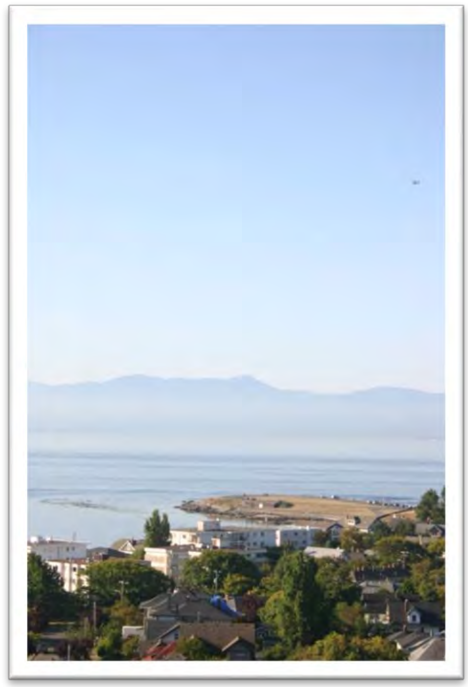
Core Area Wastewater Facilities

Environmental Monitoring Program - 2023 Report

Cycle 3 – Year 3

Capital Regional District | Parks, Recreation & Environmental Services, Environmental Protection



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CORE AREA WASTEWATER FACILITIES
ENVIRONMENTAL MONITORING PROGRAM
2023 REPORT

EXECUTIVE SUMMARY

The Capital Regional District (CRD) commissioned a new tertiary treatment plant and outfall at McLoughlin Point (McLoughlin) in 2020. Prior to this, the CRD discharged fine-screened municipal wastewater through two core area outfalls located at Macaulay Point (Macaulay) and Clover Point (Clover). Optimization of the treatment processes at McLoughlin was ongoing through 2022. Therefore, 2020 through 2022 are considered transitional years for both sewage treatment and the associated wastewater and receiving environment monitoring program in the Core Area.

CRD staff have monitored quality of the wastewater, surface water and seafloor environments in the vicinity of the Macaulay and Clover outfalls since the late 1980s. The CRD shifted the focus of monitoring to McLoughlin in 2021, but there is significant overlap with historical monitoring locations.

The CRD is required to monitor for compliance with the Municipal Wastewater Regulation (MWR) under the provincial *Environmental Management Act* and the Wastewater Systems Effluent Regulations (WSER) under the federal *Fisheries Act*.

Beyond regulatory compliance, to ensure protection of human health and the environment, the CRD undertakes monitoring as outlined in the Core Area Liquid Waste Management Plan to assess the impacts of discharged sewage on the marine environment. This monitoring is done on a five-year cycle.

The 2023 Environmental Monitoring Program (EMP) report represents Year 3 of Cycle 3 and includes:

- wastewater monitoring and analysis for conventional parameters, metals, other contaminants of concern substances and toxicity.
- receiving environment monitoring, including surface water and water column analysis for bacteriological indicators, conventional parameters, metals, and other priority substances (conducted quarterly at McLoughlin).
- wet weather overflow and bypass sampling for bacteriological indicators indicating potential for human exposure to wastewater in the marine environment, and a subset of conventional parameters indicative of wastewater strength (conducted as needed at Macaulay and Clover, and shoreline overflow locations when bypass, overflow or wet weather events occurred).
- additional investigations and research collaborations that address specific questions about water column and seafloor monitoring components and investigate emerging scientific issues regarding wastewater discharges and environmental effects.

RESULTS

Overall, risks to human health and the environment were low. The installation of tertiary treatment at McLoughlin has substantively reduced the concentrations and loadings of contaminants to the marine receiving environment relative to the historical discharge practices out of the Macaulay and Clover outfalls. As such, potential risks to human health and the environment have also been reduced.

During 2023, McLoughlin achieved a high-quality effluent but was slightly above provincial regulatory limits intermittently from March to December. This was expected as regulatory limits are exceptionally low relative to treatment plant design capabilities. Possible changes to these limits are being discussed with the regulator. In addition, CRD staff are investigating the potential that highly variable centrate return flows from the Residuals Treatment Facility may be impacting the treatment plant’s ability to continuously achieve effluent quality limits.

