



Wastewater Treatment Plant 2022 Annual Report

British Columbia Ministry of Environment

Operational Certificate PE# 13627

Issued June 16, 1998

Environmental Operators Certification Program

Certificate #516 Class IV Municipal Wastewater Treatment Plant

Issued March 12, 1999

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**The Corporation of the District of Summerland
Wastewater Treatment Plant – 2022 Annual Report**

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1.0 PURPOSE

This report is submitted in accordance to the requirements of the Summerland Wastewater Treatment Plant (SWWTP) Operational Certificate # 13627. A copy of the Operational Certificate is attached in **Appendix A**.

2.0 INTRODUCTION

The Summerland WWTP was commissioned in 1998 by Reid Crowther & Partners Ltd. The plant process is based on a 3-stage Biological Nutrient Removal (BNR) facility; it is used to remove both nitrogen and phosphorus as its primary objective. Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) are also removed by the longer retention times of a BNR facility. The biological reactions can be controlled by manipulation of the physical environment in which the active organisms work.

Process control elements include:

- Hydraulic retention in each type of zone.
- Presence or absence of dissolved oxygen.
- Presence or absence of nitrate nitrogen.
- Retention time of active organisms.
- Presence of simple organics, in particular volatile fatty acids (VFA).

The biological systems are accompanied by settling, filtration, and ultraviolet disinfection systems. The Class IV tertiary treatment plant is owned and operated by the District of Summerland and staffed in accordance with the operational certificate.

3.0 SPECIFIC AUTHORIZED DISCHARGES AND RELATED REQUIREMENTS

The SWWTP has a deep lake outfall for the wastewater effluent, located approximately 310m offshore and 44m deep in Okanagan Lake. The discharge of effluent to Okanagan Lake is at 49° 35' 00" N Latitude and 119° 37' 55" W Longitude. The location of the treatment system from which the effluent is legally discharged is described as: Lot 1, DL 508, Plan KAP57829 ODYD. The site reference number for this discharge is Environmental Monitoring System (EMS), E230437. The SWWTP discharges effluent to the

lake under the provisions of the Operational Certificate PE 13627, issued June 16, 1998. The annual report will address each section of the current Operational Certificate.

3.1 Authorized Rate of Discharge (m³/d)

The maximum authorized rate of effluent discharge for 2022 was 4,000m³/day, based on a monthly average. A magnetic flow meter is located on the influent pipe and monitors all incoming flows 24 hr/day. In 2022, we implemented a new flow meter. The average effluent discharge for 2022 was 2389 m³/day, maximum daily flow was 3472 m³ (July). See Appendix F, Table 1.0, Table 1.1 & Graph 1.0.

3.2 Effluent Quality (Discharge to Okanagan Lake)

Effluent characteristics of the treatment plant to the outfall shall be equivalent to or better than:

- 5 Day Biochemical Oxygen Demand - 10 mg/L
- Total Suspended Solids - 10 mg/L
- Total Phosphorus as P:
 - Not to exceed - 2.0 mg/L
- Total Nitrogen - 6.0 mg/L as N
- Fecal coliform - 50 MPN

Detailed effluent discharge requirements are attached in Appendix G, Table 2.0.

4.0 GENERAL REQUIREMENTS

4.1 Maintenance of Works and Emergency Procedures

The Summerland WWTP continues to work with Antero maintenance software. The program prints out monthly work orders that direct operators to perform maintenance on specific pieces of equipment. Every piece of equipment at the plant and lift stations are listed in the database. Complete manufacturer's manuals and literature for all the equipment is catalogued and readily available to all staff at the SWWTP.

Manufacturers' recommended service requirements were met in 2022. Material Safety Data Sheets (MSDS) are on file at the SWWTP and updated as required. Attached in Appendix B\C are changes made to the emergency contact list.

4.2 Bypasses

The District of Summerland wastewater treatment plant required no bypasses in 2022.

4.3 Process Modifications

District of Summerland replaced the UV system in the summer of 2022 and the new system is the exact replica as the old system. Also looking to add alarming capabilities in early 2023 to improve status of system communications with on-call operator.

4.4 Emergency Response Plan

The Emergency Response plan is up to date with new contact information. There were no spills to report in 2022. See Appendix B.

4.5 Odour Control

Odour from the treatment plant are contained in the buildings and tanks, then treated on-site in the bio filter. Air is pulled from the old head works room, new grit building, centrifuge room, equalization tank, sludge storage vault, and primary clarifier/fermenter and forced up through two compost beds. The buildings that produce dangerous gases have exhaust fans that are controlled by the continuous gas monitoring (H₂S and LEL) that rapidly change out the air if gasses are detected.

The bio filter media is used to grow beneficial bacteria used to remove offensive odors that would otherwise be released to atmosphere. The bio filter is sprinkled with reclaimed water during the summer months to keep the media moist so that Sulphur reducing bacteria can grow and consume hydrogen sulfide. New in 2022, we raised the walls around the media with cement blocks enabling us to add more wood chips.

Our lift stations contain odor control scrubbers that use carbon particles to remove odorous chemicals. Air is pulled out of the wet wells and filtered through the scrubber's which then release into the atmosphere. All lift stations except Landry kiosk have the scrubbers installed but only Peach Orchard lift station requires it to be running at all times. The rest are for backup incase odors occur. Ongoing monitoring of odor challenges are always part of the treatment process and we will continue to explore new ways to improve current systems and we also look forward to capital projects in the future.

4.6 Disinfection – Ultraviolet

Ultraviolet (UV) radiation is used for the sterilization of effluent wastewater and ensures a safe effluent discharge to Okanagan Lake. Multiple banks of lamps are maintained such that one bank may be taken out of service for cleaning/maintenance and the effluent shall still meet the fecal coliform effluent quality discharge limit. The staff cleans the UV banks on a regular basis according to manufacturer's specifications. New in 2022, we replaced our UV system as part of our capital projects. We replaced the old system with the identical brand due to past performance. (Trojan UV3000b)

Along with UV disinfection, staff also uses a 12% sodium hypochlorite solution to further reduce pathogens in the reclaimed water. This secondary step increases the pathogen removal to a 4 log reduction (99.99%). The pathogen reduction steps using filters, UV, and hypo-chlorination produces safe water that we use onsite to make polymer, wash equipment, pump cooling and onsite irrigation of grass and shrubs. Treated effluent is not used off site of the Summerland WWTP.

4.7 Facility Classification and Operator Certification

The British Columbia Environmental Operators Certification Program has classified the Summerland Wastewater Treatment Plant as a Level IV facility.

There are four full time staff members at the SWWTP and all are EOCP certified.

Employee	Position	EOCP #	Certification
Ryan Cleverdon	WWTP Chief Operator	1000746	WWT-III
Mathew Perdue	WWTP Operator	8443	WWT-IV
Jason Wright	WWTP Operator	7034	WWT-II WD-I
Kendell Wilson	WWTP Operator	1000613	WWT-I

4.8 Water Conservation

Summerland provides matching funds to the Okanagan Basin Water Board annually and is active in the creation and delivery of the “Make Water Work” campaign. This campaign provides Okanagan Valley-wide promotion of water conservation with items such as: billboards; bus signage; bus shelter signage; water-smart plants list; radio ads; digital ads; social media posts; contests; and other promotional material to encourage the conservation of water throughout the Okanagan.

Summerland has consumption-based water metering and billing and continue to work with residents in identifying issues with excessive water use. In 2022 there were 160 domestic meters that were replaced (due to leaks or non-reads), three domestic meters were repaired, ten agricultural meter replacements and one repaired.

We actively use monthly consumption data to identify potential leaks/abnormal consumption. We attempt to contact the utility account holder to inform them of the potential leak. We had about 38 utility account holders locate and fix issues in there water systems. These ranged from few cubic meters to over 1000 cubic meters of excess water consumption.

We have also noticed a drop in the number of Agricultural Irrigators that went over their annual allotment:

- 29 in 2021
- 7 in 2022

There were no amendments made to Bylaw 98-002.

4.9 Sewage Collection System – Infiltration, Inflow, and Cross Connections

The District of Summerland Public Works department is responsible for infrastructure repair and maintenance to the sewage collection system. The system currently has over 3400 connections and is fed primarily by eight lift stations located throughout the municipality. Summerland has approximately 80 kilometers of sewer lines and over 700 manhole covers. As part of the preventative maintenance

schedule the collection system is flushed annually and monitored for issues and blockages during the cleaning process.

The Wastewater Treatment Plant staff provide maintenance to eight lift stations. Regular maintenance includes daily SCADA checks for each lift station and weekly equipment checks. There were no significant equipment failures at the lift stations this year. The District mechanics provide monthly maintenance and test runs to all the lift station generators. This test increases the dependability of the generators should standby power be required in the event of a power outage.

There was no evidence of infiltration, inflow, or cross-connections in the sewer system in 2022 as flows entering the plant were normal.

4.10 Influent Wastes By-Law(s)

In 2022 the District of Summerland had four instances regarding sewage regulation Bylaw 98-002. Three were resolved and one will continue to be monitored. No changes were made to the District of Summerland Sewage Regulation Bylaw 98-002 during 2022. **Appendix E**

5.0 RECLAIMED WATER IRRIGATION OPERATIONAL REQUIREMENTS

Although authorized in the Operating Certificate, no effluent irrigation has been applied beyond the SWWTP boundary on area's designated **Restricted or Unrestricted Public Access**.

Effluent irrigation water is applied within the treatment plant boundary on the odor control filter and for irrigation purposes. The effluent is chlorinated prior to any applications to further destroy fecal coliforms and to be within the required Restricted Public Access standard of 200 MPN/100ml. All Operational Certificate requirements are met or exceeded with public health and safety given highest priority.

6.0 INFLUENT MONITORING REQUIREMENTS

6.1 INFLUENT SAMPLING PROGRAM

Once per month samples are sent to an accredited lab for the following:

- 5 day biochemical oxygen demand, mg/L;
- Total Phosphorus expressed as mg/L P;
- Total nitrogen expressed as mg/L N;

- pH

Monthly grab sample data and yearly averages for these parameters are attached in **Appendix H, Table 3.0, Graph 3.0, 3.1, 3.2**. In addition, influent sampling is done daily in-house to monitor the influent waste stream **Appendix I, Table 4.0**.

7.0 EFFLUENT – MONITORING REQUIREMENTS

7.1 Effluent Sampling

In-house Grab samples are taken daily and analyzed for the following:

- Ortho phosphorus expressed as mg/L P;
- Ammonia nitrogen expressed as mg/L N;
- Nitrate nitrogen expressed as mg/L N and;
- pH.

Attached in **Appendix K, Table 6.0, Graph 6.0, 6.1, 6.2** are the monthly averages for these effluent parameters.

7.2 Effluent Quality Excursions

The accredited lab sampling program during 2022 recorded three effluent quality excursions. Each event was recorded and reported to the Ministry of Environment. **Table 5.0**

7.3 Additional Effluent Sampling Program

Monthly grab samples are sent to an external accredited lab for the following:

- Total suspended solids
- 5 day biochemical oxygen demand
- Total and Ortho phosphorus as mg/L P
- Total nitrogen, ammonia nitrogen, nitrate/nitrite nitrogen, organic nitrogen, and total kjeldahl nitrogen, all expressed as mg/L N
- pH
- Total and Fecal coliforms MPN

Monthly/Yearly averages are attached in **Appendix J, Table 5.0, 5.1, 5.2 and Graph 5.0, 5.1, 5.2, and 5.3**

8.0 SLUDGE MONITORING REQUIREMENTS

8.1 Sludge Mass Measurement

Appendix N, Table 7.0, Table 7.1 & Graph 7.0 attached shows the total amount of primary sludge and secondary waste activated sludge hauled to the composting site at the District of Summerland landfill. In 2022 the total amount of sludge hauled was 907,370 kg. (Note: OC13627 states “volume” but it is assumed that this is a colloquialism because volume of dry solids are not easily measured so mass is provided. Also the density of the sludge is extremely close to 1kg/L so you may interchange kg with L)

8.2 Sludge Sampling Program

Waste Activated Sludge samples were sent to accredited lab – CARO Analytical Services test samples as per the Operational Certificate requirements. The sludge analysis is summarized in the attached **Appendix N, Table 7.2**.

8.3 Sludge Management Plan

DAF thickened and dewatered sludge from the process is transported to the District of Summerland landfill in liquid-tight containers. The sludge is then composted and offered to the public for beneficial reuses (soil conditioning), following Organic Matter Recycling Regulations (OMAR).

Attached in **Appendix N** (Sludge Management Plan)

9.0 LAKE SAMPLING AND MONITORING PROGRAM

9.1 Lake Sampling

In 2022 the BC government’s Ministry of Environment & Climate Change Strategy (Environmental Protection Division) signed a multi-level government agreement “Memorandum of Understanding respecting Okanagan Lake Collaborative Monitoring Agreement for 2022” (“Agreement”) between the province, OBWB, and three local governments: City of Kelowna, Regional District of Central Okanagan and District of Summerland. **Appendix L**

10.0 CONCLUSION

The Summerland Wastewater Treatment Plant (WWTP) is classified a Level IV facility with four full time staff. The operations team is knowledgeable and determined to provide the best service and

environmental protection possible for the community. Emphasis on budget, funding, maintenance, proactive upgrades and day to day operations will continue to be essential moving forward.

Ryan Cleverdon

Wastewater Treatment Plant Chief Operator

District of Summerland

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APPENDIX A

OPERATIONAL CERTIFICATE



MINISTRY OF ENVIRONMENT,
LANDS AND PARKS

OPERATIONAL CERTIFICATE

PE 13627

Under the Provisions of the Waste Management Act

The Corporation of the District of Summerland

PO Box 159

Summerland, British Columbia

V0H 1Z0

Hereinafter referred to as "the District"

is authorized to discharge effluent from a municipal sewage collection and treatment system located at Summerland, British Columbia, to Okanagan Lake, and to the ground by irrigation, and is further authorized to discharge sludge from this same system to an authorized compost facility, subject to the conditions listed below. Contravention of any of these conditions is a violation of the Waste Management Act and may result in prosecution.

1. SPECIFIC AUTHORIZED DISCHARGES AND RELATED REQUIREMENTS

- 1.1. Discharge of effluent to which this section is applicable is from a municipal sewage treatment plant to an effluent outfall located approximately as shown on the attached Appendix A. The site Environmental Monitoring System (EMS) reference number for this discharge is E230437.

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

1.2. The maximum authorized rate of effluent discharged from the sewage treatment plant averaged on a monthly basis:

1998	1,750 m3/day
1999	2,750 m3/day
2000	2,800 m3/day
2001	3,000 m3/day
2002	3,100 m3/day
2003	3,300 m3/day
2004	3,400 m3/day
2005	3,600 m3/day
2006	3,800 m3/day
2007	3,900 m3/day
2008	4,000 m3/day

1.3. Effluent Quality (Discharge to Okanagan Lake)

The characteristics of the effluent discharged from the sewage treatment plant to the outfall shall be equivalent to or better than:

(a)	5 Day Biochemical Oxygen Demand -	10 mg/L
(b)	Total Suspended Solids -	10 mg/L
(c)	Total Phosphorus as P:	
	Not to exceed -	2.0 mg/L
	99 percentile -	1.5 mg/L
	90 percentile -	1.0 mg/L
	Annual Average -	0.25 mg/L
	Level to strive for -	0.01 mg/L

The level to strive for is the lake background level. The percentile values given relate to the daily values. e.g.: 99 percentile means that 99 percent of all daily values throughout the year are not to exceed 1.5 mg/L Total Phosphorus as P.

(d)	Total Nitrogen -	6.0 mg/L as N
(e)	Faecal coliform -	50 CFU /100ml



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

3. RECLAIMED WATER IRRIGATION OPERATIONAL REQUIREMENTS

3.1. BUFFER ZONES

3.1.1. The requirement for formal buffer zones surrounding reclaimed water irrigated lands is no longer in effect, however, a buffer zone may be specified by the Regional Waste Manager. The reclaimed water irrigation system shall be managed in such a fashion as to preclude spray drift from leaving the irrigated lands in accordance with the "Health and Safety Criteria for Use of Reclaimed Wastewater" published by the Ministry of Health.

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

3.2. SURFACE RUNOFF

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

3.3. SURFACING TAIL WATER

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

3.4. HIGH WINDS -

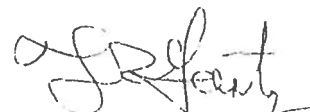
The following strategy shall be followed to minimize the necessity to shut down the irrigation system or portions thereof during windy conditions.

Devices utilized in the spray irrigation of reclaimed water shall be operated in such fashion as to preclude aerosol drift from leaving the irrigated lands.

3.5. IRRIGATION RATES

Irrigation rates shall not exceed the rates given in "The Irrigation Design Manual for Farm Systems in British Columbia", dated 1989, published by the British Columbia Ministry of Agriculture and Food, except land that slopes in excess of 20% shall not be irrigated, without the written consent of the Regional Waste Manager.

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



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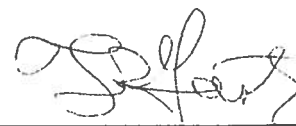
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3.6. CATTLE LAG TIME

A three day lag time is required before un-inspected beef cattle are permitted on areas sprayed with reclaimed water. No lag time is required if beef cattle are subjected to the federal meat inspection program.

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

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

3.7. SIGNAGE

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

Signage at the gate of the plant site and any irrigated areas shall have the appropriate emergency contact person(s) and phone numbers for use by the general public and others.

3.8. FENCING

Generally, fencing is required for spray irrigation systems, but is not required for trickle irrigation systems, however, fencing may be specified for trickle irrigation systems, by the Regional Waste Manager.

4. INFLUENT - MONITORING REQUIREMENTS

4.1. INFLUENT - SAMPLING PROGRAM

The District shall install and maintain a suitable sampling facility (EMS site number E230439) and obtain a grab sample of the plant influent once each month for analysis by a suitably accredited independent laboratory. A proportional continuous sampler may be used, provided that prior written approval has been obtained from the Regional Waste Manager. Proper care should be taken in sampling, storing and transporting the samples to adequately control temperature and avoid contamination, breakage, etc.



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Assistant Regional Waste Manager

4.2. INFLUENT - ANALYSES

Obtain analyses of the influent sample for the following:

- (a) 5-day biochemical oxygen demand, mg/L;
- (b) total phosphorus expressed as mg/L P;
- (c) total nitrogen, expressed as mg/L N; and
- (d) pH.

5. EFFLUENT - MONITORING REQUIREMENTS

5.1. EFFLUENT - SAMPLING PROGRAM

The District shall install and maintain a suitable sampling facility (EMS Site Number E230437) and obtain a grab sample of the effluent once daily during the period of maximum daily flow for subsequent in-house analysis, and once each month for check by a suitably accredited independent laboratory. A proportional continuous sampler may be used, provided that prior written approval has been obtained from the Regional Waste Manager. Proper care should be taken in sampling, storing and transporting the samples to adequately control temperature and avoid contamination, breakage, etc.

5.2. EFFLUENT - ANALYSES

Obtain analyses of the effluent sample for the following:

5.2.1. Daily Analyses, (in house)

- (a) ortho phosphorus expressed as mg/L P
- (b) ammonia nitrogen and nitrate nitrogen, expressed as mg/L N; and
- (c) pH,

5.2.2. Monthly Analyses (accredited lab)

- (a) total suspended solids (non-filterable residue), mg/L;
- (b) 5-day biochemical oxygen demand, mg/L;
- (c) total and faecal coliforms CFU/100 ML;
- (d) total and ortho phosphorus, all expressed as mg/L P;
- (e) total nitrogen, ammonia nitrogen, nitrate/nitrite nitrogen, organic nitrogen, and total Kjeldahl nitrogen, , all expressed as mg/L N; and
- (f) pH.



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

5.3. EFFLUENT - FLOW MEASUREMENT

Provide and maintain a suitable flow measuring device and record once per day the effluent volume discharged over a 24-hour period. Record the flows for each calendar month and for each calendar year. For the purposes of this section, effluent flows may be considered equivalent to influent measured flows.

6. SLUDGE - MONITORING REQUIREMENTS

6.1. SLUDGE - VOLUME MEASUREMENT

Install and maintain a system for measuring and recording the volumes of sludge produced, the location where the sludge was discharged, and the amount of sludge discharged at each location.


6.2. SLUDGE - SAMPLING PROGRAM

Obtain a representative sample of the sludge being produced at the treatment plant at least once every 6 months (EMS Site Number E230440).

6.3. SLUDGE - ANALYSES

Obtain analyses of the sludge sample for the following:

- (a) Total solids (T.S.), g/L;
- (b) Moisture content, %;
- (c) Volatile suspended solids (V.S.S.), g/L;
- (d) Total Kjeldahl Nitrogen (T.K.N.), g/L and g/kg dry solids;
- (e) Aluminum, mg/kg;
- (f) Arsenic, mg/kg;
- (g) Cadmium, mg/kg;
- (h) Calcium, mg/kg;
- (i) Chromium, mg/kg;
- (j) Cobalt, mg/kg;
- (k) Copper, mg/kg;
- (l) Iron, mg/kg;
- (m) Manganese, mg/kg;
- (n) Mercury, mg/kg;
- (o) Molybdenum, mg/kg;
- (p) Nickel, mg/kg;



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Assistant Regional Waste Manager

- (q) Lead, mg/kg;
- (r) Silver, mg/kg;
- (s) Sodium, mg/kg; and
- (t) Zinc, mg/kg.

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

7. GROUNDWATER MONITORING PROGRAM - MONITORING REQUIREMENTS

A Groundwater Monitoring Program, shall be submitted to the Regional Waste Manager, and his written approval obtained prior to the commencement of irrigation of any lands other than the plant grounds. The program shall be designed by a Professional Engineer or a Hydrogeological Technologist licensed to practice in the Province of British Columbia, to establish with acceptable scientific accuracy, the groundwater flow pattern and nutrient removal capability of the soil, to ensure reasonable notice of impending high phosphorus or nitrate levels that may adversely affect the shoreline waters of Okanagan Lake system or domestic water wells. The sampling, measurement frequency and analyses shall be conducted in accordance with the Groundwater Monitoring Program upon it's written approval by the Regional Waste Manager.

8. LAKE SAMPLING AND MONITORING PROGRAM

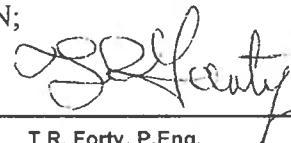
A Lake Monitoring Program shall be initiated by the District consisting of the following components:

8.1. LAKE SAMPLING

Establish two sampling sites, one downcurrent of the effluent diffuser within the initial dilution zone (EMS Site Number E227650) and the other in an appropriate location for background sampling (EMS Site Number 0500454), each acceptable to the Regional Manager. At each site collect discrete samples at depths of one meter, five meters and ten meters, then at each ten meter interval including twenty, thirty and forty meter depths, during March and September of each year.

Have the samples at 1, 5 and 10 meter depths analyzed (accredited lab) for the following:

- (a) total and ortho phosphorus , expressed as mg/L P;
- (b) total nitrogen, ammonia nitrogen, nitrate/nitrite nitrogen, organic nitrogen, and total Kjeldahl nitrogen, all expressed as mg/L N;



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- (c) faecal coliform bacteria, expressed as CFU/100 ML;
- (d) chlorophyll a, expressed as ug/L;
- (e) sodium and chloride expressed in mg/l;
- (f) dissolved oxygen, expressed in mg/l;
- (g) temperature, expressed in degrees centigrade; and
- (d) pH;

Have the samples at 20, 30 and 40 meter depths analyzed (accredited lab) for the following:

- (a) total and ortho phosphorus , expressed as mg/L P;
- (b) total nitrogen, ammonia nitrogen, nitrate/nitrite nitrogen, organic nitrogen, and total Kjeldahl nitrogen, all expressed as mg/L N;
- (c) faecal coliform bacteria, expressed as CFU/100 ML;
- (d) sodium and chloride expressed in mg/l;
- (e) dissolved oxygen, expressed in mg/l;
- (f) temperature, expressed in degrees centigrade; and
- (g) pH;

Measure and record water clarity using a secchi disk and underwater viewing box at each of the above sites.

The District must submit the proposed method of determining the location of the downcurrent sampling site to the Regional Manager for approval prior to the commencement of sampling.

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

Results of the analyses shall be forwarded to the Regional Manager within 30 days following receipt of the results by the district. The results and trend analysis shall also be included in the year-end report

9. ENVIRONMENTAL IMPACT ASSESSMENT

In the year 2003, an Environmental Impact Assessment consisting of dye dispersion and limnology studies will be required to determine the changes in contaminant concentrations in water and sediments with distance from the diffuser. When required, the dye tests shall be carried out in conjunction with a basic physical limnology description of the discharge site (temperature profile, surface and subsurface current description, sediment chemistry and benthos including scans for organic compounds and analysis of benthic invertebrate populations etc.) and shall be supplemented with a chemical limnology program to verify the dye study findings.



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The limnology and dye dispersion studies shall be carried out by qualified consultants, licensed to practice in the Province of BC. In the year prior to the study being carried out, a proposal for this assessment shall be provided to the Regional Manager. The Regional Managers may at his discretion require additional monitoring if deemed necessary.

10. SOIL ASSESSMENT AND IRRIGATION PLAN

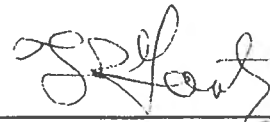
For lands other than the treatment plant site that are irrigated with reclaimed water, retain a Professional Agrologist to once per year conduct a soil assessment of the irrigated lands. Maintain records of crop production and nutrient content. Maintain records of soil, water and nutrient balances and assessments of any changes in the soil, surface or groundwater regimes. Maintain records of groundwater monitoring data. Annually submit the data and Soil Assessment as part of the Annual Report.

11. SAMPLING AND ANALYTICAL PROCEDURES

The sampling, flow and monitoring requirements above shall be carried out in accordance with the appropriate procedures listed in the table below. Alternative test methods may be used provided that the alternative test methods are authorized by the Regional Waste Manager prior to performing the actual source testing. Test methods for parameters not listed below require the consent of the Regional Waste Manager.

LIQUID EFFLUENTS, SURFACE WATER, GROUND WATER, SOILS, SEDIMENTS, VEGETATIVE MATTER:		
Parameter	Source Testing Procedure	Analytical Procedure
Metals Nutrients Organics Toxicity	British Columbia Field Sampling Manual for Continuous Monitoring plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, 1996 Permittee Edition	British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials, March, 1994, Permittee Edition

The above manuals are available from Queen's Printer Publications Centre, P.O. Box 9452, Stn. Prov. Govt, Victoria, BC, V8W 9V7 (1-800-663-6105 or (250)387-4609). The above manuals are also available for inspection at all Pollution Prevention offices.



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12. REPORTING

12.1. GENERAL REPORTING

The influent, effluent, reclaimed water and sludge quality, groundwater and lake monitoring analyses and related flow data is to be submitted to the Regional Waste Manager such that they are received by the Regional Waste Manager within 30 days of the results being received, or produced, by the District.

Monitoring data shall be entered into EMS electronically and submitted in electronic and printed format satisfactory to the Regional Waste Manager.

12.2. ANNUAL REPORTING

Annually submitted data, as detailed below, is to be combined into a single report, suitably tabulated and indexed and forwarded to the Regional Waste Manager, such that it is received by the Regional Waste Manager, on, or before March 31, each year for the previous year's monitoring. Raw data are to be attached as appendices to the report. The report shall include graphical trend analysis of amenable data, an evaluation of those trends and discussion of any points of action which may arise from the data. A copy of the Annual Report shall also be placed in the local library for public access.

12.3. EFFLUENT

Maintain records of effluent analyses and flow measurements for inspection by the Regional Waste Manager or his designate, and annually submit the data, suitably tabulated, to the Regional Waste Manager.

12.4. INFLUENT

Maintain records of influent analyses for inspection by the Regional Waste Manager or his designate, and annually submit the data, suitably tabulated, to the Regional Waste Manager.

12.5. LAKE MONITORING

Maintain records of lake monitoring for inspection by the Regional Waste Manager or his designate, and annually submit the data, suitably tabulated, to the Regional Waste Manager.

12.6. IRRIGATION

Maintain effluent water balance records. Maintain records of the duration, intensity, acreage, location and type of effluent irrigation. For lands other than the treatment plant site: Maintain records of crop production and nutrient content. Maintain records of soil, water and nutrient balances and assessments of any changes in the soil,



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surface or groundwater regimes. Maintain records of groundwater monitoring data. Annually submit the data as part of an Irrigation Plan and Soil Assessment.

12.7. SLUDGE

Maintain records of sludge analysis, sludge volumes and application sites for inspection by the Regional Waste Manager or his designate, and annually submit the data, suitably tabulated, to the Regional Waste Manager, prior to the end of the month of March, for the previous year's monitoring.

12.8. I&I

Maintain records of efforts to reduce infiltration, inflow and cross connections and annually submit the data, suitably tabulated, to the Regional Waste Manager.

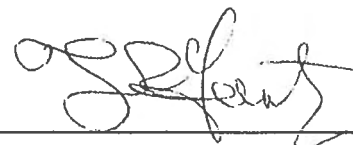
12.9. INFLUENT WASTES BY-LAW(S)

Maintain records of efforts to administer the influent wastes by-law(s) and annually submit the data, suitably tabulated, to the Regional Waste Manager. Include as an attachment, any amendments to the influent wastes by-law(s) that have been made during the past year.

12.10. WATER CONSERVATION

Maintain records of efforts to implement water conservation initiatives and annually submit the data, suitably tabulated, to the Regional Waste Manager. Include as an attachment, any amendments to the influent wastes by-law(s) that have been made during the past year.

With prior written authorization from the Regional Waste Manager, data may be submitted, suitably formatted, on computer storage media such as a floppy disk or another similar device.



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APPENDIX A

Requirements of Reclaimed water Users

The holder of this Operational Certificate (The reclaimed water supplier) shall be responsible for ensuring that contractual agreement(s) with each Reclaimed water User are in accordance with the Operational Certificate.

A copy of this Appendix is to be provided to EACH USER prior to the commencement of irrigation EACH YEAR. Documentation, indicating that Reclaimed water Users were provided a copy of this Appendix, is to be included in the Annual Report each year.

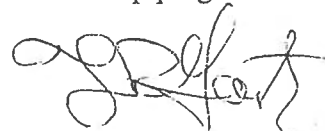
13. GENERAL REQUIREMENTS

13.1. PLANS - NEW WORKS

- 13.1.1. Plans for modifications and/or extensions to the existing reclaimed water irrigation system shall be approved by a person qualified in the design of irrigation systems and the Irrigation Plan and the Soils Assessment is to be submitted to the Regional Waste Manager for authorization prior to the commencement of irrigation on the subject property.
- 13.1.2. Design and construct the irrigation works in accordance with best current agricultural practice and the "Pollution Control Guidelines for Municipal Effluent Application to Land", dated January 1983, and any amendments thereto, issued by the Ministry of Environment of British Columbia, and also in accordance with the "B.C. Sprinkler Irrigation Manual", dated 1989, prepared by the B.C. Ministry of Agriculture and Fisheries or the "B.C. Trickle Irrigation Manual", dated 1987, prepared by the B.C. Ministry of Agriculture and Fisheries.

13.2. CONSTRUCTION CRITERIA

- 13.2.1. All reclaimed water user valves, shall be of a type, or secured in a manner, that permits operation by only personnel authorized by each wastewater user. All piping, valves and outlets should be clearly marked to differentiate reclaimed water from domestic water. All reclaimed water controllers, valves, etc., shall be affixed with reclaimed water warning signs. It is recommended that, where possible purple coloured pipe and fixtures be utilized to facilitate identification of reclaimed water piping and fixtures.



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- 13.2.2. Use or installation of hose-bibs on any irrigation system presently operating, or designated to operate with reclaimed water, regardless of the hose-bib construction or identification, is not permitted.
- 13.2.3. There shall be at least a 3 metre horizontal and a 0.3 metre vertical separation (with domestic water pipeline above the reclaimed water pipeline) between all pipelines transporting reclaimed water and those transporting domestic water.
- 13.2.4. There shall be no connection between a potable water supply, irrigation water or industrial well, and piping containing reclaimed water, except through an air gap separation or reduced pressure principle device.

13.3. FENCING

The reclaimed water user may be required by the Regional Waste Manager to erect a fence around the reclaimed water irrigation area to restrict public access. The height and type of fencing shall meet the approval of the Regional Waste Manager.

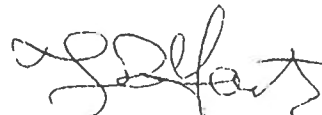
13.4. SIGNAGE

- 13.4.1. Prominent "NO TRESPASSING", signs shall be erected around agricultural and silvicultural sites irrigated with reclaimed water, warning persons of the possible health hazard during the irrigation season and advising that the water used for irrigation is NOT POTABLE. The wording shall be in language or symbols readily comprehensible by the general public. e.g. "NO TRESPASSING - RECLAIMED WATER - DO NOT DRINK"
- 13.4.2. Warning signs shall be posted in sufficient numbers and size and at strategic locations to advise the public that reclaimed water is being used. Additional signage may be required as directed by the Regional Waste Manager.

14. GENERAL REQUIREMENTS - RECLAIMED WATER IRRIGATION

14.1. BUFFER ZONES

- 14.1.1. The requirement for formal buffer zones surrounding lands irrigated with reclaimed water is no longer in effect, however, a buffer zone may be specified by the Regional Waste Manager.
- 14.1.2. Reclaimed water applied by irrigation shall not be applied to the ground any closer than 15 metres from the edge of flowing streams or bodies of water.
- 14.1.3. There shall be no reclaimed water irrigated within 30 metres of any well or in-ground reservoir for domestic supply.



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14.2. SURFACE RUNOFF

- 14.2.1. There shall be no surface runoff of irrigated reclaimed water from the irrigated lands.
- 14.2.2. The maximum ground slope shall not exceed 20% without the written consent of the Regional Waste Manager.

14.3. SURFACING RECLAIMED WATER

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

14.4. SPRAY IRRIGATION DRIFT


- 14.4.1. Reclaimed water shall be confined to the area designated and approved for irrigation with reclaimed water. The reclaimed water irrigation system shall be managed in such a fashion as to prevent aerosol drift from leaving the irrigated lands.
- 14.4.2. Precautions shall be taken to ensure that reclaimed water will not have contact with any facility or area not designated for reclamation, such as passing vehicles, buildings, domestic water facilities, fruit and vegetable gardens, or food handling facilities.
- 14.4.3. Drinking water facilities shall be protected from direct or wind blown reclaimed water spray.

14.5. IRRIGATION RATES

- 14.5.1. Irrigation rates for spray irrigation shall not exceed the rates given in "B.C. Sprinkler Irrigation Manual", dated 1989, prepared by the B.C. Ministry of Agriculture and Fisheries and irrigation rates for trickle irrigation shall not exceed the rates given in those given in "B.C. Trickle Irrigation Manual", dated 1987, prepared by the B.C. Ministry of Agriculture and Fisheries.
- 14.5.2. Soils of the irrigated lands will be monitored periodically or as otherwise directed by the Regional Waste Manager or the District, to prevent saturation, erosion, and instability.

14.6. AGRICULTURAL PRODUCTS LAG TIME

- 14.6.1. A three day lag time is required before un-inspected livestock intended for human consumption are permitted on areas irrigated with reclaimed water. No lag time is required if livestock are subjected to the federal meat inspection program.



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

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

14.7. INSECT AND VECTOR CONTROL

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

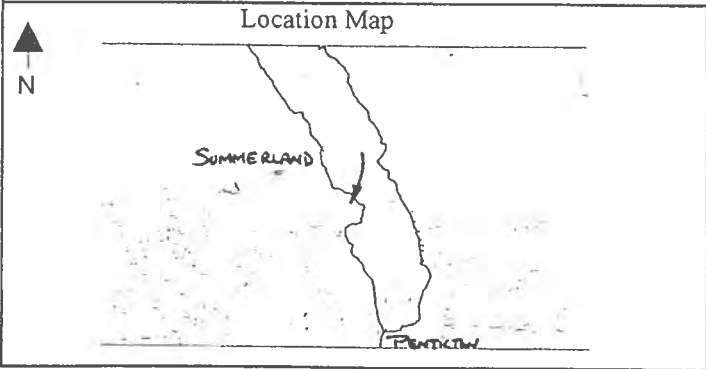
14.8. IRRIGATION OF PUBLIC AREAS

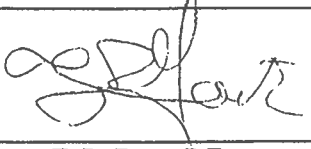
14.8.1. Irrigation on golf courses, parks or cemeteries shall only be practised when the public are not present.

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



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Assistant Regional Waste Manager



Scale:	NTS
Permit No.:	PE13627(01)
Date:	June 16, 1998
	
T. R. Forty, P.Eng. Assistant Regional Waste Manager	

APPENDIX B

EMERGENCY RESPONSE PLAN



Engineering & Public Works
Department
Wastewater Division

District of Summerland Wastewater Treatment Plant Emergency Response Manual 2022

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APPENDICES

- APPENDIX A** Wastewater Section Emergency Response Report
- APPENDIX B** Wastewater Section Spill Incident Report
- APPENDIX C** Wastewater Section Contaminated Soil or Groundwater Report
- APPENDIX D** Wastewater Section Personal Injury Report

1.0 EXECUTIVE SUMMARY

The Summerland Wastewater Treatment plant is responsible for providing final wastewater effluent that meets all regulatory requirements. Disruption to these services whether routine or as a result of an emergency is inevitable. The Utility’s challenge is to reduce risk and the overall effects of these emergencies.

The Treatment plant personnel must consider themselves responsible for providing wastewater treatment services under emergency conditions. The best way to do this is through preparation. This manual represents the wastewater plant’s principles, practices and guidelines for the treatment plant’s emergency planning and is intended to be used by all section employees.

The manual provides guidelines and a sufficient level of detail to complete the emergency planning process for most systems.

The content of this emergency response manual will be periodically updated and revised as the Utility grows and changes. New emergency procedures will be added and existing procedures revised, as utility operators or management identifies the need. The procedures laid out will be revised as equipment and processes utilized by the section are phased out, upgraded or expanded.

2.0 PLAN INTRODUCTION

2.1 How and When to Use the Plan

This emergency response plan is intended to be distributed to all wastewater operations staff. It is to be used as a guide for dealing with emergencies as they arise within any operating area and must be available for reference by all staff at all times. It is the responsibility of each staff member to familiarize themselves with the response plan and to refer to the specific area that applies during emergency situations. It is also the responsibility of each staff member to bring to the attention of their Supervisor the need to make changes, additions or modifications as they arise within their specific area. The Supervisor must ensure any and all of these additions or modifications are included in the plan and that it is updated on an annual basis.

2.2 Treatment Plant Organizational Chart

Jeremy Storvold <i>Director of Utilities</i> Devon van der Meulen <i>Manager of Water Utilities</i>	
Lift Station Operators: 1. Ryan Cleverdon 2. Jason Wright 3. Matthew Perdue 4. Kendell Wilson	WWTP Operators: 1. Ryan Cleverdon 2. Jason Wright 3. Matthew Perdue 4. Kendell Wilson

3.0 PLAN ACTIVATION PROCEDURES

3.1 First Response

All staff members must immediately report any emergency to their Supervisor and use the plan as a guide to assist in first response. **In an emergency, the most senior staff in the vicinity shall assume the responsibility of initiating the emergency response plan and assume the role of “Senior Operator” as described in the emergency response procedures that follow.** The first line Management Supervisor within each unit, or his / her designate, is responsible to ensure the plan is properly coordinated and implemented in a timely fashion. The Supervisor is also responsible to notify the section head or his / her designate immediately.

3.2 Senior Staff Notification Procedure

All emergencies involving risk to the health and safety of staff members or to the general public are to be reported to Senior Management immediately. The Senior Operator or his / her designate must ensure that Senior Management is notified immediately prior to public notification. Within 48 hours of the emergency, complete the Emergency Response Report found in Appendix A and forward it to the Supervisor and the Director of Engineering and Public Works along with any additional relevant documentation.

3.3 Public Notification Procedure

Once the Senior Operator and Senior Management have been notified of an emergency, Senior Management will notify the customers that may be affected. Depending on the severity of the emergency, senior management will determine what form notification to the public will take.

3.4 Environment and Regulatory Notification Procedure

All emergencies that may have an effect on water, sewer, or air quality are to be reported immediately to the Senior Operator and Senior Management is responsible to ensure staff know and can implement the PEP first response procedure. Refer to Section 3.4.1 - Spill Reporting Procedures.

3.4.1 Spill Reporting Procedures

.1 In these procedures, as defined by the Environmental Management Act (BC Reg. 263/90):

“Act” means the Waste Management Act;

“PEP” means the Provincial Emergency Program;

“Spill” means a release or discharge except as authorized or allowed by:

- a) Section 3 of the Act,
- b) A waste management plan approved by the minister or under the Act, or
- c) A permit, approval or order under the Act.

into the environment of a substance in an amount equal to or greater than the amount listed in Table 1.

“Substance” means a substance, product, material or other thing listed in Table 1.

“Federal Regulations” means The Transportation of Dangerous Goods Regulations made under the Transportation of Dangerous Goods Act (Canada).

“Special Waste Regulations” means BC Reg. 63/88.

.2 Spill Reporting Requirements

All staff must be acquainted with the nature of chemicals used on-site (refer to the MSDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

.1 A primary containment facility leaks a substance of reportable quantity (see Table 1):

- a) If the substance is discharged to the environment then the leak must be reported to the Immediate Supervisor
- b) If the substance is not discharged to the environment then the leak must be reported to the immediate Supervisor;
- c) If the leak is to a secondary containment the leak must be reported to the Immediate Supervisor. If failure of the secondary containment would result in discharge to the environment the Immediate Supervisor must also be notified.

.2 A primary containment facility leaks a substance of less than reportable quantity (see Table 1):

- a) If no discharge to the environment occurs then, at the discretion of staff, this leak should be reported to the Immediate Supervisor at the time of the incident or within 12 hours;
- b) If discharge to the environment does occur this leak should be reported to the Immediate Supervisor at the time of the incident or within 12 hours.

.3 Use the Wastewater Section Spill Incident Report found in Appendix B to document spills by filling out the appropriate sections and forwarding as indicated on the form.

Table 1
Summary of Reportable Spills by Quantity
(From: Environmental Management Act Reporting Schedule)

Item	Column 1 Substance spilled	Column 2 Specified amount
1	Class 1, Explosives as defined in section 2.9 of the Federal Regulations	Any quantity that could pose a danger to public safety or 50 kg
2	Class 2.1, Flammable Gases, other than natural gas, as defined in section 2.14 (a) of the Federal Regulations	10 kg
3	Class 2.2 Non-Flammable and Non-Toxic Gases as defined in section 2.14 (b) of the Federal Regulations	10 kg
4	Class 2.3, Toxic Gases as defined in section 2.14 (c) of the Federal Regulations	5 kg
5	Class 3, Flammable Liquids as defined in section 2.18 of the Federal Regulations	100 L
6	Class 4, Flammable Solids as defined in section 2.20 of the Federal Regulations	25 kg
7	Class 5.1, Oxidizing Substances as defined in section 2.24 (a) of the Federal Regulations	50 kg or 50 L
8	Class 5.2, Organic Peroxides as defined in section 2.24 (b) of the Federal Regulations	1 kg or 1 L
9	Class 6.1, Toxic Substances as defined in section 2.27 (a) of the Federal Regulations	5 kg or 5 L
10	Class 6.2, Infectious Substances as defined in section 2.27 (b) of the Federal Regulations	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
11	Class 7, Radioactive Materials as defined in section 2.37 of the Federal Regulations	Any quantity that could pose a danger to public safety and an emission level greater than the emission level established in section 20 of the "Packaging and Transport of Nuclear Substances Regulations"
12	Class 8, Corrosives as defined in section 2.40 of the Federal Regulations	5 kg or 5 L
13	Class 9, Miscellaneous Products, Substances or Organisms as defined in section 2.43 of the Federal Regulations	25 kg or 25 L
14	waste containing dioxin as defined in section 1 of the Hazardous Waste Regulation	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
15	leachable toxic waste as defined in section 1 of the Hazardous Waste Regulation	25 kg or 25 L
16	waste containing polycyclic aromatic hydrocarbons as defined in section 1 of the hazardous Waste Regulation	5 kg or 5 L
17	waste asbestos as defined in section 1 of the Hazardous Waste Regulation	50 kg
18	waste oil as defined in section 1 of the Hazardous Waste Regulation	100 L
19	waste containing a pest control product as defined in section 1 of the Hazardous Waste Regulation	5 kg or 5 L
20	PCB Wastes as defined in section 1 of the Hazardous Waste Regulation	25 kg or 25 L
21	waste containing tetrachloroethylene as defined in section 1 of the Hazardous Waste Regulation	50 kg or 50 L
22	biomedical waste as defined in section 1 of the Hazardous Waste Regulation	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
23	A hazardous waste as defined in section 1 of the Hazardous Waste Regulation and not covered under items 1 – 22	25 kg or 25 L
24	A substance, not covered by items 1 to 23, that can cause pollution	200 kg or 200 L
25	Natural gas	10 kg, if there is a breakage in a pipeline or fitting operated above 100 psi that results in a sudden and uncontrolled release of natural gas

3.5 Section and Inter Division Primary Contact Lists

**Table 2
Inter Section Primary Contact List**

Position	Name	Work No.	Cell No.
Administrators			
Director of Utilities	Jeremy Storvold	250-494-0431	250-460-6610
Manager of Water Utilities	D. van der Meulen	250-404-4075	250-462-0493
Manager of Public Works	Shawn Goodsell	250-404-4082	250-485-6216
Operations			
Wastewater Chief Operator	Ryan Cleverdon	250-494-0619	250-490-7242
Wastewater Operator	Kendell Wilson	250-494-0619	250-809-7141
Wastewater Operator	Jason Wright	250-494-0619	250-809-7141
Wastewater Operator	Mathew Perdue	250-494-0619	250-809-7141

3.5.1 Wastewater Treatment Plant Contact Procedures

To Contact Standby Personnel (24 hour) call:

- Ryan Cleverdon, Cell 250-490-7242
- Stand-By Operator, Cell 250-809-7141

If unable to reach the standby person call:

- Devon van der Meulen, Manager of Utilities 250-462-0493

3.5.2 Lift Station Contact Procedures

To Contact Standby Personnel call direct to:

After hours call:

- Ryan Cleverdon, Cell 250-490-7242
- Stand-By Operator, Cell 250-809-7141

If unable to reach standby person call:

- Devon van der Meulen, Manager of Utilities 250-462-0493

4.0 RESPONSE PROCEDURES BY UNIT

The following section is a summary of response procedures for selected emergency conditions. This is by no means exhaustive, and will be expanded and revised periodically or as the need arises. In an emergency, the most senior staff in the vicinity will assume the responsibilities designated to the *Senior Operator* in the response procedure. Following each response procedure is a list of the appropriate contact personnel or agencies and the contact's phone number. Within 48 hours of the emergency, complete the Emergency Response Report

found in Appendix A and forward it to your Immediate Supervisor along with any additional relevant documentation.

4.1 Lift Station Emergency Response

4.1.1 Staff Injury

A member of the staff has been seriously injured.

Objective: Prevent further injury and provide medical attention as quickly as possible.

Response Action	Responsibility
1. If working in confined space and the attending worker cannot retrieve the injured person with a harness: <ul style="list-style-type: none"> • If the attending worker sees that the worker(s) inside the space are in trouble, or if he cannot contact the worker(s) inside, he shall <u>immediately</u> call 911. He shall provide information such as: location, type of accident and condition of patient. Under no circumstances shall the attending worker enter the confined space to give aid until help arrives. 	<ul style="list-style-type: none"> • Senior Operator
2. Once the injured person is retrieved, or if confined space is not involved, then protect the injured person from further danger. If severely injured, do not move the person unless threatened by nearby hazard.	<ul style="list-style-type: none"> • Senior Operator
3. Establish and maintain the injured persons breathing.	<ul style="list-style-type: none"> • Senior Operator
4. Control all major bleeding.	<ul style="list-style-type: none"> • Senior Operator
5. As soon as possible, report the accident to the Assistant Superintendent.	<ul style="list-style-type: none"> • Senior Operator
6. Accompany the injured employee to the Doctor’s office or place of residence upon receiving approval from a Supervisor.	<ul style="list-style-type: none"> • Senior Operator
7. Prepare a detailed accident report within 24 hours of the incident and submit it to your Supervisor (<i>See Appendix D</i>).	<ul style="list-style-type: none"> • Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493

4.1.2 Lift Station Power Failure

A collection system lift station has ceased operation due to prolonged power failure. A prolonged power failure is one which lasts more than 10 minutes and can not be restored for 30 minutes or more.

Objective: Prevent flooding and damage to property and the environment.

Response Action	Responsibility
Contact the Manager of Utilities and inform him of the problem.	<ul style="list-style-type: none"> • Senior Operator
1. If possible, call Electrical Dept. and determine the nature of the problem and how long the power will be out.	<ul style="list-style-type: none"> • Senior Operator
2. Butler Street, Dale Meadows, Trout Creek, Crescent Beach, Landry #1, Landry #2, Peach Orchard and Hunters Hill Lift Stations are equipped with standby generators and will automatically start if power is disrupted.	<ul style="list-style-type: none"> • Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Corp. Electrical Dept	250-494-0431	250-494-6818
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493

4.1.3 Chemical Spill Response

A chemical spill that has occurred within the lift station and may impact the environment.

Objective: Prevent injury or loss of life to staff and the public. Contain and clean-up the spill as soon as possible.

