2023 Annual Wastewater Treatment Plant Report

Resort Municipality of Whistler Wastewater Treatment Plant

Operational Certificate ME-01452

WHISTLER

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1.0 INTRODUCTION

Per section 3.6 Reporting of the Operation Certificate ME-01452 for the Resort Municipality of Whistler's (RMOW) Waste Water Treatment Plant (WWTP), the intent of this document is to report discharge and receiving environment data for the operating period. The report includes trend analysis data and interpretation from the receiving environment for the reported operating year and in comparison, to previous years, in regards to the potential impact to the receiving environment. The report will also outline the past years achievement in regards to source control, water conservation programs, and environmental impact programs.

2.0 MONITORING AND REPORTING REQUIREMENTS

Per section 3.0 (Monitoring and Reporting Requirements) of the operational certificate, monitoring samples are taken by staff and collected for the WWTP to monitor discharge, receiving environment outfall and trucked waste.

Table 1 below highlights the samples taken and their frequency.

Table 1: Discharge Monitoring Sampling Parameters

Parameter	Unit of measure	Frequency	Sample Type
Chlorine residual *	mg/L	Daily	Grab
TSS	mg/L	5 times per week	Composite
Orthophosphate (as phosphorus)	mg/L	5 times per week	Composite
CBOD5**	mg/L	2 times per week	Composite
Fecal Coliform*	MPN/100mL	2 times per week	Grab
Total phosphorus	mg/L	Weekly	Composite
Iron	mg/L	Monthly	Composite
Fish Bioassay (rainbow trout) 96 hour LC50, %	% survival rate	2 times per year	Grab
Effluent volume discharge	m_3/day	1 per day over a 24 period	Composite

*if chlorine is used between May 15 and September 15 only

**COD may be used in place of $CBOD_5$ if $CBOD_5$ is examined with every 5^{th} sample

Table 2 highlights the sampling parameter requirements for the receiving environment.

Table 2: Receiving Environment Monitoring Sampling Parameters

Parameter	Unit of measure	Sample Type	Frequency
pH	-	3 times per year; winter low flow, spring freshet & fall flow	Grab
Conductivity	µmho/cm	3 times per year; winter low flow, spring freshet & fall flow	Grab
Turbidity	TU	3 times per year; winter low flow, spring freshet & fall flow	Grab
Orthophosphate (as phosphorus)	mg/L	3 times per year; winter low flow, spring freshet & fall flow	Grab
Nitrate nitrogen	mg/L	3 times per year; winter low flow, spring freshet & fall flow	Grab
Nitrite nitrogen	mg/L	3 times per year; winter low flow, spring freshet & fall flow	Grab
Ammonia nitrogen	mg/L	3 times per year; winter low flow, spring freshet & fall flow	Grab
Nitrate+Nitrite as N	mg/L	3 times per year; winter low flow, spring freshet & fall flow	Grab

Permit Excursions

The WWTP tracks and monitors the number of permit excursions that occur during the reporting period (Figure 1). For the reporting period three (3) permit excursions were recorded per sections 1.1.2 Characteristics for Discharge of Orthophosphate (as phosphorus) 1.75 mg/L, 1.1.3 Nutrient loading for discharge from May 15–September 15 inclusive of Orthophosphate (as phosphorus) 36.6 kg/month maximum and 2.9 Disinfection. The excursions are discussed further below. The Notices of Non-Compliance are attached in Appendix A.

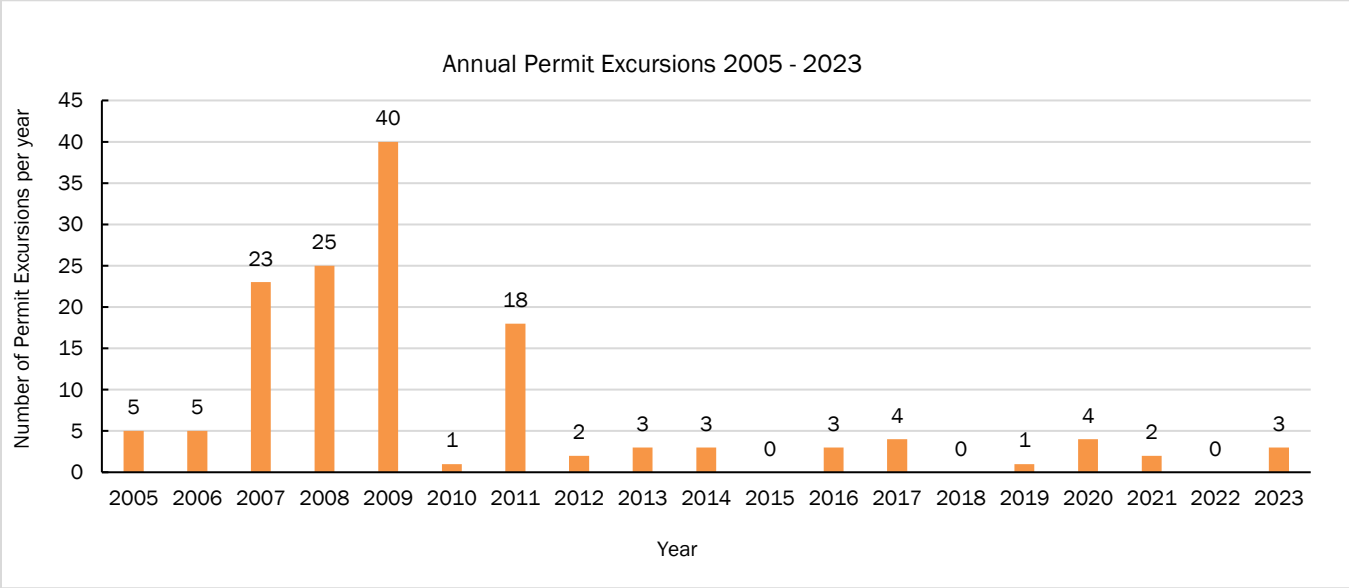


Figure 1: Number of Permit Excursions per Year 2005-2023

Outfall Inspections

Section 3.4 of the Operational Certificate requires the outfall to be inspected once every five years by independent qualified personnel to ensure that it is in good condition. As per the recommendation of the outfall inspection in 2018, regular shrub vegetation cutback has been performed as a preventative maintenance program for the outfall.

The last outfall inspection was conducted by Cascade Environmental Resource Group on May 15,2023. The WWTP outfall was visually inspected and was reported to be in "good condition". For additional details related to the 2023 outfall inspection, please refer to the report in Appendix B.

The next outfall inspection will be in the fall of 2028.

Website

Quarterly reports of WWTP monitoring data are posted on an ongoing basis to the Resort Municipality of Whistler's website, available at the following link:

https://www.whistler.ca/services/water-and-wastewater/wastewater-treatment-plant.

Facility Staffing

The RMOW WWTP facility staff qualifications met EOCP requirements (Table 3) for the report period.

Table 3: WWTP Facility Staffing List and Certifications

Name	Position	Certification
Chris Wike	Utilities Group Manager	
Wayne Dennien	Utilities Superintendent	Red Seal Certified Electrician, Instrument Tech.
Blake Carter	Supervisor - Wastewater	Red Seal Certified Electrician (from January 2024)
Ahren Snikvalds	Chief Operator Wastewater	EOCP Level II Municipal Wastewater Treatment EOCP Level I Municipal Wastewater Collection
Elizabeth Toole	Wastewater Operator IV	EOCP Level IV Municipal Wastewater Treatment
Hanna Burton	Wastewater Operator III	EOCP Level III Municipal Wastewater Treatment (from March 2024)
Eric Verreault	Operator III	EOCP Level II Municipal Wastewater Treatment
Kyle Quesnel	Operator II	EOCP Level II Municipal Wastewater Treatment EOCP Level I Municipal Wastewater Collection
Graham Cofell	Operator I	EOCP Level I Municipal Wastewater Treatment EOCP Level I Municipal Wastewater Collection
Trent Skatch	Operator I	EOCP Level II Municipal Wastewater Collection
Sean Weiss	Operator I	EOCP Level I Municipal Wastewater Treatment EOCP Level I Municipal Wastewater Collection
Neil Kearns	Lab Technician	EOCP Level II Municipal Wastewater Treatment
Bruce Eckersley	Millwright	Red Seal Certified Millwright

Other Achievements

During the report period, no volume of effluent bypassed the WWTP as the raw sewage bypass line had been removed in 2010. Further to this, the operation had no emergency shut downs and zero (0) trucks were turned away due to hazardous waste.

Waste heat from the final effluent treated by the WWTP is captured to produce heat for the RMOW's District Energy System. This system provides a low carbon heat source for space heating and/or domestic hot water heating for the residents and businesses of the Cheakamus Crossing neighborhood of the RMOW. In 2023 this system was expanded into the new Phase 2 of the development that will provide heat for domestic hot water for ~24,000 square meters of additional multi-family apartment and condominium units designed to house ~ 900 people.

3.0 DISCHARGE DISCUSSION AND ANALYSIS

Discharge Volume

The year is split into two seasons for purposes of reporting discharge. The dry season runs from May 15 – September 15 (inclusive), while the wet season is defined as January 1 – May 14 and September 16 – December 31.

Maximum allowable discharge during the dry season is 16,000 m^3/day while the maximum allowable discharge during the wet season is 25,000 m^3/day.

The average discharge during the dry season was 8,825 m^3/day and the average discharge during the wet season was 10,152 m^3/day.

The effluent discharge limit was not reached at any point in the 2023 reporting period, as shown below in Figure 2.

The wastewater treatment plant data is presented in Appendix C.

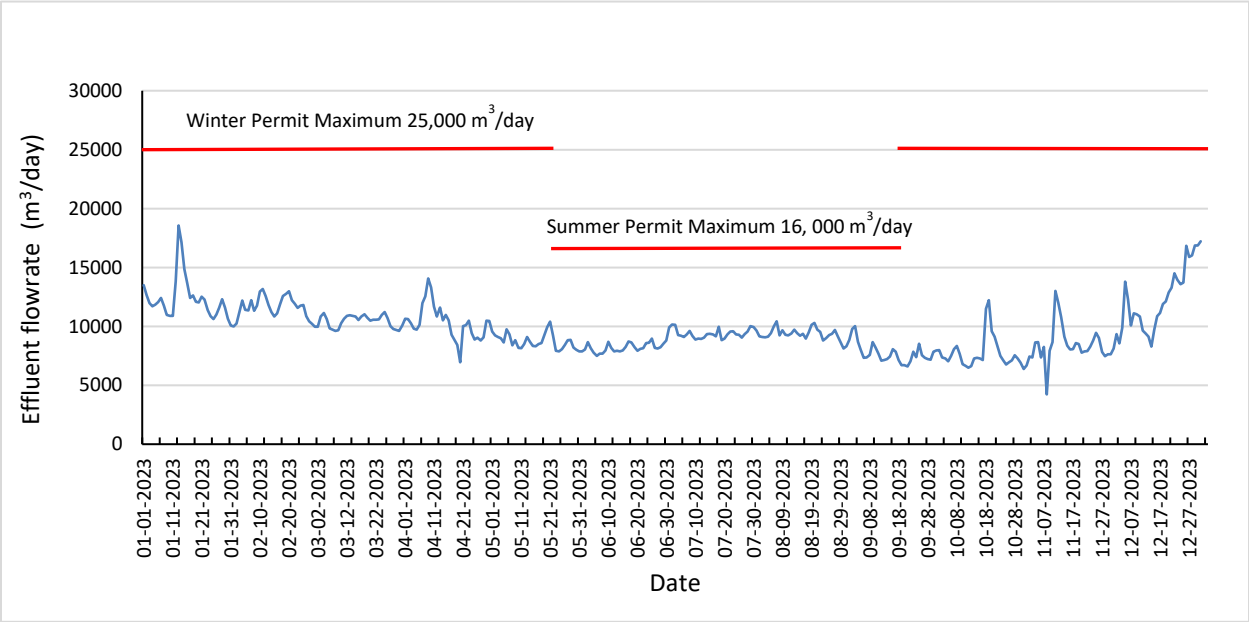


Figure 2: Whistler Wastewater Treatment Plant Daily Effluent Discharge Volume (m^3/day)

Table 4: Average and Maximum Daily Discharge (m^3) Wet and Dry Values by Year since 2004

Year	Max Discharge Dry	Max Discharge Wet	Month Max Discharge Dry	Month Max Discharge Wet
2004	10,160	14,681	August	January
2005	12,238	13,720	August	December
2005	11,402	17,174	July	January
2006	13,742	19,731	July	December
2007	13,991	24,247	August	March
2008	12,891	17,568	August	December
2009	11,623	17,859	June	April
2010	12,891	22,855	August	January
2011	12,153	19,472	July	January
2012	13,397	20,575	June	January
2013	12,525	19,351	June	March
2014	11,646	25,070	August	December
2015	11,447	25,019	August	February
2016	12,119	21,284	August	February
2017	11,670	19,852	July	March
2018	11,395	16,927	August	December
2019	11,535	15,670	June	March
2020	10,780	26,793	August	February
2021	12,913	29,686	July	November
2022	11,520	18,215	June	December
2023	10,431	18,561	July	December

Orthophosphate as Phosphorus P04-P

Orthophosphate as Phosphorous P04-P concentration is permitted in discharge to a maximum of 1.75mg/L.

This was exceeded once on June 19th, 2023, with a value of 1.80 mg P04-P/L, as shown in Figure 3

Figure 4 shows the final effluent total for the dry season on a monthly basis (the dry season defined as May 15 – September 15 inclusive). The total nutrient loading maximum for the discharge is 36.6 kg/month. The total nutrient loading maximum for the discharge is 36.6 kg/month. This was exceeded once in 2023:

- July 15 – August 14: Exceeded by 16.9 kg for a total sum of 53.5 kg.

These environmental non-compliances were reported to the Ministry of Environment, and are attached in Appendix A.

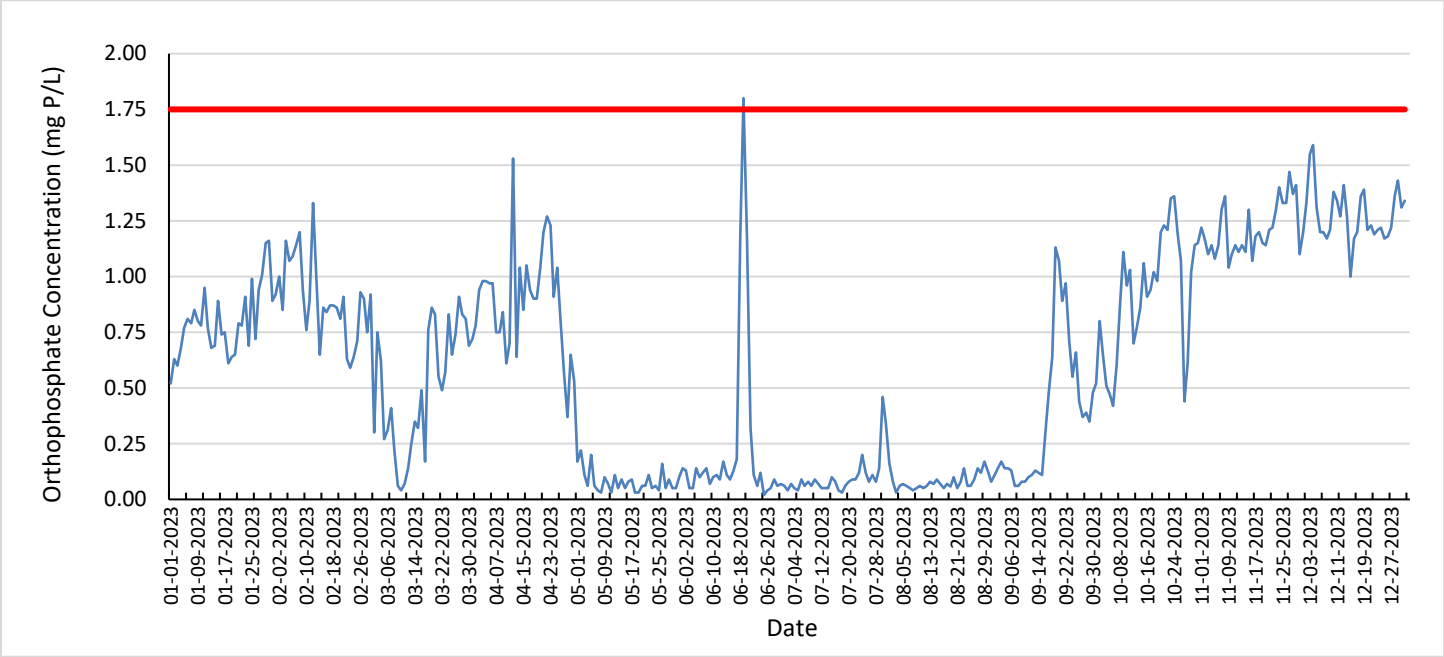


Figure 3: Final Effluent Daily Orthophosphate (PO4-P) Concentrations (mg/L)

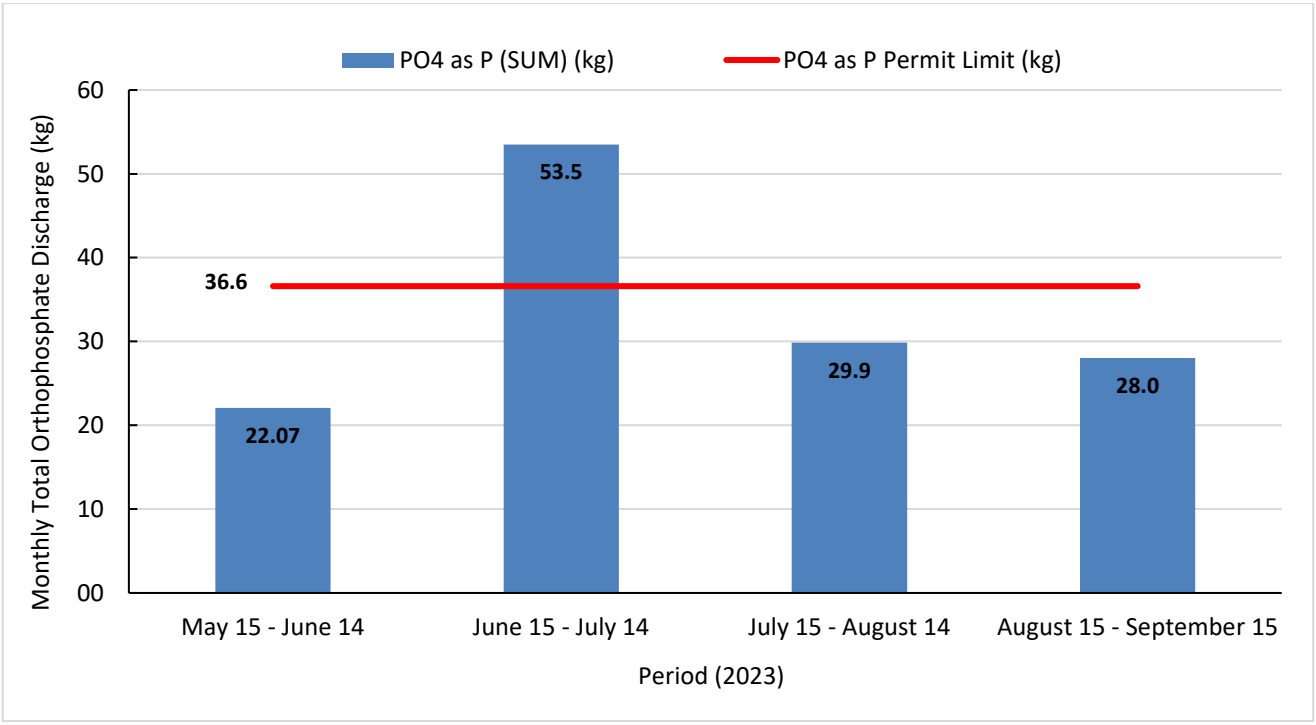


Figure 4: Final Effluent Monthly Orthophosphate (PO4-P) Discharge (kg) - May 15 - September 15, 2023

Total Phosphorus – Laboratory Results

Weekly final effluent samples are submitted to a certified laboratory for total phosphorous concentration analysis.

Figure 5 shows the laboratory results of the total phosphorus in the final effluent.

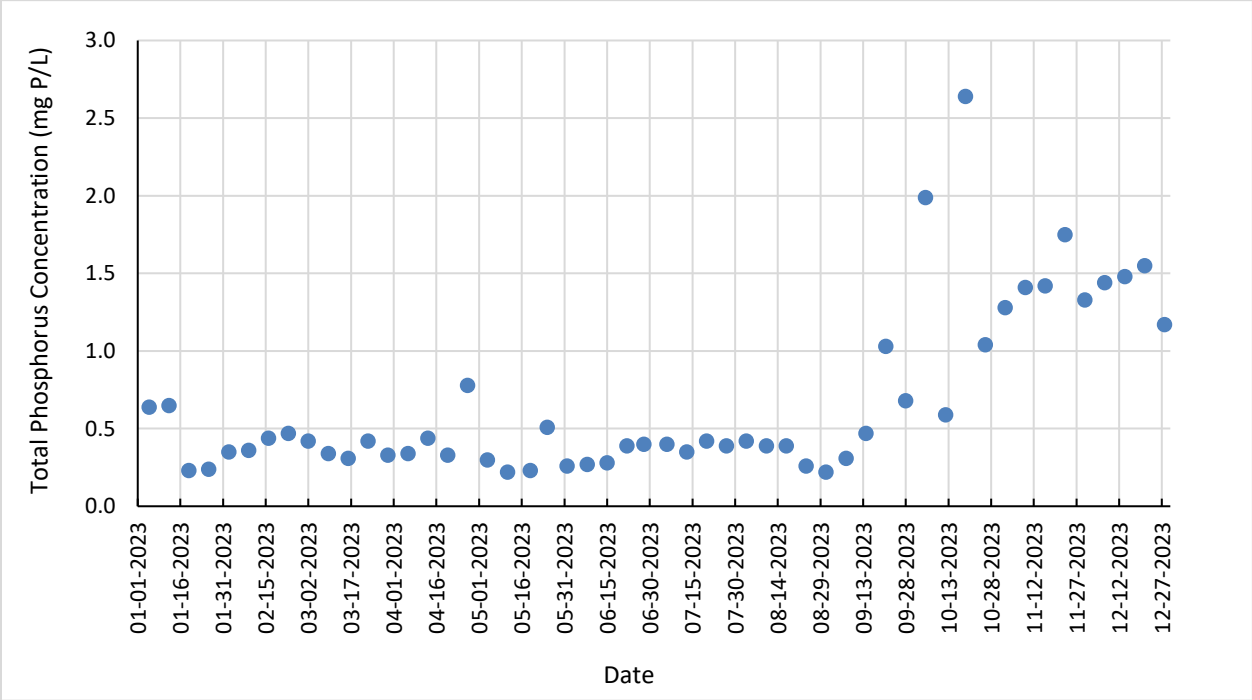


Figure 5: Final Effluent Total Phosphorous Concentration (mg/L) Weekly Laboratory Sampling Analysis

Total Suspended Solids

Total suspended solids is monitored and reported daily. As per Section 1.1.2 of the Operational Certificate, the maximum limit is 40 mg/L.

In 2023, the Total Suspended Solids (TSS) concentration did not exceed the permitted level, as highlighted in Figure 6. TSS concentrations of 25 to 38 mg/L were observed between April 10th and May 20th, 2023.

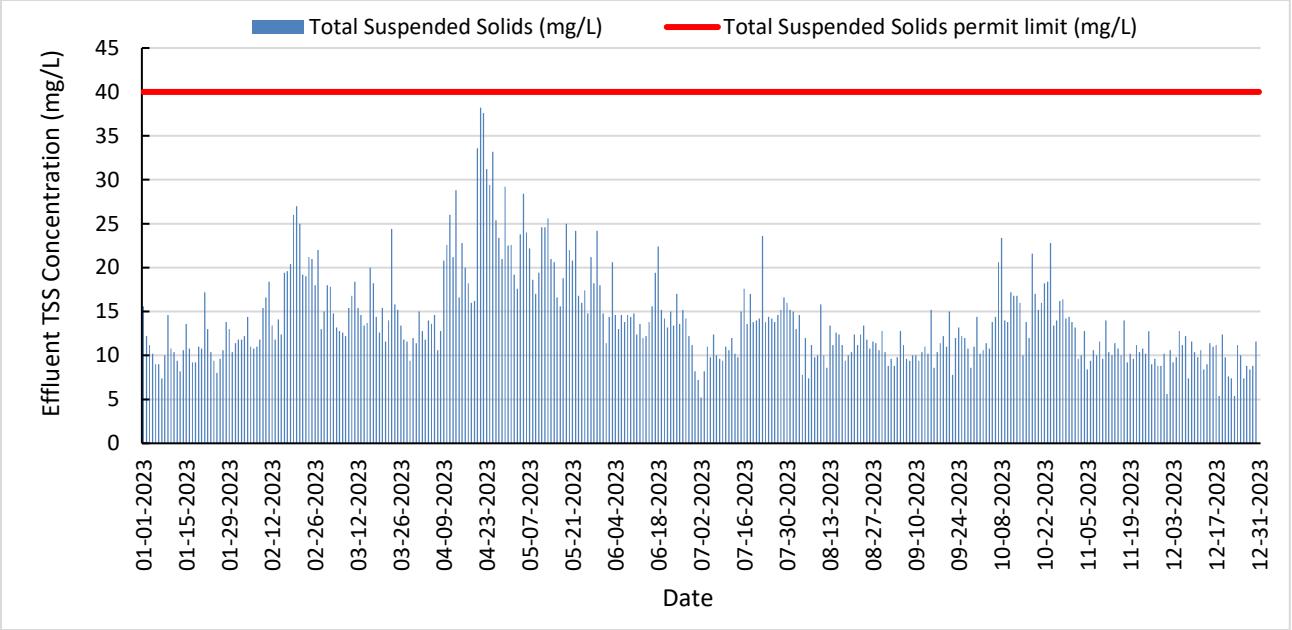


Figure 6: Daily Total Suspended Solids (mg/L) 2023

Figure 7 highlights the average Total Suspended Solids concentration, year on year, from 2005 to 2023. The average TSS for 2023 was 14 mg/L.