Wet weather high flows, (defined as two times annual dry weather flow amounts) are predicted to occur up to 70 days per year resulting in discharge of blended primary and tertiary effluent from the McLoughlin outfall. In 2023, there were only 10 days when blending occurred, however, these occurrences happened when the full tertiary treatment capacity was not yet achieved. Operators are continuing to refine internal flow balancing to ensure blending only happens when full tertiary treatment capacity is reached.

Surface water and water column sampling confirmed that the new McLoughlin outfall was operating as predicted from plume dispersion and dilution modelling. Bacteriological and other contaminant levels in the receiving environment were well below those observed when Macaulay and Clover were discharging and were below human health guidelines. This further affirms the benefit of installing treatment at McLoughlin.

The conveyance system is designed with numerous shoreline sanitary and combined sewer overflow and relief points that discharge during heavy rains, planned maintenance or following unexpected events. CRD staff conduct shoreline monitoring to assess human health risk for people engaged in recreational activities on beaches adjacent to the overflow locations. There was no shoreline monitoring conducted in 2023, but data from the historical program (up until 2021) confirmed that wastewater overflow signals typically dissipate within 48 hours. Adjacent municipal stormwater discharge signals persist longer, sometimes continuously.

ADDITIONAL INVESTIGATIONS AND RESEARCH

Additional investigations address specific questions or issues pertaining to the monitoring program, clarify aspects of the program, or provide concurrent data for the assessment of environmental effects. Some additional investigations are also requirements of the Liquid Waste Management Plan approval.

The CRD is sampling influent from the McLoughlin Wastewater Treatment Plant several times per week for the BC Centre for Disease Control (BCCDC) and for Public Health Agency of Canada. These groups are testing influent from McLoughlin and elsewhere in BC and Canada for both COVID-19 and influenza analyses. Results are available on the BCCDC and the Public Health Canada websites.

The CRD continued to participate in a related project with the University of British Columbia and Harbour Resource Partners, the consortium that built the McLoughlin Wastewater Treatment Plant. This project involves the development of a simple handheld sensor that could be used by operators to detect various pathogens in wastewater (including viruses like COVID-19), with the hope that the data would be used to inform local health authorities about changes in pathogen levels over time. No results are available currently.

In 2023, the CRD continued to participate in two Ocean Wise Conservation Association initiatives: the Salish Sea Ambient Monitoring Exchange (SSAMEx) and Pollution Tracker.

Discussions are ongoing with research laboratories regarding opportunities to assess the effectiveness of the McLoughlin WWTP to characterize and potentially reduce microplastic loadings to the environment. This work was implemented in 2024.

The CRD has also provided benthic invertebrate debris samples from Macaulay Point to a University of Chicago researcher as part of a collaborative project with Biologica (the CRD's contract benthic taxonomist). The researcher has been comparing "death assemblages" of molluscs and bivalves contained within the archived debris to "live" communities assessed as part of the routine sediment sampling program. Assessments are ongoing, with anticipation that results will be published in a relevant scientific journal.

Finally, the CRD continued participation in a second collaborative project with Biologica, University of Victoria and Metro Vancouver to develop an inexpensive benthos toxicogenomic tool that could be used in years when seafloor sampling does not take place. It could also be used at historical monitoring stations that have been abandoned. The project has a five-year timeline and in 2021 the team optimized field collection methods and successfully isolated environmental DNA (eDNA) from several indicator species. The CRD will continue to provide support, including a sampling vessel and sample access in 2024 and beyond. Results to-date have been presented at three scientific conferences in 2021 and 2022.

