Stantec

Stantec Consulting Services Inc.
725 East Fireweed Lane Suite 200, Anchorage AK 99503-2245

April 7, 2020
File: 204700415

Attention: Archie Giddings
City of Wasilla
290 E. Herning Avenue
Wasilla, AK 99654

Dear Mr. Giddings,

Reference: Wasilla WWTP Effluent Discharge Pilot Study 2019 Q4 Report

The City of Wasilla (COW) Wastewater Treatment Plant (WWTP) Effluent Discharge Pilot Study has been underway since June 24, 2019. As of December, approximately 19 million gallons of effluent has been discharged into the wetland adjacent the WWTP. This letter provides a progress report through the fourth quarter of 2019 on the Pilot Study and summarizes preliminary results as of December.

BACKGROUND

Effluent discharge commenced on June 24, 2019. For the initial discharge effluent diffusers #1 and #3 (see Appendix A) were opened, while the remaining three were left closed. Using the plug valve and flow meter constructed last fall, the discharge flow was set to approximately 80 gallons per minute (gpm), or roughly 115,000 gpd. Stantec employees observed flow and sampled surface water daily for the first week and then weekly for the following four weeks, returning to the monthly schedule from the background data collection thereafter. Water is being sampled using a combination of field testing for nitrates and laboratory testing for all other parameters, including fecal coliform cultures. Nitrate levels in surface water were used as the primary indicator to track initial spreading of the effluent into the wetland as they were easily tested in the field.

Nitrate levels in pre-discharge background surface water were very low to undetectable, except in the stream directly south of the percolation beds (i.e., sampling sites SW-17 and SW-18). This stream appears to receive a mixture of both natural surface water flow from the wetland and surface discharge from the percolation beds and has elevated nitrate levels year-round. During initial discharge nitrate levels in the effluent were approximately 30-35 milligram per liter (mg/L) with low levels of ammonia.

Low levels of background nitrates and high levels of nitrates in the effluent resulted in the ability for field testing of nitrates to allow for “real time” tracking of the effluent migration through the wetland. In addition to nitrate testing, patters of surface inundation were visually observed as another means to track effluent flow.

During the initial weeks of discharge a high priority was placed on confirming effluent discharge remained on COW property and did not flow offsite to the west. On July 1, Diffuser #3 was closed because westerly flow and associated increased nitrate levels (less than1.0 mg/L) in the surface water along the containment berm. Closing Diffuser #3 mitigated the flow of effluent to the west. Diffuser #1 has remained open and has been steadily discharging approximately 80gpm (115,000 gpd) since July 1, 2019. Flow appears to be predominately south.

FOURTH QUARTER 2019 PRELIMINARY RESULTS

The Pilot Study collects a number of water quality parameters; however, the parameters of particular concern are nitrate/ammonia and fecal bacteria which are examined in this report. Data collection has been ongoing since July 2017; however, this report only addresses the results from fourth quarter 2019.

Monthly surface water sampling continued in October, November, and December at both the regular, fixed permanent sampling locations and at various random locations along the berm and adjacent areas. Collected data includes results from the standard suite of samples submitted to SGS North American Inc. (SGS) as a contracted laboratory and field testing for nitrate levels using a Hach DR/890 portable colorimeter. In addition, quarterly subsurface water sampling at monitoring wells was conducted as scheduled in December. The following sections summarize the results from 2019 fourth quarter water quality testing.

NITRATE/AMMONIA

In October the wetland was ice free, but much of the herbaceous vegetation had died. Nitrification of ammonia was still taking place in the lagoon treatment process, so nitrate was still abundant in the neat effluent (approx. 30 mg/L). All eighteen permanent sampling locations and the Shaw property were sampled for multiple parameters including nitrate and ammonia and analyzed by SGS.

Nitrate levels were detected at or above 1 mg/L at SW-2, SW-3, SW-6, SW-9, SW-17 and SW-18, see Table 1 for values. Nitrates were detected along the east, COW-side, of the berm, but not the west, including SW-1 or the Shaw sampling site. This pattern of nitrate detections indicates that in October the effluent had a broad front relative to the point of discharge, extending from the berm to the west and SW-3 to the east (and likely further east). Given the higher concentration of nitrate at SW-3, this is likely within the main flow path. After SW-3 the effluent appears to stay generally centered in the wetlands flowing through SW-6 with nitrates now extending somewhat further south than recorded earlier during the summer, with nitrates now generally terminating at SW-9. Note that nitrate levels are not elevated at SW-4 nor SW-7, approximately 200 feet either side of SW-6. For comparison, in September when the vegetation was still active, the nitrates largely terminated at SW-6, which is approximately 400ft up-gradient of SW-9.

