0.26	0.28	0.79	1.1	< 20	< 5.4	< 2.0	< 1
2019-05-15	7.98	0.020	0.036	3.37	3.40	0.37	3.8	25	< 5.7	< 2.0	< 1
2019-06-12	7.88	0.093	0.038	8.50	8.54	0.868	9.4	23	< 6.1	< 2.0	< 1
2019-07-10	7.96	0.072	0.039	3.79	3.83	0.936	4.8	25	< 6.7	< 2.0	1.0
2019-08-14	8.02	0.059	< 0.010	1.74	1.74	0.68	2.4	< 20	< 8.0	< 2.0	6.0
2019-09-11	7.93	0.167	< 0.010	2.00	2.00	0.683	2.7	< 20	< 6.2	< 2.0	
2019-09-16											2.0
2019-10-16	7.82	0.096	< 0.010	6.59	6.59	0.777	7.4	< 20	< 5.5	< 2.0	< 1
2019-11-13	8.15	0.099	0.640	9.16	9.80	0.811	10.6	< 20	7	< 2.0	5.2
2019-12-11	7.93	0.093	0.041	5.03	5.07	1.05	6.1	22	< 7.8	< 2.0	3.1
Average	**7.96**	**0.084**	**0.0745** Note 1	**3.63**	**3.71**	**0.89**	**4.60**	**15** Note 1	**1.13** Note 1	**Non-Detect**	**3.4** Note 1
Maximum	**8.15**	**0.167**	**0.64**	**9.16**	**9.80**	**1.40**	**10.60**	**30**	**7**	**-**	**17.0**
Minimum	**7.82**	**0.020**	**Non-Detect**	**0.26**	**0.28**	**0.37**	**1.07**	**Non-Detect**	**Non-Detect**	**-**	**Non-Detect**

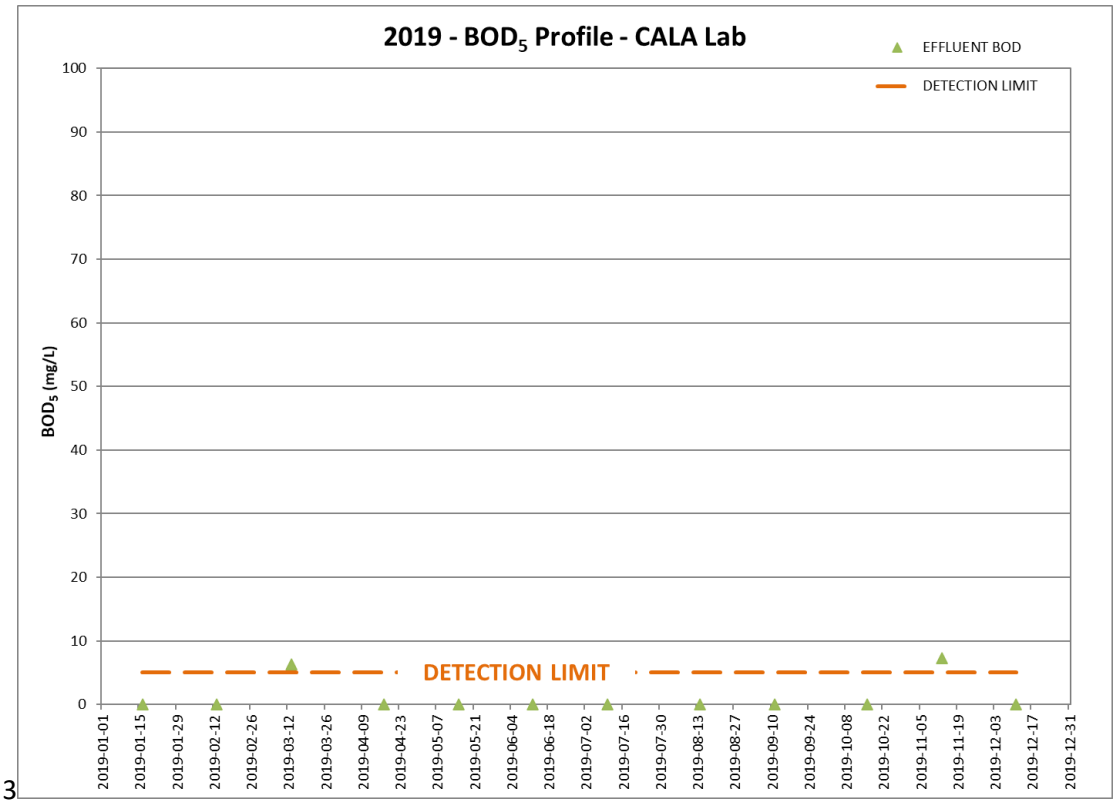
Note 1: In calculating the average, the non-detect results are considered to be equal to Zero.
Note 2: The Fecal Coliform results from November and December were reported in MPN/100ml Units instead of CFU/100ml.

C.4 Effluent Monitoring Graphical Data

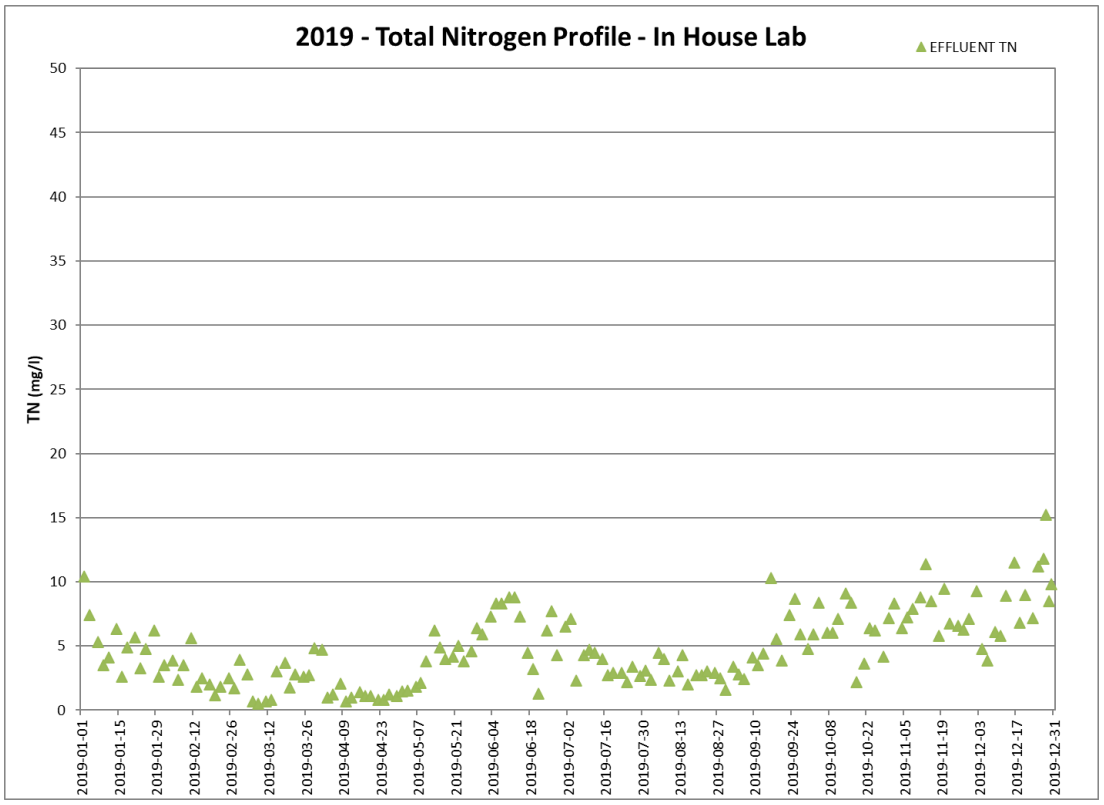


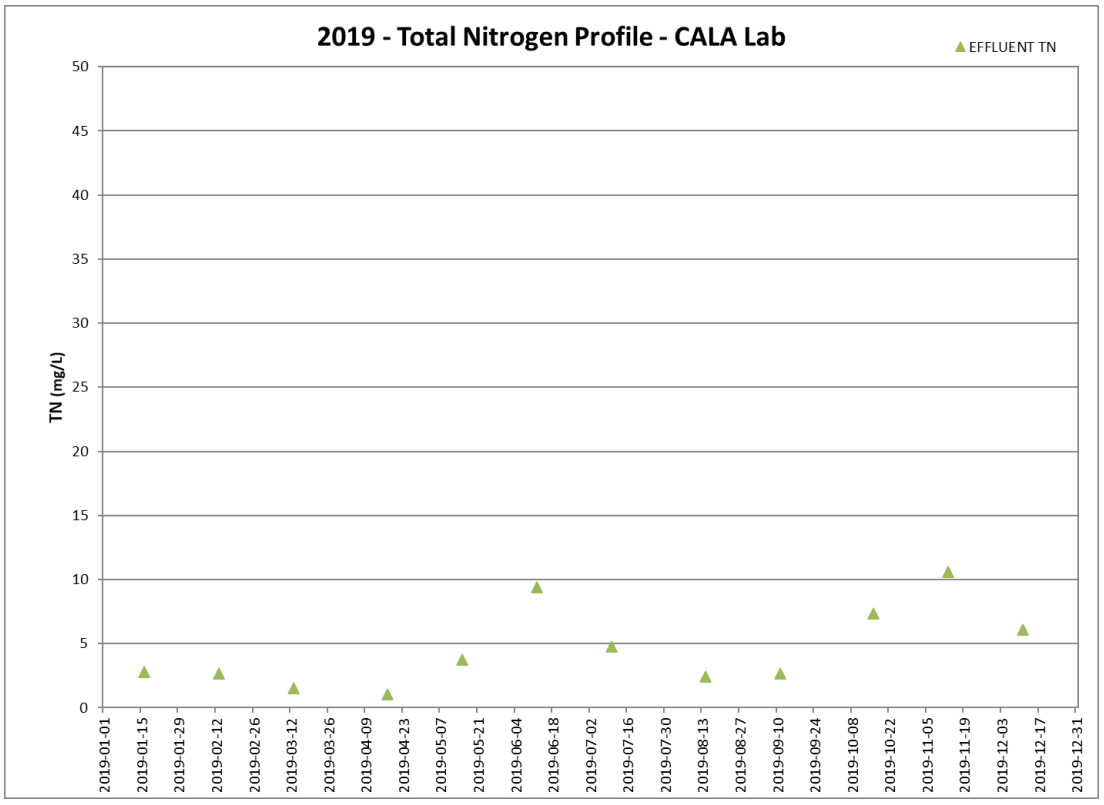


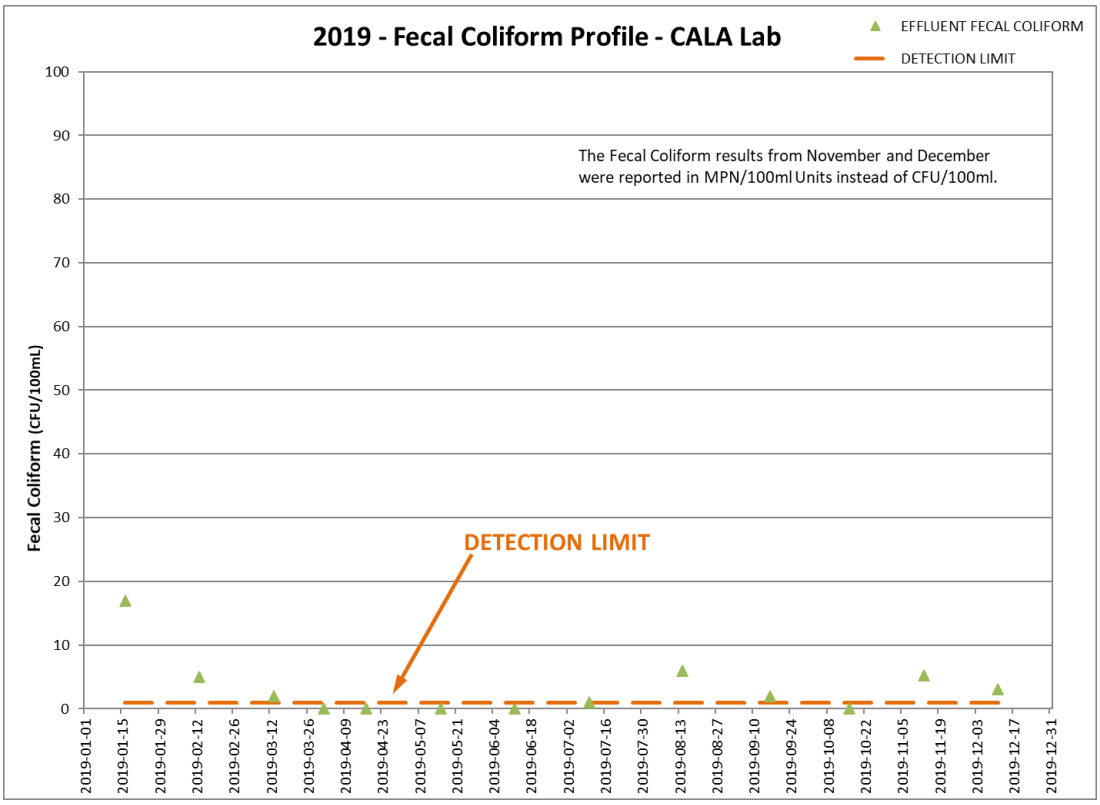

2019 - COD Profile - In House Lab
EFFLUENT COD
As the solid content of the effluent is nearly zero, the COD numbers reported for the Effluent are total COD.
COD (mg/l)
200
180
160
140
120
100
80
60
40
20
0
2019-01-01
2019-01-15
2019-01-29
2019-02-12
2019-02-26
2019-03-12
2019-03-26
2019-04-09
2019-04-23
2019-05-07
2019-05-21
2019-06-04
2019-06-18
2019-07-02
2019-07-16
2019-07-30
2019-08-13
2019-08-27
2019-09-10
2019-09-24
2019-10-08
2019-10-22
2019-11-05
2019-11-19
2019-12-03
2019-12-17
2019-12-31

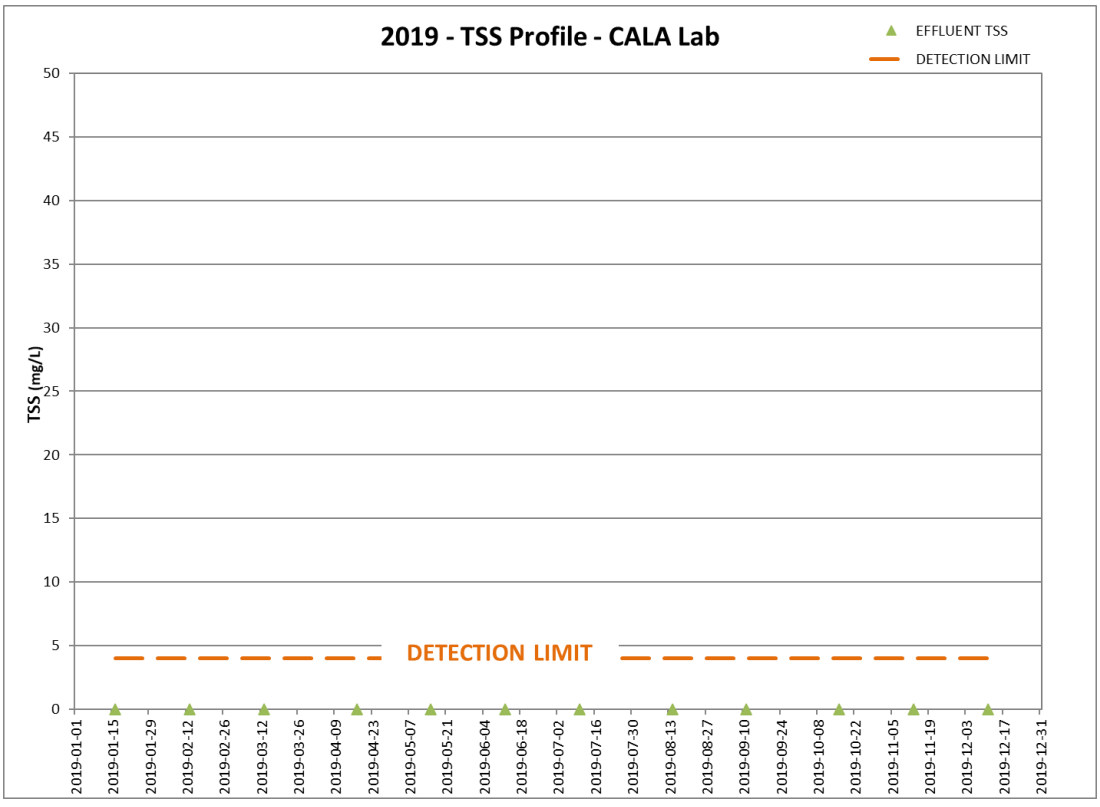

2019 - BOD5 Profile - CALA Lab
EFFLUENT BOD
DETECTION LIMIT
BOD5 (mg/L)
100
90
80
70
60
50
40
30
20
10
0
DETECTION LIMIT
2019-01-01
2019-01-15
2019-01-29
2019-02-12
2019-02-26
2019-03-12
2019-03-26
2019-04-09
2019-04-23
2019-05-07
2019-05-21
2019-06-04
2019-06-18
2019-07-02
2019-07-16
2019-07-30
2019-08-13
2019-08-27
2019-09-10
2019-09-24
2019-10-08
2019-10-22
2019-11-05
2019-11-19
2019-12-03
2019-12-17
2019-12-31

3

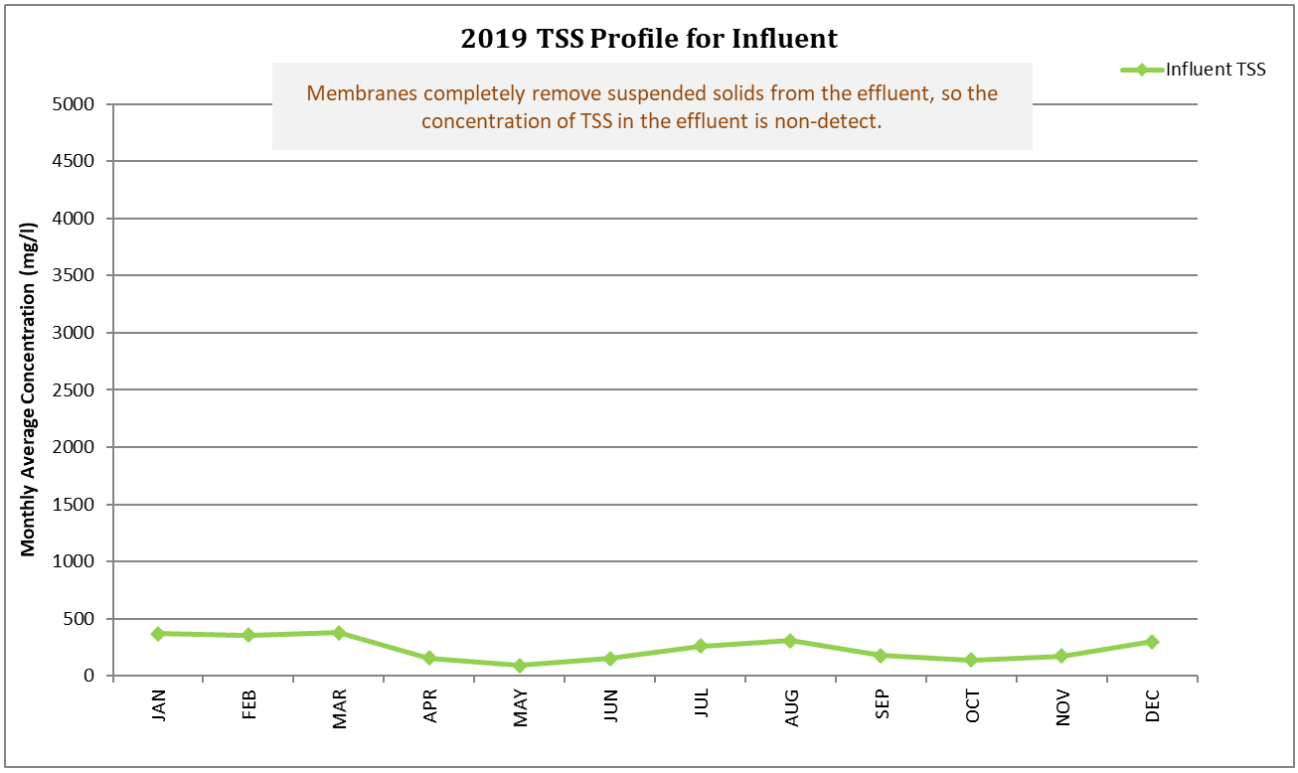

2019 - Total Nitrogen Profile - In House Lab
EFFLUENT TN
TN (mg/l)
50
45
40
35
30
25
20
15
10
5
0
2019-01-01
2019-01-15
2019-01-29
2019-02-12
2019-02-26
2019-03-12
2019-03-26
2019-04-09
2019-04-23
2019-05-07
2019-05-21
2019-06-04
2019-06-18
2019-07-02
2019-07-16
2019-07-30
2019-08-13
2019-08-27
2019-09-10
2019-09-24
2019-10-08
2019-10-22
2019-11-05
2019-11-19
2019-12-03
2019-12-17
2019-12-31