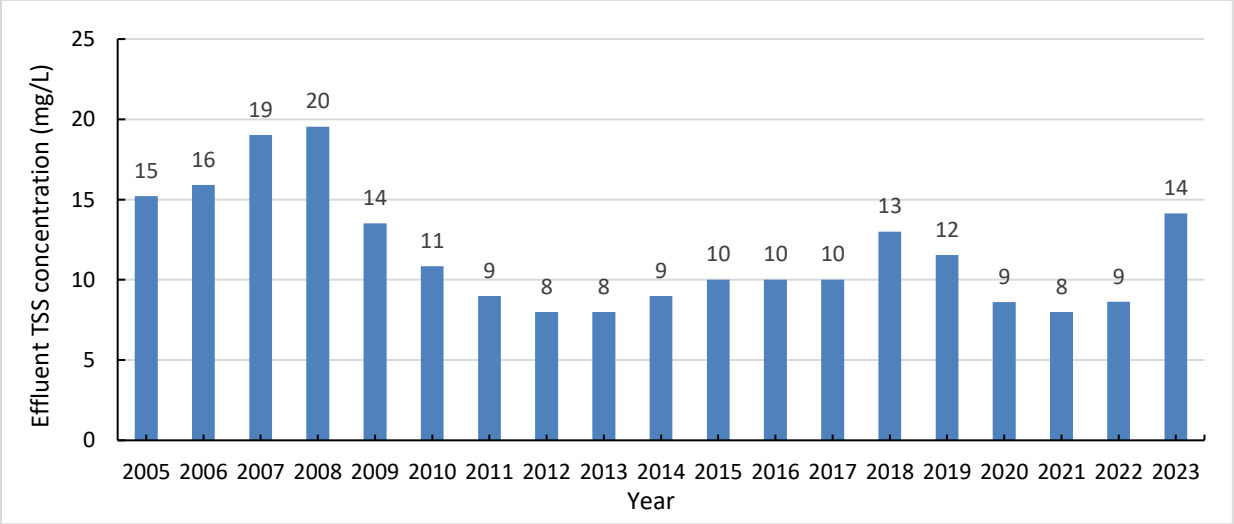


Figure 7: Annual Average Suspended Solids (mg/L) 2005 - 2023

Carbonaceous Biochemical Oxygen Demand (BOD)

As per section 1.1.2, the maximum Carbonaceous BOD limit is 30 mg/L per day for the reporting period.

In 2023 the Carbonaceous BOD concentration did not exceed the permitted level, as highlighted in Figure 8 by the weekly laboratory results.

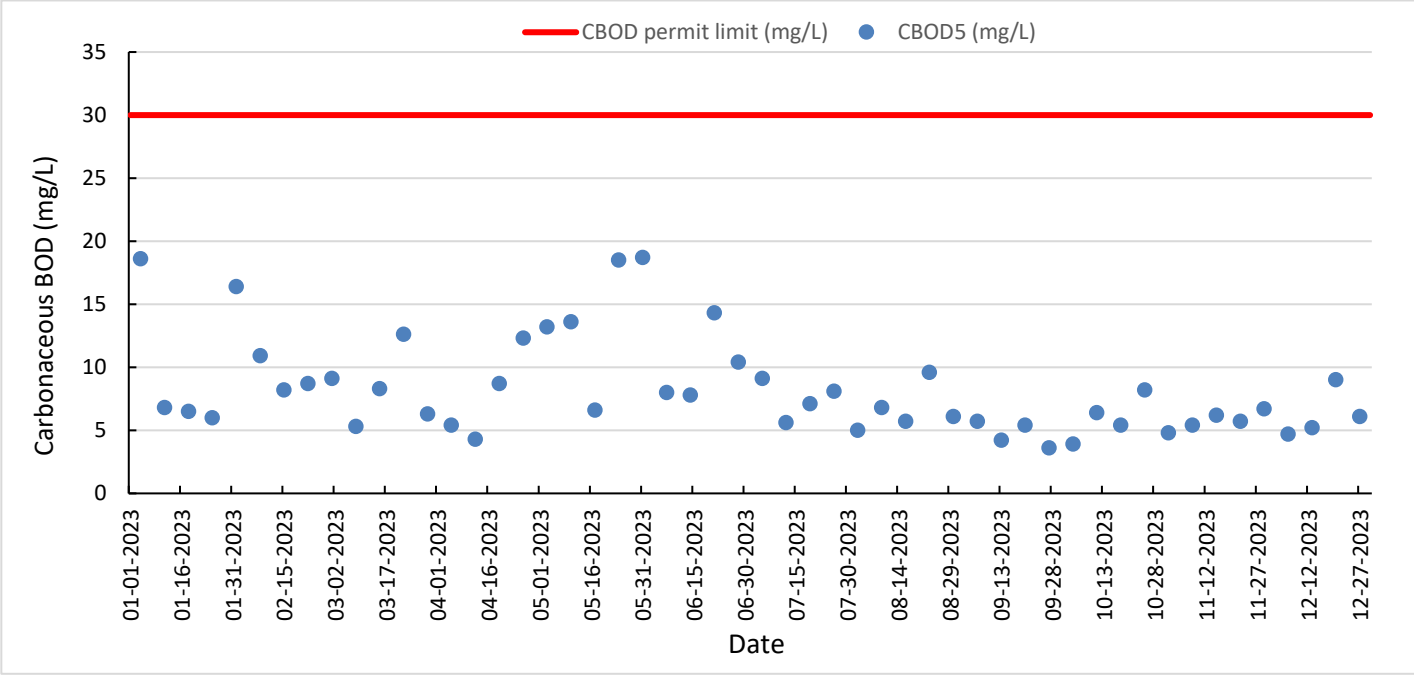


Figure 8: Weekly Carbonaceous BOD (mg/L) 2023

Effluent Disinfection

As a requirement of the Operational Certificate, the Whistler WWTP is required to disinfect the effluent from May 15 – October 15. To accomplish this, the WWTP operates a UV disinfection system during this period. Final effluent samples were taken twice weekly in this period and submitted to a certified laboratory for fecal coliform analysis throughout the disinfection period in order to confirm the effectiveness of the UV disinfection system.

Samples were taken sporadically outside of this period to validate that the UV system is working and highlight coliform results when the UV system is offline.

Figure 9 shows the results of the weekly laboratory tests from May 15 to October 15, 2023. June 21-29 values indicate a UV system malfunction (see NCR in Appendix A)

Note: results determined to be less than detection limit are shown on the graph as the laboratory detection limit of 2.0 MPN/100 mL.

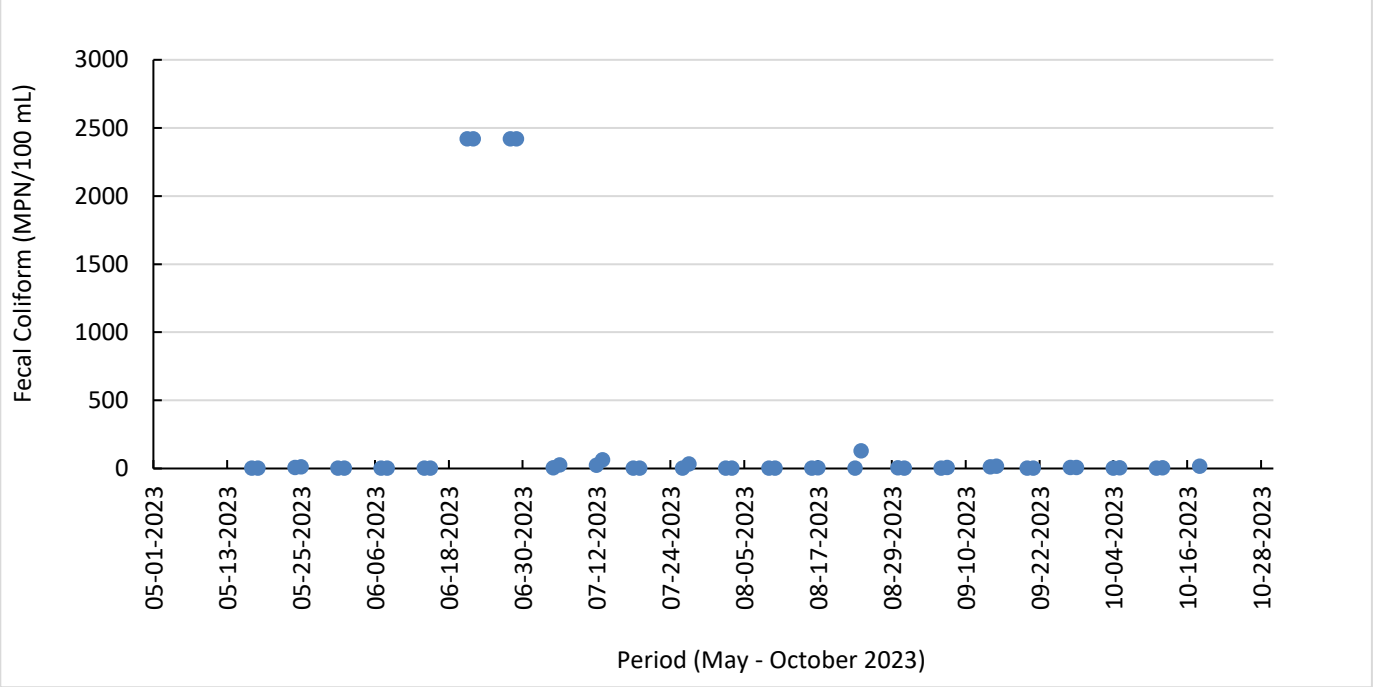


Figure 9: Weekly Fecal Coliform (MPN/mL) lab results 2023

Effluent Toxicity

Four (4) LC50 toxicity tests (Rainbow trout 96-h LC50) were performed during the report period.

Sample dates:

- 23 March 2023
- 18 May 2023
- 03 August 2023
- 16 November 2023

The results are 100% of rainbow trout fry surviving in raw (100% concentration) effluent for 96 hours. See Appendix D for results.

Receiving Environment Monitoring

The receiving environment (the Cheakamus River) is sampled once per month by WWTP staff, and the samples are submitted to a certified laboratory. Cascade Environmental Resource Group completed an analysis of the Receiving Environment data for the reporting year and analysis can be found in Appendix E.

The operating certificate requires the RMOW to monitor two sampling stations, with samples taken three times per year. The RMOW exceeds this requirement by sampling at three locations (known as Camp, Bridge and Station B) every month of the year.

4.0 CONCLUSION

This report fulfills the requirements for the Operational Certificated ME-01452. Any further inquiries can be directed to Chris Wike, Utilities Group Manager at (604) 935-8321 or cwike@whistler.ca.

APPENDIX A: NOTICES OF NON-COMPLIANCE

MINISTRY OF ENVIRONMENT
REGIONAL OPERATIONS BRANCH

NON-COMPLIANCE REPORTING MAILBOX NOTIFICATION

To: EnvironmentalNonCompliance@gov.bc.ca

Subject: 2023-06-19 Authorization # ME-01452 Section 1. Authorized Discharge, 1.1.2 Characteristics for Discharge of Orthophosphate (as phosphorus) 1.75 mg/L and 1.1.3 Nutrient Loading for Discharge May 15 - September 15 Orthophosphate (as phosphorus) 36.6 kg/month

Attention: *Non-compliance Report for* ME-01452 Section 1. Authorized Discharge, 1.1.2 Characteristics for Discharge of Orthophosphate (as phosphorus) 1.75 mg/L – 1.80 mg/L exceedance on June 19, 2023 and 1.1.3 Characteristics for Discharge of Orthophosphate (as phosphorus) 36.6 kg/month – Anticipated Orthophosphate (as phosphorus) exceedance for period of June 15 – July 14, 2023.

Date of Non-compliance: 2023-06-18 00:00 / 2023-06-19 00:00

Location of Non-compliance: 50.08448, -123.041263

Nature of Non-compliance:

The maximum orthophosphate (as phosphorus) concentration discharged shall not exceed 1.75 mg/L.

The maximum orthophosphate (as phosphorus) discharge from May 15 to September 15 shall not exceed 36.6kg/month.

On June 19, 2023, the maximum orthophosphate (as phosphorus) concentration discharged exceeded by 0.05 mg/L. The effluent orthophosphate concentration was 1.80 mg P/L.

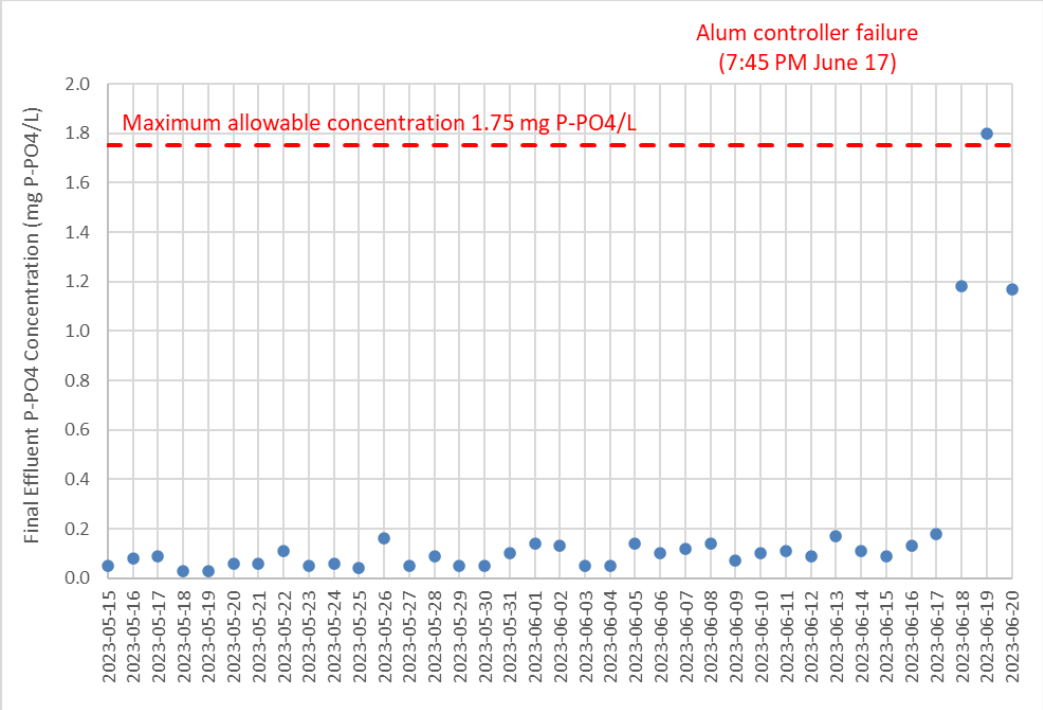
For the period of June 15 to July 14, 2023, we anticipate the monthly limit will be exceeded. The total orthophosphate (as phosphorus) discharged for the period was 37.65 kg as of June 20, 2023. We will inform the Ministry by way of a separate non compliance report at the end of the period (July 14, 2023) for the final confirmed exceedance value. Note that the RMOW has taken swift action to minimize the load discharged.

The non-compliances related to the orthophosphate discharge (load and concentration) observed in this current period are associated to a failure of the alum controller to ramp down alum dose starting at 7:45 PM June 17, 2023, resulting in a major bioreactor failure the next day.

MINISTRY OF ENVIRONMENT
REGIONAL OPERATIONS BRANCH

NON-COMPLIANCE REPORTING MAILBOX NOTIFICATION

Bioreactor and overall plant performance had been stable since the start of the summer permit season on May 15, 2023. The effluent orthophosphate concentration has been consistently below 0.2 mg P-PO4/L since May 15, until the alum controller failed at 7:45 PM on June 17., resulting in excessive alum being dosed. The excessive alum dosed lowered the effluent pH to 4.5, resulting in toxic conditions for the bioreactor. The biomass was inhibited and was unable to treat the incoming phosphate, resulting in a final effluent spike of 1.80 mg P-PO4/L (measured on the 24h composite sample).



Similarly, the load discharged from the plant during the first period of summer permit season (May 15-June 14, 2023) was 22.07 kg P-PO4, well below the maximum allowable discharge of 36.6 kg P-PO4, as presented on the graph below:

MINISTRY OF ENVIRONMENT
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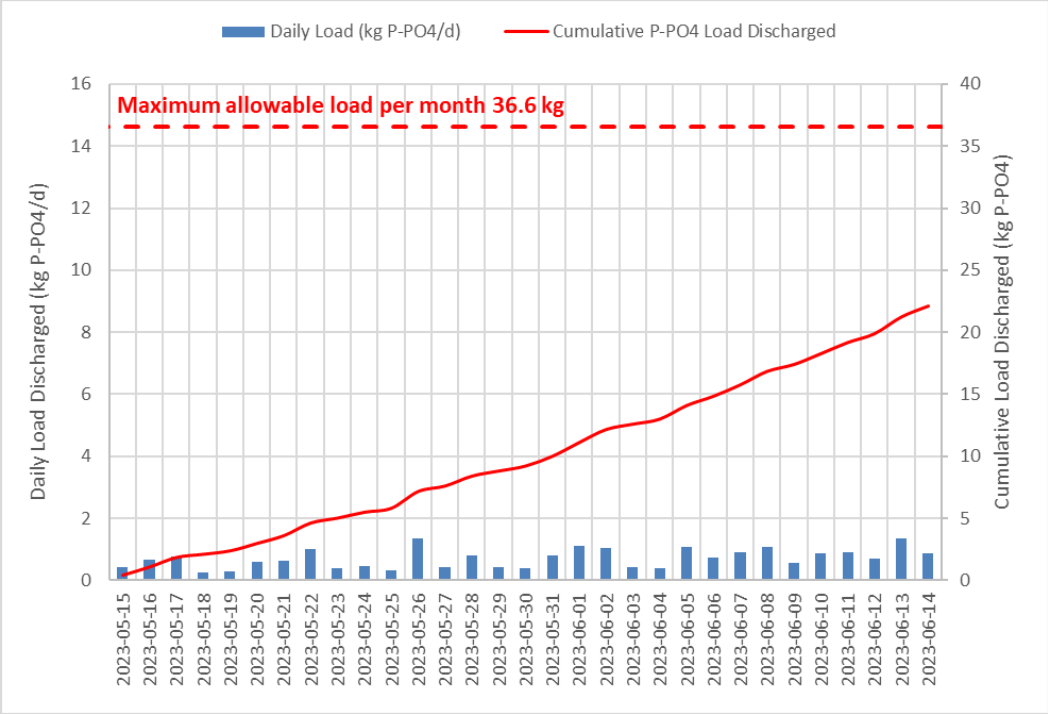
NON-COMPLIANCE REPORTING MAILBOX NOTIFICATION



The alum controller failure at 7:45 PM June 17 has resulted in an exceedance of the monthly allowable load for the June 15 to July 14 2023 period, starting on June 20 2023, when the cumulative load discharged since the start of the period reached 37.65 kg. The graph below will be updated and submitted in a separate non compliance report at the end of the monthly period (July 14 2023) when the final load exceedance value will be confirmed. Note that the RMOW has taken swift action to recover the process and minimize the impact of alum controller failure on the orthophosphate load discharged.

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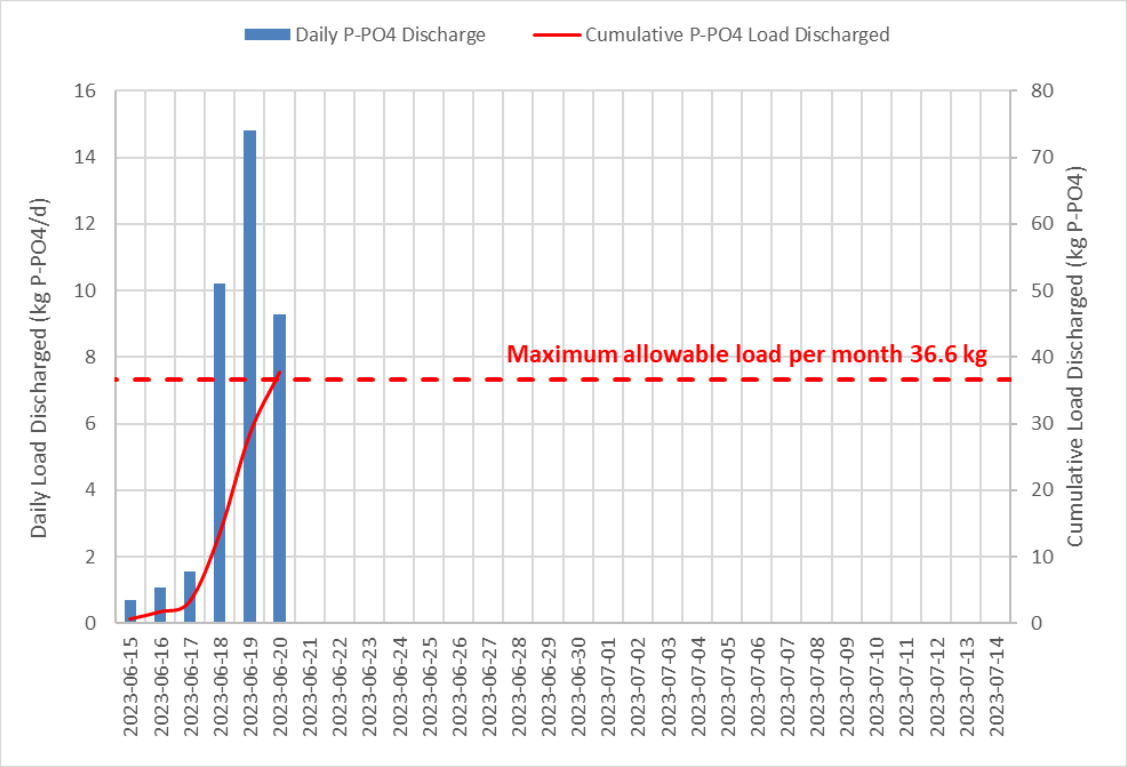
NON-COMPLIANCE REPORTING MAILBOX NOTIFICATION



Initial Response/Actions taken:

1) At the start of their shift at 7:00 AM on the morning of Sunday June 18, 2023 the operations team discovered that the alum controller failed to ramp down alum dose starting at 7:45 PM the previous evening (Saturday June 17). An alarm should have been sent by the system to alert operations that alum was dosed for 8 consecutive hours but it was not sent. The operations team stopped the alum controller and dosed alum manually starting at 7:12 AM June 18, 2023. Acetic acid was also increased to 1000 L/d to speed up bioreactor recovery. (it was previously dosed at 400 to 600 L/d since the start of the summer permit season). The graph below shows the start of the alum controller failure, the bioreactor failure and its ongoing recovery.