Nitrate detections at SW-17 and SW-18 are consistent with background results. Given the clear gap in nitrate detections between SW-9 and SW-17, the presence of nitrates in SW-17 and SW-18 are not the result of the Pilot Study discharge to the wetland.

In November thin ice (less than 3 inches) had formed over much of the open water, with several inches of snow. Due to the thin ice SW-7,10-13, and 16 were not accessible. A cordless drill was used to gain access to water, at the remaining sites. Nitrification efficiency in the treatment process had declined such that there were near equal concentrations of nitrate and ammonia in the effluent, approximately 15mg/L each. Nonetheless the pattern of nitrate detections above 1mg/L was the same as in October. Nitrate levels were detected at or above 1mg/L at SW-2, SW-3, SW-6, SW-9, SW-17, and SW-18, see Table 1 for values. Nitrates were again detected along the east, COW-side, of the berm, but not the west, including SW-1 or the Shaw sampling site. Ammonia concentrations were less than 1 mg/L, where detected. Nitrate

Reference: **Wasilla WWTP Effluent Discharge Pilot Study 2019 Q4 Report**

detections at SW-17 and SW-18 were very similar to October. Presumption is that nitrates are starting to accumulate in the wetlands by November, but have not crossed the berm.

In December ice thickness had reached 6 inches or more for any exposed surface water. Natural upwelling of groundwater onto the ice was common throughout the wetland. Overflow onto the ice on or adjacent to the berm was also evident, some of which appeared to be from groundwater although there is the potential it was from effluent flow. Nitrification in the treatment process had largely ceased with nitrate being undetectable in the effluent while the ammonia concentration was 30 mg/L. Because there was no nitrate in the neat effluent, field sampling for nitrates was not conducted. Instead, samples for surface and subsurface water samples, as well as free water on both sides of the berm, were sent to SGS for ammonia analysis. In December, only SW-3, 5, 9, 15, 17, and 18 were sampled because the ice made free water inaccessible elsewhere. Ammonia was detected at SW-3, with detections well below 1.0 mg/L at all other permanent locations sampled. However, ammonia concentrations around 2 mg/L were detected in water along the berm.

Observation of the effluent discharge point indicate that the majority of effluent flow was continuing under the ice, as there was only minor backup and ice formation resulting in a small surcharging (several inches) of effluent around the discharge diffuser. Flow is assumed to emanate from the buried rock diffuser, as flow was not observed over the ice surface. We cannot easily determine the under-ice flow path of the effluent, but it appears some effluent was flowing towards the berm at the December sampling event. Further sampling is necessary to determine the full extent of the flow to the west.

Quarterly groundwater sampling in December found low concentrations of nitrates and ammonia in monitoring wells MW-10, MW-15, B4, and B11. No detections were found in other wells. The low levels of nitrates and ammonia are similar to background levels.

Table 1: 4th Quarter Nitrate Detections above 1 mg/L

Sample Event	Effluent at Discharge Manhole	SW2	SW3	SW6	SW9	SW17	SW18
October (n=19)	~30 mg/L	12.6 mg/L	23.9 mg/L	8.05 mg/L	0.98 mg/L	3.07 mg/L	5.08 mg/L
November (n=13)	12.8 mg/L	12.5 mg/L	17.2 mg/L	11.5 mg/L	2.76 mg/L	3.45 mg/L	5.56 mg/L
December (n=6)	ND	-	ND	-	0.231 mg/L	4.79 mg/L	5.87 mg/L

Note:

1. N value listed represents the number of samples.
2. Nitrate analysis completed by SGS using Method SM21 4500NO3-F or EPA 300.0.
3. WWTP permitted for nitrate to 10 mg/L in groundwater. Treatment goal in surface water for Pilot Study has been set at 10 mg/L at property line in keeping with Alaska water quality criteria 18 AAC 80.300(b).