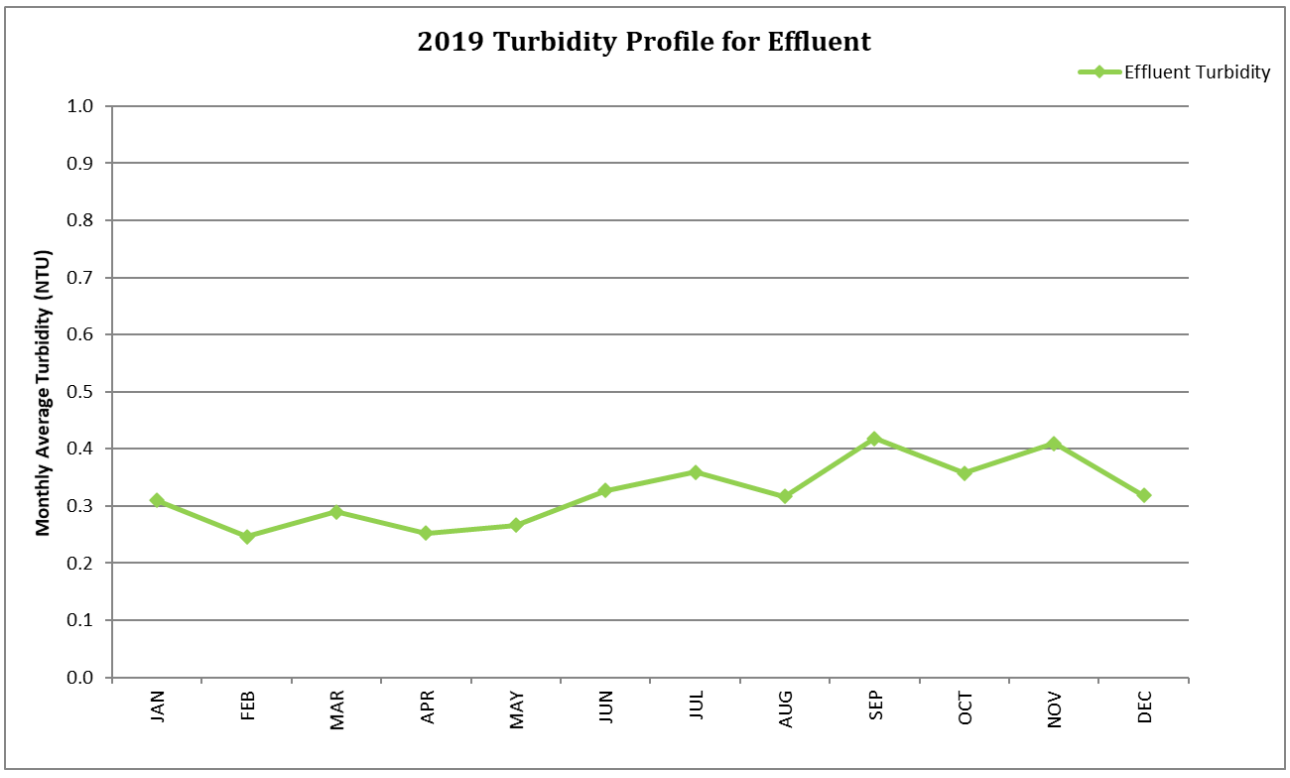

2019 - Total Nitrogen Profile - CALA Lab
EFFLUENT TN
TN (mg/L)
50
45
40
35
30
25
20
15
10
5
0
2019-01-01
2019-01-15
2019-01-29
2019-02-12
2019-02-26
2019-03-12
2019-03-26
2019-04-09
2019-04-23
2019-05-07
2019-05-21
2019-06-04
2019-06-18
2019-07-02
2019-07-16
2019-07-30
2019-08-13
2019-08-27
2019-09-10
2019-09-24
2019-10-08
2019-10-22
2019-11-05
2019-11-19
2019-12-03
2019-12-17
2019-12-31

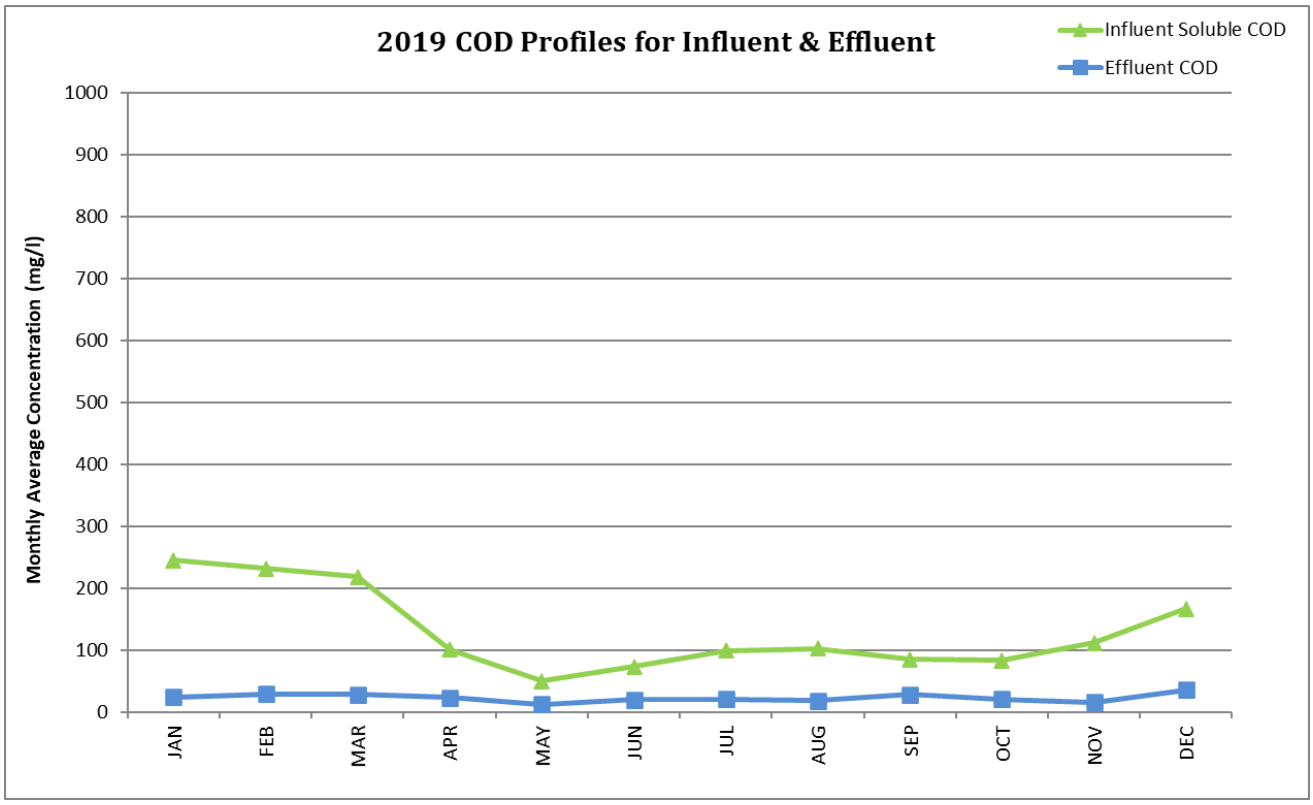

2019 - Fecal Coliform Profile - CALA Lab
EFFLUENT FECAL COLIFORM
DETECTION LIMIT
The Fecal Coliform results from November and December were reported in MPN/100ml Units instead of CFU/100ml.
Fecal Coliform (CFU/100mL)
DETECTION LIMIT

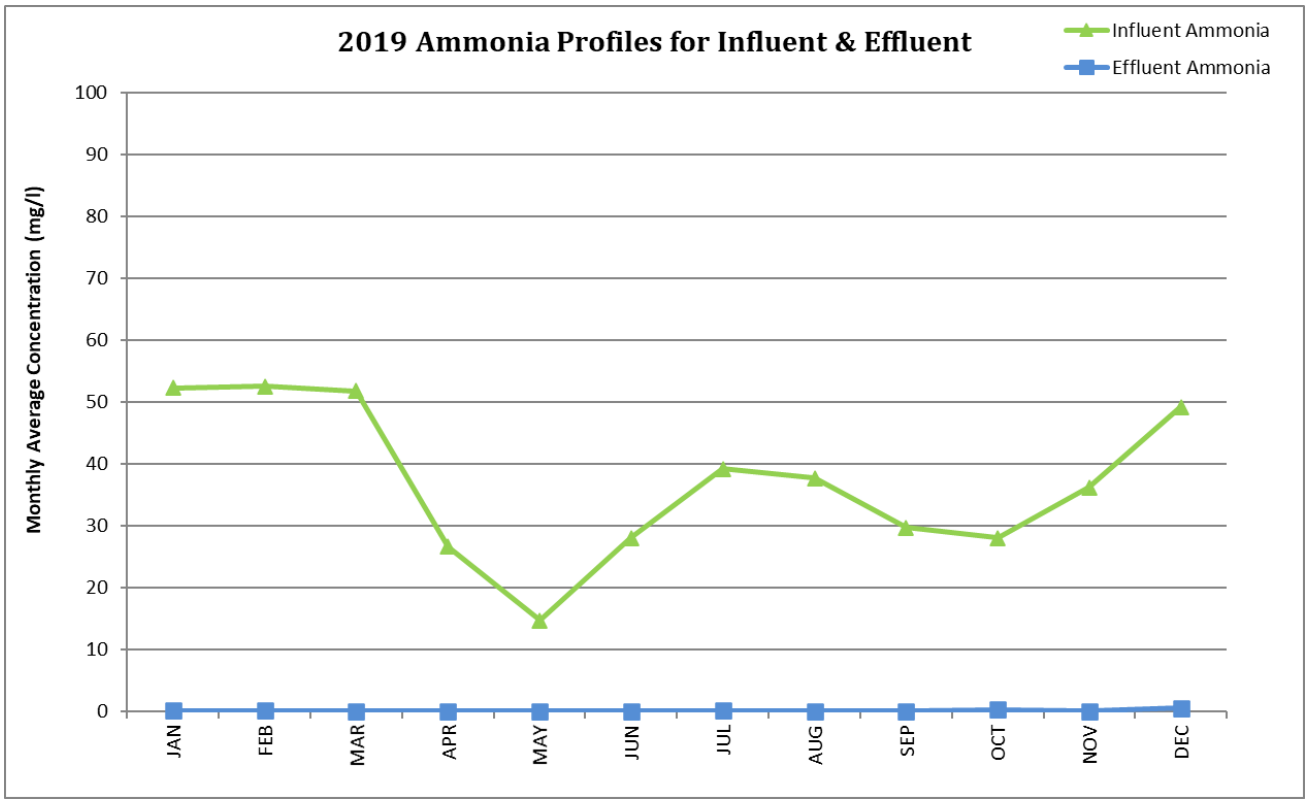

2019 - TSS Profile - CALA Lab
EFFLUENT TSS
DETECTION LIMIT
TSS (mg/L)
DETECTION LIMIT

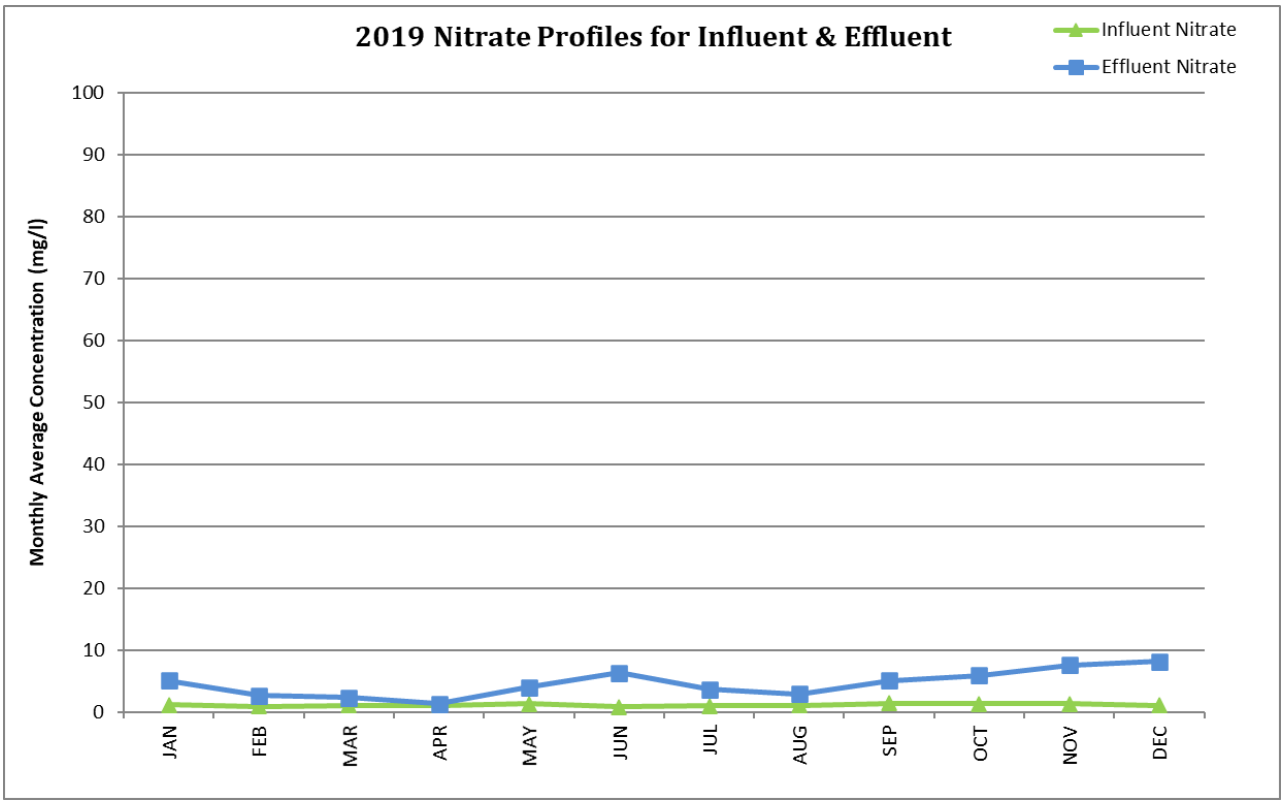
C.5 Influent & Effluent Monitoring Graphical Data (Monthly Averages)

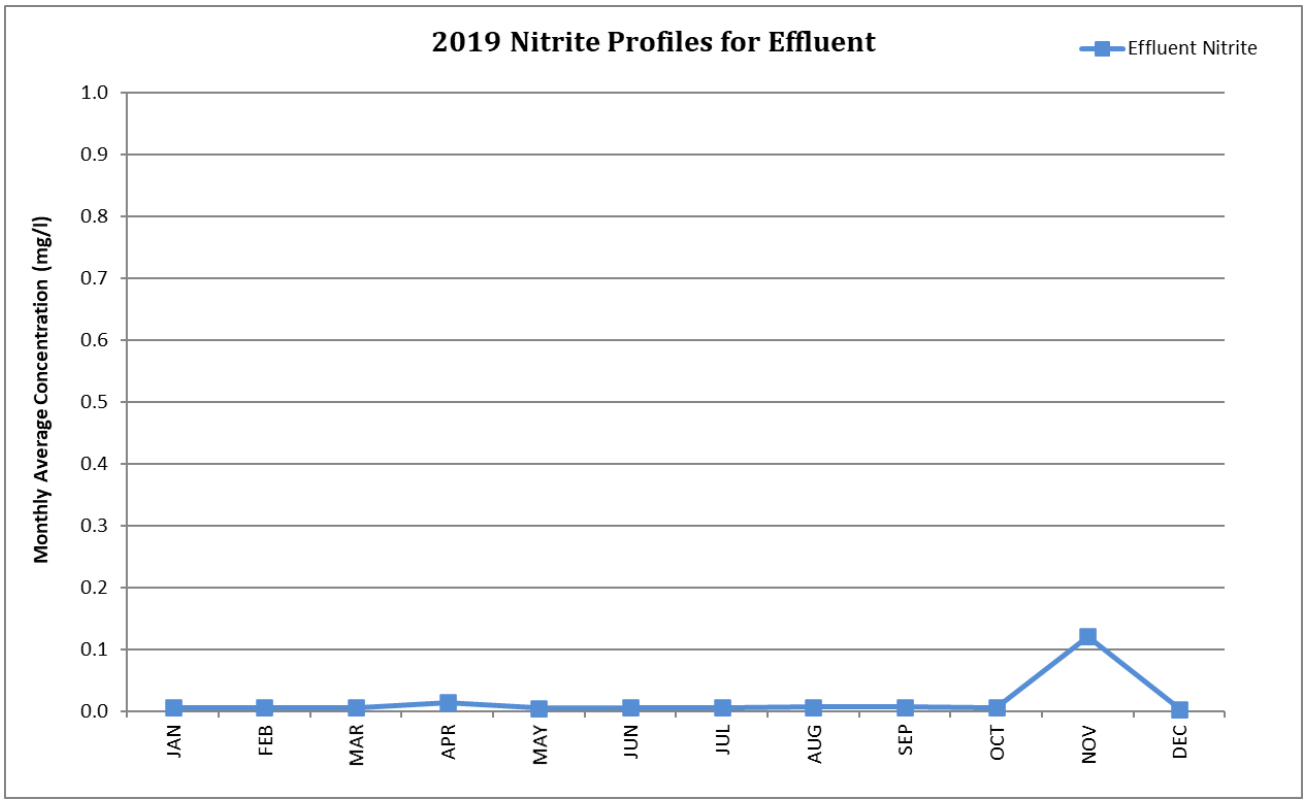


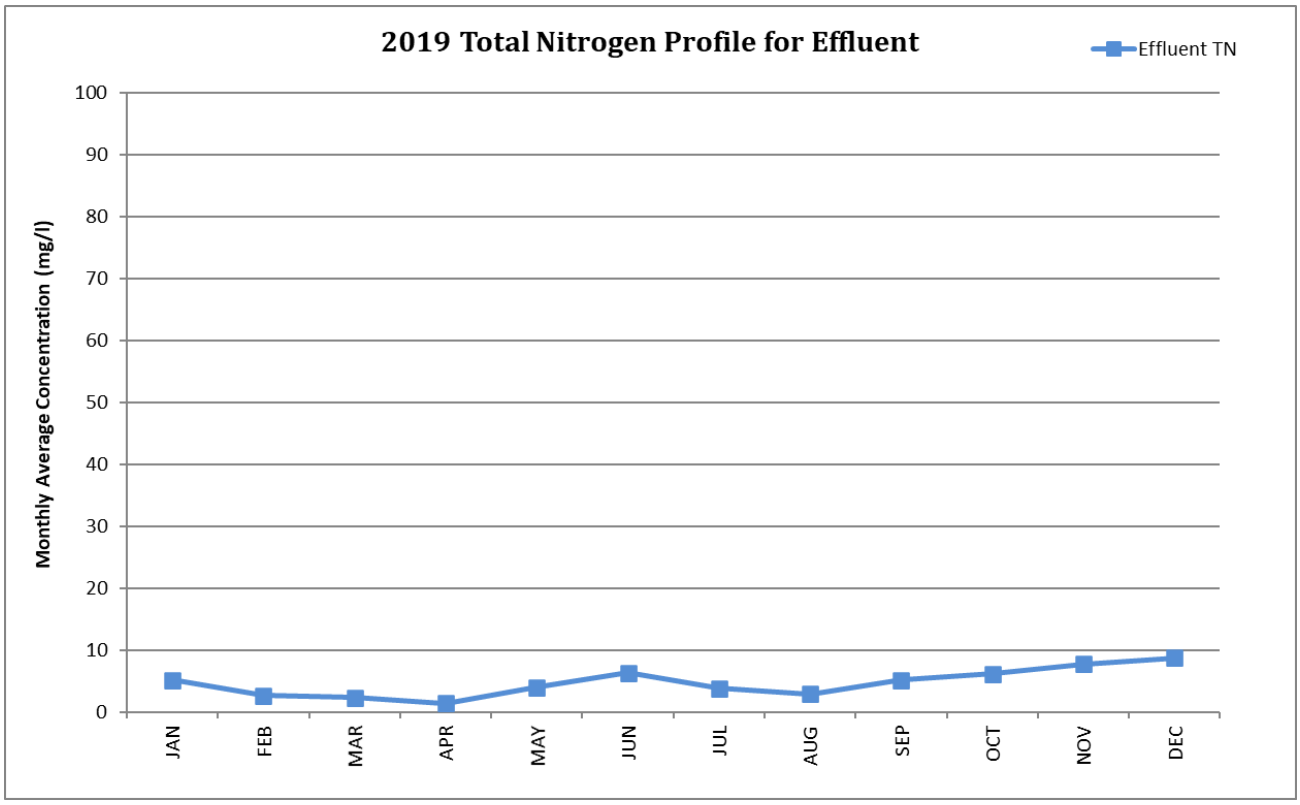


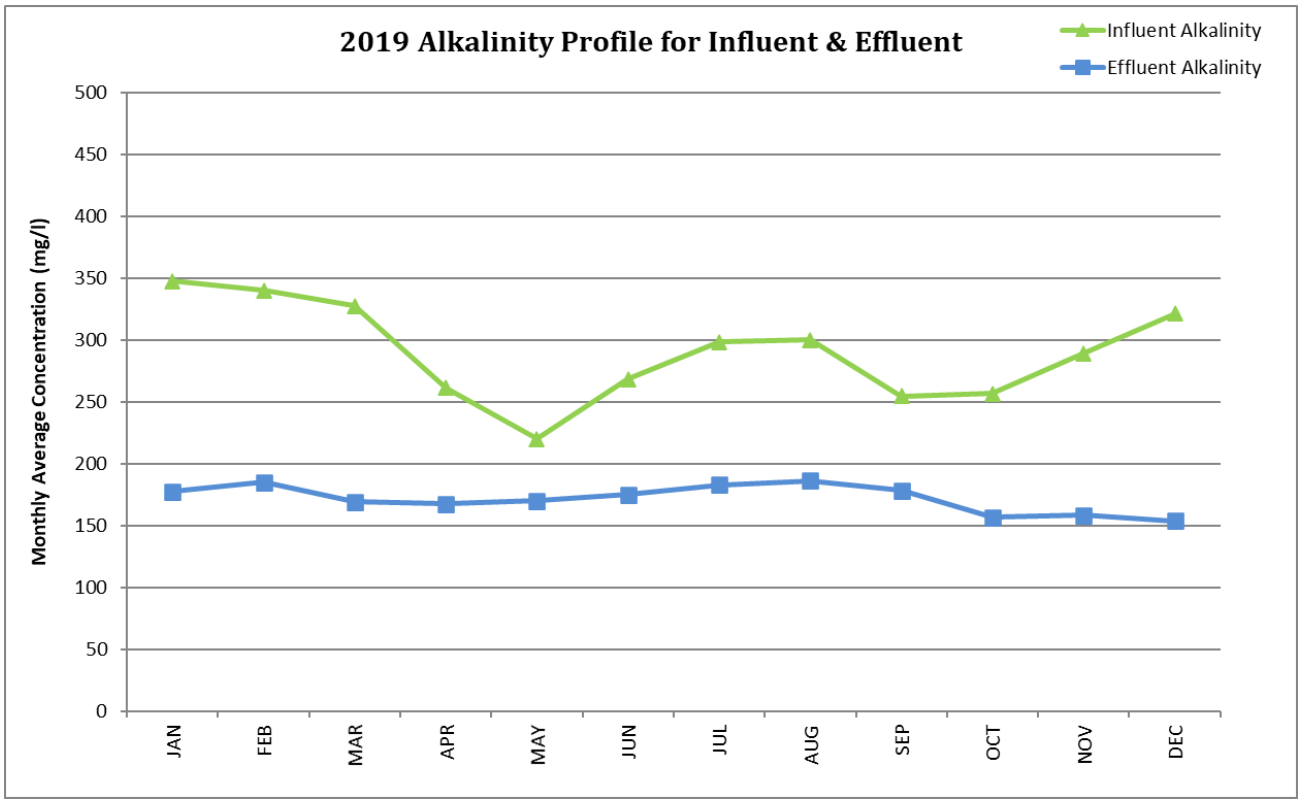

2019 COD Profiles for Influent & Effluent
Influent Soluble COD
Effluent COD
Monthly Average Concentration (mg/l)
1000
900
800
700
600
500
400
300
200
100
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