All staff must be acquainted with the nature of chemicals used on-site (refer to the MSDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

Response Procedure	Responsibility
1. When possible, the person finding a leak should stop the flow of the chemical immediately. Follow all safety procedures.	• Senior Operator
2. Upon discovery of a spill, notify the following people: <ul style="list-style-type: none"> • Manager of Utilities • Director of Works and Utilities; • Provincial Emergency Program (PEP). 	• Senior Operator
3. If public safety is at risk, notify and if necessary evacuate residence in the affected area.	• Senior Operator
4. Spills of reportable quantities must be documented by filling out the Water / Wastewater Spill Incident Report found in Appendix B (<i>Refer to Table 1 Reportable Spill Quantities</i>).	• Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493
Provincial Emergency Program (PEP)	1-800-663-3456	
Ministry of Environment	1-800-461-1127	
Summerland PEP Coordinator	250-494-7211	250-488-1220
Assistant PEP Coordinator	250-494-7211	250-488-0960
Dispatch (for Duty Officer)	911	

4.1.1.1 Spill Response and Counter Measures Plan for Ferric Chloride

- .1 A spill of Ferric Chloride has occurred. This product is classified under Item 75 as Class 9.2 (Environmentally Hazardous) according to the Spill Reporting Regulations. Any spill to the environment of more than 1 kg or 1 litre must be reported using the Spill Incident Report (*see Appendix B*).

- .2 For spills less than reportable quantities (at the discretion of the operator) notify your Immediate Supervisor at the time of the incident or within 12 hours of the spill.
- .3 Spills that do not put staff, the environment, or the public in serious danger in an attempt to contain or clean-up should be handled as follows.
- .4 Obtain the following safety equipment.

All staff must be acquainted with the nature of chemicals used on-site (refer to the SDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

Safety Equipment	Location
Rubber boots, apron and gloves	Maintenance Shop
Safety glasses and face shield	Maintenance Shop

- .5 Obtain the following containment and clean-up materials:

Containment and Clean-up Equipment	Location
Absorbent materials	Maintenance Shop
Water hose	Maintenance Shop

- .6 Utilize the containment and clean-up equipment as follows:
 - .1 While wearing the above safety equipment, secure the area and contain the spill. Recover as much product as possible with absorbent material and place in a rubber or plastic container. Wash down contaminated area thoroughly.
 - .2 A major failure of the Ferric Chloride storage tank will be contained by the secondary containment but would result in contamination of a large area. The operator should not attempt to contain or clean-up a spill of this magnitude.
 - .3 In the event of a major spill event the Fire Hall should be contacted immediately and the first response unit dispatched to the scene.

MINISTRY

4.2 Summerland Wastewater Treatment Plant Emergency Response

4.2.1 Staff Injury

A member of the staff has been seriously injured.

Objective: Prevent further injury and provide medical attention as quickly as possible.

Response Action	Responsibility
8. If working in confined space and the attending worker can not retrieve the injured person with a harness: <ul style="list-style-type: none"> • If the attending worker sees that the worker(s) inside the space are in trouble, or if he cannot contact the worker(s) inside, he shall <u>immediately</u> call 911. He shall provide information such as: location, type of accident and condition of patient. • Under no circumstances shall the attending worker enter the confined space to give aid until help arrives. 	<ul style="list-style-type: none"> • Senior Operator
9. Once the injured person is retrieved, or if confined space is not involved, then protect the injured person from further danger. If severely injured, do not move the person unless threatened by nearby hazard.	<ul style="list-style-type: none"> • Senior Operator
10. Establish and maintain the injured persons breathing.	<ul style="list-style-type: none"> • Senior Operator
11. Control all major bleeding.	<ul style="list-style-type: none"> • Senior Operator
12. As soon as possible, report the accident to the Manager of Utilities.	<ul style="list-style-type: none"> • Senior Operator
13. Accompany the injured employee to the Doctor's office or place of residence upon receiving approval from a Supervisor.	<ul style="list-style-type: none"> • Senior Operator
14. Prepare a detailed accident report within 24 hours of the incident and submit it to your Supervisor (<i>see Appendix D</i>).	<ul style="list-style-type: none"> • Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493

4.2.2 Wastewater Treatment Plant Permit Violation

The Summerland Wastewater Treatment Plant may potentially violate the operating permit.

Objective: To correct the problem as soon as possible.

WWTP Operator: On discovery of effluent flowing to Okanagan Lake with any parameter that has reached or exceeded permit requirements:

Response Procedure	Responsibility
1. Advise Senior Operator.	<ul style="list-style-type: none"> • Lab Technician
2. Collect a 500 ml grab sample of effluent from the filter building, filter a 100 ml portion from this sample, label both the filtered portion and the unfiltered portion of the sample with the type of sample, date, time collected, and the name of the person that collected the sample. Seal the lids with masking tape and store in the refrigerator.	<ul style="list-style-type: none"> • Lab Technician
3. Collect a 500 ml sample from the effluent composite sampler and handle and label as in Step 2.	<ul style="list-style-type: none"> • Lab Technician

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493
Ministry of Environment	250-490-8200	

4.2.3 Major Component or Tankage Failure Response

A major process component has failed. This may include anything from mechanical failure to failed containment walls in the bioreactor, primary and secondary clarifiers, etc.

Objective: Prevent damage to public and private property, injury to staff and the public, and restore the plant to operation as soon as possible.

Response Procedure	Responsibility
1. Alert the first available of: <ul style="list-style-type: none"> • Manager of Water Utilities • Director of Utilities. 	• Senior Operator
2. If there is danger of fire or explosion call 911.	• Senior Operator
3. If the component failure results in a chemical spill then refer to section.	• Senior Operator
4. Divert flows to any undamaged tanks that are not in use and isolate the failed component.	• Senior Operator
5. Set up temporary controls if the main control system has also failed.	• Senior Operator
6. Secure the necessary pumps, staff and equipment to repair the damage.	• Senior Operator
7. Notify PEP and Ministry of Environment if volume of spill exceeds reportable quantities (see Table 1 Reportable Spill Quantity).	• Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493
Ministry of Environment	1-800-461-1127	
Provincial Emergency Program (PEP)	1-800-663-3456	

4.2.4 Outfall Pipe Failure

A major failure of the outfall pipe has occurred.

Objective: Prevent flooding of private property due to WWTP effluent overflow.

Response Procedure	Responsibility
Notify the Manager of Utilities and the Director of Works and Utilities.	• Senior Operator
1. Of the outfall pipe failure.	
2. Notify the Ministry of Environment of the emergency and the departure from normal operating procedures.	• Senior Operator
3. Secure necessary equipment to make repairs to the outfall pipe.	• Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610

Manager of Water Utilities	250-404-4075	250-462-0493
Ministry of Environment		1-800-461-1127

4.2.4.1 Chemical Spill

A chemical spill has occurred within the plant and may impact the environment.

Objective: Prevent injury or loss of life to staff and the public. Contain and clean-up the spill as soon as possible.

All staff must be acquainted with the nature of chemicals used on-site (refer to the SDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

Response Procedure	Responsibility
1. When possible, the person finding a leak should stop the flow of the chemical immediately. Follow all safety procedures.	<ul style="list-style-type: none"> Senior Operator
2. Upon discovery of a spill, notify the following people. <ul style="list-style-type: none"> Manager of Engineering; Director of Engineering and Public Works; Provincial Emergency Program (PEP). 	<ul style="list-style-type: none"> Senior Operator
3. If public safety is at risk, notify and if necessary evacuate residence in the affected area.	<ul style="list-style-type: none"> Senior Operator
4. Spills of reportable quantities must be documented by filling out the Water / Wastewater spill Incident Report found in Appendix B (<i>Refer to Table 1 Reportable Spill Quantities</i>).	<ul style="list-style-type: none"> Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493
Provincial Emergency Program (PEP)	1-800-663-3456	
Ministry of Environment	1-800-461-1127	

4.2.4.2 Spill Response and Counter Measures Plan for Aluminum Sulfate (Alum)

- .1 A spill of Alum has occurred. This product is classified under Item 15 as Class 9.2 (Environmentally Hazardous) according to the Spill Reporting Regulations. Any spill to the environment of more than 1 kg or 1 litre must be reported using the Spill Incident Report (*see Appendix B*).

- .2 For spills less than reportable quantities, (at the discretion of the operator) notify your immediate supervisor at the time of the incident or within 12 hours of the spill.
- .3 Spills that do not put staff, the environment, or the public in serious danger in an attempt to contain or clean-up should be handled as follows.
- .4 Obtain the following safety equipment.

All staff must be acquainted with the nature of chemicals used on-site (refer to the MSDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

Safety Equipment	Location
Rubber boots, apron and gloves	Maintenance Shop
Safety glasses and face shield	Maintenance Shop

- .5 Obtain the following containment and clean-up materials:

Containment and Clean-up Equipment	Location
Absorbent materials	Maintenance Shop
Water hose	Maintenance Shop

- .6 Utilize the containment and clean-up equipment as follows:
 - .1 While wearing the above safety equipment, secure the area and contain the spill. Spills of less than 5 litres from the day tanks or the main tanks are unlikely to have an environmental impact so need not be reported to PEP. Spilled material will run into the containment area. Attempt to pump clean alum back into the tanks. If containment is breached the sump will send it to the headworks of the plant.
 - .2 Wash down contaminated areas thoroughly with water and employ absorbent materials for areas that may not be accessed with water.
 - .3 A major failure of the main alum storage tanks will be partially contained by the secondary containment but would result in contamination of a large area. The operator should not attempt to contain or clean up a spill of this magnitude.
 - .4 In the event of a major spill event the fire hall should be contacted immediately and the HAZMAT response unit dispatched to the scene.

4.2.4.3 Spill Response and Counter Measures Plan for Polymer

- .1 A spill of Polymer has occurred. This product is classified according under Item 20 of the Spill Reporting Regulations and therefore spills of greater than 200 kg have to be reported using the Spill Incident Report.
- .2 Spills of less than reportable quantities, at the discretion of staff, notify your Immediate Supervisor of the spill at the time of the incident or within 12 hours of the spill.
- .3 Spills that do not put staff, the environment, or the public in serious danger in an attempt to contain or clean-up should be handled as follows.
- .4 Obtain the following safety equipment.

All staff must be acquainted with the nature of chemicals used on-site (refer to the MSDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

Safety Equipment	Location
Approved dust mask	Maintenance Shop
Rubber gloves	Maintenance Shop
Safety goggles and face shield	Maintenance Shop
Coveralls	Administration Building
Footwear with closed tops	Standard Equipment

- .5 Obtain the following containment and clean-up materials:

Containment and Clean-up Equipment	Location
Scoop shovel and broom	Maintenance Shop
Water-tight storage containers	Maintenance Shop

- .6 Utilize the containment and clean-up equipment as follows:
 - .1 While wearing the above safety equipment, secure the area, remove all sources of ignition and contain the spill.
 - .2 Recover as much of spilled dry product as possible and place in water-tight containers for storage until the product can be used or disposed of.
 - .3 Wash down spills of dilute solutions or residual dry product with large quantities of water into internal plant sewer system.
 - .4 Upon completion of clean-up procedures, remove contaminated safety equipment and clean or service as required. Remove contaminated clothing and wash thoroughly.

4.2.4.4 Spill Response and Counter Measures Plan for Oil

- .1 A spill of oil has occurred. This product is classified under Item 20 according to the Spill Reporting Regulations and therefore spills to the environment of more than 205 liters must be reported using the Spill Incident Report.
- .2 For spills of less than reportable quantities, notify your Immediate Supervisor of the spill at the time of the incident or within 12 hours of the spill.
- .3 Spills that do not put staff, the environment, or the public in serious danger in an attempt to contain or clean-up should be handled as follows.
- .4 Obtain the following safety equipment.

Safety Equipment	Location
Gloves	Maintenance Shop
Safety glasses and face shield	Maintenance Shop
Coveralls	Administration Building

- .5 Obtain the following containment and clean-up materials:

Containment and Clean-up Equipment	Location
Scoop shovel and broom	Maintenance Shop
Absorbent materials	Maintenance Shop

- .6 Utilize the containment and clean-up equipment as follows:
 - .1 Employ absorbent materials to soak up any oil on the floor. Place the used absorbent materials in plastic bags or barrels for storage until it can be properly disposed of.
 - .2 Obtain a tank large enough to store the quantity of oil spilled into the secondary containment. Store the oil until the permanent tank can be repaired or replaced if need be.

4.2.4.5 Spill Response and Counter Measures Plan for Diesel Fuel

- .1 A spill of Diesel fuel has occurred. This product is classified under Item 6 as Class 3.3 (Flammable Liquid) according to the Spill Reporting Regulations. Any spills of more than 100 litres to the environment must be reported using the Spill Incident Report.
- .2 For spills less than reportable quantities, notify your Immediate Supervisor at the time of the incident or within 12 hours of the spill.
- .3 Spills that do not put staff, the environment, or the public in serious danger in an attempt to contain or clean-up should be handled as follows.
- .4 Obtain the following safety equipment.

Safety Equipment	Location
Rubber boots, apron and gloves	Maintenance Shop
Safety glasses and face shield	Maintenance Shop

- .5 Obtain the following containment and clean-up materials:

Containment and Clean-up Equipment	Location
Absorbent materials	Maintenance Shop
Containers	Maintenance Shop

- .6 Utilize the containment and clean-up equipment as follows:
 - .1 While wearing the above safety equipment, secure the area and eliminate all sources of ignition.
 - .2 Use absorbent materials to clean-up spilled diesel.
 - .3 Place contaminated absorbent materials in containers for storage until they can be disposed of.
 - .4 Transfer any diesel left in the tank into a temporary container until the permanent tank can be repaired or replaced.
 - .5 Upon completion of clean-up procedures, remove contaminated safety equipment and clean or service as required. Remove contaminated clothing and wash thoroughly.

4.2.4.6 Spill Response and Counter Measures Plan for *Sodium Hypochlorite*

- .1 A spill of sodium hypochlorite has occurred. This product is classified under Item 15 as Class 9.2 (Environmentally Hazardous) according to the Spill Reporting Regulations. Any spill to the environment of more than 1 kg must be reported using the Spill Incident Report.
- .2 For spills less than reportable quantities, (at the discretion of staff) notify your Immediate Supervisor at the time of the incident or within 12 hours of the spill.
- .3 Spills that do not put staff, the environment, or the public in serious danger in an attempt to contain or clean-up should be handled as follows.
- .4 Obtain the following safety equipment.

All staff must be acquainted with the nature of chemicals used on-site (refer to the MSDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

Safety Equipment	Location
Rubber boots, apron and gloves	Maintenance Shop
Safety glasses and face shield	Maintenance Shop

- .5 Obtain the following containment and clean-up materials:

Containment and Clean-up Equipment	Location
Absorbent materials	Maintenance Shop
Shovels, brooms, containers	Maintenance Shop

- .6 Utilize the containment and clean-up equipment as follows:
 - .1 While wearing the above safety equipment, secure the area.
 - .2 Attempt to control or stop the leak by repositioning containers.
 - .3 Wash spilled material into the drains or contain with absorbent materials.
 - .4 Recover any contaminated absorbent material and deposit in water-tight containers for disposal.
 - .5 Upon completion of clean-up procedures, remove contaminated safety equipment and clean or service as required. Remove contaminated clothing and wash thoroughly.

4.2.4.6 Spill Response and Counter Measures Plan for *Ferric Chloride*

- .1 A spill of Ferric Chloride has occurred. This product is classified under Item 75 as Class 9.2 (Environmentally Hazardous) according to the Spill Reporting Regulations. Any spill to the environment of more than 1 kg or 1 litre must be reported using the Spill Incident Report (See Appendix B).
- .2 For spills less than reportable quantities, (at the discretion of the operator) notify your Immediate Supervisor at the time of the incident or within 12 hours of the spill.
- .3 Spills that do not put staff, the environment, or the public in serious danger in an attempt to contain or clean-up should be handled as follows.
- .4 Obtain the following safety equipment.

All staff must be acquainted with the nature of chemicals used on-site (refer to the MSDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

Safety Equipment	Location
Rubber boots, apron and gloves	Maintenance Shop
Safety glasses and face shield	Maintenance Shop

- .5 Obtain the following containment and clean-up materials:

Containment and Clean-up Equipment	Location
Absorbent materials	Maintenance Shop
Water hose	Maintenance Shop

- .6 Utilize the containment and clean-up equipment as follows:
 - .1 While wearing the above safety equipment, secure the area and contain the spill. Recover as much product as possible with absorbent material and place in a rubber or plastic container. Wash down contaminated area thoroughly.
 - .2 A major failure of the Ferric Chloride storage tank will be contained by the secondary containment but would result in contamination of a large area. The operator should not attempt to contain or clean-up a spill of this magnitude.
 - .3 In the event of a major spill event the fire hall should be contacted immediately and the HAZMAT response unit dispatched to the scene.

4.2.5 Major Power Failure

Power to the plant has been interrupted and will remain off for an undetermined amount of time.

Scenario:

The power has gone out at the plant, the generator will automatically start and all the essential equipment will stagger start.

Response Procedure	Responsibility
Check the stand-by generator to see if it is running, check the oil pressure, amps, rpm, etc. on the diesel.	Senior Operator
When the power returns to normal do a complete walk through to insure all plant equipment has restarted. Check the SCADA System to see that all alarms have been cleared.	Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493

4.2.6 Fire Emergency Response

All staff must be acquainted with the nature of chemicals used on-site (refer to the SDS Sheets) and the potential for fire and explosion.

All staff must be informed of the location of safety equipment including fire extinguishers and first aid equipment and how to operate that equipment.

Response Procedure	Responsibility
1. Preserve life at all times, including your own	• Senior Operator
2. When approaching a fire or leaving a fire site, face the fire location at all times	• Senior Operator
3. Call 911 and provide information about the potential for chemical fires	• Senior Operator
4. Alert all staff, the Manager of Water Utilities (Devon van der Meulen) and the Director of Utilities (Jeremy Storvold)	• Senior Operator
5. Extinguish or attempt to control small fires, but at no time risk life or injury by fighting a large fire; close doors; have all personnel leave the area	• Senior Operator
6. Meet the fire trucks at the main gate and assist the first firefighters by directing them, if possible, to the main fire	• Senior Operator

7. Assist in post investigation procedures

- Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493

4.3 Community Contact List

4.3.1 EMERGENCY SERVICES AND VOLUNTEER FIRE DEPARTMENT

POLICE DEPARTMENT 911

AMBULANCE SERVICE 911

Summerland Fire Department (*call fire department and leave message*) Hall: 250-494-7211
 Rob Robinson, Fire Chief 250-404-4088
 Summerland BC V0H 1Z8

4.3.2 Utilities

CORP. ELECTRICAL DEPT 250-494-0431

BC HYDRO 1-800-224-9376

FORTIS BC NATURAL GAS 1-800-663-9911

TELUS (24 HOURS) 611

4.3.3 Additional Emergency Numbers

BC PEP
 (HAZARDOUS MATERIAL SPILLS) 1-800-663-3456

DICK'S SEPTIC (SEPTAGE HAULING) 250-494-9864

INTERIOR INSTRUMENT 250-717-8813

SOUTH OKANAGAN HEALTH UNIT 250-868-7700

WORKSAFE BC 1-888-922-3700

4.3.4 RENTAL AGENCIES

SUMMERLAND RENTAL CENTRE 250-494-9864

WESTMINSTER RENTALS 250-492-7551

4.3.5 Pump Repair Services

EMPS 1-250-765-4998

EMERGENCY 1-250-717-0025

Appendix A
Wastewater Emergency Response Report

Staff Reporting or Receiving Report of an Emergency:

Name: Date: Time: a.m. p.m.

Person Reporting Emergency (if other than Regional Staff)

Name: Telephone No.: Address:

Emergency Details

Location:
Type of Emergency (i.e. fire, flood etc.):
Surroundings:
Agencies Contacted:

Forward To: (Immediate Supervisor)

Action Taken:

Comments:

Immediate Supervisor's Signature Date

Forward to: (Department Supervisor)

Action Taken:

Comments:

Submitted: Dept. Supervisor's Signature Date
Personal Injury Report
Spill Incident Report
Emergency Response Report
Notice of Contamination

Appendix B Wastewater Spill Incident Report

Staff Reporting or Receiving Report of a Spill:

Name:	Date:	Time: a.m. <input type="checkbox"/> p.m. <input type="checkbox"/>
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Person Reporting Spill (if other than Regional Staff)

Name:	Telephone No.:
Address:	

Incident Details

Location:

Substance (i.e. oil, acid, etc.):

Reportable Quantity?
Yes No

Discharge to Secondary Containment?
Yes No N/A

Discharge to Environment?
Yes No

Affected Areas:

Agencies Contacted:

Forward To: _____
(Immediate Supervisor)

Action Taken:

Comments:

Immediate Supervisor's Signature _____
Date _____

Forward to: _____
(Department Supervisor)

Action Taken:

Comments:

Submitted:		Dept. Supervisor's Signature _____
Personal Injury Report	<input type="checkbox"/>	Date _____
Spill Incident Report	<input type="checkbox"/>	
Emergency Response Report	<input type="checkbox"/>	
Notice of Contamination	<input type="checkbox"/>	

Appendix C Wastewater Contaminated Soil or Groundwater Report

Staff Reporting or Receiving Report of Contaminated Soil or Groundwater:

Name:	Date:	Time: a.m. <input type="checkbox"/> p.m. <input type="checkbox"/>
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Person Reporting Contamination (if other than Regional Staff)

Name:	Telephone No.:
Address:	

Contamination Details

Location:

Description of Work Being Performed:

Type of Contamination: (i.e. septic, toxic substance)

Approximate Quantity of Contamination:

Agencies Contacted:

Forward To: _____
(Immediate Supervisor)

Action Taken:

Comments:

Immediate Supervisor's Signature _____
Date _____

Forward to: _____
(Department Supervisor)

Action Taken:

Comments:

Submitted:		Dept. Supervisor's Signature _____
Personal Injury Report <input type="checkbox"/>		Date _____
Spill Incident Report <input type="checkbox"/>		
Emergency Response Report <input type="checkbox"/>		
Notice of Contamination <input type="checkbox"/>		

Appendix D Wastewater Section Injury Report

Staff Injured:

Name:	Date:	Time: a.m. <input type="checkbox"/> p.m. <input type="checkbox"/>
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Staff Reporting the Injury:

Name:	Telephone No.:
Address:	

Accident Details

Location:

Injury (i.e. broken bone, abrasion, etc.):

Actions Taken (First Aid Applied):

Forward To: _____
(Immediate Supervisor)

Action Taken:

Comments:

Immediate Supervisor's Signature _____
Date _____

Forward to: _____
(Department Supervisor)

Action Taken:

Comments:

Submitted:		Dept. Supervisor's Signature _____
Personal Injury Report	<input type="checkbox"/>	Date _____
Spill Incident Report	<input type="checkbox"/>	
Emergency Response Report	<input type="checkbox"/>	
Notice of Contamination	<input type="checkbox"/>	

APPENDIX C

EMERGENCY CONTACT LIST

EMERGENCY CONTACT LIST

District of Summerland

	<u>Office</u>	<u>Cell</u>
Municipal Hall	250-494-6451	
Engineering and Public Works	250-494-0431	
Devon van der Meulen	250-404-4075	250-462-0493
Shawn Goodsell	250-404-4082	250-485-6216
Ryan Cleverdon	250-494-0619	250-490-7242
Kendell Wilson	250-494-0619	250-809-7924
Jason Wright	250-494-0619	250-488-2244
Matthew Perdue	250-494-0619	250-809-7986
WWTP EMERGENCY CELL PHONE		250-809-7141
ENGINEERING AND PUBLIC WORKS (After Hours)		250-493-0005

Electrical Services

Centrix	250-717-8813	
Electrical Utility Division	250-494-0431	
EMERGENCY (After Hours)		250-490-6818

FIRE DEPARTMENT

Fire Hall	250-494-7211	
Rob Robinson (FC)	250-494-7211	250-404-4088
Dispatch (24 hr)	250-490-2305	
EMERGENCY	911	

POLICE DEPARTMENT

RCMP Non-Emergency	250-494-7416	
EMERGENCY	911	

MINISTRY OF ENVIRONMENT

EMERGENCY	1-800-663-3456	
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Hazardous Spills

Dangerous Goods – Spills	1-800-663-3456	
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CHEMICAL SUPPLIERS

Cleartech	1-800-387-7503	
Waterhouse Environmental	1-888-921-3317	
EMERGENCY	306-664-2522	

WORKSAFE BC

EMERGENCY	604-273-7711	
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SLUDGE HAULING

Dick's Septic Service	250-494-9864	
Superior Septic Services	250-493-1865	

APPENDIX D

ODOUR INVESTIGATION & COMPLAINT FORM

DISTRICT OF SUMMERLAND ODOR QUESTIONNAIRE FORM

QUESTIONNAIRE FORM

Location: _____
Person: _____ Phone: _____
Address: _____
Date: _____ Time: _____
Concerns: _____

Strength of Odor	Description of Odor	Wind Direction	Wind Velocity
<input type="checkbox"/> Undetectable	<input type="checkbox"/> Ammonia	<input type="checkbox"/> North	<input type="checkbox"/> Calm
<input type="checkbox"/> Slight	<input type="checkbox"/> Decayed Cabbage	<input type="checkbox"/> South	<input type="checkbox"/> Mild Breeze
<input type="checkbox"/> Definite	<input type="checkbox"/> Fecal	<input type="checkbox"/> East	<input type="checkbox"/> Gusty
<input type="checkbox"/> Strong	<input type="checkbox"/> Fishy	<input type="checkbox"/> West	<input type="checkbox"/> Strong
<input type="checkbox"/> Intense	<input type="checkbox"/> Garlic	<input type="checkbox"/> None	<input type="checkbox"/> Very Strong
	<input type="checkbox"/> Medicinal		
	<input type="checkbox"/> Rotten Egg		
	<input type="checkbox"/> Skunk		
	<input type="checkbox"/> Other _____		

Participants Comments: _____

INVESTIGATOR INFORMATION

Name of Investigator: _____
Date of Investigation: _____ Time of Investigation: _____

Investigators Comments: _____

Reviewed by: _____ Date: _____

APPENDIX E

SANITARY SEWER SYSTEM REGULATION BYLAW

**THE CORPORATION OF THE
DISTRICT OF SUMMERLAND**

BYLAW NUMBER 98-002

SANITARY SEWER SYSTEM REGULATION BYLAW

WHEREAS it is expedient that all real property that has shared in sewer extension costs and is capable of being served by a sanitary sewer, should so be served and connected;

AND WHEREAS there are possible components of sewage in various concentrations which are detrimental or costly to the operation and maintenance of the sanitary sewage system and must be prohibited;

AND WHEREAS it is deemed necessary and expedient to regulate the operation and use of the sanitary sewer system of the District;

AND WHEREAS pursuant to Section 574 of the Municipal Act, being Chapter 323 of the R.S.B.C.1996 and amendments thereto, the Municipal Council may by bylaw provide for the establishment of a system of sanitary sewer works and regulate the design of said works by persons other than the municipality and require connection to said works;

NOW THEREFORE, the Municipal Council of the district of Summerland, in Open Meeting Assembled, enacts as follows:

SECTION

1.0 TITLE

- 1.1 This bylaw may be cited as "District of Summerland Sewer Regulation Bylaw Number 98-002.

2.0 APPLICABILITY

- 2.1 This bylaw applies to all lands shown in Schedule "A" attached to Bylaw Number 95-014.

3.0 SEVERABILITY

- 3.1 If any section, subsection, clauses, sub-clause or phrase of this bylaw is for any reason held to be invalid by the decision of any court of competent jurisdiction, such decision shall not affect the validity of the remaining portions of this bylaw.

4.0 SANITARY SEWER SYSTEM REGULATIONS

- 4.1 This section provides for the regulation and use of sanitary sewers for all properties that have shared in sewer extension costs and are capable of being served by a sanitary sewer system.

5.0 FORCE AND EFFECT


- 5.1 This bylaw shall come into force and effect on the date of its adoption by the Municipal Council of the Corporation of the District of Summerland.

READ A FIRST, SECOND AND THIRD TIMES by the Municipal Council this 22nd day of June, 1998.

RECONSIDERED, FINALLY PASSED AND ADOPTED BY THE MUNICIPAL COUNCIL OF THE CORPORATION OF THE DISTRICT OF SUMMERLAND THIS 13th DAY OF JULY, 1998.



MAYOR



MUNICIPAL CLERK

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SECTION 1 - ADMINISTRATION AND GENERAL REQUIREMENTS

1.1 SCOPE

- 1.1.1 This section provides for the regulation and use of sanitary sewers .
- 1.1.2 The provisions of this section shall apply to all direct or indirect discharges to any part of the public sanitary sewerage system.
- 1.1.3 This section, among other things, regulates the quantity and quality of discharged wastes and the degree of pre-treatment required; and provides for the approval of plans for waste treatment.
- 1.1.4 Nothing in this section relieves any person or organization from complying with any provision of any Federal or Provincial legislation, or any other bylaw of the District of Summerland.

1.2 DEFINITIONS

- 1.2.1 In this section, unless the context otherwise requires, the following words and terms shall have the meanings hereinafter assigned to them:

B.O.D. or "biochemical oxygen demand" means the quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory conditions in five (5) days at 20°C, expressed in milligrams per litre as determined by the appropriate procedure in "Standard Methods".

Building Drain means the horizontal piping, including any vertical offset that conducts sewage, or clear water waste to a building sewer.

Building Inspector means the District's Building Inspector as appointed by resolution of the Municipal Council or his duly appointed representative.

Building Sewer (also called a "service connection") means a pipe that is connected to a building drain one (1) metre outside a wall of a building and that leads to a public sewer (sewer connection) or a private sewage disposal system.

District Engineer means the District's Engineer as appointed by resolution of the Municipal Council or his duly appointed representative. The range of authority of the District Engineer is intended to be, but not limited to, items involving Capital Works and expenditures, sewer infrastructure integrity and when other bylaws are involved.

C.O.D. or "chemical oxygen demand" means the measure of the oxygen consuming capacity of inorganic and organic matter present in domestic or industrial wastewater as determined by the appropriate procedure described in "Standard Methods".

Cooling Water means untreated water originating from heat exchangers or similar type units.

Director of Works & Utilities means the person appointed by the Municipal Council as the head of the District's Works & Utilities Department and includes employees of the Works & Utilities Department of the District when acting under the direction of the Director of Works & Utilities.

Domestic means resulting from natural processes and not produced by commercial or industrial activities.

Domestic Wastewater means the water carried wastes produced from non-commercial or non-industrial activities and which result from normal human living processes.

Effluent means the liquid outflow of any facility designed to treat or convey wastewater.

Flammable liquid means any liquid having a flash point below 38°C and having a vapour pressure not exceeding 280 kPa at 38°C.

Garbage means solid wastes from domestic and commercial preparation, cooking, and dispensing of food, and from the handling, storage and sale of produce.

Grab Sample means an aliquot of a sampled stream or discharge collected at one particular time and place.

Grease means an organic substance recoverable by procedures set forth in "Standard Methods" and includes but is not limited to hydrocarbons, esters, fats, oils, waxes and high molecular carboxylic acids.

Industrial wastewater means all water carried wastes and waste-water excluding domestic wastewater and uncontaminated water, and includes all wastewater from any processing, institutional, commercial, or other operation where the wastewater discharged includes wastes of non-human origin.

Municipal/Municipality means the District of Summerland.

Municipal Council means the duly elected Officials of the District of Summerland.

Offal means waste portions of food, animals, fowl or fish.

One-operating-day Composite Sample (one day sample) means a composite sample discharge consisting of flow proportioned samples collected at consecutive one-hour intervals over the duration of one operating day as outlined in Schedule "E", attached to and forming part of this bylaw.

Person includes any person, a corporation, partnership or party, and the personal or other legal representative of a person to whom the context can apply according to law.

Pesticide means an organism or material that is represented, sold, used or intended to be used to prevent, destroy, repel or mitigate a pest and includes:

- (a) a plant growth regulator, plant defoliator or plant desiccant; and
- (b) a control product, other than a device that is a control product under the Pest Control Products Act (Canada).

pH means logarithm, to the base 10, of the reciprocal of the concentration of Hydrogen ions in moles per litre of solution.

Plumbing Code means any regulation made by the Lieutenant Governor of the Province of British Columbia, in accordance with Section 692 of the Municipal Act.

Plumbing fixture means a receptacle, appliance, apparatus or other device that discharges sewage or clear-water waste, and includes a floor drain.

Regional District means the Regional District of Okanagan Similkameen.

Sanitary Sewer Specified Area means an area of land within the District, defined by bylaw adopted by the Municipal Council, which is designated to receive works or service from the municipality.

Sanitary Sewer System means all sewer works and all appurtenances thereto, including sewer mains, connections, pumping stations, treatment plants, lagoons and sewer outfalls laid within any highways, municipal right-of-way or easement and owned and operated by the Municipality and installed for the purpose of conveying, treating and disposing of domestic municipal wastes and industrial wastes.

Septic Tank means any device or structure designed for the temporary storage of wastewater.

Service Connection (also called "Building Sewer") means a pipe connecting a building drain to a sanitary sewer connection at the property line or to a private sewage disposal system.

Sewer means a pipe, including manholes and other appurtenances other than a service connection, in the sewer system.

Sewer Connection means a sewer pipe extending from a public sanitary sewer to the property line of the property being served or to be served or to a Statutory Right of Way or easement in favour of the property to be served.

Special Waste means a substance that is defined as "Special Waste" as interpreted by the Waste Management Act.

Standard Methods means the Standard Methods of Water and Wastewater Analysis (19th Edition, 1995, or current edition at the time of testing) as published by the American Public Health Association, the American Water Works Association, the Canadian Standards Association, and the Water Pollution Control Federation.

Total Suspended Solids means the solid matter according to particle size, expressed in milligrams per litre, in a liquid as determined according to "Standard Methods".

Two-Hour Composite Sample means a composite sample consisting of equal portions of 8 Grab Samples collected at consecutive 15-minute intervals.

Uncontaminated Wastewater means water such as spent cooling water, de-chlorinated water discharged from a swimming pool, water used in street cleaning.

Wastewater means the water-borne wastes of the municipality derived from human or industrial sources including domestic wastewater and industrial wastewater, but does not include rain water, ground water, or drainage of uncontaminated water.

Wastewater treatment plant means any arrangement of devices and structures used for treating wastewater.

Watercourse means:

(i) the bed and shore of a river, stream, lake, creek, lagoon, swamp, marsh or other natural body of water; or

(ii) a channel, ditch, reservoir or other man-made surface feature;

whether they contain or convey water continuously or intermittently.

1.3 CONNECTION REQUIREMENT

1.3.1 The owner of every parcel of real property within a Sanitary Sewer Specified Area, for which a service connection to the sanitary sewer system can be, or has been made, and upon which a building or structure containing a plumbing fixture is situate, shall connect such building or structure to the service connection.

1.3.2 In the event of any owner failing to make the required connection within sixty (60) days of being notified in writing by the District to do so, the Director of Works & Utilities may order the required connection be made by District workmen or others at the Owner's expense and the expenses incurred shall become a lien on the land or real property on or for which the charge is imposed, done or provided and the District may recover the expenses in a similar manner to municipal taxes and the expenses shall be subject to the same penalty and interest additions as municipal taxes.

1.3.3 The Director of Works & Utilities may allow any owner of real property outside of an existing Sanitary Sewer Specified Area to connect into the existing sanitary sewer system on the basis of the following:

(a) the owner paying all costs of extending the District's sanitary sewer system including sewer development charges;

(b) the owner paying a share of an existing or future proposed specified area cost including administration and bylaw amendment costs. In either case, approval must be granted by Municipal Council.

1.4 APPLICATION FOR SANITARY SEWER CONNECTION

- 1.4.1 (a) No person shall connect any building sewer or storm building sewer to the sanitary sewer system until he has completed an application and an agreement in the form of Schedule "4.A" of this bylaw and paid the connection fee as applicable. The applicant shall, in completing such form of application and agreement, provide true and accurate information as to all details called for therein.
- (b) The applicant or an agent on his behalf must also obtain a plumbing permit and pay a sewer development charge unless such charge has been collected under the Development Cost Charge Bylaw requirements.

1.5 SEWER CONNECTIONS STANDARDS

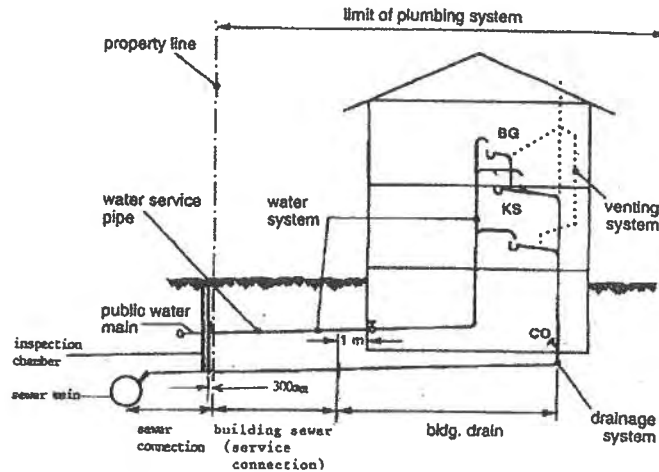
- 1.5.1 Every sewer connection shall be installed in accordance with the standards contained in the District's Subdivision and Development Bylaw, as amended or revised and shall be installed prior to the installation of every building sewer . The District shall not be responsible to meet the elevation or connect to an existing building sewer installed by the owner prior to installation of the sewer connection. Building owners shall be required to meet the sewer connection elevation.

1.6 BUILDING SEWER (Service Connection) AND INSPECTION

- 1.6.1 Every building sewer shall be constructed at the cost of the owner in accordance with the standards contained in the District's Subdivision and Development Bylaw as amended or revised, and to the requirements of the British Columbia Plumbing Code. The Director of Works & Utilities may require conformity with the District's Subdivision and Development Bylaw in the case of differing standards relative to the B.C. Plumbing Code or unique site or special situations.
- 1.6.2 The owner shall notify the District's Building Inspector as soon as the work for which a connection permit has been issued is ready for inspection and no building sewer work shall be covered until it has been inspected and approved.
- 1.6.3 If upon inspection it is determined that any building sewer work is defective, or that such work was not ready for inspection after notification as required by Article 1.6.2, the owner shall file a further Notice of Inspection, together with the required fee to cover the cost of such extra inspection.
- 1.6.4 The building sewer shall be repaired and maintained by the property owner or occupant at their expense.
- 1.6.5 Where any building sewer is abandoned, the owner or occupant shall notify the District's Building Inspector, and, upon receiving proper authorization, the owner or occupant shall block and/or seal the service connection. The service connection shall be blocked at the property line, or at the sewer main, as specified by the Director of Works & Utilities, and the costs of such work shall be borne by the property owner or occupant.

1.6.6

Plumbing System



1.7 INTERFERENCE WITH SANITARY SEWER SYSTEM

1.7.1 No person shall do any work upon, or interfere in any way with the sanitary sewer system without the written permission of the Director of Works & Utilities.

1.7.2 No person shall enter or work upon the sewer system without meeting the applicable confined space entry, street regulations or other safety requirements, required by the Workers' Compensation Act, being Chapter 437 of the R.S.B.C. 1979 and amendments thereto.

1.8 SANITARY SEWER RATES

1.8.1 All sanitary sewer rates and charges are levied and administered by the District's Fees and Charges Bylaw.

1.9 SEPTIC TANKS-HOLDING TANKS-R.V. DUMPING OUTLET

1.9.1 No septic tank shall be connected to the sanitary sewer system without the express written approval of the Director of Works & Utilities or the District's Building Inspector.

1.9.2 No person shall permit any sludge or deposit contained in any septic tank, holding tank or sewage field to enter into the sanitary sewer system. With the approval of the Director of Works and Utilities all sludge or septic tank deposits shall be disposed of at the District's disposal facility located at the District's sanitary landfill.

- 1.9.3 All existing septic tanks and holding tanks must be pumped out, removed or filled with clean sand or gravel within thirty (30) days after completion of the installation and final inspection of the sanitary sewer connection.
- 1.9.4 No person shall install a Recreation Vehicle dumping outlet on a residential lot sewer service line entering into the sanitary sewer system.
- 1.10 RIGHT OF ENTRY**
- 1.10.1 The Director of Works & Utilities or the Building Inspector and anyone authorized by them are hereby authorized to enter upon any property or premises at any reasonable time in order to ascertain whether or not the regulations contained in this bylaw have been complied with.
- 10.2 Any person interfering with or obstructing the entry of the Director of Works & Utilities or the Building Inspector or their duly authorized representative into any premises, after that person has identified himself, shall be guilty of an offense under this bylaw and shall be liable to the penalties provided herein.
- 1.10.3 No person shall hinder or prevent the Director of Works & Utilities or the Building Inspector or their duly authorized representative from entering and making reasonable inspection of any building or premises whenever necessary to secure compliance with, or prevent a violation of any provisions of this bylaw.

SECTION 2 - WASTE DISCHARGE

2.1 PROHIBITED WASTES

- 2.1.1 No person shall discharge or permit to be discharged into any pipe, main, conduit, manhole, street inlet, gutter or aperture draining into the sanitary sewer system:
- (a) Any gasoline, benzene, naphtha, alcohol, fuel, oil, solvents, acetone or flammable or explosive liquid, solid or gas.
 - (b) Any pesticides, insecticides, herbicides or fungicides save and except chemicals contained in storm water emanating from trees or vegetation treated in accordance with the Pesticide Control Act, R.S.B.C., 1979 C. 322 and regulations.
 - (c) Any corrosive, noxious or malodorous gas, liquid, or substance which either singly or by interaction with other wastes, is capable of:
 - (i) creating a public nuisance or hazard to life;
 - (ii) preventing human entry into a sewer or pump station; or
 - (iii) causing damage to the sewerage system.
 - (d) Radioactive material - except within such limits as are permitted by license issued by the Atomic Energy Control Board of Canada.
 - (e) Any material from a cesspool.

- (f) Any solid or viscous substance capable of obstructing wastewater flow or interfering with the operation of the sewerage system or treatment facilities. These substances include but are not limited to ashes, cinders, grit sand, mud, straw, grass clippings, insoluble shavings, metal, glass, rags, feathers, tar, asphalt, creosote, plastics, wood, animal paunch contents, offal, blood, bones, meat trimmings and waste, fish or fowl head, shrimp, crab or clam shells, fish scales, entrails, lard, mushrooms, tallow, baking dough, chemical residues, cannery or wine waste, bulk solids, hair and fleshings, spent grain and hops, whole or ground food or beverage containers, garbage, paint residues, cat box litter, slurries of concrete, cement, lime or mortar.
- (g) Any storm water or uncontaminated wastewater into the sanitary sewer system.
- (h) Any waste, liquid or material classified as a 'Special Waste' pursuant to the provisions of the WASTE MANAGEMENT ACT, R.S.B.C., 1979, C. 428.5 and amendments thereto.
- (i) Any material from a septic tank, holding tank or sewage disposal field, except sewage material taken from motor boats or recreational vehicles where the disposal facilities are located at public facilities such as service stations, Recreation Vehicle dealerships or marinas.

2.2

STANDARDS FOR RESTRICTED WASTES

2.2.1

Sanitary Sewer System

No person shall discharge or permit to be discharged into any pipe, main, conduit, manhole, street inlet, gutter, or aperture draining into the sanitary sewer system:

- (a) any non-domestic waste having a B.O.D. in excess of 500 milligrams per litre as analyzed in a one-operating day Composite Sample, 1000 milligrams per litre as analyzed in a 2-hour Composite Sample, and 2000 milligrams per litre as analyzed in a Grab Sample;
- (b) any non-domestic waste having a C.O.D. in excess of 750 milligrams per litre as analyzed in a one-operating-day Composite sample, 1500 milligrams per litre as analyzed in a 2-hour Composite sample, and 3000 milligrams per litre as analyzed in a Grab sample.
- (c) any non-domestic waste which contains suspended solids in a concentration that is in excess of 600 milligrams per litre as analyzed in a one-operating-day Composite Sample, 1200 milligrams per litre as analyzed in a 2-hour Composite Sample, and 2400 milligrams per litre as analyzed in a Grab Sample;
- (d) any garbage that has been ground, comminuted or shredded by a garbage disposal unit;
- (e) any non-domestic liquid or vapour having a temperature higher than 65° Celsius;
- (f) any non-domestic waste which contains oil and grease in a concentration that is in excess of 150 milligrams per litre as analyzed in a

a one-operating day Composite Sample, 300 milligrams per litre as analyzed in a 2-hour Composite Sample, and 600 milligrams per litre as analyzed in a Grab Sample, and any non-domestic waste which contains oil and grease derived from a petroleum source in a concentration that is in excess of 15 milligrams per litre as analyzed in a one-operating-day Composite Sample, 30 milligrams per litre as analyzed in a 2-hour Composite Sample, and 60 milligrams per litre as analyzed in a Grab Sample;

(g) any substance which may solidify or become viscous at temperatures above 0° Celsius;

(h) any non-domestic waste which has a pH lower than 5.0 or higher than 11.0 as determined by a Grab Sample of the discharge, or less than 5.5 or higher than 10.5 as determined by a two-hour Composite Sample.

(i) any water or waste that will by itself or with other water or wastes in the sewerage system, release noxious gases, or create any other condition deleterious to the pipe, gaskets, structures or treatment processes;

(j) any water or waste containing dyes or colouring materials which pass through a sewage works and discolour the sewage works effluent, with the exception of dyes used by the District for testing purposes;

(k) any water or waste containing a hazardous or a toxic or poisonous substance in sufficient quantity to injure or interfere with any sewer, sewage treatment equipment and sewage treatment process, to constitute a hazard to humans or animals, or to create any hazard in the receiving waters or the effluent of the sewage treatment plant.

(l) any material which exerts or causes:

(i) unusual concentrations of inert suspended solids, such as, but not limited to, fuller's earth;

(ii) unusual concentrations of dissolved solids such as but not limited to sodium chloride, calcium chloride or sodium sulphate;

(m) any water or waste added for the purpose of diluting wastes which would otherwise exceed applicable maximum concentrations;

(n) any non-domestic waste which, at the point of discharge into a sewer, contains any substance, in a combined or uncombined form, with a concentration in excess of the levels set out below. All concentrations are expressed as total concentrations, which include both the dissolved and undissolved substances.

Substance	Expressed as	Concentration in milligrams per litre		
		One Day Composite Sample	Two Hour Composite Sample	Grab Sample
Aluminum	A1	50.0	100.0	200.0
Arsenic	As	1.0	2.0	4.0
Boron	B	50.0	100.0	200.0
Cadmium	Cd	0.2	0.4	0.8
Chromium	Cr	4.0	8.0	16.0
Cobalt	Co	5.0	10.0	20.0
Copper	Cu	2.0	4.0	8.0
Cyanide	Cn	1.0	2.0	4.0
Iron	Fe	10.0	20.0	40.0
Lead	Pb	1.0	2.0	4.0
Manganese	Mn	5.0	10.0	20.0
Mercury	Hg	0.05	0.1	0.2
Molybdenum	Mo	1.0	2.0	4.0
Nickel	Ni	2.0	4.0	8.0
Phenols	-	1.0	2.0	4.0
Phosphorus	P	12.5	25.0	50.0
Silver	Ag	1.0	2.0	4.0
Sulphate	SO ₄	1500.0	3000.0	6000.0
Sulphide	S	1.0	2.0	4.0
Tin	Sn	5.0	10.0	20.0
Zinc	Zn	3.0	6.0	12.0

Note: More restrictive guidelines may be required by the Director of Works & Utilities if he considers there is some detrimental effect on the District's treatment plant, infrastructure or workmen.

- (o) any water or waste containing substances in such concentrations that are not amenable to treatment or reduction by the sewage treatment process employed, or are amenable to treatment only to such a degree that the sewage treatment plant effluent cannot, during normal operation, meet the requirement of any other agency having jurisdiction over discharges to the receiving waters.

- (p) any material or substance (e.g. enzymes and/or bacteria) that alters the structure of the waste(s) but does not reduce the loading (C.O.D.).

2.3 ACCIDENTAL DISCHARGES

- 2.3.1 Every person responsible for, or aware of, the accidental discharge of prohibited substances into the sanitary sewer system shall report the same forthwith to the Director of Works & Utilities in order that the necessary precautions can be taken to minimize the deleterious effects of the discharge.

SECTION 3 - ADDITIONAL REQUIREMENTS FOR CONNECTION TO THE SANITARY SEWER SYSTEM

3.1 WASTEWATER TREATMENT FACILITIES

- 3.1.1 Any industrial wastewaters likely to damage or increase maintenance costs on the sewer system or which may detrimentally affect the sewage treatment plant; or contaminate surface or sub-surface waters, shall be pre-treated to render them innocuous prior to discharge into a public sewer.
- 3.1.2 Discharges of liquid wastes exceeding the strength, nature, quantity or quality permitted by this bylaw, shall be pre-treated in a facility designed, constructed and operated by the discharger so as to fulfill all of the requirements of this bylaw. The Director of Works & Utilities may waive this requirement in lieu of surcharge billings for waste discharge with issuance of Waste Discharge Permits and the payment of the fees as outlined in Schedule "4.B", attached to and forming part of this bylaw.
- 3.1.3 All details pertaining to the treatment process or processes, capacity, location, materials, equipment, methods of construction and all operational procedures and methods of process control of treatment facilities shall be approved by the Director of Works & Utilities before any portion of such facilities is installed. The approval of such plans and devices shall not imply that the treatment process or processes will comply with the regulations and/or restrictions contained in this bylaw.
- 3.1.4 All wastewater treatment facilities must be kept clear of obstructions so as to provide immediate access for inspection and servicing.