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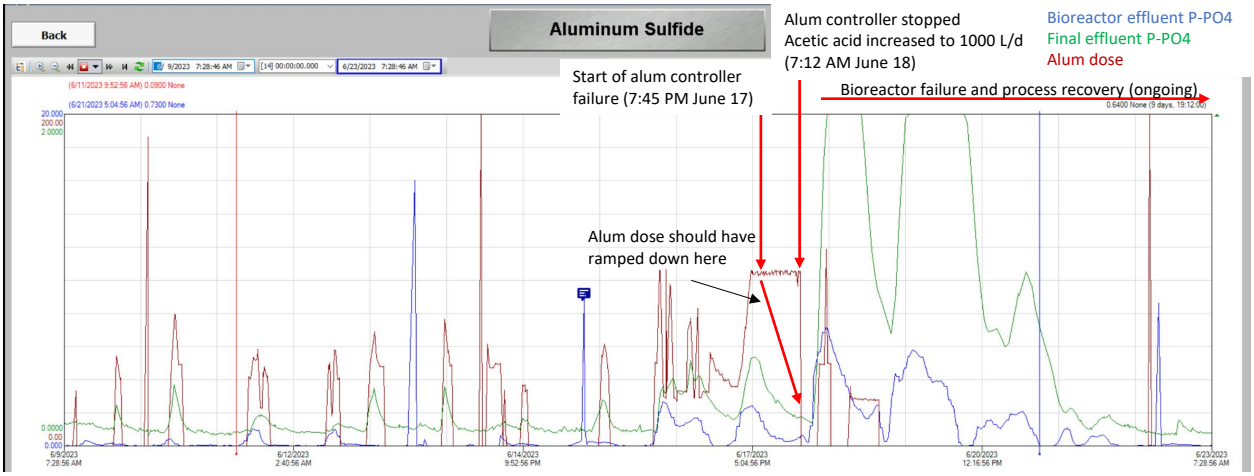
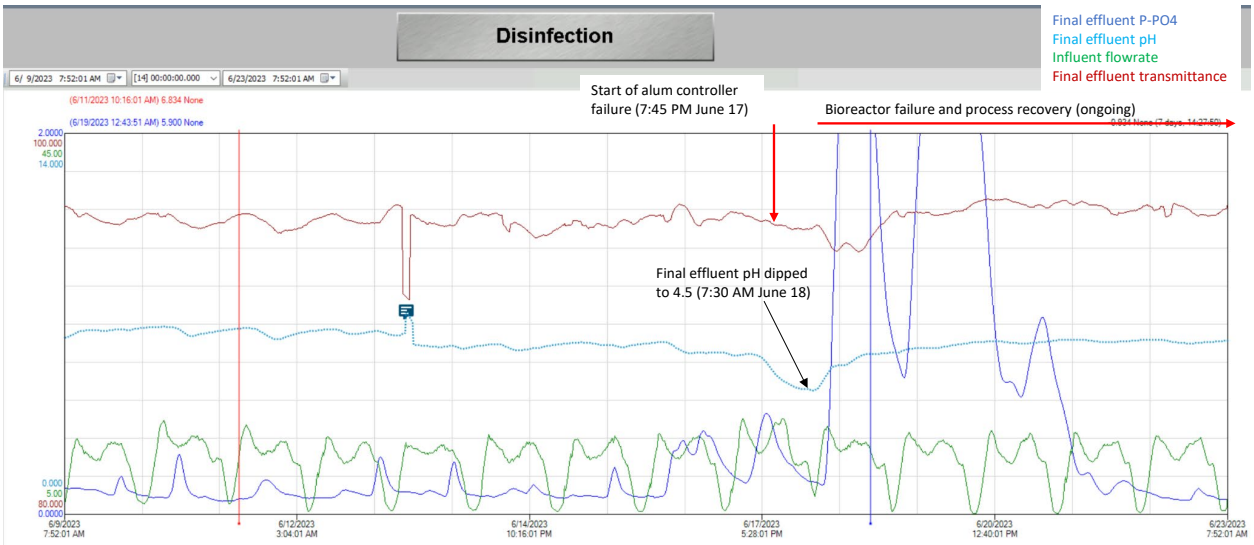
NON-COMPLIANCE REPORTING MAILBOX NOTIFICATION



The alkalinity consumption by alum lead to a low effluent pH (4.5 at 7:30 AM June 18), which in turn caused pH-related inhibition of the biomass in the bioreactor and the subsequent failure of the bioreactor to treat orthophosphate adequately. The graph below shows the final effluent pH and final effluent p-PO4 trends.



2) The process, bioreactor performance and final effluent quality were continuously monitored by the operations team and the process engineer throughout the day of June 18, 2023. Manual pH measurements confirmed the final effluent pH was around 4. Alum was dosed manually at low speed in an effort to minimize the P-PO4 discharge.
3) On the morning of June 19, it was decided to turn off alum completely and maintain the acetic acid dose at 1000 L/d to allow the bioreactor to recover. The low pH at the effluent currently (around 6.4 on June 23) indicates that there is alum accumulated in the sludge and it will likely take about 1 SRT (solids retention time, 9-10 days) to flush the alum out of the system. Continued alum addition could have slowed and even

inhibited the bioreactor recovery.

4) The alum controller failure was documented and shared with the PLC programmer to identify the cause. On June 20, the cause of the alum controller failure was identified and corrected by the PLC programmer. The alum pump automatic control system encountered a programming error in its speed control. The error forced the alum pump to remain fixed at its maximum speed rather than to follow its setpoint. This programing error was found only to be a problem under certain conditions and not a problem under steady state conditions. The coding error has been rectified and the alum controller is now working correctly, ready to be restarted when the bioreactor and process recovers.

Monitoring conducted:
The operations team and the process engineer closely checked the performance of the bioreactor and the secondary clarifiers to evaluate the impact of chemical dosage adjustments. Phosphorus ($P\text{-}PO_4$) concentration was continuously monitored at both the bioreactor influent and effluent and at the final effluent. pH at the final effluent was continuously monitored and Alkalinity and pH at the influent and effluent of the bioreactor were also measured.

The operations team and the process engineer discussed results and action plan to recover the process several times daily starting at 7:AM June 18, when the alum controller failure was discovered, until a noticeable improvement in performance was achieved on June 21.
Every observation and action taken was carefully logged by the operational team.

Future action items:
As of June 23, the bioreactor performance is very close to what it was prior to alum pump controller failure of June 17. Final effluent pH has not fully recovered yet and is anticipated to do so within the next two weeks. The operations team and the process engineer continue to monitor the process closely such that the alum controller will be turned back on as soon as it is reasonably safe for the process to do so, ensuring that that P-PO4 discharge is minimized from the plant throughout the rest of the summer permit period.

The RMOW is considering programming additional alarms, such as low final effluent pH and total volume of alum dosed, to prevent process failures of this type to occur in the future.

The RMOW is planning a tertiary filtration upgrade at the WWTP to improve the robustness of its P removal process and ensure compliance with # ME-01452.

Contact information: For additional information, please contact Chris Wike at 604-935-8321, or via email at cwike@whistler.ca.

MINISTRY OF ENVIRONMENT
REGIONAL OPERATIONS BRANCH

NON-COMPLIANCE REPORTING MAILBOX NOTIFICATION

To: EnvironmentalNonCompliance@gov.bc.ca
Subject: 2023-06-21 Authorization # ME-01452 Section 2. General Requirements, 2.9 Disinfection

Attention: *Non-compliance Report for* ME-01452 Section 2. General Requirements, 2.9 Disinfection. Fecal coliform concentration indicating final effluent was not disinfected June 21, 22, 28 and 29, 2023.

Date of Non-compliance: 2023-06-21 00:00 / 2023-06-29 00:00

Location of Non-compliance: 50.08448, -123.041263

Nature of Non-compliance:

The effluent shall be disinfected from May 15 to October 15 inclusive.

Final effluent fecal coliform testing results seem to indicate that the effluent was not disinfected June 21 to 29. Fecal coliforms are tested on grab samples twice per week on Wednesdays and Thursdays from May 15 to October 15 inclusive. Note that the delay is about 1 week for fecal coliform results from sampling to lab reporting.

The table below shows the final effluent fecal coliform results from the start of permit season, two consecutive weeks of results which indicate the final effluent was not disinfected (in **bold**) and the subsequent recovery of disinfection performance as of July 5, 2023.

It is suspected that algae and stringy materials interfered with the UV lamps' automatic cleaning mechanism which affected disinfection performance. Both banks of the UV disinfection system were operated at 100% intensity from July 7 to 25, 2023 as a precautionary measure, until the UV manufacturer service technician could inspect the system.

MINISTRY OF ENVIRONMENT
REGIONAL OPERATIONS BRANCH

NON-COMPLIANCE REPORTING MAILBOX NOTIFICATION

Table 1: Final Effluent Fecal Coliform Results – RMOW Wastewater Treatment Plant

Date	Fecal Coliform (MPN/100mL) CARO Labs
2023-05-17	2
2023-05-18	3
2023-05-24	12
2023-05-25	7
2023-05-31	2
2023-06-01	3
2023-06-07	2
2023-06-08	2
2023-06-14	2
2023-06-15	1
2023-06-21	**>2420**
2023-06-22	**>2420**
2023-06-28	**>2420**
2023-06-29	**>2420**
2023-07-05	6
2023-07-06	26
2023-07-12	23
2023-07-13	63

Initial Response/Actions taken:

1) The UV disinfection system had been thoroughly cleaned, lamps, quartz sleeves and wipers were replaced as required prior to the start of the summer disinfection season on May 15 and had been operating without any major issue.
2) On June 28, 2023, elevated final effluent fecal coliforms results (>2420 MPN/100 mL) were received for the sampling days of June 21 and 22, 2023 but were initially thought to be a sampling or laboratory error as all other water quality parameters, including continuous final effluent transmittance, were within typical ranges for this period. This magnitude of fecal coliform concentration is typical of what is measured when the UV disinfection system is off. RMOW staff observed that the UV system had been outputting slightly lower levels of UV intensity than normal, but when comparing the original O&M target UV intensity parameter to the current actual intensity, the system was still above the specified 14 mW/cm2. No low dose or low UV intensity alarms were triggered on the UV disinfection system.
3) On July 5, 2023 the operating team cleaned the UV banks.
4) On July 6, 2023, elevated final effluent fecal coliforms results were again received

(>2420 MPN/100 mL) for the June 28 and 29, 2023 sampling days.

5) On July 7, the operating team removed the two UV banks from the channel to confirm the condition and operation of the lamps, wiper mechanisms and sensors. A lamp and wiper were replaced. The RMOW instrument technician compared all setpoints, alarm values and parameters to that of the original O&M manual to confirm that a value was not inadvertently changed. He also confirmed that all the signals back to SCADA were accurate. The only issue identified by the team after their thorough inspection was a printed circuit board which was not working correctly.
6) As a precautionary measure, the operations team ran both UV banks at 100% power from July 7 to 25, 2023 (the system was designed to provide disinfection with one bank at 50% power).
7) Final effluent fecal coliforms results received July 12, 2023, for July 5 and 6, 2023 sampling days indicate that the effluent was disinfected (fecal coliform concentrations back to normal as of July 5 and 6, 2023).
8) A service technician from the UV system manufacturer (Wedeco) was called on July 7, 2023, and visited the site on July 25, 2023. After inspecting the system, he concluded that the likely cause of the poor disinfection performance was algae and other debris interfering with the automatic cleaning mechanism of the UV lamps. Both banks were cleaned and both UV banks are now operating at 50% in maintenance mode.
9) The high temperatures observed this year favour algae growth in the secondary clarifiers, which are cleaned daily to meet the TSS and P-PO4 limits in the facility's Operational Certificate. Algae and other stringy materials from secondary clarifier cleaning may have got caught in the automatic cleaning mechanism and impacted UV performance.

Monitoring conducted:
The operations team and the process engineer closely checked the water quality parameters which affect UV disinfection performance (final effluent TSS and transmittance) and continued to monitor final effluent fecal coliforms twice weekly. Every observation and action taken was carefully logged by the operational team.

Future action items:
As of July 5, 2023, the disinfection performance has been restored. The operations team will continue to monitor the disinfection system closely and will increase the frequency of visual inspections and cleaning of the UV banks and automatic cleaning system to ensure disinfection performance remains adequate. Both UV banks will remain on at 50% power until October 15, 2023. Lamps, sensors and other equipment required for the UV system will be inspected regularly and changed as required.

Contact information: For additional information, please contact Chris Wike at 604-935-8321, or via email at cwike@whistler.ca.

MINISTRY OF ENVIRONMENT
REGIONAL OPERATIONS BRANCH

NON-COMPLIANCE REPORTING MAILBOX NOTIFICATION

MINISTRY OF ENVIRONMENT
REGIONAL OPERATIONS BRANCH

NON-COMPLIANCE REPORTING MAILBOX NOTIFICATION

To: EnvironmentalNonCompliance@gov.bc.ca

Subject: 2023-06-20 Authorization # ME-01452 Section 1. Authorized Discharge, 1.1.3 Nutrient Loading for Discharge May 15 - September 15 Orthophosphate (as phosphorus) 36.6 kg/month

Attention: *Non-compliance Report for* ME-01452 Section 1. Authorized Discharge, 1.1.3 Characteristics for Discharge of Orthophosphate (as phosphorus) 36.6 kg/month – Orthophosphate (as phosphorus) exceedance for period of June 15 – July 14, 2023.

Date of Non-compliance: 2023-06-15 00:00 / 2023-07-15 00:00

Location of Non-compliance: 50.08448, -123.041263

Nature of Non-compliance:

The maximum orthophosphate (as phosphorus) discharge from May 15 to September 15 shall not exceed 36.6kg/month.

For the period of June 15 to July 14, 2023, the monthly load limit was exceeded. The total orthophosphate (as phosphorus) discharged for the period was 53.5 kg. We had informed the Ministry of the anticipated load exceedance in the NC report submitted for the June 19 2023 P-PO4 concentration exceedance. Note that the RMOW took swift action to minimize the P-PO4 load discharged.

The non-compliances related to the orthophosphate discharge (load and concentration) observed are associated to a failure of the alum controller to ramp down alum dose starting at 7:45 PM June 17, 2023, resulting in a major bioreactor failure the next day.

Bioreactor and overall plant performance had been stable since the start of the summer permit season on May 15, 2023. The effluent orthophosphate concentration has been consistently below 0.2 mg P-PO4/L since May 15, until the alum controller failed at 7:45 PM on June 17., resulting in excessive alum being dosed. The excessive alum dosed lowered the effluent pH to 4.5, resulting in toxic conditions for the bioreactor. The biomass was inhibited and was unable to treat the incoming phosphate, resulting in a total discharged load of 53.5 kg P-PO4 for the period of June 15 – July 14 2023, 16.9 kg of P-PO4 more than the permitted 36.6 kg P-PO4 monthly load.

MINISTRY OF ENVIRONMENT
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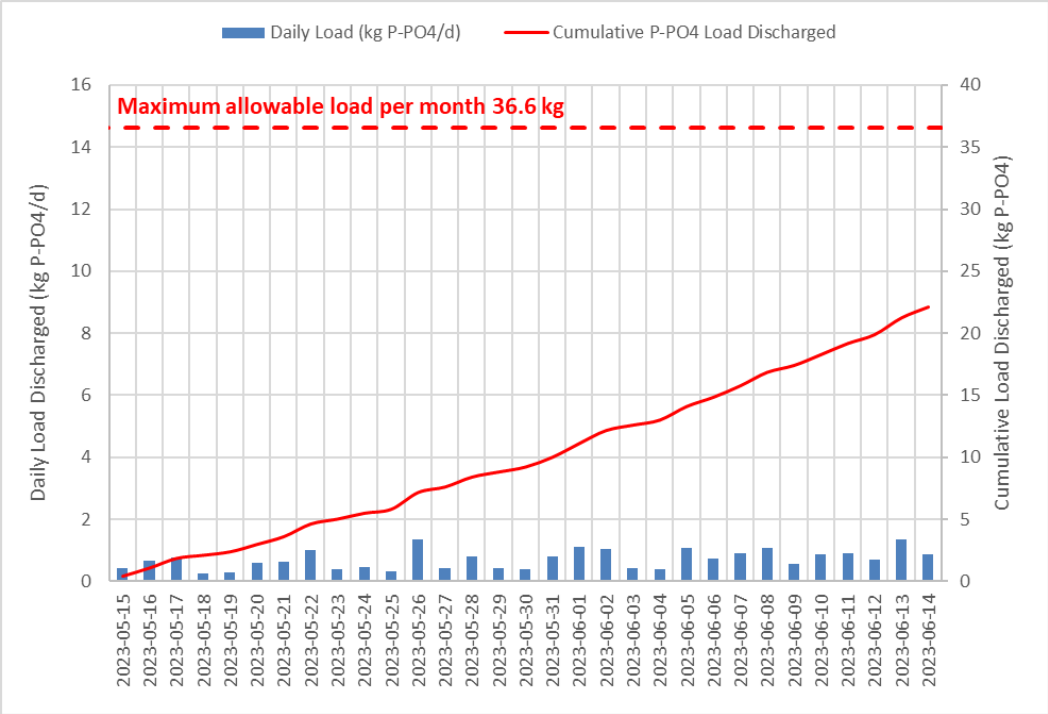
NON-COMPLIANCE REPORTING MAILBOX NOTIFICATION

The load discharged from the plant during the first period of summer permit season (May 15-June 14, 2023) was 22.07 kg P-PO4, well below the maximum allowable discharge of 36.6 kg P-PO4, as presented on the graph below:



The alum controller failure at 7:45 PM June 17 has resulted in an exceedance of the monthly allowable load for the June 15 to July 14 2023 period, starting on June 20 2023, when the cumulative load discharged since the start of the period reached 37.65 kg. The graph below shows the final load exceedance for the June 15 to July 14 2023 period. The load discharged during the period was 53.5 kg P-PO4, 16.9 kg more than the permitted 36.6 kg P-PO4 monthly load. Note that the RMOW took swift action to recover the process and minimized the impact of the alum controller failure on the orthophosphate load discharged.

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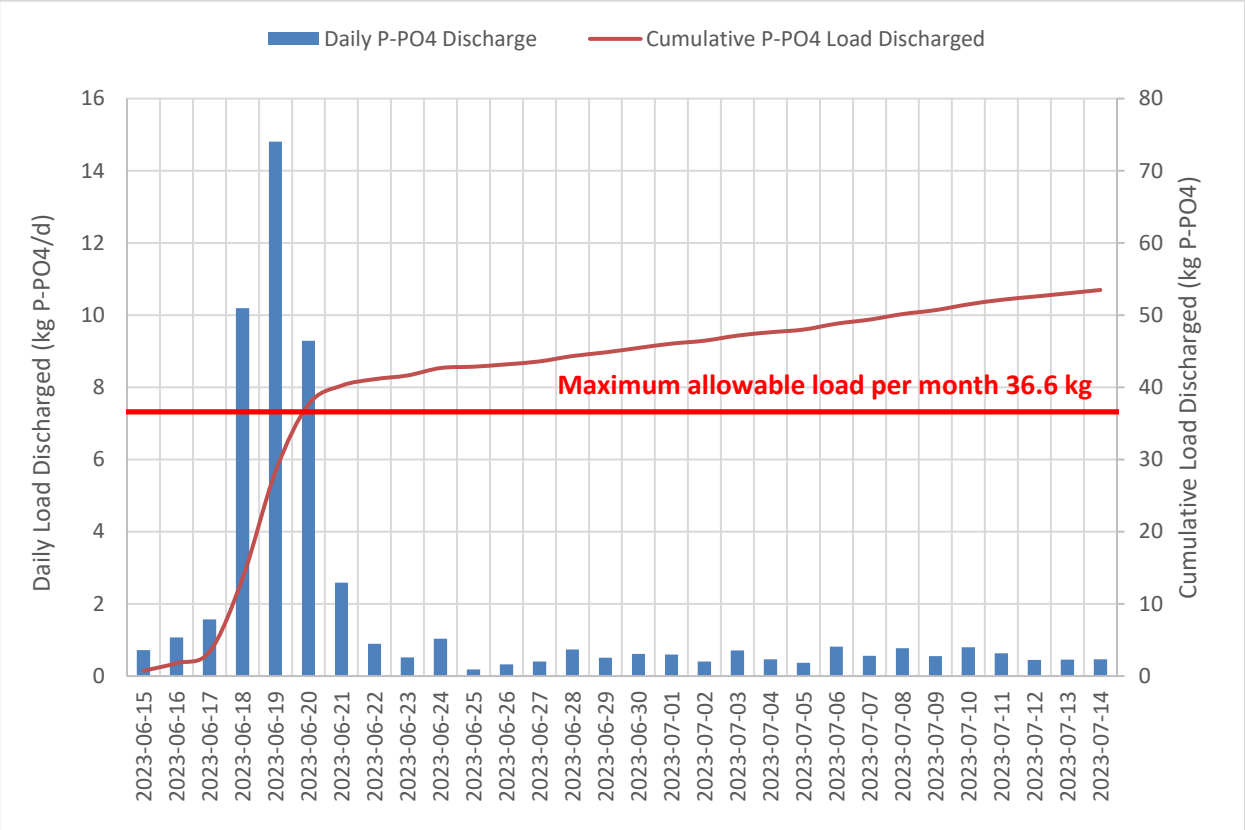
NON-COMPLIANCE REPORTING MAILBOX NOTIFICATION



Initial Response/Actions taken:

1) At the start of their shift at 7:00 AM on the morning of Sunday June 18, 2023 the operations team discovered that the alum controller failed to ramp down alum dose starting at 7:45 PM the previous evening (Saturday June 17). An alarm should have been sent by the system to alert operations that alum was dosed for 8 consecutive hours but it was not sent. The operations team stopped the alum controller and dosed alum manually starting at 7:12 AM June 18, 2023. The alum controller was turned off until June 27 2023 to allow the bioreactor and effluent pH to recover. Acetic acid was also increased to 1000 L/d from June 18 to 25 to speed up bioreactor recovery. (it was previously dosed at 400 to 600 L/d since the start of the summer permit season). The graph below shows the start of the alum controller failure, the bioreactor failure, its recovery and current status. The failure and recovery period lasted 4 days from June 18 to 21, due to the corrective actions implemented by RMOW staff in a timely fashion. The bioreactor has been stable since June 22 2023. Recent P-PO4 bumps observed at the outlet of the bioreactor and final effluent are normal variations and it is expected that the plant will not exceed its P-PO4 load limit for the rest of the summer permit season.

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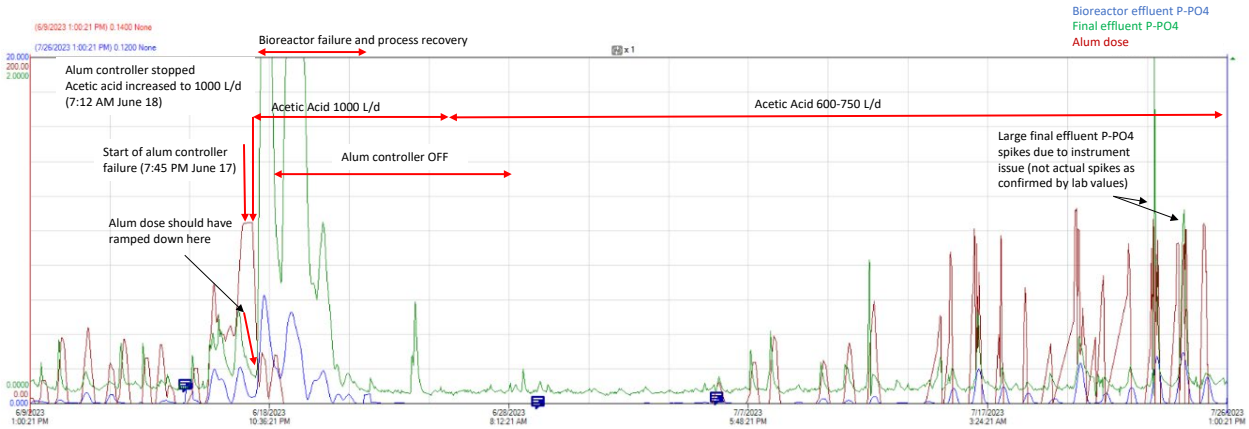
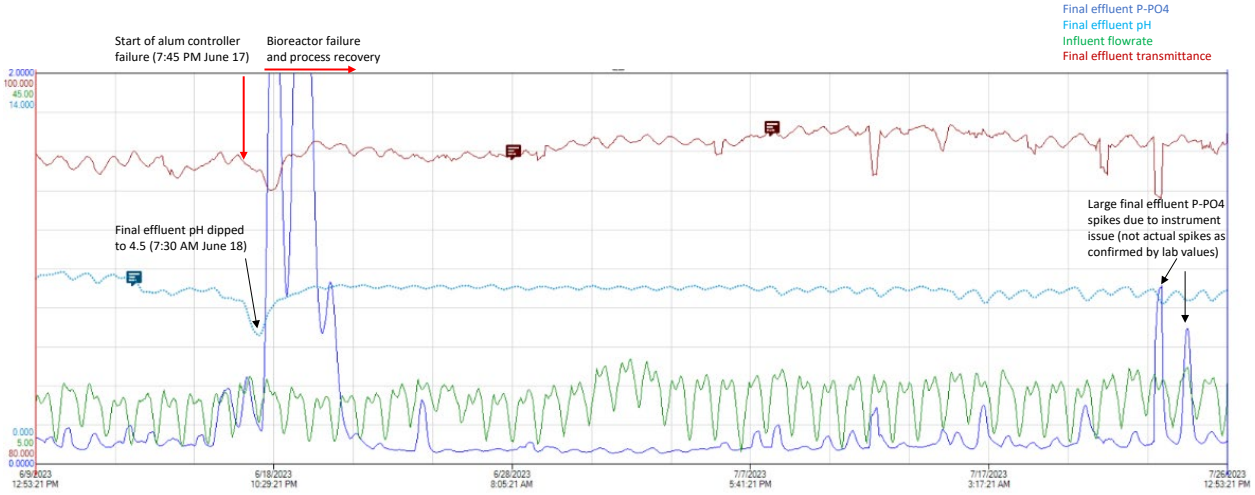


The failure of the bioreactor to treat orthophosphate adequately was caused by pH-related inhibition of the biomass in the bioreactor. Alkalinity consumption by alum lead to a low effluent pH (4.5 at 7:30 AM June 18) and inhibitory conditions for the biomass.

The graph below shows the final effluent pH and final effluent P-PO4 trends. The effluent pH and P-PO4 have since recovered and have been stable since June 22, 2023.