Reference: **Wasilla WWTP Effluent Discharge Pilot Study 2019 Q4 Report**

FECAL BACTERIA

Fecal coliform (FC), *E. coli* and total coliform (TC) levels were determined at surface water collection sites through EPA approved laboratory culture methods by SGS. Wetland background results prior to effluent application found that fecal bacteria were common throughout the wetland, with peak concentrations during the warmest months (July and August), presumably from wildlife (e.g. moose and rodents). Typical background levels of fecal bacteria are dozens of colonies per 100 mL, with occasional levels of hundreds of colonies per 100mL. In contrast the neat effluent typically has many thousands of colonies to tens of thousands of colonies per 100mL. During the fourth quarter sampling roughly half the sampling sites had detectable levels of fecal bacteria. However, fecal bacteria levels were low, a dozen colonies per 100mL or less, and declined in each successive month with declining water temperatures and decreasing pH (see table for summary). For comparison, the effluent in December contained over thirty-six thousand colonies per 100mL. Even at SW-3, the sampling location closest to the effluent discharge, had just fifteen fecal coliform colonies per 100mL. These results support the conclusion that fecal bacteria in the effluent are removed and/or die within a few hundred feet of discharge.

Table 2: 4th Quarter 2019 Fecal Coliform and E. Coli Result Summary

Sample Event	Mean Water Temp °C	Mean pH	Mean FC (col/100mL)	Mean FC % Detect	*Mean E. coli* (MPN/100mL)	*Mean E. coli* % Detect	Mean TC (MPN/100mL)
October (n=19)	4.1	6.2	10	53	12	68	390
November (n=13)	0.75	5.61	7	54	9	54	227
December (n=6)	0.15	5.56	3	67	3	71	135

Note:

4. Temperature and pH are provided as arithmetic means. Other values are geometric means.
5. N value listed represents the number of samples.

BERM STATUS

An earthen containment berm constructed in the northwest corner of the COW property was provided as a protective measure to prevent flow offsite to the west. The berm is constructed from gravel fill placed on a geotextile mat on top of the natural wetland soils. While it was expected the berm would sink into the ground as the wetlands soil compressed and subsided, this occurred to a greater degree than anticipated, to the point the top of the berm became inundated with surface water prior to the start of discharge.

Reference: Wasilla WWTP Effluent Discharge Pilot Study 2019 Q4 Report

Despite additional efforts to raise the berm with additional fill, the berm continues to subside, and the center section remains under water. Furthermore, at least some volume of effluent has flowed into the standing surface water around the berm. However, as of December, there is no conclusive evidence that the effluent discharge has impacted water quality to the west of the berm or off COW property. Monitoring of the water quality around the berm, particularly to the west, remains a high priority of this study.

Current plans are to add additional fill to the berm this winter, so we suggest any increase in discharge rate wait until spring of 2020. (Additional fill was added to the berm in March of 2020 raising the berm roughly 3 feet above surrounding water level).

DIFFUSER

As of December, effluent continues to only be discharged from Diffuser #1. Daily observations of the diffuser are made by facility staff to ensure its continued flow in cold conditions, to monitor the formation of ice, and to look for excessive overflow, if any, to the berm.

Throughout the fourth quarter the diffuser functioned as designed, even after the formation of ice across most of the wetland. It appears the effluent remains unfrozen on the surface for approximately 50 to 75 feet before it begins to flow under the ice. Significant effluent backflow and effluent ice formation have not occurred.

CONCLUSION

In general, the wetland appears to be doing a satisfactory job of the polishing treatment of the WWTP effluent. Despite surface ice formation across the wetland, effluent continues to flow through the vegetative layers, without glaciation or buildup of ice.

Nitrates are removed within property limits and fecal coliform levels are not distinguishable from pre-discharge background levels. As of December, nitrification in the WWTP treatment process has ceased and ammonia is now the dominant form of nitrogen. Ammonia levels show a similar pattern of effluent distribution to that of the nitrates during the fourth quarter.

Based on results as of December, it appears the wetland has capacity to accept effluent through at least the first half of winter. As of December, we recommend continuation of the Pilot Study. Until the containment berm is reinforced, we do not recommend increasing the discharge rate.