3.2 DESIGN REQUIREMENTS FOR NON-RESIDENTIAL USES CONNECTING TO THE SANITARY SEWERAGE SYSTEM

- 3.2.1 Where an owner or occupier of premises upon which an industrial or commercial activity is proposed or is carried on wishes to connect these premises to the sewerage system he shall comply with Article 3.2.3 herein.
- 3.2.2 Where an owner or occupier intends to expand an industrial or commercial activity so that the quantity, biochemical oxygen demand, chemical oxygen demand, suspended solids concentration or grease concentration of the sewage will be increased, he shall comply with Article 3.2.3 herein.
- 3.2.3 Except as provided in Article 3.2.4, the owner shall supply to the Director of Works & Utilities plans and reports certified by a professional engineer registered in the Province of British Columbia indicating:
- (a) the proposed or existing development or addition, including flow schematic drawing,
 - (b) the daily volumes and peak discharges,
 - (c) the type of waste to be processed or discharged,
 - (d) the anticipated biochemical oxygen demand and the amount of suspended solids or grease,
 - (e) the pH factor and temperature of the wastewater,
 - (f) toxic chemicals contained in the wastewater,
 - (g) the proposed pre-treatment, including dimensions of the proposed facility,
 - (h) flow equalizing or mixing facilities,
 - (i) the location of sampling manhole,
 - (j) the monitoring equipment,
 - (k) any other information deemed necessary by the Director of Works & Utilities.
- 3.2.4 The Director of Works & Utilities may deal with the application and make a decision thereon without the above information if in his opinion the nature of the application is such that a decision can be properly made without such information.
- 3.2.5 Grease and oil interceptors shall be installed as close to the source of the material as practical and provided upstream of the service connection on private property for all food preparation facilities including restaurants, canning operations, killing and processing facilities. Such interceptors shall be so located as to be readily and easily accessible for cleaning and inspection. All interceptors shall be maintained by the owner at his expense in continuously efficient operation such that all provisions of this bylaw are complied with at all times.

3.2.6 Grease, oil and sand interceptors shall be installed as close to the source of the material as practical and provided upstream of the service connection on private property for all vehicle repair and maintenance establishments and service stations. Interceptors will be required for other types of industries or commercial establishments as appropriate for the proper handling of liquid waste containing grease in excessive amounts or any flammable wastes, sand, grit or other harmful ingredients. Such interceptors shall be so located as to be readily and easily accessible for cleaning and inspection. All interceptors shall be maintained by the owner at his expense in continuously efficient operation at all times. These types of building services shall be connected to the sanitary sewer where available.

3.2.7 Separate sand traps and oil and grease interceptors shall be provided upstream of the service connection on private property for all establishments which provide car, vehicle, or equipment washing facilities. Sand traps shall be located upstream from the oil and grease interceptors, and shall have a minimum liquid depth of 1 metre and a maximum overflow rate of 8 L/m/m² under peak flow conditions. Sand and silt shall be removed from sand traps before these materials occupy 25 percent of the liquid depth. Accumulated oil and grease shall be skimmed off the surface of the interceptors and other sumps often enough to prevent these materials from escaping to the sewer.

3.3 VOLUME CONTROL

3.3.1 Where wastewater is discharged into the sewerage system in volumes which are highly variable or unusual, the owner or occupier shall ensure that discharges do not exceed the limits established by the Director of Works & Utilities. The owner or occupier of the premises shall take such measures, as required by the Director of Works & Utilities, to equalize the discharge volumes and strengths.

3.3.2 Equipment necessary to comply with clause 3.3.1 shall be provided, maintained and operated by the owner or occupier of such premises in a manner satisfactory to the Director of Works & Utilities.

SECTION 4 - CONTROL OF INDUSTRIAL WASTES

4.1 SPECIAL CONTROL MANHOLES

4.1.1 Any property owner or occupier discharging or likely to discharge wastewater to the public sewer which may exceed the STANDARDS FOR RESTRICTED WASTES, as deemed by the Director of Works & Utilities, shall have installed a control manhole at an accessible location and suitable for the inspection and sampling of the discharged waters.

- 4.1.2 The design and location of the control manhole shall be approved by the Director of Works & Utilities. Construction shall comply with the approved design.
- 4.1.3 The control manhole shall be installed and maintained at the sole expense of the owner of the premises and shall be accessible at all times to the District's Inspector.
- 4.1.4 All industrial wastewater discharged to public sewers shall first pass through the control manholes.
- 4.1.5 The control manhole shall conform with the District's standard sewer manhole STD-200 except that the barrel diameter shall be 1200 mm instead of 1050 mm. The standard cast iron frame and cover will be acceptable.
- The control manhole shall be located on a straight run of service extending from 3 metres upstream of the manhole to 2 metres downstream. The section of service on which the manhole is located shall have a gradient not exceeding 2 percent.
- A permanent style Palmer Bowlus flume flow meter shall be installed as an integral part of the control manhole, and shall be sized to suit the peak design flows.
- 4.1.6 Where installation of a control manhole is not possible, an alternative device or facility may be substituted for approval by the Director of Works & Utilities.

4.2 MONITORING OF WASTEWATER

- 4.2.1 Should any testing of wastewater show that it is not in compliance with this bylaw, the Director of Works & Utilities, in addition to any other provision of this bylaw may direct the owner to so comply with the bylaw and may, in addition, direct the owner at his expense to install such monitoring and recording equipment as the Director of Works & Utilities deems necessary and supply the results of such monitoring to the Director of Works & Utilities, as required.
- 4.2.2 All tests, measurements, analyses and examinations of wastewater, its characteristics or contents shall be carried out in accordance with "Standard Methods." Initial testing shall be arranged and paid for by the discharger. Additional testing or re-testing of wastewater, made necessary by non-compliance with this bylaw, or at the request of the Director of Works & Utilities, shall be carried out at the cost of the discharger.
- 4.2.3 Sampling shall be carried out by methods acceptable to the Director of Works & Utilities. Normally the analyses will be performed on samples composited by volume as per Schedule "4.E" attached to and forming part of this bylaw. Values for pH will be determined from samples composited over a short period of time.

4.3 CONTROL OF WASTE DISPOSAL

- 4.3.1 The Director of Works & Utilities may at any time require a person who intends to dispose of wastes of liquid, semi-liquid or solid nature to show proof that these wastes are being stored and subsequently disposed of in a place and

manner which is acceptable to the Director of Works & Utilities the information must also include method of packaging, storing and transporting of the waste.

- 4.3.2 The Director of Works & Utilities may require a person to provide an analysis, prepared by a qualified chemist, of the waste referred to in Article 4.3.1.

SECTION 5 - PROTECTION OF PUBLIC SANITARY SEWER SYSTEM

5.1 DISCONNECTION OF SANITARY SEWER

- 5.1.1 Where any wastewater which:
- (a) creates an immediate danger to any person, or
 - (b) endangers or interferes with the operation of the sewerage system discharged to the sewer system.

The Director of Works & Utilities may, in addition to any action provided for in this bylaw, disconnect, plug or seal off the sewer line discharging the unacceptable wastewater into the sewer system or take such other action as is necessary to prevent such wastewater from entering the sewerage system.

In addition or as an alternate action, the Director of Works & Utilities may order the shut-off of water service to the subject property.

- 5.1.2 The unacceptable wastewater described in article 5.1.1 may be physically prevented from being discharged into the sewer system until evidence satisfactory to the Director of Works & Utilities has been produced to ensure that no further discharge of hazardous wastewater will be made to the sewer system.
- 5.1.3 The owner or occupier of the land from which the wastewater, described in Article 5.1.2 herein, is being discharged shall pay the costs incurred by the District in taking all necessary action relative to the sewer disconnection and/or re-connection.
- 5.1.4 The costs incurred in Article 5.1.3 shall be in addition to and not in substitution for any fine or other penalty to which the owner or occupier of the premises in question may be subject pursuant to the provisions of this bylaw.
- 5.1.5 The sewer or drain shall not be reconnected until the costs in Article 5.1.3 are paid.

5.2 RECOVERY OF COSTS FOR DAMAGE TO THE PUBLIC SANITARY SEWER SYSTEM

- 5.2.1 Where any person contravenes any provision of this bylaw and thereby causes damage to the sewer system, such person shall be liable to the District for all costs incurred in making repairs or taking remedial action.

- 5.2.2 If such costs are not paid forthwith after demand, the District may recover the same by action in any court of competent jurisdiction.

SECTION 6 - PENALTIES

6.1 PENALTIES

- 6.1.1 Every person who violates any of the provisions of this bylaw or who suffers or permits any act or thing to be done in contravention of or in violation of any of the provisions of this bylaw or who neglects to do or refrains from doing anything required to be done pursuant to any of the provisions of this bylaw, or who does any act which violates any of the provisions of this bylaw shall be guilty of an offence and each day during which such violation occurs or is allowed to continue shall constitute a separate offence.
- 6.1.2 Every person guilty of an offence against this bylaw shall be liable under summary conviction to a penalty of up to \$2,000.00 for each offence.

SECTION 7 - MASCULINE/SINGULAR

- 7.1 Wherever the masculine is used throughout this bylaw, it shall also mean the feminine; and wherever the singular is used throughout this bylaw, it shall also mean the plural.

SCHEDULE 4.A
APPLICATION FOR SANITARY SEWER



Job # _____

THE DISTRICT OF SUMMERLAND UTILITY SERVICE REQUEST FORM

Date: _____

Roll Number: _____

Name: _____
Full Name of Owner(s)

Phone Number: _____

Mailing Address: _____

Street or Box Number

City

Province

Postal Code

Legal Description of Property: Lot(s): _____ Block: _____ District Lot: _____ Plan Number: _____

Street Address: _____ Phone Number: _____

Type of Development: _____

REQUESTED SERVICES

Sanitary Sewer	<input type="checkbox"/>	Driveway access *	<input type="checkbox"/>	Electrical: New	<input type="checkbox"/>
Domestic Water	<input type="checkbox"/>	Other _____	<input type="checkbox"/>	Service Change	<input type="checkbox"/>
				Amperage	<input type="checkbox"/>
				Voltage	<input type="checkbox"/>

* A sketch plan showing the driveway design, location and associated grades must be provided with this type of requested service as per Bylaw 92-047.

Check here if there is a preferred location for any of the other requested services other than a driveway access. (If checked, a map or sketch should be attached to this utility service request form which identifies the preferred location.)

OFFICE USE ONLY					
Sanitary Sewer:	_____	_____	_____	Cost Estimate	_____
	Connection size	Service line cost	Main extension cost		
Water:	_____	_____	_____	Cost Estimate	_____
	Connection size	Service line cost	Main extension cost		
Electrical:	_____	_____	_____	Cost Estimate	_____
	Temporary service	New service	Electrical surcharge		
Other:	_____	_____	_____	Cost Estimate	_____
				Total Costs	_____
Date	_____	Amount Received	_____	Signature	_____

I/We agree to be governed by the bylaws of the Corporation of the District of Summerland relative to the above requested services. Should the actual cost of service installation exceed the above noted cost estimates, the owner(s)/agent will be responsible for the balance owing.

Signature of owner(s)/agent: _____ Date: _____

SCHEDULE "4.B"

SANITARY SEWER REGULATIONS

1. The Waste Discharge Permit fees required under this by-law shall be paid to the District of Summerland.
2. The holder of a validated "Temporary Waste Discharge Permit" (Schedule "4.C" attached to and forming part of this bylaw) or "Waste Discharge Permit" (Schedule "4.D" attached to and forming part of this bylaw) is required to notify the issuing authority when the discharge period has terminated. If the discharge needs to continue, then an application for a new "Temporary Waste Discharge Permit" or "Waste Discharge Permit" must be submitted together with the application fee.
3. Waste Discharge Permit Fees:
 - 3.1 A Waste Discharge Application Fee as established in the District's Fees and Charges Bylaw shall be paid upon application for a "Temporary Waste Discharge Permit" or "Waste Discharge Permit".
 - 3.2 For authorized discharges to the sanitary sewer there will be a surcharge to cover the costs of treatment, plus G.S.T. The surcharge is based upon flow and load.
 - 3.3 The surcharge for authorized discharge to the sanitary sewer shall be based on the District of Summerland Fees and Charges Bylaw and amendments thereto.

SCHEDULE "4.C"
Sanitary Sewer Regulations
Temporary Waste Discharge Permit Assessment/Application Form

Mailing Address: Director of Works & Utilities,
 Box 159, Summerland, B.C. VOH IZO
 Phone: (250) 494-6451
 FAX: (250) 494-1415

Date: _____

*PLEASE ANSWER ALL QUESTIONS COMPLETELY. PRINT NEATLY OR TYPE.
 NOTE THAT ADDITIONAL INFORMATION MAY BE REQUIRED.*

1. Company Name: _____

2. Site Address: _____

3. Mailing Address: _____

4. Person to call regarding this form:

Name	Title	Phone No.
------	-------	-----------

5. Nature or type of business (brief description): _____

6. Estimate the average daily wastewater discharge:

To Sanitary Sewer	_____ m ³ /day	No. of days	_____
To Storm Sewer	_____ m ³ /day	No. of days	_____

How was this estimated? _____

7. Surcharge Fee Calculation (if applicable):

_____ x _____ x _____ + \$100 App Fee x 1.07 GST = _____ Total
 m³/day no. of days \$/m³

8. Expiration date or period of discharge, if applicable:

9. Check (ü) the contaminants expected to be present in the discharge.

- | | |
|--------------|----------------|
| a) " Acids | b) " Aluminium |
| c) " Ammonia | d) " Boron |
| e) " Arsenic | f) " Cadmium |

g)	"	Caustics & Bases	h)	"	Chromium
i)	"	Chemical Oxygen Demand	j)	"	Cobalt
k)	"	Cyanide	l)	"	Copper
m)	"	Five-day Biochemical Oxygen Demand	n)	"	Iron
o)	"	Fluoride	p)	"	Lead
q)	"	Fuels/Flammable	r)	"	Manganese
s)	"	Oil & Grease (Non-Petroleum)	t)	"	Mercury
u)	"	Oil & Grease (Petroleum)	v)	"	Molybdenum
w)	"	Organic Solvents	x)	"	Nickel
y)	"	Pesticides	z)	"	Other _____
aa)	"	Phenols (total)	bb)	"	Selenium
cc)	"	Phenols(chlorinated)	dd)	"	Silver
ee)	"	Sulphate	gg)	"	Tin
ff)			ii)	"	Zinc
hh)	"	Sulphide			

10. Attach concentrations and corresponding volumes of substances checked in Question 9.

11. Does your operation discharge Special Waste as defined under the Special Waste Regulation of the Waste Management Act of British Columbia?

a) " Yes " No " To be determined

I, _____		
declare that the information given on this form is correct and accurate to the best of my knowledge.		
_____	_____	
Date	Signature	
Approved		
_____	_____	_____
Paid by receipt No:	Date	Environmental Section

NOTE: Personal information collected on this form is collected for the purpose of processing this application and for administration and enforcement of the Sanitary Sewer Regulation Bylaw No. 97-006. The information is collected under the authority of Bylaw 97-006 and the Municipal Act. If you have any questions about this collection, please contact the Municipal Treasurer @ 1-250--494-6451.

SCHEDULE "4.D"
**DISTRICT OF SUMMERLAND
WASTE DISCHARGE PERMIT**

Under the provisions of the

District of Summerland

Sanitary Sewer Regulation Bylaw No. 98-002

hereinafter referred to as the Permittee,

is authorized to discharge Non-Domestic Waste to SANITARY SEWER

located at _____

This WASTE DISCHARGE PERMIT has been issued under

the terms and conditions, including definitions,

prescribed in the District of Summerland's

Sanitary Sewer Regulation Bylaw No. 98-002

hereinafter referred to as the BYLAW

and in the attached Appendices A, B, C, D and E for discharge sources

and works existing or planned on _____

This Appendix sets out the standard conditions, engineering units, and the requirements for emergency procedures.

A. STANDARD CONDITIONS

1. Except as otherwise provided in this WASTE DISCHARGE PERMIT, hereinafter referred to as the "Permit", all terms and conditions stipulated in the Bylaw shall apply to this Permit.
2. The terms and conditions of this Permit may be amended, by the Director of Works & Utilities pursuant to the Bylaw.
3. Definitions contained within Bylaw Number 98-002 apply to this Permit.

B. ENGINEERING UNITS

The engineering units specified in this Permit are in accordance with the Metric System of measure. Approximately equivalent values for the British System can be calculated using the following conversion factors:

IGPD	divided by	220	=	M3/day
IGPM	divided by	0.22	=	l/min
cfs	divided by	35.31	=	m3/s

ppm	divided by	1	=	mg/L
lb	divided by	2.205	=	kg

Where:

m ³	=	cubic metres	IGPD	=	Imperial gallons per day
L	=	litres	IGPM	=	imperial gallons per minute
mg	=	milligrams	cfs	=	cubic feet per second
kg	=	kilograms	ppm	=	parts per million
min	=	minutes	lb	=	pounds
s	=	seconds			

C. MAINTENANCE AND OPERATION OF WORKS AND PROCEDURES

Pollution control works and procedures associated with maintaining the discharge criteria and/or the monitoring requirements specified in the Permit shall be employed at all times during the discharge of industrial/commercial wastes to sewer. All such works and procedures shall be inspected regularly and maintained in good working condition.

D. EMERGENCY PROCEDURES

In the event of an emergency or condition which prevents the continuing operation of any pollution control works or procedures designated by this Permit or results, or may result in a violation of any discharge criteria specified in this Permit, the Permittee shall notify the District of Summerland at 494-0431 regular hours or 493-0005 after hours at the first available opportunity, and shall undertake appropriate remedial action as soon as possible.

E. BY-PASSES

The discharge of wastes which by-pass any pollution control works or are not in accordance with procedures designated by the Permit is prohibited, unless prior approval of the Director of Works & Utilities is obtained and confirmed in writing.

F. DISCHARGE MONITORING

1. Additional discharge measurement, sampling, analysis and reporting shall be undertaken by the Permittee when required by the Director of Works & Utilities.
2. All sampling, measurements, tests and analyses of waste discharges shall be carried out in accordance with the latest edition of "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, or an alternate method approved by the Director of Works & Utilities. Samples shall be analyzed by an independent agency at the expense of the discharger, unless other arrangements have been approved by the Director of Works & Utilities.

G. pH MONITORING

Enforcement of pH levels, as listed in Appendix C of this Permit, shall be based on GRAB SAMPLE. The Permittee should be aware that pH levels measured in a Composite Sample will provide an average pH of the waste stream and will not indicate

the total range of pH in the effluent. The Permittee is encouraged to do periodic GRAB SAMPLE pH analyses to ensure permit compliance.

This Appendix sets out requirements for the monitoring of the discharge of Non-Domestic Waste from a _____. Any changes in method or location of monitoring must be authorized, in writing, by the Director of Works & Utilities.

A. DISCHARGE SAMPLING AND ANALYSES

The Permittee shall carry out the following sampling and analysis program, to commence on _____.

1. Continuous Discharges

- (a) Effective _____, the Permittee shall measure or estimate, using an approved flow monitoring device or method, the daily discharge during each month of operation. The following information shall be recorded:

Total flow for the month (m³)
Number of operating days during the month
Average daily flow for the month (m³/day)
Maximum daily flow for the month (m³/day)

- (b) One Composite Sample, in accordance with Schedule E of Bylaw No. 6618-90, shall be collected from Sample Point _____, as described in Appendix B, Section B, during one normal operating day once per _____. The Composite Sample shall consist of equal portions of discrete samples collected on a minimum frequency of _____ over the period of discharge to SEWER. This sample shall be analyzed for the following parameters:

The sample start and stop times shall be recorded.

- (c) The Discharge flow for the periods that the Composite Sample specified in Section _____ are collected shall be recorded.

- (d) During the period that the Composite Sample described in Section _____ is taken, one GRAB SAMPLE shall be collected from Sample Point _____, as described in Appendix B, Section B. This GRAB SAMPLE shall be analyzed for the following parameters:

The sample date and time shall be recorded.

2. Batch Discharges

- (a) The Permittee shall maintain a log of each batch discharge to SEWER. For each month of operation, the following information shall be reported for each batch discharge:

Type of batch discharge
Volume (m³)

Date on which discharging occurred

The discharge log shall be kept available for inspection for a minimum period of one year.

(b) _____ GRAB SAMPLE(s) shall be collected from one batch discharge from the Sample Point _____, as described in Appendix B, Section B, once per _____. This sample shall represent the quality of the total batch and shall be analyzed for the following parameters:

The sampling dates and times shall be recorded.

(c) _____ GRAB SAMPLE(s) shall be collected from one batch discharge from the Sample Point _____, as described in Appendix B, Section B, once per _____. This sample shall represent the quality of the total batch and shall be analyzed for the following parameters:

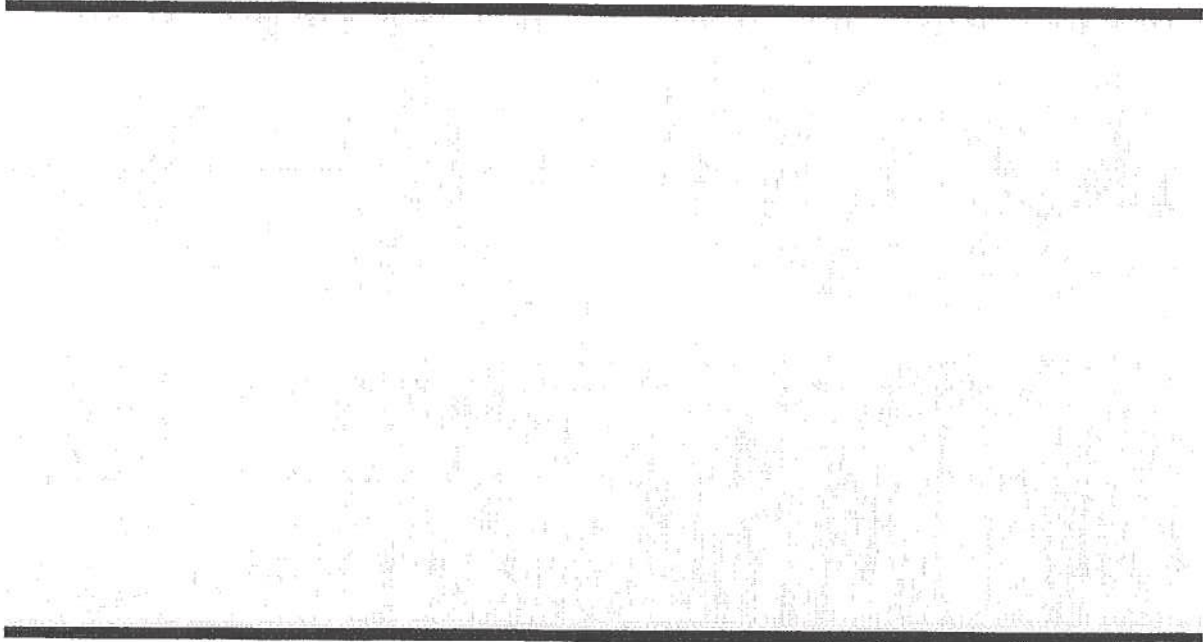
(d) _____ The Discharger shall record the total volume of each batch discharge from which the samples specified in Sections _____ are collected.

B. LOCATION OF APPROVED SAMPLE POINTS

The approved sample points are as follows, and as shown on the attached schematic of approved sample points and treatment processes. Sample point _____ is considered to be the point of discharge to SEWER.

SAMPLE POINT NO.	DESCRIPTION
Sample Point 1	_____
Sample Point 2	_____

**PHOTOGRAPH OF APPROVED SAMPLING POINT
SUPPLIED BY PERMITTEE**



This Appendix sets out requirements for the quantity and quality of the discharge of Non-Domestic Waste from a _____. Where a compliance program has been specified, existing works or procedures must be maintained in good operating condition and operated in a manner to minimize the discharge of contaminants during the interim period until the net works have been installed.

AUTHORIZED DISCHARGE CHARACTERISTICS

1. AUTHORIZED RATE OF DISCHARGE

The Permittee shall not exceed the following:

2. AUTHORIZED DISCHARGE CRITERIA

- a) The Permittee shall not discharge PROHIBITED WASTE as defined in Section 2.1 of the Bylaw.
- b) The Permittee shall not discharge RESTRICTED WASTE as defined in Section 2.2 of the Bylaw with the following exceptions:

<u>Parameter</u>	<u>Authorized Range or Maximum Concentration</u>	<u>Compliance By</u>
------------------	--	----------------------

- c) The Permittee shall not discharge SPECIAL WASTE as defined in Section 2.1 of the Bylaw.
- d) The Permittee shall not discharge STORM WATER or COOLING WATER as defined in Section 2.1 of the Bylaw.

This Appendix sets out the waste sources, works and procedures for the authorized discharges to SEWER. The Director of Works & Utilities may require that further works be installed if the existing works, in his opinion, do not provide an acceptable level of treatment. New works or alterations to existing works must be approved, in principle, by the Director of Works & Utilities. New waste sources must be authorized, in writing, by the Director of Works & Utilities.

AUTHORIZED WORKS AND PROCEDURES

The authorized waste sources, works and procedures to treat and/or control the waste discharge are:

<u>SOURCE</u>	<u>COMPLETION DATE</u>	<u>WORKS & PROCEDURES</u>
1. _____	_____	_____
2. _____	_____	_____

REPORTING REQUIREMENTS FOR WASTE DISCHARGE PERMIT

The Permittee is required to submit the following reports to the Director of Works & Utilities:

- a) By not later than _____ and at three month intervals thereafter, the Permittee shall submit a report detailing the results of the discharge sampling and analysis program for the preceding _____ as specified in Appendix B, Sections _____.
- b) By not later than _____, the Permittee shall submit a written report outlining the specifications of the flow monitoring device or method used to determine the flow rate as described in Appendix B, Section A.1 of this Permit.

Additional reporting shall be undertaken by the Permittee when required by the Director of Works & Utilities.

Schedule "4.E"
Evaluation of Wastewater

Flow Proportioned Sampling

Proper sampling techniques are essential for accurate testing in evaluation of wastewater. To be representative of the entire flow, samples should be taken where the wastewater is well mixed.

An instantaneous grab sample represents conditions at the time of sampling only, and cannot be considered to represent a longer time period, since the character of a wastewater is usually not stable.

A composite sample is a mixture of individual grabs proportioned according to the wastewater flow pattern. Compositing is commonly accomplished by collecting individual samples at regular time intervals, for example, every hour on the hour, and by storing them in a refrigerator or ice chest; coincident flow rates are read from an installed flow meter or are determined from some other flow recording device. A representative sample is obtained by mixing together portions of individual samples relative to flow rates at sampling times.

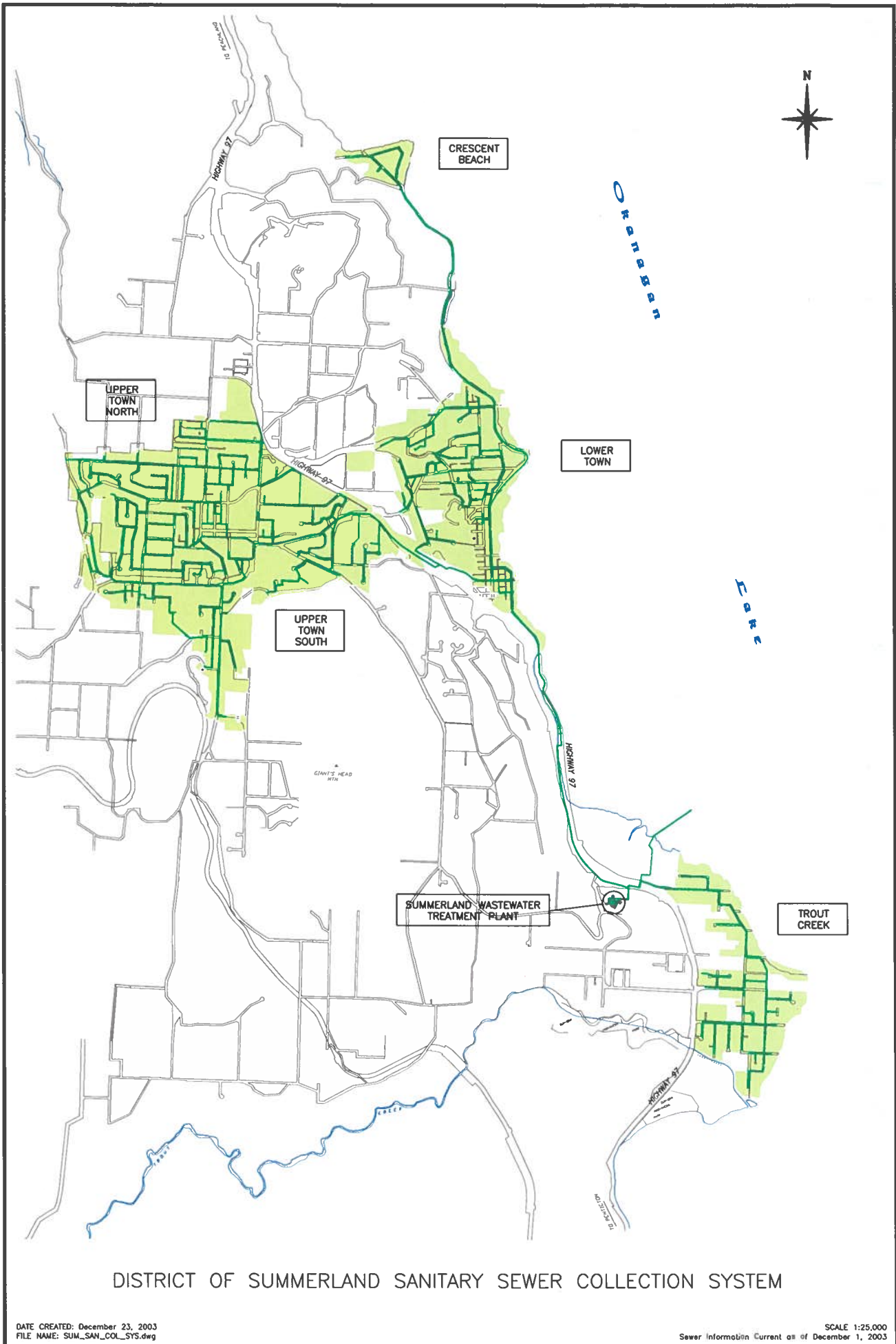
Composite samples representing specified time periods are tested to appraise plant performance and loadings. Weekday specimens collected over a 24-hour period are most common. Average daily BOD, TSS, and Oil & Grease data are used to calculate plant yield treatment efficiencies. Integrated samples during the period of peak flow, usually 8 to 12 hr. depending on influent variation, allow determination of maximum loadings on treatment units.

Example:

Hourly samples were taken of wastewater entering a treatment system. The following equations illustrate the portions to be used from the hourly grabs to provide composite samples for the 24-hr duration and during the period of maximum 8-hr loading, between 9 A.M. and 5 P.M. The composite sample volumes needed for laboratory testing are approximately 2500ml.

Calculations for the portions of hourly samples to be used in compositing are tabulated as follows:

		Portions of Hourly Samples			
		in Millilitres for:			
Time	Flow (gpm)	24-hr Composite		8-hr Composite	
Midnight	490	0.15	x 490 =	74	
1 A.M.	420	0.15	x 420 =	63	
2 A.M.	360	0.15	x 360 =	54	
3 A.M.	310	0.15	x 310 =	47	
4 A.M.	290	0.15	x 290 =	43	
5 A.M.	310	0.15	x 310 =	46	
6 A.M.	390	0.15	x 390 =	58	
7 A.M.	560	0.15	x 560 =	84	
8 A.M.	620	0.15	x 620 =	93	
9 A.M.	900	0.15	x 900 =	135	0.3 x 900 = 270
10 A.M.	1040	0.15	x 1040 =	156	0.3 x 1040 = 310
11 A.M.	1130	0.15	x 1130 =	170	0.3 x 1130 = 340
Noon	1160	0.15	x 1160 =	174	0.3 x 1160 = 350
1 P.M.	1120	0.15	x 1120 =	168	0.3 x 1120 = 340
2 P.M.	1060	0.15	x 1060 =	159	0.3 x 1060 = 320
3 P.M.	1000	0.15	x 1000 =	150	0.3 x 1000 = 300
4 P.M.	950	0.15	x 950 =	143	0.3 x 950 = 290
5 P.M.	910	0.15	x 910 =	136	
6 P.M.	870	0.15	x 870 =	130	
7 P.M.	810	0.15	x 810 =	121	
8 P.M.	760	0.15	x 760 =	114	
9 P.M.	690	0.15	x 690 =	103	
10 P.M.	630	0.15	x 630 =	94	
11 P.M.	540	0.15	x 540 =	81	
Total composite sample volumes				2596 ml	2520 ml



DISTRICT OF SUMMERLAND SANITARY SEWER COLLECTION SYSTEM



Bylaw Services
13211 Henry Ave, Box 159, Summerland BC, V0H 1Z0
Tel: 250-494-6451 Fax: 250-494-1415
www.summerland.ca

January 13, 2023

District of Summerland Works and Utilities Wastewater Division
7630 Dunn Street
Summerland BC
V0H1Z4

Re: District of Summerland Sewage Regulation Bylaw 98-002 – 2022 Report

In 2022 we had four (4) instances regarding the District of Summerland Sewage Regulation Bylaw 98-002.

Date	Address	Issue
April 15, 2022	6402 Giants Head	RV connected to Sanitary Sewer system. Resolved
June 27, 2022	Trout Creek	Homes pumping flood water out onto the street. Resolved
July 18, 2022	13803 Spencer	RV connected to Sanitary Sewer system. Resolved
October 28, 2022	915 Wharf	RV being used as accommodation. Has been hooked to sewer in the past. Not hooked up during any site visits but still a concern as trailer does not move. Owner claims using facilities in the home. Monitoring

Compliance with the regulation has been achieved for these issues. The October concern continues to be monitored for compliance.

Yours Truly,

A handwritten signature in blue ink, appearing to read "D Krell".

Darren Krell
Bylaw Enforcement Officer

APPENDIX F

FLOW ANALYSIS

Table 1.0
Daily Average and Monthly Total Flows, 2022

2022	Authorized Daily Flow <i>m3/d</i>	Average Daily Flow <i>m3/d</i>	Total Monthly Flow <i>m3</i>
January	4000	2179.3	67557.0
February	4000	2143.7	60023.4
March	4000	2207.8	68442.9
April	4000	2250.3	67508.4
May	4000	2042.8	63326.4
June	4000	2634.8	79044.4
July	4000	2942.4	91214.0
August	4000	2599.6	80586.2
September	4000	2505.0	75151.4
October	4000	2429.4	75311.6
November	4000	2261.1	67832.6
December	4000	2452.7	76034.0

Yearly Min	2043	60023
Yearly Avg	2387	72669
Yearly Max	2942	91214
Total		872,032

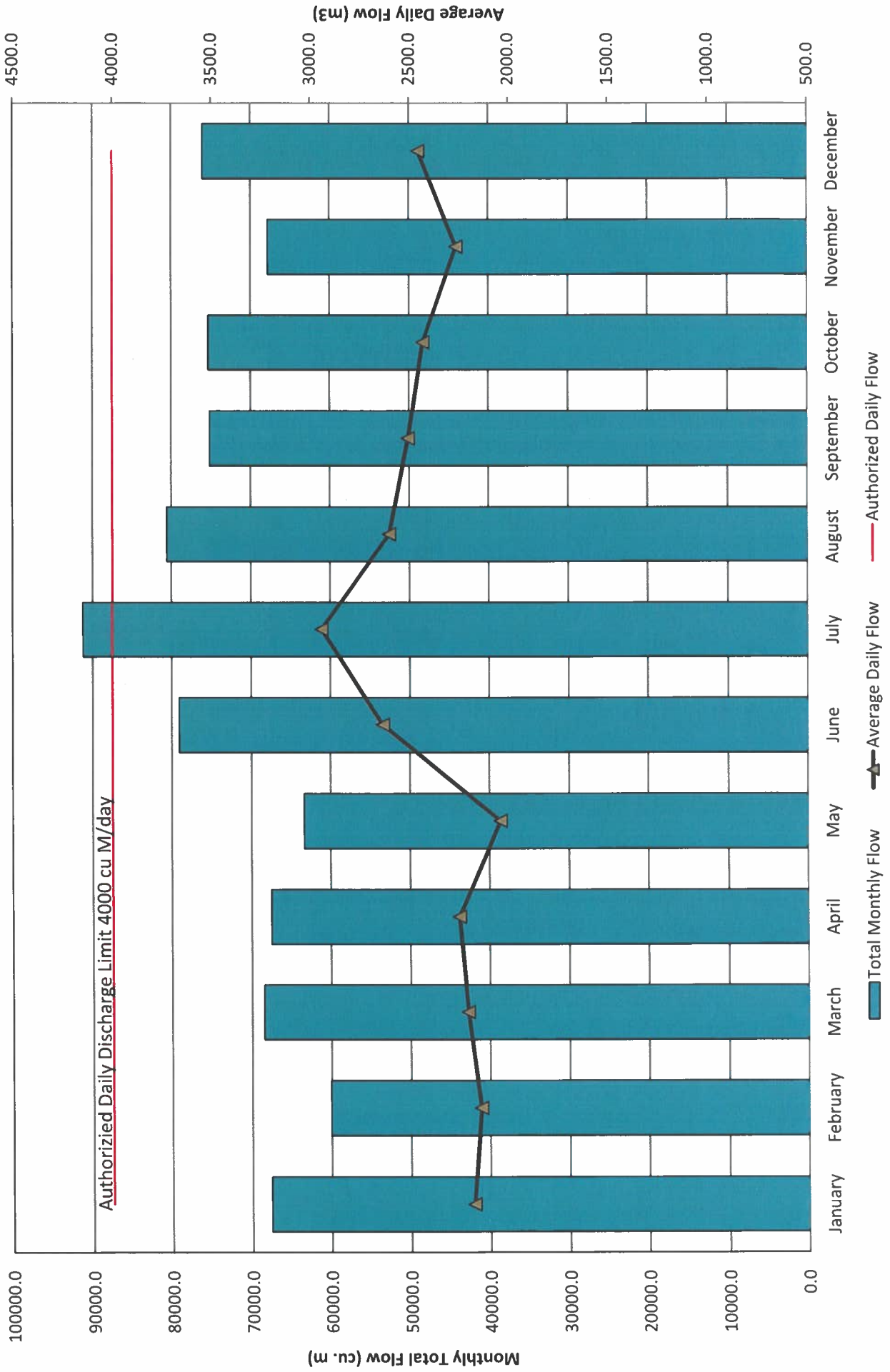
Table 1.1
Daily Average and Monthly Total Flows, 2022

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	2192.2	2168.0	2165.1	2250.2	2284.1	2352.5	3057.1	2741.0	2499.9	2421.6	2283.5	2388.7
2	2206.1	2161.0	2348.1	2115.2	2221.2	2356.1	3114.3	2694.7	2498.2	2488.4	2298.4	2365.5
3	2183.0	2181.1	2278.0	2230.0	2318.4	2550.0	3220.0	2705.0	2571.6	2462.1	2360.7	2301.1
4	2162.1	2161.6	2250.1	2223.1	2315.4	2343.5	3472.0	2665.0	2504.5	2492.3	2505.2	2421.3
5	2264.9	2094.8	2233.5	2251.2	2422.7	2481.8	3263.1	2626.4	2636.4	2473.1	2349.1	2439.0
6	2163.8	2129.5	2253.7	2277.2	2264.4	2371.5	3214.4	2483.9	2510.2	2516.9	2390.5	2441.7
7	2201.6	2157.1	2251.1	2276.5	2146.2	2331.9	3412.2	2583.0	2423.8	2514.8	2301.3	2434.1
8	2133.9	2270.8	2291.1	2207.7	2213.9	2386.4	3279.1	2554.6	2483.8	2407.5	2307.1	2411.9
9	2205.5	2226.8	2273.6	2185.2	2226.3	2512.6	3148.9	2607.0	2579.7	2411.0	2300.5	2406.3
10	2185.1	2221.6	2261.3	2317.6	2262.9	2471.2	2535.9	2651.0	2561.1	2498.0	2287.3	2346.2
11	2202.7	2117.9	2144.4	2255.9	2345.9	2423.4	2632.0	2603.0	2621.6	2444.2	2331.6	2406.2
12	2391.4	2077.9	2149.2	2326.9	2316.7	2528.0	3052.0	2548.0	2603.2	2501.0	2306.3	2343.1
13	2290.6	2150.8	2257.3	2250.1	2247.5	2616.0	2902.6	2499.5	2916.1	2620.2	2411.9	2374.3
14	2077.3	2138.2	2166.3	2291.4	2170.7	2563.9	2882.0	2505.0	2833.0	2466.4	2384.1	2409.9
15	2097.3	2130.8	2166.8	2263.7	2260.2	2612.1	3016.3	2570.0	2564.3	2432.3	2377.0	2334.6
16	2097.0	2134.9	2214.4	2263.5	2242.9	2575.6	2963.4	2653.0	2530.0	2530.6	2374.0	2468.5
17	2076.1	2069.4	2257.5	2284.4	2301.7	2057.2	2978.7	2607.0	2407.6	2472.7	2374.0	2416.8
18	2037.5	2070.0	2261.9	2373.4	2311.3	2075.2	2966.3	2660.5	2443.1	2522.5	2344.2	2446.6
19	2059.0	2043.1	2174.6	2312.5	2301.3	2875.2	2950.0	2634.2	2452.3	2494.8	2281.2	2508.1
20	2337.4	2108.4	2149.1	1889.2	2307.6	2812.2	3000.3	2544.9	2659.6	2418.0	2394.8	2586.0
21	2196.6	2197.8	2135.2	2337.7	2289.7	2792.5	2839.4	2616.0	2470.1	2429.6	2335.8	2560.3
22	2105.3	2131.7	2180.6	2286.0	2221.8	2770.5	2757.6	2644.3	2322.4	2251.3	275.2	2560.8
23	2189.3	2163.4	2177.8	2193.6	574.4	2885.8	2642.8	2755.0	2313.2	2368.1	2280.8	2502.5
24	2186.8	2153.5	2260.6	2287.4	51.7	2890.0	2742.2	2669.0	2307.0	2347.5	2259.0	2572.3
25	2171.8	2131.8	2152.2	2291.5	54.4	2974.5	2725.2	2609.0	2395.7	2343.9	2202.7	2418.8
26	2183.3	2111.7	2083.1	2261.3	1304.2	3132.0	2799.0	2640.9	2408.6	2421.7	2242.6	2525.4
27	2203.5	2134.3	2111.5	2255.7	2264.7	3106.9	2739.0	2508.3	2411.9	2429.8	2338.7	2625.3
28	2138.8	2185.5	2146.7	2266.1	2220.2	3150.5	2669.0	2487.0	2406.0	2325.3	2307.2	2625.0
29	2146.2		2203.4	2283.4	2314.7	3075.3	2778.3	2562.0	2399.4	2246.4	2305.4	2407.7
30	2247.8		2227.8	2200.8	2327.5	2970.1	2750.1	2518.0	2417.1	2364.7	2322.5	2466.7
31	2223.1		2216.9		2221.8		2710.8	2440.0		2194.9		2519.3
Minimum	2038	2043	2083	1889	52	2057	2536	2440	2307	2195	275	2301
Maximum	2391	2271	2348	2373	2423	3151	3472	2755	2916	2620	2505	2625
Average	2179	2144	2208	2250	2043	2635	2942	2600	2505	2429	2261	2453
Flow Total	67,557	60,023	68,443	67,508	63,326	79,044	91,214	80,586	75,151	75,312	67,833	76,034

Yearly Treated Total 872,032 cu.m

Note: Flow meter had no flow as flows were diverted to old headworks for repairs. (May23-26)

Graph 1.0
Monthly Total and Daily Average Flows, 2022



APPENDIX G

EFFLUENT QUALITY PARAMETERS

Table 2.0
Effluent Quality Parameters 2022

Parameter	Permissible Level
BOD (mg/l)	10
Total Suspended Solids (mg/l)	10
Total Phosphorus (mg/l as P)	2.0
99 Percentile	1.5
90 Percentile	1.0
Annual Average	0.25
Level to strive for	0.01
Total Nitrogen (mg/l as N)	6.0
Fecal Colifom (MPN)	50

APPENDIX H

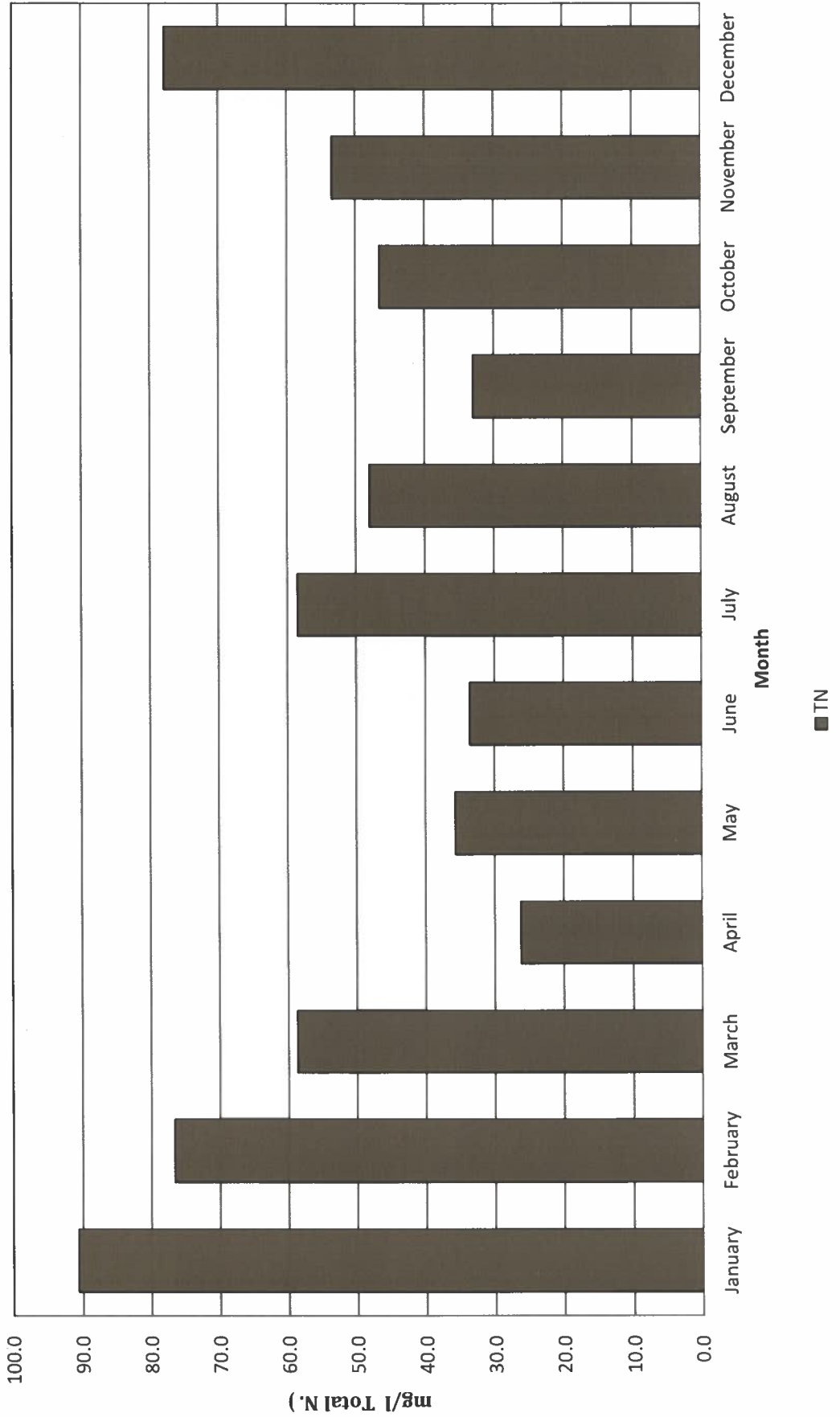
INFLUENT ANALYSIS ACCREDITED LAB

Table 3.0
**Monthly Grab Sample Data and Yearly Average
 Accredited Lab Influent Analysis, 2022**

Influent						
Month	Lab	BOD mg/L	TN mg/L	TP mg/L	pH	pH
January	CARO	215	90.6	6.19	7.42	7.42
February	CARO	235	76.6	5.99	7.59	7.59
March	CARO	305	58.7	6.27	7.68	7.68
April	CARO	122	26.2	2.92	7.86	7.86
May	CARO	404	35.7	4.18	7.18	7.18
June	CARO	142	33.6	3.68	7.53	7.53
July	CARO	125	58.5	5.93	7.55	7.55
August	CARO	105	48.0	4.65	7.47	7.47
September	CARO	77	33.0	3.41	7.23	7.23
October	CARO	158	46.5	4.36	7.37	7.37
November	CARO	198	53.4	5.61	7.47	7.47
December	CARO	354	77.8	8.66	7.94	7.94
Min		77	26.2	2.92	7.18	7.18
Average		203	53.2	5.15	7.52	7.52
Max		404	90.6	8.66	7.94	7.94