2) The process, bioreactor performance and final effluent quality were continuously monitored by the operations team and the process engineer throughout the day of June 18, 2023. Manual pH measurements confirmed the final effluent pH was around 4. Alum was dosed manually at low speed in an effort to minimize the P-PO4 discharge.
3) On the morning of June 19, it was decided to turn off alum completely and maintain the acetic acid dose at 1000 L/d to allow the bioreactor to recover. The low pH at the effluent currently (around 6.4 on June 23) indicates that there is alum accumulated in the sludge and it will likely take about 1 SRT (solids retention time, 9-10 days) to flush the alum out of the system. Continued alum addition could have slowed and even inhibited the bioreactor recovery.
4) The alum controller failure was documented and shared with the PLC programmer to

identify the cause. On June 20, the cause of the alum controller failure was identified and corrected by the PLC programmer. The alum pump automatic control system encountered a programming error in its speed control. The error forced the alum pump to remain fixed at its maximum speed rather than to follow its setpoint. This programing error was found only to be a problem under certain conditions and not a problem under steady state conditions. The coding error has been rectified and the alum controller is now working correctly, ready to be restarted when the bioreactor and process recovers.

5) A final effluent pH alarm has been programmed. Its current setpoint is at pH 5.7. When pH 5.7 is measured at the effluent, the RMOW operations team turns off alum addition and monitors the process and effluent pH attentively.

Monitoring conducted:
The operations team and the process engineer closely checked the performance of the bioreactor and the secondary clarifiers to evaluate the impact of chemical dosage adjustments. Phosphorus ($P\text{-}PO_4$) concentration was continuously monitored at both the bioreactor influent and effluent and at the final effluent. pH at the final effluent was continuously monitored and Alkalinity and pH at the influent and effluent of the bioreactor were also measured.

The operations team and the process engineer discussed results and action plan to recover the process several times daily starting at 7:AM June 18, when the alum controller failure was discovered, until a noticeable improvement in performance was achieved on June 21. The operations team and process engineer continue to meet weekly and communicate several times per week to ensure optimal performance of the process and meeting permit requirements. Every observation and action taken is carefully logged by the operational team.

Future action items:
As of June 23, the bioreactor performance and final effluent pH are very close to what they were prior to alum pump controller failure of June 17. The operations team and the process engineer continue to monitor the process closely such that P-PO4 discharge is minimized from the plant throughout the rest of the summer permit period.

The RMOW has programmed additional alarms, such as low final effluent pH and alum pump run time (8 consecutive hours), to prevent process failures of this type to occur in the future. The RMOW is also considering automating the stopping of alum addition when final effluent pH reaches 5.7.

The RMOW is planning a tertiary filtration upgrade at the WWTP to improve the robustness of its P removal process and ensure compliance with # ME-01452.

Contact information: For additional information, please contact Chris Wike at 604-935-8321, or via email at cwike@whistler.ca.

APPENDIX B: OUTFALL INSPECTION REPORT (2023)

CASCADE ENVIRONMENTAL
RESOURCE GROUP LTD

MEMORANDUM

DATE: May 17, 2023

TO: Ahren Snikvalds, Resort Municipality of Whistler

FROM: Macaila Wagner, Cascade Environmental Resource Group Ltd.
Candace Rose-Taylor, Cascade Environmental Resource Group Ltd.

RE: Whistler Wastewater Treatment Plant Outfall Inspection 2023
Operational Certificate ME-01452

FILE #: 013-34-12

Cascade Environmental Resource Group Ltd. (Cascade) was retained by the Resort Municipality of Whistler (RMOW) to conduct a visual inspection of the Whistler Wastewater Treatment Plant (WWTP) on the Cheakamus River, in accordance with the Operational Certificate issued by the BC Ministry of Water, Land and Air Protection (WLAP), #ME-01452. The inspection was completed on May 15, 2023, by Candace Rose-Taylor, R.P. Bio., and Macaila Wagner, B.I.T., of Cascade.

The WWTP outfall is located on the Cheakamus River (Photo 1) and was visually inspected for abnormal cracks and disrepair in the concrete, evidence of effluent leakage in the surrounding riprap berm, and evidence of wildlife activity around the outfall. The effluent was discharging directly into the Cheakamus River as water levels are currently flowing high due to freshet. The outfall sign is positioned above the high-water mark of the Cheakamus River in alignment with the outfall (Photo 1). The sign was upgraded the week prior to the inspection and now includes a pictogram and written identification of the sewer outfall. The outfall was deemed in "good condition", with no physical deterioration or noticeable leakage outside of the outfall area (Photo 1 to Photo 5). The surrounding berm was comprised of bare large riprap boulders. There was no evidence of scavenging or denning wildlife (tracks, feces, fur) within the immediate vicinity of the outfall. A mother black bear (*Ursus americanus*), and three cubs, were repeatedly observed walking the dyke, as well as climbing the fence to access the vegetation at the WWTP. Bear feces was observed along the dyke (Photo 9) and in the vicinity of the WWTP infrastructure (Photo 10). The WWTP staff also reported a bobcat (*Lynx rufus*) sighting on the dyke two weeks prior to the inspection.

The WWTP Operational Certificate states that an outfall inspection is required once every five years; therefore, a subsequent inspection should be scheduled for the year 2028. Cascade recommends the following inspection be completed in the fall, when water levels are lower, so the inside of the outfall can be accessed. Please do not hesitate to contact Cascade with any questions or concerns regarding this report.

Prepared by:

Macaila Wagner, B.Sc., B.I.T.
Environmental Technician
Cascade Environmental Resource Group Ltd

Reviewed by

Candace Rose-Taylor, R.P. Bio.
Principal
Cascade Environmental Resource Group Ltd.

PHOTOS

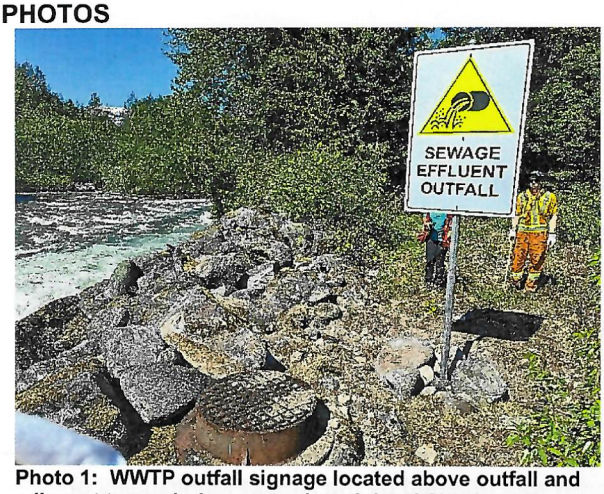


Photo 1: WWTP outfall signage located above outfall and adjacent to manhole access river right of Cheakamus River, May 15, 2023.

Photo 2: Manhole access to WWTP effluent outfall pipe, May 15, 2023.

Photo 3: WWTP effluent outfall signage located on Cheakamus River, looking upstream, May 15, 2023.

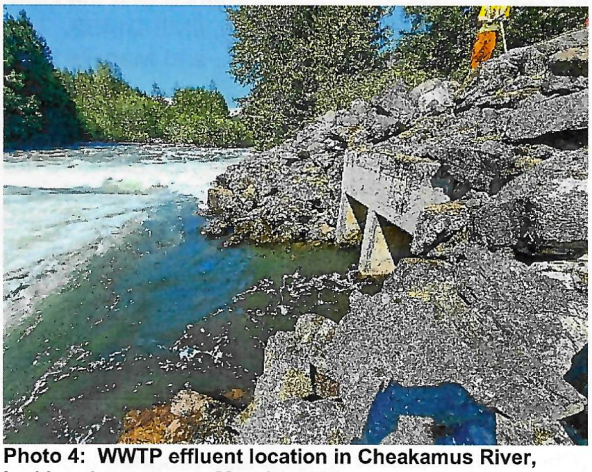


Photo 4: WWTP effluent location in Cheakamus River, looking downstream, May 15, 2023.

Photo 5: WWTP outfall interior, May 15, 2023.

Photo 6: View across Cheakamus River to river left from WWTP outfall, May 15, 2023.

Photo 7: Looking upstream from the WWTP outfall, May 15, 2023.

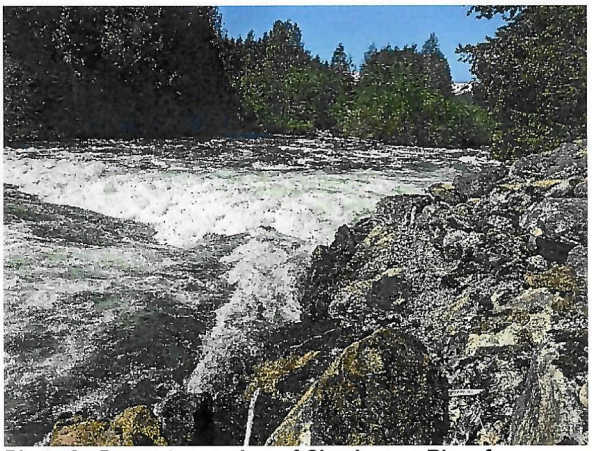


Photo 8: Downstream view of Cheakamus River from WWTP outfall, May 15, 2023.

Photo 9: Bear feces observed along the top of the dyke upstream of the WWTP outfall. May 15, 2023.

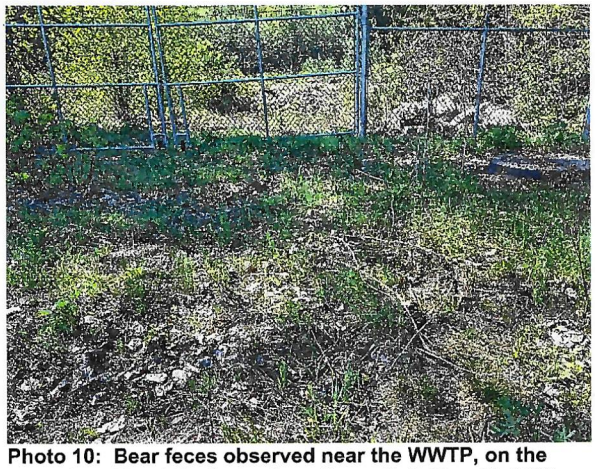


Photo 10: Bear feces observed near the WWTP, on the opposite side of the fence from the outfall. May 15, 2023.

APPENDIX C: WASTEWATER TREATMENT PLANT DATA

Date	Effluent (m^3/day)	Total Suspended Solids (mg/L)	$CBOD_5$ (mg/L)	Soluble PO_4 as P (mg/L)	PO_4 as P (kg/day)	Total Phosphorous (mg/L)	Fecal Coliform (cfu/100mL)
01-01-2023	13497	16		0.52	7.02		
01-02-2023	12657	12		0.63	7.97		
01-03-2023	11969	11		0.60	7.18		
01-04-2023	11694	10	19	0.68	7.95		
01-05-2023	11848	9		0.77	9.12	0.64	
01-06-2023	12069	9		0.81	9.78		
01-07-2023	12406	7		0.79	9.80		
01-08-2023	11753	10		0.85	9.99		
01-09-2023	10972	15		0.80	8.78		
01-10-2023	10898	11		0.78	8.50		
01-11-2023	10897	10	7	0.95	10.35		
01-12-2023	13828	9		0.77	10.65	0.65	
01-13-2023	18561	8		0.68	12.62		
01-14-2023	17136	11		0.69	11.82		
01-15-2023	14852	14		0.89	13.22		
01-16-2023	13650	11		0.74	10.10		
01-17-2023	12403	9		0.75	9.30		
01-18-2023	12619	9	7	0.61	7.70		
01-19-2023	12090	11		0.64	7.74	0.23	
01-20-2023	12021	11		0.65	7.81		
01-21-2023	12529	17		0.79	9.90		
01-22-2023	12280	13		0.78	9.58		
01-23-2023	11389	10		0.91	10.36		
01-24-2023	10864	9		0.69	7.50		
01-25-2023	10614	8	6	0.99	10.51		
01-26-2023	10993	10		0.72	7.91	0.24	
01-27-2023	11585	11		0.94	10.89		
01-28-2023	12293	14		1.01	12.42		
01-29-2023	11608	13		1.15	13.35		
01-30-2023	10637	10		1.16	12.34		
01-31-2023	10090	11		0.89	8.98		
02-01-2023	10004	12	16	0.92	9.20		
02-02-2023	10241	12		1.00	10.24	0.35	
02-03-2023	11216	12		0.85	9.53		
02-04-2023	12190	14		1.16	14.14		
02-05-2023	11408	11		1.07	12.21		
02-06-2023	11343	11		1.09	12.36		
02-07-2023	12234	11		1.14	13.95		
02-08-2023	11329	12	11	1.20	13.59		

02-09-2023	11760	15		0.94	11.05	0.36	
02-10-2023	12947	17		0.76	9.84		
02-11-2023	13165	18		0.89	11.72		
02-12-2023	12578	13		1.33	16.73		
02-13-2023	11826	12		0.97	11.47		
02-14-2023	11211	14		0.65	7.29		
02-15-2023	10847	12	8	0.86	9.33		
02-16-2023	11120	19		0.84	9.34	0.44	
02-17-2023	11875	20		0.87	10.33		
02-18-2023	12581	20		0.87	10.95		
02-19-2023	12757	26		0.86	10.97		
02-20-2023	12972	27		0.81	10.51		
02-21-2023	12210	25		0.91	11.11		
02-22-2023	11927	19	9	0.63	7.51		
02-23-2023	11558	19		0.59	6.82	0.47	
02-24-2023	11772	21		0.64	7.53		
02-25-2023	11811	21		0.71	8.39		
02-26-2023	10873	18		0.93	10.11		
02-27-2023	10437	22		0.90	9.39		
02-28-2023	10210	13		0.75	7.66		
03-01-2023	9968	15	9	0.92	9.17		
03-02-2023	9973	18		0.30	2.99	0.42	
03-03-2023	10826	18		0.75	8.12		
03-04-2023	11126	15		0.62	6.90		
03-05-2023	10609	13		0.27	2.86		
03-06-2023	9828	13		0.31	3.05		
03-07-2023	9724	13		0.41	3.99		
03-08-2023	9628	12	5	0.22	2.12		2420
03-09-2023	9670	15		0.06	0.58	0.34	2420
03-10-2023	10265	17		0.04	0.41		
03-11-2023	10656	18		0.07	0.75		
03-12-2023	10879	15		0.14	1.52		
03-13-2023	10950	15		0.25	2.74		
03-14-2023	10889	13		0.35	3.81		
03-15-2023	10843	14	8	0.32	3.47		2420
03-16-2023	10548	20		0.49	5.17	0.31	2420
03-17-2023	10842	18		0.17	1.84		
03-18-2023	11029	14		0.76	8.38		
03-19-2023	10738	13		0.86	9.23		
03-20-2023	10478	15		0.83	8.70		
03-21-2023	10564	12		0.55	5.81		
03-22-2023	10567	14	13	0.49	5.18		2420
03-23-2023	10582	24		0.57	6.03	0.42	2420
03-24-2023	10963	16		0.83	9.10		
03-25-2023	11225	15		0.65	7.30		
03-26-2023	10707	13		0.74	7.92		
03-27-2023	10010	12		0.91	9.11		

03-28-2023	9783	12		0.83	8.12		
03-29-2023	9693	9	6	0.81	7.85		2420
03-30-2023	9607	12		0.69	6.63	0.33	4840
03-31-2023	10079	11		0.72	7.26		
04-01-2023	10641	15		0.78	8.30		
04-02-2023	10626	13		0.94	9.99		
04-03-2023	10263	12		0.98	10.06		
04-04-2023	9805	14		0.98	9.61		
04-05-2023	9713	14	5	0.97	9.42		2420
04-06-2023	10141	15		0.97	9.84	0.34	2420
04-07-2023	11986	11		0.75	8.99		
04-08-2023	12537	13		0.75	9.40		
04-09-2023	14066	21		0.84	11.82		
04-10-2023	13312	23		0.61	8.12		
04-11-2023	11676	26		0.70	8.17		
04-12-2023	10829	21	4	1.53	16.57		2420
04-13-2023	11608	29		0.64	7.43	0.44	2420
04-14-2023	10515	17		1.04	10.94		
04-15-2023	10966	23		0.85	9.32		
04-16-2023	10500	20		1.05	11.03		
04-17-2023	9292	18		0.94	8.73		
04-18-2023	8867	16		0.90	7.98		
04-19-2023	8422	16	9	0.90	7.58		818
04-20-2023	6966	34		1.04	7.24	0.33	770
04-21-2023	10021	38		1.20	12.03		
04-22-2023	10104	38		1.27	12.83		
04-23-2023	10498	31		1.23	12.91		
04-24-2023	9425	29		0.91	8.58		
04-25-2023	8874	33		1.04	9.23		
04-26-2023	9034	25	12	0.81	7.32		2420
04-27-2023	8790	23		0.57	5.01	0.78	2420
04-28-2023	9071	21		0.37	3.36		
04-29-2023	10498	29		0.65	6.82		
04-30-2023	10464	23		0.53	5.55		
05-01-2023	9553	23		0.17	1.62		
05-02-2023	9233	19		0.22	2.03		
05-03-2023	9104	18	13	0.11	1.00		3
05-04-2023	8993	24		0.06	0.54	0.30	2
05-05-2023	8632	28		0.20	1.73		
05-06-2023	9752	24		0.06	0.59		
05-07-2023	9307	22		0.04	0.37		
05-08-2023	8405	19		0.03	0.25		
05-09-2023	8830	17		0.10	0.88		
05-10-2023	8180	19	14	0.07	0.57		3
05-11-2023	8149	25		0.03	0.24	0.22	3
05-12-2023	8510	25		0.11	0.94		
05-13-2023	9100	26		0.05	0.46		

05-14-2023	8696	21		0.09	0.78		
05-15-2023	8350	21		0.05	0.42		
05-16-2023	8313	17		0.08	0.67		
05-17-2023	8493	16	7	0.09	0.76		2
05-18-2023	8587	19		0.03	0.26		3
05-19-2023	9264	25		0.03	0.28	0.23	
05-20-2023	9943	22		0.06	0.60		
05-21-2023	10399	21		0.06	0.62		
05-22-2023	9223	24		0.11	1.01		
05-23-2023	7928	17		0.05	0.40		
05-24-2023	7865	16	19	0.06	0.47		7
05-25-2023	8078	17		0.04	0.32	0.51	12
05-26-2023	8407	15		0.16	1.35		
05-27-2023	8835	21		0.05	0.44		
05-28-2023	8851	18		0.09	0.80		
05-29-2023	8203	24		0.05	0.41		
05-30-2023	8025	18		0.05	0.40		
05-31-2023	7884	15	19	0.10	0.79		2
06-01-2023	7877	11		0.14	1.10	0.26	3
06-02-2023	8043	14		0.13	1.05		
06-03-2023	8657	21		0.05	0.43		
06-04-2023	8140	15		0.05	0.41		
06-05-2023	7781	13		0.14	1.09		
06-06-2023	7487	15		0.10	0.75		
06-07-2023	7688	14	8	0.12	0.92		2
06-08-2023	7696	15		0.14	1.08	0.27	2
06-09-2023	7969	14		0.07	0.56		
06-10-2023	8691	15		0.10	0.87		
06-11-2023	8169	12		0.11	0.90		
06-12-2023	7880	14		0.09	0.71		
06-13-2023	7941	12		0.17	1.35		
06-14-2023	7887	12	8	0.11	0.87		2
06-15-2023	7948	14		0.09	0.72	0.28	1
06-16-2023	8260	16		0.13	1.07		
06-17-2023	8727	19		0.18	1.57		
06-18-2023	8637	22		1.18	10.19		
06-19-2023	8228	15		1.80	14.81		
06-20-2023	7938	14		1.17	9.29		
06-21-2023	8091	13	14	0.32	2.59		2420
06-22-2023	8152	15		0.11	0.90	0.39	2420
06-23-2023	8595	13		0.06	0.52		
06-24-2023	8615	17		0.12	1.03		
06-25-2023	8971	14		0.02	0.18		
06-26-2023	8182	15		0.04	0.33		
06-27-2023	8123	14		0.05	0.41		
06-28-2023	8229	12	10	0.09	0.74	0.40	2420
06-29-2023	8522	11		0.06	0.51		2420

06-30-2023	8792	8		0.07	0.62		
07-01-2023	9922	7		0.06	0.60		
07-02-2023	10149	5		0.04	0.41		
07-03-2023	10119	8		0.07	0.71		
07-04-2023	9264	11		0.05	0.46		
07-05-2023	9212	10	9	0.04	0.37		6
07-06-2023	9100	12		0.09	0.82	0.40	26
07-07-2023	9327	10		0.06	0.56		
07-08-2023	9606	10		0.08	0.77		
07-09-2023	9178	9		0.06	0.55		
07-10-2023	8892	11		0.09	0.80		
07-11-2023	8968	11		0.07	0.63		
07-12-2023	8946	12	6	0.05	0.45		23
07-13-2023	9039	10		0.05	0.45	0.35	63
07-14-2023	9356	10		0.05	0.47		
07-15-2023	9384	15		0.10	0.94		
07-16-2023	9314	18		0.08	0.75		
07-17-2023	9146	14		0.04	0.37		
07-18-2023	9958	17		0.03	0.30		2
07-19-2023	8826	14	7	0.06	0.53		2
07-20-2023	8959	14		0.08	0.72	0.42	
07-21-2023	9307	14		0.09	0.84		
07-22-2023	9569	24		0.09	0.86		
07-23-2023	9582	14		0.12	1.15		
07-24-2023	9323	14		0.20	1.86		
07-25-2023	9286	14		0.12	1.11		
07-26-2023	9057	14	8	0.08	0.72		2
07-27-2023	9335	15		0.11	1.03	0.39	33
07-28-2023	9565	15		0.08	0.77		
07-29-2023	10025	17		0.14	1.40		
07-30-2023	9952	16		0.46	4.58		
07-31-2023	9652	15		0.34	3.28		
08-01-2023	9141	15		0.16	1.46		
08-02-2023	9101	13	5	0.08	0.73		1
08-03-2023	9085	15		0.03	0.27	0.42	2
08-04-2023	9137	8		0.06	0.55		
08-05-2023	9414	12		0.07	0.66		
08-06-2023	9990	7		0.06	0.60		
08-07-2023	10431	11		0.05	0.52		
08-08-2023	9234	10		0.04	0.37		
08-09-2023	9670	10	7	0.05	0.48		2
08-10-2023	9276	16		0.06	0.56	0.39	2
08-11-2023	9230	10		0.05	0.46		
08-12-2023	9400	9		0.06	0.56		
08-13-2023	9735	13		0.08	0.78		
08-14-2023	9423	11		0.07	0.66		
08-15-2023	9214	13		0.09	0.83		

08-16-2023	9383	12	6	0.07	0.66		2
08-17-2023	8966	11		0.05	0.45	0.39	4.5
08-18-2023	9485	9		0.07	0.66		
08-19-2023	10127	10		0.06	0.59		
08-20-2023	10297	10		0.10	1.03		
08-21-2023	9720	12		0.05	0.49		
08-22-2023	9521	11		0.08	0.76		
08-23-2023	8794	12	10	0.14	1.23		2
08-24-2023	8991	13		0.06	0.54	0.26	130
08-25-2023	9274	12		0.06	0.56		
08-26-2023	9373	11		0.09	0.84		
08-27-2023	9694	12		0.14	1.36		
08-28-2023	9161	11		0.12	1.10		
08-29-2023	8642	11		0.17	1.47		
08-30-2023	8122	13	6	0.13	1.06		4.5
08-31-2023	8301	10		0.08	0.66	0.22	2.
09-01-2023	8860	9		0.11	0.97		
09-02-2023	9778	10		0.14	1.37		
09-03-2023	10014	9		0.17	1.70		
09-04-2023	8683	10		0.14	1.22		
09-05-2023	7974	13		0.14	1.12		
09-06-2023	7330	11	6	0.13	0.95		2
09-07-2023	7364	10		0.06	0.44	0.31	6.8
09-08-2023	7574	9		0.06	0.45		
09-09-2023	8669	10		0.08	0.69		
09-10-2023	8203	10		0.08	0.66		
09-11-2023	7680	9		0.10	0.77		
09-12-2023	7096	10		0.11	0.78		
09-13-2023	7156	11	4	0.13	0.93		
09-14-2023	7228	10		0.12	0.87	0.47	13
09-15-2023	7435	15		0.11	0.82		17
09-16-2023	8078	9		0.29	2.34		
09-17-2023	7851	10		0.48	3.77		
09-18-2023	7150	11		0.64	4.58		
09-19-2023	6711	12		1.13	7.58		
09-20-2023	6721	11	5	1.07	7.19		2
09-21-2023	6589	15		0.89	5.86	1.03	2
09-22-2023	7026	8		0.97	6.82		
09-23-2023	7837	12		0.71	5.56		
09-24-2023	7397	13		0.55	4.07		
09-25-2023	8535	12		0.66	5.63		
09-26-2023	7556	12		0.44	3.32		
09-27-2023	7343	11	4	0.37	2.72		7.8
09-28-2023	7232	9		0.39	2.82	0.68	7.8
09-29-2023	7183	11		0.35	2.51		
09-30-2023	7852	14		0.48	3.77		
10-01-2023	7958	10		0.52	4.14		