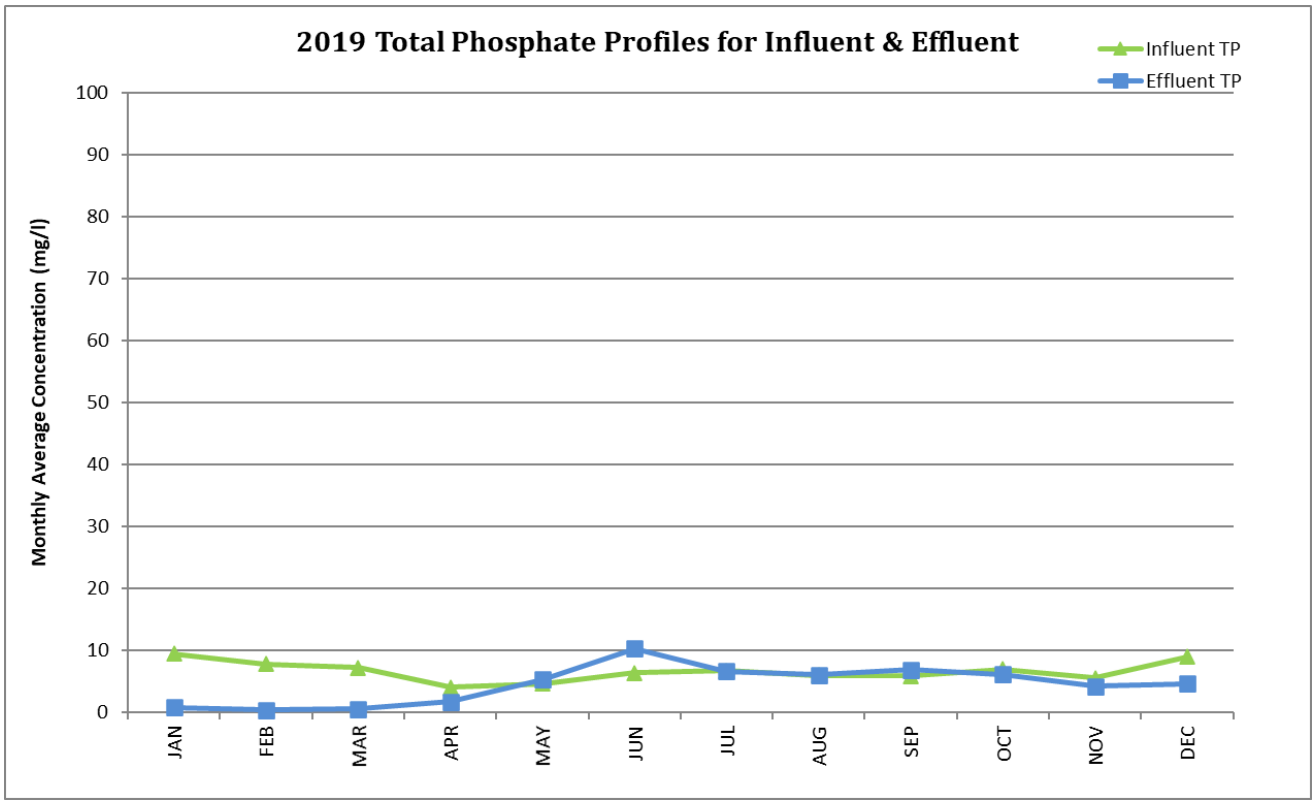

2019 Ammonia Profiles for Influent & Effluent
Influent Ammonia
Effluent Ammonia
Monthly Average Concentration (mg/l)
100
90
80
70
60
50
40
30
20
10
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

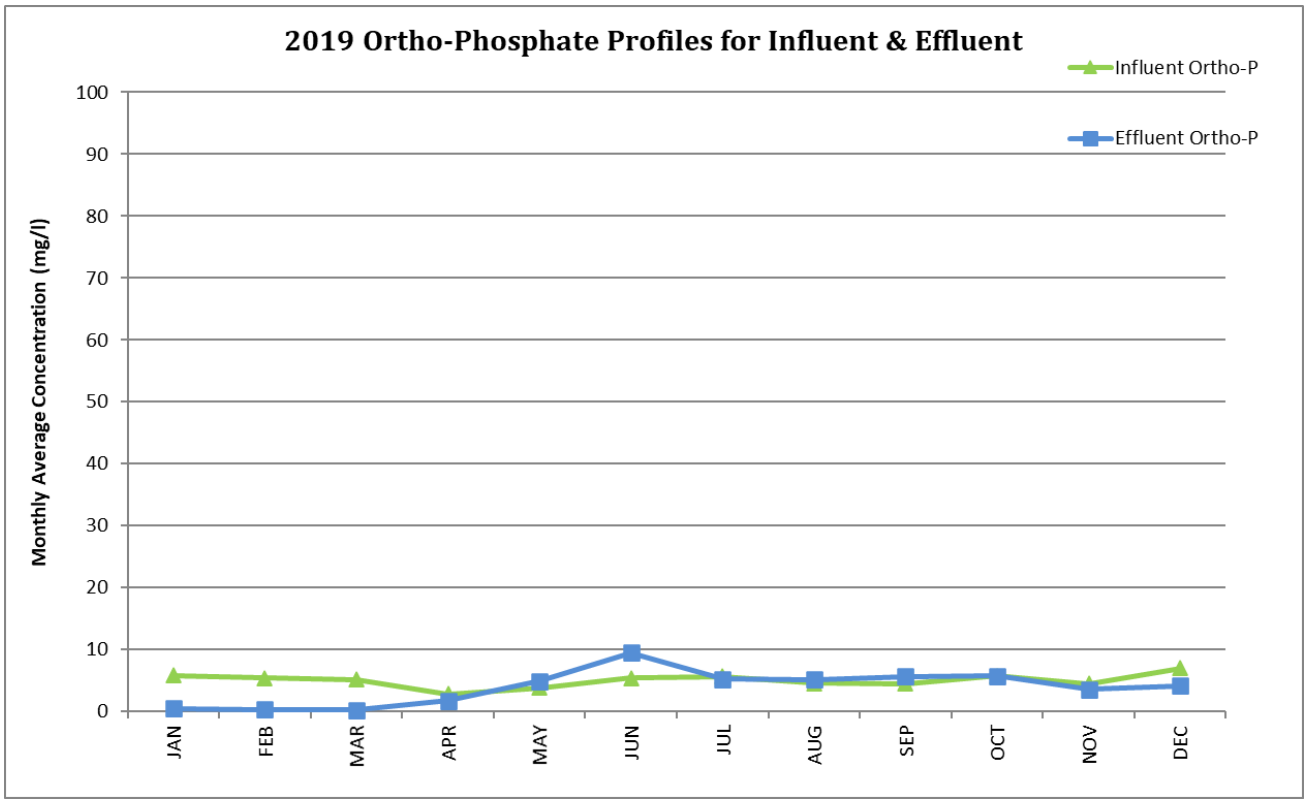

2019 Nitrate Profiles for Influent & Effluent
Influent Nitrate
Effluent Nitrate
Monthly Average Concentration (mg/l)
100
90
80
70
60
50
40
30
20
10
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC


2019 Nitrite Profiles for Effluent
Effluent Nitrite
Monthly Average Concentration (mg/l)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC


2019 Total Nitrogen Profile for Effluent
Effluent TN
Monthly Average Concentration (mg/l)
100
90
80
70
60
50
40
30
20
10
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

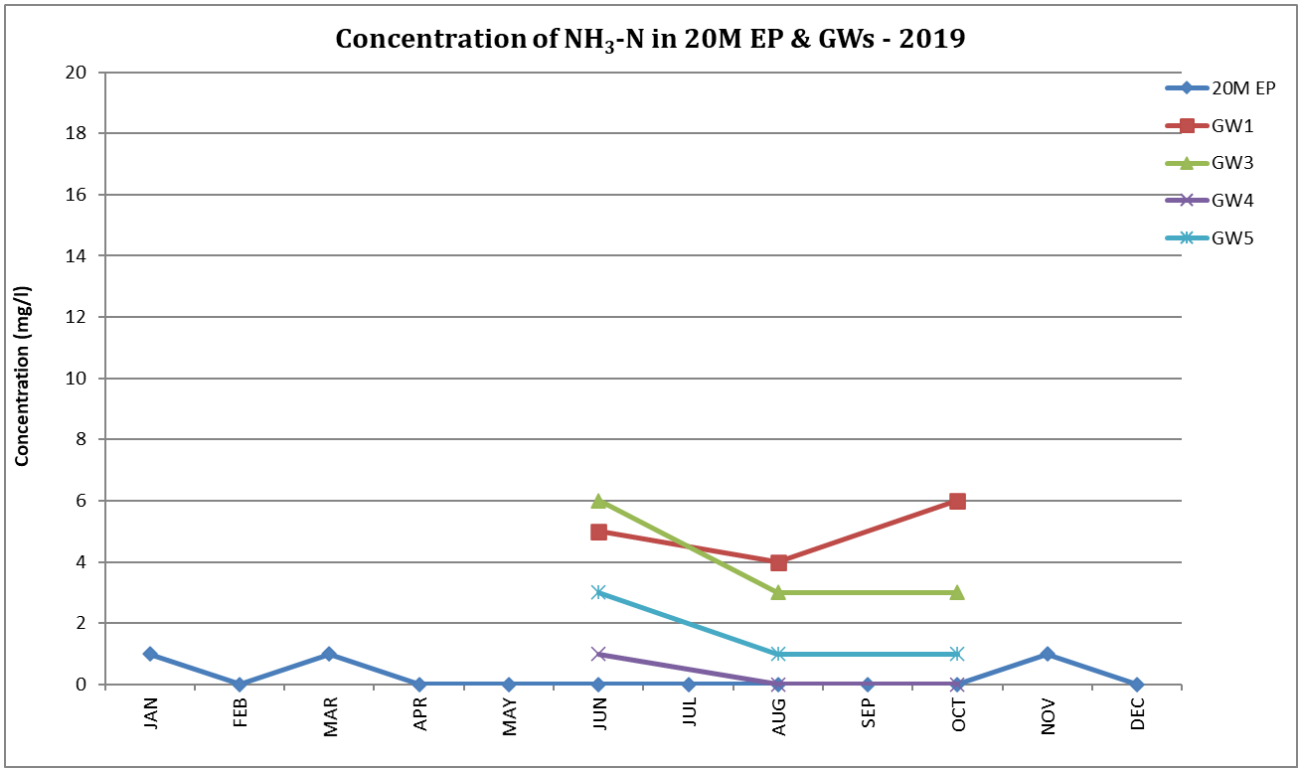

2019 Alkalinity Profile for Influent & Effluent
Influent Alkalinity
Effluent Alkalinity
Monthly Average Concentration (mg/l)
500
450
400
350
300
250
200
150
100
50
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

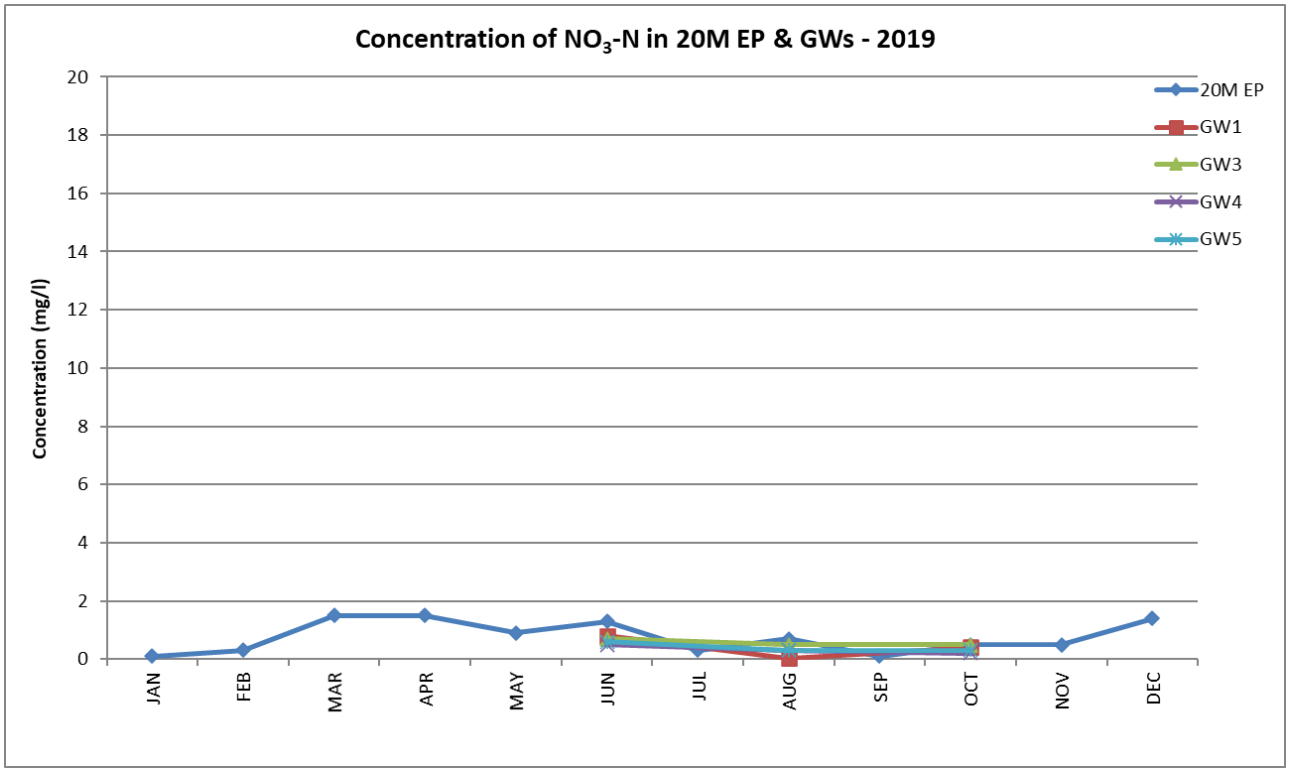

2019 Total Phosphate Profiles for Influent & Effluent
Influent TP
Effluent TP
Monthly Average Concentration (mg/l)
100
90
80
70
60
50
40
30
20
10
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

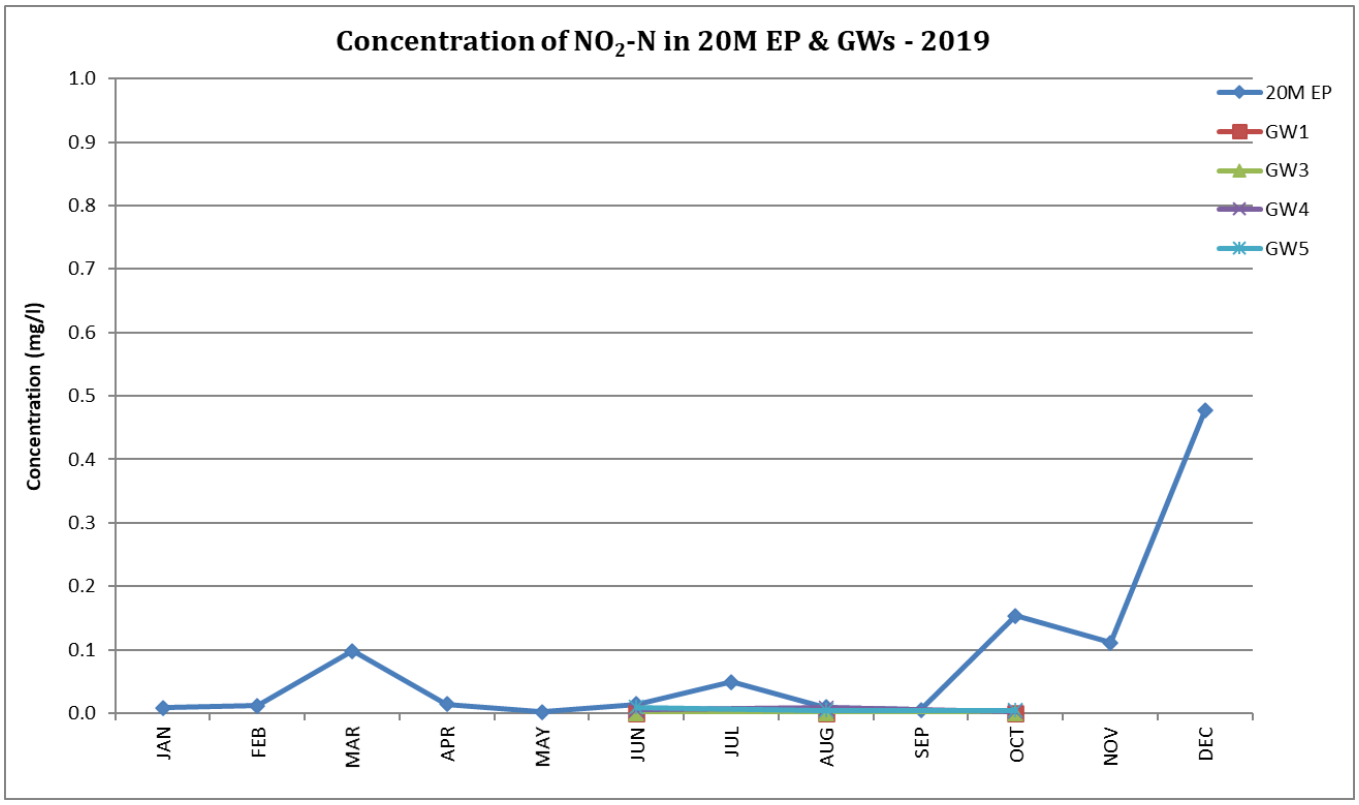

2019 Ortho-Phosphate Profiles for Influent & Effluent
Influent Ortho-P
Effluent Ortho-P
Monthly Average Concentration (mg/l)
100
90
80
70
60
50
40
30
20
10
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

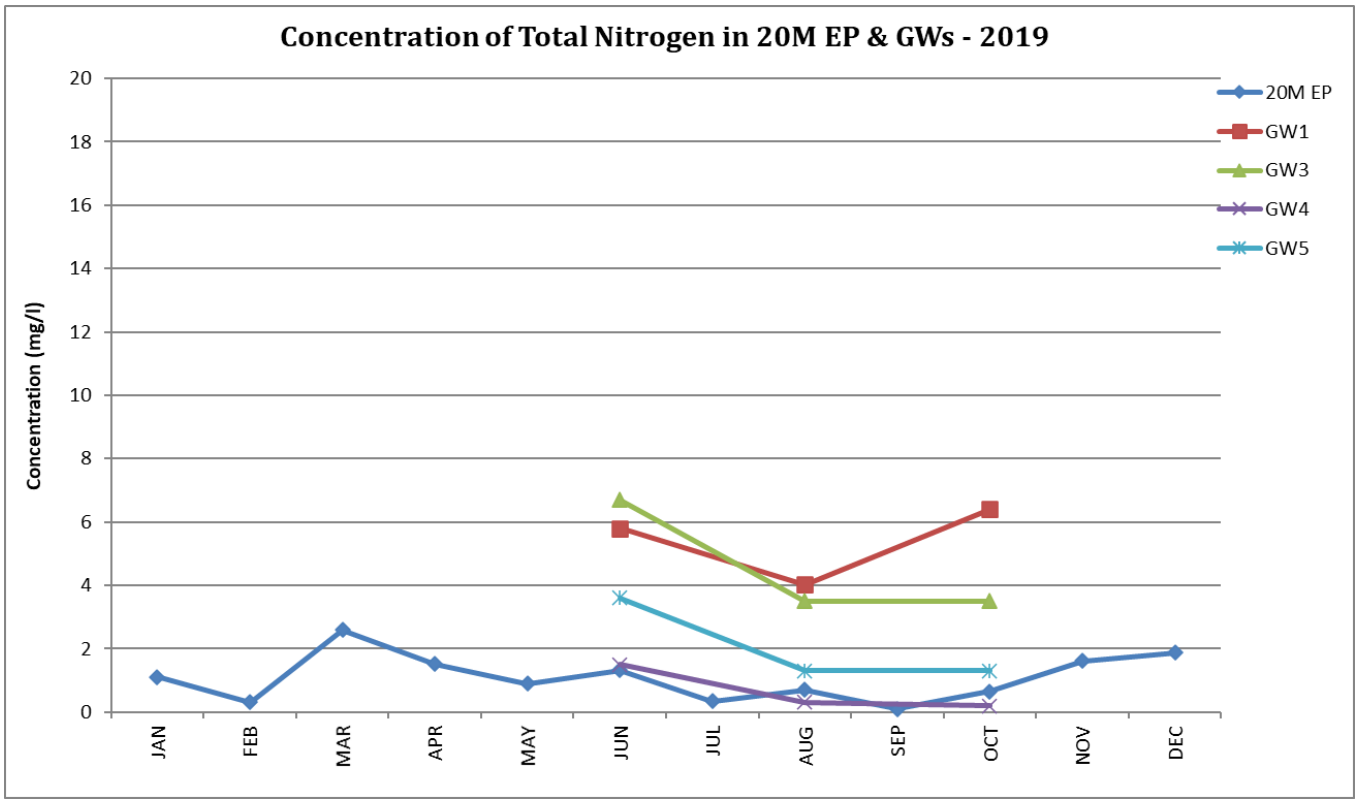
Appendix D - Ground Water (GW) & Surface Water (SW) Monitoring Data