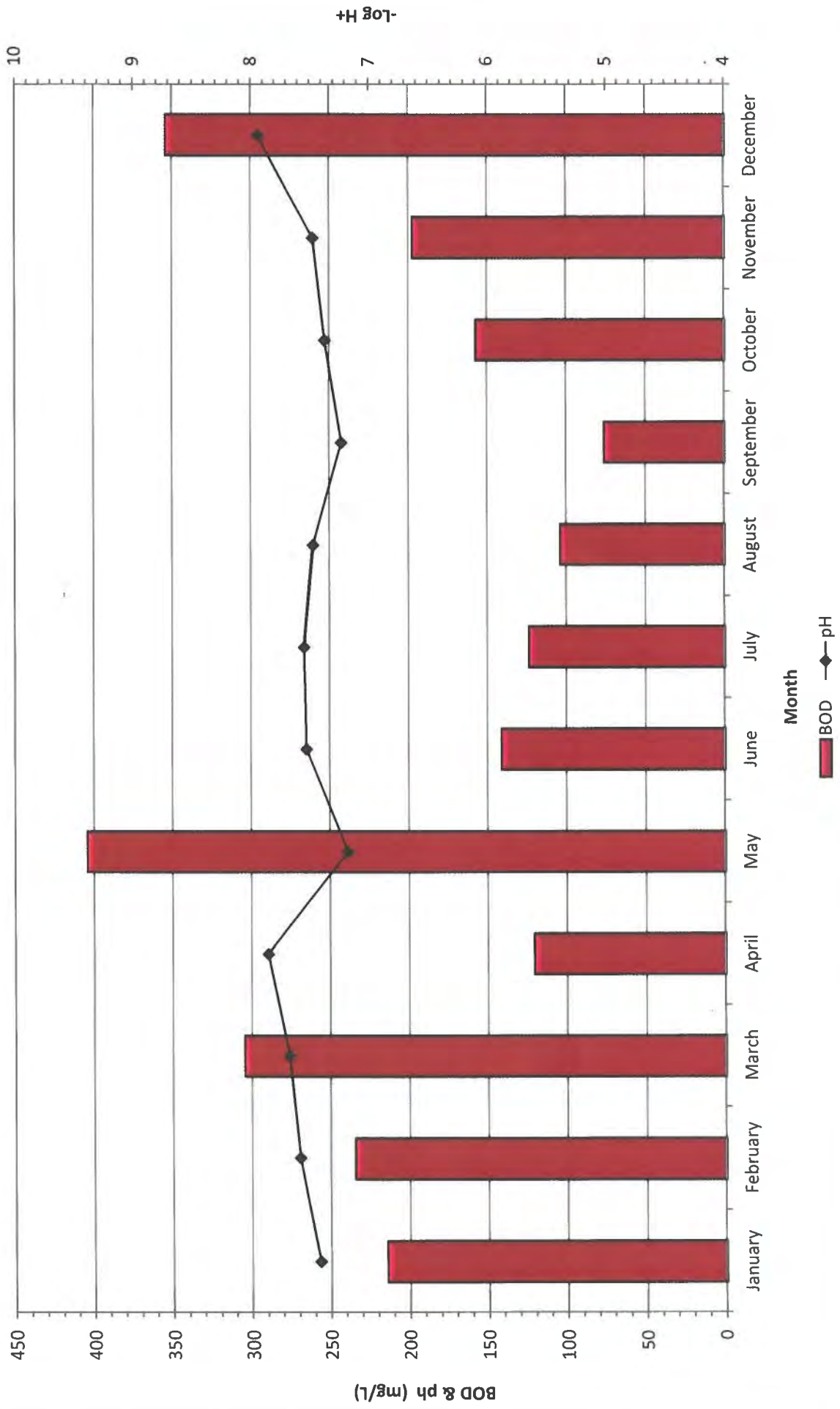
Table 3.0

Graph 3.0
Monthly Grab Sample Data
Total Nitrogen
Accredited Lab Influent Analysis, 2022



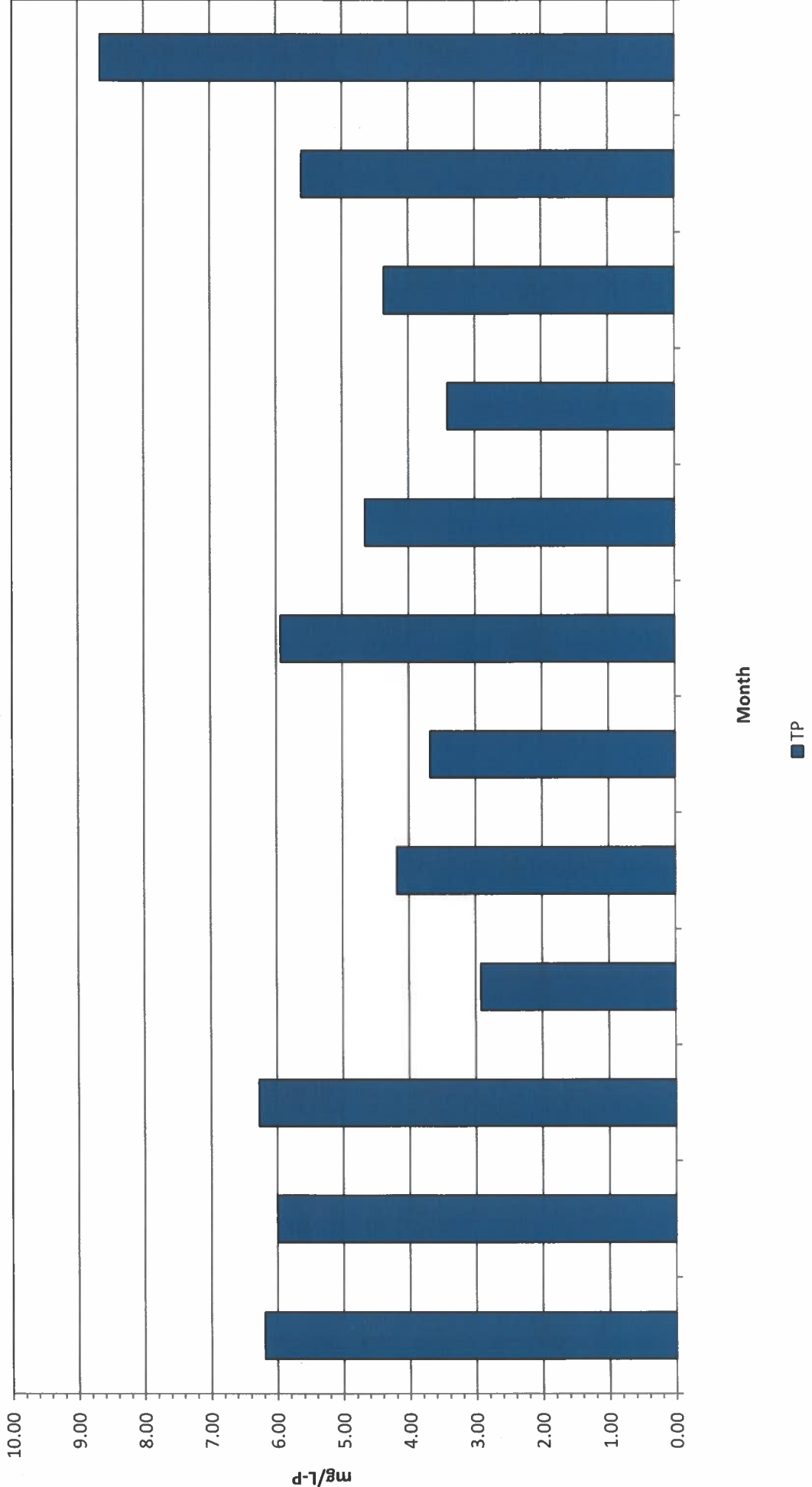
Graph 3.0

Graph 3.1
Monthly Grab Sample Data
BOD & pH
Accredited Lab Influent Analysis, 2022



Graph 3.1

Graph 3.2
Monthly Grab Sample Data
Total Phosphorus
Accredited Lab Influent Analysis, 2022



APPENDIX I

INFLUENT ANALYSIS INTERNAL LAB

Table 4.0
Grab Sample Data
Monthly and Yearly Averages
Internal Lab Influent Analysis, 2022

Month	Influent		
	OPO-4	NH3-N	pH
	<i>mg/l</i>	<i>mg/l</i>	<i>mg/l</i>
January	5.76	48.39	7.84
February	4.95	19.55	7.96
March	4.78	26.24	8.00
April	5.73	43.48	8.12
May	6.65	53.92	7.97
June	5.47	38.84	7.52
July	5.89	50.78	7.52
August	8.07	42.84	7.37
September	11.38	44.52	7.38
October	4.99	43.73	7.47
November	5.79	47.14	7.67
December	4.83	44.82	7.65
Yearly Min	4.78	19.55	7.37
Yearly Avg	6.19	42.02	7.71
Yearly Max	11.38	53.92	8.12

APPENDIX J

EFFLUENT ANALYSIS ACCREDITED LAB

Table 5.0

Monthly and Yearly Averages
Accredited Lab Effluent Analysis, 2022

Effluent											
Month	Lab	Total Coliforms	Fecal Coliforms	TSS	BOD	TKN-N	TN	NH3-N	TP		
January	Caro	25	4	2.0	8.4	3.84	6.01	2.56	0.126		
February	Caro	13	1	4.0	<7.5	3.59	5.73	1.96	0.139		
March	Caro	13	<1	3.2	25.0	2.74	5.46	1.19	0.122		
April	Caro	28	8	2.2	<7.0	1.33	4.07	0.10	0.107		
May	Caro	13	<1	2.0	<5.3	1.72	4.38	0.13	0.140		
June	Caro	102	12	4.7	10.8	1.73	4.47	0.19	0.210		
July	Caro	67	1	4.4	<7.0	2.36	4.52	0.67	0.322		
August	Caro	79	<1	3.0	<7.0	1.55	4.51	0.16	0.208		
September	Caro	23	2	<4.0	<5.6	1.00	3.57	0.07	0.122		
October	Caro	2	<1	<2.0	<6.8	0.98	3.33	0.07	0.126		
November	Caro	1	1	<2.0	<5.1	0.95	3.76	<0.05	0.086		
December	Caro	<1	<1	<2.0	<6.1	1.00	3.16	0.09	0.084		
Min		1	1	2.0	<2.9	0.95	3.16	0.07	0.084		
Average		33	6	2.9	6.0	1.90	4.41	0.65	0.149		
Max		102	12	4.7	<8.0	3.84	6.01	2.56	0.322		

Table 5.0

Table 5.1
Monthly and Yearly Averages
Accredited Lab Effluent Analysis, 2022

Effluent Month	Lab	OPO-4	pH	Organic Nitrogen	Nitrates	Nitrites	C3 Reclaimed Effluent		
							Total Coliforms	C3 Fecal Coliforms	C3 Fecal Coliforms
January	Caro	<0.0050	7.12	1.28	2.07	0.110	<1	<1	<1
February	Caro	<0.0050	7.53	1.63	1.82	0.312	<1	<1	<1
March	Caro	<0.0050	7.73	1.56	2.51	0.204	1.0	<1	<1
April	Caro	0.01	8.07	1.23	2.68	0.057	10.0	1.0	1.0
May	Caro	<0.0050	7.62	1.59	2.62	0.043	2.0	<1	<1
June	Caro	0.006	7.56	1.54	2.71	0.029	<1	<1	<1
July	Caro	0.058	7.65	1.69	2.04	0.117	770.0	91.0	91.0
August	Caro	<0.0050	7.31	1.39	2.92	0.042	92.0	1.0	1.0
September	Caro	0.017	7.28	0.93	2.55	0.027	2420.0	1.0	1.0
October	Caro	0.0076	7.33	0.915	2.32	0.029	<1	<1	<1
November	Caro	0.0055	7.24	0.95	2.80	0.011	<1	<1	<1
December	Caro	<0.0050	7.02	0.906	2.16	<0.01	<1	<1	<1
Min		0.01	7.02	0.91	1.82	0.01	1.0	1.0	1.0
Average		0.02	7.46	1.30	2.43	0.09	2.6	23.5	23.5
Maximum		0.06	8.07	1.69	2.92	0.31	2420.0	91.0	91.0

Table 5.2
 Yearly Average
 External Lab Results 2007-2022

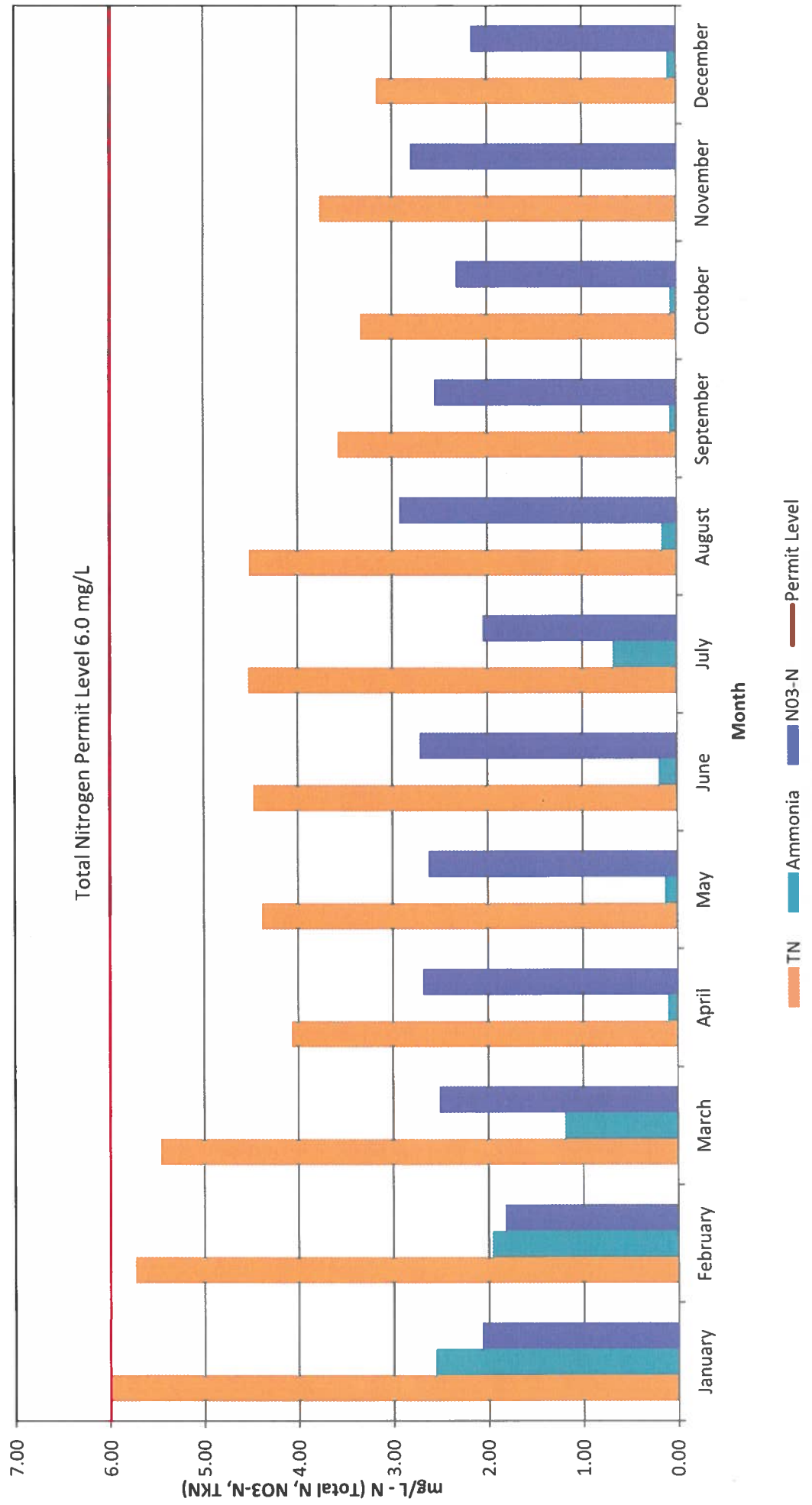
External Lab Results 2007-2022

EFFLUENT									
Year	Lab	Fecal Coliforms	TSS	BOD	TN	Total P			
2007	CARO	111	3.1		6.80				
2008	CARO	7	2.7		6.74				
2009	CARO	9	2.3	10	5.82				
2010	CARO	5	1.6	11.0	4.71				
2011	CARO	45	4.3	1	6.43				
2012	CARO	13	2.4	<10	4.55	0.221			
2013	CARO	0	2.7	<10	6.45	0.803			
2014	CARO	1549	3.0	<10	5.45	0.484			
2015	CARO	7	3.5	<10	5.55	0.275			
2016	CARO	0	0.0	0	4.74	0.198			
2017	CARO	5	0.6	2	3.91	0.212			
2018	CARO	27	3.0	6	4.34	0.432			
2019	CARO	9	2.7	<6.5	5.68	0.236			
2020	CARO	4	2.8	8	5.03	0.212			
2021	CARO	6	2.9	<6.1	4.34	0.163			
2022	CARO	3	3.0	8.5	4.41	0.149			

INFLUENT

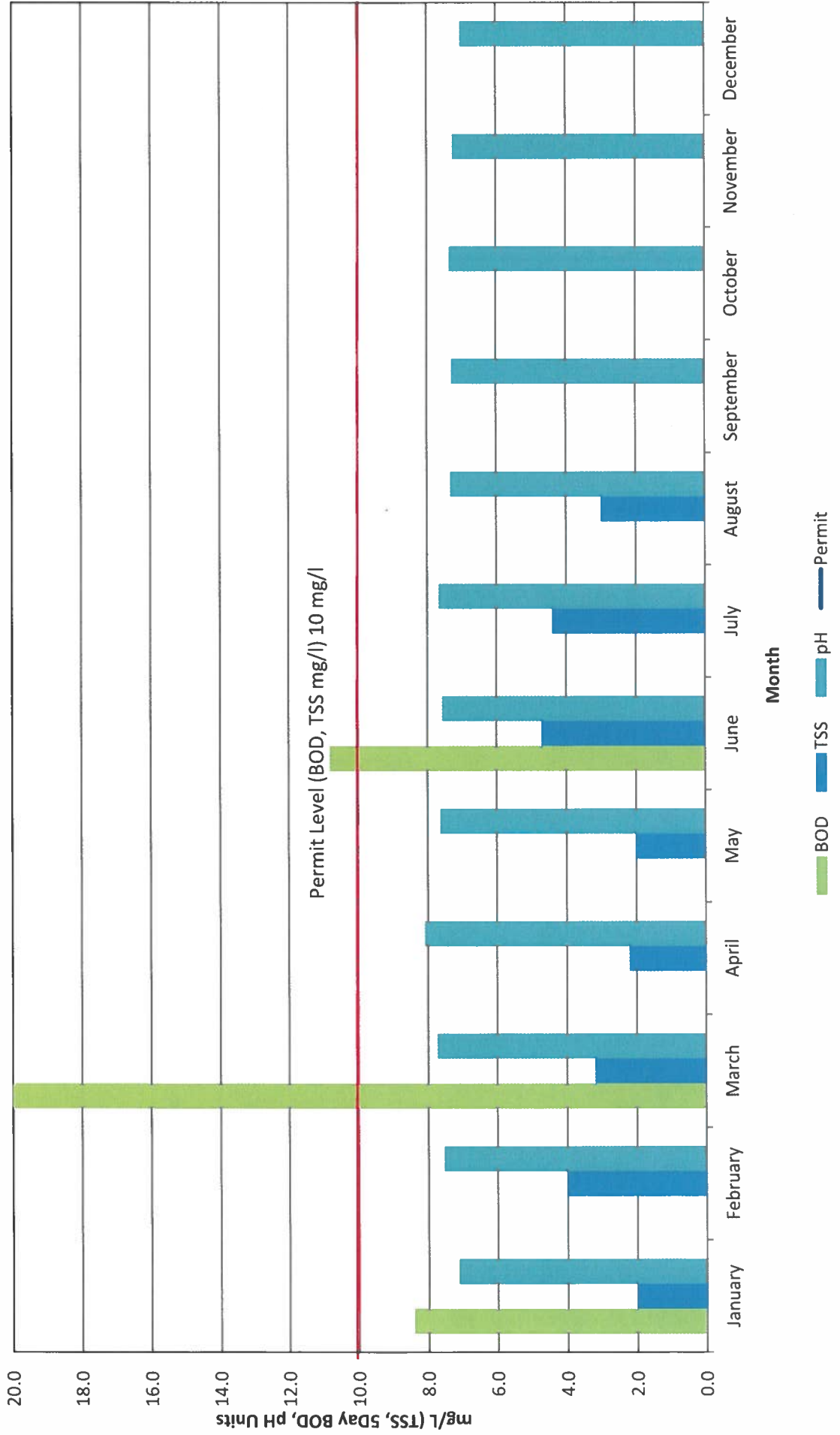
Year	Lab	BOD	TN	TP	pH
2007	CARO	181	46.6	7.4	7.2
2008	CARO	182	36.4	5.8	6.9
2009	CARO	139	38.3	4.8	7.5
2010	CARO				
2011	CARO	223	47.1	7.1	7.6
2012	CARO	222	48.1	6.8	7.5
2013	CARO	222	48.1	6.8	7.5
2014	CARO	228	46.9	5.4	7.4
2015	CARO	319	46.1	7.2	7.3
2016	CARO	391	65.8	10.6	7.1
2017	CARO	268	52.4	7.7	7.4
2018	CARO	224	45.6	6.1	7.0
2019	CARO	309	56.4	11.6	7.1
2020	CARO	296	49.9	9.8	6.6
2021	CARO	269	57.7	7.8	7.2
2022	CARO	203	53.2	5.2	7.5

Graph 5.0
Monthly Grab Sample Data
Accredited Lab Effluent Analysis - 2022

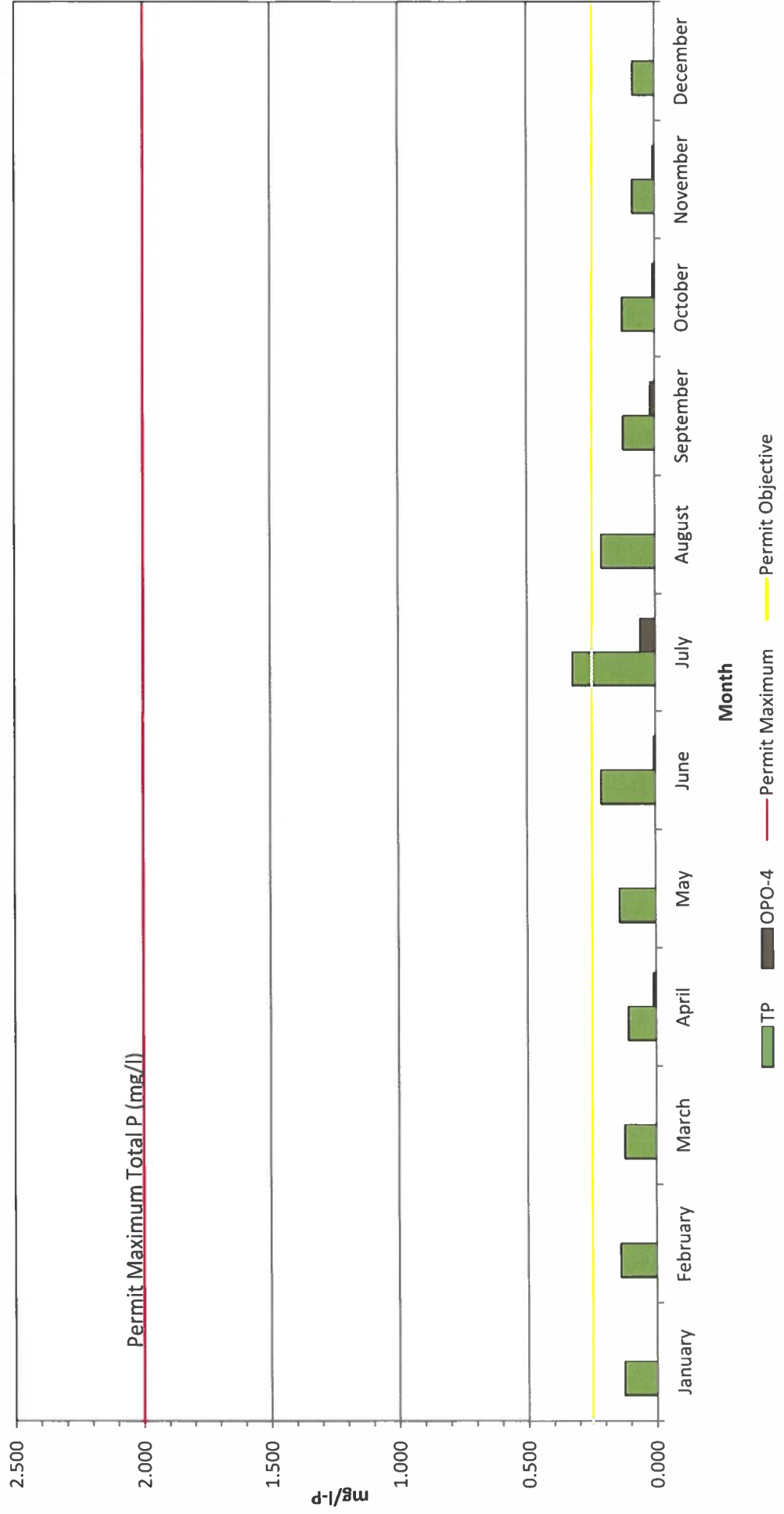


Graph 5.0

Graph 5.1
Monthly Grab Sample Data
TSS, 5-Day BOD, pH
Accredited Lab Effluent Analysis - 2022



Graph 5.2
Monthly Grab Sample Data
Total Phosphorous
Accredited Lab Effluent Analysis - 2022



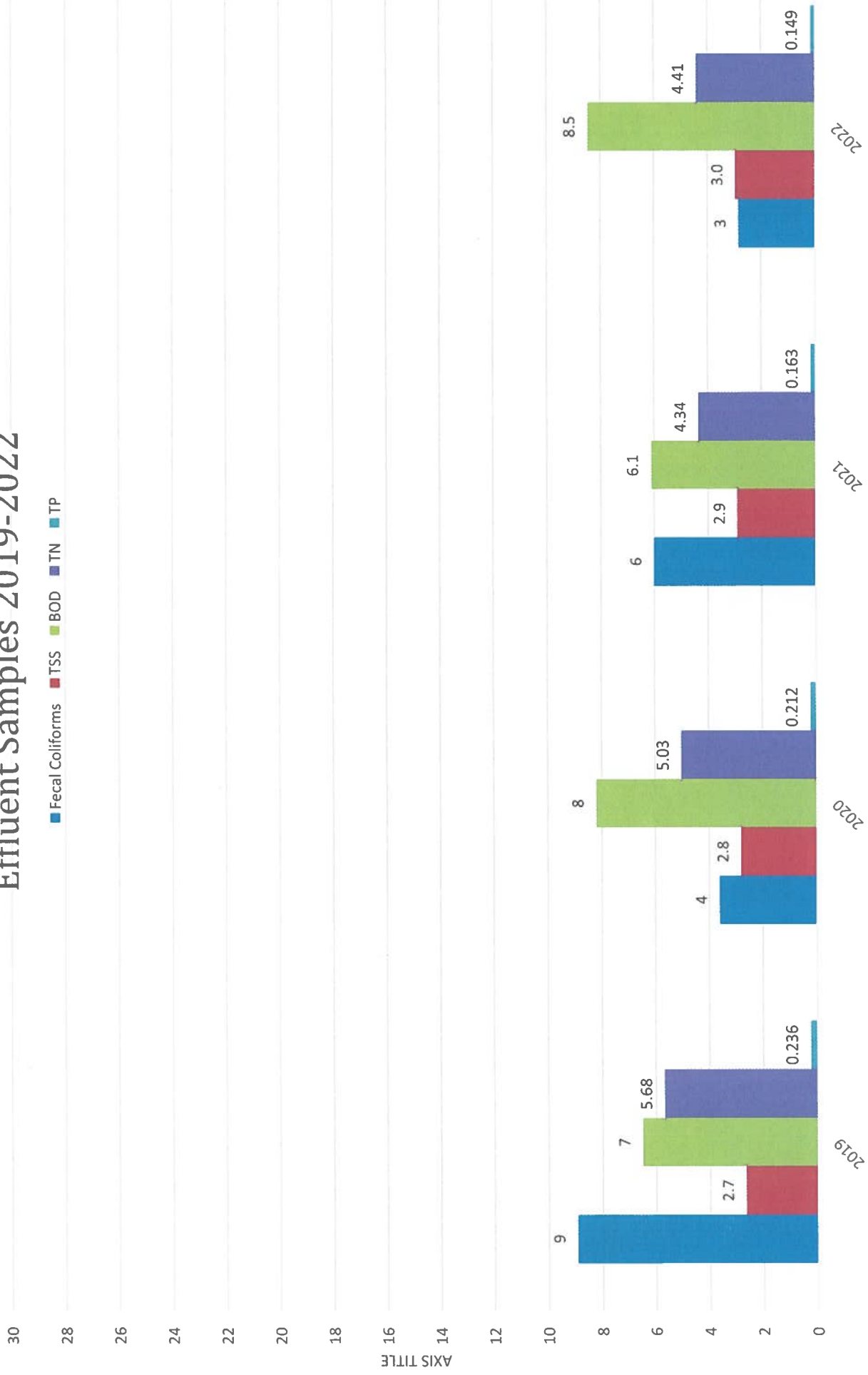
Graph 5.2

Graph 5.3

External Lab Yearly Averages

Effluent Samples 2019-2022

■ Fecal Coliforms ■ TSS ■ BOD ■ TN ■ TP

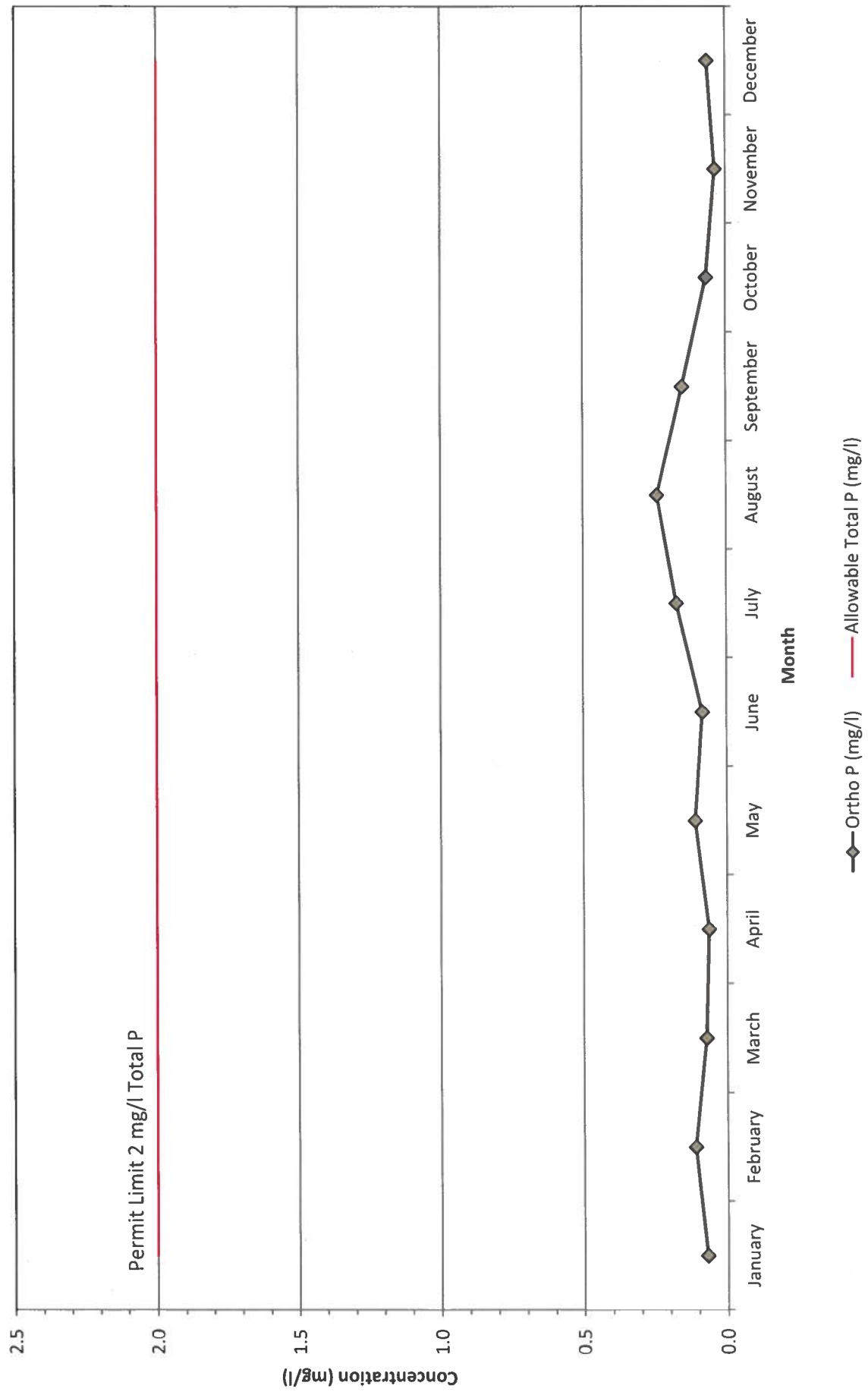


APPENDIX K

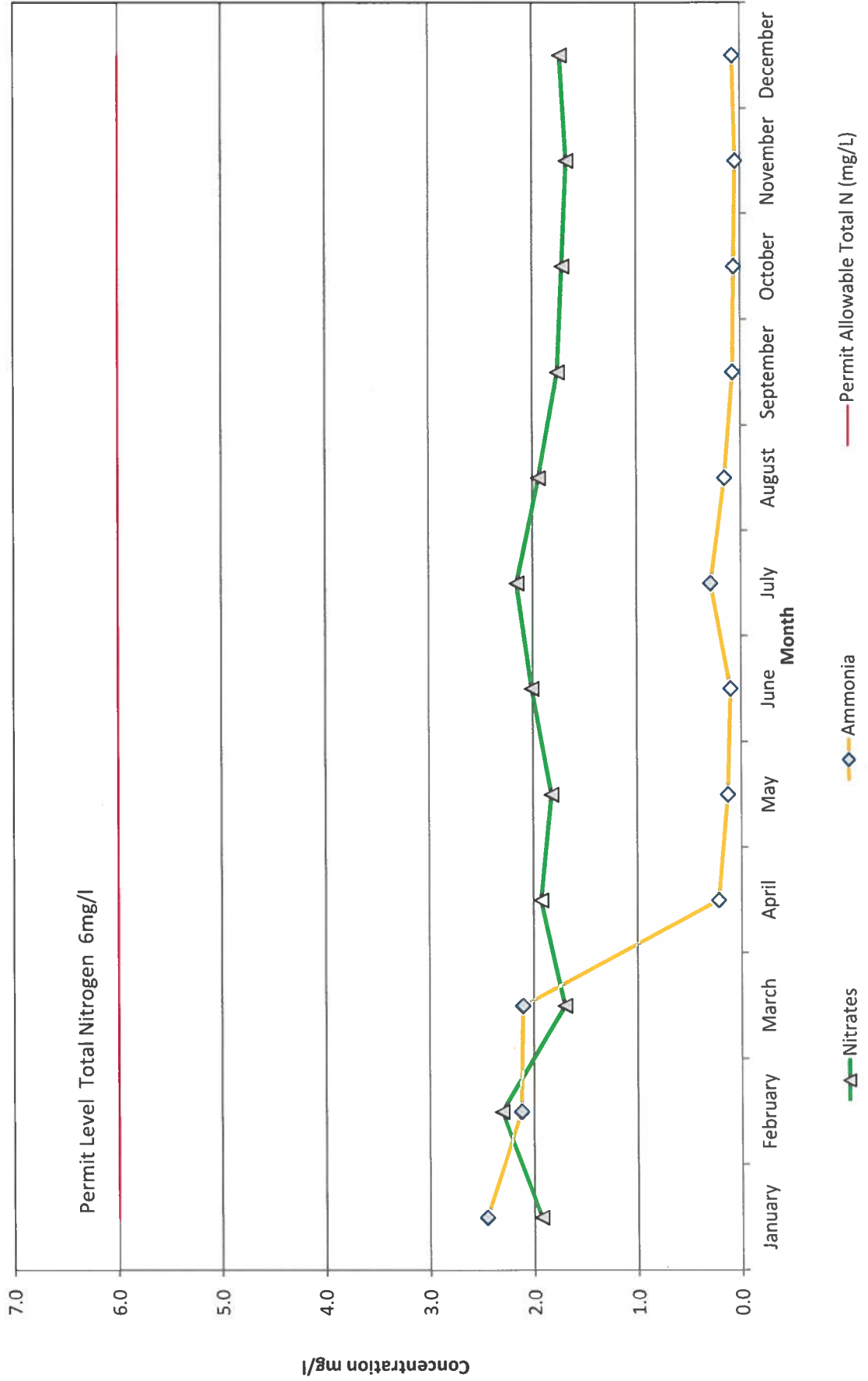
EFFLUENT ANALYSIS INTERNAL LAB

Table 6.0 Grab Samples, Monthly and Annual Averages Internal Effluent Analysis, 2022					
2022	Final Effluent				
	Ortho-P mg/L	Nitrates mg/L	Ammonia mg/L	pH	
January	0.070	1.9	2.45	6.58	
February	0.111	2.3	2.12	7.05	
March	0.072	1.7	2.10	6.99	
April	0.062	1.9	0.22	7.02	
May	0.110	1.8	0.13	6.87	
June	0.084	2.0	0.10	6.70	
July	0.174	2.2	0.29	6.62	
August	0.242	1.9	0.16	6.64	
September	0.152	1.8	0.08	6.46	
October	0.067	1.7	0.06	6.53	
November	0.037	1.7	0.05	6.78	
December	0.064	1.7	0.08	6.65	
Yearly Min	0.037	1.7	0.05	6.46	
Yearly Avg	0.104	1.9	0.65	6.74	
Yearly Max	0.242	2.3	2.45	7.05	

Graph 6.0
Monthly Average Grab Sample Data:
Ortho P, Internal Lab 2022

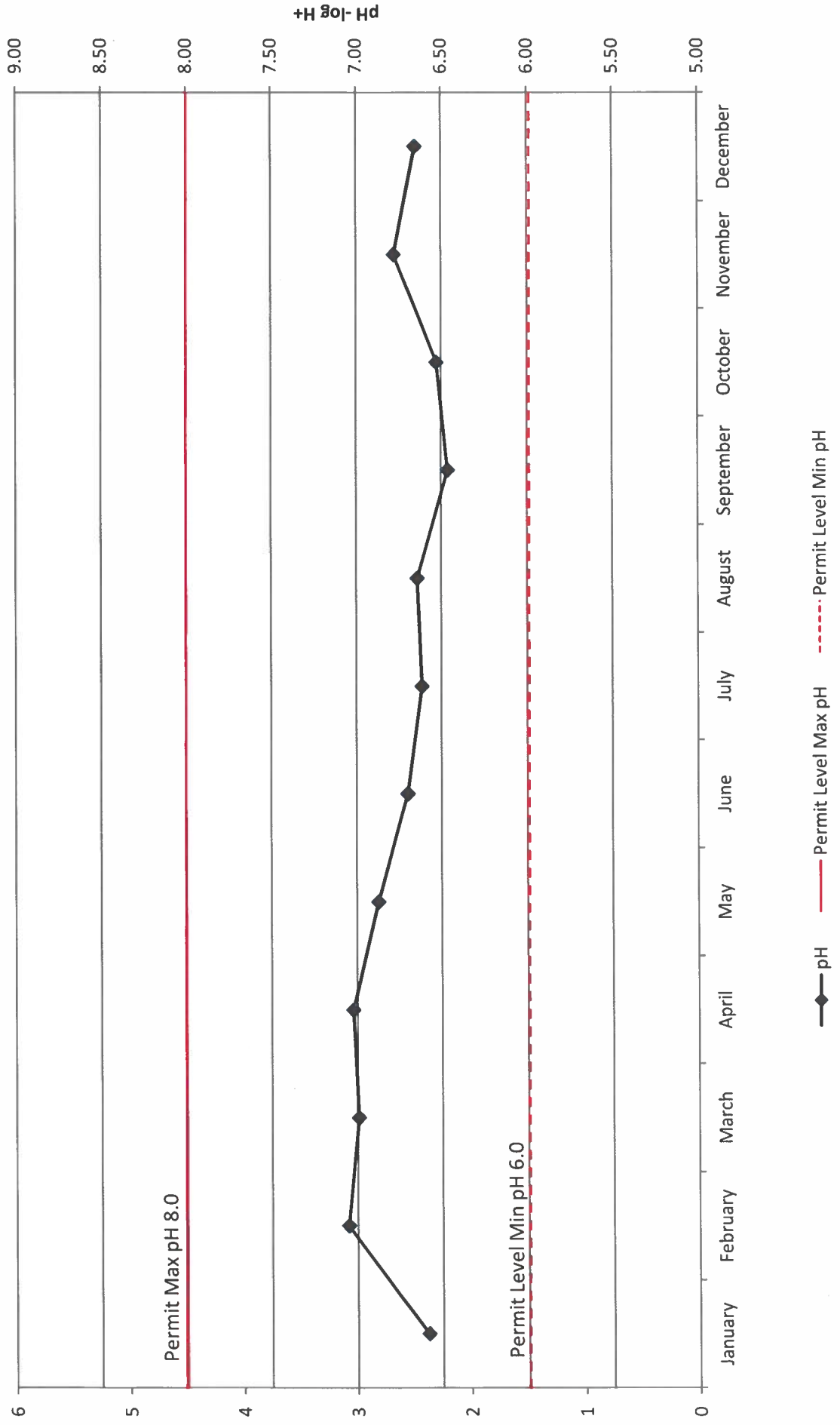


Graph 6.1
Monthly Average Grab Sample Data
Nitrates & Ammonia
Internal Lab Effluent Analysis - 2022



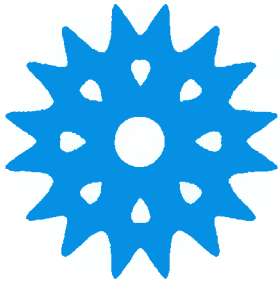
Graph 6.1

Graph 6.2
 Monthly Average Grab Sample Data
 pH
 Internal Lab Effluent Analysis - 2022



APPENDIX L

LAKE SAMPLING



LARRATT
AQUATIC

Okanagan Lake Collaborative Monitoring Agreement 2022 Summary Report

Prepared for:
Okanagan Basin Water Board
BC Ministry of Environment and Climate Change Strategy

Executive Summary

The British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) in partnership with local municipalities, commissioned an annual collaborative monitoring program to sample water quality in Okanagan Lake every year since 2011. Now operated by the Okanagan Basin Water Board (OBWB), sampling occurred monthly from March to September at four locations 2022.

A primary function of the monitoring was to determine attainment of Okanagan Lake water quality objectives, along with increasing the temporal resolution of water quality data for Okanagan Lake, specifically with the goal of determining trends in nutrient and biological data. Similar to previous years, parameters such as temperature and dissolved oxygen were measured throughout the water column as well as several chemical parameters including silica, nitrogen, and phosphorus at discrete depths. Biological data including phytoplankton and zooplankton biomass with taxonomic identification were also collected. This report summarizes the 2022 findings and sets these recent data within the context of this program (2011-2022).

The results to date indicate that the Armstrong Arm is the most impacted by human activities and watershed degradation. These impacts include including agriculture, cattle range, logging, septic systems adjacent to the shoreline, and now the White Rock Lake wildfire. This site had the most exceedances and the most parameters trending towards greater exceedances. Weather was the dominant factor on water quality at Okanagan Centre, Kelowna, and Summerland but long-term data still demonstrates human impacts.

Physical

Okanagan Lake is usually stratified from May to November, it mixes in mid-November and then freely mixes over the winter. Secchi depth was highest in late winter and decreased each spring in response to increased phytoplankton activity. Water clarity was typical for Okanagan Lake in 2022. Armstrong Arm and Summerland failed to meet the Secchi depth objective in 2022.

Chemical

Dissolved oxygen (DO) is essential for all aquatic animals and is high throughout Okanagan Lake at all times except in the hypolimnion of the Armstrong Arm where DO fell below the water quality objective each summer including 2022. Silica, an important micronutrient, had stable concentrations in Okanagan Lake over the past 20 years.

Total nitrogen (TN) exceeded the objective at all sites during 2022 as it did in most years. There were significant increasing trends in TN from 2011-2022 at Kelowna, Okanagan Centre, and Armstrong Arm, driven in part by a decades-long increasing trend in nitrate in the deep water of Okanagan Lake. This increasing nitrate trend has continued through multiple wet-dry climate cycles and is likely caused by increasing human impacts within the Okanagan region and possibly also climate change.

Total phosphorus (TP) had a year-over-year increasing trend at all sites from 2011-2022, and forms part of a longer-term trend since the mid-2000s. TP includes phosphorus associated with suspended sediment carried into the lake. It increased in Okanagan Lake during wet years such as 2017-2018 and decreased during dry years such as 2019 and 2021. Dissolved phosphorus is less affected by freshets than TP and was stable or declining at the three main basin sites while it also increased in the Armstrong Arm.

The ratio of total nitrogen to total phosphorus (N:P) available to phytoplankton will play a major role in which types of phytoplankton proliferate in a lake. A lower N:P ratio (abundant phosphorus relative to nitrogen) will favour the growth of cyanobacteria. The N:P ratio failed to meet the objective in the Armstrong Arm in 2022 with a downwards trend at all sites (farther from meeting objective).

Biological

Chlorophyll-a was used as a measure of photosynthetic activity in Okanagan Lake. A decreasing north to south trend in the chlorophyll-a data occurred over the course of this study. All sites met the chlorophyll-a objectives during 2022. However, a significant increasing trend occurred at Kelowna, Okanagan Centre, and Armstrong Arm from 2011-2022, part of a trend since the mid-2000s.

Phytoplankton abundance during 2022 was high compared to 2011-2021 because of elevated cyanobacteria densities. All sites met the phytoplankton biovolume objective but failed to meet the phytoplankton taxonomy objective during 2022 because of elevated cyanobacteria densities, particularly the Armstrong Arm.

Zooplankton biomass met the objective at Okanagan Centre in 2022. All sites failed to meet the objective of >5% cladocerans in some samples during 2022. A decline in cladoceran abundance was noted at Armstrong Arm from 2018-2022.

The following areas of concern have been identified that may require further investigation on the part of the Ministry:

- Chronically low Secchi depth in the Armstrong Arm
- Increasing nitrate in hypolimnion of Okanagan Lake since 1970s
- Increasing total phosphorus at all sites except Summerland since early 2000s
- Decreasing N:P ratio in the Armstrong Arm
- High densities of potentially toxic cyanobacteria in Armstrong Arm during 2018-2021
- Role of Climate Change in water quality changes in Okanagan Lake
- Phosphorus loading to the Armstrong Arm and north basin of Okanagan Lake from the White Rock Lake wildfire

Water Quality Objectives, 2011-2022 Values, and Trends for Okanagan Lake

Table 1: Okanagan Lake water quality objectives

Parameter (Nordin, 2005)	Summerland	Kelowna	Ok Centre	Armstrong Arm
Secchi Depth (growing season average: Apr-Sep)	>7m	>6m	>6m	>5m
Dissolved Oxygen (minimum in bottom waters)	-	-	-	>5 mg/L
TP (mg/L as P) (maximum at spring overturn)	<0.007	<0.008	<0.008	<0.01
Chlorophyll-a (µg/L) (maximum seasonal average)	<4.5	<4.5	<4	<5
TN (mg/L as N) (maximum at spring overturn)	<0.230	<0.230	<0.230	<0.250
N:P Ratio (spring weighted ratio)	>25:1	>25:1	>25:1	>25:1
Algae Taxonomy (% heterocystous cyanobacteria)	<5%	<5%	<5%	<5%
Algae Biomass (µL/L) (growing season average)	<0.75	<0.75	<0.75	<0.75
Zooplankton Biomass (µg/L) (growing season average)	>50	>50	>50	>50
Zooplankton Taxonomy (% cladocerans)	>5%	>5%	>5%	>5%

Table 2: Attainment of Okanagan Lake water quality objectives compared to growing season averages during 2011-2022

Objective	Summerland	Kelowna	Ok Centre	Armstrong Arm
Secchi Depth	6.4	6.4	7	3.3
Dissolved Oxygen	7.96	8.25	8.20	1.84
TP (mg/L) 0-10m:	0.006	0.007	0.009	0.011
20-45m:	0.004	0.008	0.006	0.027
Chlorophyll-a (µg/L)	1.99	2.33	2.46	3.62
TN (mg/L) 0-10m:	0.224	0.227	0.225	0.253
20-45m:	0.246	0.251	0.245	0.323
N:P Ratio 0-10m:	45:1	43:1	34:1	18:1
20-45m:	52:1	49:1	32:1	18:1
Algae Taxonomy (% heterocystous cyanobacteria)	15.6%	14.0%	15.7%	29.9%
Algae Biovolume (µL/L)	0.164	0.229	0.273	0.269
Zooplankton Biomass (µg/L)	18.8	37.9	58.1	39.8
Zooplankton Taxonomy (% cladocerans)	2.4%	3.3%	6.3%	7.9%

Legend:

Achieved objective	Achieve objective in some but not all samples	Did not achieve objective
--------------------	---	---------------------------

Table 3: Summary of trends compared to attainment of water quality objectives in Okanagan Lake during 2011-2022

Objective	Summerland	Kelowna	Ok Centre	Armstrong Arm
Secchi Depth	-	-	-	-
Dissolved Oxygen	-	-	-	-
TP (mg/L) 0-10m:	↑	↑	↑	↑
Chlorophyll-a (µg/L)	-	↑	↑	↑
TN (mg/L) 0-10m:	-	↑	↑	↑
N:P Ratio 0-10m:	↓	↓	↓	↓
Algae Taxonomy (% heterocystous cyanobacteria)	-	-	-	-
Algae Biovolume (µL/L)	↑	↑	-	-
Zooplankton Biomass (µg/L)	-	-	-	-
Zooplankton Taxonomy (% cladocerans)	-	-	-	↓

Legend:

Achieved objective	Achieve objective in some but not all samples	Did not achieve objective
--------------------	---	---------------------------

Preferred Citation

Self, J., 2023. Okanagan Collaborative 2022 Summary Report. Prepared by Larratt Aquatic Consulting Ltd. Prepared for Okanagan Basin Water Board.