ERRATA - 1ST QUARTER 2020 LOOK AHEAD

Discharge continued into 2020, with regular monthly monitoring and sampling events. During the sampling event on February 27, ammonia was found in the surface water immediately to the west side of the depressed berm at a concentration of 36.3 mg/L suggesting that the effluent discharge plume was starting to cross the berm and flow west. Examination of surface ice conditions suggested that winter surface freeze had finally progressed to the point flow to south was being slowed, resulting in a surcharge of several inches of liquid height at the discharge. The surcharge was enough to increase spread of effluent plume further to east and west than previously observed, sending a small portion of the discharge across the sunken portion of the separation berm.

Reference: Wasilla WWTP Effluent Discharge Pilot Study 2019 Q4 Report

On March 3, ammonia was detected at SW1 at a concentration of 1.57 mg/L. SW1 is approximately 70 feet from the COW property line. No elevated ammonia concentrations were found off COW property or at the Shaw sample location to date.

The pilot study discharge was temporarily suspended on March 5. Discharge will resume in April or May at a time to be determined based on surface thaw.

The 1st quarter 2020 discharge report is being prepared now; the 1st quarter report will provide detailed findings and elaborate on the discharge termination.

Also, in March, additional fill has been placed on the separation berm, raising it approximately three feet above surrounding grade. It is expected this will settle once surface ice melts. Final height of berm will be examined in May or June.

City of Wasilla and Stantec have begun looking at construction of two additional discharge diffusers further to the east to address any tendency for late winter discharge to migrate westerly.

Thank you,

Stantec Consulting Services Inc.

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Attachment: Appendices
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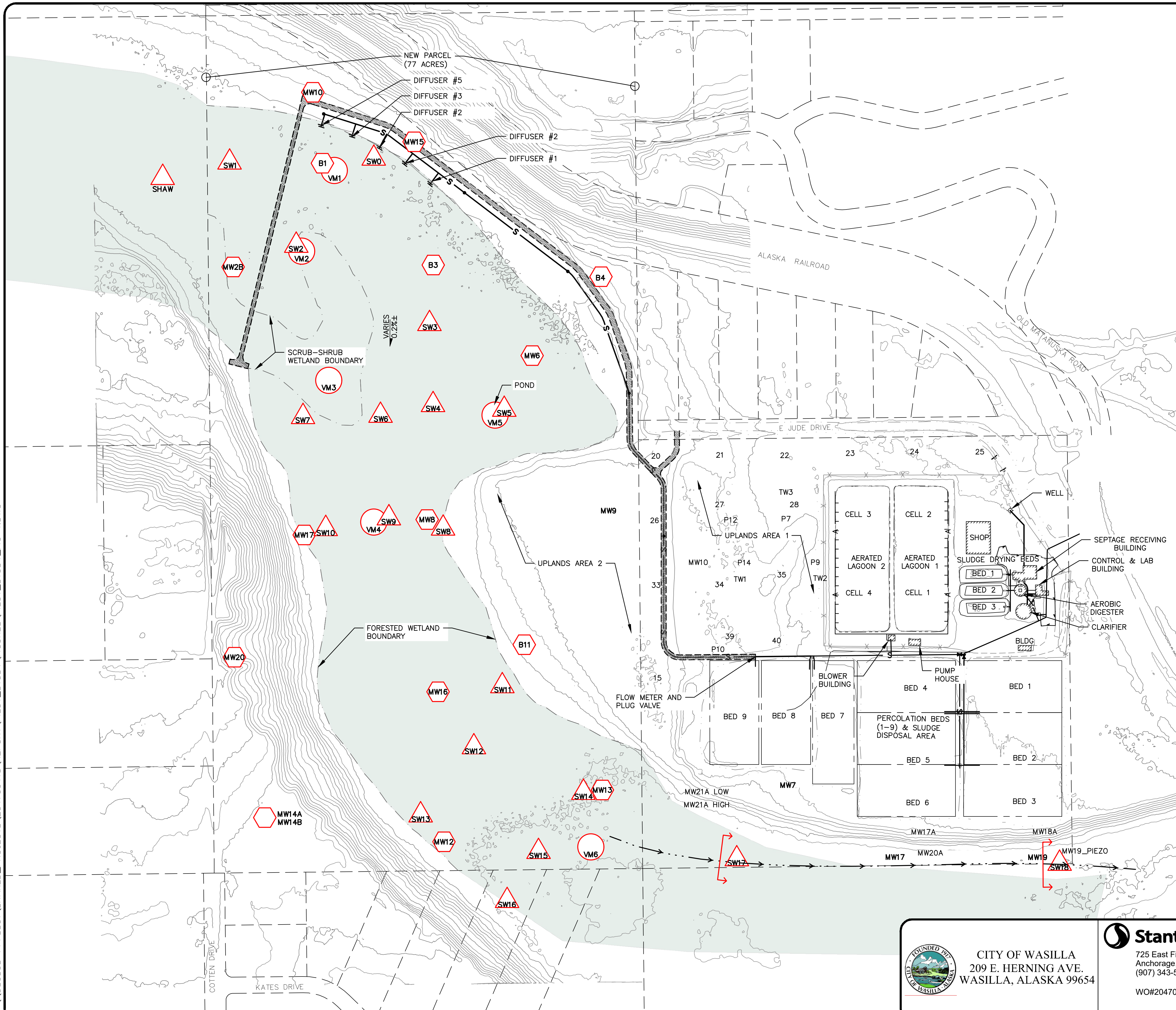
APPENDIX A