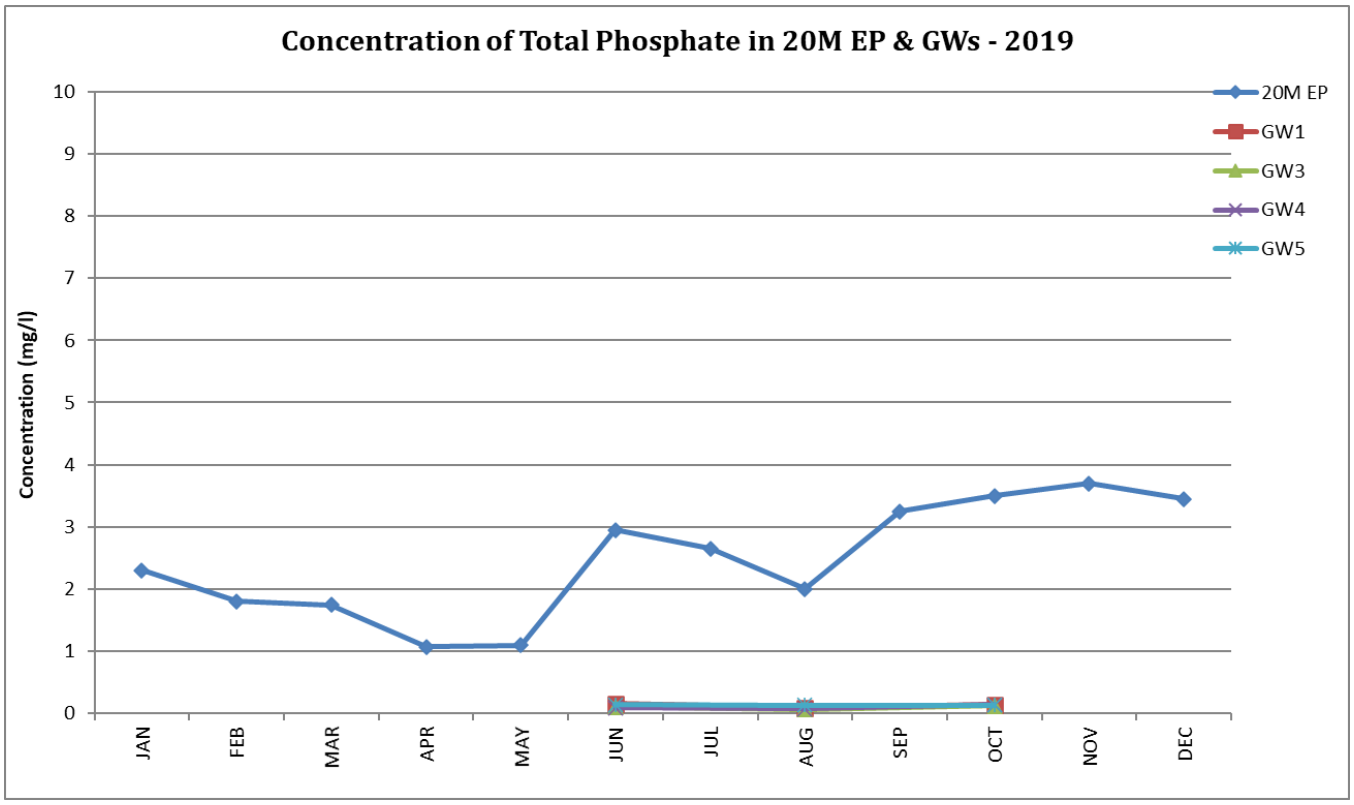
D.1 Ground Water Graphical Data

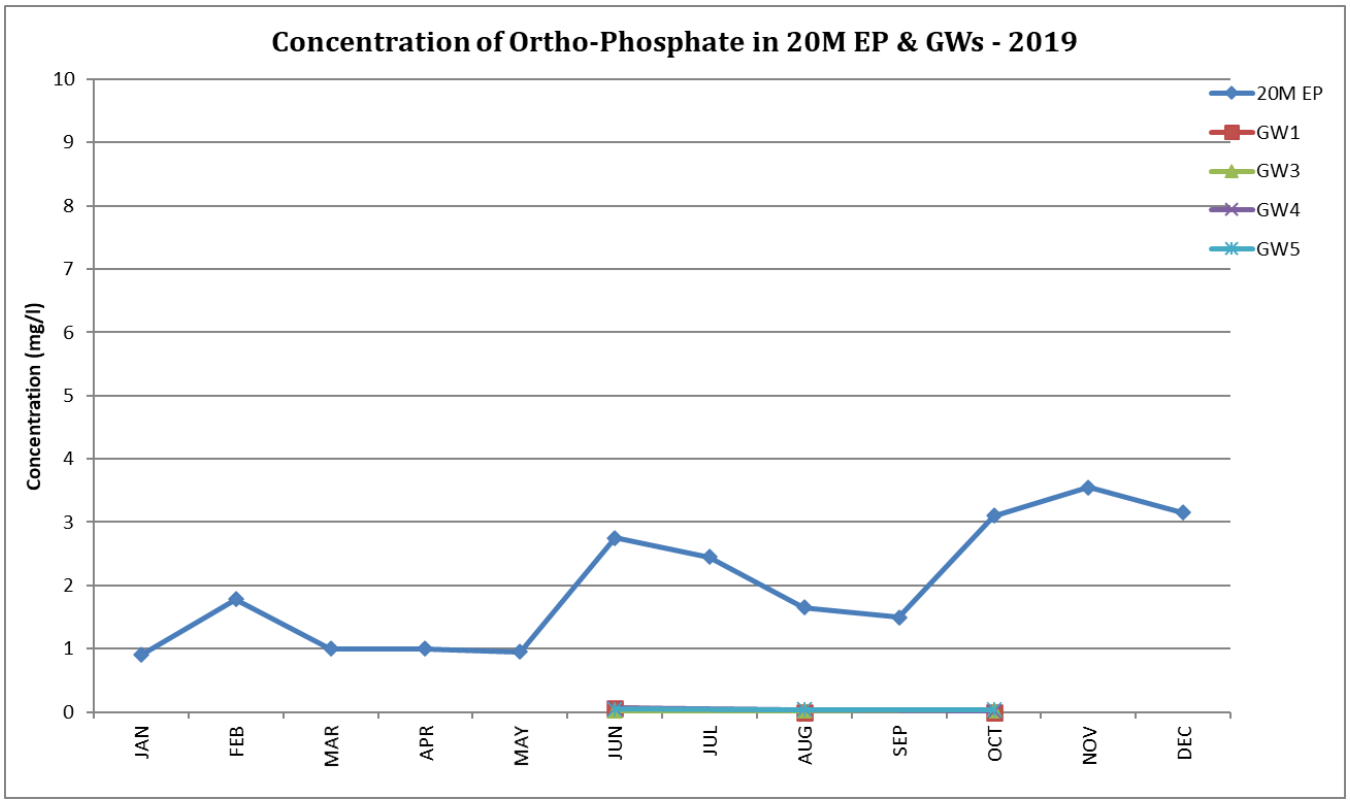




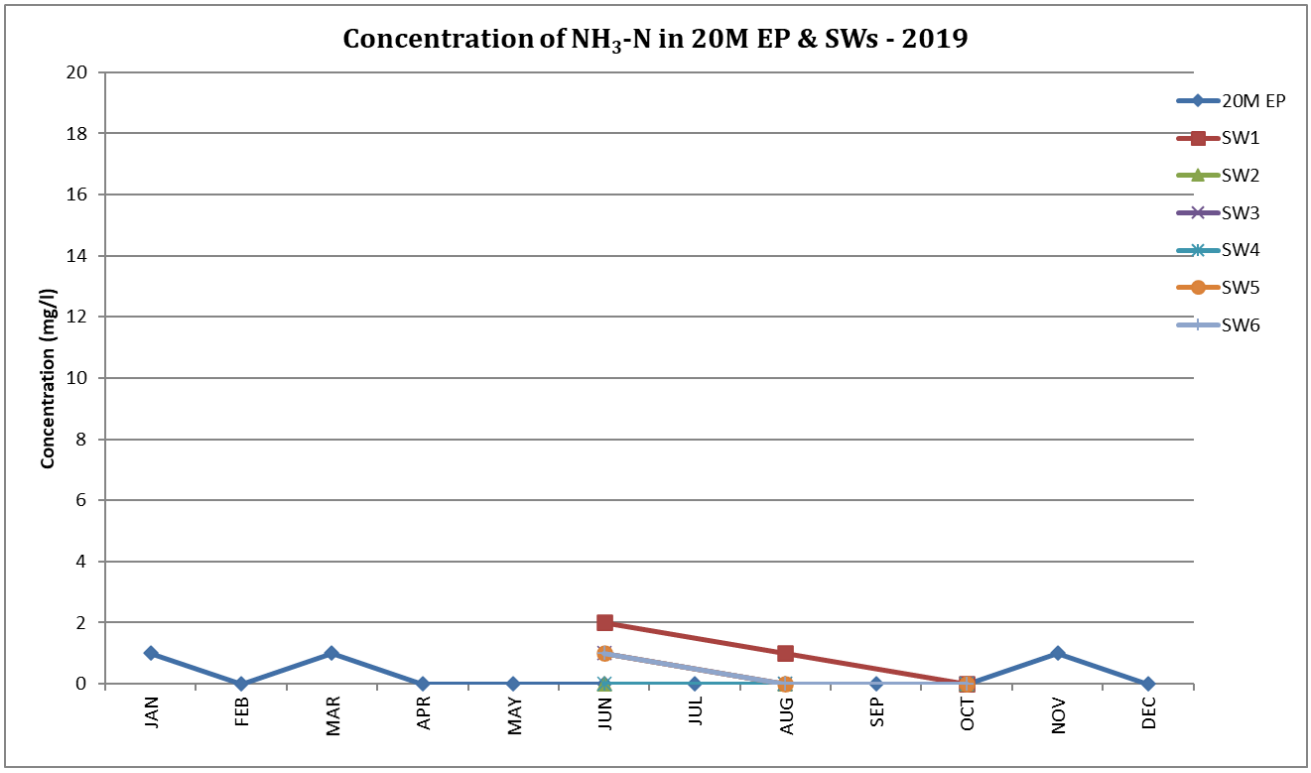

Concentration of NO_2-N in 20M EP & GWs - 2019
Concentration (mg/l)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
20M EP
GW1
GW3
GW4
GW5

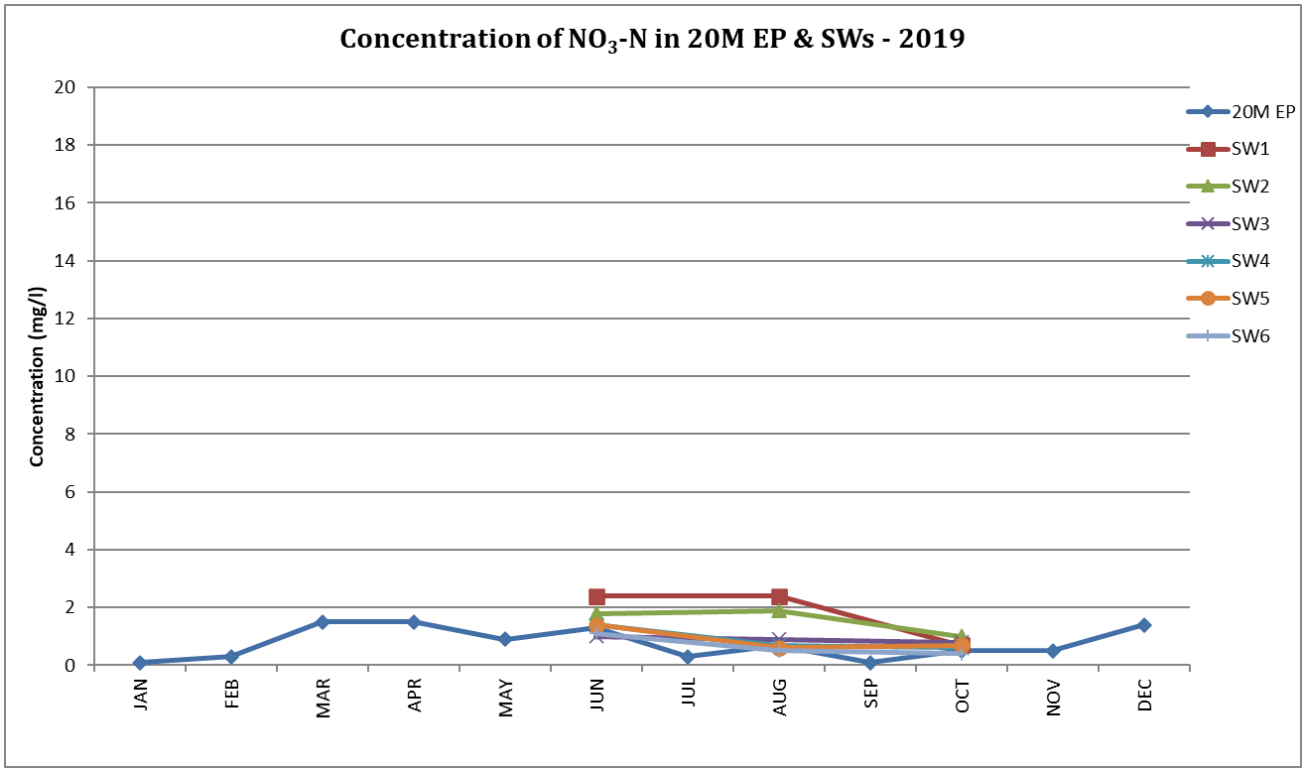

Concentration of Total Nitrogen in 20M EP & GWs - 2019
Concentration (mg/l)
20
18
16
14
12
10
8
6
4
2
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
20M EP
GW1
GW3
GW4
GW5

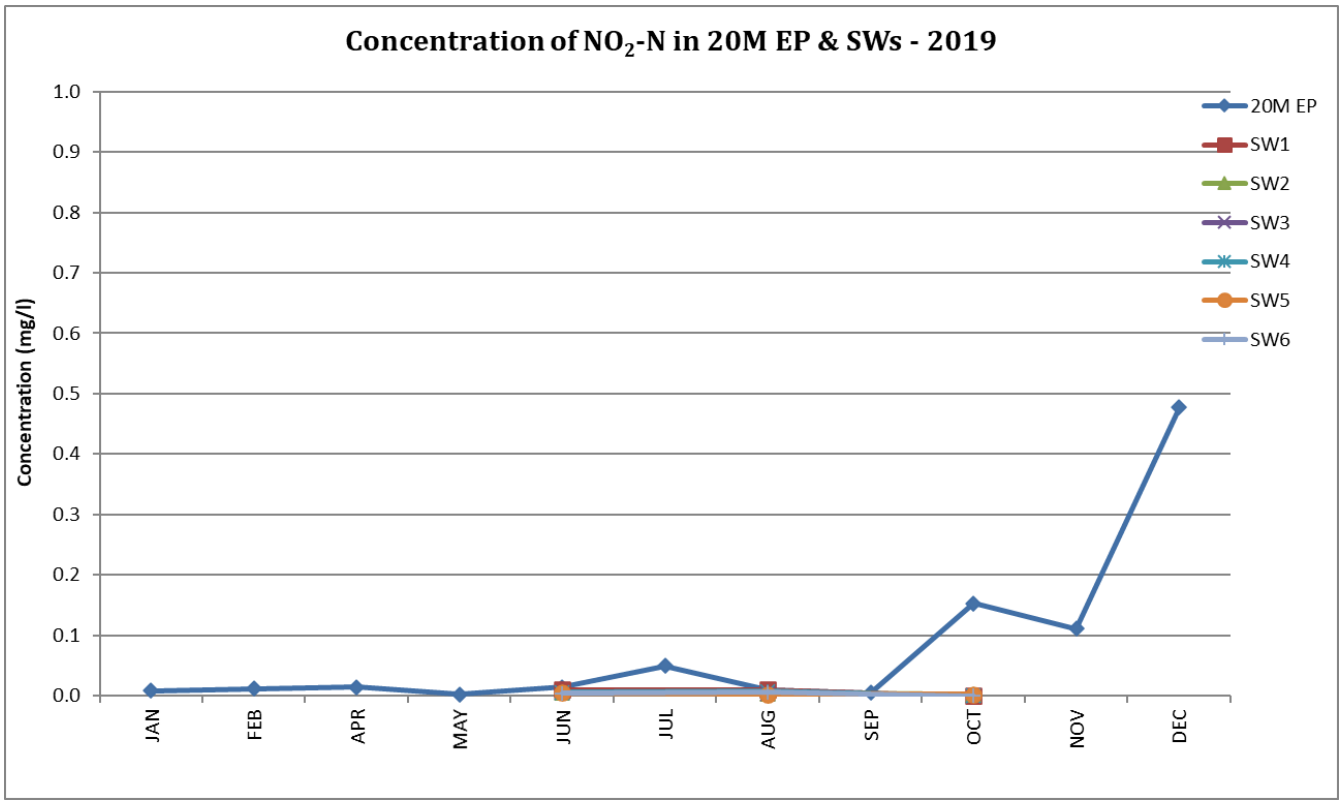

Concentration of Total Phosphate in 20M EP & GWs - 2019
Concentration (mg/l)
0
1
2
3
4
5
6
7
8
9
10
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
20M EP
GW1
GW3
GW4
GW5

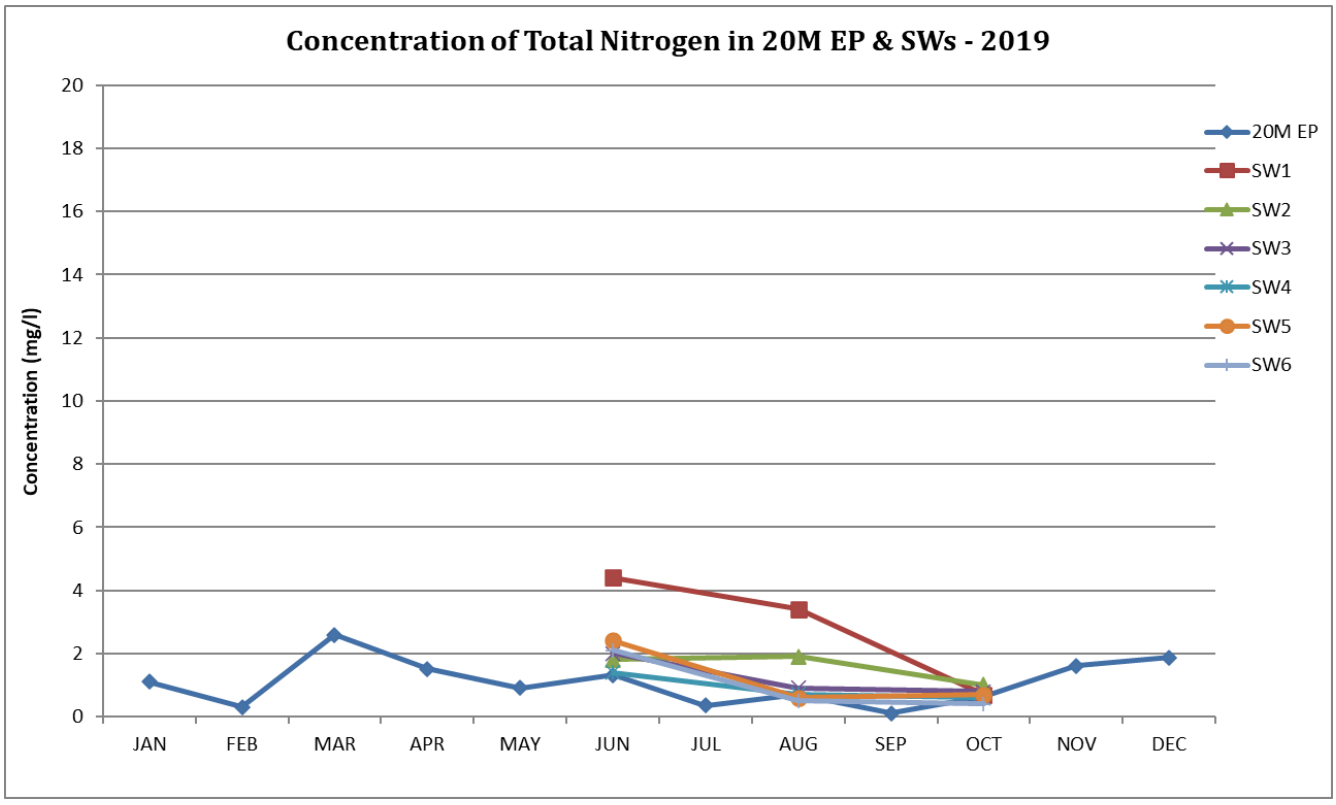

Concentration of Ortho-Phosphate in 20M EP & GWs - 2019
Concentration (mg/l)
0
1
2
3
4
5
6
7
8
9
10
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
20M EP
GW1
GW3
GW4
GW5