Report prepared by: Larratt Aquatic Consulting Ltd.

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Definitions

The following terms are defined as they are used in this report.

Term	Definition
Algae bloom	A superabundant growth of algae that may result in surface scum depending on type of algae that is blooming
Anoxic	Devoid of oxygen
Bioavailable	Available for use by plants or animals
Chlorophyll-a	Primary photosynthetic pigment in algae; used as a measure of photosynthetic activity
Cyanobacteria	Bacteria-like algae having cyanochrome as the main photosynthetic pigment
Diatoms	Algae that have hard, silica-based "shells" frustules
Fall overturn	Surface waters cool and sink, until a fall storm mixes the water column
Eutrophic	Nutrient-rich, biologically productive water body
Hypoxic	Very low dissolved oxygen
Macronutrient	The major constituents of cells: nitrogen, phosphorus, carbon, sulphate, H
Micronutrient	Small amounts are required for growth; Si, Mn, Fe, Co, Zn, Cu, Mo etc.
Microflora	The sum of algae, bacteria, fungi, <i>Actinomyces</i> , etc., in water or biofilms
Monomictic	"One Mixing": describes lakes that are thermally stratified in summer and mixed in winter
Nutrient limitation	A nutrient will limit or control the potential growth of organisms e.g. P or N
Phytoplankton	Algae that float, drift or swim in water columns of reservoirs and lakes
Plankton	Those organisms that float or swim in water
Riparian	The interface between land and a stream or lake
Secchi depth	Depth where a 20 cm Secchi disk can be seen; measures water transparency
Thermocline	The lake zone of greatest change in water temperature with depth (> 1°C/m); it separates the surface water (epilimnion) from the cold hypolimnion below
Zooplankton	Minute animals that graze algae, bacteria and detritus in water bodies

Term	Definition
AFDM	Ash-free dry mass
Chl-a	Chlorophyll-a units µg/L
DO	Dissolved oxygen units mg/L
N	Nitrogen units mg/L as N
Ortho-P	Orthophosphate = SRP monomeric inorganic phosphorus units mg/L as N
P	Phosphorus units mg/L as P
DIN	Dissolved inorganic nitrogen = ammonia + nitrate + nitrite units mg/L as N
TDN	Total dissolved nitrogen = ammonia + nitrate + nitrite + dissolved organic N units mg/L as N
TDP/DP	Total dissolved phosphorus units mg/L as P
TN	Total nitrogen: organic + dissolved units mg/L as N
TP	Total phosphorus: organic + dissolved units mg/L as P

Lake Classification by Trophic Status Indicators (Nordin, 1985)

Trophic Status	chlorophyll-a ug/L	Total P ug/L	Total N ug/L	Secchi disc m	Phytoplankton density (cells/mL)	Phytoplankton biomass (mg/m ³)
Oligotrophic	0 – 2	1 – 10	<100	> 6	<1000	0-500
Mesotrophic	2 – 5	10 – 20	100 – 500	3 – 6	1000-5000	500-2000
Eutrophic	>5	> 20	500-1000	< 3	>5000	>2000

Nutrient Balance Definitions for Microflora (Dissolved Inorganic N : Dissolved Inorganic P) (Nordin, 1985)

Phosphorus Limitation	Co-Limitation of N and P	Nitrogen Limitation
> 15 : 1	< 15 : 1 – 5 : 1	5 : 1 or less

1.0 Introduction

1.1 Overview

The British Columbia Ministry of Environment and Climate Change Strategy (ENV) in partnership with the City of Kelowna, the Regional District of Central Okanagan, and the District of Summerland began a seasonal sampling program of Okanagan Lake in 2011 to increase the temporal resolution of water quality data being gathered. This program was performed collaboratively between ENV staff, Okanagan Nation Alliance (ONA; 2011), and Larratt Aquatic Consulting (2012-2022). The current program is overseen by the Okanagan Basin Water Board (OBWB). Okanagan Lake was sampled monthly from March to September from 2011-2021 at four key sites (Figure 1, Table 4).

Table 4: GPS coordinates of sampling sites

Site Name	EMS ID	Latitude	Longitude
Summerland	0500454	49.600550°	-119.628030°
Kelowna	0500236	49.861350°	-119.513420°
Ok Centre	0500730	50.089900°	-119.478270°
Armstrong Arm	0500239	50.315450°	-119.357180°

Note: EMS = Environmental Monitoring System and serves as ENV's database of water quality

Sampling focused on three broad subjects at each site: physical parameters, water chemistry, and biological activity.

Physical parameters including temperature profiles were taken at each site on each date to build a composite image of conditions in Okanagan Lake over time (Figure 4). Secchi depth, a measure of water clarity, was also recorded for each site.

In addition, dissolved oxygen profiles were taken and a range of parameters were chemically analyzed from samples taken in the epilimnion (1-5-10 m composite) and the hypolimnion (20-32-45 m composite). Chemistry focused on the major nutrients in their various forms. Chemistry results were analyzed by ALS Environmental throughout this study.

Biological sampling included generic parameters such as chlorophyll-a concentration and biomass, as well as detailed taxonomic classification of phytoplankton (algae) and zooplankton.

The 2022 data were added to the existing 2011 – 2021 database upon which all the analyses in this report were performed. Water quality objectives were based upon Nordin (2005) (Appendix 1).

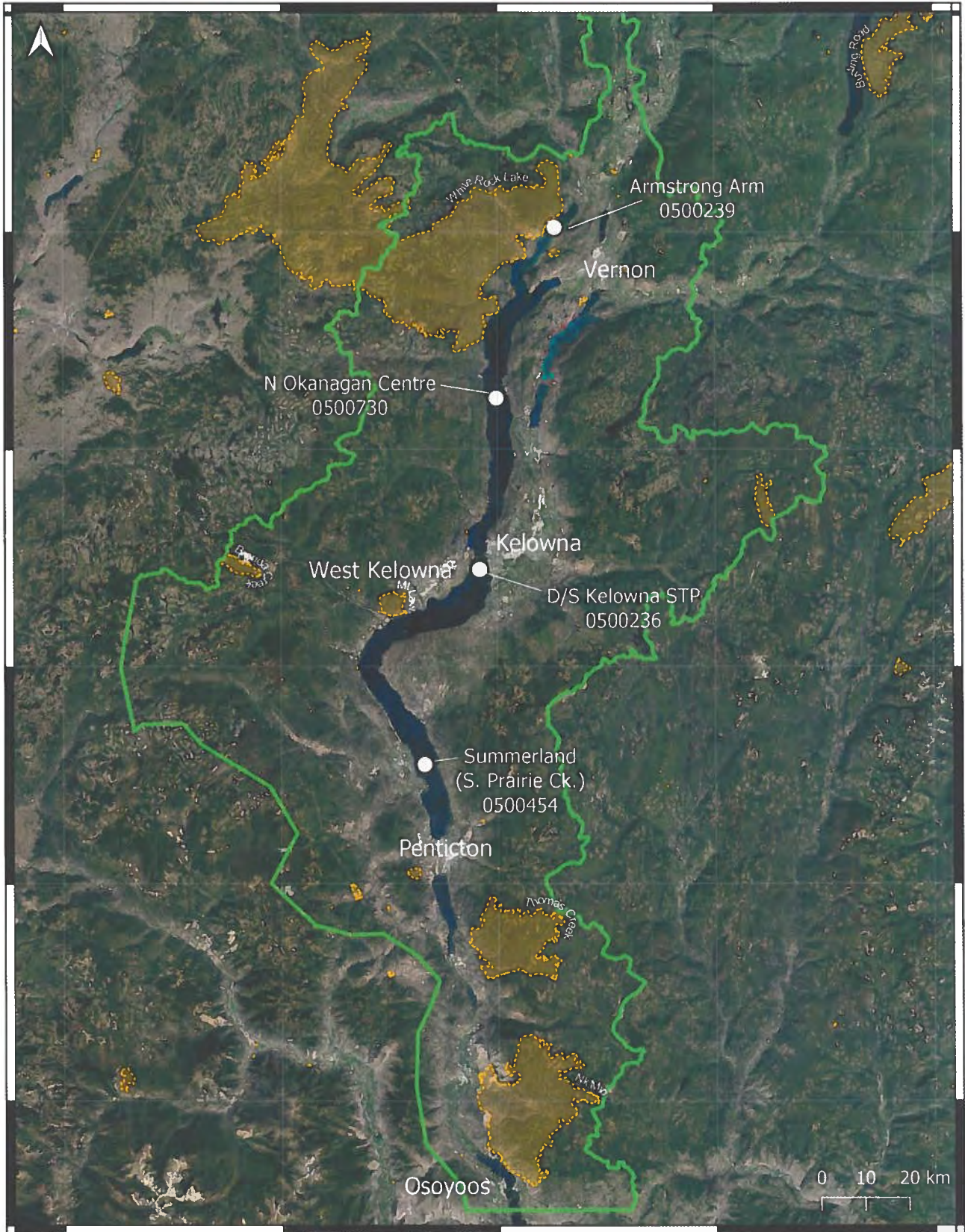


Figure 1: Okanagan Basin Watershed with four sampling locations identified and 2021 wildfires marked

1.2 Weather and Climate Conditions in 2022

The weather during any given year will have a major impact on physical conditions, water chemistry, and biological activity in Okanagan Lake during that and subsequent years. The weather during 2022 was another unusual year for the Okanagan climate (Figure 2). Spring was cooler than normal for the Okanagan with a large freshet in the Mission Creek watershed followed by a shift to hot dry weather that extended into October. The water level of Okanagan Lake was near record low throughout the first half of 2022, but the large freshet led to high water levels during the summer. Both the peak water level and inflows as measured at Mission Creek (08NM116) were amongst the top 10 for Okanagan Lake since record keeping began in the 1940s. Hot dry weather led to a rapid drawdown of Okanagan Lake that led to below average water levels by the end of the year (Figure 3). This type of extreme weather is expected to become more frequent and more intense because of Climate Change.

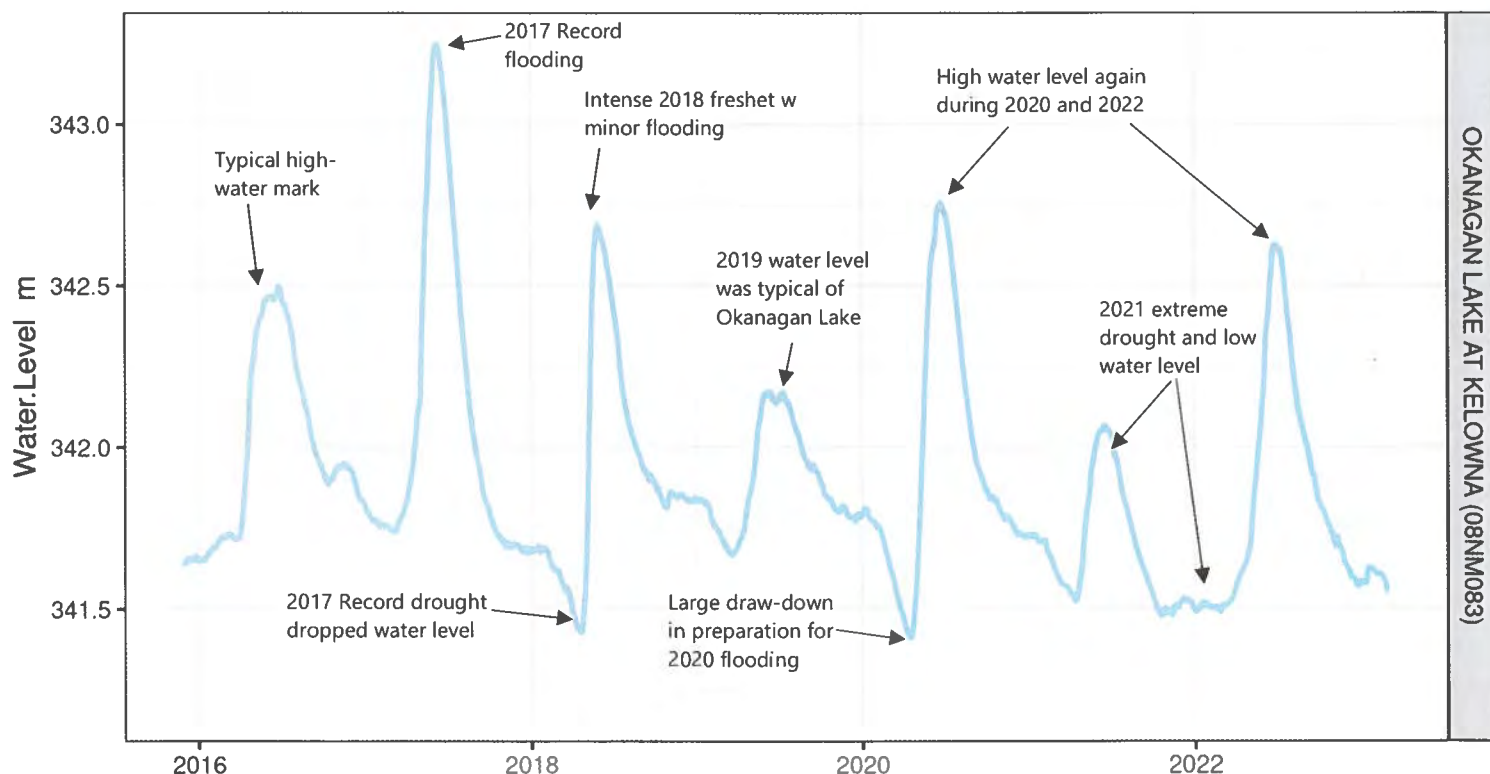


Figure 2: Water level in Okanagan Lake at Kelowna from 2016-2022

Source: (Water Office, 2022)

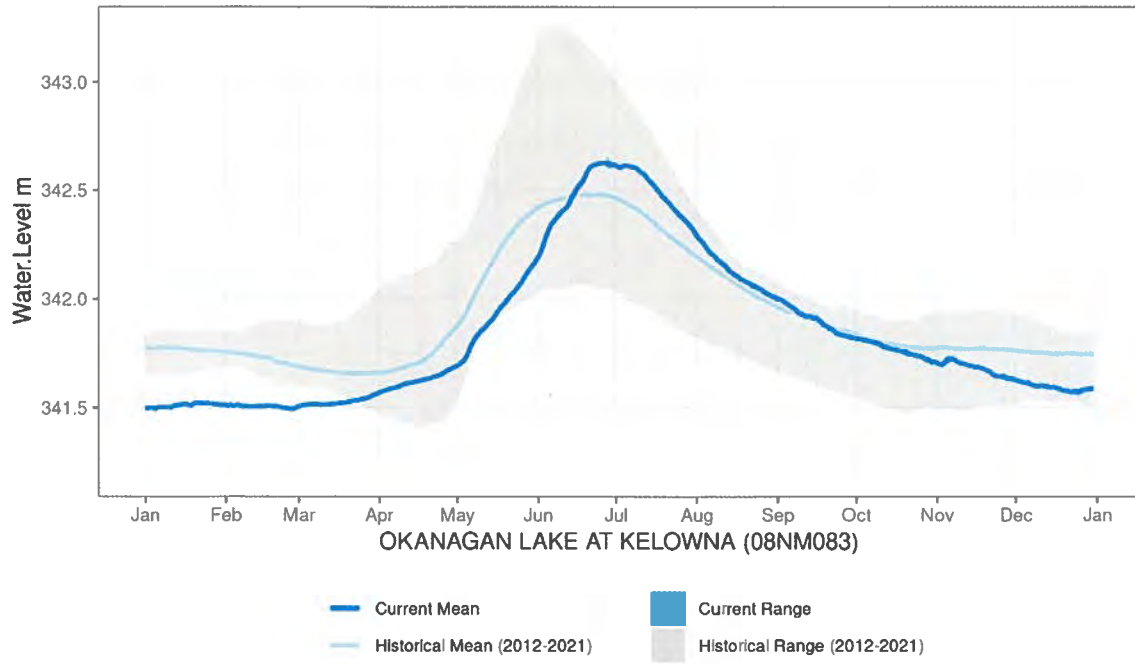


Figure 3: Water level in Okanagan Lake during 2022 compared to 2012-2021

Source: (Water Office, 2022)

2.0 Results & Discussion

2.1 Physical

2.1.1 Temperature

Okanagan Lake is a deep monomictic lake. From May to November each year, the surface water (epilimnion) is thermally isolated from the deep water (hypolimnion) by a thermocline. The sun warms the epilimnion to over 20 °C each summer while water below 20 m changes temperature by less than 4 °C annually (Figure 4).

The three main basin sites (Summerland, Kelowna, and OK Centre) exhibit similar thermal behavior while the northern Armstrong Arm site is shallower and reaches a higher surface temperature each summer (Figure 4). Thermal stratification in Okanagan Lake breaks down each November and the water column freely circulates through the winter. There were no statistically significant trends in the 2011–2022 temperature data either annually, seasonally (Mann-Kendall trend tests).

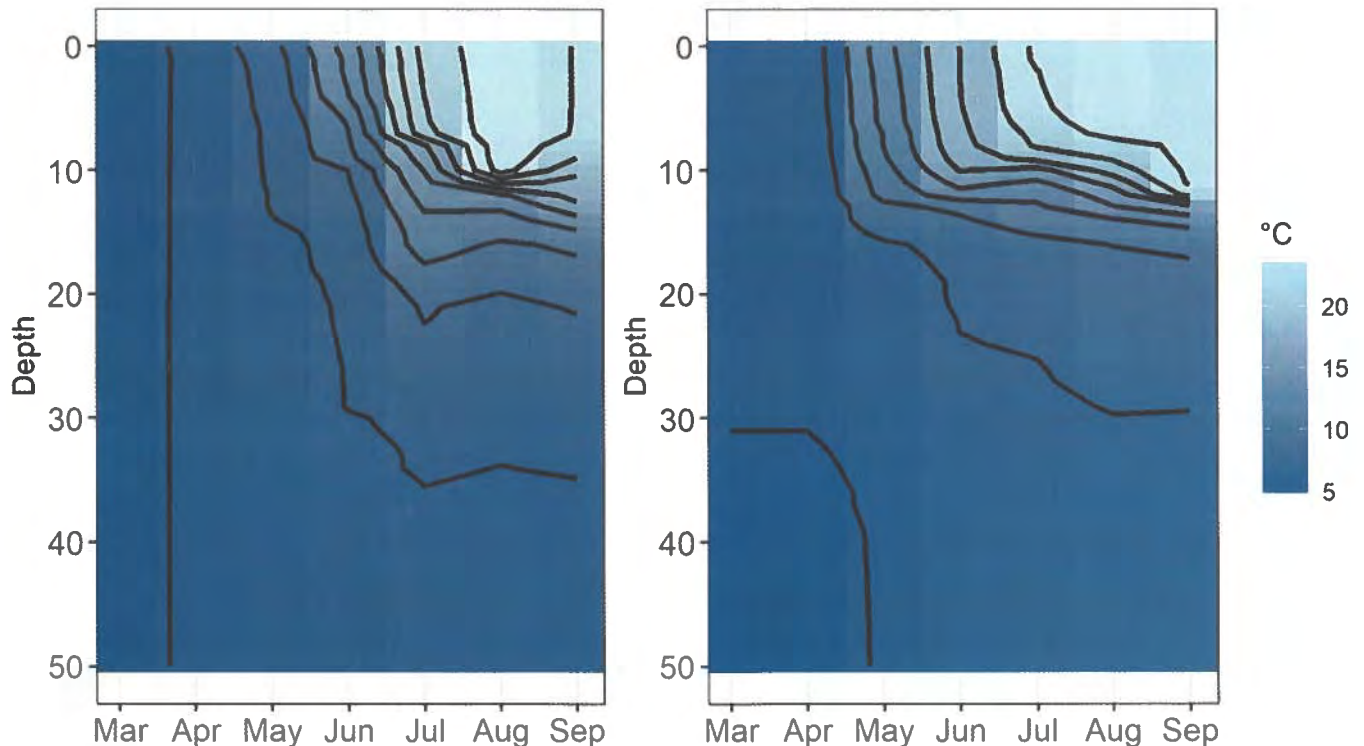


Figure 4: Temperature profiles for Okanagan Lake at Summerland (left) and Armstrong Arm (right), 2022

Notes: Lines represent contours of same temperature or dissolved oxygen within the water column through time. Samples not collected during March 2020 at Armstrong Arm because of ice-cover

Surface water temperatures of Okanagan Lake at all four sites were below average throughout the cool, wet spring before transitioning to above average during the late summer into fall months (Figure 5).

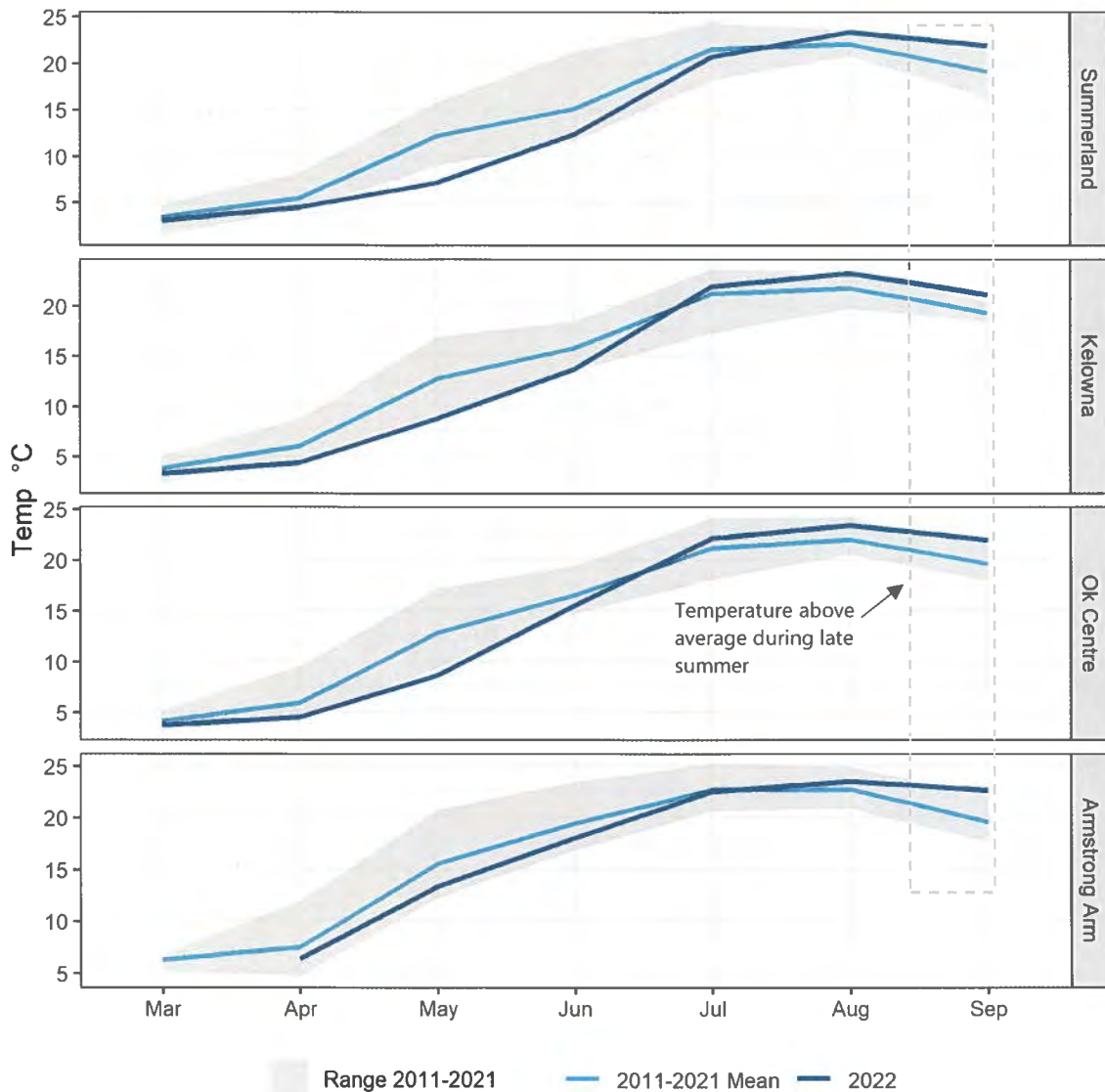


Figure 5: Temperature at Okanagan Lake sampling sites during 2022 compared to 2011-2021

2.1.2 Water Clarity and Secchi Depth

Water clarity, as measured by Secchi depth, ranged from a minimum of only 1.8 m at Armstrong Arm in June to a maximum of 15.9 m at Okanagan Centre in March during 2022 (Table 5). Secchi depth averages were near the 2011-2022 average during 2022 (Figure 6, Figure 7). Armstrong Arm and Summerland failed to meet their respective objectives during 2022 (Table 5). The overall average for Okanagan Lake historically has been 6.5-6.6 m but averaged 5.8 ± 2.4 m in 2022 (Andrusak et al., 2006; Nordin, 2005). The relatively low water clarity during 2022 may relate to an increasing trend in chlorophyll-a observed throughout the lake during the past 10 years (Figure 17).

Secchi depth followed a consistent pattern each year. Maximum Secchi depths occurred in the late winter when biological activity was the lowest. During increased spring algal growth and freshet, the Secchi depth dropped dramatically to the lowest of the year at all sites. As nutrients were used up, algae concentrations diminished, and water clarity increased through the summer and into the fall (Figure 6).

The Secchi depth in the Armstrong Arm was much lower than at the other sites in Okanagan Lake during all years. This is clearly illustrated in Figure 7. Secchi depth was stable from 2011-2022 and there were no statistically significant year-over-year trends in the Secchi depth data from 2011-2021 but there was a significant drop when the 1973-2022 historical data was considered (Mann-Kendall tests, Figure 7). This long-term trend is related to a period of high water clarity in the years following the installation of nutrient removal systems at wastewater treatment plants; the current lower water clarity likely relates to the cumulative effects of increased population and human activities within the Okanagan watershed over the past 30 years.

Table 5: Growing Season (Apr-Sep) Secchi depth in meters at Okanagan Lake sampling sites, 2022

Site	Objective	Average	StdDev	Max	Min
Summerland	7.0	6.4	1.8	8.5	3.5
Kelowna	6.0	6.4	2.7	8.8	1.8
Ok Centre	6.0	7.0	2.4	10.8	4.4
Armstrong Arm	5.0	3.3	0.5	3.9	2.6

Note: Objective refers to growing season average (Apr-Sep); Coloured shading indicates status of objective during that year with green meaning met objective and red meaning failed to meet objective

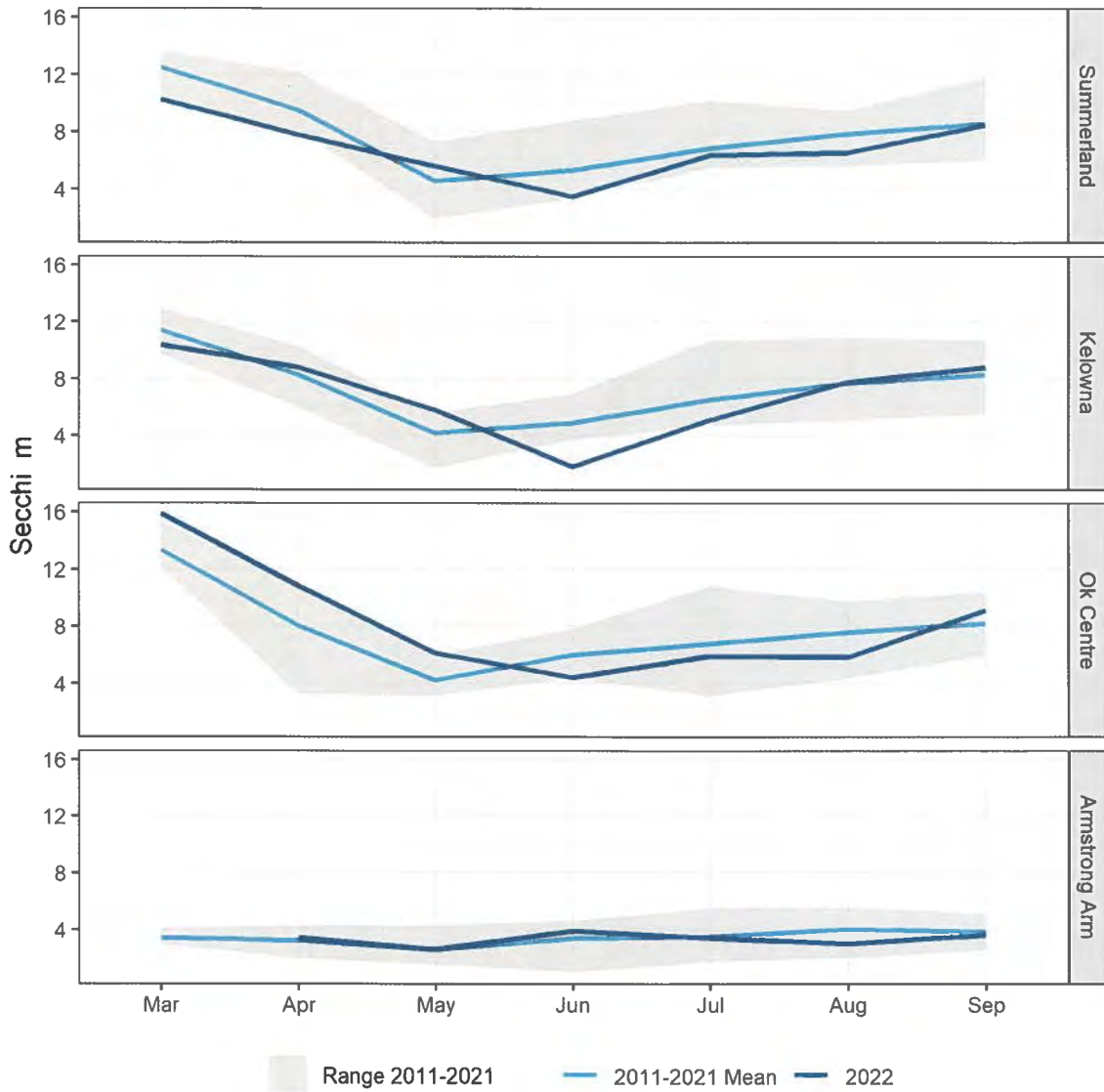


Figure 6: Secchi depth at Okanagan Lake sampling sites during 2022 compared to 2011-2021

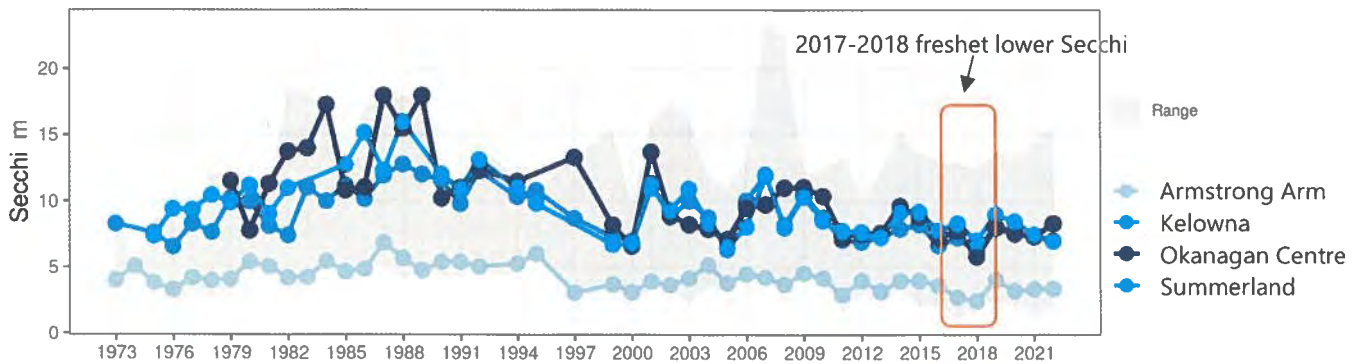


Figure 7: Annual average secchi depth in Okanagan Lake from 1973-2022

2.2 Chemistry

Chemistry sampling focused on dissolved oxygen, nitrogen and phosphorus (the most important aquatic nutrients), and silica, a key micronutrient. Increasing nutrient trends frequently result from human activities such as wastewater effluent disposal, riparian degradation, agriculture, fertilizer use, storm water, etc. These human-caused impacts are gradual and are easiest to detect as year-over-year trends. As the database grows, it will become easier to separate climatic impacts from human impacts.

2.2.1 Dissolved Oxygen

Dissolved oxygen (DO) is essential for all aquatic animals. Low DO will stress fish and possibly preclude them from certain portions of the water column. Hypoxic conditions occur when DO is very low (<2 mg/L) and this has a profound impact on water chemistry through the mobilization of nutrients and metals from the sediment. The three major basin sites (Summerland, Kelowna, and OK Centre) exhibit similar thermal and high dissolved oxygen behavior while the northern Armstrong Arm site is shallower and behaves differently. The latter reaches a higher surface temperature and experiences a reduction in dissolved oxygen in the deep water each summer (Figure 8). The reduction in dissolved oxygen is caused by decomposition of organic material in the sediment and deep water and can lead to internal nutrient loading if oxygen becomes depleted. The Armstrong Arm is the only site with a dissolved oxygen objective (>5 mg/L in bottom water), a threshold that it fails to meet every year. By September 2022, the low dissolved oxygen zone (depth below red line in Figure 8) had expanded to 35 m thick with a minimum concentration of only 1.84 mg/L.

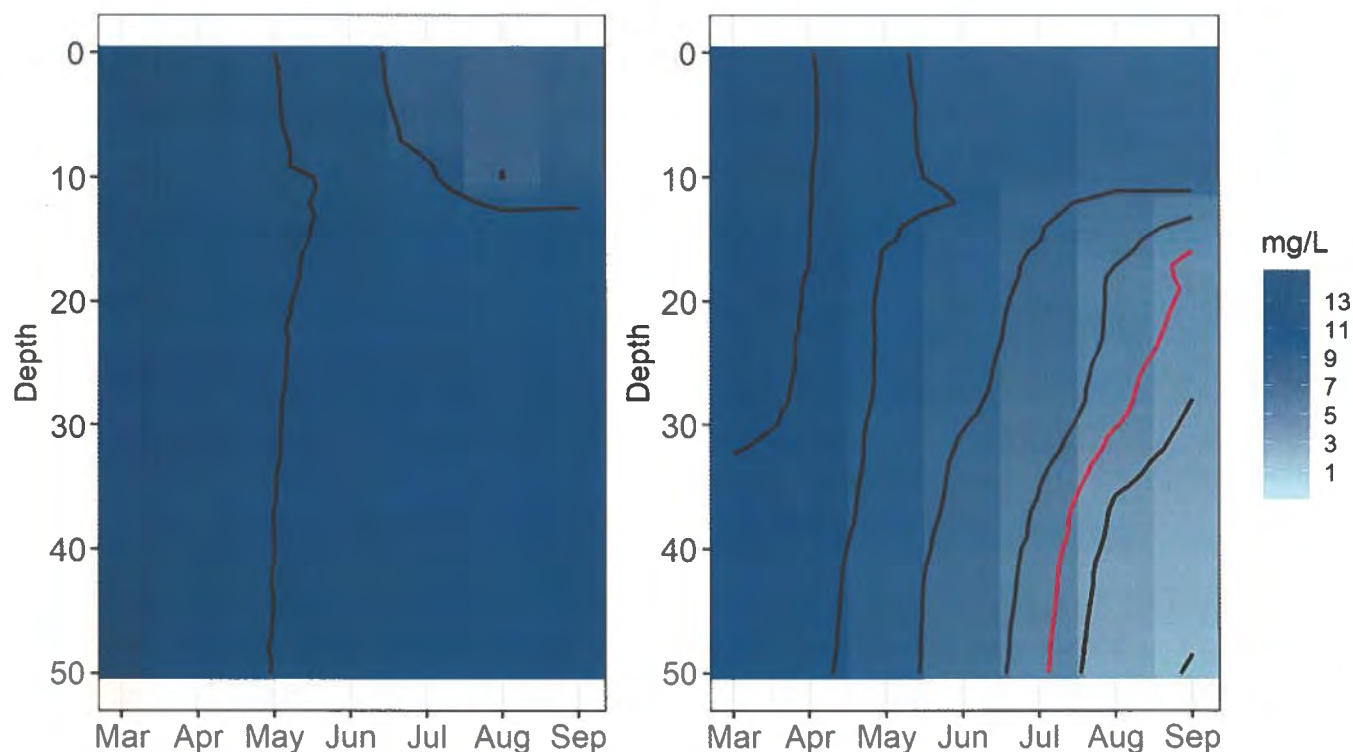


Figure 8: Dissolved oxygen profiles for Okanagan Lake at Summerland (left) and Armstrong Arm (right) during 2022

Dissolved oxygen profile illustrates high dissolved oxygen concentrations at Summerland and characteristic oxygen depletion in deep waters of the Armstrong Arm. Lines represent contours of same dissolved oxygen within the water column through time. Note: The red line on dissolved oxygen plot represents Water Quality Objective; all water below this line does not meet the objective.

2.2.2 Silica

Diatoms, a major group of algae in Okanagan Lake, use silica (measured as dissolved silica) as a structural building block for their cell walls. While no objectives for silica concentrations in Okanagan Lake have been set, monitoring continues as silica is a key micronutrient for this important group of algae. Silica sampling shifted to only March and September beginning in 2015 because it did not change significantly over the course of the growing season from 2011-2014. Silica was higher during 2017-2018, likely an effect of the flooding and intense freshets during those years, but when looking at the long-term data, there was an increasing trend from the 1970s to 2000 followed by a period of stability since 2000 (Table 6, Figure 9). There was unusually low silica at the Kelowna sample point on Aug 16, 2022 but the cause was unclear. The cause of the change in silica from increasing to stable is not known.

Table 6: Silica concentration in mg/L at Okanagan Lake sampling sites, 2022

Site	Average	StdDev	Max	Min
Armstrong Arm	7.91	1.20	9.97	6.15
Kelowna	6.07	2.45	7.72	1.26
Ok Centre	7.32	0.49	7.82	6.52
Summerland	7.31	0.24	7.62	6.83

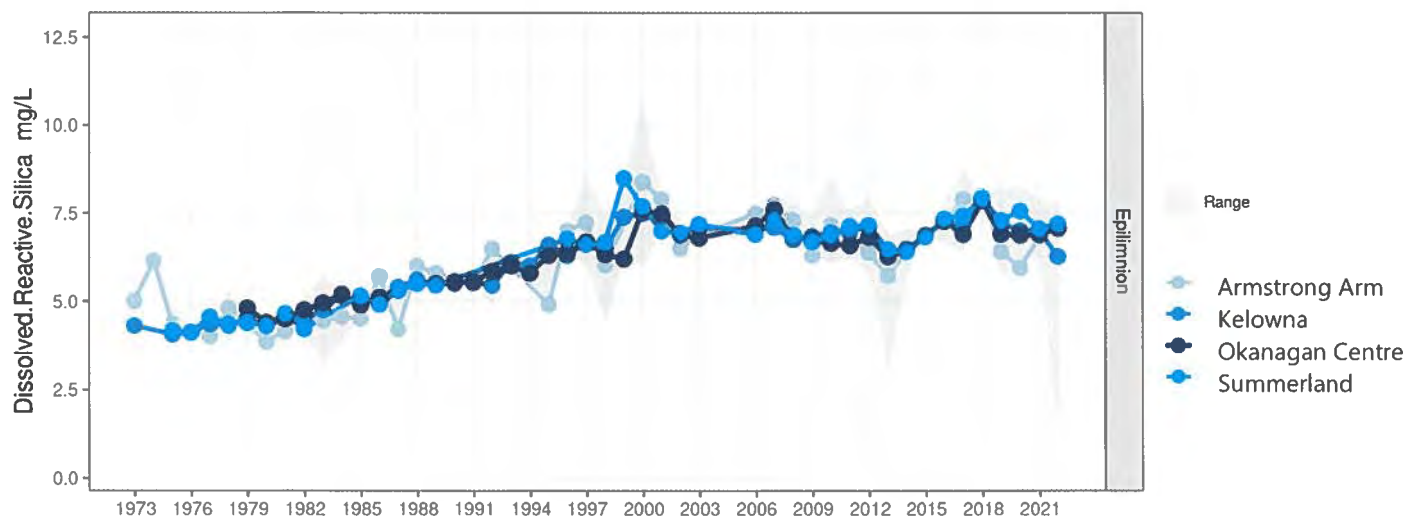


Figure 9: Annual average silica concentration in Okanagan Lake at each sampling site by year with trends highlighted, 1973-2022

2.2.3 Nitrogen and Phosphorus

Nitrogen and phosphorus are the most important nutrients in most aquatic environments. Nutrient limitation occurs when an essential element (typically nitrogen or phosphorus) is in relatively short supply. Algae production is limited by the availability of that nutrient despite potential abundance of other nutrients. In the Okanagan, phosphorus is the main limiting nutrient while dissolved inorganic nitrogen also limits productivity during the summer. Their concentrations are directly linked to the amount of algae that the lake produces (Nordin, 2005).

Nitrogen

Total nitrogen (TN) averaged 0.248 ± 0.041 mg/L as N in the epilimnion of Okanagan Lake during 2022. The objective for Okanagan Lake was set as a spring value (March sample date¹) of 0.230 mg/L for the main basins and 0.250 mg/L for the Armstrong Arm. The objective was exceeded at all sites during 2022 as it has in most years (Table 7). TN increased in the hypolimnion at all sites except Summerland from 2011-2022 (Mann-Kendall, $p \leq 0.02$; Table 7). Average TN values were comparable to those found in the literature for Okanagan Lake (0.17-0.23 mg/L as N; Andrusak et al., 2000).

¹ The Armstrong Arm sample is typically collected in early April because of ice-cover in that part of the lake

Table 7: Total nitrogen in mg/L as N concentration at Okanagan Lake sampling sites, 2022

Site	Depth	Objective	Trend	Avg	SD	Max	Min
Summerland	<10m	0.230	-	0.224	0.030	0.265	0.184
	>20m		-	0.246	0.014	0.265	0.225
Kelowna	<10m	0.230	-	0.227	0.031	0.271	0.187
	>20m		↑	0.251	0.035	0.299	0.186
Ok Centre	<10m	0.230	-	0.225	0.020	0.250	0.200
	>20m		↑	0.245	0.016	0.277	0.228
Armstrong Arm	<10m	0.250	-	0.253	0.017	0.276	0.232
	>20m		↑	0.323	0.061	0.4	0.26

Note: Red shaded cells indicate that the Spring value exceeded the objective while green indicates that the value met the objective. Statistical significance of general trends derived from all data for a site may disappear when depths are split apart due to smaller sample size

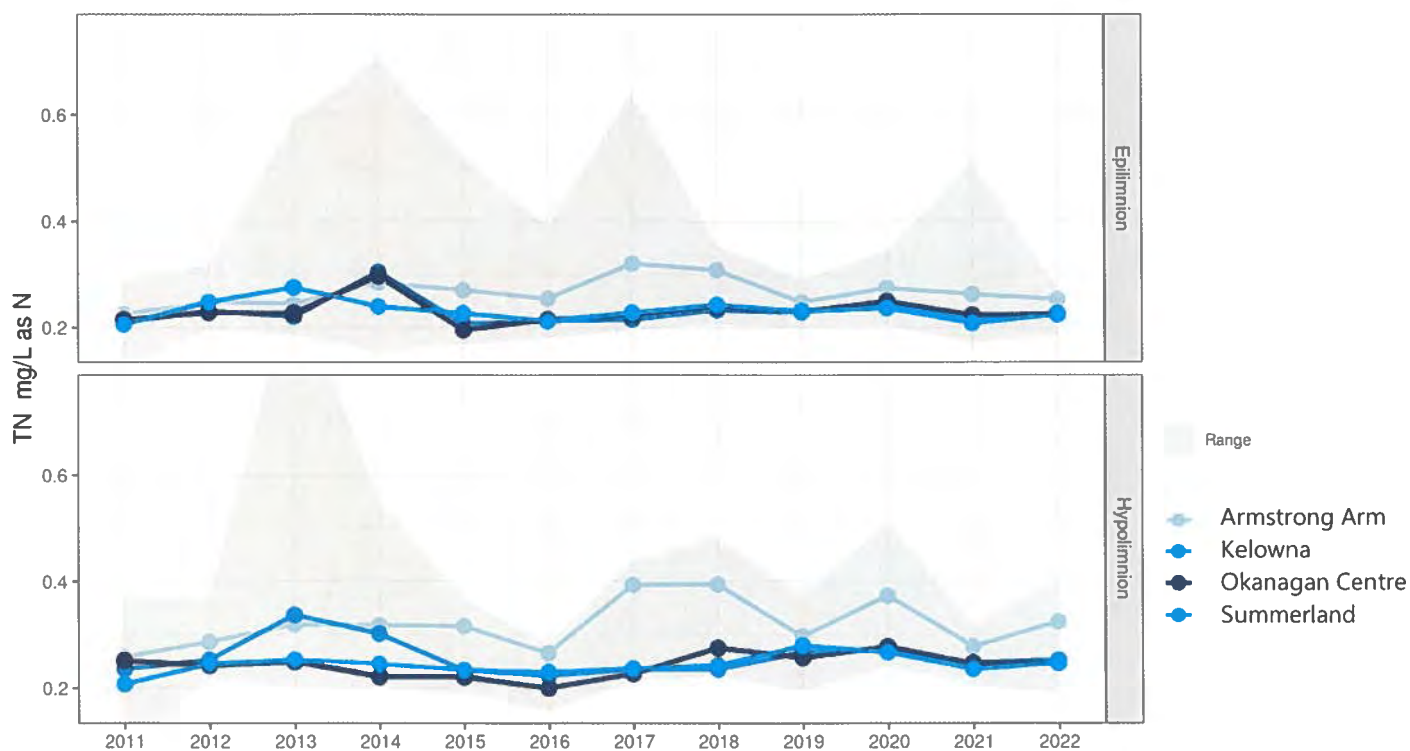


Figure 10: Annual average total nitrogen in Okanagan Lake, 2011-2022

Hypolimnetic nitrate increased at all sites from 2011-2022 (Mann-Kendall, $p < 0.001$; Figure 11). Analysis of the entire Okanagan Lake water chemistry database indicates that this trend has been ongoing for decades (1973-2022 dataset; Mann-Kendall, $p < 0.001$; Figure 11). This suggests a connection to human activities in the region because the trend has continued through several wet-dry climate cycles. There is also recent research noting that changes in nitrate concentration are a marker of climate change (Mas-Pla & Menció, 2019; Stuart et al., 2011). Layered on top of this trend are short-term increases in nitrate during and after wet years such as 2017-2018, 2020, and 2022.

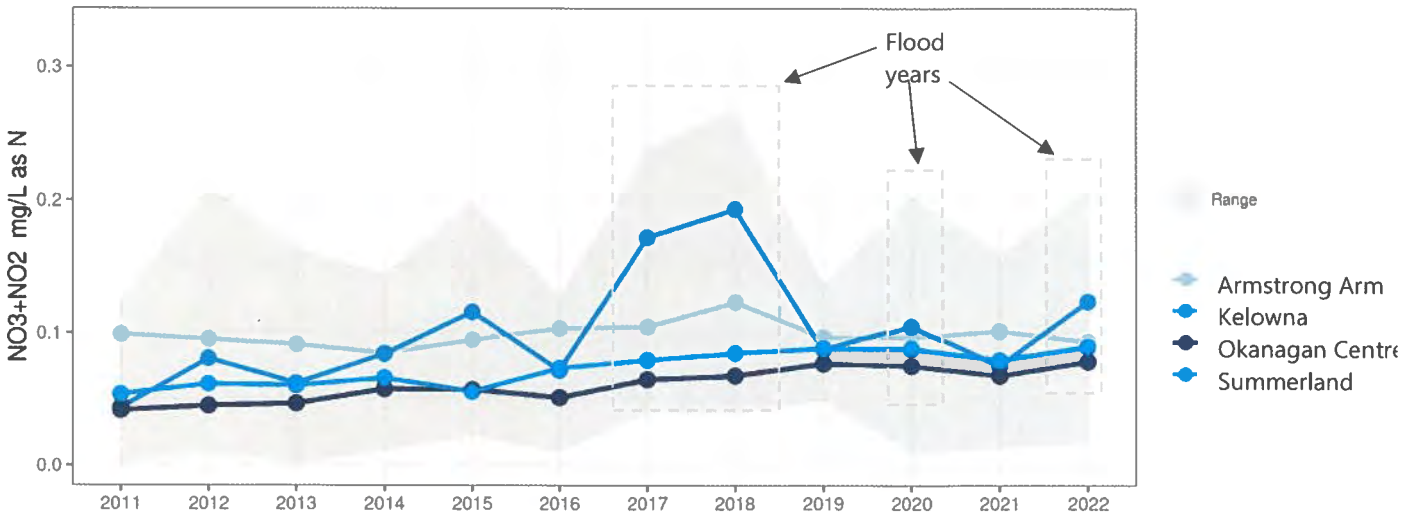


Figure 11: Annual average nitrite (NO₂) + nitrate (NO₃) in mg/L as N in the deep water of Okanagan Lake, 2011-2022

Nitrate is rapidly consumed by algae in the epilimnion each spring and thermal stratification prevents replenishment from the deeper water during the summer (Figure 11). Nitrate increased dramatically each summer in the hypolimnion of the Armstrong Arm because of chemistry associated with the low-DO conditions (Figure 12). For example, nitrate increased from <0.0032 mg/L as N in the epilimnion to 0.208 mg/L as N in the hypolimnion by Sept 2022.