10-02-2023	7984	11		0.80	6.39		
10-03-2023	7350	11		0.64	4.70		
10-04-2023	7276	11	4	0.51	3.71		2
10-05-2023	7048	14		0.47	3.31	1.99	4.5
10-06-2023	7490	14		0.42	3.15		
10-07-2023	8065	21		0.60	4.84		
10-08-2023	8348	23		0.88	7.35		
10-09-2023	7650	14		1.11	8.49		
10-10-2023	6778	14		0.96	6.51		
10-11-2023	6662	17	6	1.03	6.86		2
10-12-2023	6482	17		0.70	4.54	0.59	6.1
10-13-2023	6621	17		0.77	5.10		
10-14-2023	7292	16		0.86	6.27		
10-15-2023	7339	10		1.06	7.78		
10-16-2023	7286	14		0.91	6.63		
10-17-2023	7155	12		0.94	6.73		
10-18-2023	11496	22	5	1.02	11.73		17
10-19-2023	12211	17		0.98	11.97	2.64	13
10-20-2023	9578	15		1.20	11.49		
10-21-2023	9114	16		1.23	11.21		
10-22-2023	8320	18		1.21	10.07		
10-23-2023	7508	18		1.35	10.14		
10-24-2023	7120	23		1.36	9.68		
10-25-2023	6763	13	8	1.19	8.05		49
10-26-2023	6959	14		1.07	7.45	1.04	130
10-27-2023	7123	16		0.44	3.13		
10-28-2023	7555	16		0.61	4.61		
10-29-2023	7276	14		1.02	7.42		
10-30-2023	6930	14		1.14	7.90		
10-31-2023	6396	14		1.15	7.36		
11-01-2023	6685	13	5	1.22	8.16		7.8
11-02-2023	7443	10		1.17	8.71	1.28	16000
11-03-2023	7360	10		1.10	8.10		
11-04-2023	8638	13		1.14	9.85		
11-05-2023	8660	8		1.08	9.35		
11-06-2023	7369	9		1.14	8.40		
11-07-2023	8269	11		1.30	10.75		
11-08-2023	4228	10	5	1.36	5.75		
11-09-2023	7926	12		1.04	8.24	1.41	9200
11-10-2023	8659	10		1.10	9.53		
11-11-2023	13014	14		1.14	14.84		
11-12-2023	12008	10		1.11	13.33		
11-13-2023	10796	10		1.14	12.31		
11-14-2023	9120	11		1.11	10.12		
11-15-2023	8365	11	6	1.30	10.87		16000
11-16-2023	8042	10		1.07	8.60	1.42	35000
11-17-2023	8056	14		1.18	9.51		

11-18-2023	8573	9		1.20	10.29		
11-19-2023	8489	10		1.15	9.76		
11-20-2023	7762	10		1.14	8.85		
11-21-2023	7878	11		1.21	9.53		
11-22-2023	7916	10	6	1.22	9.66		9000
11-23-2023	8298	11		1.30	10.79	1.75	350
11-24-2023	8789	10		1.40	12.30		
11-25-2023	9463	13		1.33	12.59		
11-26-2023	9011	9		1.33	11.98		
11-27-2023	7820	10		1.47	11.50		
11-28-2023	7466	9		1.37	10.23		
11-29-2023	7639	9	7	1.41	10.77		3500
11-30-2023	7622	10		1.10	8.38	1.33	3500
12-01-2023	8110	6		1.20	9.73		
12-02-2023	9357	11		1.33	12.44		
12-03-2023	8561	9		1.55	13.27		
12-04-2023	9890	10		1.59	15.73		
12-05-2023	13798	13		1.31	18.08		
12-06-2023	12286	11	5	1.20	14.74		5400
12-07-2023	10070	12		1.20	12.08	1.44	24000
12-08-2023	11104	7		1.17	12.99		
12-09-2023	11033	12		1.21	13.35		
12-10-2023	10833	10		1.38	14.95		
12-11-2023	9654	10		1.34	12.94		
12-12-2023	9394	11		1.27	11.93		
12-13-2023	9118	8	5	1.41	12.86		16000
12-14-2023	8274	9		1.27	10.51	1.48	9200
12-15-2023	9734	11		1.00	9.73		
12-16-2023	10867	11		1.17	12.71		
12-17-2023	11134	11		1.20	13.36		
12-18-2023	11888	5		1.36	16.17		
12-19-2023	12102	12		1.39	16.82		
12-20-2023	12871	10	9	1.21	15.57		
12-21-2023	13294	8		1.23	16.35	1.55	
12-22-2023	14496	7		1.19	17.25		
12-23-2023	13959	5		1.21	16.89		
12-24-2023	13594	11		1.22	16.58		
12-25-2023	13725	10		1.17	16.06		
12-26-2023	16836	7		1.18	19.87		
12-27-2023	15876	9	6	1.22	19.37		16000
12-28-2023	16017	8		1.36	21.78	1.17	24000
12-29-2023	16854	9		1.43	24.10		
12-30-2023	16857	12		1.31	22.08		
12-31-2023	17215	17		1.34	23.07		

APPENDIX D: ACUTE LETHALITY TEST RESULTS

Acute Toxicity Test Results

Sample YVS108FE
collected March 23, 2023

Final Report

April 6, 2023

Submitted to: **Resort Municipality of Whistler**
Whistler, BC

8664 Commerce Court, Burnaby, BC V5A 4N7

SAMPLE INFORMATION

Sample ID	Dates			Receipt temp.
	Collected	Received	Rainbow trout test initiation	
YVS108FE	23-Mar-23 at 0900h	23-Mar-23 at 1252h 25-Mar-23 at 1050h*	27-Mar-23 at 1405h*	12.4 – 12.8 °C 12.9°C*

*Data provided by Nautilus Environmental Company Inc. (Calgary)

TESTS

- Rainbow trout 96-h LC50 test

RESULTS

Toxicity test results

Sample ID	LC50 (% v/v)*
YVS108FE	>100

LC = Lethal Concentration CL = Confidence Limits
*Data provided by Nautilus Environmental Company Inc. (Calgary)

QA/QC

QA/QC summary	Rainbow trout*
Reference toxicant LC50 (95% CL)	3.9 (3.6 – 4.3) g/L KCl[1]
Reference toxicant historical mean (2 SD range)	3.9 (3.3 – 4.7) g/L KCl
Reference toxicant CV	6%
Organism health history	Acceptable
Protocol deviations	None
Water quality range deviations	None
Control performance	Acceptable
Test performance	Valid

[1]Test date: March 15, 2023, LC = Lethal Concentration, CL = Confidence Limits, SD = Standard Deviation, CV = Coefficient of Variation
*Data provided by Nautilus Environmental Company Inc. (Calgary)

Report By:
Benji Mackay, B.Sc.
Laboratory Biologist

Reviewed By:
Emma Marus, B.Sc.
Biologist

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 96-h rainbow trout (*Oncorhynchus mykiss*) LC50 test.

Test species	*Oncorhynchus mykiss*
Organism source	Hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	20-L glass aquarium
Test volume	10 to 20 L (depending on size of fish)
Test solution depth	≥15 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Dechlorinated City of Calgary municipal tap water
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test measurements	Temperature, dissolved oxygen, pH, and conductivity measured at test initiation and termination; salinity measured in the undiluted sample at test initiation; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/13, with 2007 & 2016 amendments
Statistical software	CETIS Version 2.1.4
Test endpoint	Survival (96-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Potassium chloride (KCl)

APPENDIX B – Toxicity test data

NAUTILUS ENVIRONMENTAL

Trout Bench Sheet

Method TRD Client NAU 104 Reference 2223-1960 Chamber 2

Test Log

Day	Date	Time	Initial	Chem. Cart	Daily Data Review
0	2023/03/27	1405 *	KCRM/AG	7	NA
1	2023/03/28	1030	BS	-	ML
2	2023/03/29	0940	MS	-	JC
3	2023/03/30	0840	AG	-	NA
4	2023/03/31	0915	BS	7	ML

Note: * ; time when the test was loaded with fish

Sample Information

Initial pH: 6.5
Initial EC (µS/cm): 500
Salinity (ppt): 0

Sample Pre-Aeration

Aeration rate adjusted to 6.5 +/- 1 mL/min/L (yes/no)

Preaeration time	0 hours	0.5 hours	1 hour	1.5 hours	2 hours
DO(mg/L) of 100%	7.9	8.4			
Temp (°C) of 100%	15				

DO in mg/L (70% - 100% saturation)**
6.2 mg/L - 8.9 mg/L at 14°C
6.1 mg/L - 8.8 mg/L at 15°C
6.0 mg/L - 8.6 mg/L at 16°C
**corrected for altitude

Test Chemistry and Biology

Conc.	CTL	6.25	12.5	25	50	100		
pH (units) (range: **5.5-8.5**)								
Day 0	8.1	8.0	7.9	7.7	7.4	6.9		
Day 4	7.9	8.0	7.9	7.9	7.8	7.6		
EC (uS/cm)								
Day 0	291	393	396	401	410	475		
Day 4	389	394	398	402	413	429		
DO (mg/L) (**70-100% saturation at test temp.**)								
Day 0	8.8	8.8	8.8	8.8	8.8	8.6		
Day 4	8.8	8.8	8.8	8.8	8.8	8.8		
Temperature (°C) (range: **14-16°C**)								
Day 0	15	15	15	15	15	15		
Day 4	15	15	15	15	15	15		
Number Alive (In brackets number stressed)								
Day 0	10	10	10	10	10	10		
Day 1	10	10	10	10	10	10 (3)		
Day 2	10	10	10	10	10	10 (2)		
Day 3	10	10	10	10	10	10		
Day 4	10	10	10	10	10	10		

Validity Criteria: must be ≤ 10% mortality and/or stressed behavior in the control
Unless otherwise noted, behavior is considered to be normal

Control Organism Data

Control Fish	Length (cm)	Weight (g)
1	3.9	0.5
2	4.0	0.6
3	4.7	0.8
4	4.5	0.8
5	3.8	0.4
6	4.0	0.5
7	5.0	1.0
8	4.2	0.6
9	4.1	0.6
10	4.1	0.6

Loading Density (g/L): 0.4 (must be ≤0.5 g/L)
Mean Length (cm): 4.2
Length Range (cm): 3.8-5.0
Mean Weight (g): 0.6 (Must be ≥0.3g)
Weight Range: (g): 0.4 - 1.0

Test Organism Information

Batch 20221221TR
Source Trout Lodge
Tank # 12
Days Held at 15± 2°C 73 (must be ≥14 days)
Percent stock mortality 0 (7 days prior to test, must be <2%)
Test Volume (L) 18

Comments :

Reviewed By: TP Date Reviewed: MAR 31 2023

APPENDIX C – Chain-of-custody form

Nautilus Environmental
4340 Vardever Ave.
San Diego, CA 92120
Phone 858.587.7333
Fax 858.587.3961

Chain of Custody

March 23 2023 1 1

Sample Collection By: Neil Kearns

Report to:
- Company: RMOW
- Address: 1135 Cheakamus Lk Rd
- City/State/Zip: Whistler, BC V8E 0A4
- Contact: Neil Kearns
- Phone: 604-935-8384
- Email: nkearns@whistler.ca

Invoice To:
- Company: RMOW
- Address: 4325 Blackcomb Way
- City/State/Zip: Whistler, BC V8E 0X5
- Contact: Jenny James/ Laura Bowack
- Phone: 604-935-8385
- Email: ap@whistler.ca

	SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	NO. OF CONTAINERS	COMMENTS	ANALYSES REQUIRED: LC50 96 hr	Receipt Temperature (°C)
1	YVS108FE	March 23/2023	9:00 AM	Water	Jerry Can	2		x	12.4-12.8
2									
3									
4									
5								2305197	
6									
7									
8									
9									
10									

PROJECT INFORMATION
- Client:
- PO No.:
- Shipped Via:

SAMPLE RECEIPT
- Total No. of Containers: 2
- Received Good Condition? Y
- Matches Test Schedule? Y

SPECIAL INSTRUCTIONS/COMMENTS: PLEASE RETURN ALL CONTAINER FROM PREVIOUS TESTS ALSO THANK YOU :)

- Sublet to Calgary

RELINQUISHED BY (CLIENT)
(Signature) (Time) 9:00am
(Printed Name) Neil Kearns March 23 2023
(Company) RMOW

RELINQUISHED BY (COURIER)
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY (COURIER)
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY (LABORATORY)
(Signature) TM (Time) 12:52
(Printed Name) Tyrone (Date) Mar. 23/23
(Company) Nautilus

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

DISTRIBUTION: WHITE - Nautilus Environmental, COLOR - Originator

NAUTILUS ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby (1)
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary ( )
10823 27 Street SE
Calgary, Alberta, Canada
T2Z 3V9
Phone 403.253.7121

Point Edward ( )
704 Mara Street, Suite 122
Point Edward, Ontario, Canada
N7V 1X4
Phone 519.339.8787

Chain of Custody

Date_____Page__of__

Report to:		Invoice To:	
Company	(1)	Company	
Address		Address	
City/Prov/PC		City/Prov/PC	
Contact	Ditty Kakkassery	Contact	
Phone		Phone	
Email	ditty@nautilusenvironmental.ca	Email	
		PO No.	

Sample Collection By: **Sample Type:** Grab ( ) OR Composite ( )

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	ANALYSES REQUIRED: Rainbow Trout LC50	Receipt Temperature (°C)
1	YVS108FE	23/03/23	9:00		2x20L	230519	X	
2	2223-1960							
3	2023/03/25							
4	1050							
5	FedEx							
6	N2							
7	2x20L Pails							
8	No 5 / No 1							
9	Cost Condition							
10	12.9°C							

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

RELINQUISHED BY (CLIENT)

Tyrone TH
(Printed Name) (Signature)

Nautilus Mar. 23/23 @ ~~9:00~~ 15:30 TH
(Company) (Date DD/MM/YY and Time)

RECEIVED BY (LABORATORY)

(Printed Name) (Signature)

(Company) (Date DD/MM/YY and Time)

Our liability is limited to the cost of the test requested. The test results only relate to the sample as received. No liability in whole or in part is assumed for the collection, handling, or transport of the sample, application or interpretation of the test data or results in part or in whole.

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

END OF REPORT

Acute Toxicity Test Results

Sample YVS108FE
collected May 18, 2023

Final Report

June 8, 2023

Submitted to: **Resort Municipality of Whistler**
Whistler, BC

8664 Commerce Court, Burnaby, BC V5A 4N7

SAMPLE INFORMATION

Sample ID	Dates			Receipt temp.
	Collected	Received	Rainbow trout test initiation	
YVS108FE	18-May-23 at 0900h	18-May-23 at 1227h 19-May-23 at 0910h*	20-May-23 at 1435h*	18.8-18.9°C 17.3°C*

*Data provided by Nautilus Environmental Company Inc. (Calgary)

TESTS

- Rainbow trout 96-h LC50 test

RESULTS

Toxicity test results

Sample ID	LC50 (% v/v)*
YVS108FE	>100

LC = Lethal Concentration
*Data provided by Nautilus Environmental Company Inc. (Calgary)

QA/QC

QA/QC summary	Rainbow trout*
Reference toxicant LC50 (95% CL)	3.7 (3.3 – 4.1) g/L KCl[1]
Reference toxicant historical mean (2 SD range)	3.9 (3.3 – 4.7) g/L KCl
Reference toxicant CV	6%
Organism health history	Acceptable
Protocol deviations	None
Water quality range deviations	None
Control performance	Acceptable
Test performance	Valid

[1]Test date: May 10, 2023, LC = Lethal Concentration, CL = Confidence Limits, SD = Standard Deviation, CV = Coefficient of Variation
*Data provided by Nautilus Environmental Company Inc. (Calgary)

Report By:
Carley Winter, B.Sc.
Laboratory Biologist

Reviewed By:
Gabriella Utomo, B.Sc.
Senior Biologist

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 96-h rainbow trout (*Oncorhynchus mykiss*) LC50 test.

Test species	*Oncorhynchus mykiss*
Organism source	Hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	20-L glass aquarium
Test volume	10 to 20 L (depending on size of fish)
Test solution depth	≥15 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Dechlorinated City of Calgary municipal tap water
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test measurements	Temperature, dissolved oxygen, pH, and conductivity measured at test initiation and termination; salinity measured in the undiluted sample at test initiation; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/13, with 2007 & 2016 amendments
Statistical software	CETIS Version 2.1.4
Test endpoint	Survival (96-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Potassium chloride (KCl)

APPENDIX B – Toxicity test data

NAUTILUS

Trout Bench Sheet

Method TRD Client NAU104 Reference 2223-2546 Chamber 2

Test Log

Day	Date	Time	Initial	Chem. Cart	Daily Data Review
0	2023/05/20	1435 *	KZ/AM	7	AI
1	2023/05/21	0930	JK	-	AM
2	2023/05/22	0900	JK	-	CL
3	2023/05/23	0830	NZ	-	MM
4	2023/05/24	1110	JK	7	BS

Note: * ; time when the test was loaded with fish

Sample Information

Initial pH: KZ 7.2
Initial EC (µS/cm): ~~1049~~ 529
Salinity (ppt): 0

Sample Pre-Aeration

Aeration rate adjusted to 6.5 +/- 1 mL/min/L (yes/no)

Preaeration time	0 hours	0.5 hours	1 hour	1.5 hours	2 hours
DO(mg/L) of 100%	7.3	7.7			
Temp (°C) of 100%	16				

DO in mg/L (70% - 100% saturation)**
6.2 mg/L - 8.9 mg/L at 14°C
6.1 mg/L - 8.8 mg/L at 15°C
6.0 mg/L - 8.6 mg/L at 16°C
**corrected for altitude

Test Chemistry and Biology

Conc.	CTL	6.25	12.5	25	50	100		
pH (units) (range: 5.5-8.5)								
Day 0	8.4	8.1	8.0	7.7	7.4	6.9		
Day 4	8.0	8.1	8.1	8.1	8.0	7.9		
EC (uS/cm)								
Day 0	383	404	410	442	480	559		
Day 4	394	411	415	449	492	569		
DO (mg/L) (70-100% saturation at test temp.)								
Day 0	8.8	8.8	8.8	8.8	8.8	7.7		
Day 4	8.8	8.8	8.8	8.8	8.8	8.8		
Temperature (°C) (range: 14-16°C)								
Day 0	15	15	15	15	15	15		
Day 4	15	15	15	15	15	15		
Number Alive (In brackets number stressed)								
Day 0	10	10	10	10	10	10		
Day 1	10	10	10	10	10	10		
Day 2	10	10	10	10	10	10		
Day 3	10	10	10	10	10	10		
Day 4	10	10	10	10	10	10		

Validity Criteria: must be ≤ 10% mortality and/or stressed behavior in the control
Unless otherwise noted, behavior is considered to be normal

Control Organism Data

Control Fish	Length (cm)	Weight (g)
1	3.5	0.5
2	3.7	0.6
3	3.7	0.6
4	3.4	0.4
5	3.7	0.6
6	3.0	0.4
7	3.3	0.5
8	3.3	0.4
9	3.3	0.5
10	3.3	0.4

Loading Density (g/L): 0.3 (must be ≤0.5 g/L)
Mean Length (cm): 3.4
Length Range (cm): 3.0-3.7
Mean Weight (g): 0.5 (Must be ≥0.3g)
Weight Range: (g): 0.4-0.6

Test Organism Information

Batch 20230412TR
Source Smoky Trout Farm
Tank # 9
Days Held at 15± 2°C 38 (must be ≥14 days)
Percent stock mortality 0 (7 days prior to test, must be <2%)
Test Volume (L) 18

Comments :

Reviewed By: CW Date Reviewed: MAY 25 2023

APPENDIX C – Chain-of-custody form

Nautilus Environmental

4340 Vendever Ave.
San Diego, CA 92120
Phone 858.587.7333
Fax 858.587.3961

Chain of Custody

may 18th 2023 1 1

Sample Collection By: Neil Kearns

Report to:		Invoice To:	
Company	RMOW	Company	RMOW
Address	1135 Cheakamus Lk Rd	Address	4325 Blackcomb Way
City/State/Zip	Whistler, BC V8E 0A4	City/State/Zip	Whistler, BC V8E 0X5
Contact	Neil Kearns	Contact	Ahren Snikveld/ Laura Bowack
Phone	604-935-8384	Phone	604-935-8385
Email	nkearns@whistler.ca	Email	ap@whistler.ca

	SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	NO. OF CONTAINERS	COMMENTS	ANALYSES REQUIRED: LC50 96 hr	Receipt Temperature (°C)
1	YVS108FE	May 18th 2023	9:00 AM	Water	Jerry Can	2		x	18.8-18.9
2									
3									
4									
5								4	
6								9	
7								8	
8								0	
9								3	
10								2	

PROJECT INFORMATION		SAMPLE RECEIPT	
Client:		Total No. of Containers	2
PO No.:		Received Good Condition?	
Shipped Via:		Matches Test Schedule?	

SPECIAL INSTRUCTIONS/COMMENTS: PLEASE RETURN ALL CONTAINER FROM PREVIOUS TESTS ALSO THANK YOU :)

RELINQUISHED BY (CLIENT)
(Signature) (Time) 9am
(Printed Name) Neil Kearns (Date) May 18th 2023
(Company) RMOW

RELINQUISHED BY (COURIER)
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY (COURIER)
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY (LABORATORY)
(Signature) TH (Time) 12:27
(Printed Name) Tyrone (Date) May 18/23
(Company) Nautilus

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

DISTRIBUTION: WHITE - Nautilus Environmental, COLOR - Originator

NAUTILUS ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby ( )
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary ( )
10823 27 Street SE
Calgary, Alberta, Canada
T2Z 3V9
Phone 403.253.7121

Point Edward ( )
704 Mara Street, Suite 122
Point Edward, Ontario, Canada
N7V 1X4
Phone 519.339.8787

Chain of Custody

Date_____Page__of__

Report to:		**Invoice To:**	
Company	Nautilus Environmental Company Inc.	**Company**	Same
Address		**Address**	
City/Prov/PC		**City/Prov/PC**	
Contact	Ditty Kakkassery	**Contact**	
Phone		**Phone**	
Email	ditty@nautilusenvironmental.ca	**Email**	
		PO No.	

Sample Collection By: **Sample Type:** Grab (•) OR Composite ( )

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	ANALYSES REQUIRED: 96h RBT LC50	Receipt Temperature (°C)
1	YVS108FE	May 18, 2023	09:00	Water	2x20L	WO# 230894	✓	
2	2223-2346							
3	20231015/19							
4	0910							
5	Purolator							
6	ACIET							
7	2x20L pails							
8	nosinoI							
9	good cond.							
10	17.3°C							

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

RELINQUISHED BY (CLIENT)

Ditty K (Printed Name) DK (Signature)

(Company) May 18/23; 1400h (Date DD/MM/YY and Time)

RECEIVED BY (LABORATORY)

(Printed Name) (Signature)

(Company) (Date DD/MM/YY and Time)

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

END OF REPORT

Acute Toxicity Test Results

Sample YVS108FE
collected on August 3, 2023

Final Report

September 12, 2023

Submitted to: **Resort Municipality of Whistler**
Whistler, BC

8664 Commerce Court, Burnaby, BC V5A 4N7

SAMPLE INFORMATION

Sample ID	Dates			Receipt temp.
	Collected	Received	Rainbow trout test initiation	
YVS108FE	03-Aug-23 at 0900h	03-Aug-23 at 1240h	04-Aug-23 at 0900h	20.4 – 21.1°C

TESTS

- Rainbow trout 96-h LC50 test

RESULTS

Toxicity test results

Sample ID	LC50 (% v/v)
YVS108FE	>100

LC = Lethal Concentration

QA/QC

QA/QC summary	Rainbow trout
Reference toxicant LC50 (95% CL)	1.2 (1.1 – 1.3) g/L KCl[1]
Reference toxicant historical mean (2 SD range)	1.8 (1.1 – 3.0) g/L KCl
Reference toxicant CV	27%
Organism health history	Acceptable
Protocol deviations	None
Water quality range deviations	None
Control performance	Acceptable
Test Performance	Valid

[1]Test date: July 24, 2023, LC = Lethal Concentration, CL = Confidence Limits, SD = Standard Deviation, CV = Coefficient of Variation

Report By:
Ditty Kakkassery, R.P. Bio.
Laboratory Supervisor

Reviewed By:
Mikayla Oldach, M.Sc.
Environmental Toxicologist

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 96-h rainbow trout (*Oncorhynchus mykiss*) LC50 test.