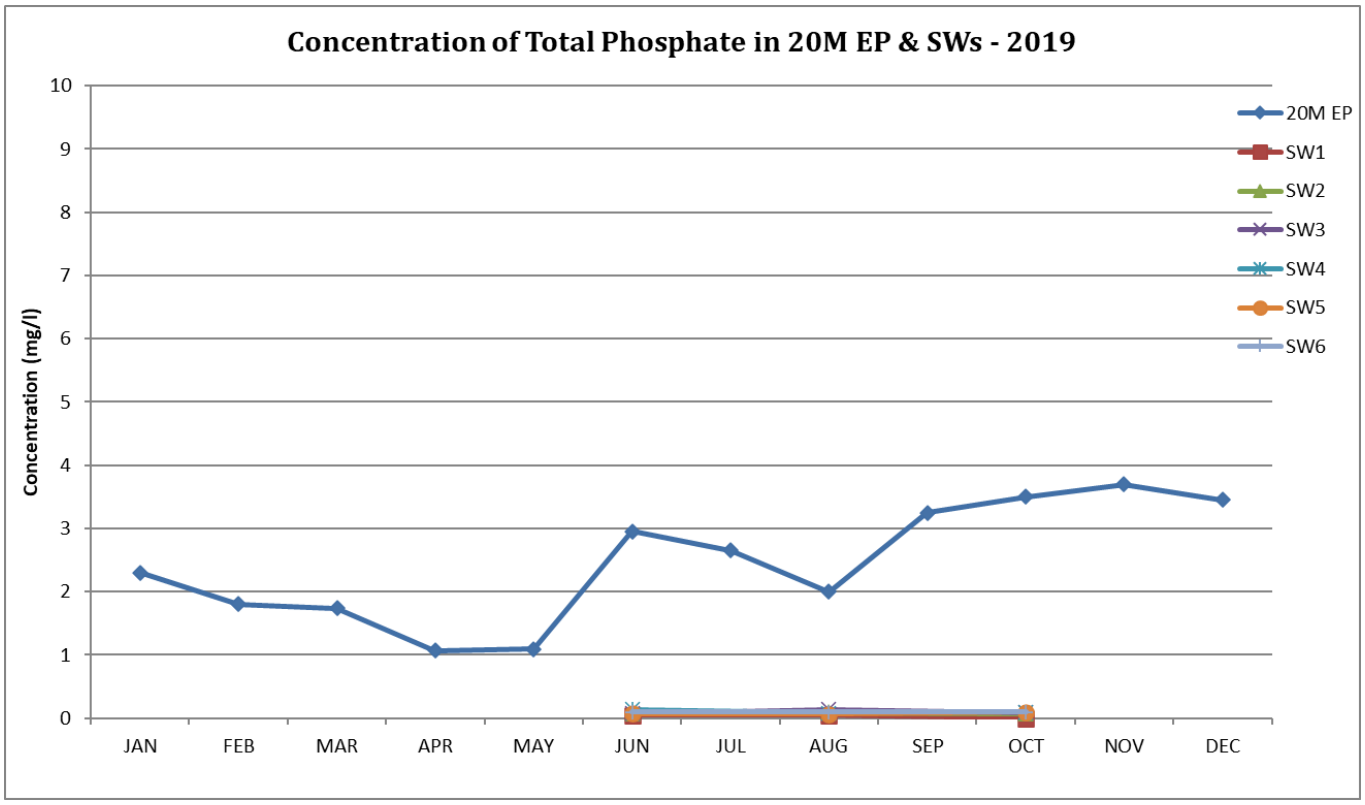
D.2 Surface Water Graphical Data

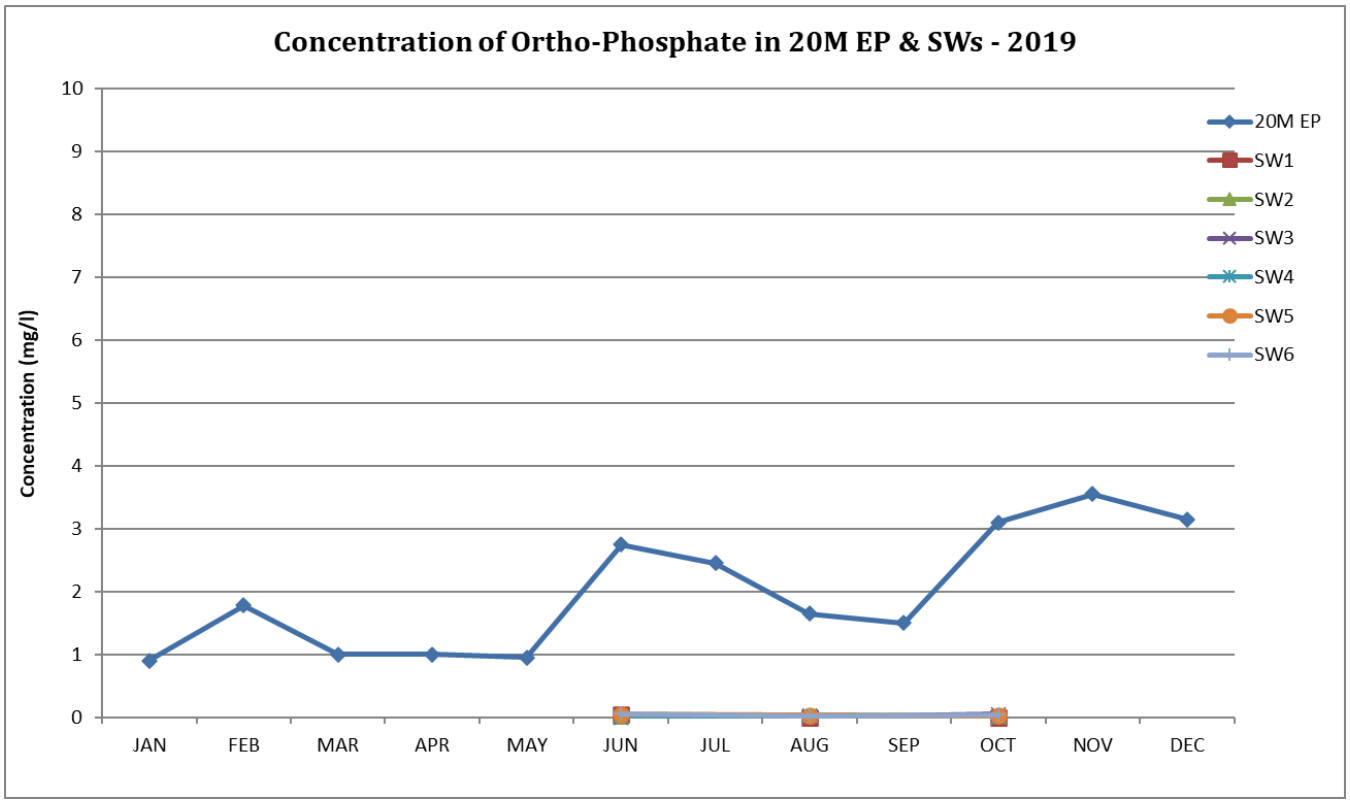





Concentration of NO_2-N in 20M EP & SWs - 2019
Concentration (mg/l)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
JAN
FEB
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
20M EP
SW1
SW2
SW3
SW4
SW5
SW6


Concentration of Total Nitrogen in 20M EP & SWs - 2019
Concentration (mg/l)
20
18
16
14
12
10
8
6
4
2
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
20M EP
SW1
SW2
SW3
SW4
SW5
SW6


Concentration of Total Phosphate in 20M EP & SWs - 2019
Concentration (mg/l)
0
1
2
3
4
5
6
7
8
9
10
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
20M EP
SW1
SW2
SW3
SW4
SW5
SW6


Concentration of Ortho-Phosphate in 20M EP & SWs - 2019
Concentration (mg/l)
0
1
2
3
4
5
6
7
8
9
10
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
20M EP
SW1
SW2
SW3
SW4
SW5
SW6

Appendix E - 2011 BC-MSR Permitted Uses and Standards for Reclaimed Water

Environmental Management Act
Municipal Sewage Regulation
[includes amendments up to B.C. Reg. 4/2010, January 14, 2010]

Schedule 2

[am. B.C. Regs. 321/2004, s. 31 (z) to (cc); 305/2007, s. 9; 4/2010, s. 3.]

Permitted Uses and Standards for Reclaimed Water

(Section 10 of this Regulation)

Reclaimed Water Category and Permitted Uses (1)	Treatment Requirements (2)	Effluent Quality Requirements (3)	Monitoring Requirements (5)
UNRESTRICTED PUBLIC ACCESS			
URBAN - Parks (6) - Playgrounds - Cemeteries - Golf Courses (6) - Road Rights-of-Way - School Grounds (6) - Residential Lawns - Greenbelts - Vehicle and Driveway Washing - Landscaping around Buildings - Toilet Flushing	Secondary (7) Chemical Addition (8) Filtration (4) Disinfection (9) Emergency Storage (2)	pH = 6 - 9 ≤ 10 mg/L BOD_5 ≤ 2 NTU (10) Number of fecal coliform organisms ≤ 2.2/100 mL (11) (12) General (13) (14) (15)	pH - weekly BOD - weekly Turbidity - continuous Coliform (16) - daily

Reclaimed Water Category and Permitted Uses (1)	Treatment Requirements (2)	Effluent Quality Requirements (3)	Monitoring Requirements (5)
- Outside Landscape Fountains - Outside Fire Protection - Street Cleanings AGRICULTURAL - Aquaculture - Food Crops Eaten Raw - Orchards and Vineyards - Pasture (no lag time for animal grazing) - Frost Protection (17), Crop Cooling and Chemical Spraying on crops eaten raw - Seed Crops RECREATIONAL (18) - Stream Augmentation - Impoundments for Boating and Fishing - Snow Making for Skiing and Snowboarding			
RESTRICTED PUBLIC ACCESS			

Reclaimed Water Category and Permitted Uses (1)	Treatment Requirements (2)	Effluent Quality Requirements (3)	Monitoring Requirements (5)
AGRICULTURAL - Commercially processed food crops (19) - Fodder, Fibre - Pasture (20) - Silviculture - Nurseries - Sod Farms - Spring Frost Protection (17) - Chemical Spray - Trickle/Drip Irrigation of Orchards and Vineyards URBAN/RECREATIONAL (18) - Landscape Impoundments - Landscape Waterfalls - Snow Making not for Skiing and Snowboarding CONSTRUCTION - Soil Compaction - Dust Control	Secondary (7) Disinfection (9)	pH = 6 - 9 $\leq$ 45 mg/L BOD_5 $\leq$ 45 mg/L TSS (26) number of fecal coliform organisms $\leq$ 200/100 mL (11)(21)(22) General (14)(23)	pH - weekly BOD - weekly TSS - daily Coliform - weekly

Reclaimed Water Category and Permitted Uses (1)	Treatment Requirements (2)	Effluent Quality Requirements (3)	Monitoring Requirements (5)
- Aggregate Washing - Making Concrete - Equipment Washdown INDUSTRIAL (24) - Cooling Towers - Process Water - Stack Scrubbing - Boiler Feed ENVIRONMENTAL (18) - Wetlands (25)			

Numeric values in parentheses refer to numbered explanations in the explanatory notes, Appendix 1 to Schedule 2

≤ means less than or equal to

≥ means greater than or equal to

> means greater than

Appendix 1 to Schedule 2

Explanatory Notes

1) The type of reclaimed water use permitted must be one of those indicated on this Schedule. Other proposed types of reclaimed water use will be assessed by the director on an individual basis and must, in consultation with the Ministry of Health Services, be approved in writing by the director.

2) Reliability must be provided for all treatment processes as set out in Schedule 7. Emergency storage must satisfy the requirements of section 10 of this regulation.

3) Effluent quality limits must be calculated as running mean values and apply to the reclaimed water at the point of discharge from the treatment facility or, if storage is provided, at the point of distribution or use.

4) Sixty day storage after secondary treatment is acceptable in lieu of filtration provided the final effluent quality requirements are met and the discharger demonstrates to the satisfaction of a director that no short circuiting is occurring or likely to occur and that no viruses at levels of concern to local health authorities are detected in the reclaimed water.

5) Subject to Note 1 Appendix 1 to Schedule 6, these requirements take precedence over the requirements of Schedule 6.

6) Remote areas of parks, school grounds during vacation periods, and golf courses may be considered under the restricted public access category, provided: a minimum of 60 days storage is provided; the discharger demonstrates to the satisfaction of a director that access is controlled, that environmental concerns are addressed and that any concerns of the local health authorities are resolved; and, the director, in consultation with the local health authorities, approves the use in writing.

7) Secondary treatment as defined by section 1 of this regulation.

8) Chemical addition includes coagulant or polymer prior to filtration. Use is restricted to those coagulants and polymers shown to be non-toxic.

9) For distribution of reclaimed water, the discharger must ensure that minimum total chlorine residual of 0.5 mg/L is maintained at the point of initial use. This requirement may be waived by a director, provided the discharger demonstrates, to the satisfaction of the director and local health authorities, that fecal coliforms remain below levels prescribed by this Schedule at the point of use and that the users are adequately informed regarding appropriate use of the reclaimed water.

10) Turbidity limit must be met prior to disinfection. The average turbidity must be based on a 24-hour time period. The turbidity must not exceed 5 NTU at any time. If TSS is used in lieu of turbidity, the average TSS must not exceed 5 mg/L.

11) The median value, as determined from the bacteriological results of the last 7 samples for which analyses have been completed, must not exceed the coliform limits specified.

12) For unrestricted public access use, the number of fecal coliform organisms must not exceed 14/100 mL in any sample.

13) The reclaimed water provider must demonstrate that reclaimed water does not contain pathogens or parasites at levels which are a concern to local health authorities. Reclaimed water must be clean, odourless, non-irritating to skin and eyes and must contain no substances that are toxic on ingestion.

14) Where available agricultural (crop) limits must govern criteria for metals. High nutrient levels may adversely affect some crops during certain growth stages. Crop limits and season must govern nutrient application.

15) The reclaimed water provider must obtain monitoring results, and confirm that water quality requirements are met, prior to distribution.

16) Based on an initial 60 days of compliance with the quality limit, the discharger must conduct weekly presence or absence testing for coliform monitoring. If presence of any coliform is detected daily fecal coliform testing must be reinstated until the quality limit is in compliance. Fourteen tests must be conducted to demonstrate that the discharge is back in compliance and then weekly presence/absence testing must be resumed.

17) Discharger must consult with the ministry of the minister responsible for the administration of the Ministry of Agriculture and Food Act regarding the difference between spraying for frost protection and spring frost protection techniques.

18) If chlorine is used as a disinfectant then dechlorination is necessary to protect aquatic species of flora and fauna. The use of alternative disinfection methods is recommended. Possible effects on groundwater must be evaluated. Receiving water quality requirements may necessitate additional treatment. The temperature of the reclaimed water must not adversely affect the ecosystem. Nutrient removal may be necessary to limit algae growth in impoundments.

19) Commercially processed food crops are those that, prior to sale to the public or others, have undergone chemical or physical processing such as, but not limited to, canning, heat treatment, fermentation and pickling, sufficient to destroy pathogens.

20) Milking animals must be prohibited from grazing for 6 days after irrigation ceases. Other cattle must be prohibited from grazing for 3 days after irrigation ceases unless the meat is inspected under the Federal Meat Inspection Program.

21) For restricted public access use, the number of fecal coliform organisms must not exceed 800/100 mL in any sample.

22) Worker contact with reclaimed water must be minimized. A higher level of disinfection to achieve the number of fecal coliform organisms < 14/100 mL must be provided where frequent worker contact with reclaimed water is likely.

23) Setback distance to potable water well must be > 30 m. A provider of reclaimed water must ensure that windblown spray will not exceed the boundaries of the property to which the reclaimed water is being applied and that windblown spray must not reach areas accessible to the public.

24) A provider of reclaimed water must consult specific industry's recommended water quality limits for make-up water.

25) Notwithstanding note 21, for wetlands where no diving, swimming, or wading activities occur, the number of fecal coliform organisms must not exceed 1 000/100 mL as determined in accordance with note 11 to this Appendix and the number of fecal coliform organisms must not exceed 4 000/100 mL in any sample.

26) For lagoon systems, the maximum TSS level must not exceed 60 mg/L.

Appendix F - Reclaimed Water Monitoring Data

F.1 2019 Irrigation Summary

The following table summarizes the monthly irrigation flow rates for phase 1 and phase 2 in 2019. In summary, **29,655 m^3** of treated effluent was used for irrigation in 2019. The irrigation daily flows are provided in the next section.

Irrigation Summary - 2019		
Month	**Phase 1 Total Volume**	**Phase 2 Total Volume**
	m^3	*m^3*
June	2,432	1,316
July	4,215	4,721
August	3,575	5,902
September	2,884	4,610
Total Irrigation Volume (m^3)	13,106	16,549

F.2 Irrigation Daily Flow Data

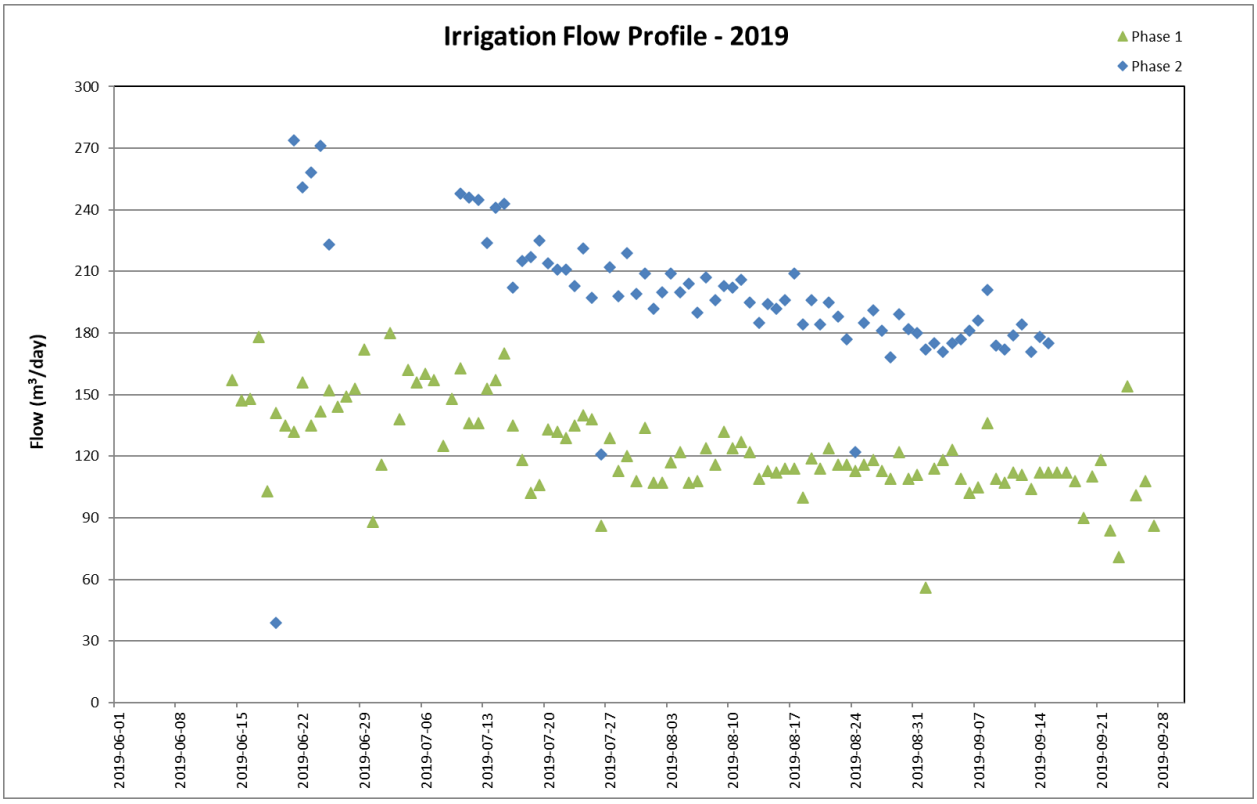
Irrigation Data June - 2019				
Date	**Phase 1 Daily Flow**	**Phase 1 Free Residual Chlorine**	**Phase 2 Daily Flow**	**Phase 2 Free Residual Chlorine**
	m^3/day	*mg/L*	*m^3/day*	*mg/L*
2019-06-01	-	-	-	-
2019-06-02	-	-	-	-
2019-06-03	-	-	-	-
2019-06-04	-	-	-	-
2019-06-05	-	-	-	-
2019-06-06	-	-	-	-
2019-06-07	-	-	-	-
2019-06-08	-	-	-	-
2019-06-09	-	-	-	-
2019-06-10	-	-	-	-
2019-06-11	-	-	-	-
2019-06-12	-	-	-	-
2019-06-13	-	0.09	-	-
2019-06-14	157.00	0.11	-	-
2019-06-15	147.00	0.14	-	-
2019-06-16	148.00	0.11	-	-
2019-06-17	178.00	0.11	-	-
2019-06-18	103.00	0.29	-	-
2019-06-19	141.00	0.10	39.00	1.06
2019-06-20	135.00	0.18	-	0.06
2019-06-21	132.00	0.25	274.00	0.07
2019-06-22	156.00	0.07	251.00	0.01
2019-06-23	135.00	0.07	258.00	0.03
2019-06-24	142.00	0.49	271.00	0.13
2019-06-25	152.00	0.08	223.00	0.09
2019-06-26	144.00	0.13	-	-
2019-06-27	149.00	0.08	-	-
2019-06-28	153.00	0.08	-	-
2019-06-29	172.00	0.09	-	-
2019-06-30	88.00	0.28	-	-
Average	143.06	0.15	219.33	0.21
Maximum	178.00	0.49	274.00	1.06
Minimum	88.00	0.07	39.00	0.01