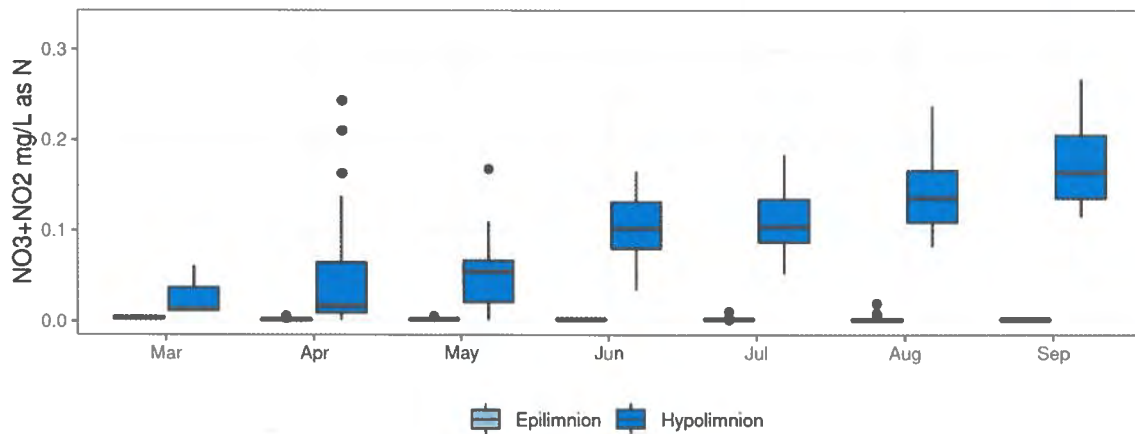


Figure 12: Nitrate + nitrite in Okanagan Lake at Armstrong Arm by month illustrating seasonal accumulation of nitrate in low oxygen hypolimnion, 2011-2022

Phosphorus

Total phosphorus (TP) measures all forms of phosphorus including those that may not be bioavailable. Total phosphorus averaged 0.009 ± 0.008 mg/L as P across Okanagan Lake during 2022 (Table 8). The TP objective for Okanagan Lake applies to the maximum phosphorus concentration at the spring overturn (Nordin, 2005; taken as March²). The objectives range from 0.007 mg/L in the south basin to 0.010 mg/L in the Armstrong Arm.

The TP objective was exceeded in the epilimnion and hypolimnion of Armstrong Arm in 2022, as it was in most years from 2011-2022 (Table 8). Increasing trends in TP occurred at all sites from 2011-2022 (Mann-Kendall, $p \leq 0.02$; Table 8, Figure 13). This trend was driven, in part, by large increases in TP during wet years such as 2012-2013 and 2017-2018, 2020, and 2022. TP includes phosphorus associated with suspended sediment carried into the lake and it increases in Okanagan Lake during wet years and decreases during dry years (Figure 13).

Table 8: Total phosphorus (mg/L as P) at Okanagan Lake sampling sites during 2022

Site	Depth	Objective	Trend	Avg	SD	Max	Min
Summerland	<10m	0.007	-	0.006	0.001	0.007	0.004
	>20m		↑	0.004	0.001	0.006	0.003
Kelowna	<10m	0.008	↑	0.007	0.003	0.011	0.003
	>20m		↑	0.008	0.007	0.024	0.003
Ok Centre	<10m	0.008	↑	0.009	0.006	0.022	0.004
	>20m		↑	0.006	0.001	0.008	0.005
Armstrong Arm	<10m	0.010	↑	0.011	0.004	0.016	0.006
	>20m		↑	0.027	0.012	0.045	0.016

Note: Red shaded cells indicate that spring overturn value exceeded the objective while green shaded cells met the objective during 2022. Trends are based upon 2011-2022 data only

² The Armstrong Arm spring sample is typically collected in early April because of ice-cover in March

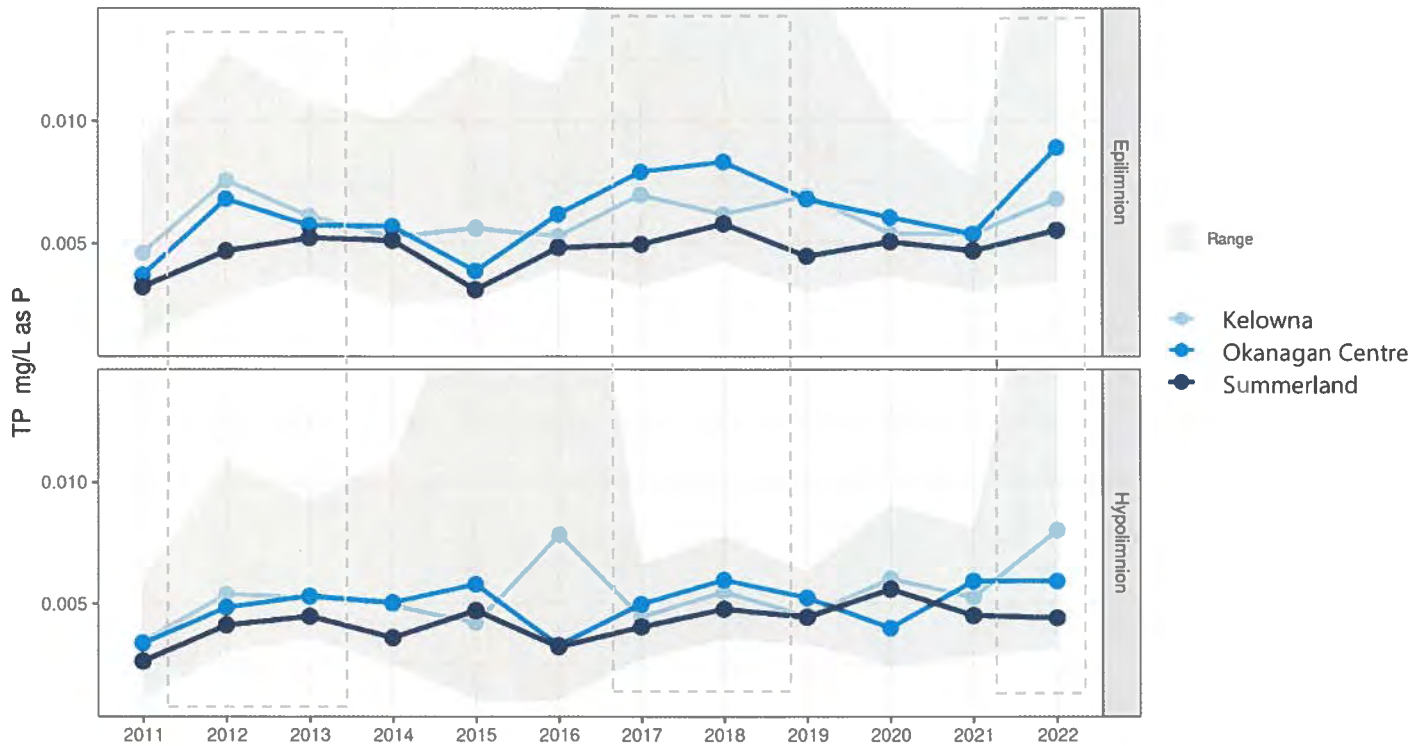


Figure 13: Annual average total phosphorus in Okanagan Lake at the three major basin sampling sites by year from 2011-2022

Notes: Grey boxes indicate wet years, decreasing trend from 1973-2005 and increasing trend from 2005-2022

TP experienced minor seasonal variation with a slight increase during freshet in some years at Summerland, Kelowna and Okanagan Centre while there was dramatic variation in the Armstrong Arm over the course of each growing season. TP increased in the hypolimnion during the summer, possibly from phosphorus released from the sediment under low-oxygen conditions while algae productivity reduced surface concentrations over the growing season (Figure 14).

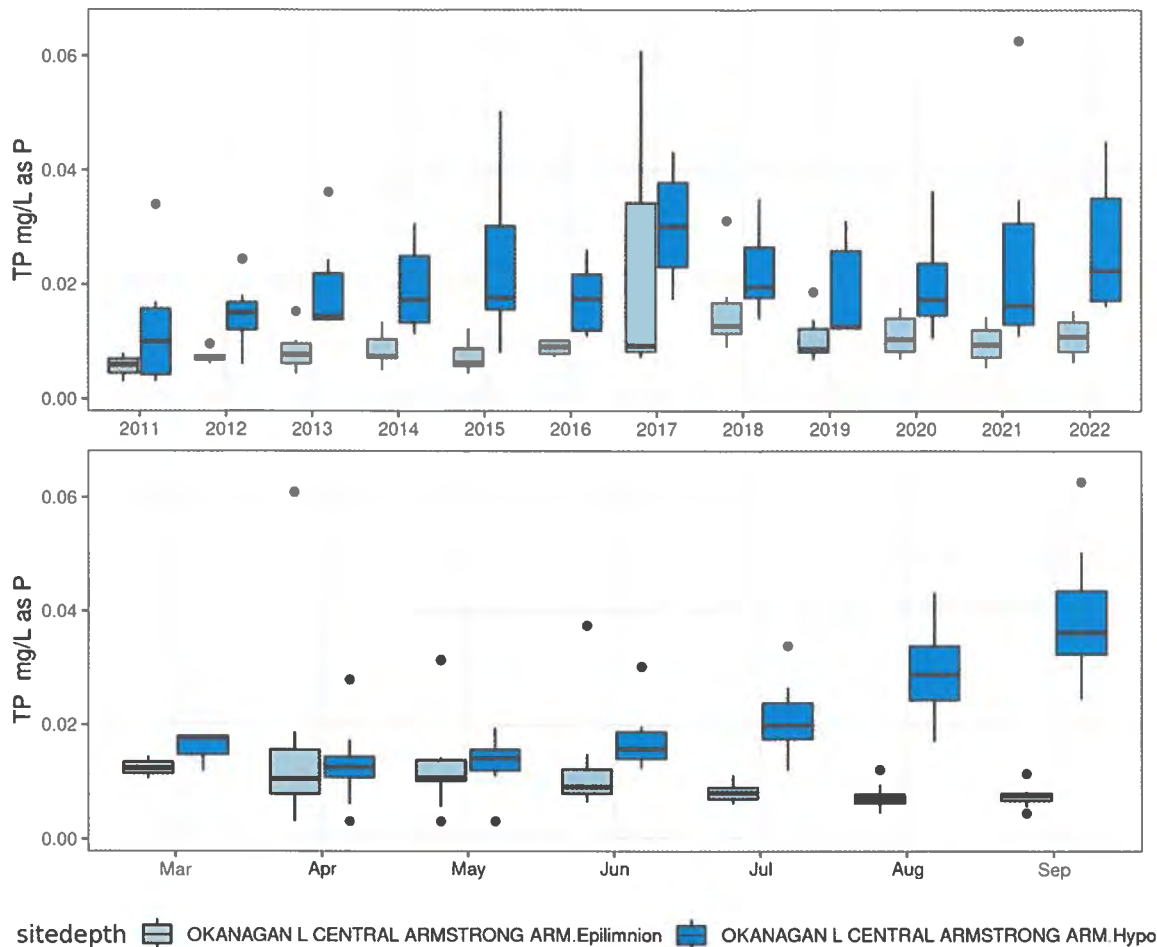


Figure 14: Total phosphorus in the Armstrong Arm, 2011-2022

Note: small reduction in epilimnetic TP over the growing season but it does not drop below detection as nitrate does

Dissolved phosphorus (TDP) measures the more bioavailable forms of phosphorus and is a good indicator of potential impacts to biota. TDP in the epilimnion of the Armstrong Arm increased from 2011-2015 but was stable over the past 5 years while the hypolimnion continued to increase (Mann-Kendall for 2011-2021 in the hypolimnion, $p < 0.001$). TDP was stable at Kelowna and Okanagan Centre but decreased at Summerland from 2011-2021 (Mann-Kendall, $p \leq 0.02$). Despite the stable long-term trend, TDP was noticeably higher in the Okanagan Centre epilimnion samples following the White Rock Lake Fire (Figure 15). Ortho-phosphate measures only the soluble reactive phosphorus fraction of the TDP and there were no significant trends in ortho-phosphate data at any of the sites from 2011-2022 with 79% of samples from the major basin sample sites having undetectable concentrations during 2022. Anoxic conditions in the Armstrong Arm increase hypolimnetic orthophosphate each summer.

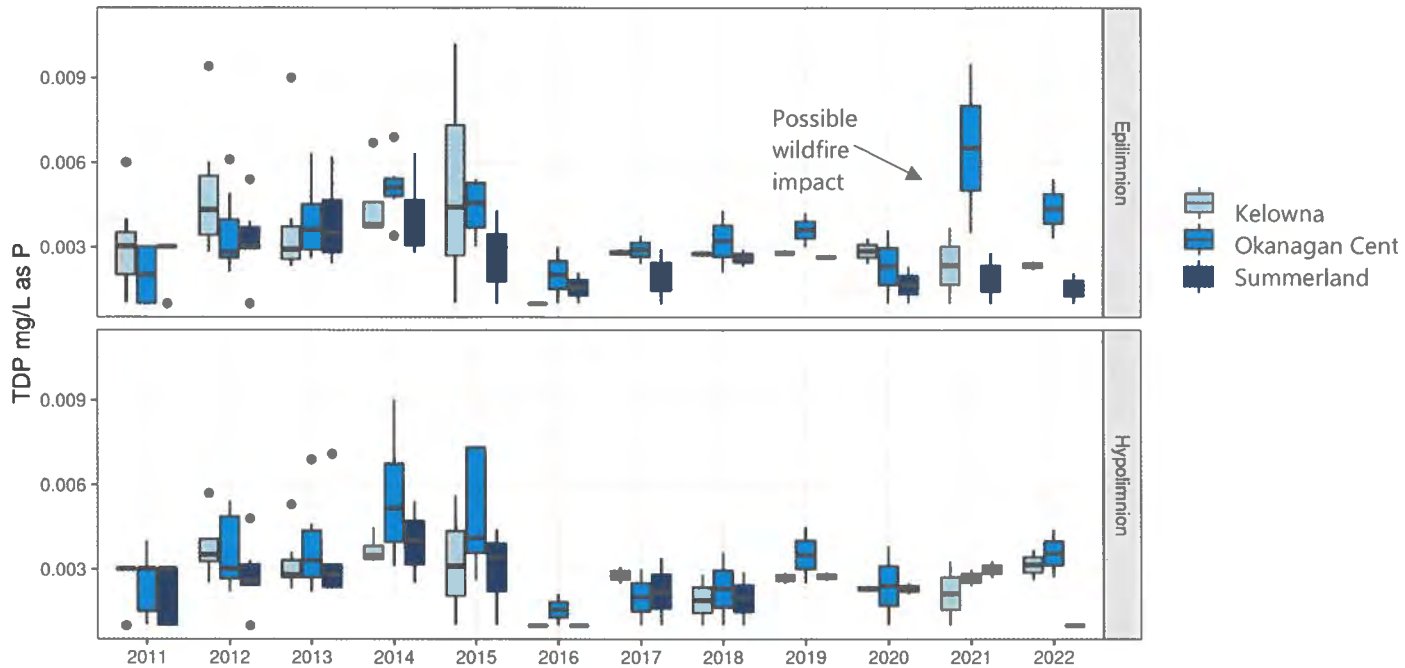


Figure 15: Annual average dissolved phosphorus in Okanagan Lake illustrating declining long-term trend at Okanagan Centre, Kelowna, and Summerland from 2011-2022

N:P Ratio

The ratio of nitrogen to phosphorus is a key factor in determining which types of phytoplankton will proliferate. Many species of cyanobacteria can fix atmospheric nitrogen and are therefore limited primarily by available phosphorus. These algae are more likely to bloom when phosphorus is abundant relative to nitrogen. The Okanagan Lake objective for the spring ratio of total nitrogen to total phosphorus is >25:1 in March samples. The objective was met at Summerland, Kelowna, and Okanagan Centre during 2022 while the Armstrong Arm had higher phosphorus concentrations than the rest of Okanagan Lake and did not meet the objective in 2022 (Figure 13, Table 9). The TN:TP ratio decreased in the at all sites from 2011-2022 (Mann-Kendall, $p < 0.02$) (Figure 13). The declining TN:TP trend is related to corresponding increasing trends in TP in the hypolimnion of Okanagan Lake at Kelowna and Armstrong Arm, a trend that is related to the recent series of flood years (2017-2018, 2020, and 2022; Table 8).

Table 9: Ratio of average TN to average TP during spring at Okanagan Lake sampling locations, 2011-2022

Site	Depth	TN	TP	2021 Ratio	Objective	Trend
Summerland	<10m	0.224	0.0055	45:1	>25:1	↓
	>20m	0.246	0.0044	52:1	>25:1	-
Kelowna	<10m	0.227	0.0068	43:1	>25:1	-
	>20m	0.251	0.0080	49:1	>25:1	↓
Ok Centre	<10m	0.225	0.0089	34:1	>25:1	↓
	>20m	0.245	0.0059	32:1	>25:1	↓
Armstrong Arm	<10m	0.253	0.0109	18:1	>25:1	↓
	>20m	0.323	0.0268	18:1	>25:1	↓

Note: red shaded cells indicate that the value did not meet the objective while green shaded cells met the objective during 2022

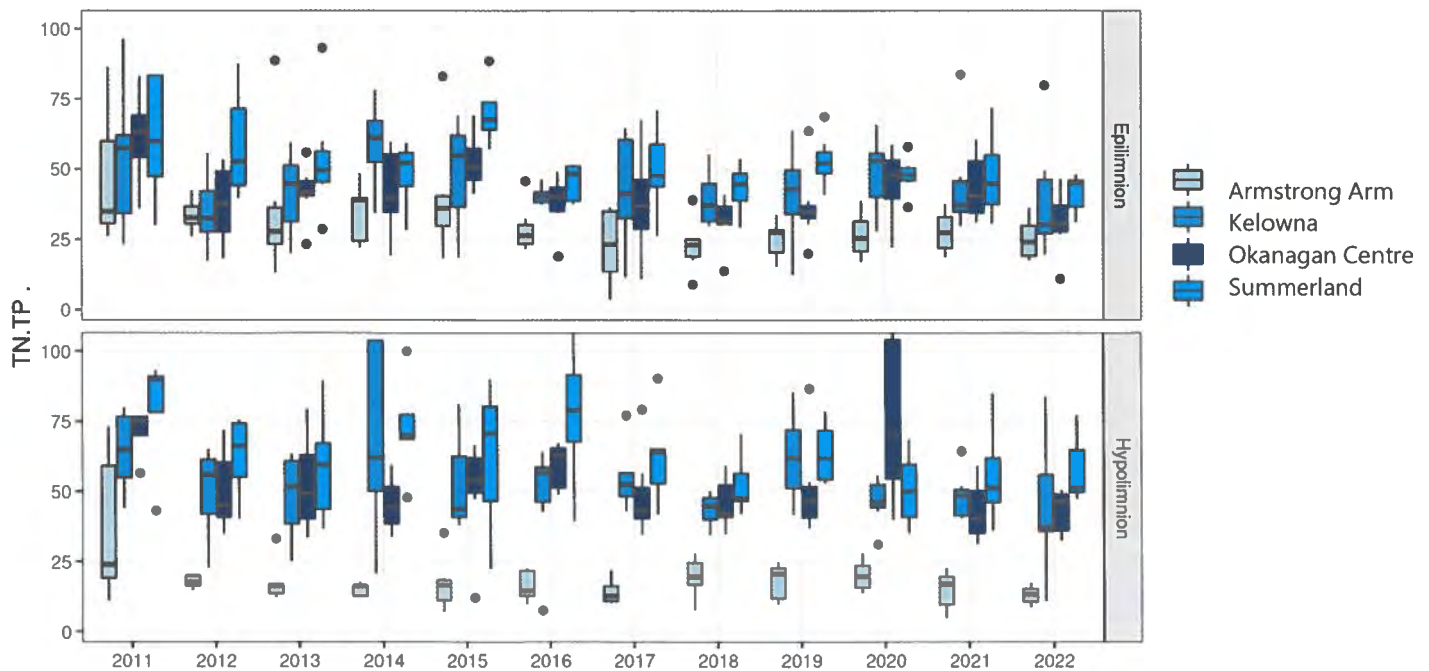


Figure 16: Nitrogen to phosphorus ratio at Okanagan Lake sampling sites 2011-2022

2.3 Biology

2.3.1 Phytoplankton

The Armstrong Arm of Okanagan Lake is shallower and has the potential to produce more phytoplankton and zooplankton than the deep basins of Okanagan Lake regardless of human activity. Phytoplankton and zooplankton samples were taken from all four sites were analyzed during 2022. Biomass analysis and taxonomic identification were performed on the taxonomy samples while chlorophyll-a concentrations were monitored as a productivity metric for phytoplankton abundance.

Chlorophyll-a

Chlorophyll-a (chl-a) is a photosynthetic pigment found in most freshwater algae species. As expected, chl-a followed an inverse trend to Secchi depth (Figure 6, Figure 17). Chl-a was lowest in the late winter and peaked in April-May during the increased spring algal growth before decreasing through the summer. During 2022, chl-a concentrations met the objectives at all sites (Table 10). Spring chl-a concentrations were high with a maximum of 5.5 µg/L in the Armstrong Arm (Table 10). Average chl-a concentrations in the Armstrong Arm have declined significantly since 2017 and averaged the lowest since 2014 (Mann-Kendall, $p=0.04$), an encouraging result after the dramatic increase from the 2017-2018 flooding (Figure 17). Chl-a concentration at the three major basin sites was stable from 2011-2016 and then again from 2018-2022 but there was a large increase during 2017-2018 because of the flooding during those years. While not yet statistically significant, there was a small apparent decrease in annual averages from 2017-2022 at Okanagan Centre (Figure 17).

In most years, including 2022, there was a north to south decreasing trend in the chlorophyll-a data with the Armstrong Arm having the highest and Summerland having lowest average concentrations (Table 10).

Table 10: Chlorophyll-a in µg/L at Okanagan Lake sampling sites, 2011-2022

Site	Objective	Trend	Average	StdDev	Max	Min
Summerland	4	-	1.99	0.96	3.28	0.82
Kelowna	4.5	↑	2.33	1.29	4.59	1.03
Ok Centre	4.5	↑	2.46	1.34	4.87	1.34
Armstrong Arm	5	↑	3.62	1.06	5.53	2.37

Note: Green shading indicates met objective during 2022

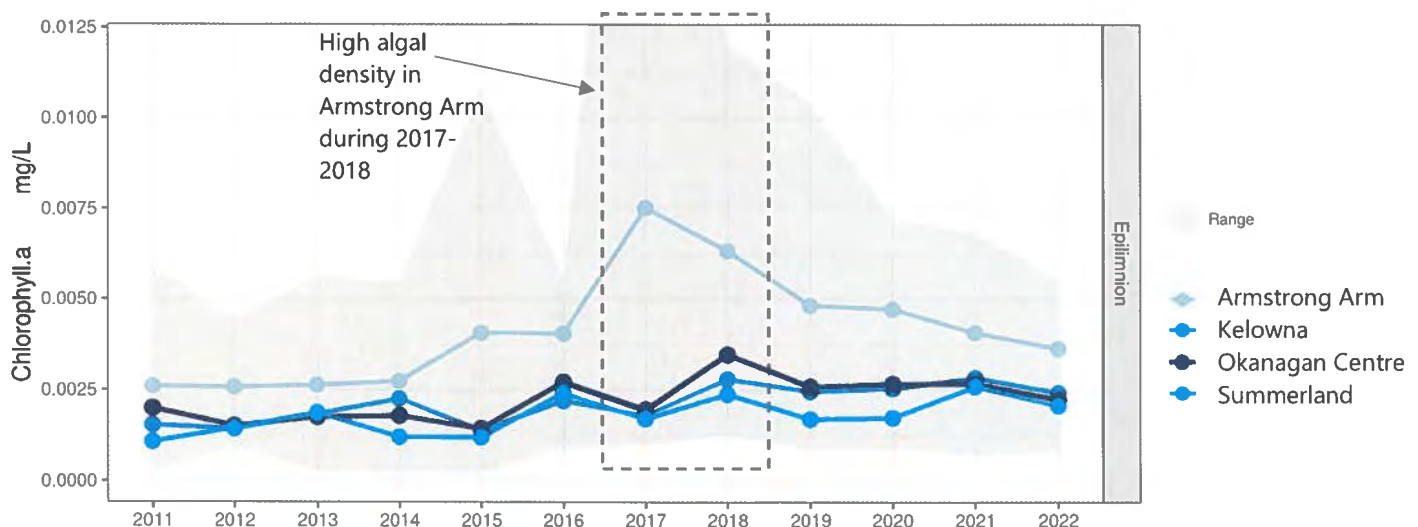


Figure 17: Annual chlorophyll-a concentration at the four Okanagan Lake sampling sites, 2011-2022

Phytoplankton Biovolume

Phytoplankton biovolume samples were collected as one litre composites from 1-10 m and the biovolumes were determined taxonomically. From 2011-2014, biomass was determined using ash-free dry mass (AFDM). It is not possible to directly compare the results from the two methodologies and only the 2015-2022 results are considered here.

The objective is that the growing season average should be <0.75 µL/L (Table 11). Samples from all sites met the objective during 2022.

Phytoplankton biovolume increased significantly from 2015-2021 at Summerland and at Kelowna (MK tests, $p=0.001$) - a trend that matches chlorophyll-a and is related to increased nutrient delivery from the recent large freshets (Figure 18). Productivity was lower during 2022 than 2021. A one-year lag has been observed between wet years and elevated productivity in Okanagan Lake and this effect helps explain why 2019 and 2021 production was very high despite the much smaller freshets (Figure 18). This may lead to higher productivity in 2023 because of the large 2022 freshet.

Table 11: Phytoplankton biovolume in µL/L at Okanagan Lake sampling sites, 2022

Site	Objective	Trend	Average	StdDev	Max	Min
Summerland	<0.75	↑	0.164	0.113	0.353	0.016
Kelowna	<0.75	↑	0.229	0.165	0.495	0.008
Ok Centre	<0.75	-	0.273	0.127	0.499	0.107
Armstrong Arm	<0.75	-	0.269	0.254	0.763	0.061

Notes: Green shading = met objective while red shading = did not meet objective.

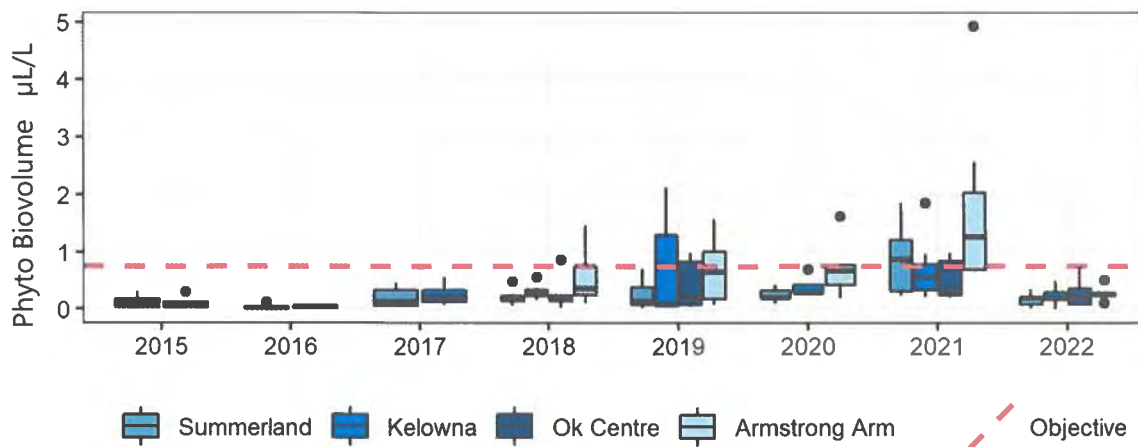


Figure 18: Phytoplankton Biovolume at Summerland and Kelowna, 2015-2022

Phytoplankton Taxonomy

Algae samples were identified to the species level and then grouped into broad algae types for analysis in this report. Diatoms tend to proliferate in the spring and their numbers decrease through the summer. Cyanobacteria were always numerous throughout the growing season in Okanagan Lake, but typically peaked in the late summer (Figure 19, Table 12). Algae counts were

highest in the Armstrong Arm throughout the year but all sites experienced high densities of cyanobacteria during 2022 (Figure 20). The Armstrong Arm experienced particularly high cyanobacteria densities during the late summer (maximum of 42,526 cells/mL during April) led by *Planktolyngbya sp.*, *Anacystis sp.*, and *Aphanizomenon sp.*, all potentially toxic species. Very high cyanobacteria densities in the Armstrong Arm may be a marker for nutrients delivered to Okanagan Lake from the areas burned in the White Rock Lake wildfire.

Table 12: Average phytoplankton counts by major algae groups in cells/mL, 2022

Algae Type	2022 Averages			
	Summerland	Kelowna	Okanagan Centre	Armstrong Arm
Diatoms	440	286	392	323
Greens	139	67	139	541
Yellow-Brown	270	437	565	526
Cyanobacteria	5916	4900	6659	16600
Dinoflagellates	0	12	16	61
Other.Flagellates	6727	5711	7781	18044
Total Algae	440	286	392	323



Figure 19: Taxonomic breakdown of algae by major types during 2022

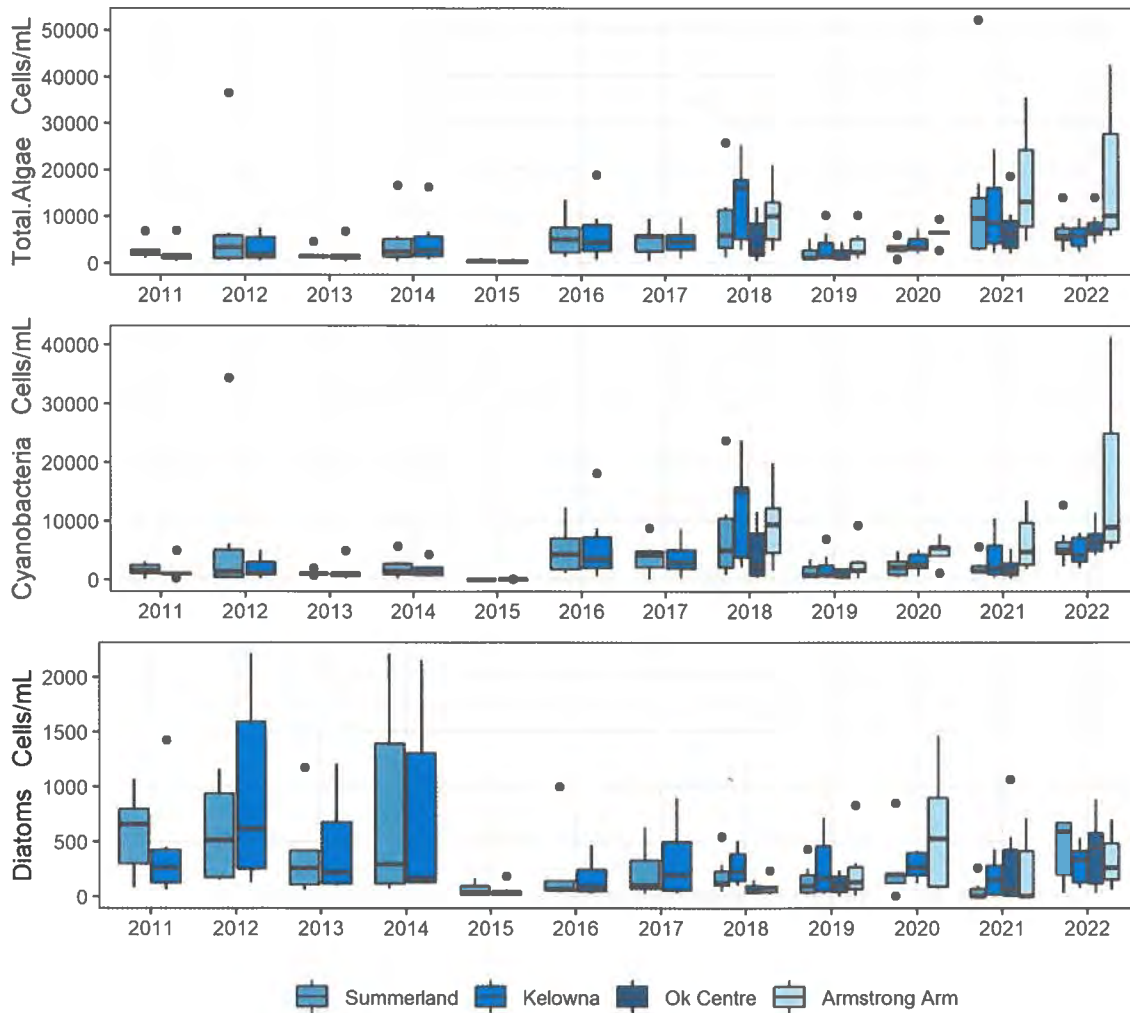


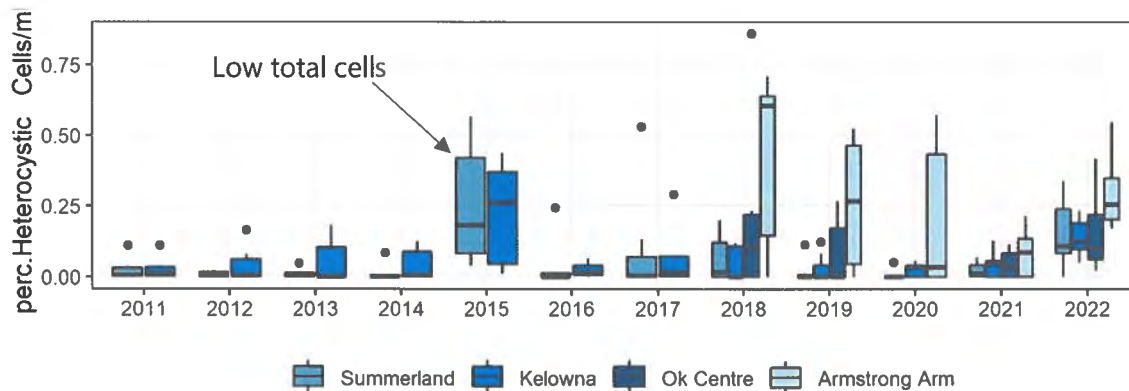
Figure 20: Total algae, cyanobacteria, and diatom counts in Okanagan Lake, 2011-2022

The Okanagan Lake objective for phytoplankton taxonomy states that no more than 5% of total cell counts should be heterocystous cyanobacteria in a given sample. These and other cyanobacteria can produce toxins that are harmful to human health when they are present in high concentrations. The heterocystous cyanobacteria objective was exceeded during most years including 2022 (93% of samples from 2022 exceeded this objective; Table 13). While problematic, the cyanobacteria densities observed at during 2022 were not high enough to cause acute health concerns at any of the sites. While densities were elevated during 2022, no significant year-over-year trends were detected in the heterocystous cyanobacteria counts from 2011-2022.

Table 13: Percent of total algae counts that were heterocystous cyanobacteria from 2022

Site	Objective	Trend	# Exceeding	Average	StdDev	Max	Min
Summerland	<5%	-	6/7	15.6%	12%	34%	0%
Kelowna	<5%	-	7/7	14.0%	7%	23%	5%
Ok Centre	<5%	-	6/7	15.7%	14%	42%	2%
Armstrong Arm	<5%	-	6/7	29.9%	14%	55%	17%

Note: Yellow shading indicates that the site did not meet the objective in some but not all samples


Figure 21: Percent of total algae counts that were heterocystous cyanobacteria, 2011-2022

2.3.2 Zooplankton

Biomass

Zooplankton biomass samples were obtained using a 150 µm net lowered to 45 m and raised vertically at a rate of approximately 0.5 m/second. The 150 µm net mesh size lets most phytoplankton pass through, while collecting most zooplankton. Samples were identified taxonomically and the biomass was calculated from the abundance.

The Okanagan Lake objective is a growing season average of >50 µg/L (Nordin, 2005). This objective was met at Okanagan Centre during 2022 with all sites near the 2015-2022 average (Table 14, Figure 22). While biomass during 2021 was unusually high, skewing trend results, there were no significant trends were detected in zooplankton biomass from 2015-2022 beyond the interannual variation. The cause of the elevated 2021 zooplankton density remains uncertain and was not repeated during 2022.

Table 14: Zooplankton biomass in µg/L at Okanagan Lake sampling sites, 2022

Site	Objective	Trend	Average	StdDev	Max	Min
Summerland	>50 µ/L	-	18.8	16.8	37.9	3.8
Kelowna		-	37.9	19.0	65.7	16.4
Okanagan Centre		-	58.1	16.1	75.7	32.4
Armstrong Arm		-	39.8	23.4	74.2	9.5

Note: Data includes only Apr-Aug results, Mar and Sep results not released by lab at time of writing.

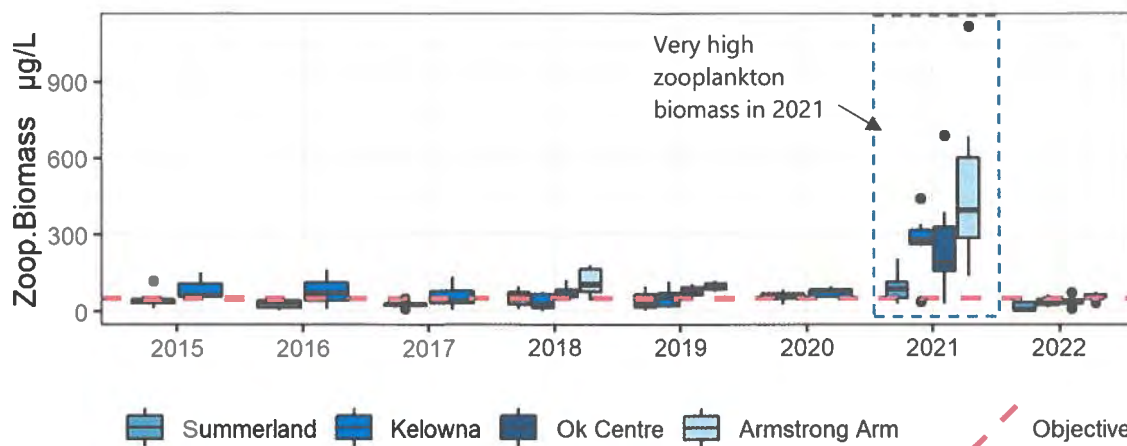


Figure 22: Zooplankton Biomass at the Kelowna and Summerland sampling locations by year, 2015-2022

Notes: There was a change in lab methodology in 2015, preventing comparison with previous years' data; 2022 data includes only Apr-Aug results, Mar and Sep results not released by lab at time of writing.

Zooplankton Taxonomy

Zooplankton samples were taxonomically identified to the species level and then grouped for analysis in this report. Copepods were the most numerous during every year of the study and averaged between 76% at Armstrong Arm and 94% at Summerland in 2022 (Table 15).

The objective for Okanagan Lake is a minimum of 5% of the sample counts be cladocerans. Approximately half of the samples met this objective at Okanagan Centre, an improvement compared to 2021 while Armstrong Arm, Kelowna, and Summerland had poorer objective achievement during 2022.

The average zooplankton abundances were consistent with values found in the literature (Andrusak et al., 2000; Rae and Andrusak, 2006; Andrusak et al., 2006). There was a decreasing trend in total zooplankton abundance in the Armstrong Arm from 2018-2022 (Table 15).

Table 15: Growing Season average percent cladocerans zooplankton, 2022

Site	Objective	# of samples exceeding	Trend	Average	StdDev	Max	Min
Summerland		1/5	-	2.4%	3.5%	7.5%	0.0%
Kelowna	>5% /	1/5	-	3.3%	4.6%	11.1%	0.3%
Okanagan Centre	sample	3/5	-	6.3%	6.2%	14.9%	0.1%
Armstrong Arm		2/5	↓	7.9%	8.3%	18.9%	0.7%

Notes: Yellow shading = met objective in approximately half of samples, red shading = rarely met objective; Data includes only Apr-Aug results, Mar and Sep results not released by lab at time of writing.

3.0 Conclusions

This report summarizes the 2022 findings within the context of the 2011-2022 dataset. This report also extracts trends from the data accumulated by the Okanagan Lake Collaborative Sampling program to date (2011-2022) and compares those to the long-term historical database (1973-2022). The effects of Climate Change are already being felt in the Okanagan in recent years with repeated swings between large freshets and intensely dry summers; Fall was unusually hot and dry throughout the southern interior during 2022. While the results to date indicate that Okanagan Lake exhibits evidence of human activities, the Armstrong Arm is most impacted by continued human activities and watershed degradation, a situation likely to get worse because of the White Rock Lake wildfire. This site had the most exceedances and the most problematic trends, that is, trends moving parameters towards greater exceedances and poorer water quality.

Dissolved Oxygen Each year the temperature of Okanagan Lake increases seasonally in the surface waters until the lake becomes thermally stratified, usually in May. This physical dynamic isolates the deep water from the atmosphere and leads to oxygen depletion below the thermocline in Armstrong Arm. The Armstrong Arm therefore failed to meet the dissolved oxygen objective in 2022, as it has in each year of this study.

Nutrients

Silica analysis of water samples revealed a long period of stable conditions over the past 20 years.

Total nitrogen increased in the Armstrong Arm from 2011-2022 while increasing trends were noted in the hypolimnion at Kelowna. Total nitrogen exceeded the water quality objectives at all sites during 2022. Nitrate increased significantly in the Armstrong Arm and in the hypolimnion at all sites from 2011-2022. This is part of a decades long increasing trend in hypolimnetic nitrate in Okanagan Lake that has continued through multiple wet-dry climate cycles and is likely caused by increasing human impacts within the Okanagan region.

Phosphorus concentrations were highest in the Armstrong Arm where they exceeded the objective during 2022. There were increasing trends in TP from 2011-2022 at all four sites driven in part by increases during wet years such as 2017-2018. The Armstrong Arm is more heavily impacted by human activities and has numerous phosphorus sources such as nutrient enrichment of the Deep Creek watershed from over 100 years of agriculture, and the rise may become exacerbated by nutrients shed from the areas burned during the 2021 White Rock Lake fire. Dissolved phosphorus (TDP) and ortho-P represent the more bioavailable forms of phosphorus and were stable or declining at Summerland, Kelowna, Okanagan Centre while DP increased at the Armstrong Arm. Samples from the Armstrong Arm exceeded the nitrogen-phosphorus ratio objective in 2022, with a decreasing trend in that ratio from 2011-2022 at all sites.

Phytoplankton Productivity Chlorophyll-a (chl-a) concentrations increased each spring during the annual spring high algal growth period and then decreased over the summer and into the fall. Peak chl-a was moderate at all sites during 2022. Previous research by ENV has

identified a one-year lag between major nutrient inputs and increases in phytoplankton productivity so it was expected that 2022 productivity would be lower after the small 2021 freshet. The chl-a and phytoplankton biovolume objectives were met at all sites during 2022.

The taxonomic data indicated that cyanobacteria numerically dominated the phytoplankton samples in 2022, as in every year studied. Samples from all sites exceeded the <5% heterocystous cyanobacteria objective in at least some samples during 2022 and Kelowna exceeded the objective in all samples.

Zooplankton Productivity Zooplankton biomass was stable from 2015-2022 with an unusually high result during 2021. Zooplankton biomass met the objective of >50 µg/L at at Okanagan Centre during 2022, the only site to do so. Copepods numerically dominated most samples. The water quality objective of >5% of zooplankton as cladocerans was achieved in 1/3 of samples from 2022.

Table 16 to Table 18 summarize the findings of this report for 2011-2022 by pairing trends to objective exceedances. Special focus should be paid to parameters that did not meet the objective and for which the data trended in the adverse direction over the course of the sampling program.

Similar to the 2011-2021 report, the following areas of concern have been identified that may require further investigation on the part of the Ministry:

- Chronically low Secchi depth in the Armstrong Arm
- Increasing nitrate in hypolimnion of Okanagan Lake since 1970s
- Increasing total phosphorus at all sites except Summerland since early 2000s
- Decreasing N:P ratio in the Armstrong Arm
- High densities of potentially toxic cyanobacteria in Armstrong Arm during 2018-2022
- Phosphorus loading to the Armstrong Arm and north basin of Okanagan Lake from the White Rock Lake wildfire

Armstrong Arm frequently exceeds most objectives and is the site most at risk of water quality degradation including harmful algae blooms, poor drinking water quality, anoxic conditions, and further eutrophication. There is also high likelihood of further degradation as a consequence of the White Rock Lake wildfire. It must be acknowledged that Armstrong Arm is shallower and therefore would be more productive than the deep basins of Okanagan Lake regardless of human activity. However, human activities in the watershed have impacted this northern-most basin of the lake.

The period of 2016-2022 was marked by multiple extreme weather events that have left a distinct mark on the water quality record of Okanagan Lake. Climate Change and is expected to increase the frequency and intensity of extreme weather events in the future. Climate Change also compounds the loss of resilience in Okanagan watersheds leading to greater water quality changes from those extreme weather events.

Table 16: Okanagan Lake Water Quality Objectives

Objectives (Nordin, 2005)	Summerland	Kelowna	Ok Centre	Armstrong Arm
Secchi Depth (growing season average)	7m	6m	6m	5m
Dissolved Oxygen (minimum in bottom waters)	-	-	-	>5 mg/L
TP (mg/L as P) (maximum at spring overturn)	0.007	0.008	0.008	0.01
Chlorophyll-a (µg/L) (maximum seasonal average)	<4.5	<4.5	<4	<5
TN (mg/L as N) (maximum at spring overturn)	0.230	0.230	0.230	0.250
N:P Ratio (spring weighted ratio)	>25:1	>25:1	>25:1	>25:1
Algae Taxonomy (% heterocystous cyanobacteria)	<5%	<5%	<5%	<5%
Algae Biomass (µL/L) (growing season average)	<0.75	<0.75	<0.75	<0.75
Zooplankton Biomass (µg/L) (growing season average)	>50	>50	>50	>50
Zooplankton Taxonomy (% cladocerans)	>5%	>5%	>5%	>5%

Table 17: Attainment of Okanagan Lake water quality objectives compared to growing season averages during 2022

Objective	Summerland	Kelowna	Ok Centre	Armstrong Arm
Secchi Depth	6.4	6.4	7	3.3
Dissolved Oxygen	7.96	8.25	8.20	1.84
TP (mg/L) 0-10m:	0.006	0.007	0.009	0.011
20-45m:	0.004	0.008	0.006	0.027
Chlorophyll-a (µg/L)	1.99	2.33	2.46	3.62
TN (mg/L) 0-10m:	0.224	0.227	0.225	0.253
20-45m:	0.246	0.251	0.245	0.323
N:P Ratio 0-10m:	45:1	43:1	34:1	18:1
20-45m:	52:1	49:1	32:1	18:1
Algae Taxonomy (% heterocystous cyanobacteria)	15.6%	14.0%	15.7%	29.9%
Algae Biovolume (µL/L)	0.164	0.229	0.273	0.269
Zooplankton Biomass (µg/L)	18.8	37.9	58.1	39.8
Zooplankton Taxonomy (% cladocerans)	2.4%	3.3%	6.3%	7.9%

Legend:

Achieved objective	Achieve objective in some but not all samples	Did not achieve objective
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Table 18: Summary of trends (2011-2022) and the water quality objectives for Okanagan Lake collaborative sampling program during 2022

Objective	Summerland	Kelowna	Ok Centre	Armstrong Arm
Secchi Depth	-	-	-	-
Dissolved Oxygen	-	-	-	-
TP (mg/L) 0:10m:	↑	↑	↑	↑
Chlorophyll-a (µg/L)	-	↑	↑	↑
TN (mg/L) 0-10m:	-	↑	↑	↑
N:P Ratio 0-10m:	↓	↓	↓	↓
Algae Taxonomy (% heterocystous cyanobacteria)	-	-	-	-
Algae Biovolume (µL/L)	↑	↑	-	-
Zooplankton Biomass (µg/L)	-	-	-	-
Zooplankton Taxonomy (% cladocerans)	-	-	-	↓

Legend:

Achieved objective	Achieve objective in some but not all samples	Did not achieve objective
--------------------	---	---------------------------

↑ = Increasing Trend

↓ = Decreasing Trend

- = No Trend

4.0 Recommendations

The following recommendations are made for the program moving forward:

- Continue the monitoring program, unchanged in 2023
- Complete another summary report at the end of the next three-year cycle (next in 2024)
- Continue to analyze taxonomy samples in Okanagan Centre and Armstrong Arm

5.0 References

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Wehr, J. (2002). *Freshwater algae of North America: ecology and classification*. http://books.google.ca/books?hl=en&lr=&id=likPwCt1ioEC&oi=fnd&pg=PP2&dq=Freshwater+Algae+of+North+America:+Ecology+and+Classification+&ots=hL32vxVcVg&sig=wMq94pq1DoQb6FBYBpZWg8_QayU

6.0 Appendices

6.1 Appendix 1: 2011-2022 Sampling Data

All data used in this report can be found in the data transfer file
MoE-Synth-DB.xlsx

6.2 Appendix 2: Statistics and Graphing Overview

Statistical analyses were performed on data to support interpretations made throughout this report. The use of the word ‘significantly’ within this report is understood to signify that the claim being made has stood up under statistical analysis. Unless otherwise stated, all statistical analyses were performed to a confidence of greater than or equal to 95% ($p \leq 0.05$). The \pm symbol indicates plus or minus the standard deviation throughout this report.