Test species	*Oncorhynchus mykiss*
Organism source	Fish hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	5-gallon glass aquaria
Test volume	10 - 20 L, depending on size of fish
Test solution depth	≥15 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Dechlorinated Metro Vancouver municipal tap water
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light/8 hours dark
Aeration	6.5 ±1 mL/min/L
Test Measurements	Temperature, dissolved oxygen, pH, and conductivity measured at test initiation and termination; salinity measured at test initiation; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/13, with 2007 & 2016 amendments
Statistical software	CETIS Version 2.1.4
Test endpoints	Survival (96-hour LC50)
Test acceptability criteria for controls	Survival ≥ 90%
Reference toxicant	Potassium chloride (KCl)

APPENDIX B Toxicity test data

Rainbow Trout Summary Sheet

Client: RMOW

Start Date/Time: August 4, 2023 | 0900h

Work Order No.: 231350

Test Species: *Oncorhynchus mykiss*

Sample Information:

Sample ID: YVS108FE
Sample Date: August 3, 2023
Date Received: August 3, 2023
Sample Volume: 2 x 20L
Other: –

Test Validity Criteria:
≥ 90% Control Survival
WQ Ranges:
T (°C) = 15 ± 1; DO (mg/L) = 7.0 to 10.3; pH = 5.5 to 8.5

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L $CaCO_3$): 11
Alkalinity (mg/L $CaCO_3$): 21

Test Organism Information:

Batch No.: 071023
Source: Aqua Farms
No. Fish/Volume (L): 10/12L
Loading Density (g/L): 0.25
Mean Length ± SD (mm): 34 ± 2 Range: 30 – 37
Mean Weight ± SD (g): 0.30 ± 0.06 Range: 0.21 – 0.44

KCl Reference Toxicant Results:

Reference Toxicant ID: RBTK78
KCl Lot #: 213248
Date Initiated: July 24123
96-h LC50 (95% CL) [g/L KCl]: 1.2 (1.1 – 1.3)

Reference Toxicant Mean and Historical Range [g/L KCl]: 1.8 (1.1 – 3.0)
Reference Toxicant CV (%): 27%

Test Results: The 96h LC50 is estimated to be >100% (v/v)

Reviewed by: MDO

Date reviewed: September 12, 2023

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: RMOW
Sample I.D. YVS108FE
W.O. # 231350
RBT Batch #: 071023
Date Collected/Time: Aug 3/23 @ 0900h
Date Setup/Time: Aug 4/23 @ 0900h
CER #: 7
Sample Setup By: IMe

Thermometer: CER#7
D.O. meter/probe: MP-1 / 1
Cond./Salinity meter/probe: MP-1 / 1
pH meter/probe: MP-1 / 1

Number Fish/Volume: 10 / 12L
7-d % Mortality: 0.95
Total Pre-aeration Time (mins): 30
Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	16.0		15.5
D.O. (mg/L)	7.6		8.4
pH	6.7		6.8
Cond. (µS/cm)	447		447
Salinity (ppt)	0.3		0.3

Concentration	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
(% v/v)	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Ctrl				10	10	10	~~9~~ 10	15.0				15.0	9.8				8.6	7.0				7.0	54	60
6.25				10	10	10	~~9~~ 10	15.0				15.0	9.7				9.5	7.0				7.1	80	84
12.5				10	10	10	10	15.5				15.0	9.9				9.9	6.9				7.2	117	125
25				10	10	10	10	15.5				15.0	9.9				9.6	6.9				7.2	161	170
50				10	10	10	10	15.5				15.0	9.5				9.7	7.0				7.3	253	262
100				10	10	10	10	15.5				15.0	8.4				9.4	6.8				7.3	447	464
Initials				IMe	TC	TC	AvG	IMe	—	—	—	AvG	IMe	—	—	—	AvG	IMe	—	—	—	AvG	IMe	AvG

Sample Description/Comments: Yellow, clear, odourless, no particulates

Fish Description at 96 h: All remaining fish appear Normal.
Number of Stressed Fish at 96 h: 0

Other Observations: * one fish found outside tank
Test solution depth in each vessel ≥15 cm? (Y/N): Y

Reviewed by: MDO
Date Reviewed: September 12, 2023

APPENDIX C – Chain-of-custody form

Nautilus Environmental

4340 Vandever Ave.
San Diego, CA 92120
Phone 858.587.7333
Fax 858.587.3961

Chain of Custody

March 17 2022 1 1

Sample Collection By: Neil Kearns

Report to:		Invoice To:	
Company	RMOW	Company	RMOW
Address	1135 Cheakamus Lk Rd	Address	4325 Blackcomb Way
City/State/Zip	Whistler, BC V8E 0A4	City/State/Zip	Whistler, BC V8E 0X5
Contact	Neil Kearns	Contact	Ahren Snikveld/ Laura Bowack
Phone	604-935-8384	Phone	604-935-8385
Email	nkearns@whistler.ca	Email	ap@whistler.ca

	SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	NO. OF CONTAINERS	COMMENTS	ANALYSES REQUIRED: LC50 96 hr	Receipt Temperature (°C)
1	YVS108FE	August 3/2023	9:00 AM	Water	Jerry Can	2 x20 L		x	20.4-21.1°C
2									
3									
4									
5								0	
6								5	
7								3	
8								1	
9								2	
10									

PROJECT INFORMATION		SAMPLE RECEIPT		RELINQUISHED BY (CLIENT)	RELINQUISHED BY (COURIER)
Client:		Total No. of Containers	2	(Signature) (Time) 9:00am	(Signature) (Time)
PO No.:		Received Good Condition?	Y	(Printed Name) Neil Kearns August 3 2023	(Printed Name) (Date)
Shipped Via:		Matches Test Schedule?	Y	(Company) RMOW	(Company)

SPECIAL INSTRUCTIONS/COMMENTS: PLEASE RETURN ALL CONTAINER FROM PREVIOUS TESTS ALSO THANK YOU :)

RECEIVED BY (COURIER)	RECEIVED BY (LABORATORY)
(Signature) (Time)	(Signature) TU (Time) Aug. 3/23
(Printed Name) (Date)	(Printed Name) Tyrone (Date) 12:40
(Company)	(Company) NautEnv

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

DISTRIBUTION: WHITE - Nautilus Environmental, COLOR - Originator

END OF REPORT

Acute Toxicity Test Results

Sample YVS108FE
collected on November 16, 2023

Final Report

December 6, 2023

Submitted to: **Resort Municipality of Whistler**
Whistler, BC

8664 Commerce Court, Burnaby, BC V5A 4N7

SAMPLE INFORMATION

Sample ID	Dates			Receipt temp.
	Collected	Received	Rainbow trout test initiation	
YVS108FE	16-Nov-23 at 0900h	16-Nov-23 at 1350h	20-Nov-23 at 1025h	12.1 – 12.6°C

TESTS

- Rainbow trout 96-h LC50 test

RESULTS

Toxicity test results

Sample ID	LC50 (% v/v)
YVS108FE	>100

LC = Lethal Concentration

QA/QC

QA/QC summary	Rainbow trout
Reference toxicant LC50 (95% CL)	2.3 (2.0 – 2.6) g/L KCl[1]
Reference toxicant historical mean (2 SD range)	1.4 (0.6 – 3.1) g/L KCl
Reference toxicant CV	42%
Organism health history	Acceptable
Protocol deviations	None
Water quality range deviations	None
Control performance	Acceptable
Test performance	Valid

[1]Test date: November 12, 2023, LC = Lethal Concentration, CL = Confidence Limits, SD = Standard Deviation, CV = Coefficient of Variation

Report By:
Kyle Vu, B.Sc.
Laboratory Biologist

Reviewed By:
Gabriella Utomo, B.Sc.
Senior Biologist

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 96-h rainbow trout (*Oncorhynchus mykiss*) LC50 test.

Test species	*Oncorhynchus mykiss*
Organism source	Hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	20-L glass aquarium
Test volume	10 to 20 L (depending on size of fish)
Test solution depth	≥15 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Dechlorinated Metro Vancouver municipal tap water
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test measurements	Temperature, dissolved oxygen, conductivity, and pH measured at test initiation and termination; salinity measured in the undiluted sample at test initiation; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/13, with 2007 & 2016 amendments
Statistical software	CETIS Version 2.1.4
Test endpoint	Survival (96-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Potassium Chloride (KCl)

APPENDIX B Toxicity test data

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project #: RMOW
W.O. # 231910
Sample I.D. YVS10SFE
Date Collected/Time: Nov. 16, 2023/0900 h
Date Setup/Time: Nov. 20, 2023/1025h
Date Terminated/Time: Nov. 24, 2023/1220h
CER #: 9
Sample Setup By: AMD

Reference Toxicant ID/Date: RBTK87/ Nov. 12, 2023
Thermometer: CER#2
D.O. meter/probe: MPi / D1
Cond./Salinity meter/probe: MPi / C1
pH meter/probe: MPi / P1

RBT Source/Batch #: Aquafarms 100523
Number Fish/Volume: 10/12L
7-d % Holding Mortality: 0
Total Pre-aeration Time (min.): 30
Aeration rate adjusted to 6.5 ± 1 mL/min·L (Y/N): Y
Dilution Water Type: Dechlorinated Municipal Tap Water
Dilution Water H/A (mg/L as CaCO3): 18/17

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	14.0		14.0
D.O. (mg/L)	8.2		9.7
pH	6.3		6.9
Cond. (µS/cm)	449		450
Salinity (ppt)	0.3		0.3

Concentration	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
(% v/v)	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
ctrl				10	10	10	10	15.5				15.5	10.0				9.9	7.3				7.0	63	69
6.25				10	10	10	10	15.5				15.5	10.1				9.9	7.2				7.2	89	95
12.5				10	10	10	10	15.0				15.5	10.0				9.9	7.2				7.2	132	138
25				10	10	10	10	15.0				15.5	10.0				9.8	7.0				7.3	156	163
50				10	10	10	10	15.0				15.5	9.5				9.8	6.7				7.3	263	269
100				10	10	10	10	14.0				16.0	9.6 AMD 9.7				9.8	6.8 AMD 6.9				7.4	450	454
Initials				AMD	AMD	AMD	AMD	AMD				AMD	AMD				AMD	AMD				AMD	AMD	AMD

Sample Description/Comments: clear yellow-coloured, chemical-odoured liquid without particulates

Fish Description at 96 h: All fish appear normal

Number of Stressed Control Fish at 96 h: 0

Other Observations:

Test solution depth in each vessel ≥15 cm? (Y/N): Y

Reviewed by: GRN

Date Reviewed: Dec 5/23

Rainbow trout (Oncorhynchus mykiss) Length and Weight Sheet

Client: RMOW
Sample ID: YVS10SFE
W.O. #: 231910
Batch #: Aquafarms 100523

Balance ID: Bal - 3
Start Date/Time: Nov 20, 2023 / 1025
End Date/Time: Nov 24, 2023 / 1229h
Date/Time Measured: Nov 24, 2023 / 1239h

	Length (mm)	Weight (g)
1	40	0.51
2	43	0.72
3	39	0.51
4	35	0.42
5	34	0.35
6	39	0.50
7	33	0.36
8	40	0.55
9	32	0.25
10	33	0.28
Total	368	~~4.45~~ AMD 4.45
Mean	37	~~0.44~~ AMD 0.44
Std. Dev.	4	~~0.14~~ AMD 0.14
Low	32	0.25
High	43	0.72

Volume Tested (L): 12

Loading Density (g/L): 0.37

Initials: AMD

Reviewed by: GSH Date Reviewed: Dec-5/23

APPENDIX C – Chain-of-custody form

Nautilus Environmental

4340 Vandever Ave.
San Diego, CA 92120
Phone 858.587.7333
Fax 858.587.3961

Chain of Custody

March 17 2022 1 1

Sample Collection By: Neil Kearns

Report to:

Company	RMOW
Address	1135 Cheakamus Lk Rd
City/State/Zip	Whistler, BC V8E 0A4
Contact	Neil Kearns
Phone	604-935-8384
Email	nkearns@whistler.ca

Invoice To:

Company	RMOW
Address	4325 Blackcomb Way
City/State/Zip	Whistler, BC V8E 0X5
Contact	Arhen Snikvelds/ Laura Bowack
Phone	604-935-8385
Email	ap@whistler.ca

	SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	NO. OF CONTAINERS	COMMENTS	ANALYSES REQUIRED: LC50 96 hr	Receipt Temperature (°C)
1	YVS108FE	Nov 16/2022	9:00 AM	Water	Jerry Can	2		x	12.1-12.6°C
2									
3									
4									
5								10	
6								9	
7								1	
8								3	
9								3	
10								2	

PROJECT INFORMATION

Client:	
PO No.:	
Shipped Via:	

SAMPLE RECEIPT

Total No. of Containers	2
Received Good Condition?	
Matches Test Schedule?	

SPECIAL INSTRUCTIONS/COMMENTS: PLEASE RETURN ALL CONTAINER FROM PREVIOUS TESTS ALSO THANK YOU :)

RELINQUISHED BY (CLIENT)

(Signature) (Time) 9:00am

(Printed Name) Neil Kearns Nov. 16 2022

(Company) RMOW

RELINQUISHED BY (COURIER)

(Signature) (Time)

(Printed Name) (Date)

(Company)

RECEIVED BY (COURIER)

(Signature) (Time)

(Printed Name) (Date)

(Company)

RECEIVED BY (LABORATORY)

(Signature) Tu (Time)

(Printed Name) Tymra (Date)

(Company) Nautilus

Nov. 16/23
@ 13:50

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

DISTRIBUTION: WHITE - Nautilus Environmental, COLOR - Originator

END OF REPORT

APPENDIX E: RECEIVING ENVIRONMENT MONITORING

CASCADE ENVIRONMENTAL
RESOURCE GROUP LTD

DATE:	**April 1, 2024**
TO:	**Chris Wike, Neil Kearns, Resort Municipality of Whistler**
FROM:	**Sarah Lindsay, Cascade Environmental Resource Group Ltd.**
	Candace Rose-Taylor, Cascade Environmental Resource Group Ltd.
RE:	**2023 Whistler Wastewater Treatment Plant Report: Receiving Environment Data Analysis**
FILE #:	**013-34-13**

1 Introduction

The Resort Municipality of Whistler (RMOW) retained Cascade Environmental Resource Group Ltd. (Cascade) to conduct the data analysis of the Receiving Environment Monitoring section of the 2023 Annual Wastewater Treatment Plant Report. The Whistler Wastewater Treatment Plant (WWTP) is operated by the RMOW under the operational certificate ME-01452 under the provisions of the *Environmental Management Act*, which requires the RMOW to sample the WWTP discharge effluent and the receiving environment in the Cheakamus River and summarize the sample data in an annual report.

2 Receiving Environment Monitoring

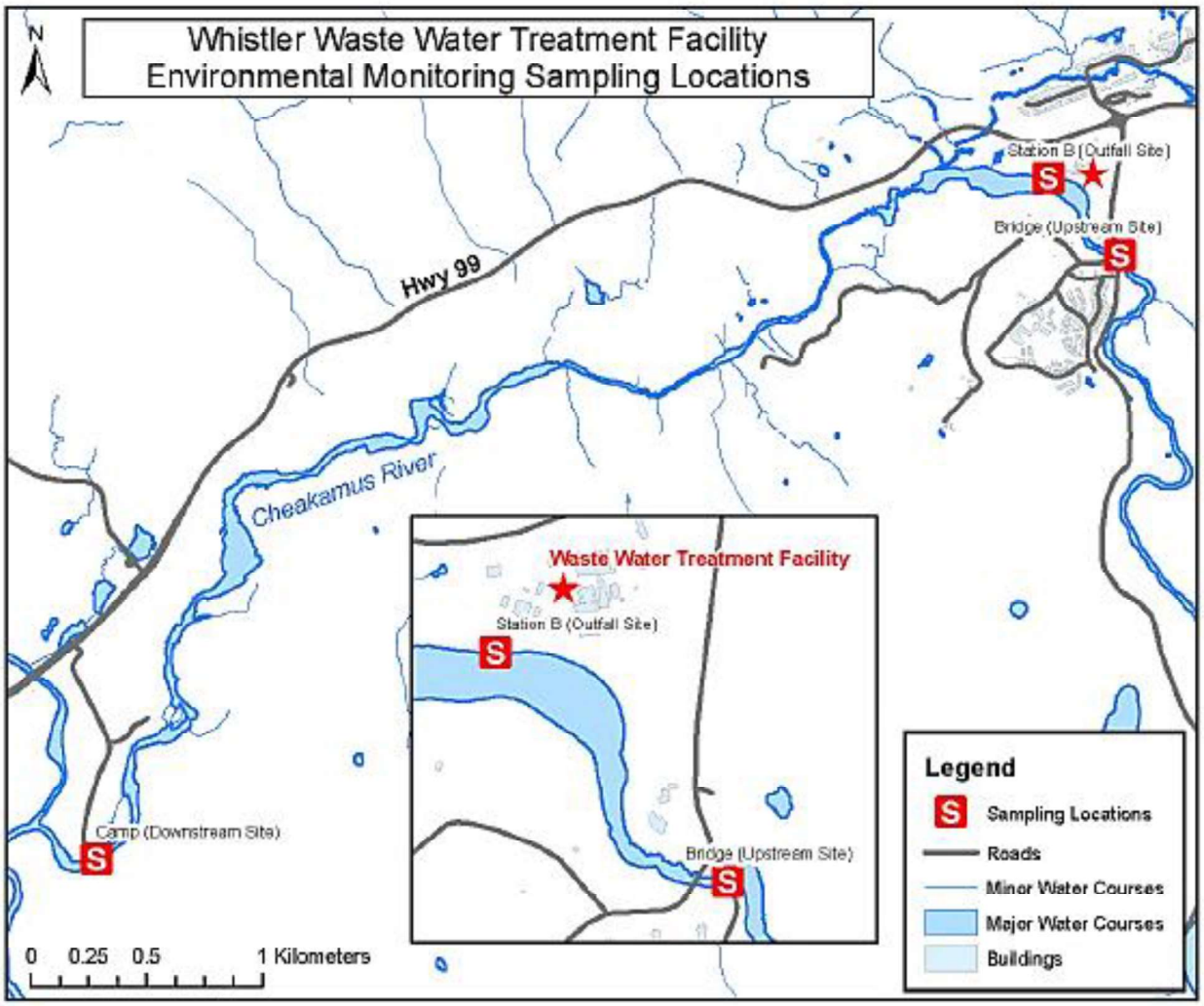
The receiving environment (the Cheakamus River) is sampled once per month by WWTP staff, and the samples are submitted to a certified laboratory. The operational certificate requires the RMOW to monitor two sampling stations, with a grab sample taken three times per year. The RMOW exceeds this requirement by sampling at three locations, every month of the year.

The monitored parameters are compared at three sampling locations: Upstream, Outfall and Downstream (see Map 1). The sample locations are as follows: the upstream sampling location is at the 'Bridge', approximately 100 metres upstream of the outfall; the outfall location is also referred to as 'Station B'; and the downstream sampling location is also known as 'Camp', which is approximately 4 kilometres downstream of the outfall.

Parameters required for sample analysis in the receiving environment by the operational certificate are pH, conductivity, turbidity, orthophosphate (as phosphorous), nitrate nitrogen, nitrite nitrogen, and ammonia nitrogen. Results that fall below the laboratory detection limit are represented graphically in this report as equal to the laboratory detection limit.

This report is intended to meet the operational certificate reporting requirements to be provided by a qualified professional that includes a compendium of both discharge and receiving environment data, a trend analysis review and interpretation of analytical data for results of the 2023 sample year and comparisons with past years in terms of potential impact to the receiving environment.

Map 1: Whistler Wastewater Treatment Plant Environmental Monitoring Sampling Locations



3 Water Quality Guidelines

Receiving environment sample results were compared to several water quality guidelines to determine compliance. Guidelines exist for many of the sample parameters: the operational certificate (ME-01452), current British Columbia approved water quality guidelines for aquatic life (BC WQG), and the Province of BC *Environmental Management Act* Contaminated Sites Regulation (CSR) - Schedule 3.2 – Generic Numerical Water Standards. The BC WQGs provide policy direction and are used as the basis for determining the allowable limits in waste discharge authorizations, however they do not have direct legal standing. The CSR standards are legally upheld in BC. The operational certificate requirements must be met to maintain legal authorization to operate the WWTP. All water quality standards used in this report are for the protection of freshwater aquatic life. Legally binding guidelines will be used (operational certificate and CSR) where possible and the most conservative guidelines will be prioritized.

Table 1: Guidelines for Water Samples in the Receiving Environment

Parameter	Unit	Operational Certificate	CSR	BC WQG
Ammonia-N	mg/L	-	1.3 (pH ≥ 8.5) 3.7 (pH 8.0 – < 8.5) 11.3 (pH 7.5 – < 8.0) 18.5 (pH 7.0 – 7.5) 18.4 (pH < 7.0)	Varies with temperature and pH
Conductivity	µS/cm	No guideline or standard for conductivity - typical range in Western Canadian surface waters is 4.8 to 84,600 µS/cm (NAQUADAT, 1985)		
Nitrate-N	mg/L	-	400	3.0
Nitrite-N	mg/L	-	200 (Cl < 2 mg/L) 400 (Cl 2 – < 4 mg/L) 600 (Cl 4 – < 6 mg/L) 800 (Cl 6 – < 8 mg/L) 1000 (Cl 8 – < 10 mg/L) 2000 (Cl ≥ 10 mg/L)	0.02 (when Cl^- ≤ 2 mg/L) 30-day average 0.06 (Cl^- ≤ 2 mg/L) short-term
Nitrate + Nitrite	mg/L	-	400	3.0
Orthophosphate (as phosphorus)	mg/L	1.75	-	0.01* (for recreational use)
pH	-	-	-	6.5-9.0
Turbidity	NTU	-	-	±8 (clear water/ 24 hours) ±2 (clear water/ 30 days) ±5 (background is 8-50) ±10% (background is >50)

4 pH in the Receiving Environment

The provincial water quality guidelines for aquatic life state that pH should measure between 6.5 and 9.0. Sample results from 2023 are displayed in Figure 1. Results show that except for one sample in September at the outfall location, all samples comply with the guideline range (displayed in red) and exhibit minimal variation throughout the year. The September sampling event is 0.05 below the guideline and is consistent with the low pH trend observed in the upstream background sample. The average pH measurements for 2023 are 6.83 upstream, 6.82 at the outfall, and 6.84 at the downstream.

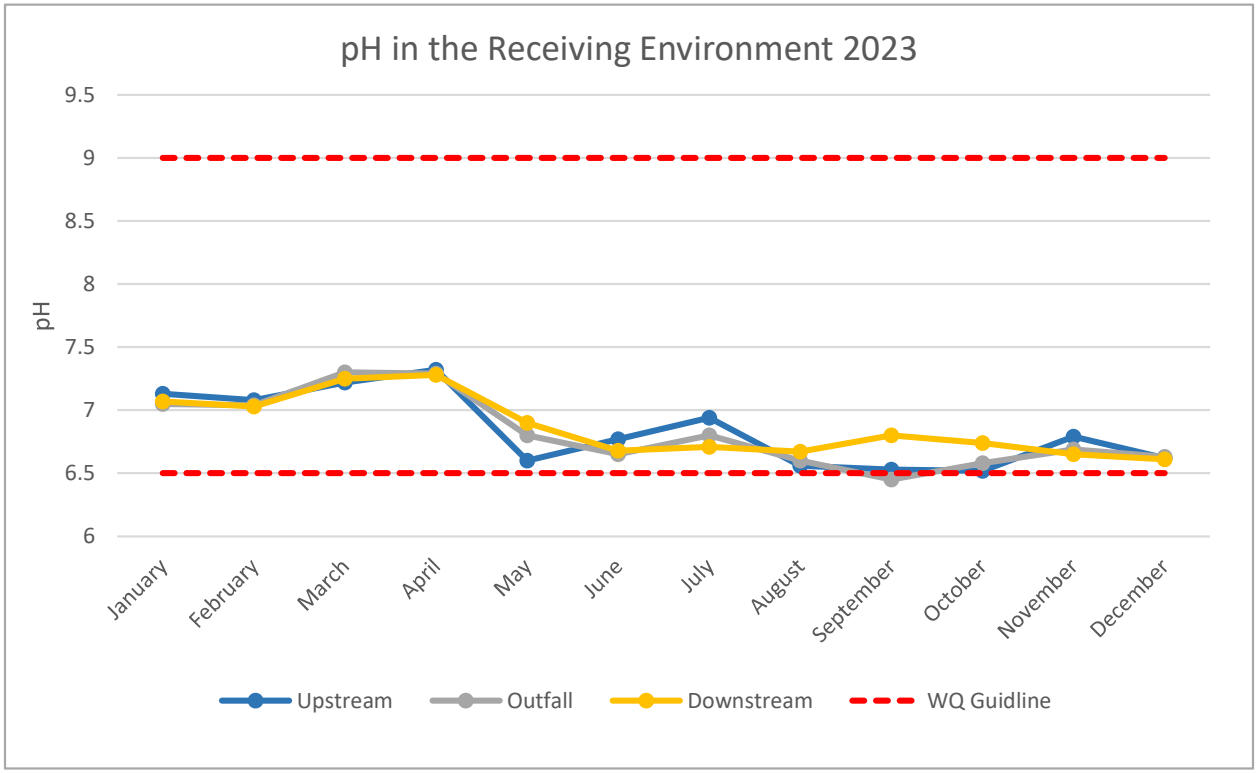


Figure 1: Whistler Wastewater Treatment Plant pH Monitoring in the Receiving Environment for 2023.

Figure 2 compares the pH sample results from 2016 to 2023 at the outfall location, to the provincial water quality guidelines graphed in red. The pH has remained within the WQG for all years sampled, except for two instances. The most recent instance occurred in September 2023 where the outfall pH measured 6.45. The second instance was a measurement of 6.1, not identified on the graph, taken at the downstream sample location in October 2017. However, the recorded pH at the outfall during this same sample event was 6.68, which complies with the guidelines.