Irrigation Data July - 2019				
Date	Phase 1 Daily Flow	Phase 1 Free Residual Chlorine	Phase 2 Daily Flow	Phase 2 Free Residual Chlorine
	m^3/day	mg/L	m^3/day	mg/L
2019-07-01	116.00	0.08	-	-
2019-07-02	180.00	0.17	-	-
2019-07-03	138.00	0.09	-	-
2019-07-04	162.00	0.10	-	-
2019-07-05	156.00	0.10	-	-
2019-07-06	160.00	0.19	-	-
2019-07-07	157.00	0.14	-	-
2019-07-08	125.00	0.30	-	-
2019-07-09	148.00	0.11	-	0.04
2019-07-10	163.00	0.05	248.00	0.79
2019-07-11	136.00	0.14	246.00	0.10
2019-07-12	136.00	0.12	245.00	0.14
2019-07-13	153.00	0.08	224.00	0.10
2019-07-14	157.00	0.08	241.00	0.14
2019-07-15	170.00	0.09	243.00	0.11
2019-07-16	135.00	0.06	202.00	0.12
2019-07-17	118.00	0.05	215.00	0.06
2019-07-18	102.00	0.09	217.00	0.05
2019-07-19	106.00	0.07	225.00	0.07
2019-07-20	133.00	0.14	214.00	0.24
2019-07-21	132.00	0.17	211.00	0.12
2019-07-22	129.00	0.11	211.00	0.19
2019-07-23	135.00	0.06	203.00	0.07
2019-07-24	140.00	0.09	221.00	0.04
2019-07-25	138.00	0.04	197.00	0.07
2019-07-26	86.00	0.06	121.00	0.05
2019-07-27	129.00	0.07	212.00	0.58
2019-07-28	113.00	0.19	198.00	0.74
2019-07-29	120.00	0.09	219.00	0.09
2019-07-30	108.00	0.05	199.00	0.05
2019-07-31	134.00	0.13	209.00	0.06
Average	135.97	0.11	214.59	0.17
Maximum	180.00	0.30	248.00	0.79
Minimum	86.00	0.04	121.00	0.04

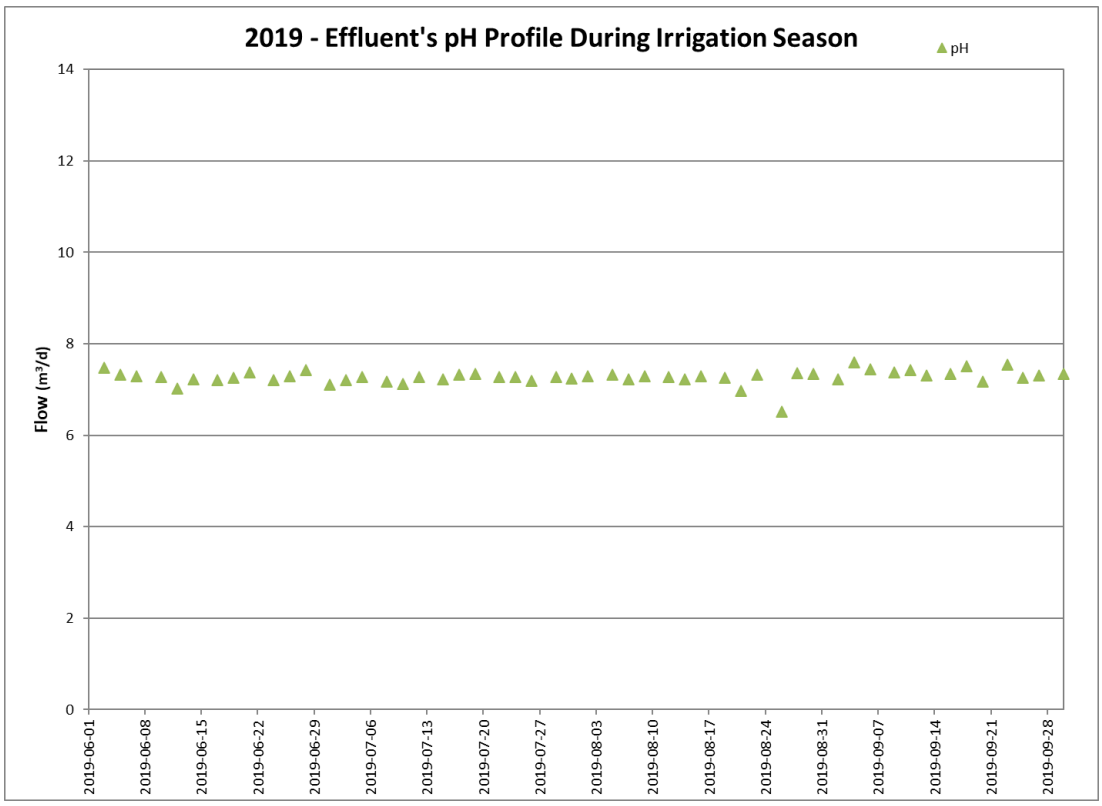
Irrigation Data August - 2019				
Date	**Phase 1 Daily Flow**	**Phase 1 Free Residual Chlorine**	**Phase 2 Daily Flow**	**Phase 2 Free Residual Chlorine**
	m^3/day	*mg/L*	*m^3/day*	*mg/L*
2019-08-01	107.00	0.04	192.00	0.09
2019-08-02	107.00	0.07	200.00	0.02
2019-08-03	117.00	0.06	209.00	0.03
2019-08-04	122.00	0.07	200.00	0.02
2019-08-05	107.00	0.05	204.00	0.03
2019-08-06	108.00	0.06	190.00	0.05
2019-08-07	124.00	0.03	207.00	0.03
2019-08-08	116.00	0.08	196.00	0.05
2019-08-09	132.00	0.08	203.00	0.04
2019-08-10	124.00	0.10	202.00	0.04
2019-08-11	127.00	0.04	206.00	0.01
2019-08-12	122.00	0.02	195.00	0.04
2019-08-13	109.00	0.08	185.00	0.03
2019-08-14	113.00	0.02	194.00	0.10
2019-08-15	112.00	0.04	192.00	0.04
2019-08-16	114.00	0.05	196.00	0.04
2019-08-17	114.00	0.35	209.00	0.96
2019-08-18	100.00	0.04	184.00	0.02
2019-08-19	119.00	0.02	196.00	0.03
2019-08-20	114.00	0.04	184.00	0.03
2019-08-21	124.00	0.05	195.00	0.10
2019-08-22	116.00	0.04	188.00	0.18
2019-08-23	116.00	0.12	177.00	0.11
2019-08-24	113.00	0.10	122.00	0.06
2019-08-25	116.00	0.09	185.00	0.14
2019-08-26	118.00	0.06	191.00	0.09
2019-08-27	113.00	0.09	181.00	0.03
2019-08-28	109.00	0.06	168.00	0.03
2019-08-29	122.00	0.05	189.00	0.03
2019-08-30	109.00	0.10	182.00	0.06
2019-08-31	111.00	0.18	180.00	0.09
Average	115.32	0.07	190.39	0.08
Maximum	132.00	0.35	209.00	0.96
Minimum	100.00	0.02	122.00	0.01

Irrigation Data September - 2019				
Date	**Phase 1 Daily Flow**	**Phase 1 Free Residual Chlorine**	**Phase 2 Daily Flow**	**Phase 2 Free Residual Chlorine**
	m^3/day	*mg/L*	*m^3/day*	*mg/L*
2019-09-01	56.00	0.04	172.00	0.08
2019-09-02	114.00	0.04	175.00	0.05
2019-09-03	118.00	0.06	171.00	0.07
2019-09-04	123.00	0.04	175.00	0.05
2019-09-05	109.00	0.06	177.00	0.07
2019-09-06	102.00	0.04	181.00	0.04
2019-09-07	105.00	0.09	186.00	0.06
2019-09-08	136.00	0.06	201.00	0.03
2019-09-09	109.00	-	174.00	0.05
2019-09-10	107.00	0.05	172.00	0.05
2019-09-11	112.00	0.06	179.00	0.07
2019-09-12	111.00	0.04	184.00	0.05
2019-09-13	104.00	0.03	171.00	0.04
2019-09-14	112.00	0.03	178.00	0.06
2019-09-15	112.00	0.08	175.00	0.02
2019-09-16	112.00	0.07	181.00	0.07
2019-09-17	112.00	0.07	174.00	0.05
2019-09-18	108.00	0.02	181.00	0.03
2019-09-19	90.00	0.15	173.00	0.05
2019-09-20	110.00	0.07	183.00	0.05
2019-09-21	118.00	0.11	159.00	0.04
2019-09-22	84.00	1.12	174.00	0.42
2019-09-23	71.00	0.05	192.00	0.02
2019-09-24	154.00	0.07	174.00	0.06
2019-09-25	101.00	0.08	172.00	0.02
2019-09-26	108.00	0.07	176.00	-
2019-09-27	86.00	-	-	-
2019-09-28	-	-	-	-
2019-09-29	-	-	-	-
2019-09-30	-	-	-	-
Average	106.81	0.10	177.31	0.06
Maximum	154.00	1.12	201.00	0.42
Minimum	56.00	0.02	159.00	0.02

F.3 Irrigation Flow Graphical Data



F.4 Irrigation Daily pH Graphical Data



Appendix G - 20 Million Exfiltration Pond Monitoring Data

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	9060562
PROJECT	20 Million Monthly - PE06738	**REPORTED**	2019-06-18 09:08

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifier
20 Mil (Exfiltration Pond) (E275065) (9060562-01) | Matrix: Wastewater | Sampled: 2019-06-05 13:00						
Anions						
Chloride	**53.6**	± 3.0	0.10	mg/L	2019-06-11	
Nitrate (as N)	**0.623**	± 0.039	0.010	mg/L	2019-06-07	
Nitrite (as N)	**0.011**	± 0.002	0.010	mg/L	2019-06-07	
Phosphate (as P)	**1.79**	± 0.31	0.0050	mg/L	2019-06-07	
Sulfate	**46.5**	± 5.5	1.0	mg/L	2019-06-07	
Calculated Parameters						
Hardness, Total (as CaCO3)	**186**		0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	**0.634**		0.0100	mg/L	N/A	
Nitrogen, Total	**1.80**		0.0500	mg/L	N/A	
Nitrogen, Organic	**1.00**		0.0500	mg/L	N/A	
Sodium Adsorption Ratio	**1.4**		0.1	-	2019-06-17	
General Parameters						
Ammonia, Total (as N)	**0.165**	± 0.025	0.020	mg/L	2019-06-10	
BOD, 5-day	< 8.0		2.0	mg/L	2019-06-13	
Chemical Oxygen Demand	**19**	± 4	20	mg/L	2019-06-11	
Conductivity (EC)	**528**	± 13	2.0	µS/cm	2019-06-07	
Nitrogen, Total Kjeldahl	**1.16**	± 0.15	0.050	mg/L	2019-06-10	
Phosphorus, Total (as P)	**2.47**	± 0.27	0.0020	mg/L	2019-06-12	
Solids, Total Suspended	**3.0**	± 0.9	2.0	mg/L	2019-06-11	
Turbidity	**0.37**	± 0.06	0.10	NTU	2019-06-07	
Microbiological Parameters						
Coliforms, Fecal	< 1		1	CFU/100 mL	2019-06-06	
Total Metals						
Aluminum, total	**0.0105**	± 0.0085	0.0050	mg/L	2019-06-17	
Antimony, total	**0.00020**	± 0.00018	0.00020	mg/L	2019-06-17	
Arsenic, total	**0.00135**	± 0.00043	0.00050	mg/L	2019-06-17	
Barium, total	**0.0278**	± 0.0036	0.0050	mg/L	2019-06-17	
Beryllium, total	< 0.00010		0.00010	mg/L	2019-06-17	
Bismuth, total	< 0.00010		0.00010	mg/L	2019-06-17	
Boron, total	**0.0596**	± 0.0218	0.0050	mg/L	2019-06-17	
Cadmium, total	**0.000104**	± 0.000032	0.000010	mg/L	2019-06-17	
Calcium, total	**62.6**	± 8.9	0.20	mg/L	2019-06-17	
Chromium, total	< 0.00050		0.00050	mg/L	2019-06-17	
Cobalt, total	**0.00058**	± 0.00007	0.00010	mg/L	2019-06-17	
Copper, total	**0.00323**	± 0.00060	0.00040	mg/L	2019-06-17	
Iron, total	**0.061**	± 0.020	0.010	mg/L	2019-06-17	
Lead, total	< 0.00020		0.00020	mg/L	2019-06-17	
Lithium, total	**0.00328**	± 0.00066	0.00010	mg/L	2019-06-17	
Magnesium, total	**7.15**	± 1.00	0.010	mg/L	2019-06-17	
Manganese, total	**0.0219**	± 0.0194	0.00020	mg/L	2019-06-17	

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	9060562
PROJECT	20 Million Monthly - PE06738	**REPORTED**	2019-06-18 09:08

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifier
20 Mil (Exfiltration Pond) (E275065) (9060562-01) | Matrix: Wastewater | Sampled: 2019-06-05 13:00, Continued						
Total Metals, Continued						
Mercury, total	< 0.000040		0.000040	mg/L	2019-06-17	CT5
Molybdenum, total	**0.00141**	± 0.00023	0.00010	mg/L	2019-06-17	
Nickel, total	**0.00218**	± 0.00057	0.00040	mg/L	2019-06-17	
Phosphorus, total	**2.80**	± 0.57	0.050	mg/L	2019-06-17	
Potassium, total	**14.0**	± 2.2	0.10	mg/L	2019-06-17	
Selenium, total	**0.00151**	± 0.00042	0.00050	mg/L	2019-06-17	
Silicon, total	**2.0**	± 1.7	1.0	mg/L	2019-06-17	
Silver, total	< 0.000050		0.000050	mg/L	2019-06-17	
Sodium, total	**42.8**	± 7.8	0.10	mg/L	2019-06-17	
Strontium, total	**0.802**	± 0.098	0.0010	mg/L	2019-06-17	
Sulfur, total	**20.3**	± 7.3	3.0	mg/L	2019-06-17	
Tellurium, total	< 0.00050		0.00050	mg/L	2019-06-17	
Thallium, total	< 0.000020		0.000020	mg/L	2019-06-17	
Thorium, total	< 0.00010		0.00010	mg/L	2019-06-17	
Tin, total	< 0.00020		0.00020	mg/L	2019-06-17	
Titanium, total	< 0.0050		0.0050	mg/L	2019-06-17	
Tungsten, total	< 0.0010		0.0010	mg/L	2019-06-17	
Uranium, total	**0.000357**	± 0.000044	0.000020	mg/L	2019-06-17	
Vanadium, total	**0.0013**	± 0.0005	0.0010	mg/L	2019-06-17	
Zinc, total	**0.0280**	± 0.0072	0.0040	mg/L	2019-06-17	
Zirconium, total	< 0.00010		0.00010	mg/L	2019-06-17	

Sample Qualifiers:

CT5 This sample has been incorrectly preserved for Mercury analysis

Appendix H - CARO Lab Reports (CALA Certified Lab)

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	9011251
PROJECT	Monthly Effluent - PE06738	**REPORTED**	2019-01-23 17:09

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Effluent- E228382 (9011251-01) | Matrix: Wastewater | Sampled: 2019-01-16 13:00						
Anions						
Nitrate (as N)	**1.40**	N/A	0.010	mg/L	2019-01-18	
Nitrite (as N)	< 0.010	N/A	0.010	mg/L	2019-01-18	
Calculated Parameters						
Nitrate+Nitrite (as N)	**1.40**	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**2.80**	N/A	0.100	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	**0.050**	N/A	0.020	mg/L	2019-01-17	
BOD, 5-day	< 8.7	N/A	2.0	mg/L	2019-01-22	
Chemical Oxygen Demand	**22**	N/A	20	mg/L	2019-01-22	
Nitrogen, Total Kjeldahl	**1.40**	N/A	0.050	mg/L	2019-01-20	
pH	**7.96**	N/A	0.10	pH units	2019-01-17	HT2
Solids, Total Suspended	< 3.3	N/A	2.0	mg/L	2019-01-22	
Microbiological Parameters						
Coliforms, Fecal	**17**	N/A	1	CFU/100 mL	2019-01-17	

Sample Qualifiers:

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	9020866
PROJECT	Monthly Effluent - PE06738	**REPORTED**	2019-02-20 15:18

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Effluent- E228382 (9020866-01) | Matrix: Wastewater | Sampled: 2019-02-13 13:00						
Anions						
Nitrate (as N)	**1.45**	N/A	0.010	mg/L	2019-02-14	
Nitrite (as N)	< 0.010	N/A	0.010	mg/L	2019-02-14	
Calculated Parameters						
Nitrate+Nitrite (as N)	**1.45**	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**2.65**	N/A	0.100	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	**0.113**	N/A	0.020	mg/L	2019-02-15	
BOD, 5-day	< 6.3	N/A	2.0	mg/L	2019-02-19	
Chemical Oxygen Demand	**29**	N/A	20	mg/L	2019-02-15	
Nitrogen, Total Kjeldahl	**1.20**	N/A	0.050	mg/L	2019-02-15	
pH	**8.00**	N/A	0.10	pH units	2019-02-14	HT2
Solids, Total Suspended	< 3.3	N/A	2.0	mg/L	2019-02-15	
Microbiological Parameters						
Coliforms, Fecal	**5**	N/A	1	CFU/100 mL	2019-02-14	

Sample Qualifiers:

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	9031085
PROJECT	Monthly Effluent - PE06738	**REPORTED**	2019-03-21 10:17

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Effluent- E228382 (9031085-01) | Matrix: Wastewater | Sampled: 2019-03-13 13:00						
Anions						
Nitrate (as N)	**0.319**	N/A	0.010	mg/L	2019-03-14	
Nitrite (as N)	**0.082**	N/A	0.010	mg/L	2019-03-14	
Calculated Parameters						
Nitrate+Nitrite (as N)	**0.402**	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**1.51**	N/A	0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	**0.045**	N/A	0.020	mg/L	2019-03-15	
BOD, 5-day	**6.3**	N/A	2.0	mg/L	2019-03-19	
Chemical Oxygen Demand	**30**	N/A	20	mg/L	2019-03-20	
Nitrogen, Total Kjeldahl	**1.10**	N/A	0.050	mg/L	2019-03-15	
pH	**7.91**	N/A	0.10	pH units	2019-03-15	HT2
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2019-03-15	
Microbiological Parameters						
Coliforms, Fecal	**2**	N/A	1	CFU/100 mL	2019-03-14	

Sample Qualifiers:

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	9040127
PROJECT	Monthly Effluent - PE06738	**REPORTED**	2019-04-04 12:23

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Effluent- E228382 (9040127-01) | Matrix: Wastewater | Sampled: 2019-04-01 13:00						
Microbiological Parameters						
Coliforms, Fecal	< 1	N/A	1	CFU/100 mL	2019-04-02	

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	9041778
PROJECT	Monthly Effluent - PE06738	**REPORTED**	2019-04-25 10:08

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Effluent- E228382 (9041778-01) | Matrix: Wastewater | Sampled: 2019-04-17 13:00						
Anions						
Nitrate (as N)	**0.263**	N/A	0.010	mg/L	2019-04-18	
Nitrite (as N)	**0.018**	N/A	0.010	mg/L	2019-04-18	
Calculated Parameters						
Nitrate+Nitrite (as N)	**0.282**	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**1.07**	N/A	0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	**0.098**	N/A	0.020	mg/L	2019-04-19	
BOD, 5-day	< 5.4	N/A	2.0	mg/L	2019-04-23	
Chemical Oxygen Demand	< 20	N/A	20	mg/L	2019-04-23	
Nitrogen, Total Kjeldahl	**0.790**	N/A	0.050	mg/L	2019-04-24	
pH	**7.96**	N/A	0.10	pH units	2019-04-23	HT2
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2019-04-23	
Microbiological Parameters						
Coliforms, Fecal	< 1	N/A	1	CFU/100 mL	2019-04-18	

Sample Qualifiers:

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	9051516
PROJECT	Monthly Effluent - PE06738	**REPORTED**	2019-05-27 08:23

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Effluent- E228382 (9051516-01) | Matrix: Wastewater | Sampled: 2019-05-15 13:00						
Anions						
Nitrate (as N)	**3.37**	N/A	0.010	mg/L	2019-05-17	
Nitrite (as N)	**0.036**	N/A	0.010	mg/L	2019-05-17	
Calculated Parameters						
Nitrate+Nitrite (as N)	**3.40**	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**3.77**	N/A	0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	**0.020**	N/A	0.020	mg/L	2019-05-21	
BOD, 5-day	< 5.7	N/A	2.0	mg/L	2019-05-23	
Chemical Oxygen Demand	**25**	N/A	20	mg/L	2019-05-21	
Nitrogen, Total Kjeldahl	**0.373**	N/A	0.050	mg/L	2019-05-22	
pH	**7.98**	N/A	0.10	pH units	2019-05-22	HT2
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2019-05-20	
Microbiological Parameters						
Coliforms, Fecal	< 1	N/A	1	CFU/100 mL	2019-05-16	