Trends were determined through Mann-Kendall linear regression. Mann-Kendall is a non-parametric test for linearity in data. The test produces a Tau-value and a p-value. The Tau value gives the direction of the data and the p-value indicates whether the trend is statistically significant.

Throughout this report the monthly sampling data was grouped seasonally for additional analyses. March, April, and May data were combined as “Spring”; June, July, and August as “Summer”; and September as “Fall”.

Correlations were performed using the Pearson’s Correlation method and all R values reported at Pearson’s Correlation Coefficients.

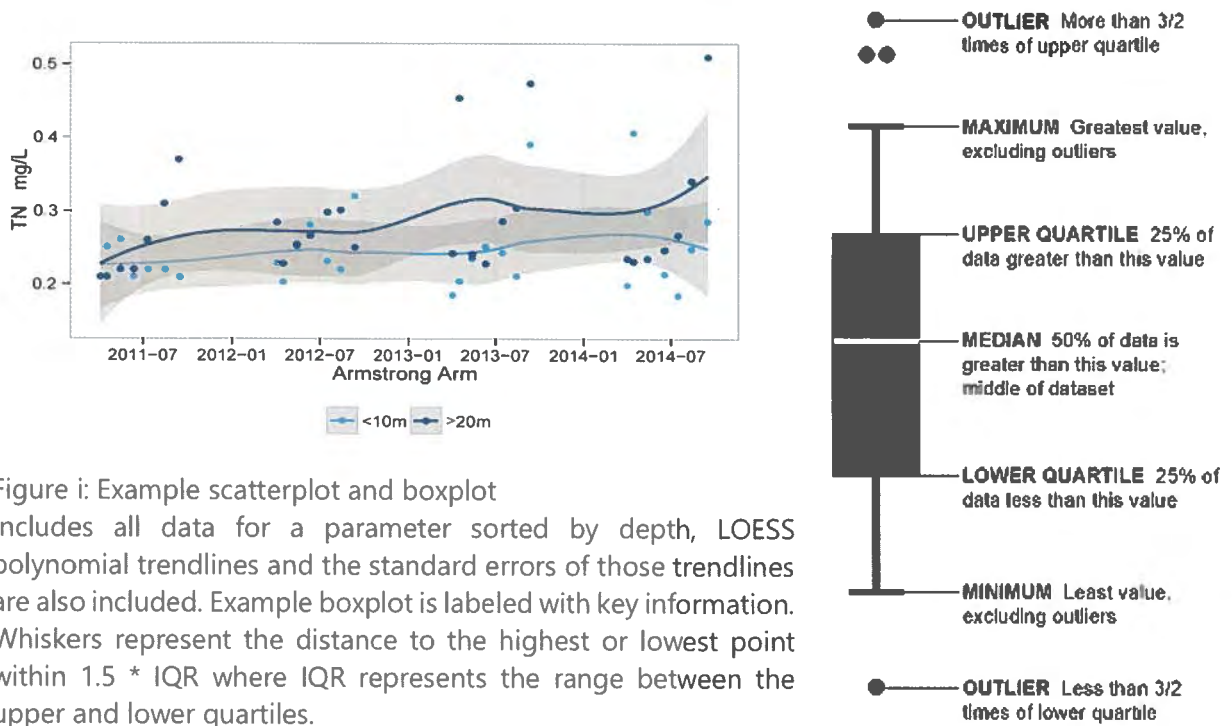
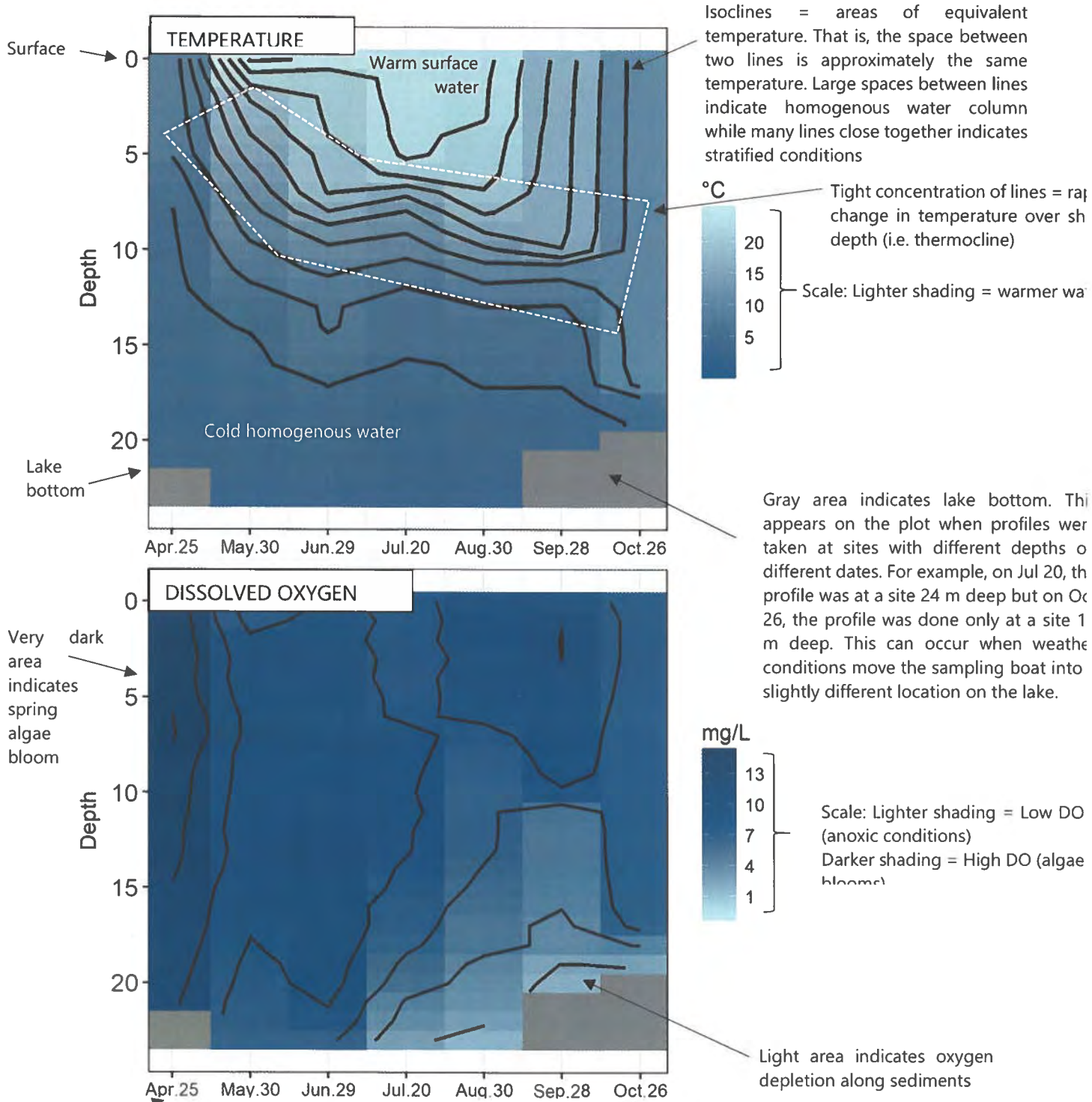


Figure i: Example scatterplot and boxplot
Includes all data for a parameter sorted by depth, LOESS polynomial trendlines and the standard errors of those trendlines are also included. Example boxplot is labeled with key information. Whiskers represent the distance to the highest or lowest point within $1.5 * IQR$ where IQR represents the range between the upper and lower quartiles.

How to Read Temperature/DO Profile Plot

Temperature and dissolved oxygen profiles were routinely collected as part of this study. They are displayed in several locations throughout this report. An example of a temperature graph and a dissolved oxygen graph, descriptions of their key features and how to read them are presented here.



Each vertical column in graph represents conditions within a column of the lake on given date. For example, on Apr 25, DO was very high through entire water column but on Sept 28, there was significant oxygen depletion in the deep water

-----End of Report-----

**OKANAGAN LAKE COLLABORATIVE MONITORING
AGREEMENT
– MEMORANDUM OF UNDERSTANDING**

BETWEEN:

**the Province of British Columbia as Represented by the Ministry of
Environment and Climate Change Strategy
(Hereinafter referred to as “ENV”)**

AND

City of Kelowna

AND

Regional District of Central Okanagan

AND

District of Summerland

(Hereinafter referred to as “Local Governments”)

AND

Okanagan Basin Water Board

(Hereinafter referred to as “OBWB”)

Each a “party” and collectively as “parties”

The Parties of this Collective Monitoring Agreement – Memorandum of Understanding (MOU) as identified in Operation Certificates 12211, 11652, and 13627 agree as follows:

SECTION 1.0 INTERPRETATION

- 1.1 In this MOU, each of the following terms, unless stipulated otherwise, have the meaning provided in this Section:
- (a) **“Annual Monitoring Schedule”** means the sample collection for an understanding of water quality and aquatic ecosystem health in Okanagan Lake in relation to Section 3.0 as agreed upon by the parties.
 - (b) **“Water Quality Objectives”** means the 2005 First Update of the Water Quality Objectives for Okanagan Lake. See attachment 1 for summary table.
 - (c) **“EMA”** means the *Environmental Management Act, c. 53, SBC, 2003*, and the regulations, codes of practice, and authorizations made under EMA.

SECTION 2.0 OBJECTIVE

The objective of the MOU is for the parties to work collaboratively, for the benefit of the parties, to:

- a) provide high quality, integrated and timely water quality information that will be available to users and government for the sustainable environmental management of Okanagan Lake’s water quality, and
 - b) inform liquid waste management planning at the watershed level.
- 2.1 The benefits to the parties may include the following:
- 2.1.1 Local Governments: cost effective collaborative implementation of their receiving environment monitoring requirements in their wastewater authorization under the EMA.
 - 2.1.2 ENV: obtain high quality sampling data and annual reports for long-term lake water quality for Water Quality Objectives attainment.
 - 2.1.3 OBWB: obtain high quality data and reports on the water quality of Okanagan Lake in support of OBWB’s mandate and their approach to basin-wide coordinated water management.

SECTION 3.0 SUBJECT MATTER

3.1 Monitoring and Reporting

Collaborative Background Monitoring

- 3.1.1 The background monitoring program and accompanying report(s) produce data and its interpretation which can be used in meeting the receiving environment monitoring and environmental impact assessment requirements for the Local Governments' existing Operational Certificates under EMA
- 3.1.2 Background monitoring will occur at the following four Environmental Monitoring System (EMS) sites:
- City of Kelowna: 0500236
 - Regional District of Central Okanagan: 0500730*
 - District of Summerland: 0500454
 - Armstrong Arm: 0500239
- *0500730 has been historically used in place of E231770
- 3.1.3 The monitoring in the upcoming year will follow the annual monitoring schedule as finalized by the parties prior to March 31 of that same year.
- 3.1.4 Analysis of water chemistry and plankton taxonomy for the four sites listed in Section 3.1.2 will be completed by laboratories contracted by ENV unless otherwise agreed to by the parties.
- 3.1.5 An annual report and, every third year, a trend analysis report of the Okanagan Lake trophic status, water quality, and attainment of Water Quality Objectives will be produced.

Operational Certificates and Okanagan Lake Monitoring

- 3.1.6 Monitoring in Okanagan Lake specific to individual Operational Certificates (OC) may be added to the collaborative water monitoring program. Details will be included in the annual monitoring schedule as identified in Section 3.1.3.
- 3.1.7 Local Governments may use the data collected for the OC identified in the annual monitoring schedule, and its interpretation, towards their receiving environment monitoring requirements under their EMA authorizations and towards plans and applications under EMA.
- 3.1.8 Effluent monitoring requirements and compliance with terms and conditions of the authorizations under EMA remain in effect.

Other Use of Okanagan Lake Monitoring Data

- 3.1.9 ENV and OBWB, by their participation in this collaborative monitoring MOU, may use the data collected under Section 3.1.1 and 3.1.6. and its interpretation towards their understanding and management of aquatic health and water quality in Okanagan Lake.
- 3.1.10 Data collected in accordance with this MOU will be entered into ENV's Environmental Monitoring System (EMS) or its subsequent program and will be accessible to the public through an ENV webpage.
- 3.1.11 Reports created in accordance with this MOU pertaining to the background monitoring data and its analysis under Section 3.1.5 will be accessible to the public through a web page.

3.2 Roles and Responsibilities

- 3.2.1 ENV will be responsible for collection and analysis of samples for the four sites listed in Section 3.1.2 for the months of March and September in each year.
- 3.2.2 ENV will contribute in-kind costs of the program by, creating the laboratory requisition forms and managing the invoices for the Provincial Government's contracted laboratories doing analyses.
- 3.2.3 OBWB will procure and manage a contract on behalf of the Local Governments, for the sample collection as per the annual monitoring schedule identified in Section 3.1.3 and the writing of an annual summary report, in a manner that is consistent with the high-quality standards of previous years. Every third year, the report will include trend analyses by incorporating monitoring data from previous years and will meet the established high-quality standards.
- 3.2.4 Local Governments will provide reimbursement costs to ENV and to OBWB as agreed to between each of the parties and in accordance with the terms of this MOU.
- 3.2.5 Other Local Governments with effluent discharges to Okanagan Lake may become parties under the terms of this MOU with consent from all parties.
- 3.2.6 Other aquatic monitoring in Okanagan Lake in addition to the monitoring provided in the annual monitoring schedule may be done by the parties without affecting this MOU.

3.3 Cost Responsibilities for the Sampling Program:

- 3.3.1 Costs of this program include laboratory analysis, sample collection, shipping, and report writing costs.

3.3.2 ENV and the Local Governments will be responsible for the costs as identified below:

ENV

- Water chemistry sample collection, shipping, and laboratory analysis for March and September of each year at the four background sites
- Plankton sample collection, shipping, and laboratory analysis for the four background sites for March and September of each year.
- Plankton laboratory analysis for sites and months not covered by the Local Governments as identified in the annual monitoring schedule in Section 3.1.3.

Local Governments

- Sampling collection and shipping for specified months as per the annual monitoring schedule for water chemistry and plankton at the four background sites identified in Section 3.1.2
- Laboratory analysis of samples for water chemistry at the four background sites collected for those months identified in the annual monitoring schedule as the responsibility of Local Governments.
- Laboratory analysis of plankton samples collected at those background sites and during those months identified in the annual monitoring schedule as being the responsibility of the Local Governments.
- Any sample collection, shipping, and laboratory analysis of water chemistry and plankton collected specific to individual Operational Certificate requirements.
- Interpretation and reporting of the background results annually and every third year, a spatial and temporal trend analysis, as well as any report prepared from the sampling done to meet the individual Operational Certificate requirements.

3.3.3 Funding from other sources can cover portions of the collaborative water monitoring program if there is agreement by all the parties.

SECTION 4.0 SECURITY AND CONFIDENTIALITY

4.1 All information and documentation provided to, collected by, delivered to or compiled by ENV, in the performance of its duties and responsibilities will be dealt with in accordance with all applicable provisions of Federal, Provincial and Municipal Statutes, particularly the *Privacy Act*, R.S.C. 1985, c, P-21, and the *Access to Information Act*, R.S.C. 1985, c. A-1, and the *Freedom of Information and Protection of Privacy Act*, R.S.B.C. 2004, c.165.

SECTION 5.0 BASIS OF PAYMENT

- 5.1 The Local Governments will reimburse ENV for the costs of laboratory services pertaining to water chemistry, laboratory analysis, and plankton laboratory analysis.
- 5.2 The Local Governments will each provide funds to OBWB for the contracted services of water sampling and report writing.
- 5.3 The breakdown of costs to the Local Governments will be based on the percentage of the authorized maximum volume of effluent each Local Government contributes to the total that can be discharged to Okanagan Lake. The breakdown is as follows:
 - City of Kelowna: 50%
 - Regional District of Central Okanagan: 32%
 - District of Summerland: 18%
- 5.4 Local Governments will reimburse ENV and OBWB the amount of costs based on their percentage in Section 5.3.
- 5.5 The division of costs may be re-evaluated if another municipal effluent discharges routinely to Okanagan Lake and a new Local Government becomes a party to the MOU.

SECTION 6.0 METHOD OF PAYMENT

- 6.1 ENV will provide, to each Local Government, or OBWB as appropriate, an invoice setting out the costs of laboratory analyses incurred as per the annual monitoring schedule. The invoice will include an ENV contact and mailing address.
- 6.2 Each Local Government or OBWB as appropriate, are responsible for providing payment to ENV of all invoices received from ENV before the end of March each year, by way of cheque to the **Minister of Finance for British Columbia**.
- 6.3 Local Governments will provide reimbursement to OBWB for all costs incurred from sample collection, shipping, analyses, and report preparation as identified in Section 3.3.2 by a method agreed upon between the parties.

SECTION 7.0 LIABILITY

- 7.1 No Party will be held liable for the actions of another.
- 7.2 Section 7.1 will survive the termination of this MOU for any reason whatsoever.
- 7.3 The Parties agree to maintain, at their own expense, all necessary insurance relating to their respective responsibilities under this MOU.

SECTION 8.0 DISPUTE RESOLUTION

- 8.1 Any new issue, matter of general concern or dispute arising from this MOU will be dealt with by the parties or their representatives.
- 8.2 Any dispute or disagreement will not be submitted to a third party for resolution.

SECTION 9.0 TERM OF AGREEMENT

- 9.1 This MOU will begin upon the date of the last final party signing and end May 31, 2026.
- 9.2 It is understood by the parties that the intent of this MOU was followed as of April 1, 2022, to be in accordance with the individual Local Government OC requirements.
- 9.3 Any party to this MOU may terminate its participation in this MOU upon provision of sixty (60) days written notice to the other parties of their intention.
- 9.4 Regardless of the reason for termination, ENV and OBWB will not have any obligation to Local Governments beyond the reimbursement of any surplus funds given to ENV or OBWB prior to the effective date of termination.

SECTION 10.0 NOTICE

- 10.1 All official notices and communications pertinent to implementation of this MOU will be in writing and will be electronically mailed, mailed, or delivered. For the purposes of the delivery of notice, the addresses for delivery are:

For ENV

Ministry of Environment & Climate Change Strategy

Attention:

Kym Keogh, Ministry of Environment & Climate Change Strategy,
Environmental Protection Division

400-640 Borland St., Williams Lake, BC, V2G 2K1

For OBWB

Okanagan Basin Water Board

Attention:

Anna Warwick Sears, Executive Director

1450 KLO Road, Kelowna, BC, V1W 3Z4

For Local Governments

City of Kelowna

Attention

Mike Gosselin, Wastewater Operations Manager

951 Raymer Avenue, Kelowna, BC V1Y 4Z7

Regional District of Central Okanagan

Attention:

RDCO Chief Administrative Officer or signing officer

1450 K.L.O. Road, Kelowna, BC, V1W 3Z4

District of Summerland

Attention:

Devon van der Meulen, Manager of Water Utilities

13211 Henry Avenue Box 159 Summerland, BC, V0H 1Z4

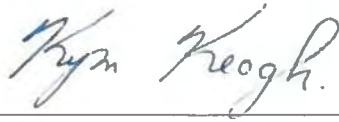
SECTION 11.0 SAVING PROVISION

- 11.1 Nothing in this MOU is in any way intended to replace or amend any obligation that the parties are bound to or required to perform by operation of law.

SECTION 12.0 GENERAL

12.1 This MOU reflects the good faith and spirit of cooperation of the parties but is not legally binding on any of the parties.

Signed on behalf of ENV:



Kym Keogh
Ministry of Environment & Climate Change Strategy
Province of British Columbia

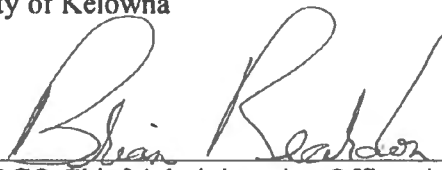
October 27, 2022
Date

Signed on behalf of Local Governments:



Mike Gosselin
City of Kelowna

9.6.2022
Date



Brian Keaton
RDCO Chief Administrative Officer /or signing officer
Regional District of Central Okanagan

28 SEPT. 2022
Date



Devon van der Meulen
District of Summerland

October 6, 2022
Date

Signed on behalf of OBWB:



Anna Warwick Sears
Okanagan Basin Water Board

Sept. 7, 2022
Date

Attachment 1: Excerpt from the Water Quality Objectives for Okanagan Lake Report. A First Update, January 2005

https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-objectives/ok_lakes_update-jan2005.pdf

A summary of the objectives that are proposed for Okanagan Lake:

	North Basin 0500730	Central Basin 0500236	South Basin 0500454	Armstrong Arm 0500239
Secchi disc transparency (m) growing season average ¹	6	6	7	5
Dissolved Oxygen	-	-	-	5 mg/L min in bottom waters
Total Phosphorus (ug/L) maximum at spring overturn ²	8	8	7	10
Chlorophyll-a (ug/L) maximum seasonal average ^{1,3}	4.5	4.5	4	5
Total Nitrogen (ug/L) maximum ²	230	230	230	250
T:P ratio (spring weight ratio) ²	>25:1	>25:1	>25:1	>25:1
Phytoplankton structure (heterocystous cyanobacteria ⁴ by numbers) ^{1,3}	<5%	<5%	<5%	<5%
Phytoplankton growing season average biomass ^{1,3}	<0.75 g/m ³	<0.75 g/m ³	<0.75 g/m ³	<0.75 g/m ³
Zooplankton designated species mix minimum biomass ^{1,5,6}	50 ug/m ³	50 ug/m ³	50 ug/m ³	50 ug/m ³
Zooplankton Structure (minimum of cladocera by numbers) ^{1,5,6}	5%	5%	5%	5%
Contaminants ⁷ in fish tissue and <i>Mysis</i> ⁸ tissue	Below human consumption and wildlife protection guidelines	Below human consumption and wildlife protection guidelines	Below human consumption and wildlife protection guidelines	Below human consumption and wildlife protection guidelines

- ¹ Growing season average for Okanagan Lake WQOs are based on monthly samples from April to September.
- ² Objectives should be checked in the spring before stratification begins (typically February to March). Objectives are based on an average inflow determined by the year prior to sampling.
- ³ Collected in the epilimnion
- ⁴ Nitrogen-fixing species
- ⁵ Collected in the top 50 meters of the lake
- ⁶ Dominant species include calanoid copepod *Leptodiapomus ashlandi*, the cyclopoid *Diacyclops bicuspidatus*, and the cladocerans *Daphnia galeata mendotae*, *Diaphanosoma* and *Bosmina*.
- ⁷ Contaminants identified in Objectives Report are mercury, dioxins and furans, DDT and metabolites, PCBs and a scan of agricultural chemicals that might be a risk. 5 Fish at least one kg in weight from each location every five years.
- ⁸ *Mysis* is considered an important transporter of PCBs and DDTs from the sediments to fish.

APPENDIX M

LAB ANALYSIS REPORTS



CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0	WORK ORDER	22A1770
ATTENTION	Ryan Cleverdon	RECEIVED / TEMP REPORTED	2022-01-18 10:40 / 3.2°C 2022-01-24 16:28
PO NUMBER PROJECT PROJECT INFO	Dist. of Summerland WWTP - PE13627	COC NUMBER	No Number

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks



You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry



It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve



Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

If you have any questions or concerns, please contact me at bwhitehead@caro.ca

Authorized By:

Brent Whitehead
Client Service Team Lead

1-888-311-8846 | www.caro.ca

#110 4011 Viking Way Richmond, BC V6V 2K9 | #102 3677 Highway 97N Kelowna, BC V1X 5C3 | 17225 109 Avenue Edmonton, AB T5S 1H7 | #108 4475 Wayburne Drive Burnaby, BC V5G 4X4



TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22A1770
2022-01-24 16:28

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (22A1770-01) Matrix: Wastewater Sampled: 2022-01-18 08:00					
<i>General Parameters</i>					
Solids, Total Suspended	2.0		2.0 mg/L	2022-01-24	
Effluent (E230437) (22A1770-02) Matrix: Wastewater Sampled: 2022-01-18 08:00					
<i>Anions</i>					
Nitrate (as N)	2.07		0.010 mg/L	2022-01-19	
Nitrite (as N)	0.110		0.010 mg/L	2022-01-19	
Phosphate (as P)	< 0.0050		0.0050 mg/L	2022-01-19	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	2.18		0.0100 mg/L	N/A	
Nitrogen, Total	6.01		0.100 mg/L	N/A	
Nitrogen, Organic	1.28		0.100 mg/L	N/A	
<i>General Parameters</i>					
Ammonia, Total (as N)	2.56		0.050 mg/L	2022-01-21	
BOD, 5-day	8.4		2.0 mg/L	2022-01-24	
Nitrogen, Total Kjeldahl	3.84		0.050 mg/L	2022-01-19	
pH	7.12		0.10 pH units	2022-01-19	HT2
Phosphorus, Total (as P)	0.126		0.0050 mg/L	2022-01-19	
Effluent Coliform (E230437) (22A1770-03) Matrix: Wastewater Sampled: 2022-01-18 08:00					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	25		1 MPN/100 mL	2022-01-18	
Coliforms, Fecal (Q-Tray)	4		1 MPN/100 mL	2022-01-18	
C3 Coliform (E231678) (22A1770-04) Matrix: Fresh Water Sampled: 2022-01-18 08:00					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	< 1		1 MPN/100 mL	2022-01-18	
Coliforms, Fecal (Q-Tray)	< 1		1 MPN/100 mL	2022-01-18	
Influent (E230439) (22A1770-05) Matrix: Fresh Water Sampled: 2022-01-18 08:00					
<i>Anions</i>					
Nitrate (as N)	< 0.010		0.010 mg/L	2022-01-19	
Nitrite (as N)	< 0.010		0.010 mg/L	2022-01-19	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	< 0.0100		0.0100 mg/L	N/A	
Nitrogen, Total	90.6		2.00 mg/L	N/A	



TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22A1770
2022-01-24 16:28

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (22A1770-05) Matrix: Fresh Water Sampled: 2022-01-18 08:00, Continued					
<i>General Parameters</i>					
BOD, 5-day	215		2.0 mg/L	2022-01-24	
Nitrogen, Total Kjeldahl	90.6		0.050 mg/L	2022-01-21	
pH	7.42		0.10 pH units	2022-01-19	HT2
Phosphorus, Total (as P)	6.19		0.0050 mg/L	2022-01-19	

Sample Qualifiers:

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



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22A1770
2022-01-24 16:28

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	SM 2540 D* (2017)	Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
mg/L	Milligrams per litre
MPN/100 mL	Most Probable Number per 100 millilitres
pH units	pH < 7 = acidic, pH > 7 = basic
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued or once samples expire, whichever comes first. Longer hold is possible if agreed to in writing. The quality control (QC) data is available upon request

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline(s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.



CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0	WORK ORDER	22B2007
ATTENTION	Ryan Cleverdon	RECEIVED / TEMP REPORTED	2022-02-15 10:30 / 10.4°C
PO NUMBER		REPORTED	2022-02-23 12:11
PROJECT	Dist. of Summerland WWTP - PE13627	COC NUMBER	No Number
PROJECT INFO			

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Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

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Authorized By:

Brent Whitehead
Account Manager

1-888-311-8846 | www.caro.ca

#110 4011 Viking Way Richmond, BC V6V 2K9 | #102 3677 Highway 97N Kelowna, BC V1X 5C3 | 17225 109 Avenue Edmonton, AB T5S 1H7 | #108 4475 Wayburne Drive Burnaby, BC V5G 4X4



TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22B2007
2022-02-23 12:11

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (22B2007-01) Matrix: Wastewater Sampled: 2022-02-15 07:30					
<i>General Parameters</i>					
Solids, Total Suspended	4.0	2.0	mg/L	2022-02-17	
Effluent (E230437) (22B2007-02) Matrix: Wastewater Sampled: 2022-02-15 07:30					
<i>Anions</i>					
Nitrate (as N)	1.82	0.010	mg/L	2022-02-16	
Nitrite (as N)	0.312	0.010	mg/L	2022-02-16	
Phosphate (as P)	< 0.0050	0.0050	mg/L	2022-02-16	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	2.13	0.0100	mg/L	N/A	
Nitrogen, Total	5.73	0.100	mg/L	N/A	
Nitrogen, Organic	1.63	0.100	mg/L	N/A	
<i>General Parameters</i>					
Ammonia, Total (as N)	1.96	0.050	mg/L	2022-02-17	
BOD, 5-day	< 7.5	2.0	mg/L	2022-02-22	
Nitrogen, Total Kjeldahl	3.59	0.050	mg/L	2022-02-21	
pH	7.53	0.10	pH units	2022-02-16	HT2
Phosphorus, Total (as P)	0.139	0.0050	mg/L	2022-02-22	
Effluent Coliform (E230437) (22B2007-03) Matrix: Wastewater Sampled: 2022-02-15 07:30					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	13	1	MPN/100 mL	2022-02-15	
Coliforms, Fecal (Q-Tray)	1	1	MPN/100 mL	2022-02-15	
C3 Coliform (E231678) (22B2007-04) Matrix: Fresh Water Sampled: 2022-02-15 07:30					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	< 1	1	MPN/100 mL	2022-02-15	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2022-02-15	
Influent (E230439) (22B2007-05) Matrix: Fresh Water Sampled: 2022-02-15 07:30					
<i>Anions</i>					
Nitrate (as N)	< 0.010	0.010	mg/L	2022-02-16	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-02-16	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	76.6	2.00	mg/L	N/A	



TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22B2007
2022-02-23 12:11

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (22B2007-05) Matrix: Fresh Water Sampled: 2022-02-15 07:30, Continued					PRES
<i>General Parameters</i>					
BOD, 5-day	235		2.0 mg/L	2022-02-22	
Nitrogen, Total Kjeldahl	76.6		0.050 mg/L	2022-02-21	
pH	7.59		0.10 pH units	2022-02-16	HT2
Phosphorus, Total (as P)	5.99		0.0050 mg/L	2022-02-22	

Sample Qualifiers:

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

PRES Sample has been preserved for NH3, TKN, TP in the laboratory and the holding time has been extended.



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22B2007
2022-02-23 12:11

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	SM 2540 D* (2017)	Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
mg/L	Milligrams per litre
MPN/100 mL	Most Probable Number per 100 millilitres
pH units	pH < 7 = acidic, pH > 7 = basic
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

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CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0	WORK ORDER	22C2151
ATTENTION	Ryan Cleverdon	RECEIVED / TEMP REPORTED	2022-03-15 11:00 / 3.6°C 2022-03-22 14:18
PO NUMBER		COC NUMBER	No Number
PROJECT PROJECT INFO	Dist. of Summerland WWTP - PE13627		

Introduction:

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Big Picture Sidekicks



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Authorized By:

Brent Whitehead
Account Manager

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TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22C2151
2022-03-22 14:18

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (22C2151-01) Matrix: Wastewater Sampled: 2022-03-15 08:00					
<i>General Parameters</i>					
Solids, Total Suspended	3.2	2.0	mg/L	2022-03-17	
Effluent (E230437) (22C2151-02) Matrix: Wastewater Sampled: 2022-03-15 08:00					
<i>Anions</i>					
Nitrate (as N)	2.51	0.010	mg/L	2022-03-17	
Nitrite (as N)	0.204	0.010	mg/L	2022-03-17	
Phosphate (as P)	< 0.0050	0.0050	mg/L	2022-03-17	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	2.71	0.0100	mg/L	N/A	
Nitrogen, Total	5.46	0.100	mg/L	N/A	
Nitrogen, Organic	1.56	0.100	mg/L	N/A	
<i>General Parameters</i>					
Ammonia, Total (as N)	1.19	0.050	mg/L	2022-03-17	
BOD, 5-day	25.0	2.0	mg/L	2022-03-21	
Nitrogen, Total Kjeldahl	2.74	0.050	mg/L	2022-03-21	
pH	7.73	0.10	pH units	2022-03-18	HT2
Phosphorus, Total (as P)	0.122	0.0050	mg/L	2022-03-17	
Effluent Coliform (E230437) (22C2151-03) Matrix: Wastewater Sampled: 2022-03-15 08:00					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	13	1	MPN/100 mL	2022-03-16	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2022-03-16	
C3 Coliform (E231678) (22C2151-04) Matrix: Fresh Water Sampled: 2022-03-15 08:00					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	1	1	MPN/100 mL	2022-03-16	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2022-03-16	
Influent (E230439) (22C2151-05) Matrix: Fresh Water Sampled: 2022-03-15 08:00					
<i>Anions</i>					
Nitrate (as N)	< 0.010	0.010	mg/L	2022-03-17	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-03-17	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	58.7	2.00	mg/L	N/A	



TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22C2151
2022-03-22 14:18

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (22C2151-05) Matrix: Fresh Water Sampled: 2022-03-15 08:00, Continued					PRESa
<i>General Parameters</i>					
BOD, 5-day	305		2.0 mg/L	2022-03-21	
Nitrogen, Total Kjeldahl	58.7		0.050 mg/L	2022-03-21	
pH	7.68		0.10 pH units	2022-03-18	HT2
Phosphorus, Total (as P)	6.27		0.0050 mg/L	2022-03-17	

Sample Qualifiers:

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

PRES Sample has been preserved for NH3, TKN, TP in the laboratory and the holding time has been extended.

PRESa Sample has been preserved for TP, TKN in the laboratory and the holding time has been extended.



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22C2151
2022-03-22 14:18

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	SM 2540 D* (2017)	Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

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CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0	WORK ORDER	22D1435
ATTENTION	Ryan Cleverdon	RECEIVED / TEMP REPORTED	2022-04-12 10:10 / 13.4°C 2022-04-21 13:44
PO NUMBER		COC NUMBER	No Number
PROJECT PROJECT INFO	Dist. of Summerland WWTP - PE13627		

Introduction:

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Authorized By:

Brent Whitehead
Account Manager

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TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22D1435
2022-04-21 13:44

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (22D1435-01) Matrix: Wastewater Sampled: 2022-04-12 08:15					
<i>General Parameters</i>					
Solids, Total Suspended	2.2	2.0	mg/L	2022-04-20	HT1
Effluent (E230437) (22D1435-02) Matrix: Wastewater Sampled: 2022-04-12 08:15					
<i>Anions</i>					
Nitrate (as N)	2.68	0.010	mg/L	2022-04-15	
Nitrite (as N)	0.057	0.010	mg/L	2022-04-15	
Phosphate (as P)	0.0100	0.0050	mg/L	2022-04-15	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	2.74	0.0100	mg/L	N/A	
Nitrogen, Total	4.07	0.0500	mg/L	N/A	
Nitrogen, Organic	1.23	0.0500	mg/L	N/A	
<i>General Parameters</i>					
Ammonia, Total (as N)	0.101	0.050	mg/L	2022-04-19	
BOD, 5-day	< 7.0	2.0	mg/L	2022-04-19	
Nitrogen, Total Kjeldahl	1.33	0.050	mg/L	2022-04-20	
pH	8.07	0.10	pH units	2022-04-21	HT2
Phosphorus, Total (as P)	0.107	0.0050	mg/L	2022-04-19	
Effluent Coliform (E230437) (22D1435-03) Matrix: Wastewater Sampled: 2022-04-12 08:15					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	28	1	MPN/100 mL	2022-04-13	
Coliforms, Fecal (Q-Tray)	8	1	MPN/100 mL	2022-04-13	
C3 Coliform (E231678) (22D1435-04) Matrix: Fresh Water Sampled: 2022-04-12 08:15					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	10	1	MPN/100 mL	2022-04-13	
Coliforms, Fecal (Q-Tray)	1	1	MPN/100 mL	2022-04-13	
Influent (E230439) (22D1435-05) Matrix: Fresh Water Sampled: 2022-04-12 08:15					
<i>Anions</i>					
Nitrate (as N)	< 0.010	0.010	mg/L	2022-04-15	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-04-15	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	26.2	2.00	mg/L	N/A	



TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22D1435
2022-04-21 13:44

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (22D1435-05) Matrix: Fresh Water Sampled: 2022-04-12 08:15, Continued					PRES
<i>General Parameters</i>					
BOD, 5-day	122	2.0	mg/L	2022-04-19	
Nitrogen, Total Kjeldahl	26.2	0.050	mg/L	2022-04-20	
pH	7.86	0.10	pH units	2022-04-21	HT2
Phosphorus, Total (as P)	2.92	0.0050	mg/L	2022-04-19	

Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.
 HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.
 PRES Sample has been preserved for Nitrogen, total phos in the laboratory and the holding time has been extended.



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22D1435
2022-04-21 13:44

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

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CERTIFICATE OF ANALYSIS

REPORTED TO Summerland, District of
Box 159
SUMMERLAND, BC V0H 1Z0

ATTENTION Ryan Cleverdon

PO NUMBER

PROJECT Dist. of Summerland WWTP - PE13627

PROJECT INFO

WORK ORDER 22E1193

RECEIVED / TEMP 2022-05-10 11:00 / 15.2°C

REPORTED 2022-05-16 16:21

COC NUMBER No Number

Introduction:

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Authorized By:

Brent Whitehead
Account Manager

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TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22E1193
2022-05-16 16:21

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (22E1193-01) Matrix: Wastewater Sampled: 2022-05-10 08:00					
<i>General Parameters</i>					
Solids, Total Suspended	2.0	2.0	mg/L	2022-05-16	
Effluent (E230437) (22E1193-02) Matrix: Wastewater Sampled: 2022-05-10 08:00					
<i>Anions</i>					
Nitrate (as N)	2.62	0.010	mg/L	2022-05-11	
Nitrite (as N)	0.043	0.010	mg/L	2022-05-11	
Phosphate (as P)	< 0.0050	0.0050	mg/L	2022-05-11	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	2.67	0.0100	mg/L	N/A	
Nitrogen, Total	4.38	0.0500	mg/L	N/A	
Nitrogen, Organic	1.59	0.0500	mg/L	N/A	
<i>General Parameters</i>					
Ammonia, Total (as N)	0.128	0.050	mg/L	2022-05-12	
BOD, 5-day	< 5.3	2.0	mg/L	2022-05-16	
Nitrogen, Total Kjeldahl	1.72	0.050	mg/L	2022-05-13	
pH	7.62	0.10	pH units	2022-05-12	HT2
Phosphorus, Total (as P)	0.140	0.0050	mg/L	2022-05-13	
Effluent Coliform (E230437) (22E1193-03) Matrix: Wastewater Sampled: 2022-05-10 08:00					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	13	1	MPN/100 mL	2022-05-10	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2022-05-10	
C3 Coliform (E231678) (22E1193-04) Matrix: Fresh Water Sampled: 2022-05-10 08:00					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	2	1	MPN/100 mL	2022-05-10	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2022-05-10	
Influent (E230439) (22E1193-05) Matrix: Fresh Water Sampled: 2022-05-10 08:00					
<i>Anions</i>					
Nitrate (as N)	< 0.010	0.010	mg/L	2022-05-11	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-05-11	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	35.7	1.00	mg/L	N/A	



TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22E1193
2022-05-16 16:21

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (22E1193-05) Matrix: Fresh Water Sampled: 2022-05-10 08:00, Continued					PRESa
<i>General Parameters</i>					
BOD, 5-day	404		2.0 mg/L	2022-05-16	
Nitrogen, Total Kjeldahl	35.7		0.050 mg/L	2022-05-13	
pH	7.18		0.10 pH units	2022-05-12	HT2
Phosphorus, Total (as P)	4.18		0.0050 mg/L	2022-05-13	

Sample Qualifiers:

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

PRES Sample has been preserved for Nitrogen, total phos in the laboratory and the holding time has been extended.

PRESa Sample has been preserved for Total phos in the laboratory and the holding time has been extended.



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22E1193
2022-05-16 16:21

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

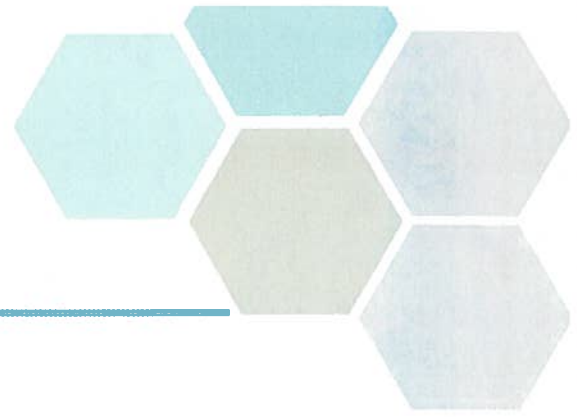
Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
mg/L	Milligrams per litre
MPN/100 mL	Most Probable Number per 100 millilitres
pH units	pH < 7 = acidic, pH > 7 = basic
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

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CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0	WORK ORDER	22F1986
ATTENTION	Ryan Cleverdon	RECEIVED / TEMP REPORTED	2022-06-14 11:15 / 10.3°C
PO NUMBER		REPORTED	2022-06-21 13:02
PROJECT	Dist. of Summerland WWTP - PE13627	COC NUMBER	No #
PROJECT INFO			

Introduction:

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Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

If you have any questions or concerns, please contact me at bwhitehead@caro.ca

Authorized By:

Brent Whitehead
Account Manager

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TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22F1986
2022-06-21 13:02

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (22F1986-01) Matrix: Wastewater Sampled: 2022-06-14 08:00					
<i>General Parameters</i>					
Solids, Total Suspended	4.7	2.0	mg/L	2022-06-21	
Effluent (E230437) (22F1986-02) Matrix: Wastewater Sampled: 2022-06-14 08:00					
<i>Anions</i>					
Nitrate (as N)	2.71	0.010	mg/L	2022-06-17	
Nitrite (as N)	0.029	0.010	mg/L	2022-06-17	
Phosphate (as P)	0.0060	0.0050	mg/L	2022-06-17	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	2.74	0.0100	mg/L	N/A	
Nitrogen, Total	4.47	0.0500	mg/L	N/A	
Nitrogen, Organic	1.54	0.0500	mg/L	N/A	
<i>General Parameters</i>					
Ammonia, Total (as N)	0.191	0.050	mg/L	2022-06-16	
BOD, 5-day	10.8	2.0	mg/L	2022-06-20	
Nitrogen, Total Kjeldahl	1.73	0.050	mg/L	2022-06-17	
pH	7.56	0.10	pH units	2022-06-18	HT2
Phosphorus, Total (as P)	0.210	0.0050	mg/L	2022-06-17	
Effluent Coliform (E230437) (22F1986-03) Matrix: Wastewater Sampled: 2022-06-14 08:00					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	102	1	MPN/100 mL	2022-06-14	
Coliforms, Fecal (Q-Tray)	12	1	MPN/100 mL	2022-06-14	
C3 Coliform (E231678) (22F1986-04) Matrix: Fresh Water Sampled: 2022-06-14 08:00					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	< 1	1	MPN/100 mL	2022-06-14	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2022-06-14	
Influent (E230439) (22F1986-05) Matrix: Fresh Water Sampled: 2022-06-14 08:00					
<i>Anions</i>					
Nitrate (as N)	< 0.010	0.010	mg/L	2022-06-17	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-06-17	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	33.6	2.00	mg/L	N/A	



TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22F1986
2022-06-21 13:02

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (22F1986-05) Matrix: Fresh Water Sampled: 2022-06-14 08:00, Continued					PRES
<i>General Parameters</i>					
BOD, 5-day	142	2.0	mg/L	2022-06-20	
Nitrogen, Total Kjeldahl	33.6	0.050	mg/L	2022-06-17	
pH	7.53	0.10	pH units	2022-06-18	HT2
Phosphorus, Total (as P)	3.68	0.0050	mg/L	2022-06-17	

Sample Qualifiers:

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

PRES Sample has been preserved for TKN + TP in the laboratory and the holding time has been extended.

PRESa Sample has been preserved for TP, TKN + NH3 in the laboratory and the holding time has been extended.



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22F1986
2022-06-21 13:02

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

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pH units	pH < 7 = acidic, pH > 7 = basic
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CERTIFICATE OF ANALYSIS

REPORTED TO Summerland, District of
Box 159
SUMMERLAND, BC V0H 1Z0

ATTENTION Ryan Cleverdon

PO NUMBER

PROJECT Dist. of Summerland WWTP - PE13627

PROJECT INFO

WORK ORDER 22G3435

RECEIVED / TEMP 2022-07-26 10:35 / 20.7°C

REPORTED 2022-08-03 12:30

COC NUMBER No Number

Introduction:

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Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

Work Order Comments:

This is a revised report; please refer to Appendix 3 for details.

If you have any questions or concerns, please contact me at bwhitehead@caro.ca

Authorized By:

Brent Whitehead
Account Manager

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TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22G3435
2022-08-03 12:30

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (22G3435-01) Matrix: Wastewater Sampled: 2022-07-26 08:30					
<i>General Parameters</i>					
Solids, Total Suspended	4.4	2.0	mg/L	2022-07-30	
Effluent (E230437) (22G3435-02) Matrix: Wastewater Sampled: 2022-07-26 08:30					
<i>Anions</i>					
Nitrate (as N)	2.04	0.010	mg/L	2022-07-28	
Nitrite (as N)	0.117	0.010	mg/L	2022-07-28	
Phosphate (as P)	0.0580	0.0050	mg/L	2022-07-28	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	2.16	0.0100	mg/L	N/A	
Nitrogen, Total	4.52	0.0500	mg/L	N/A	
Nitrogen, Organic	1.69	0.0500	mg/L	N/A	
<i>General Parameters</i>					
Ammonia, Total (as N)	0.673	0.050	mg/L	2022-07-28	
BOD, 5-day	< 7.0	2.0	mg/L	2022-08-01	
Nitrogen, Total Kjeldahl	2.36	0.050	mg/L	2022-07-29	
pH	7.65	0.10	pH units	2022-07-30	HT2
Phosphorus, Total (as P)	0.322	0.0050	mg/L	2022-07-28	
Effluent Coliform (E230437) (22G3435-03) Matrix: Wastewater Sampled: 2022-07-26 08:30					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	67	1	MPN/100 mL	2022-07-26	
Coliforms, Fecal (Q-Tray)	1	1	MPN/100 mL	2022-07-26	
C3 Coliform (E231678) (22G3435-04) Matrix: Fresh Water Sampled: 2022-07-26 08:30					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	770	1	MPN/100 mL	2022-07-26	
Coliforms, Fecal (Q-Tray)	91	1	MPN/100 mL	2022-07-26	
Influent (E230439) (22G3435-05) Matrix: Fresh Water Sampled: 2022-07-26 08:30					
<i>Anions</i>					
Nitrate (as N)	< 0.010	0.010	mg/L	2022-07-28	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-07-28	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	58.5	2.00	mg/L	N/A	



TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22G3435
2022-08-03 12:30

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (22G3435-05) Matrix: Fresh Water Sampled: 2022-07-26 08:30, Continued					PRESa
<i>General Parameters</i>					
BOD, 5-day	125	2.0	mg/L	2022-08-01	
Nitrogen, Total Kjeldahl	58.5	0.050	mg/L	2022-07-29	
pH	7.55	0.10	pH units	2022-07-30	HT2
Phosphorus, Total (as P)	5.93	0.0050	mg/L	2022-07-28	

Sample Qualifiers:

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

PRES Sample has been preserved for Nitrogen, phos in the laboratory and the holding time has been extended.

PRESa Sample has been preserved for Phos in the laboratory and the holding time has been extended.



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22G3435
2022-08-03 12:30

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

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APPENDIX 3: REVISION HISTORY

REPORTED TO PROJECT	Summerland, District of Dist. of Summerland WWTP - PE13627			WORK ORDER REPORTED	22G3435 2022-08-03 12:30
Sample ID	Changed	Change	Analysis	Analyte(s)	
22G3435-03	2022-08-03	Result Revised	Coliforms, Fecal (QT)	Coliforms, Fecal (Q-Tray)	
22G3435-03	2022-08-03	Result Revised	Coliforms, Total (QT)	Coliforms, Total (Q-Tray)	



CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0	WORK ORDER	22H2323
ATTENTION	Ryan Cleverdon	RECEIVED / TEMP REPORTED	2022-08-16 11:00 / 21.1°C 2022-08-22 13:12
PO NUMBER		COC NUMBER	No Number
PROJECT PROJECT INFO	Dist. of Summerland WWTP - PE13627		

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<https://www.caro.ca/terms-conditions>

If you have any questions or concerns, please contact me at bwhitehead@caro.ca

Authorized By:

Brent Whitehead
Account Manager

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TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22H2323
2022-08-22 13:12

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (22H2323-01) Matrix: Wastewater Sampled: 2022-08-16 08:30					
<i>General Parameters</i>					
Solids, Total Suspended	3.0	2.0	mg/L	2022-08-19	
Effluent (E230437) (22H2323-02) Matrix: Wastewater Sampled: 2022-08-16 08:30					
<i>Anions</i>					
Nitrate (as N)	2.92	0.010	mg/L	2022-08-18	
Nitrite (as N)	0.042	0.010	mg/L	2022-08-18	
Phosphate (as P)	< 0.0050	0.0050	mg/L	2022-08-18	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	2.96	0.0100	mg/L	N/A	
Nitrogen, Total	4.51	0.0500	mg/L	N/A	
Nitrogen, Organic	1.39	0.0500	mg/L	N/A	
<i>General Parameters</i>					
Ammonia, Total (as N)	0.161	0.050	mg/L	2022-08-17	
BOD, 5-day	< 7.0	2.0	mg/L	2022-08-22	
Nitrogen, Total Kjeldahl	1.55	0.050	mg/L	2022-08-21	
pH	7.31	0.10	pH units	2022-08-17	HT2
Phosphorus, Total (as P)	0.208	0.0050	mg/L	2022-08-19	
Effluent Coliform (E230437) (22H2323-03) Matrix: Wastewater Sampled: 2022-08-16 08:30					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	79	1	MPN/100 mL	2022-08-16	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2022-08-16	
C3 Coliform (E231678) (22H2323-04) Matrix: Fresh Water Sampled: 2022-08-16 08:30					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	92	1	MPN/100 mL	2022-08-16	
Coliforms, Fecal (Q-Tray)	1	1	MPN/100 mL	2022-08-16	
Influent (E230439) (22H2323-05) Matrix: Fresh Water Sampled: 2022-08-16 08:30					
<i>Anions</i>					
Nitrate (as N)	< 0.010	0.010	mg/L	2022-08-18	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-08-18	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	48.0	2.00	mg/L	N/A	



TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22H2323
2022-08-22 13:12

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (22H2323-05) Matrix: Fresh Water Sampled: 2022-08-16 08:30, Continued					PRES
<i>General Parameters</i>					
BOD, 5-day	105	2.0	mg/L	2022-08-22	
Nitrogen, Total Kjeldahl	48.0	0.050	mg/L	2022-08-21	
pH	7.47	0.10	pH units	2022-08-17	HT2
Phosphorus, Total (as P)	4.65	0.0050	mg/L	2022-08-19	

Sample Qualifiers:

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

PRES Sample has been preserved for Phos in the laboratory and the holding time has been extended.