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Terms & Abbreviations

ADWF	Average Dry Weather Flow
BAF	Biological Aerated Filters
BOD	Biochemical Oxygen Demand
CALA	Canadian Association for Laboratory Accreditation Inc.
CBOD	Carbonaceous Biochemical Oxygen Demand
CCME	Canadian Council of Ministers of the Environment
CFU	Colony-forming unit
Cl	Chloride
COD	Chemical Oxygen Demand
COND	Conductivity
CPS	Clover Pump Station
CRD	Capital Regional District
CSO	Combined sewer overflow
CTD	Conductivity-temperature-depth
EMP	Environmental Monitoring Program
ENT	enterococci
ENV	BC Ministry of Environment and Climate Change Strategy
FC	Fecal Coliform
ICES	International Council for the Exploration of the Sea
IDZ	Initial Dilution Zone
LWMP	Liquid Waste Management Program
MBBR	Moving Bed Biofilm Reactors
MPWWTP	McLoughlin Point Wastewater Treatment Plant
MLD	Megalitres per day
MMAG	Marine Monitoring Advisory Group
MPS	Macaulay Pump Station
NH_3	Ammonia
NO_2	Nitrite
NO_3	Nitrate
NP	Nonylphenols
NSERC	Natural Sciences and Engineering Research Council of Canada
OC	Organochlorine pesticides
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCDD	Polychlorinated dibenzo-p-dioxins
PDBE	Polybrominated diphenyl ethers
PFAS	Per- and poly-fluoroalkyl substances
PFOS	Perfluorooctane sulfonate
PICES	North Pacific Marine Science Organization
PPCP	Pharmaceuticals and personal care products
QA/QC	Quality assurance/quality control
SCADA	Supervisory Control and Data Acquisition
SETAC	Society of Environmental Toxicology and Chemistry
SSAMEx	Salish Sea Ambient Monitoring Exchange
SSO	Sanitary sewer overflow
TDP	Total dissolved phosphorus
TKN	Total Kjeldahl nitrogen
TOC	Total organic carbon
TP	Total phosphorus
TSS	Total Suspended Solids

Terms & Abbreviations

US EPA	US Environmental Protection Agency
UVIC	University of Victoria
WAD	Weak acid dissociable (WAD) cyanide
WMEP	Wastewater Marine Environment Program
WQG	Water Quality Guidelines
WSER	Wastewater Systems Effluent Regulations
MWR	Municipal Wastewater Regulation
WWTP	Wastewater Treatment Plant

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1.0 BACKGROUND

The Capital Regional District (CRD) treats Core Area wastewater at the McLoughlin Point Wastewater Treatment Plant (MPWWTP;Figure 1.1). This facility was commissioned in August 2020 to replace the previous practice of discharging fine-screened (6 mm) wastewater through the Macaulay Point (Macaulay) and Clover Point (Clover) outfalls. The MPWWTP treats most of the Core Area wastewater to a tertiary standard before discharging through a 1,925 metre (m) long outfall to the Salish Sea (Juan de Fuca Straight). This outfall includes a 210 m multiport diffuser that terminates at approximately 60 m depth and is located approximately 200 m east of the existing Macaulay Point outfall terminus.

CRD Core Area Liquid Waste Management Plan and Sewage Treatment Upgrades

In March 2003, the CRD Core Area Liquid Waste Management Plan (LWMP) (CRD, 2000) was approved by the BC Ministry of Environment and Climate Change Strategy (ENV). The plan outlined the CRD's strategy to manage liquid wastes for the next 25 years. Commitments made in this plan were designed to protect public health and the environment from the impacts of liquid waste discharges. On July 21, 2006, the CRD received a letter from the minister of environment requiring an amendment to the plan. The amendment detailed a schedule for the provision of secondary or better sewage treatment and requested that the CRD continue the current monitoring program. Plan amendment #7 (CRD, 2009) was submitted to ENV in December 2009, along with follow up amendments #8 (CRD, 2010), #9 (CRD, 2014), #10 (CRD, 2016a), #11 (CRD, 2016b), and #12 (CRD, 2017). These amendments have all been conditionally approved by ENV and included the CRD’s commitment to build the new plant at McLoughlin Point, plus a facility at Hartland Landfill to treat the resulting sewage residuals to a Class A biosolids standard, as per the BC Organic Matter Recycling Regulation. Amendment #12, detailing the District of Oak Bay’s plans to eliminate the two combined sewer overflow (CSO) locations in the Clover system, was also conditionally approved in June 2018.