Site Plan



LEGEND

- APPROXIMATE STREAM CHANNEL
- PARCEL BOUNDARY
- WETLANDS
- SW5 — SURFACE WATER SAMPLING SITE
- MW6 B5 — SUBSURFACE WATER SAMPLING SITE
- VM5 — VEGETATION MONITORING SITE
- STREAM GAGING STATION

NOTES:

1. CONTOURS SHOWN ARE PRIMARILY BASED ON 2001 MSB LIDAR DATA WITH SUPPLEMENTAL SURVEY DATA. CONTOURS WITHIN WETLANDS HAVE BEEN ESTIMATED.
2. SURFACE WATER, SUBSURFACE WATER, AND VEGETATION SAMPLING LOCATIONS WERE COLLECTED WITH A HANDHELD GPS.
3. ALL EXISTING WWTP MONITORING WELLS ARE SHOWN ON THIS FIGURE. ONLY MONITORING WELLS BEING USED AS PART OF THIS PROJECT ARE SHOWN WITH HEXAGON LABEL.

CITY OF WASILLA
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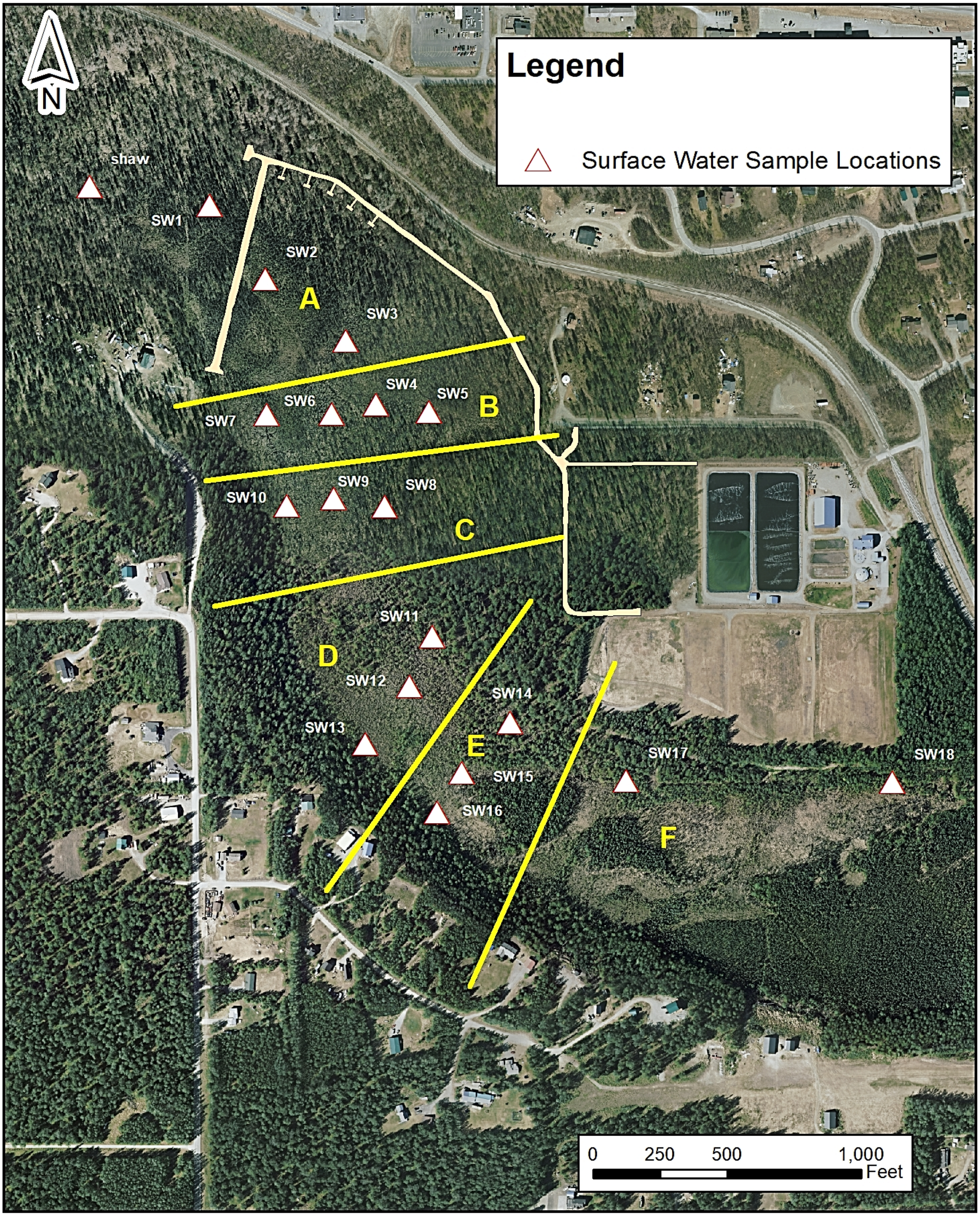
CITY OF WASILLA
WASTEWATER OUTFALL PILOT STUDY

SAMPLING SITES

DATE	FIGURE
06/06/18	1

APPENDIX B

Data Summaries



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CITY OF WASILLA
WASTE WATER OUTFALL FEASIBILITY STUDY

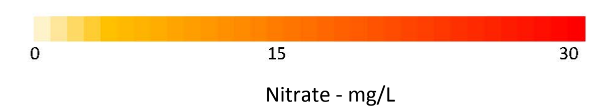
Pilot Study - Surface Water Groups

DATE	FIGURE
2019	

Nitrate - mg/L																															
Sample Location		Pre-discharge																								Post-discharge					
Sample Month		Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
A	SHAW	-	-	-	-	-	-	-	-	-	-	-	0	-	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	0	-
	SW1	0	0	0	0	0	-	-	-	-	0	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	0	-
	SW2	0	0	0	0	0	-	-	-	-	0	0	0	0	0	0	0	-	-	-	-	-	0	0	-	0	0	2.38	12.6	12.5	-