PRESa Sample has been preserved for Phos, nitrogen in the laboratory and the holding time has been extended.



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22H2323
2022-08-22 13:12

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
mg/L	Milligrams per litre
MPN/100 mL	Most Probable Number per 100 millilitres
pH units	pH < 7 = acidic, pH > 7 = basic
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

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CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0	WORK ORDER	2211661
ATTENTION	Ryan Cleverdon	RECEIVED / TEMP REPORTED	2022-09-13 11:00 / 18.2°C
PO NUMBER		REPORTED	2022-09-20 14:14
PROJECT	Dist. of Summerland WWTP - PE13627	COC NUMBER	No Number
PROJECT INFO			

Introduction:

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Authorized By:

Brent Whitehead
Account Manager

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TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 2211661
2022-09-20 14:14

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (2211661-01) Matrix: Wastewater Sampled: 2022-09-13 08:00					
<i>General Parameters</i>					
Solids, Total Suspended	< 4.0	2.0	mg/L	2022-09-18	
Effluent (E230437) (2211661-02) Matrix: Wastewater Sampled: 2022-09-13 08:00					
<i>Anions</i>					
Nitrate (as N)	2.55	0.010	mg/L	2022-09-17	HT1
Nitrite (as N)	0.027	0.010	mg/L	2022-09-17	HT1
Phosphate (as P)	0.0167	0.0050	mg/L	2022-09-17	HT1
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	2.57	0.0100	mg/L	N/A	
Nitrogen, Total	3.57	0.0500	mg/L	N/A	
Nitrogen, Organic	0.930	0.0500	mg/L	N/A	
<i>General Parameters</i>					
Ammonia, Total (as N)	0.071	0.050	mg/L	2022-09-16	
BOD, 5-day	< 5.6	2.0	mg/L	2022-09-19	
Nitrogen, Total Kjeldahl	1.00	0.050	mg/L	2022-09-16	
pH	7.28	0.10	pH units	2022-09-18	HT2
Phosphorus, Total (as P)	0.122	0.0050	mg/L	2022-09-16	
Effluent Coliform (E230437) (2211661-03) Matrix: Wastewater Sampled: 2022-09-13 08:00					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	23	1	MPN/100 mL	2022-09-14	
Coliforms, Fecal (Q-Tray)	2	1	MPN/100 mL	2022-09-14	
C3 Coliform (E231678) (2211661-04) Matrix: Fresh Water Sampled: 2022-09-13 08:00					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	> 2420	1	MPN/100 mL	2022-09-14	
Coliforms, Fecal (Q-Tray)	1	1	MPN/100 mL	2022-09-14	
Influent (E230439) (2211661-05) Matrix: Fresh Water Sampled: 2022-09-13 08:00					
					PRES
<i>Anions</i>					
Nitrate (as N)	< 0.010	0.010	mg/L	2022-09-17	HT1
Nitrite (as N)	< 0.010	0.010	mg/L	2022-09-17	HT1
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	33.0	2.00	mg/L	N/A	



TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 221661
2022-09-20 14:14

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (221661-05) Matrix: Fresh Water Sampled: 2022-09-13 08:00, Continued					PRES
<i>General Parameters</i>					
BOD, 5-day	77.4	2.0	mg/L	2022-09-19	
Nitrogen, Total Kjeldahl	33.0	0.050	mg/L	2022-09-16	
pH	7.23	0.10	pH units	2022-09-18	HT2
Phosphorus, Total (as P)	3.41	0.0050	mg/L	2022-09-16	

Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.
 HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.
 PRES Sample has been preserved for TKN, TP in the laboratory and the holding time has been extended.



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 221661
2022-09-20 14:14

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

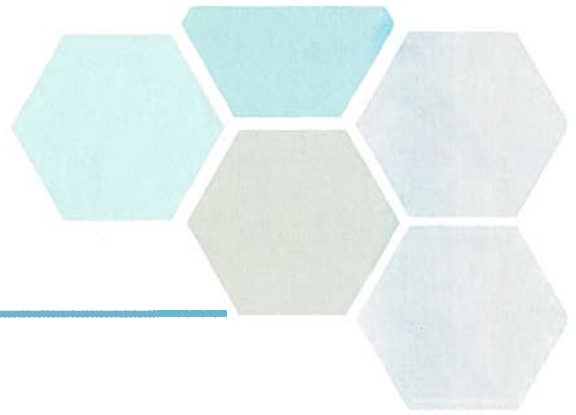
Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
>	Greater than the specified Result
mg/L	Milligrams per litre
MPN/100 mL	Most Probable Number per 100 millilitres
pH units	pH < 7 = acidic, pH > 7 = basic
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

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CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0	WORK ORDER	22J1347
ATTENTION	Ryan Cleverdon	RECEIVED / TEMP REPORTED	2022-10-12 10:45 / 4.0°C 2022-10-19 10:09
PO NUMBER		COC NUMBER	No Number
PROJECT PROJECT INFO	Dist. of Summerland WWTP - PE13627		

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TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22J1347
2022-10-19 10:09

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (22J1347-01) Matrix: Wastewater Sampled: 2022-10-12 08:30					
<i>General Parameters</i>					
Solids, Total Suspended	< 2.0	2.0	mg/L	2022-10-17	
Effluent (E230437) (22J1347-02) Matrix: Wastewater Sampled: 2022-10-12 08:30					
PRES					
<i>Anions</i>					
Nitrate (as N)	2.32	0.010	mg/L	2022-10-15	
Nitrite (as N)	0.029	0.010	mg/L	2022-10-15	
Phosphate (as P)	0.0076	0.0050	mg/L	2022-10-15	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	2.35	0.0100	mg/L	N/A	
Nitrogen, Total	3.33	0.0500	mg/L	N/A	
Nitrogen, Organic	0.915	0.0500	mg/L	N/A	
<i>General Parameters</i>					
Ammonia, Total (as N)	0.065	0.050	mg/L	2022-10-16	
BOD, 5-day	< 6.8	2.0	mg/L	2022-10-17	
Nitrogen, Total Kjeldahl	0.980	0.050	mg/L	2022-10-19	
pH	7.33	0.10	pH units	2022-10-16	HT2
Phosphorus, Total (as P)	0.126	0.0050	mg/L	2022-10-14	
Effluent Coliform (E230437) (22J1347-03) Matrix: Wastewater Sampled: 2022-10-12 08:30					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	2	1	MPN/100 mL	2022-10-12	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2022-10-12	
C3 Coliform (E231678) (22J1347-04) Matrix: Fresh Water Sampled: 2022-10-12 08:30					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	< 1	1	MPN/100 mL	2022-10-12	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2022-10-12	
Influent (E230439) (22J1347-05) Matrix: Fresh Water Sampled: 2022-10-12 08:30					
PRESa					
<i>Anions</i>					
Nitrate (as N)	< 0.010	0.010	mg/L	2022-10-15	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-10-15	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	46.5	2.00	mg/L	N/A	



TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22J1347
2022-10-19 10:09

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (22J1347-05) Matrix: Fresh Water Sampled: 2022-10-12 08:30, Continued					PRESa
<i>General Parameters</i>					
BOD, 5-day	158	2.0	mg/L	2022-10-17	
Nitrogen, Total Kjeldahl	46.5	0.050	mg/L	2022-10-19	
pH	7.37	0.10	pH units	2022-10-16	HT2
Phosphorus, Total (as P)	4.36	0.0050	mg/L	2022-10-14	

Sample Qualifiers:

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

PRES Sample has been preserved for TKN, NH3, TP in the laboratory and the holding time has been extended.

PRESa Sample has been preserved for TKN, TP in the laboratory and the holding time has been extended.



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22J1347
2022-10-19 10:09

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

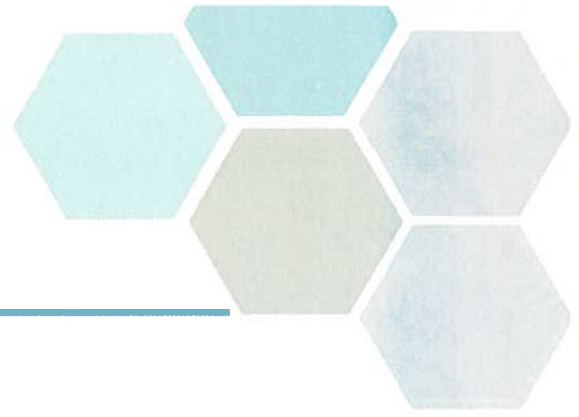
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CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0	WORK ORDER	22K0985
ATTENTION	Ryan Cleverdon	RECEIVED / TEMP REPORTED	2022-11-08 11:00 / 12.0°C
PO NUMBER		REPORTED	2022-11-15 14:44
PROJECT	Dist. of Summerland WWTP - PE13627	COC NUMBER	No Number
PROJECT INFO			

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Account Manager

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TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22K0985
2022-11-15 14:44

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (22K0985-01) Matrix: Wastewater Sampled: 2022-11-08 08:30					
<i>General Parameters</i>					
Solids, Total Suspended	< 2.0	2.0	mg/L	2022-11-09	
Effluent (E230437) (22K0985-02) Matrix: Wastewater Sampled: 2022-11-08 08:30					
<i>Anions</i>					
Nitrate (as N)	2.80	0.010	mg/L	2022-11-09	
Nitrite (as N)	0.011	0.010	mg/L	2022-11-09	
Phosphate (as P)	0.0055	0.0050	mg/L	2022-11-09	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	2.81	0.0100	mg/L	N/A	
Nitrogen, Total	3.76	0.0500	mg/L	N/A	
Nitrogen, Organic	0.950	0.0500	mg/L	N/A	
<i>General Parameters</i>					
Ammonia, Total (as N)	< 0.050	0.050	mg/L	2022-11-09	
BOD, 5-day	< 5.1	2.0	mg/L	2022-11-15	
Nitrogen, Total Kjeldahl	0.950	0.050	mg/L	2022-11-13	
pH	7.24	0.10	pH units	2022-11-11	HT2
Phosphorus, Total (as P)	0.0862	0.0050	mg/L	2022-11-10	
Effluent Coliform (E230437) (22K0985-03) Matrix: Wastewater Sampled: 2022-11-08 08:30					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	1	1	MPN/100 mL	2022-11-08	
Coliforms, Fecal (Q-Tray)	1	1	MPN/100 mL	2022-11-08	
C3 Coliform (E231678) (22K0985-04) Matrix: Fresh Water Sampled: 2022-11-08 08:30					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	< 1	1	MPN/100 mL	2022-11-08	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2022-11-08	
Influent (E230439) (22K0985-05) Matrix: Fresh Water Sampled: 2022-11-08 08:30					
<i>Anions</i>					
Nitrate (as N)	< 0.010	0.010	mg/L	2022-11-09	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-11-09	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	53.4	1.00	mg/L	N/A	



TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22K0985
2022-11-15 14:44

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (22K0985-05) Matrix: Fresh Water Sampled: 2022-11-08 08:30, Continued					PRESa
<i>General Parameters</i>					
BOD, 5-day	198		2.0 mg/L	2022-11-15	
Nitrogen, Total Kjeldahl	53.4		0.050 mg/L	2022-11-13	
pH	7.47		0.10 pH units	2022-11-11	HT2
Phosphorus, Total (as P)	5.61		0.0050 mg/L	2022-11-10	

Sample Qualifiers:

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

PRES Sample has been preserved for NH3, TKN, TP in the laboratory and the holding time has been extended.

PRESa Sample has been preserved for TKN, TP in the laboratory and the holding time has been extended.



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22K0985
2022-11-15 14:44

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
mg/L	Milligrams per litre
MPN/100 mL	Most Probable Number per 100 millilitres
pH units	pH < 7 = acidic, pH > 7 = basic
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

General Comments:

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Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline(s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.



CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0	WORK ORDER	22L0475
ATTENTION	Ryan Cleverdon	RECEIVED / TEMP REPORTED	2022-12-06 11:00 / 12.4°C 2022-12-12 17:38
PO NUMBER		COC NUMBER	No Number
PROJECT	Dist. of Summerland WWTP - PE13627		
PROJECT INFO			

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks



You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry



It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve



Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

By engaging our services, you are agreeing to CARO Analytical Service's Standard Terms and Conditions outlined here:
<https://www.caro.ca/terms-conditions>

If you have any questions or concerns, please contact me at bwhitehead@caro.ca

Authorized By:

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TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22L0475
2022-12-12 17:38

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (22L0475-01) Matrix: Wastewater Sampled: 2022-12-06 08:30					
<i>General Parameters</i>					
Solids, Total Suspended	< 2.0	2.0	mg/L	2022-12-08	
Effluent (E230437) (22L0475-02) Matrix: Wastewater Sampled: 2022-12-06 08:30					
<i>Anions</i>					
Nitrate (as N)	2.16	0.010	mg/L	2022-12-07	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-12-07	
Phosphate (as P)	< 0.0050	0.0050	mg/L	2022-12-07	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	2.16	0.0100	mg/L	N/A	
Nitrogen, Total	3.16	0.0500	mg/L	N/A	
Nitrogen, Organic	0.906	0.0500	mg/L	N/A	
<i>General Parameters</i>					
Ammonia, Total (as N)	0.093	0.050	mg/L	2022-12-08	
BOD, 5-day	< 6.1	2.0	mg/L	2022-12-12	
Nitrogen, Total Kjeldahl	0.999	0.050	mg/L	2022-12-09	
pH	7.02	0.10	pH units	2022-12-07	HT2
Phosphorus, Total (as P)	0.0838	0.0050	mg/L	2022-12-09	
Effluent Coliform (E230437) (22L0475-03) Matrix: Wastewater Sampled: 2022-12-06 08:30					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	< 1	1	MPN/100 mL	2022-12-06	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2022-12-06	
C3 Coliform (E231678) (22L0475-04) Matrix: Fresh Water Sampled: 2022-12-06 08:30					
<i>Microbiological Parameters</i>					
Coliforms, Total (Q-Tray)	< 1	1	MPN/100 mL	2022-12-06	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2022-12-06	
Influent (E230439) (22L0475-05) Matrix: Fresh Water Sampled: 2022-12-06 08:30					
<i>Anions</i>					
Nitrate (as N)	< 0.010	0.010	mg/L	2022-12-07	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-12-07	
<i>Calculated Parameters</i>					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	77.8	2.00	mg/L	N/A	



TEST RESULTS

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22L0475
2022-12-12 17:38

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (22L0475-05) Matrix: Fresh Water Sampled: 2022-12-06 08:30, Continued					PRESa
<i>General Parameters</i>					
BOD, 5-day	354	2.0	mg/L	2022-12-12	
Nitrogen, Total Kjeldahl	77.8	0.050	mg/L	2022-12-09	
pH	7.94	0.10	pH units	2022-12-07	HT2
Phosphorus, Total (as P)	8.66	0.0050	mg/L	2022-12-09	

Sample Qualifiers:	
HT2	The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.
PRES	Sample has been preserved for NH3, TKN, TP in the laboratory and the holding time has been extended.
PRESa	Sample has been preserved for TKN, TP in the laboratory and the holding time has been extended.



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT Summerland, District of
Dist. of Summerland WWTP - PE13627

WORK ORDER REPORTED 22L0475
2022-12-12 17:38

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2017)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2017)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

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APPENDIX N

SLUDGE ANALYSIS AND LANDFILL SCALE WEIGHTS

Compost Facility Operations Guide; Best Practices



Engineering and Public Works
District of Summerland

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COMPOST FACILITY OPERATIONS GUIDE; BEST PRACTICES

1. Background Information

Compost is a valuable soil amendment formed by the breakdown of organic material by microorganisms such as bacteria, fungi, and actinomycetes. Similar to the making of bread, cheese, beer or wine, it employs the metabolic activity of microbes to produce a desirable end product. Composting occurs naturally if the right conditions are present. For composting to proceed properly, the prepared mixture of composting organic feedstocks must have certain characteristics in order to create the conditions for these microbes to thrive.

Carbon to Nitrogen Ratio

There must be a balance of carbon-rich feedstocks and nitrogen-rich feedstocks in the composting mixture. This provides the microorganisms with the balanced diet they need. Carbon-rich materials include brown leaves, brown pine needles, and ground-up wood and branches. Nitrogen-rich feedstocks include grass clippings, green leaves, fruit culls and biosolids.

Moisture

There must be sufficient moisture for the microorganisms to continue to metabolize the feedstocks and convert them to humus. If the mixture of organic feedstocks is too dry, materials will not break down, or will do so very slowly. With dry compost there is a risk of fire from spontaneous combustion or spark. This situation is discussed in more detail in Section 11.

If the mixture is too wet, it will break down very slowly and generate odours. Overly wet compost will not reach the temperatures required for the destruction of pathogens and weed seeds.

Oxygen

Oxygen must be present for the right microbes to remain active. With insufficient oxygen, the desirable aerobic microbes will become dormant, and the anaerobes will take over the composting process. It is important to avoid this situation because anaerobes compost very slowly, they produce foul odours which can result in complaints, and they do not generate the higher temperatures necessary for destruction of pathogens and weed seeds. It is important to aerate the pile to encourage the metabolic action of aerobic microorganisms.

Pile Size

To ensure the above conditions are met, in a commercial operation, compost piles must be large enough to allow temperatures to build up. Most backyard composters lack the size necessary to generate the heat needed to kill pathogens. As mentioned above, piles that are too large are subject to spontaneous combustion, as discussed in Section 11.

2. Government Regulations

The two main regulations that must be followed in the production of biosolids compost that is to be sold, are:

- The Federal *Fertilizers Act*
- The Provincial *Organic Matter Recycling Regulation (OMRR)*, of the *Environmental Management Act*

These can both be found online.

Records of pile turnings, pile temperatures, and lab test results, and these records must be kept on file for a period of not less than 36 months. In order to track the compost through the processes of turning, temperature readings, and testing, each windrow should be given a unique identification number. This number must follow the product all the way through to the consumer, and must be recorded on all sales receipts.

One effective way of keeping track of individual batches is to maintain a log book with a page for each windrow, recording temperatures, turning dates, and sampling dates. The original lab results must also be kept on file.

3. Building piles

Mixing Feedstocks

As previously explained, the feedstocks used must be balanced with one another for carbon and nitrogen content. The C:N ratio of the finished compost must fall between 15 and 35. Mixing ground yard waste and brown leaves (carbon-rich feedstocks) with grass clippings, biosolids and seasonal fruit culls (nitrogen-rich feedstocks) generally produces a good C:N ratio, provided the biosolids are mixed in at a percentage of no more than 25% of the premix volume.

A combination of different particle sizes is important to give the pile the proper 'structure' to allow the composting to proceed in an aerobic fashion. Having some larger pieces of up to 5 inches in their longest dimension creates air spaces within the pile, allowing the desirable aerobic microbes to flourish.

Aeration is also enhanced through the use of correct techniques when building piles. Allowing the premixed feedstocks to 'dribble' off the edge of the loader bucket when building (or turning) piles will keep the structure as fluffy as possible and ensure sufficient oxygen is present to get the process started, and keep it active for several days. Figure 1 provides a graphic representation of the effect the turning frequency has on pile temperature (taken from the Master Composter's Resource Manual).

Mix feedstocks as uniformly as possible. A homogeneous mixture of the feedstocks is necessary to get the compost process started and keep it proceeding smoothly. The microbes need to be able to access both carbon and nitrogen readily. It is also important in avoiding the possibility of spontaneous combustion.

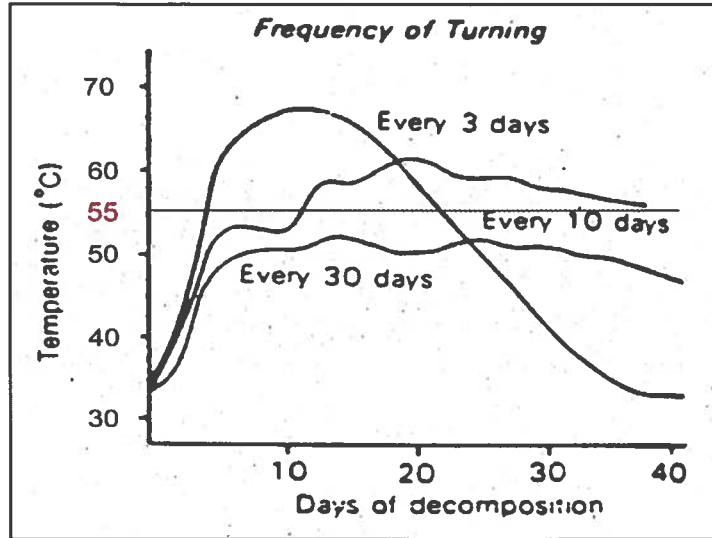


Figure 1

Pile Size

Pile size is partly dictated by the equipment used to build the windrows, but in general, the height should not exceed 3.7 meters (12 feet) as this reduces effectiveness and increases the risk of fire.

4. Adding Water

On the coast, composting operations are often conducted under cover to keep the rain off the piles. In the Okanagan, it is most often a lack of process water which is of concern. Insufficient moisture in the compost windrow leads to:

- slow or stalled composting;
- the possibility of overly high temperatures resulting in risk of fire; and
- incomplete composting that results in a compost with nitrogen content that is too high for regulatory requirements, or for safe use in horticultural applications.

Overly wet piles also create problems. Too much moisture fills up valuable air spaces, resulting in compost that breaks down anaerobically and produces strong foul odours.

The moisture content of composting feedstocks must fall between 40 and 65%, both for effective composting, and for meeting regulatory requirements. In fact,

regulations allow compost to be as dry as 35%, but spontaneous combustion can occur at moisture levels between 25% and 40%, so it is best to keep the compost above this range, especially once the active turning phase is complete.

Water can be added by a water truck or irrigation system with emitters set up along the top of the windrow. It is helpful to use a loader bucket to create a trough in the top of the windrow before adding water, to allow the water to sink into the pile rather than run down the sides. It is important to turn the pile as soon as possible after adding moisture to keep the piles uniformly moist. The addition of moisture is best timed to occur early on the same day as, or on the day before, a scheduled turning.

There are some issues associated with adding water to windrowed compost that operators should be aware of. The first is leachate control. If compost containing biosolids is being produced on porous ground, there is a possibility of pathogens and other dissolved materials entering the ground water.

If the operation is located in an area which has buried garbage underlying the compost windrows, irrigating the compost may add water to the buried waste, resulting in the production of toxic gases, leachate, greenhouse gases and odours.

To avoid problems with leachate production and groundwater contamination, piles should not be overwatered. Added moisture should be confined to the compost windrow without overspray or ponding adjacent to windrows. Piles should be turned as soon after moisture addition as possible to incorporate the moisture evenly into the compost.

5. Turning Piles

The District of Summerland uses a 'turned windrow' composting process. According to the BC Organic Matter Recycling Regulation (OMRR), the following procedure must be followed for turned windrows, in order to produce Class 'A' compost that is approved for sale:

"...the windrow composting method whereby organic matter is processed in a windrow involving periodic aeration and mixing of the windrow, with a temperature of not less than 55° Celsius maintained for at least 15 days and not fewer than 5 turnings of the windrow made during the high temperature period to promote uniform exposure of the compost to thermophilic temperatures."

Turning piles redistributes nutrients and moisture by breaking up pockets of unmixed material, and results in a better quality compost product in less time. It cools hot compost piles so that beneficial microbes remain active, and stops

development of the conditions that result in spontaneous combustion. Most importantly, turning piles introduces oxygen throughout the compost.

In a large compost pile, aerobic microbes are present throughout the pile, metabolizing feedstocks and converting organic material to humus. The microbes need oxygen to do this, and soon use up the available oxygen in the material surrounding them. For microbes located near the outside of the pile, this is not a problem, as air infiltrates the material to replace the oxygen lost. Deeper into the pile, as the oxygen is depleted, it is less readily replaced. Once the oxygen has been used up, the aerobic microbes become dormant until there is more oxygen present.

If the more vigorous aerobes become inactive, the anaerobic microbes can gain a foothold and start breaking down the compost feedstocks. There are several consequences to this: Anaerobes work very slowly, they do not generate the temperatures necessary for pathogen and weed seed destruction, and they produce bad-smelling metabolic byproducts. In practical terms, this means that the compost could take as much as ten times as long to be ready for screening and sale, taking up valuable space and losing potential revenue. The compost cannot be approved for sale, even if it has broken down sufficiently because potentially harmful pathogens will still be present and odours will result in complaints from the public.

According to OMRR, windrows must be turned five times during the thermophilic, high temperature phase. This means that once the temperature has risen above 55°C for several days, it's time to turn the pile. The pile should be turned again until the required number of five turns has been achieved while the temperature remains high.

The regulations require the temperature to remain in the thermophilic phase for 15 days. This is easily achieved provided the pile is constructed properly. Turnings should also occur:

- if the pile or part of the pile cools down below 55°C, if the time/temperature requirements have not yet been met, in order to kick start the process,
- if the pile temperature rises above 73°C, to cool the pile down and avoid a potential fire situation,
- if temperatures taken in different parts of the pile vary by more than fifteen degrees, even if they are within the 55 to 75 degree range,
- if the compost is overly wet, to encourage evaporation of excess moisture, or
- if water has been added to the windrow, to ensure even incorporation.

Equipment operators should strive to loosen up the material as much as possible when turning, and avoid simply moving masses of coagulated material from one point to another. As mentioned in Section 3 on Building Piles, material should be

tossed or allowed to dribble off the edge of the loader bucket to ensure air comes into contact with as much of the material as possible. To achieve maximum penetration of air into the finished windrow, operators should avoid compacting or patting down piles.

Wheel loaders are most commonly used for turning windrows, but excavators can also be effective. Windrow turners can be particularly useful pieces of equipment in a facility that plans to continue operating into the foreseeable future.

6. Recording Temperatures

Pile temperatures are taken with a long temperature probe inserted all the way into the pile and left in place for at least 20 seconds, or until the reading has stabilized. Pile temperatures must be recorded on each business day. With long windrows, as in the situation with the Summerland operation, temperatures should be taken from at least three evenly spaced points on the pile and averaged to give the 'official' reading.

The temperature of screened product should also be taken three days after screening or turning. This gives an indication of the maturity of the compost, or of how complete the composting process is. If the compost is 'finished', there will be little energy left in the pile to drive the composting process, and a low temperature will indicate that the microbes are no longer actively metabolizing this material. The temperature should be no more than 20 degrees higher than the ambient temperature.

If the temperature is too high, the material must once more be turned on a Monday, Tuesday or Friday (to avoid weekend work), and the temperature taken again, three days later, with the above process repeated until the compost is deemed mature.

7. Screening

Once compost has met time, temperature and turning requirements, and has achieved a dark colour and earthy smell, it is ready for screening.

For efficient screening, the compost must be between 35% and 55% moisture content. Compost that is too dry will blow around in the screening process, resulting in loss of the desirable fine portion of the compost. Compost that is too wet will blind the screener, resulting in poor separation of fines and 'overs', requiring rescreening at a later date.

The compost at the Summerland Landfill is screened to ½ inch. This practice should continue as it produces a good grade of product. The screen openings can be reduced to as little as ¼ inch for a fine specialty product for topdressing lawns, or to as large as ¾ of an inch if there are concerns about excessive 'overs'. The operator should be aware that larger screen openings could allow small rocks into the finished product, reducing the product's attractiveness and value.

8. Testing

When to Sample

Testing is carried out on the product which is offered to the public for sale. This means compost must be screened and mature before taking samples for testing. As mentioned in Section 6, compost maturity is determined by taking the temperature of the compost with a temperature probe three days after turning, or screening a pile. If the temperature does not rise to more than 20 degrees Celsius above ambient temperature, the compost may be considered mature.

If the temperature exceeds this parameter, it is an indication that the feedstocks are continuing to break down, and that the composting process is not yet complete. If this happens, the Operator should wait one week, turn the pile, and take another temperature reading 3 days after turning. Repeat as necessary until maturity is reached. After maturity samples can be collected for testing at least 3 days after a turn.

Preparation

It is important to plan ahead when sampling. Samples to be tested for microbiological parameters must be tested within 72 hours of collection. It's best to sample early in the week, and get samples to the commercial lab as promptly as possible once they have been collected. The lab should be notified at least one day in advance that samples will be arriving, so that they can prepare the necessary media and reagents. The ideal scenario involves notifying the lab on a Friday or Monday, and collecting samples on a Monday or Tuesday.

Tests Required

Physical Parameters

Compost must be sampled for the following physical parameters once for every 1000 Tonnes, or once per year; whichever comes first. This is currently the annual production rate in Summerland, so unless production increases, one sample per year is sufficient. Summerland were to have two or more separate compost products, there would need to be a duplicate set of test results for each type of compost.

Take one composite sample annually of at least 750 ml (3+ cups) total to test for the following (regulatory limits for each factor are shown in brackets):

- C:N Ratio (15-35)
- Percent foreign matter ($\leq 1\%$)
- Sharp foreign matter (0%)
- Percent Moisture (35%-65%)
- Arsenic ($\leq 13 \mu\text{g/g}$ dry wt)
- Cadmium (≤ 3 “)
- Chromium (≤ 100 “)
- Cobalt (≤ 34 “)
- Copper (≤ 400 “ – limit under review; may go to 600)
- Lead (≤ 150 “)
- Mercury (≤ 2 “)
- Molybdenum (≤ 5 “)
- Nickel (≤ 62 “)
- Selenium (≤ 2 “)
- Zinc (≤ 500 “)
- Percent Organic Matter ($> 15\%$)*
- Total Nitrogen (N)**
- Water insoluble nitrogen**
- Total and Available Phosphorus (P_2O_5)**
- Soluble Potash (K_2O)**
- pH**

*Required under Federal Fertilizers Act

**These parameters are not required under the Organic Matter Recycling Regulation, but are important in order to explain to customers how to use the product, as required by the Federal Fertilizers Act. The Federal Fertilizers Act also requires testing for metals, but has less stringent limits, so operators should follow the Provincial OMRR limits, in brackets after each parameter.

Microbiological Parameters

In addition, each batch or windrow must be tested for microbiological parameters. There are approximately 7 windrows produced per year, and 10 samples must be taken over the year, as per the Federal Fertilizers Act. Taking 2 samples from each batch, from different locations on the stockpile ensures that regulatory requirements are being met. Take samples using sterile technique, to test for:

- Fecal coliforms (< 1000 mpn/g dry wt) (required by both Fertilizers Act and OMRR)
- *Salmonella* (nondetect) (required under Fertilizers Act)

How to Collect Samples

Pre-label sample bags (large Ziploc freezer bags) with Sharpie marker:

- Date and time of sampling
- Name: "District of Summerland Compost"
- Windrow or 'batch' identification number
- Sample number (1, 2, 3... etc)
- What samples are to be tested for

Sampling for Physical Parameters

For the annual comprehensive sample, sterile technique is not of concern. Remove top 6 inches of compost from the outside surface of the compost pile. This is done because the compost on the pile surface may have become either dried out or saturated in precipitation, and fine material blows away, so surface samples are not representative of the product.

Use a gloved hand or a clean trowel to take a handful of compost and place it in a large pre-labeled Ziploc freezer bag. Repeat this procedure to take samples from at least 3 different evenly spaced locations to make up a composite sample. Make sure bag is sealed between samples, and again immediately after final sample is added to the bag to ensure minimal moisture loss.

Sampling for Microbiological Parameters

Use sterile technique to collect samples to be tested for fecal coliforms and *Salmonella*.

First rinse trowel with squirt bottle containing 10% Javex (or 80% Ethanol, or other approved disinfectant), taking care not to splatter clothing. Wipe with clean paper towel to remove excess disinfectant.

"Vectors" such as birds, insects and small mammals have access to the pile surface, and may deposit fecal coliforms there. This surface material must be removed before sampling to avoid contamination of samples. With a gloved hand, scoop off the top 5 centimeters (2 inches) of compost from the pile surface at the sampling location in an area of 60cm by 60cm (2 feet x 2 feet), sweeping sideways. Start at the top of the area to be cleared and work to the bottom to avoid contaminating the freshly cleared area with surface compost. Discard the glove, and put on a clean one. Use the sterilized trowel and clean disposable glove to dig a hole between 35 cm to 60 cm (14 to 24 inches) deep horizontally into the pile. Ensure the trowel touches just the bottom and sides of the hole while digging, without touching the inside top surface.

To collect the sample, the staff person should invert the labeled sampling bag over their hand and grab a large handful of compost from the inside top surface of the hole, using the freezer bag. Try to get the sample from as deep into the hole as possible, without allowing compost from the surface of the pile to touch the inverted bag. Turn the bag right-side-out over the sample, squeezing out

excess air as the bag is sealed, and taking care not to touch the interior of the bag.

Place the bagged sample directly into a cooler with frozen ice packs in it to chill the samples and keep them cold. Spreading the compost out into a thin layer within the bag allows it to cool more quickly.

Repeat for the second sample, in a different location, preferably on the other side of the pile. Make sure the trowel is cleaned off, then rinsed with disinfectant solution for each sampling location, but the glove can be left on after the first sampling location to clear away the surface material at the second location, before changing.

Every effort should be made to get the samples to the lab the same day as sampling.

9. Labeling requirements

The Canadian Food Inspection Agency, through the Federal Fertilizers Act has specific labeling requirements regarding compost. The “label” refers to information that must be given to each customer, each time they purchase the product. For a bulk product, the required information may be presented as a handout, or printed directly on the receipt.

Handouts have been prepared that must be given to each customer. According to the Federal Fertilizers Act, the information they must carry includes:

- The product name (“Compost”)
- The net weight (this will appear on the receipt)
- The company name and complete postal address
- The lot number (this is the windrow or batch identification number)
- Guaranteed analysis – only percent organic matter and percent moisture are required. The District is not making official nutrient claims, and therefore is not required to list the percentages of nitrogen, phosphorus and potassium.
- Directions for use – this is a soil conditioner that should be mixed with soil at no more than 1 part compost to 4 parts soil.
- Cautionary statements – the label should recommend hand washing after using the product.

10. Selling Compost Product

The compost produced at the Summerland Landfill is a high quality product, rich in nutrients and high in organic content. It improves the texture and water-holding capacity of soil, and provides macro and micronutrients that increase

plant vigour, improving disease and insect resistance, flower colour, drought resistance, and growth rate. It is important that this product not be undervalued.

When a customer purchases a landscaping material like compost, they usually have a required volume in mind. For instance, they may want a bucket of compost to mix into their hanging baskets, or they may need a cubic yard to mulch their shrub bed. Most customers will want to purchase the product by volume.

The District of Summerland compost is sold by the kilogram or tonne. The mass of a given volume of compost can vary significantly depending on its moisture content, and moisture content can vary wildly by time of year. The same amount of effort and expense goes into producing that volume regardless of moisture content, thus compost moisture content should be kept as consistent as possible.

11. Compost Fires

The Mechanics of Spontaneous Combustion

Fires frequently occur in compost windrows and feedstock stockpiles. There are many different sources of combustion, including welding sparks, lightning, cigarette butts, and heat from equipment and vehicles, but spontaneous combustion is the most common and least understood cause of compost fires.

Spontaneous combustion occurs when organic materials self-heat to a temperature high enough to cause them to ignite. Typically, composting materials ignite at temperatures between 150 and 200°C.

In a compost pile, the temperature rises due to the biological activity within the pile. If the temperature reaches 70 or 80°C, the microorganisms die or become dormant and the biological heating stops. In a pile with low moisture content, there is insufficient evaporation to cool the pile down once this point is reached.

From this point to the ignition temperature (150°C and higher), heat-releasing chemical reactions take over. As the temperature rises, the speed of the temperature increase accelerates, with the reaction rate doubling with every 10°C increase in temperature.

There are some key conditions in which spontaneous combustion will occur:

- presence of biological activity
- moisture levels between 25% and 40%
- large or well-insulated piles
- limited air flow
- time for temperature to build up

A non-uniform mixture of materials or uneven moisture distribution are also factors that can contribute to spontaneous combustion.

Large undisturbed piles such as feedstock stockpiles and curing piles are at greatest risk.

Warning: A large pile containing an undetected smoldering fire could change to a flaming fire if the material is opened up, and oxygen is allowed to fuel the fire. Workers should not walk on top of piles at risk of spontaneous combustion as they may break through a crust to a pocket of smoldering fire. Temperature probes can help monitor pile temperature, but operators should be aware that the temperature can vary significantly from adjacent locations in the pile, especially in non-uniform piles.

Avoiding Fires

Monitor organics piles for hot spots – high temperature, visible vents, smoke or burning smell

Ensure adequate ventilation and moisture content

Avoid piles higher than 3.7 meters (12 feet)

Ensure that piles are not left undisturbed for long periods of time

Extinguishing Fires

The fire department should be called (phone 911) to deal with any fire. Surface fires and internal fires are handled differently. For surface fires, arising from lightning, sparks or heat from equipment etc, the best method of suppression is simply to apply water.

For fires that arise due to spontaneous combustion, which is more likely an internal fire, equipment should be stationed around the perimeter of the pile; *never* on top. Material should be removed from the edges of the pile, and soaked, working inwards until the burning sections are isolated and quenched.

As material is removed it should be spread on the ground or stacked in small piles to cool.

Compost fires should not be smothered with soil, as it could take up to two years for the pile to cool.

12. Compost Facility Layout

How the compost facility is laid out can have an enormous impact on the cost of the operation. Every time a piece of equipment touches the compost, the cost of running the operation goes up. The distance over which materials are moved also affects the bottom line.

The quality and safety of the finished product can be affected by poor facility design. The operation should be structured to avoid cross contamination, where pathogens from fresh biosolids are transferred to "pasteurized" material that has already undergone the pathogen-reduction process. Pathogens from raw biosolids get caught up in equipment tires, and traffic patterns should be carefully planned and adhered to.

A linear or circular layout where feedstocks enter at one end, and customers leave the facility with finished compost at the other end is the most practical.

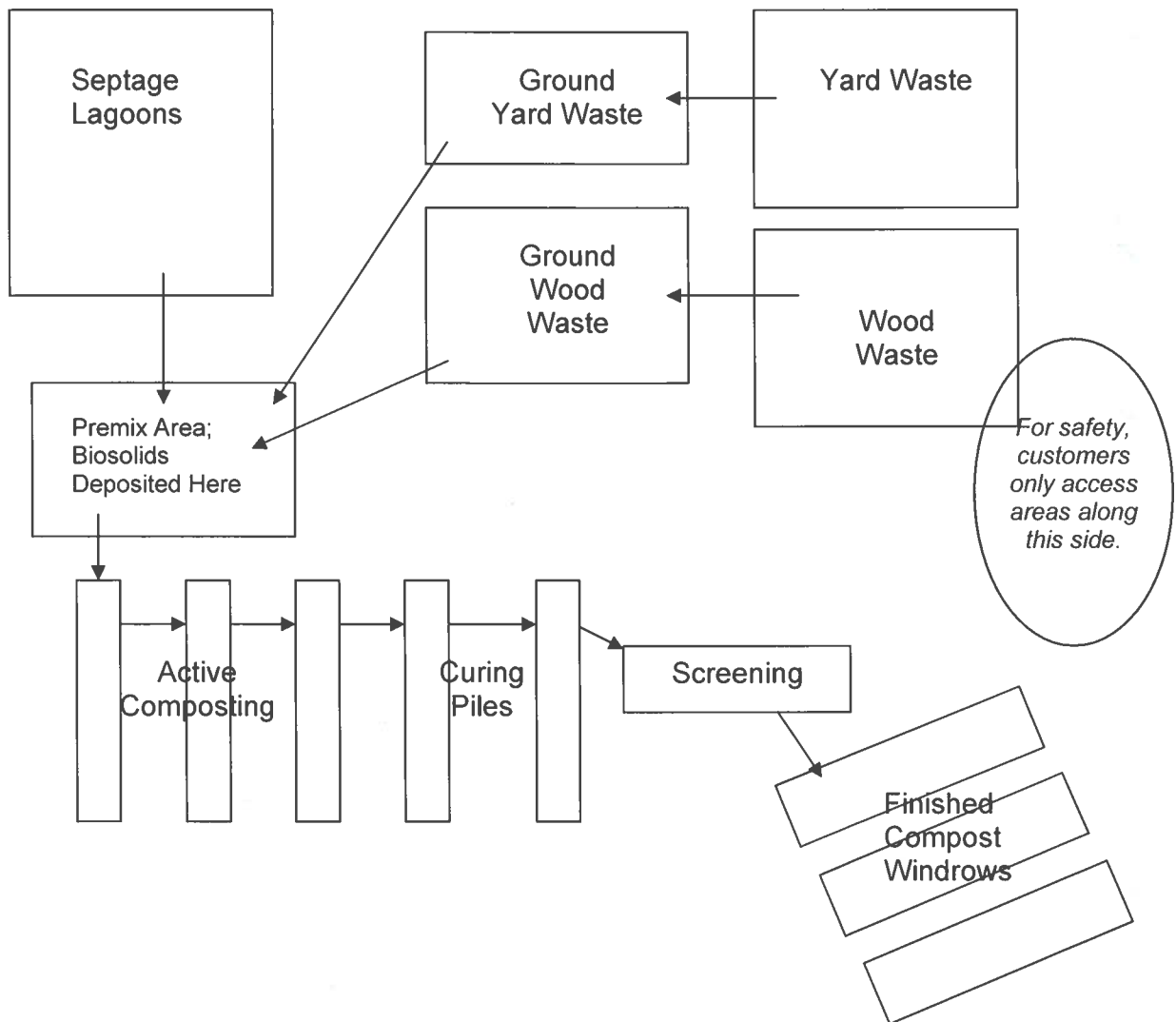


Table 7.0
Dewatered Primary Sludge and Waste Activated Sludge Hauled to Compost Site, 2022

Date	January kg	February kg	March kg	April kg	May kg	June kg	July kg	August kg	September kg	October kg	November kg	December kg
1		5400	2680	6100		7780					4400	
2		5330	6630						3420		6120	6560
3					5740	6190						
4	8160		7860		6350		7290	6730		6330	7240	
5	6310			7310			7460			6940		
6				8230	4720				4430			5680
7	8670			7740		7460			5650	8040		5230
8		6440	7370			6370					6810	
9		5680						6650	4750			5140
10					6750	5440					4240	
11	8250	7310	5920	6800	6550			8300		3570		
12	5560									6510		
13					5930		7950		5930			4900
14	5750			9910		6050			5960	7800		6390
15		6660	6400			8250	6750				8670	
16		6600	4060								5520	4080
17					6750			9020				
18	6790	9170	3600	6710	7740					8290		
19	6460				8190		5910	8550		3510		
20				8690			7750					
21						6870			6350			
22		8220	6390	7230		6450	7200		4610	5820	4090	6730
23		7620	4200					6470	6980		7500	
24					5100	8090		3890				
25	7550	7380	8340							5190	6930	
26	5500			7470			7120	3900		6590		
27				7770	8460		7910		4930			
28	6460	8760				6750			7470	5430		5190
29			2290	6830		7020	7370		4880		5040	4950
30			7100			4170		4600			6420	2940
31					7040			3750				
Minimum	5500	5330	2290	6100	4720	4170	5910	3750	3420	3510	4090	2940
Maximum	8670	9170	8340	9910	8460	8250	7950	9020	7470	8290	8670	7110
Average	6860	7048	5603	7566	6610	6684	7271	6186	5464	6168	6082	5408
Count	11	12	13	12	12	13	10	10	13	12	12	12
Std. Dev.	1130	1264	2005	1021	1151	1120	605	2045	1109	1567	1446	1186
Total	75460	84570	72840	90790	79320	86890	72710	61860	71030	74020	72980	64900

Loads to Compost	142 Trucks
Total Hauled	907,370 kg/yr
Average Hauled	2,486 kg/day

Table 7.1 Historical Primary Sludge and Waste Activated Sludge Hauled to Compost Site , 2022							
Month	2006	2007	2008	2009	2010	2011	2012
January	75130	77595	93254	71154	63065	44235	75460
February	30850	84694	66295	66295	50385	39690	84570
March	67085	80175	116670	60640	70395	69505	72840
April	87605	70525	100190	90035	90035	57625	90790
May	43535	89963	86190	131120	162100	71235	79320
June	79745	95420	99060	93565	73755	48200	86890
July	72010	94720	79535	70105	72930	72770	72710
August	82815	93980	64655	132065	83385	89675	
September	98345	54615	82570	72925	67350	72955	71030
October	55825	98595	72555	82050	63200	67835	74020
November	64935	50260	90295	71555	41855	62995	72980
December	57185	44250	46820	101765	76365	49285	64900
Yearly Total (kg)	815,065	934,792	998,089	1,043,274	914,820	746,005	845,510
Yearly Month Avg. (kg)	67,922	77,899	83,174	86,940	76,235	62,167	76,865
Yearly Day Avg. (kg)	2,233	2,561	2,734	2,858	2,506	2,044	2,316

Month	2013	2014	2015	2016	2017	2018	2019
January	41355	60415	43540	74165	54020	79080	44250
February	77115	59680	55500	71450	45460	40720	49590
March	112085	54875	77675	60610	50640	51950	55650
April	113790	86640	74665	63380	63370	86970	52860
May	75220	67120	71870	75910	87480	89720	108840
June	75235	82945	53840	75230	66140	67100	50340
July	72395	58500	87490	67200	87960	81870	77930
August	45520	73515	38660	82220	84420	47320	72860
September	74910	68430	51990	67990	77490	91530	68440
October	86735	69805	47775	41450	70010	53450	118160
November	47235	33770	49285	48520	75090	51000	81690
December	48035	59805	16845	50290	59830	39420	58070
Yearly Total (kg)	869,630	775,500	669,135	778,415	821,910	780,130	838,680
Yearly Month Avg. (kg)	72,469	64,625	55,761	64,868	68,493	65,011	69,890
Yearly Day Avg. (kg)	2,383	2,125	1,833	2,133	2,252	2,137	2,298

Month	2020	2021	2022	2023	2024	2025	2026
January	68660	86330	75460	0	0	0	0
February	63920	76010	84570	0	0	0	0
March	77720	111960	72840	0	0	0	0
April	91550	91200	90790	0	0	0	0
May	100950	71940	79320	0	0	0	0
June	86300	92870	86890	0	0	0	0
July	89950	92770	72710	0	0	0	0
August	79590	90070	61860	0	0	0	0
September	80680	65530	71030	0	0	0	0
October	73080	85810	74020	0	0	0	0
November	54520	87940	72980	0	0	0	0
December	96700	83510	64900	0	0	0	0
Yearly Total (kg)	963,620	1,035,940	907,370				
Yearly Month Avg. (kg)	80,302	86,328	75,614				
Yearly Day Avg. (kg)	2,640	2,838	2,486				

Table 7.2
Dewatered Sludge Analysis 2022

2021	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>
15-Mar-22	8590	0.95	0.63	104	<0.10	13.6	10.9	0.541	12300	8.5	1.13	286
11-Nov-22	10300	0.66	0.69	129	<0.10	15.5	16.0	0.527	8100	6.0	1.05	261
Min	8590	0.66	0.63	104	0.00	13.6	10.9	0.527	8100	6.0	1.05	261
Average	9445	0.81	0.66	117	0.00	14.6	13.5	0.534	10200	7.3	1.09	274
Maximum	10300	0.95	0.69	129	0.00	15.5	16.0	0.541	12300	8.5	1.13	286

	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Ag
	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>
15-Mar-22	1650	8.69	0.84	2760	37.5	0.392	7.71	6.12	16000	3300	1.98	1.43
11-Nov-22	1900	4.98	0.67	2930	36.9	0.631	8.47	5.32	17900	2190	2.03	1.35
Min	1650	4.98	0.67	2760	36.9	0.392	7.71	5.32	16000	2190	1.98	1.35
Average	1775	6.84	0.76	2845	37.2	0.512	8.09	5.72	16950	2745	2.01	1.39
Maximum	1900	8.69	0.84	2930	37.5	0.631	8.47	6.12	17900	3300	2.03	1.43

	Na	Sr	S	Te	Tl	Th	Sn	Ti	U	V	Zn	Zr
	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>	<i>mg/kg</i>
15-Mar-22	429	77	2780	<0.1	<0.1	<0.5	11.0	57.0	8.92	2.0	334	10.7
11-Nov-22	390	82	4320	<0.1	<0.1	<0.5	10.9	56.9	8	2.9	304	6.8
Min	390	77	2780	0.00	0.00	0.00	10.9	56.9	8.00	2.0	304	6.8
Average	410	80	3550	0.00	0.00	0.00	11.0	57.0	8.46	2.5	319	8.8
Maximum	429	82	4320	0.00	0.00	0.00	11.0	57.0	8.92	2.9	334	10.7

Graph 7.0
Dewatered Sludge to Landfill
Yearly Weights 2012 - 2022