The McLoughlin WWTP operates under *BC Municipal Wastewater Regulation* registration RE-108831, which was originally issued in June 2020 and revised in February 2021. The MPWWTP also meets all requirements of the Federal *Wastewater Systems Effluent Regulation* (WSER). The Macaulay and Clover outfalls historically operated under permits issued by ENV under the 2004 *BC Environmental Management Act* [formerly the *BC Waste Management Act* (BCMoE, 2004)]. Following the commissioning of the McLoughlin facility, the permit for Clover was cancelled effective June 20, 2021, and for Macaulay effective January 7, 2022. The transitional authorizations for Macaulay and Clover, to discharge deleterious substances under WSER, were also cancelled effective December 31, 2020. All three outfalls also operate under the long-term direction of the LWMP (see Appendix A1 for more detail).

Sewage Treatment at McLoughlin Point Wastewater Treatment Plant

Screening and grit removal occurs at the Macaulay and Clover pump stations (Figure 1.1) prior to pumping flows to McLoughlin Point Wastewater Treatment Plant. The MPWWTP can handle up to 432 megalitres per day (MLD), which is four times the Average Dry Weather Flow (ADWF = 108 MLD per day). Treatment processes include:

- Primary Treatment:
  - Lamella plate settlers for flows up to 216 MLD (i.e., 2xADWF).
  - High rate Densadegs for flows exceeding 216 MLD and up to 432 MLD (i.e., 2-4xADWF).
- Secondary Treatment: a sequence of Moving Bed Biofilm Reactors (MBBR) and Biological Aerated Filters (BAF) for primary flows up to 216 MLD.
- Tertiary Treatment: Cloth Disk Filters for secondary flows up to 216 MLD.

High Flow Bypass and Overflows

Flows up to 216 MLD (i.e., 2xADWF) receive full tertiary treatment at MPWWTP. When flows exceed 216 MLD, typically during wet weather, the flows above 216 MLD receive primary treatment only (high rate Densadeg) and are then blended with the tertiary effluent prior to outfall discharge.