	SW3	0	0	0	0	0	-	-	-	-	-	0	0	0	0	0	0	-	-	-	-	-	0	0	0	4.39	9.6	13.3	24.1	17.2	0
B	SW4	0	0	0	0	0	-	-	-	-	0	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	2.585	-
	SW5	0	0	0	0	0	0.04	0.06	0	-	0	0	0	0	0	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0
	SW6	-	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0	0	0	8.17	11.5	-
	SW7	-	0	0	0	-	-	-	-	-	-	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	-	-
C	SW8	-	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	0	-
	SW9	0	0	0	0	0	-	-	-	-	0	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0	0	0	1.01	2.76	0.231
	SW10	-	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	-	-
D	SW11	-	0	0	0	-	-	-	-	-	-	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	-	-
	SW12	-	0	0	0	0	-	-	-	-	0	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	-	-
	SW13	-	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	-	-
E	SW14	0	0	0	0.34	-	-	-	-	-	-	0.63	0	0	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	0.597	-
	SW15	0	0	0	0	0	0.07	0.06	-	-	0	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	0	0
	SW16	-	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0	0	0	0	-	-
F	SW17	-	2.18	2.22	1.95	4.79	3.19	2.92	2.96	2.4	1.07	1.16	1.07	1.48	1.49	2.23	1.6	3.41	3.26	3.08	2.68	1.3	1.44	1.16	1.5	2.25	3.32	2.43	3.08	3.45	4.79
	SW18	-	4.88	4.68	3.79	7.44	5.02	3.92	4	1.51	1.74	2.54	8.25	6.08	5.62	5.21	7.08	7.85	3.34	3.28	3.04	2.2	2.47	2.23	4.17	3.54	4.13	3.26	5.82	5.56	5.87