Sample Qualifiers:

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	9061234
PROJECT	Monthly Effluent - PE06738	**REPORTED**	2019-06-20 12:10

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Effluent- E228382 (9061234-01) | Matrix: Wastewater | Sampled: 2019-06-12 13:00						
Anions						
Nitrate (as N)	**8.50**	N/A	0.010	mg/L	2019-06-14	
Nitrite (as N)	**0.038**	N/A	0.010	mg/L	2019-06-14	
Calculated Parameters						
Nitrate+Nitrite (as N)	**8.54**	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**9.41**	N/A	0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	**0.093**	N/A	0.020	mg/L	2019-06-17	
BOD, 5-day	< 6.1	N/A	2.0	mg/L	2019-06-18	
Chemical Oxygen Demand	**23**	N/A	20	mg/L	2019-06-17	
Nitrogen, Total Kjeldahl	**0.868**	N/A	0.050	mg/L	2019-06-16	
pH	**7.88**	N/A	0.10	pH units	2019-06-14	HT2
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2019-06-14	
Microbiological Parameters						
Coliforms, Fecal	< 1	N/A	1	CFU/100 mL	2019-06-13	

Sample Qualifiers:

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	9071162
PROJECT	Monthly Effluent - PE06738	**REPORTED**	2019-07-17 16:19

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Effluent- E228382 (9071162-01) | Matrix: Wastewater | Sampled: 2019-07-10 13:00						
Anions						
Nitrate (as N)	**3.79**	N/A	0.010	mg/L	2019-07-12	
Nitrite (as N)	**0.039**	N/A	0.010	mg/L	2019-07-12	
Calculated Parameters						
Nitrate+Nitrite (as N)	**3.83**	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**4.76**	N/A	0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	**0.072**	N/A	0.020	mg/L	2019-07-11	
BOD, 5-day	< 6.7	N/A	2.0	mg/L	2019-07-17	
Chemical Oxygen Demand	**25**	N/A	20	mg/L	2019-07-12	
Nitrogen, Total Kjeldahl	**0.936**	N/A	0.050	mg/L	2019-07-17	
pH	**7.96**	N/A	0.10	pH units	2019-07-12	HT2
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2019-07-15	
Microbiological Parameters						
Coliforms, Fecal	**1**	N/A	1	CFU/100 mL	2019-07-11	

Sample Qualifiers:

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	9081285
PROJECT	Monthly Effluent - PE06738	**REPORTED**	2019-08-22 10:09

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Effluent- E228382 (9081285-01) | Matrix: Wastewater | Sampled: 2019-08-14 13:00						
Anions						
Nitrate (as N)	**1.74**	N/A	0.010	mg/L	2019-08-16	
Nitrite (as N)	< 0.010	N/A	0.010	mg/L	2019-08-16	
Calculated Parameters						
Nitrate+Nitrite (as N)	**1.74**	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**2.42**	N/A	0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	**0.059**	N/A	0.020	mg/L	2019-08-15	
BOD, 5-day	< 8.0	N/A	2.0	mg/L	2019-08-21	
Chemical Oxygen Demand	< 20	N/A	20	mg/L	2019-08-16	
Nitrogen, Total Kjeldahl	**0.680**	N/A	0.050	mg/L	2019-08-17	
pH	**8.02**	N/A	0.10	pH units	2019-08-15	HT2
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2019-08-20	
Microbiological Parameters						
Coliforms, Fecal	**6**	N/A	1	CFU/100 mL	2019-08-15	

Sample Qualifiers:

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	9091250
PROJECT	Monthly Effluent - PE06738	**REPORTED**	2019-09-20 10:12

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Effluent- E228382 (9091250-01) | Matrix: Wastewater | Sampled: 2019-09-11 13:00						
Anions						
Nitrate (as N)	**2.00**		0.010	mg/L	2019-09-13	
Nitrite (as N)	< 0.010		0.010	mg/L	2019-09-13	
Calculated Parameters						
Nitrate+Nitrite (as N)	**2.00**		0.0100	mg/L	N/A	
Nitrogen, Total	**2.69**		0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	**0.167**		0.020	mg/L	2019-09-18	
BOD, 5-day	< 6.2		2.0	mg/L	2019-09-18	
Chemical Oxygen Demand	< 20		20	mg/L	2019-09-16	
Nitrogen, Total Kjeldahl	**0.683**		0.050	mg/L	2019-09-18	
pH	**7.93**		0.10	pH units	2019-09-14	HT2
Solids, Total Suspended	< 2.0		2.0	mg/L	2019-09-19	HT1

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.

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	9091579
PROJECT	Monthly Effluent - PE06738	**REPORTED**	2019-09-23 14:19

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Effluent- E228382 (9091579-01) | Matrix: Wastewater | Sampled: 2019-09-16 13:00						
Microbiological Parameters						
Coliforms, Fecal	**2**		1	CFU/100 mL	2019-09-17	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	9101716
PROJECT	Monthly Effluent - PE06738	**REPORTED**	2019-10-23 14:22

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Effluent- E228382 (9101716-01) | Matrix: Wastewater | Sampled: 2019-10-16 13:00						
Anions						
Nitrate (as N)	**6.59**		0.010	mg/L	2019-10-18	
Nitrite (as N)	< 0.010		0.010	mg/L	2019-10-18	
Calculated Parameters						
Nitrate+Nitrite (as N)	**6.59**		0.0100	mg/L	N/A	
Nitrogen, Total	**7.37**		0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	**0.096**		0.020	mg/L	2019-10-21	
BOD, 5-day	< 5.5		2.0	mg/L	2019-10-22	
Chemical Oxygen Demand	< 20		20	mg/L	2019-10-18	
Nitrogen, Total Kjeldahl	**0.777**		0.050	mg/L	2019-10-19	
pH	**7.82**		0.10	pH units	2019-10-18	HT2
Solids, Total Suspended	< 2.0		2.0	mg/L	2019-10-22	
Microbiological Parameters						
Coliforms, Fecal	< 1		1	CFU/100 mL	2019-10-17	

Sample Qualifiers:

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	N001751
PROJECT	Monthly Effluent - PE06738	**REPORTED**	2019-11-24 12:41

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Effluent- E228382 (N001751-01) | Matrix: Wastewater | Sampled: 2019-11-13 13:00						
Anions						
Nitrate (as N)	**9.16**		0.010	mg/L	2019-11-15	
Nitrite (as N)	**0.640**		0.010	mg/L	2019-11-15	
Calculated Parameters						
Nitrate+Nitrite (as N)	**9.80**		0.0100	mg/L	N/A	
Nitrogen, Total	**10.6**		0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	**0.099**		0.020	mg/L	2019-11-18	
BOD, 5-day	**7.3**		2.0	mg/L	2019-11-20	
Chemical Oxygen Demand	< 20		20	mg/L	2019-11-18	
Nitrogen, Total Kjeldahl	**0.811**		0.050	mg/L	2019-11-16	
pH	**8.15**		0.10	pH units	2019-11-16	HT2
Solids, Total Suspended	< 2.0		2.0	mg/L	2019-11-18	
Microbiological Parameters						
Coliforms, Fecal	**5.2**		1.0	MPN/100 mL	2019-11-14	

Sample Qualifiers:

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Silverhawk Utilities	**WORK ORDER**	9121118
PROJECT	Monthly Effluent - PE06738	**REPORTED**	2019-12-19 13:24

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Effluent- E228382 (9121118-01) | Matrix: Wastewater | Sampled: 2019-12-11 13:00						
Anions						
Nitrate (as N)	**5.03**		0.010	mg/L	2019-12-13	
Nitrite (as N)	**0.041**		0.010	mg/L	2019-12-13	
Calculated Parameters						
Nitrate+Nitrite (as N)	**5.07**		0.0100	mg/L	N/A	
Nitrogen, Total	**6.12**		0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	**0.093**		0.020	mg/L	2019-12-16	
BOD, 5-day	< 7.8		2.0	mg/L	2019-12-18	
Chemical Oxygen Demand	**22**		20	mg/L	2019-12-16	
Nitrogen, Total Kjeldahl	**1.05**		0.050	mg/L	2019-12-14	
pH	**7.93**		0.10	pH units	2019-12-13	HT2
Solids, Total Suspended	< 2.0		2.0	mg/L	2019-12-18	
Microbiological Parameters						
Coliforms, Fecal	**3.1**		1.0	MPN/100 mL	2019-12-12	

Sample Qualifiers:

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

Appendix I - Irrigation Site Monitoring Report

SILVER STAR MOUNTAIN RESORT EFFLUENT IRRIGATION PROGRAM

2019 Report of Soil and Vegetation Monitoring

December 2019

Prepared for:

Silverhawk Utilities

Silver Star Mountain Resort,

Vernon BC

Prepared by:

R. McDougall, M.Sc., PAg.

Consulting Agrologist

Enderby, BC

List of Abbreviations

General abbreviations used in this document:

BCMWLAP – British Columbia Ministry of Water Land and Air Protection

CSR – Contaminated Sites Regulation

MSR – Municipal Sewage Regulation

Unit abbreviations used in this document:

bdl – below detection limit (value is less than laboratory's detection limit)

cm – centimeter

dS – deciSiemen

E.C. – electrical conductivity

L – litre

m – meter

mg – milligram

na – data not available or average value not reliable

ppm – parts per million

PVC – polyvinylchloride

Contents

Executive Summary

Silverhawk Utilities, which owns and manages the wastewater treatment system at Silver Star Mountain Resort near Vernon B.C., began irrigating treated effluent from the system on areas surrounding the treatment works in fall 2002 under a temporary Approval from the B.C. Ministry of Water, Land and Air Protection (BCMWLAP, now BC Ministry of Environment). Effluent irrigation has continued on the site since summer 2003 under the Municipal Sewage Regulation (now the Municipal Wastewater Regulation). This report contains the results of site, soil and tree needle monitoring in the effluent-irrigated areas during October 2019 to meet the requirements of the regulation.

Annual monitoring on the site consists of an assessment of the site including the condition of the irrigation infrastructure, perimeter ditches and site fencing; condition of the vegetation on site; soil moisture monitoring at various locations around the area; soil sampling for indicator parameters at four permanent monitoring locations and foliar (tree needle) sampling for nutrients and micronutrients (alternate years).

Irrigation of effluent on the site during 2019 appeared to be conducted in an environmentally safe manner. Soil moisture sampling throughout the irrigated area suggested that irrigation was not excessive during the period leading up to the shutdown of the system for winter; soils throughout the irrigated area were moist to wet but not saturated at the time of monitoring. The soil nutrient and quality assessment did not identify any areas of concern. Foliar testing did not identify any concerns. No site degradation due to irrigation was noted.

1. Introduction

This report contains the results of the annual site, soil and vegetation monitoring of the effluent irrigated areas at Silver Star Mountain Resort, near Vernon B.C., in October 2019. Silverhawk Utilities, which owns and manages the wastewater treatment system at Silver Star Mountain Resort, began irrigating treated effluent from the system on areas surrounding the treatment works in fall 2002 under a temporary Approval from the B.C. Ministry of Water, Land and Air Protection (BCMWLAP, now B.C. Ministry of Environment). In spring 2003, an Environmental Impact Study and Monitoring Plan were prepared for the proposed irrigation areas as required under the Municipal Sewage Regulation (MSR) (now the Municipal Wastewater Regulation). Following acceptance of the plan by the BCMWLAP, the effluent irrigation program was started on the site.

Annual monitoring on the site consists of an assessment of the site including the condition of the irrigation infrastructure, perimeter ditches and site fencing; condition of the vegetation on site; soil moisture monitoring at various locations around the area; soil sampling for indicator parameters at four permanent monitoring locations and foliar sampling in alternate years.

The on-site monitoring does not include an assessment of the impact of the effluent on slope or terrain stability on the site. That is beyond the scope of monitoring currently conducted on the site for this report.

2. Effluent irrigation infrastructure on the site

Effluent is irrigated onto two distinct areas of the site, described as Phase I and Phase II areas. The site map in Appendix 3 shows the location of these irrigated areas.

In the Phase I irrigation area, the irrigation infrastructure was installed in August 2002 and consists of a network of 1" PVC pipe with sprinkler heads at regular intervals throughout the area. The area is approximately 1.8 hectares in size and is located on sloping ground above the exfiltration pond. Sprinkler lines run vertically in the upper two thirds of the site, and laterally in a smaller area just above the pond. A perimeter ditch runs below the upper irrigated area and terminates at the exfiltration pond.

The Phase II irrigation area is located to the northeast of Ponds #1 and #3 and above the roadway that runs through the area. Irrigation infrastructure was installed in the upper two thirds of the Phase II area during summer 2003, and irrigation was commenced on the site on August 24, 2003. The irrigated area is approximately 4.8 hectares in size. The irrigation infrastructure consists of a mainline that runs up the slope in the middle of the area from the roadway to the site boundary, with six laterals running off it to left and right. One lateral extends back across the roadway and runs into the lower part of the Phase II area. The entire lower boundary of the area is surrounded with a substantial ditch approximately 30 to 45 cm deep which terminates at the exfiltration pond.

3. Monitoring methods

3.1 Permanent monitoring sites

In fall 2003, three permanent monitoring points were established on the site, one in the middle of the Phase I area and two in the Phase II area, the first along line 3 which represents an upslope position on the site and the second along line 6 which is in a downslope position (see Figure 1: Silver Star site map

found in Appendix 3). Permanent monitoring sites were marked with large wooden stakes. On October 27, 2004, a control site was identified and a permanent marker installed to identify the site. The control site is located above and to the south of the Phase II area (also shown on the site map). The wooden stakes marking monitoring spots are replaced as they rot or are damaged by cattle activity.

3.2 Site assessment

A surface inspection of the irrigated areas was conducted on October 8, 2019 by undertaking a thorough walk-through of the site, noting any visible impacts of irrigation on site, soil or vegetation. Presence and condition of ditches, signage and marking tape was also noted.

3.3 Soil moisture monitoring

Soil moisture assessment was done on October 8, 2019. Soil moisture determination was made by augering holes in the soil at the permanent monitoring points to 45 cm depth and performing a 'hand-squeeze test' on the samples to determine moisture content at various depths. The augered soil was assessed for moisture content based on the hand squeeze test. Samples were rated as dry (leaves no moisture on hand following a handful being tightly squeezed), damp (leaves a moist but not wet patch on hand following a tight squeeze), moist (leaves a wet mark on the hand when squeezed but no moisture can be squeezed out of the sample) or wet (hand is wet after the sample is tightly squeezed and water is visible on the outside of the soil sample). It was assumed that a 'dry' sample was at or below the soil's permanent wilting point and a 'wet' sample was saturated based on standard hand sampling methodology. A 'moist' sample is at approximately field capacity.

3.4 Soil sampling for nutrient and quality assessment

On October 8, 2019 soil samples were collected from the four permanent monitoring points for soil nutrient and quality assessment. Surface organic material was scraped off the sampling area prior to sampling, exposing the mineral soil. Three composite samples were collected from each permanent monitoring point (three samples at each of three depths in the soil). The samples were collected randomly from an area within 50 cm of each permanent stake. Samples were collected using a narrow Dutch auger and were collected from the 0 to 15, 15 to 30 and 30 to 45 cm depths. The three samples from each depth at each hole were mixed to make one composite sample from each depth which was submitted for nutrient analysis to Element (formerly Exova) Laboratories in Edmonton, Alberta. Twelve soil samples were submitted for analysis.

3.5 Vegetation testing

On October 8, 2019 foliar samples were collected from the current year's growth on young Douglas fir trees from around the four permanent monitoring sites. Each sample was a composite of three subsamples representing three individual trees (this was reduced in 2011 from five sampled previously as the height of trees has increased over the years making it difficult to find enough small trees to sample). The trees sampled were approximately 1-3 metres tall. Samples were collected from the top third of each tree, and three tips per tree were collected, each approximately 10 cm long. Samples were collected from trees within 5 metres of the monitoring stake where possible, or within the range of irrigation spray in the irrigated areas. These samples were combined to make one sample per permanent sampling point. The

samples were submitted to Element (formerly Exova) Laboratories in Edmonton, Alberta for foliar nutrient and micronutrient analysis.

Vegetation quality will be assessed again in fall 2021.

4. Results of monitoring program

4.1 Site conditions

At the time of the site visit on October 8, 2019, irrigation had been shut down for the winter in both areas. There had been a light snowfall prior to the site visit amounting to 2-3 cm of snow on the ground. There was no surface water visible anywhere on the site. The irrigation infrastructure appeared to be in good condition. Sprinkler risers and heads had been removed for the winter but the irrigation mainline and laterals remained in place (Photographs 1 & 2).

The site was in excellent condition at the time of the site visit (see photographs). There was evidence of cattle grazing on the site this year as there has been for the past several years. Vegetation had been well grazed along all of the irrigation lines and mainline. There remain small areas of the site where cattle hoof damage is visible. Dirt mounds from mole or pocket gopher activity were noted in a few areas of the site – noted since fall 2016 but not prior to that.

The exfiltration pond from which effluent is pumped was very low at the time of the site visit. There was a layer of green algae on the surface of part of the pond at the time of the site visit (Photograph 4) (also noted in several previous years).

4.2 Management of irrigated areas

2019 irrigation season

In 2019, the Phase I area was irrigated from June 13 to September 27. Irrigation was on in the Phase II area from July 9 to September 26. As in previous years, the site was irrigated primarily during the period of maximum evapotranspiration on the site.

Access restriction and signage

At the time of the site visit, hazard tape had been removed for the winter. Signage was present in some areas but had not been put up for the winter yet in other areas.

Ditching

There was no change in the condition of site ditches in 2019. The Phase I and Phase II area ditches appeared to be in good order at the time of the site assessment (Photograph 3). There remains a small amount of trampling damage to the sides of the ditch in part of the Phase II area which could now use some repair (damage has been noted since fall 2009 but has not significantly worsened since then). The condition of the ditches appears to be adequate to contain runoff water that might occur as the result of leakage from irrigation infrastructure but in the trampled area may not contain the flow from a large leak such as bursting of the mainline.

Surface erosion and runoff

There was no visible evidence of erosion caused by runoff or leakage from piping anywhere around the site.

Resurfacing of effluent

There was no evidence of resurfacing of effluent downslope in either the Phase I or Phase II area.

4.3 Soil moisture status

Soil moisture monitoring was conducted at the same time as soil sampling in all areas of the site using the protocol outlined in section 3.3. Four holes were augered throughout the site to monitor soil moisture, one close to each of the permanent monitoring points (identified on the site map, Appendix 3).

The soil in the holes dug at both the Phase I and Phase II monitoring sites was moist to wet but not saturated to 45 cm. This is drier than was noted in October 2018.

At the control site (permanent monitoring point 4), the soil was damp to moist to a depth of 45 cm which was drier than was observed in the irrigated areas.

The soil moisture monitoring done in fall 2019 suggests that irrigation in both areas of the site was not excessive in the several weeks leading up to the site assessment. It is not possible to assess the irrigation rate during the early part of the season.

4.4 Irrigation rate

The Phase I area received 13,088 cubic metres (2.9 million Imperial gallons) of effluent in 2019. The Phase II area was irrigated with 16,592 cubic metres (3.6 million Imperial gallons) of effluent in 2019 for a total of 29,680 cubic metres (6.5 million gallons). This is within the application rate guidelines outlined in the 2003 Environmental Impact Study which indicated that the 6.6 hectare site could utilize more than 30,000 cubic metres of effluent per irrigation season.

4.5 Soil nutrient status

Tables 1a-d (Appendix 1) contain soil quality and nutrient data from surface soil samples collected from the four permanent monitoring points in fall 2019 and for comparison, historical data from 2003 to 2018 as well as average values for each parameter since sampling began. Table 2 contains soil nitrate, pH and electrical conductivity data from 2019 for three depths in the soil, 0 to 15 cm, 15 to 30 cm and 30 to 45 cm. The soil sampling protocol is outlined in section 3.4.

No soil quality or nutrient issues were noted in samples collected from the site in fall 2019. Effluent irrigation does not appear to have negatively impacted these parameters in 2019.

Soil quality parameters - electrical conductivity (E.C.) and pH

Both parameters remain within the range of values observed since effluent irrigation began on the site and are within the desirable range for vegetation growth.

Soil electrical conductivity (E.C.), a measure of the soil's salinity, was measured at 0.2 to 0.28 dS/m in irrigated areas and at 0.08 dS/m at the control site in fall 2019. This is within the range observed since

effluent irrigation began. The observed E.C. values are well below the level considered to be of concern for plant growth (3-4 dS/m). E.C. was also measured at two subsurface depths, 15 to 30 cm and 30 to 45 cm. E.C. was low at all sampling depths (Table 2, Appendix 1). Effluent irrigation in 2019 does not appear to have negatively impacted soil electrical conductivity.

Surface soil pH was 7.2 in effluent irrigation areas, and was at 6.3 in the control area. These values are similar to those observed since effluent irrigation began on the site. The pH in the irrigated areas has been slightly higher than the pH observed at the control site since fall 2006 (Table 1). Subsurface soil pH values were very similar to those observed in the surface soil. The pH of the irrigated areas has not changed measurably in the past ten years and remains acceptable for growth of vegetation. The effluent does not appear to be negatively impacting soil pH.

Soil available nutrients

Plant-available nitrogen (measured as nitrate and ammonium) in the irrigated areas was very low again in fall 2019 as it has been for several years but within the range measured since effluent irrigation began. The effluent does not appear to be oversupplying the soil with nitrogen.

Plant-available phosphorus levels (measured by the Bray P1 analytical method) in fall 2019 were higher than observed in the past several years in effluent irrigated areas and unchanged in the control area. Phosphorus in the Phase I area has increased in the past several years; this may be an anomaly and will continue to be monitored. Soil values for this parameter have fluctuated from year to year but do not appear to be trending upwards or downwards since effluent irrigation began which suggests that the amount of phosphorus applied in the effluent is being utilized by the vegetation on site.