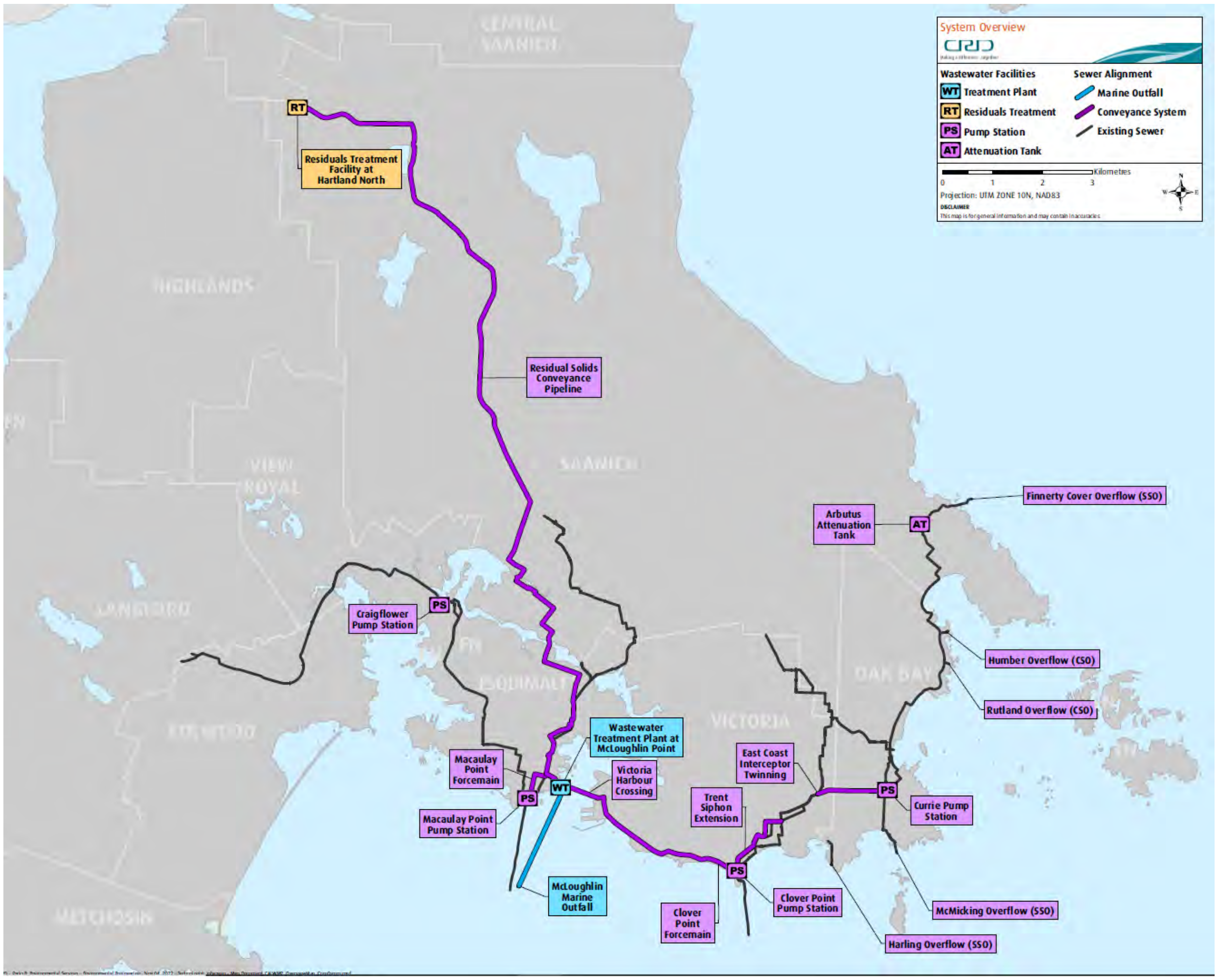
Both Clover and Macaulay pump stations have upgraded capacity to pump 4xADWF to MPWWTP. During heavy rain events, flows may exceed this threshold. In these rain events, flows exceeding 4xADWF are screened to 6 mm and discharged out the Macaulay and/or Clover long outfalls – effectively operating as sanitary sewer overflow points for the upstream conveyance system. These overflows have been very rare since commissioning of the WWTP.

Wastewater has been discharged from the Macaulay and Point outfalls for over 100 years. The Macaulay outfall has been in use since 1915, with the initial discharge at low tide level. In 1971, to alleviate shoreline pollution, the discharge location was moved offshore. The outfall is now approximately 1,800 m long and terminates in a multiport diffuser at a depth of 60 m. The discharge of municipal wastewater at Clover began in 1894. Discharge was to the shoreline until 1981, when construction of an extended outfall was completed. The Clover outfall is approximately 1,160 m long and discharges through a multiport diffuser at a depth of approximately 65 m.

The treated McLoughlin and screened wet weather Macaulay and Clover wastewaters are discharged to the deep, cold, and fast-moving waters of Juan de Fuca Strait. The non-saline wastewater is then rapidly diluted as it mixes with surrounding saline receiving water. As the wastewater plume mixes with the saline water, it rapidly rises and traps at mean depths of 20-50 m (McLoughlin) and 45-60 m (Macaulay and Clover), with some plume surfacing predicted and measured during periods of slack tide, predominantly during the winter months (Hodgins, 2006; Lorax, 2019).

Monitoring year 2023 represents Cycle 3, Year 3 of the Environmental Monitoring Program (EMP; formerly the Wastewater and Marine Environment Program [WMEP]). As the Residuals Treatment Facility at Hartland Landfill is regulated under a separate provincial authorization (ME-109471), biosolids monitoring results are presented in separate reports (CRD, 2024 and HRMG, 2024).

Figure 1.1 Locations of Major Core Area Wastewater Facilities and Discharge Locations



In addition to the three main discharge points, there are several shoreline sanitary sewer overflow (SSO) and two combined sewer overflow (CSO) locations in the upstream conveyance system (Figure 1.1) that serve as wet weather and emergency bypass and overflow locations.