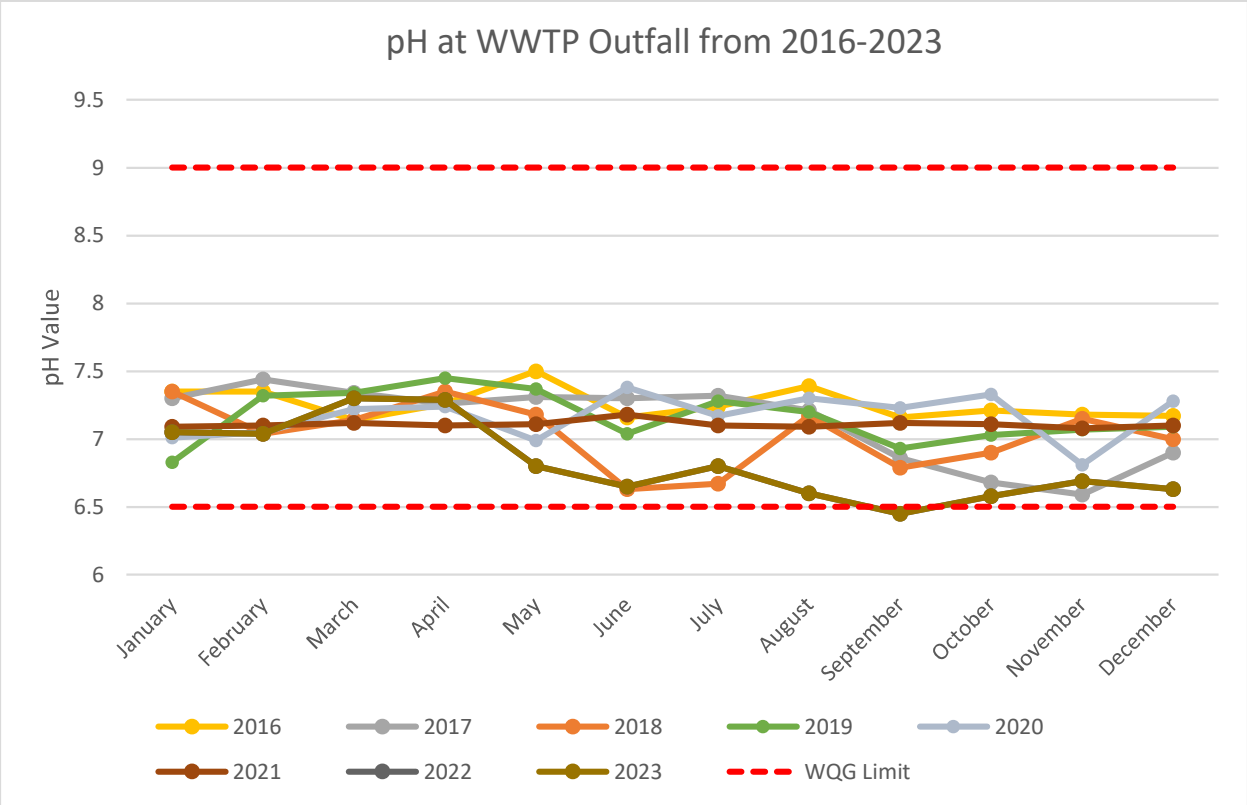


Figure 2: pH at the Whistler WWTP Outfall on the Cheakamus River from 2016-2023.

5 Conductivity in the Receiving Environment

The water quality samples from the Cheakamus River receiving environment in 2023 demonstrated an electrical conductivity range of 26.8 to 177 µS/cm at all sample locations. This is higher than the data from 2016 to 2021 that had an overall range of 26 to 121 µS/cm. Higher than average values were seen in September and were recorded at both the upstream (154 µS/cm) and the downstream (177 µS/cm) water quality locations. Samples taken at the outfall of the waste treatment plant were within normal range (32.4 µS/cm). This data indicates that raises in the conductivity of the samples were due to outside factors not related to the waste treatment plant. Conductivity typically ranges from 4.8 to 84,600 µS/cm in Western Canada surface waters (NAQUADAT, 1985); therefore, all conductivity results are within range.

Figure 3 displays conductivity results from the outfall location with a general trend of higher readings in the winter months (December to April) and lower in summer months (May to November). Increased conductivity may be due to increased salts and minerals present during months with higher precipitation. The average conductivity at the outfall during the winter of 2023 is 73.82 µS/cm and 41.22 µS/cm in the summer. This trend is consistent with previous years sampling data.

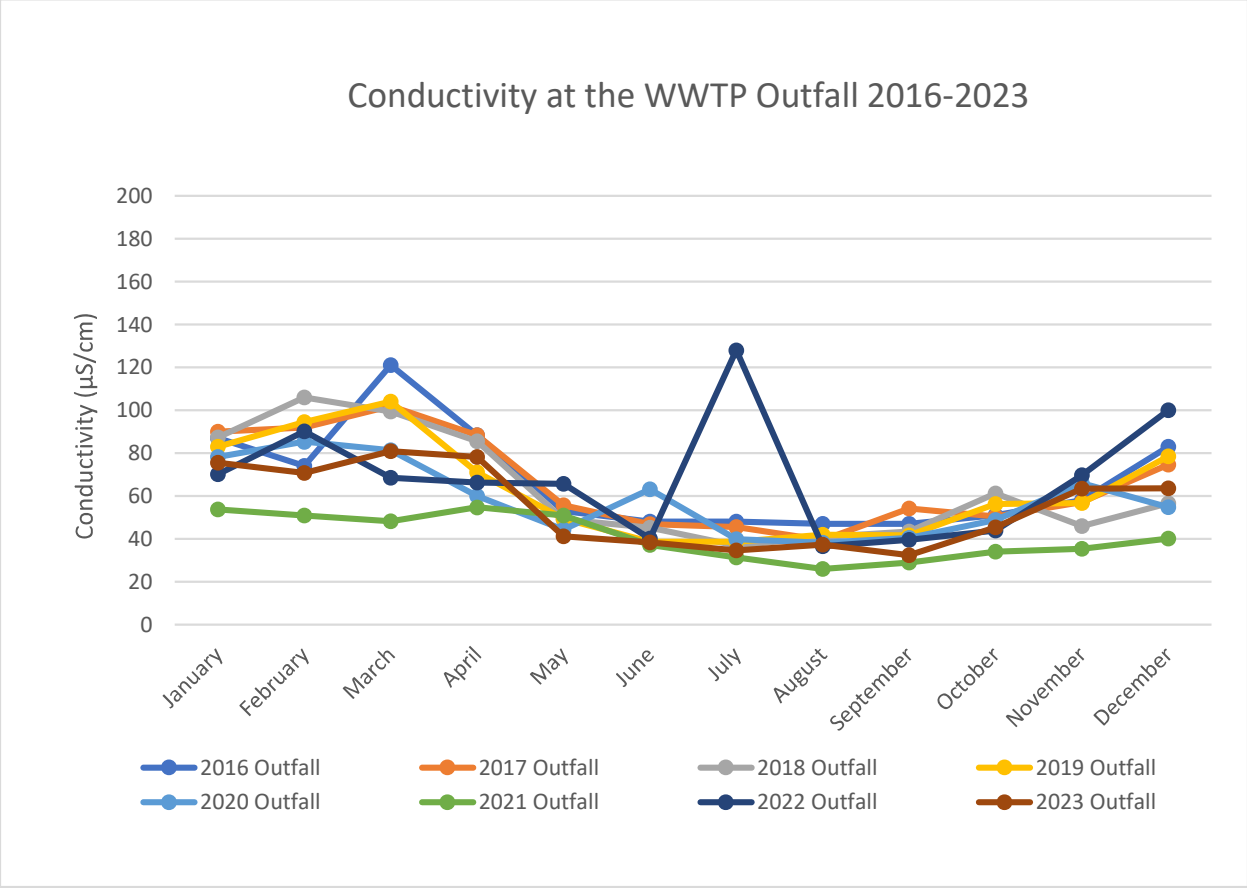


Figure 3: Conductivity Sample Results from the Whistler WWTP Outfall on the Cheakamus River from 2016-2023.

6 Turbidity in the Receiving Environment

There are no operational certificates or CSR guidelines for the turbidity of water. The BC WQG states that in clear waters (less than 8 NTU) the allowable turbidity is a short-term change of 8 NTU from background. When background is between 8 to 50 NTU, the allowable change is 5 NTU, and when background is over 50 NTU the allowable change is 10% from background. The upstream sample location will provide the background turbidity measurement.

Figure 4 displays the results for turbidity samples in the receiving environment for the year 2023 with the BC WQG displayed in red. There is no sample event for the year 2023 that exceeds the BC WQG for turbidity.

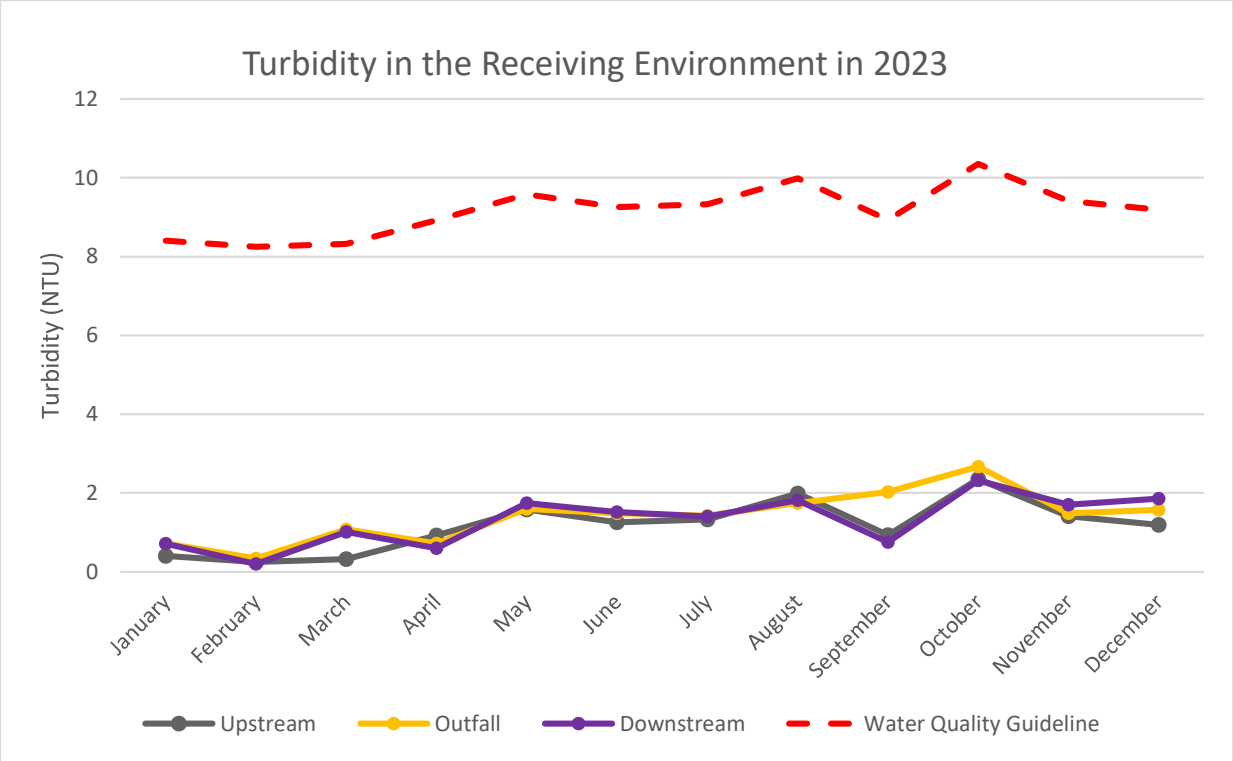


Figure 4: 2023 Turbidity Sample Results of the Whistler WWTP Receiving Environment.

Figure 5 depicts the results of turbidity samples from the years 2016 to 2023 at the Whistler WWTP Outfall sample location. Turbidity records for this period have not exceeded the BC WQG.

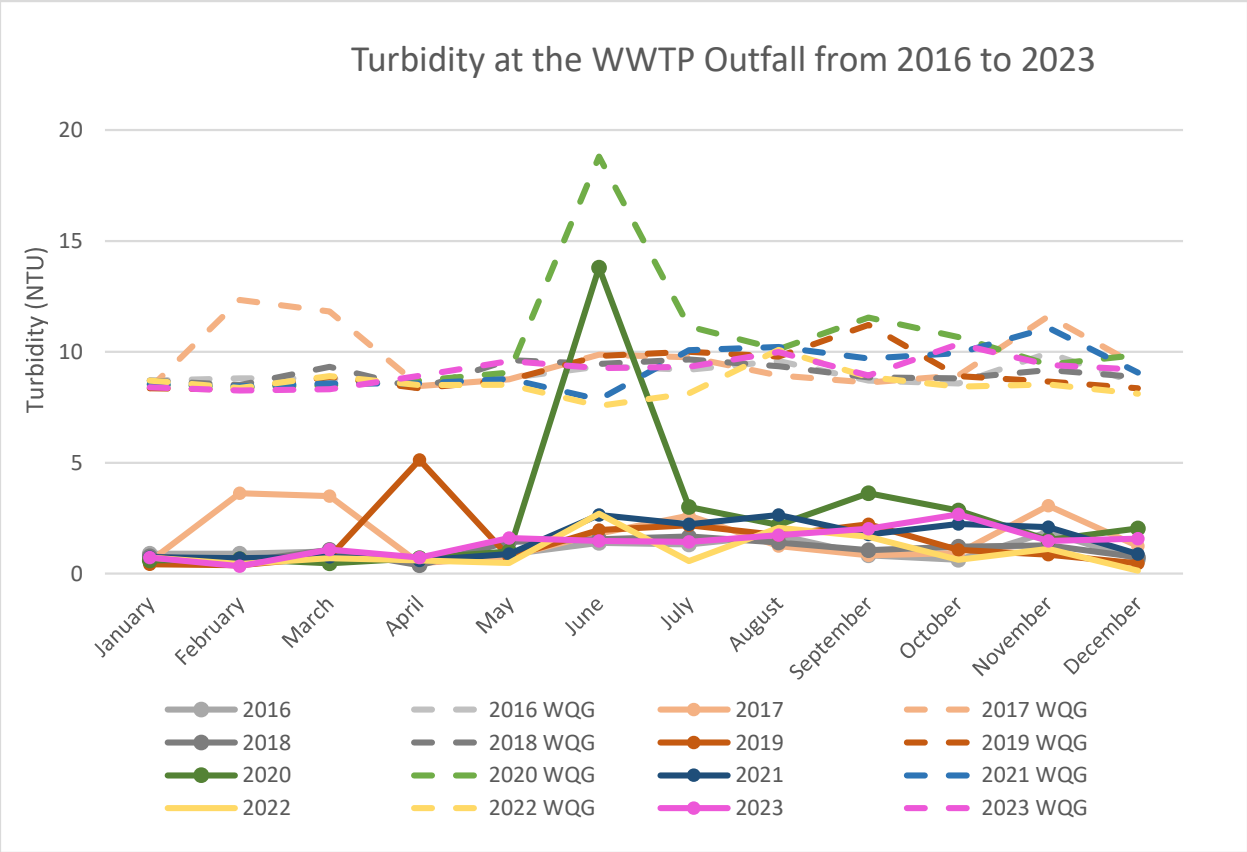


Figure 5: Turbidity Results at the Whistler WWTP Outfall from 2016 to 2022 and Guidelines.

7 Phosphorous in the Receiving Environment

There are no water quality guidelines for phosphate, orthophosphate or total phosphorous by the BC WQG or CSR for the protection of freshwater aquatic life, as this is non-toxic to aquatic organisms at levels and forms present in the environment. Most phosphorous in freshwater occurs as organic phosphates (95%), whereas orthophosphate is inorganic. The operational certificate specifies a maximum limit of 1.75 mg/L of ortho-phosphate (as phosphorous) for WWTP discharge. The total phosphorous does not exceed the limit of 1.75 mg/L, therefore orthophosphate also does not exceed the limit for any sample event within the receiving environment.

Sampling parameters differed throughout the year with phosphate being measured from January through October at all three locations and at the outfall in December, and total phosphorous being measured at all three locations in November and at the upstream and downstream location in December. Figure 6 displays phosphate sampling results, while Figure 7 displays phosphorous sampling results.

The Canadian Council of Ministers of the Environment (CCME) provide water quality guidelines for all of Canada. The CCME guideline displayed in Figure 6 provides a recommended framework for total phosphorous in the freshwater aquatic environment (CCME, 2004). The upstream environment ranges from Oligotrophic (0.004 to 0.01 mg/L), to Eutrophic (0.035 to 0.1 mg/L) depending on the time of year. Based on annual average and median concentrations, the average Meso-eutrophic range limits are outlined in red, as well as the CCME recreational limit (0.1 mg/L) for Figure 6. Although trends are seen outside of the average range all phosphorous and phosphate levels measured were well within the operational certificate limit of 1.75 mg/L for WWTP discharge.

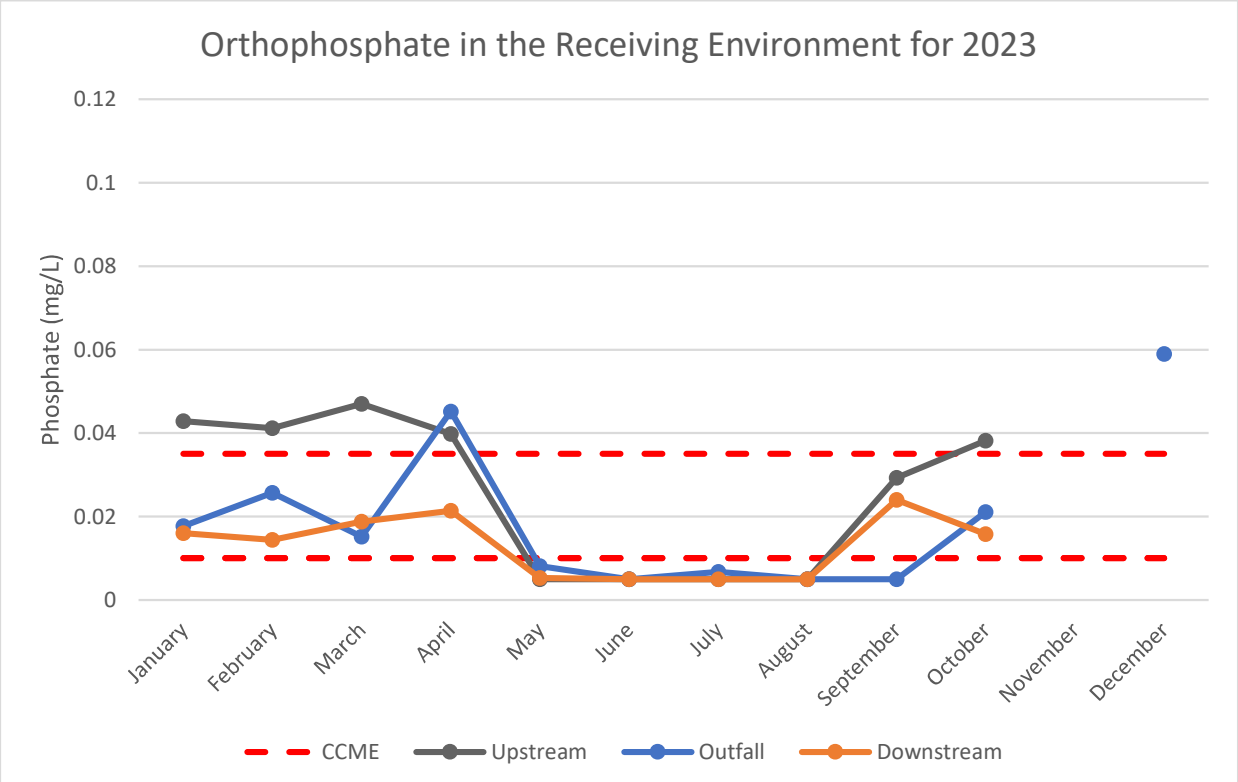


Figure 6: Orthophosphate Sample Results for the year 2023 in the Receiving Environment. All values that were recorded as <0.005 mg/L are displayed as 0.005 mg/L for graphing purposes. *See Figure 7 for November December missing data.

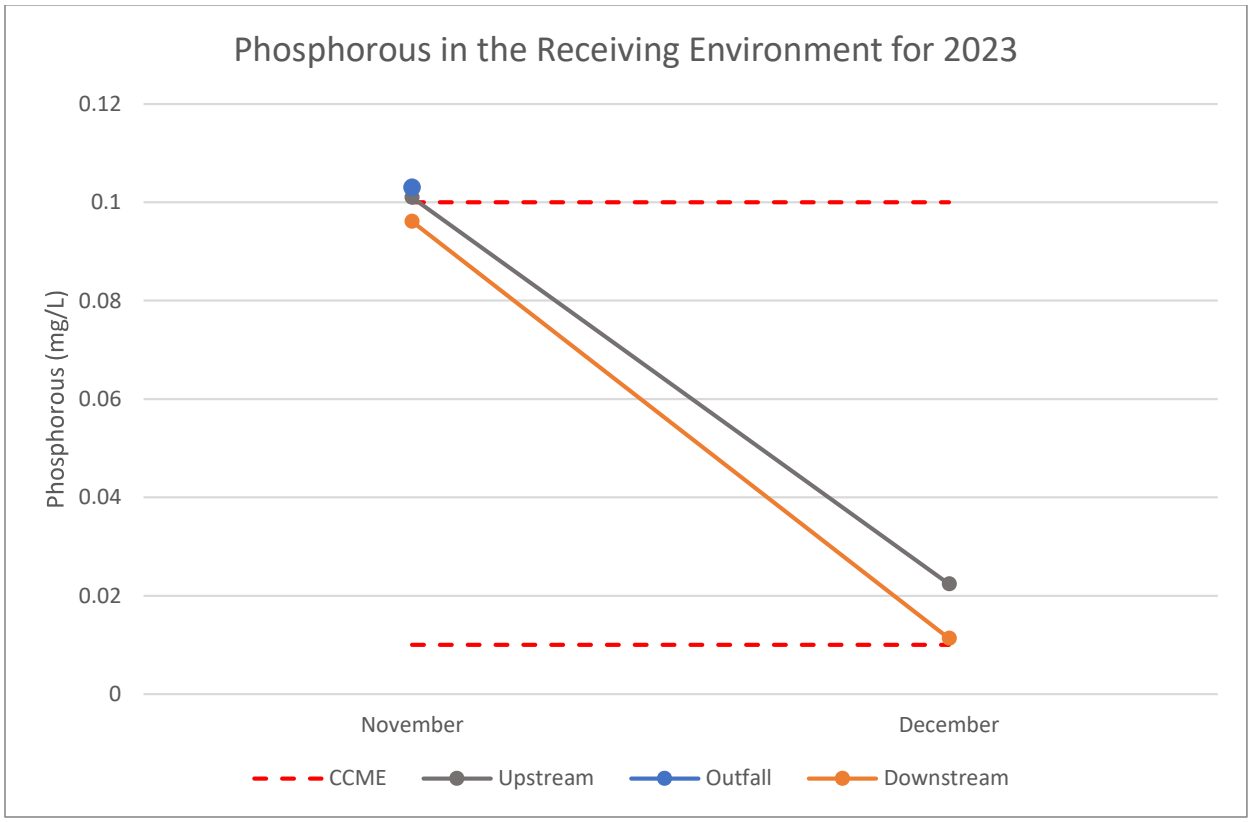


Figure 7: Total Phosphorous Sample Results for the year 2023 in the Receiving Environment.

Figure 8 displays the orthophosphate sample results from the outfall location in the receiving environment for the years 2016 to 2023. The operational certificate has a limit of 1.75 mg/L of orthophosphate which is not exceeded at any sample event.