Other macro-nutrients: Plant-available potassium (measured by the ammonium acetate analytical method) was slightly higher than measured in the past several years in irrigated areas, and unchanged in the control area. (Table 1, Appendix 1). The soil concentrations of sodium and sulphur were within the range of values observed since effluent irrigation began. There are no concerns with these macronutrients at this time.

Soil exchangeable calcium and magnesium: In the 15 year summary done in fall 2017, it was noted that the soil concentration of exchangeable calcium and magnesium appeared to have increased in both irrigated and non-irrigated areas since effluent irrigation began. Levels observed in fall 2019 were lower than observed in the past several years at all monitoring sites, and all were within the range of historical values. No concerns were noted with these two nutrients.

4.6 Soil trace element concentration

Soil trace element concentrations were not assessed in fall 2019.

4.7 Vegetation quality assessment

Visual assessment

The vegetation on site in general appeared to be healthy and continues to grow vigorously. At the time of the site assessment, there did not appear to be any visible impacts on the vegetation that could be attributed to effluent application in either the Phase I or Phase II area (Photographs 1-3).

The brush and tree removal in both areas appears to be adequate at this time. The area is now much more open than it was prior to 2008 which is allowing the remaining trees to grow more freely.

Vegetation nutrient and micronutrient status

Tables 3a and 3b (Appendix 1) contain the foliar nutrient and micronutrient data from conifer needle samples collected from the four permanent monitoring sites, and for comparison, data from samples collected from fall 2003 through 2017. The foliage sampling protocol is found in section 3.5.

There were no nutrient or micronutrient concerns identified with any of the conifer needle samples collected from the irrigated areas in fall 2019. In general, the needle samples collected in fall 2019 had concentrations of nutrients and micronutrients within the range observed since monitoring began. In all samples including the control, the concentrations of all nutrients except calcium were within the low to medium range for conifer needles; calcium ranged from high to very high in concentration and was somewhat elevated even in the control sample suggesting a site influence. There do not appear to be any concerns with any of the nutrients or micronutrients monitored in tissue samples in fall 2019.

4.8 Current vegetation on site

The vegetation in both irrigated areas remains a mix of conifers (interior or white spruce (*Picea glauca*), Douglas fir, (*Pseudotsuga menzesii* var. *glauca*), lodgepole pine (*Pinus contorta* var. *latifolia*) and larch (*Larix occidentalis*)) and deciduous species (poplar (Populus spp,), alder (Alnus spp.) and others). The ground cover is a mix of agronomic grasses, herbs and shrubs. Thinning in both areas of the site has opened the site allowing the remaining trees to grow more freely. This has resulted in conifers beginning to dominate the site and a reduction in undergrowth and shrubs. There has been fairly intensive grazing of the whole site in the past several years which has also contributed to the reduction in undergrowth on the site.

5. Areas of concern

There were no issues identified with any of the soil nutrient and quality data collected in fall 2019. Soil moisture levels were in the moist to wet range, but not saturated, indicating that irrigation in the period leading up to sampling was not excessive. 2019 tree needle data did not identify any areas of concern. Thinning and brushing has largely been completed in the irrigation areas which was recommended in previous monitoring reports. There is some cattle trampling damage to an area of the perimeter ditch in the Phase II area which could be repaired.

6. Conclusions

In general, the effluent irrigation program managed by Silverhawk Utilities at Silver Star Mountain Resort in 2019 appeared to be conducted in an environmentally acceptable manner. Soil moisture levels throughout the irrigated area suggested that irrigation was not excessive on site during the latter part of the irrigation season. Soil nutrient and quality assessment did not identify any areas of concern. The site assessment did not identify any areas of surface soil erosion or other damage to the site due to effluent irrigation.

7. Recommendations for the 2020 Effluent Irrigation Season

- Staff should monitor soil moisture status periodically through the irrigation season to ensure that over-irrigation is not occurring (soil should not be saturated following irrigation). Staff should also allow periods of time throughout the irrigation season when each area is not irrigated – providing for wetting and drying cycles in the soil to facilitate nutrient cycling. Rotating one week shut off periods should be sufficient.
- Staff should continue to keep records on volume of effluent irrigated in each area.
- Effluent should continue to be analyzed for the parameters and at frequencies as outlined in the Environmental Impact Assessment. This should include **twice per season** analysis for: conductivity, sodium absorption ratio, pH, nutrients (total nitrogen, nitrate, ammonium, phosphorus, potassium, calcium, magnesium, sodium, chloride and sulphate) and once per season (mid-season) analysis for trace elements (trace metal scan including CSR metals plus phosphorus, potassium, boron and iron). **Sampling should occur at irrigation start up and mid-season, not at the end of the season**.
- In fall 2020, soil moisture status and soil nutrient status should be assessed using the same protocol as in previous years.
- Conifer needle nutrient testing should be done in fall 2021.

Appendix 1. Tables

Table 1a. Surface Soil Quality Data from the Phase I Area – 2003 through 2019

		NH4		NO3	Avail. P	Avail. K	SO4	Ca	Na	Mg	pH	E.C.
		ppm		ppm	ppm	ppm	ppm	ppm	ppm	ppm	pH units	mS/cm
Phase 1												
Fall 2003		81.1		12	55	129	23	931	176	74	6.5	0.76
Fall 2004		19.2		17	127	130	18	1296	171	95	6.5	0.56
Fall 2005		-		11	60	140	6	1250	101	75	7	0.29
Fall 2006		5.6		15	67	180	3	1130	118	68	6.9	0.26
Fall 2007		13		13	76	150	6	1850	98	100	7.1	0.45
Fall 2008		0.4		21	120	180	7	1240	110	77	7.2	0.38
Fall 2009		0.5		8	110	153	9	1480	110	86	7.1	0.29
Fall 2010		0.8	<	2	60	127	7	1140	90	67	7	0.11
Fall 2011	<	0.4		2	60	153	13	1110	110	70	7.2	0.28
Fall 2012		1.3	<	2	59	142	14	1260	110	77	7.1	0.26
Fall 2013		6.1	<	2	82	154	7	1560	100	86	7.6	0.24
Fall 2014		0.6	<	2	70	122	17	1930	110	104	7.5	0.5
Fall 2015	<	0.4	<	2	90	158	11	1380	110	79	7.5	0.24
Fall 2016		1.2	<	2	50	201	20	1670	68	82	7.5	0.38
Fall 2017	<	0.4	<	2	100	131	10	1730	103	87	7.9	0.33
Fall 2018		0.4	<	2	140	190	20	1770	78	86	7.6	0.26
Fall 2019	<	0.3	<	10	400	300	20	1610	101	89	7.2	0.2
Average	**<**	**8**	**<**	**7**	**102**	**161**	**12**	**1432**	**110**	**82**	**7.2**	**0.34**

Table 1b. Surface Soil Quality Data from the Phase II (upper monitoring point) – 2003 through 2019

	NH4 ppm		NO3 ppm	Avail. P ppm	Avail. K ppm	SO4 ppm	Ca ppm	Na ppm	Mg ppm	pH pH units	E.C. mS/cm
Phase II upper											
Fall 2003	13.5		2	14	106	16	1116	152	41	6.4	0.32
Fall 2004	9.6		5	35	189	25	1204	243	76	6.4	0.72
Fall 2005	na		6	28	170	15	2060	164	115	7	0.57
Fall 2006	10.6		29	34	190	4	2050	134	93	7.2	0.46
Fall 2007	2.4		2	27	140	8	1960	112	83	7	0.3
Fall 2008	2.9		25	47	290	13	1950	140	89	7.6	0.54
Fall 2009	9.7		4	49	202	15	2640	130	120	7.2	0.52
Fall 2010	1.3		4	50	134	11	2180	110	102	7.2	0.25
Fall 2011	0.5		4	33	169	10	2860	140	124	7	0.3
Fall 2012	6		2	42	202	12	2080	130	95	7.2	0.28
Fall 2013	9.3		3	40	170	8	2370	90	102	7.5	0.28
Fall 2014	0.8		7	70	165	11	2720	100	122	7.6	0.35
Fall 2015	1.3		4	58	223	10	2550	100	121	7.5	0.44
Fall 2016	2.9	<	2	49	222	11	2730	77	121	7.6	0.48
Fall 2017	0.7	<	2	90	155	15	2420	108	109	7.3	0.54
Fall 2018	2.4		3	75	248	35	2940	80	122	7.2	0.4
Fall 2019	1.4		2	80	279	28	2280	88	107	7.2	0.28
Average	**5**		**6**	**48**	**191**	**15**	**2242**	**123**	**102**	**7.2**	**0.41**

Table 1c. Surface Soil Quality Data from the Phase II Area (lower monitoring point) – 2003 through 2019

	NH4		NO3	Avail. P	Avail. K	SO4	Ca	Na	Mg	pH	E.C.
	ppm		ppm	ppm	ppm	ppm	ppm	ppm	ppm	pH units	mS/cm
Phase II line 6 (lower monitoring point)											
Fall 2003	13.5		4	12	74	15	1372	114	48	6.4	0.48
Fall 2004	6.4		4	11	83	18	1154	141	48	6.4	0.4
Fall 2005	na	<	1	49	160	5	1340	12	112	6.3	0.16
Fall 2006	15.8		38	32	180	3	2160	135	94	7	0.61
Fall 2007	10.9		4	23	120	6	1900	94	77	7	0.26
Fall 2008	1.7		27	33	110	2	1920	130	79	7.2	0.55
Fall 2009	2.4		6	30	138	1	2260	130	95	7.2	0.37
Fall 2010	1.3	<	2	24	137	10	1980	110	91	7.2	0.23
Fall 2011	< 0.4	<	2	24	170	13	2170	130	103	7	0.28
Fall 2012	5		3	22	186	12	2010	130	94	7.1	0.29
Fall 2013	12.5		2	28	202	10	1840	110	90	7.4	0.28
Fall 2014	0.8		11	57	139	13	2970	120	143	7.3	0.41
Fall 2015	< 0.5		8	41	174	13	2550	110	122	7.1	0.36
Fall 2016	3.4	<	2	58	210	7	2740	82	123	7.5	0.29
Fall 2017	< 0.5	<	2	57	151	18	2510	98	110	7.3	0.38
Fall 2018	0.5		2	33	213	25	2670	92	105	7.4	0.29
Fall 2019	0.7		3	90	282	21	2100	85	103	7.2	0.22
Average	**5**	**<**	**7**	**37**	**161**	**11**	**2097**	**107**	**96**	**7.1**	**0.34**

Table 1d. Surface Soil Quality Data from the Control Area – 2004 through 2019 (Note: monitoring of control area began in 2004)

	NH4		NO3	Avail. P	Avail. K	SO4	Ca	Na	Mg	pH	E.C.
	ppm		ppm	ppm	ppm	ppm	ppm	ppm	ppm	pH units	mS/cm
Control											
Fall 2004	trace		5	33	117	15	832	77	68	5.3	0.24
Fall 2005	-		4	17	140	14	2090	128	75	7.1	0.37
Fall 2006	16.1	<	1	52	200	6	1450	16	105	6.2	0.12
Fall 2007	32.3		3	30	130	3	1180	10	62	6.2	0.16
Fall 2008	2.4	<	1	27	120	12	1270	20	72	6.5	0.07
Fall 2009	0.6	<	2	35	110	<1	1250	30	59	6.2	0.09
Fall 2010	26.2	<	2	27	120	3	1340	30	70	6.4	0.11
Fall 2011	1.5	<	2	34	133	3	1220	40	65	6.1	0.12
Fall 2012	7.9	<	2	41	177	3	1430	30	91	6.2	0.11
Fall 2013	7.2	<	2	31	192	2	1260	30	76	6.6	0.1
Fall 2014	2.6	<	2	39	132	5	1490	30	95	6	0.13
Fall 2015	3.1	<	2	32	128	2	1360	30	90	6.2	0.09
Fall 2016	1.8	<	2	30	127	2	1280	30	75	6.1	0.13
Fall 2017	2	<	2	37	124	2	1520	59	106	6.8	0.1
Fall 2018	2.3	<	2	20	179	20	1580	30	92	6.3	0.2
Fall 2019	0.9	<	2	23	119	2	1340	bdl	55	6.3	0.08
Average	**8**	**<**	**2**	**32**	**141**	**6**	**1368**	**39**	**79**	**6.3**	**0.14**

Table 2. Surface and Subsurface Soil Quality Data in 2019

Sampling Depth	Nitrate-N (NO_3-N) ppm	Sulphate-S (SO_4-S) ppm	Electrical Conductivity (E.C.) dS/m	pH pH units
Phase 1 area				
0-15 cm	bdl	20	0.2	7.2
15-30 cm	8	11	0.24	6.9
30-45 cm	4	9	0.22	7.1
Phase II area: line 3 (upper monitoring point)				
0-15 cm	2	28	0.28	7.2
15-30 cm	bdl	10	0.22	7.3
30-45 cm	bdl	10	0.24	7.1
Phase II area: line 6 (lower monitoring point)				
0-15 cm	3	21	0.22	7.2
15-30 cm	3	10	0.25	7.1
30-45 cm	bdl	6	0.2	7.3
Control area				
0-15 cm	bdl	2	0.08	6.3
15-30 cm	bdl	bdl	0.1	6.2
30-45 cm	bdl	10	0.07	6.3

bdl = value below laboratory detection limit.

Table 3a. Foliar Nutrient and Micronutrient Data from Phase I and Phase II (upper) Areas (foliar monitoring in alternate years after 2009).

Area	Nitrogen	Boron	Calcium	Copper	Iron	Potassium	Magnesium	Manganese	Molybdenum	Sodium	Phosphorus	Sulphur	Zinc
	%	ppm	%	ppm	ppm	%	%	ppm	ppm	ppm	%	%	ppm
Phase I line 4													
Fall 2003	2.02	21.1	0.68	4.1	68.6	0.9	0.1	345.6	0.2	179.1	0.29	0.13	32.3
Fall 2004	1.71	29.7	0.34	2.6	105.8	0.58	0.08	190.6	bdl	91.8	0.19	0.1	18.9
Fall 2005	1.92	24.6	0.5	3.8	128	0.72	0.1	150	0.8	200	0.26	0.15	47.1
Fall 2006	1.77	19.8	0.64	2.5	82.9	0.74	0.08	85.8	bdl	100	0.21	0.12	33.8
Fall 2007	1.49	16.1	1.29	2	80.9	0.5	0.06	48.6	bdl	300	0.17	0.2	18.2
Fall 2008	1.85	41	1.01	3.7	202	0.73	0.1	97.8	2	500	0.23	0.14	29.1
Fall 2009	1.73	20	0.72	3.7	170	0.62	0.09	167	0.7	100	0.21	0.1	27.8
Fall 2011	1.19	18	0.65	3.6	110	0.74	0.1	135	0.8	400	0.25	0.1	40.3
Fall 2013	1.58	13.2	0.85	2.6	154	0.63	0.1	77.2	0.6	100	0.24	0.097	27.4
Fall 2015	1.35	20.7	2.28	2.99	125	0.72	0.12	128	0.5	300	0.31	0.137	26.3
Fall 2017	1.07	20	0.61	2	170	0.67	0.12	170	bdl	bdl	0.24	0.11	26
Fall 2019	1.19	9.5	1	2.2	130	0.41	0.011	120	bdl	170	0.24	0.1	27
Average	**1.57**	**21.1**	**0.88**	**3.0**	**127**	**0.66**	**0.09**	**143**	**0.8**	**222**	**0.24**	**0.12**	**29.5**
Phase II line 3 (upper monitoring point)													
Fall 2003	1.27	2.1	0.93	7.8	86.6	0.72	0.08	85.1	1.2	63.6	0.19	0.09	43.8
Fall 2004	1.51	26.2	0.57	1.6	103.7	0.57	0.07	125.7	bdl	107.5	0.19	0.1	48.2
Fall 2005	1.83	9	0.73	2.9	234	0.59	0.07	92.3	bdl	700	0.24	0.12	35.5
Fall 2006	1.79	7.3	0.98	2	172	0.53	0.09	102	bdl	300	0.25	0.12	46.4
Fall 2007	1.65	8.59	0.78	2.1	105	0.6	0.06	44.7	bdl	300	0.18	0.12	29.2
Fall 2008	2.09	36	0.89	14.2	220	0.79	0.09	72.6	0.85	300	0.26	0.13	45.2
Fall 2009	1.48	13	0.83	3.4	224	0.54	0.07	150	bdl	700	0.2	0.1	23.4
Fall 2011	1.26	14	0.61	3.4	79	0.67	0.1	69.1	bdl	100	0.24	0.1	36.1
Fall 2013	1.7	12.8	0.61	2.5	85	0.59	0.09	106	bdl	100	0.22	0.091	31
Fall 2015	1.39	15.9	0.59	2.88	57	0.68	0.11	134	0.5	100	0.24	0.1	34.1
Fall 2017	1.21	6.3	0.68	2.5	94	0.73	0.076	60	bdl	100	0.29	0.1	27
Fall 2019	1.49	11	1.1	2.8	150	0.49	0.11	180	bdl	bdl	0.32	0.11	41
Average	**1.56**	**13.5**	**0.78**	**4.0**	**134**	**0.63**	**0.08**	**101.8**	**0.9**	**261**	**0.24**	**0.11**	**36.7**

Bdl – value below laboratory detection limit.

Table 3b. Foliar Nutrient and Micronutrient Data from Phase II (lower) and Control Areas (foliar monitoring in alternate years after 2009)

Area	Nitrogen %	Boron ppm	Calcium %	Copper ppm	Iron ppm	Potassium %	Magnesium %	Manganese ppm	Molybdenum ppm	Sodium ppm	Phosphorus %	Sulphur %	Zinc ppm
Phase II line 6 (lower monitoring point)													
Fall 2003	1.39	5.3	0.68	4.4	81.2	0.79	0.12	194.6	1.1	10.9	0.25	0.09	65.2
Fall 2004	1.46	21.8	0.49	bdl	72.8	0.61	0.08	102.3	bdl	55.1	0.2	0.08	37.3
Fall 2005	1.53	16.2	0.62	3	120	0.7	0.09	93.3	bdl	100	0.25	0.1	49.1
Fall 2006	2.01	29.5	0.91	8	-	0.48	0.09	107	5.5	500	0.24	0.11	86.1
Fall 2007	1.75	9.38	0.67	1.7	164	0.57	0.06	50.8	bdl	200	0.18	0.12	21.9
Fall 2008	1.87	35	0.92	6.52	330	0.74	0.1	84.4	1.2	800	0.28	0.13	25.5
Fall 2009	1.37	12	0.85	2.4	210	0.54	0.09	152	bdl	400	0.21	0.1	26
Fall 2011	1.17	16	0.71	3.2	107	0.74	0.13	104	0.6	200	0.26	0.1	36.2
Fall 2013	1.44	12.1	0.79	2.56	139	0.56	0.1	82.2	bdl	100	0.24	0.096	28.6
Fall 2015	1.52	15.9	1.34	2.89	110	0.72	0.12	108	0.7	100	0.28	0.126	33.3
Fall 2017	1.51	13	0.97	2.6	150	0.69	0.11	120	bdl	bdl	0.3	0.13	36
Fall 2019	1.39	8.9	0.69	2.9	180	0.58	0.087	57	0.8	bdl	0.27	0.097	28
Average	**1.53**	**16.3**	**0.80**	**3.7**	**151**	**0.64**	**0.10**	**104.6**	**1.7**	**246.6**	**0.25**	**0.11**	**39.4**
Control													
Fall 2003	-	-	-	-	-	-	-	-	-	-	-	-	-
Fall 2004	1.32	23	0.46	0.6	36	0.62	0.07	191	bdl	29.1	0.18	0.08	52.3
Fall 2005	1.58	10.6	0.51	3.5	63.5	0.79	0.08	234	bdl	bdl	0.23	0.11	62.6
Fall 2006	1.4	10.4	0.8	2.7	48	0.69	0.1	255	bdl	bdl	0.22	0.09	68.7
Fall 2007	1.17	6.73	0.5	1.4	24.1	0.7	0.06	104	bdl	bdl	0.18	0.13	33.6
Fall 2008	1.63	28	0.53	4.9	90.4	0.9	0.1	268	bdl	bdl	0.24	0.11	59.4
Fall 2009	1.48	11	0.43	3.5	57	0.87	0.11	156	bdl	bdl	0.21	0.09	33.6
Fall 2011	1.25	16	0.48	3.8	47	0.77	0.11	144	bdl	bdl	0.22	0.09	38.6
Fall 2013	1.86	10.8	0.51	3.17	47	0.82	0.11	138	bdl	bdl	0.23	0.092	35
Fall 2015	1.56	13.9	0.61	3.41	41	0.82	0.1	116	bdl	bdl	0.21	0.095	32.3
Fall 2017	1.74	14	0.46	4.8	53	1	0.13	140	bdl	bdl	0.25	0.12	33
Fall 2019	1.49	14	0.77	2.9	79	0.55	0.1	220	bdl	bdl	0.22	0.095	34
Average	**1.50**	**14**	**0.55**	**3.2**	**53**	**0.78**	**0.10**	**179**	**bdl**	**bdl**	**0.22**	**0.10**	**43.9**

Bdl – value below laboratory detection limit.

Appendix 2. Photographs

Photograph 1. Condition of Phase I Area – October 8, 2019

Photograph 2. Condition of Phase II Area – October 8, 2019

	**Photograph 3.** Condition of ditches – October 8, 2019
	**Photograph 4.** Effluent storage lagoon – October 8, 2019

Appendix 3 – Site Map

Figure 1: Site map of Silver Star Mountain Resort Phase I and Phase II wastewater treatment plant effluent irrigation areas (map provided by Silverhawk Utilities).