The Arbutus Flow Attenuation Tank was installed in the upstream conveyance system (near Haro Woods) as part of the MPWWTP construction project. This tank substantively reduces the frequency of SSO discharge events relative to the old configuration.

The two CSO locations (Humber and Rutland pump stations) are within the District of Oak Bay. Oak Bay is required to separate these systems and are actively working towards this goal at Humber Pump Station. The separation plan for Rutland pump station is still in planning stages. Until fully separated, the frequency of CSO discharge events will remain unchanged as they are operated independently of the adjacent trunk conveyance system during wet weather events.

Clover and Macaulay pump stations have upgraded capacity to pump 4xADWF to MPWWTP. During heavy rain events, flows may exceed this threshold. In these rain events, flows exceeding 4xADWF are screened to 6 mm and discharged out the Macaulay and/or Clover long outfalls.

1.1 Approach and Program Components

The current monitoring program components were developed in conjunction with BC ENV and MMAG, as part of the newest environmental monitoring program based on a five-year cycle. The first cycle (Cycle 1) took place from 2011-2015, but one component (the fish survey) was delayed until 2018 due to logistical challenges. Cycle 2 began in 2016 and ended in 2020. Cycle 3 began in 2021 and will end in 2025. The objectives of the monitoring program [as presented in the Core Area Liquid Waste Management Plan (CRD, 2000) and updated in amendment #7 (CRD, 2009)] are as follows:

- monitor and assess wastewater quality and quantity.
- monitor and assess the potential effects of the wastewater discharges to the marine environment.
- monitor and assess the potential effects of the wastewater discharges to human health.
- provide information to the CRD's Regional Source Control Program.
- provide information to wastewater managers regarding plant and outfall diffuser performance.
- provide compliance monitoring results to regulatory agencies.
- provide scientific assessment to the general public regarding the use of the marine environment for the disposal of municipal wastewater.

A summary of the monitoring components and sampling frequency of the current five-year EMP Cycle 3 is presented in Table 1.1. The 2023 monitoring program is presented in Table 1.2 and consists of the following components:

- wastewater monitoring and analysis for a list of substances, including conventional parameters, metals, other compounds of concern and toxicity (conducted monthly at McLoughlin).
- receiving environment monitoring including surface water and water column analysis for bacteriological indicators of potential for human exposure to wastewater in the marine environment. Additionally, a list of substances, including conventional parameters, metals, and other priority substances (conducted quarterly at McLoughlin, and only if they are discharging coincident with routine McLoughlin sampling, around the Macaulay and Clover outfalls).
- wet weather overflow and bypass sampling for bacteriological indicators of potential for human exposure to wastewater in the marine environment, and a subset of conventional parameters indicative of wastewater strength (conducted as needed at Macaulay and Clover, and around the various shoreline overflow locations when bypass, overflow or wet weather events occurred).
- continuing additional investigations that address specific questions about water column and seafloor monitoring components and that investigate emerging scientific issues regarding wastewater discharges and environmental effects.

Reclaimed water monitoring is also a requirement of the EMP, but the reclaimed water system was abandoned early in 2021 due to operational challenges. As such, no reclaimed water data will be presented in this report.

An evidence-based approach is used to assess potential environmental effects. Wastewater is analysed on a regular basis to monitor the substances present in sewage. The potential effects of these substances on organisms in surface waters and the water column are assessed by comparing the concentrations that are predicted in the marine environment to water quality guidelines. The predicted concentrations are calculated by applying computer model-derived receiving environment dilution factors to the wastewater concentrations. Predicted concentrations are then confirmed by surface and water column monitoring around each outfall. Human health risks are assessed via the surface, water column and shoreline bacteriological monitoring. Concentrations of substances present in the wastewater discharges are also analysed in sediments around the outfalls and at reference sites. Sediment chemistry results are compared to various sediment quality guidelines as a screening tool to predict potential effects on biological organisms in the marine environment. Finally, organisms that live around the outfalls are monitored to assess direct *in situ* outfall effects.