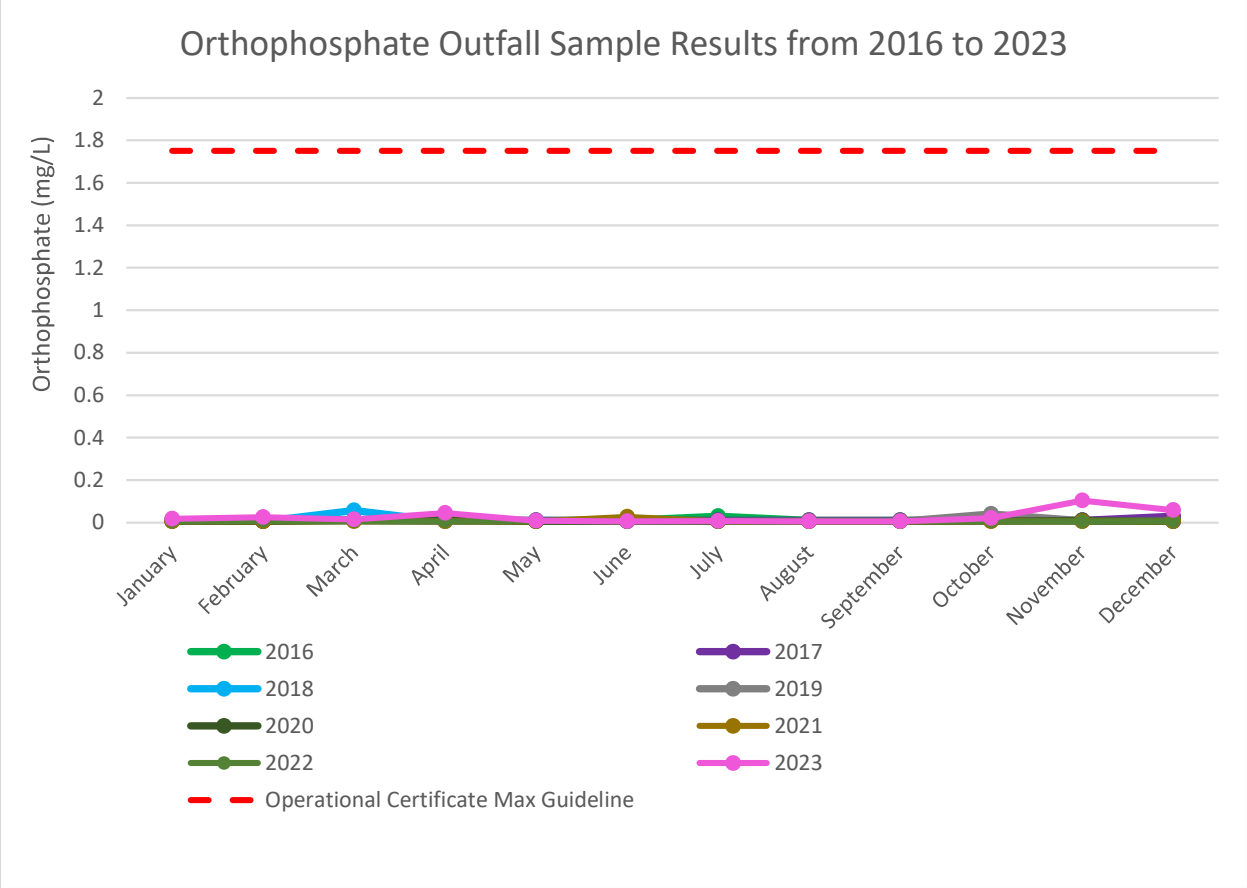


Figure 8: Orthophosphate Sample Results from the Outfall Location between 2016 to 2023. All values that were recorded as <0.005 mg/L are displayed as 0.005 mg/L for graphing purposes.

8 Nitrogen in the Receiving Environment

8.1 Nitrate Nitrogen

The CSR guideline for nitrate nitrogen of 400 mg/L was not exceeded for any sample event between 2016 to 2023. Figure 9 and Figure 10 display the BC WQG of 3.0 mg/L which is also not exceeded for any sample event between 2016 to 2023 in the receiving environment.

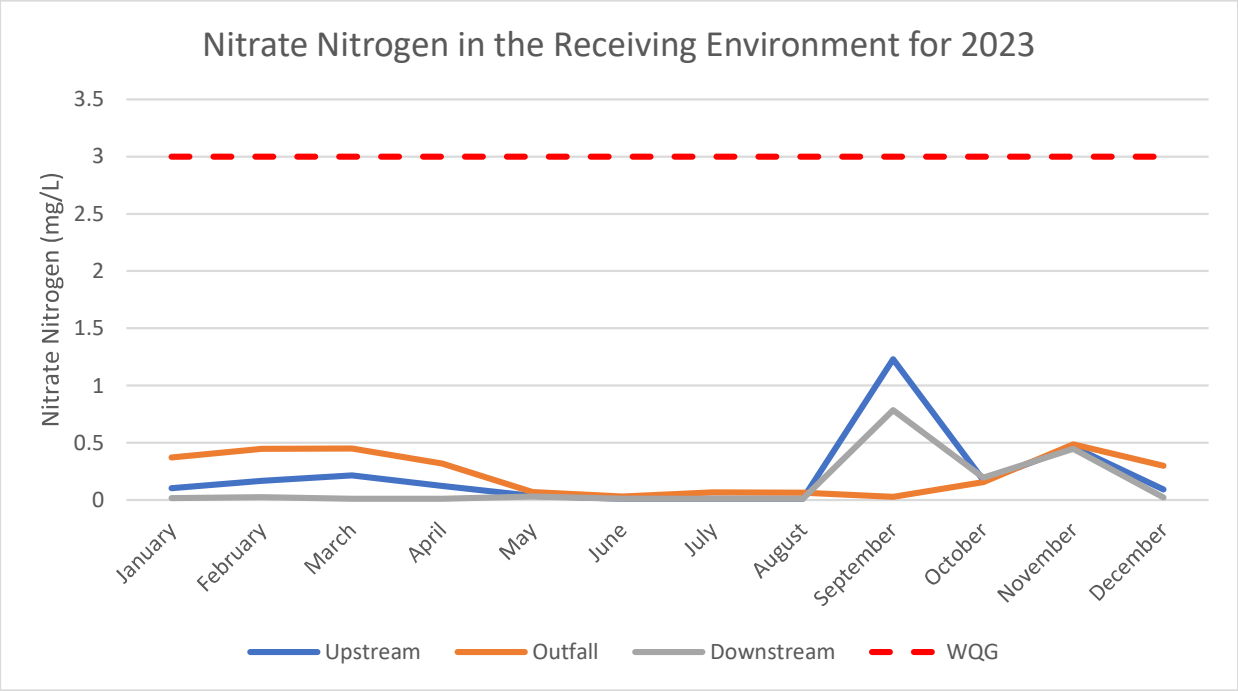


Figure 9: Nitrate Nitrogen Sample Results in the Receiving Environment for 2023.

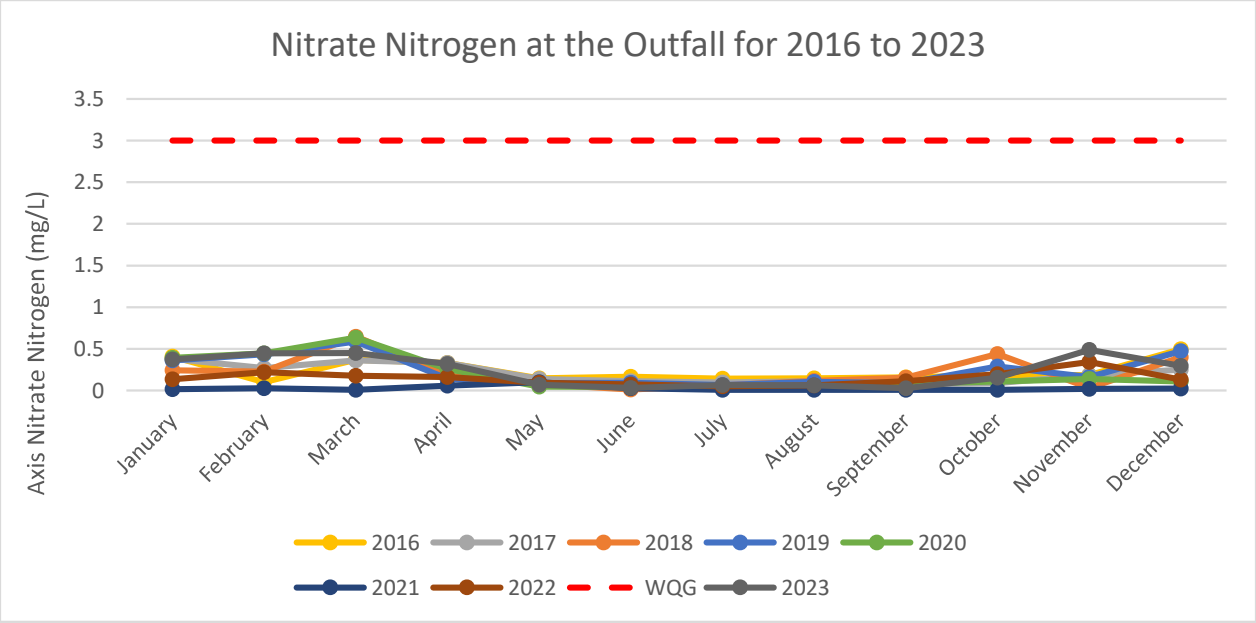


Figure 10: Nitrate Nitrogen Sample Results at the Outfall Sample Location between 2016 and 2023.

8.2 Nitrite Nitrogen

The CSR guideline is 0.2 mg/L for nitrite nitrogen, determined from chlorine concentrations. No sample event from 2016 to 2023 in the receiving environment exceeds the CSR guideline.

The BC WQG when chlorine is less than 2 mg/L is 0.02 mg/L of nitrite nitrogen for a 30-day period (long-term) and 0.06 mg/L for a short-term maximum concentration of nitrite nitrogen. Chlorine sampling was initiated in June of 2020 following the recommendations from the 2019 Wastewater Treatment Plant Report. As the chlorine results for 2023 show a concentration of <0.02 mg/L at all locations, the guidelines provided in Figure 11 assume that the chlorine concentrations are below 2 mg/L for the entire year. Chlorine sampling should continue to be conducted for all sample events when nitrite nitrogen is sampled.

Figure 11 displays the nitrite nitrogen sample results for the year 2023. No sample events exceeded the short-term maximum BC WQG of 0.06 mg/L or the 30-day BC WQG of 0.02 mg/L.

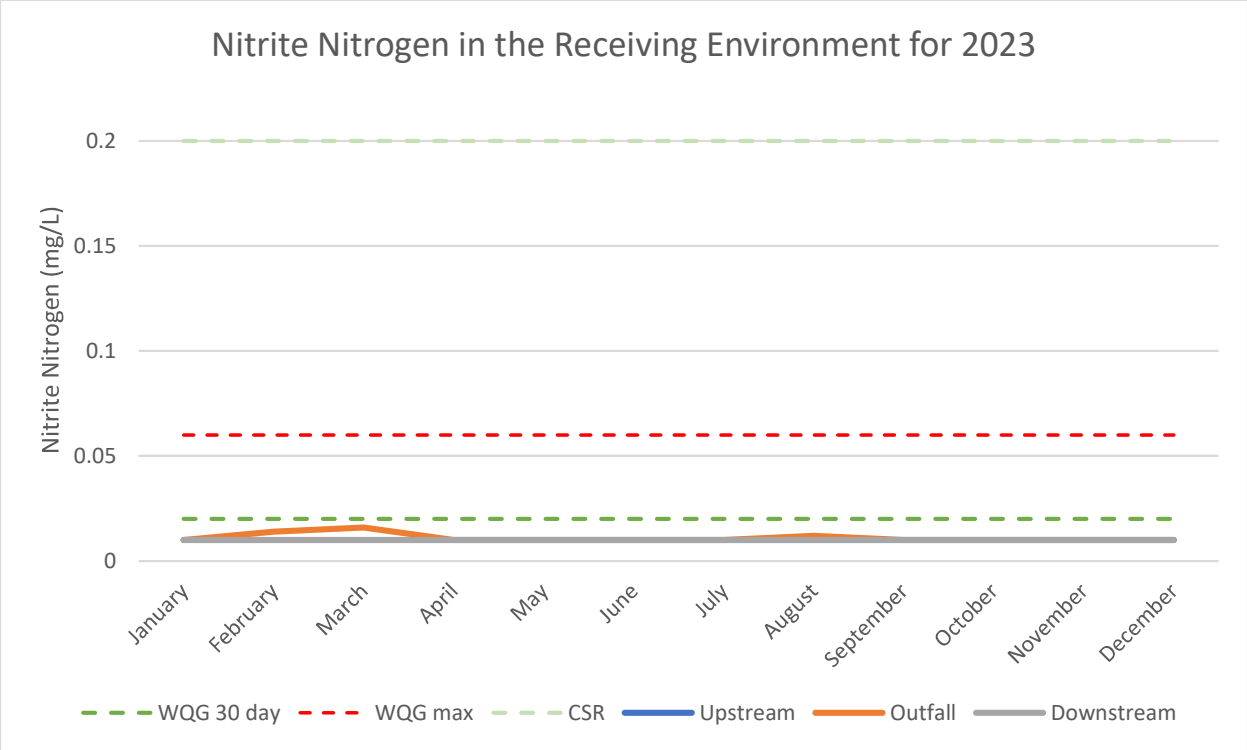


Figure 11: Nitrite Nitrogen Sample Results of the Receiving Environment for 2023. All values that were recorded as <0.010 and <0.005 mg/L, are displayed as 0.01 mg/L and 0.005 mg/L for graphing purposes.

Figure 12 displays the nitrite nitrogen sample results at the outfall location from the years 2016 to 2023. The CSR guideline of 0.2 mg/L nitrite nitrogen was not exceeded at any sample event.

No exceedances of the BC 30-day WQG of 0.02 mg/L were seen in the 2023 sample results. Exceedances were observed in 2016 to 2022 typically in winter months at the outfall location (December to March). The BC WQG maximum limit of 0.06 mg/L was exceeded in February of 2017 and February of 2018, but no exceedance of this guideline has been observed in the years since.

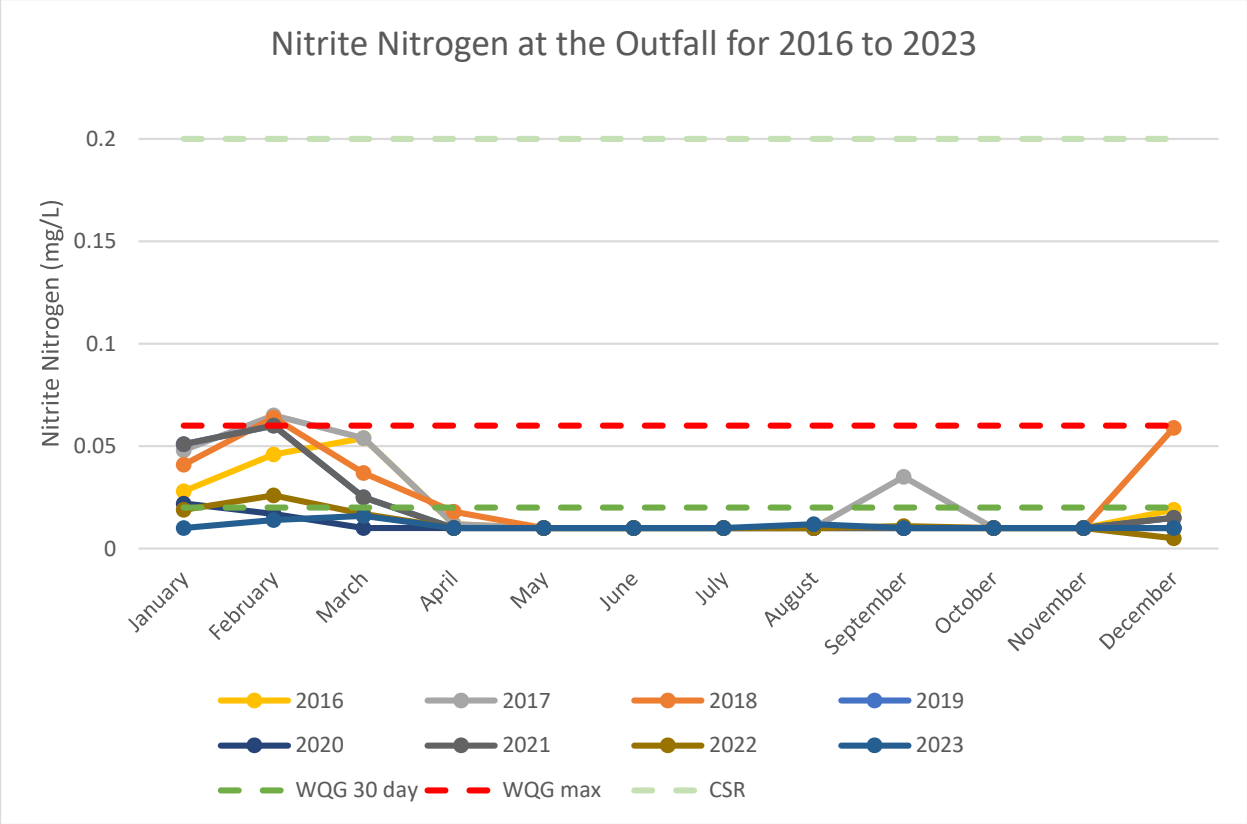


Figure 12: Nitrite Nitrogen Sample Results at the Outfall between 2016 to 2023. All values that were recorded as <0.010 and <0.005 mg/L, are displayed as 0.01 mg/L and 0.005 mg/L for graphing purposes.

8.3 Ammonia Nitrogen

The CSR guideline for ammonia nitrogen varies based on pH. The most conservative CSR guideline value for the 2022 sampling year was 11.3 mg/L which was not exceeded for any sample event.

Figure 13 displays the BC WQG in red for ammonia nitrogen, that varies based on temperature and pH. The BC WQG was not exceeded at any sample event in 2023. Temperature and pH should continue to be recorded whenever ammonia is sampled.

Figure 14 displays the results for ammonia nitrogen in the receiving environment for the sample years 2019 to 2023. The WQG differs for each sample event based on the pH and temperature. No sample event exceeds the BC WQG.

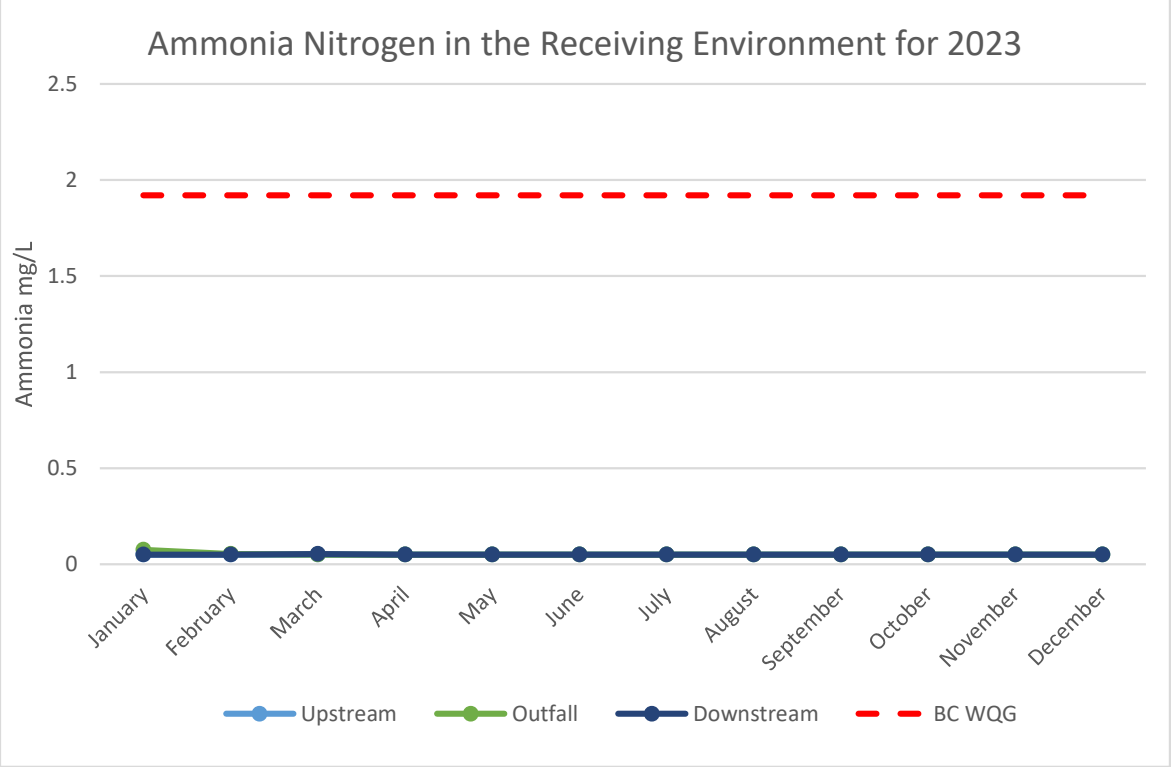


Figure 13: Ammonia Nitrogen in the Receiving Environment for 2023. All values that were recorded as <0.05 mg/L are displayed as 0.05 mg/L for graphing purposes.

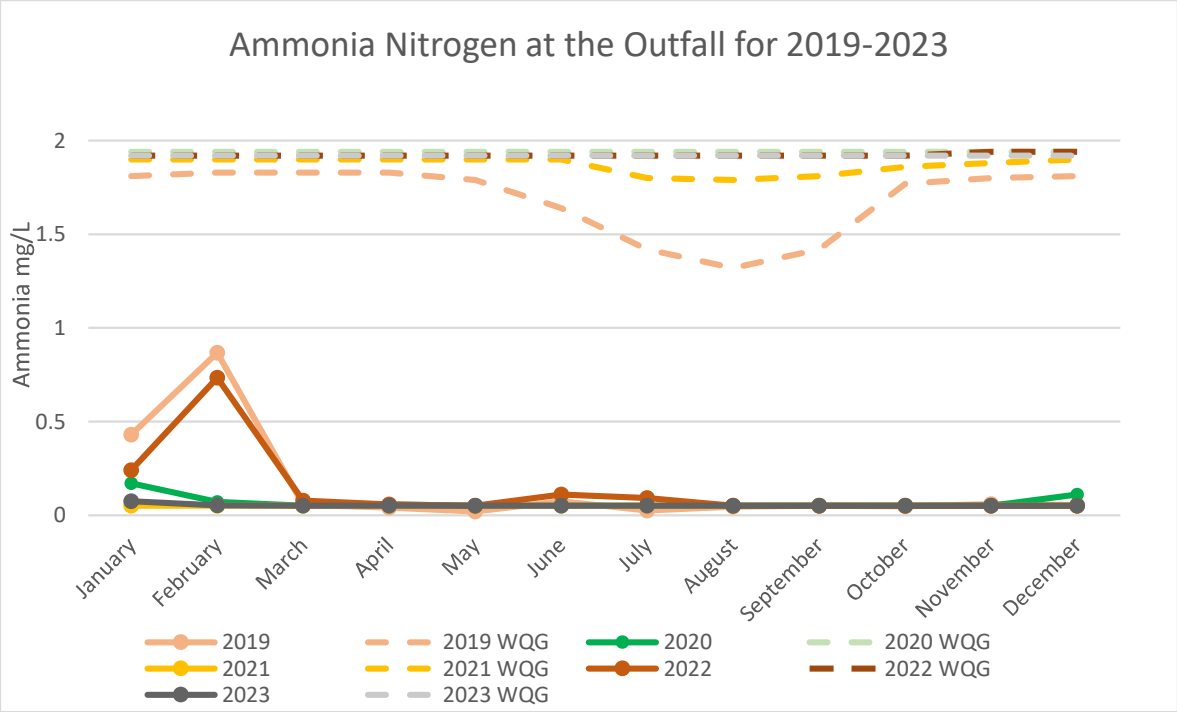


Figure 14: Ammonia Nitrogen Sample Results at the Outfall for 2019 to 2023. All values that were recorded as <0.05 mg/L are displayed as 0.05 mg/L for graphing purposes.

9 Conclusions and Recommendations

The monthly samples taken by the RMOW from the Cheakamus River receiving environment in the year 2023 all comply with the CSR Standards and the operational certificate sampling standards for the following sample parameters: orthophosphate (as phosphorous), nitrate nitrogen, nitrite nitrogen and ammonia nitrogen. All sample events for the year 2023 comply with the BC water quality guidelines (WQG) for turbidity. The pH guidelines were met for all sampling events apart from September where measurements were 0.05 below the guideline. No guidelines or standards are available for conductivity. However, conductivity measurements throughout 2023, are all within the natural range of western Canadian surface waters (NAQUADAT, 1985).

The BC WQG was exceeded for the maximum allowable nitrite nitrogen in February 2017 and February 2018, and the 30-day average was exceeded for winter months in 2016 to 2022 at the Outfall sampling location. Nitrite nitrogen measurement from the background (upstream) sample location was within the BC WQG. There are no downstream nitrite concentrations that exceed WQG for the years 2016 to 2022. The exceedances of nitrite nitrogen above BC WQG are localized at the outfall location during winter months and dissipate before reaching the downstream sample location. Low flows of the Cheakamus River in winter months or increased WWTP discharge may result in higher effluent concentrations. The CSR standard is not exceeded at any time.

Orthophosphate results comply with the operational certificate for all sample events from 2016 to 2022. The CCME guideline provides a framework to observe the total phosphorous concentrations that may be outside of the natural range of the Cheakamus River. Due to inconsistent sampling criteria the CCME guideline is difficult to calculate and apply to the 2023 year, however phosphorous levels were well within the operational certificate limit. It is recommended that the RMOW keep to consistent sampling criteria throughout all sampling events.

It is recommended that the RMOW continue to include chlorine measurements and field temperature measurements whenever samples are taken in the receiving environment for nitrite nitrogen and ammonia nitrogen due to the guideline requirements.

It is also recommended that the RMOW monitor discharge for high nitrite nitrogen particularly in winter months when samples at the Outfall have exceeded the BC WQG limits in previous years.

Should you have any questions regarding this report or would like further information, please do not hesitate to contact the Cascade Whistler office.

Prepared by:

Sarah Lindsay, B.Sc., B.I.T.,
Environmental Technician
Cascade Environmental Resource Group Ltd.

Reviewed by:

Candace Rose-Taylor, M.Sc., R.P. Bio., P.Biol., E.P.
Principal
Cascade Environmental Resource Group Ltd.

References

BC Government, 2023. Contaminated Sites Regulation (*Environmental Management Act*). B.C. Reg. 375/96. Schedule 3.2. http://www.bclaws.ca/civix/document/id/complete/statreg/375_96_08#Schedule3.2. Accessed March 26, 2024.

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