Note:

1. Blank (-) values indicate lack of liquid water for sampling.
2. Group E and F associated with WWTP seepage, not effluent discharge.



Fecal Coliform (FC) - col/100mL

Sample Location		Pre-discharge																								Post-discharge					
Sample Month		Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
A	**SHAW**	-	-	-	-	-	-	-	-	-	-	-	3.3	0	72	12	0	-	-	-	-	-	0	3	5	1030	36	4	0	6.7	-
	SW1	4	1110	0	0	0	-	-	-	-	0	7	0	36	39	2	1	-	-	-	-	-	0	1	2	0	17	8.3	0	0	-
	SW2	20	10	0	320	0	-	-	-	-	2	1	0	40	6	1	0	-	-	-	-	-	0	3	-	6.6	50	46	6.7	76	-
	SW3	3	30	0	90	0	-	-	-	-	-	0	0	24	13	9	37	-	-	-	-	-	0	1	-	16	0	2421	4.9	15	15
B	**SW4**	1	10	0	0	0	-	-	-	-	7	0	2	9	20	11	-	-	-	-	-	-	0	0	0	94	0	20	1.7	0	-
	SW5	720	18	0	164	0	0	1	0	-	5	0	17	83	38	26	36	1	0	0	0	-	1	0	0	21	66	20	0	0	1.7
	SW6	-	2	0	8	-	-	-	-	-	6	0	0	30	21	10	-	-	-	-	-	-	0	1	1	78	20	10	5	1.7	-
	SW7	-	5	3	280	-	-	-	-	-	-	0	0	6670	14	51	10	-	-	-	-	-	0	11	1	40	10	560	38	-	-
C	**SW8**	-	0	0	181	-	-	-	-	-	10	0	0	21	0	0	1	-	-	-	-	-	0	0	1	4.9	120	10	0	0	-
	SW9	3	5	1	12	0	-	-	-	-	92	0	0	85	2	1	0	-	-	-	-	-	1	1	5	64	12	2	0	1.7	0
	SW10	-	16	14	3	-	-	-	-	-	0	0	0	58	390	10	2	-	-	-	-	-	0	0	17	3.3	40	0	0	-	-
D	**SW11**	-	0	0	0	-	-	-	-	-	-	0	0	0	1	14	0	-	-	-	-	-	0	0	0	290	155	4	0	-	-
	SW12	-	330	3	23	217	-	-	-	-	13	3	0	270	27	86	2	-	-	-	-	-	0	1	1	27	100	10	13	-	-
	SW13	-	160	7	13	-	-	-	-	-	1	0	0	93	2	0	77	-	-	-	-	-	0	0	340	310	55	6	0	-	-
E	**SW14**	1	280	11	4	-	-	-	-	-	-	1	0	4	0	0	17	-	-	-	-	-	0	0	30	210	9.1	10	0	0	-
	SW15	112	160	4	40	9	24	3	-	-	6	0	8	36	42	2	360	-	-	-	-	-	1	0	13	727	0	2	3.3	10	0
	SW16	-	0	0	8	-	-	-	-	-	11	0	7	800	20	0	0	-	-	-	-	-	1	0	260	55	0	0	3.3	-	-
F	**SW17**	-	120	18	79	5	1420	0	3	0	11	0	109	55	12	17	69	10	0	1	1	31	0	0	110	1540	153	70	22	3.3	3.3
	SW18	-	55	2	23	7	430	1	2	0	4	2	460	29	10	8	30	0	2	0	1	8	2	6	120	1020	96	10	109	0	1.7

Note:

1. Blank (-) values indicate lack of liquid water for sampling.
2. Group E and F associated with WWTP seepage, not effluent discharge.