The organisms that have the potential for the most severe effects in the marine environment close to the outfalls are those that are sessile and/or continuously exposed to the wastewater discharges. These include benthic invertebrate communities off the McLoughlin and Macaulay outfalls and mussel communities off the Clover outfall. Prior to 2011, these organisms were monitored annually. As part of the revised EMP design, their monitoring frequency was reduced to only once (mussel communities) or twice (benthic invertebrate communities) in the five-year cycle. This reduced frequency has allowed for the addition of sediment toxicity and bioaccumulation assessments, along with a finfish health assessment.

In addition to the sediment toxicity and bioaccumulation studies, the health of the seafloor communities is evaluated by assessing what organisms are present, along with their abundance, growth, and reproductive status. These biological indicators provide a direct assessment of *in situ* environmental effects. Potential effects to higher trophic levels (e.g., fish and marine mammals) are also assessed by measuring concentrations of substances present in wastewater, sediments, benthic invertebrates, mussel, finfish and crab tissue.

The five-year monitoring cycles will continue to be supplemented by additional investigations as necessary. Additional investigations are important elements of the monitoring program, with some of the investigations part of the requirements under the Core Area LWMP 2003 approval. Current additional investigations are presented in Table 5.1 and are discussed in Section 5.1. Results from these investigations are incorporated in the overall assessment of effects on the marine environment.

1.2 Data Presentation and Analysis

Summary data reports are now provided following each of the first four years of a five-year cycle, beginning with the 2011 monitoring year. These data reports will include any completed statistical assessments of the data, and the results used to confirm the suitability of the upcoming year’s monitoring design. A more comprehensive interpretive report will be prepared at the end of each five-year cycle (after year five) and will include detailed statistical and environmental risk assessments of all data collected within the five-year cycle. The comprehensive report for Cycle 1 was expanded to include 2016-2019 Cycle 2 data. The final report was received in the fall of 2020 (Hatfield, 2021) and a summary of the findings was presented in CRD, 2021.

This report presents a summary of the results of the 2023 Core Area EMP (Cycle 3, Year 3), along with any data and analyses of results from previous years that have not yet been presented. Limited statistical analyses have been performed on the 2023 data; a more detailed and comprehensive statistical assessment of the results will be undertaken as part of a future Cycle 3 (2021-2025) review that will be initiated in 2024/2025.

Table 1.1 Monitoring Components of the Five-Year McLoughlin, Macaulay and Clover Environmental Monitoring Program (Cycle 3)

Monitoring Component	Sub-component	Year 1 (2021)			Year 2 (2022)			Year 3 (2023)			Year 4 (2024)			Year 5 (2025)		
		McL[1]	Mac[1]	Clo[1]	McL	Mac	Clo	McL	Mac	Clo	McL	Mac	Clo	McL	Mac	Clo
WASTEWATER																
Wastewater	daily, weekly, monthly and quarterly chemistry	√			√			√			√			√		
	quarterly high-resolution chemistry	√			√			√			√			√		
	monthly toxicity testing	√			√			√			√			√		
	ad hoc wet weather, overflow and bypass chemistry		√	√		√	√		√	√		√	√		√	√
SEAFLOOR																
Sediment	sediment chemistry				√	√	√				√	√				√
	pore-water chemistry				√	√	√				√	√				
	sediment toxicity				√	√	√				√	√				
	sediment/benthic invertebrate bioaccumulation				√	√					√	√				
Benthic Invertebrates	community structure				√	√					√	√				
Mussels	community indices and health															√
	tissue chemistry															√
Fish	health indices														√	√
	whole fish and fillet tissue chemistry														√	√
SURFACE WATER AND WATER COLUMN																
Surface Water	bacteria	√			√			√			√			√		
Water Column	bacteria, conventionals, metals	√			√			√			√			√		
Ad Hoc Wet Weather, Overflow and Bypass Events	surface and water column bacteria		√	√		√	√		√	√		√	√		√	√
	shoreline bacteria	various conveyance system sanitary and combined sewer overflow shoreline locations														
REPORTING AND ADDITIONAL INVESTIGATIONS																
Additional Investigations	dependent upon emerging environmental issues and recommendations	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Reporting	annual data summary report	√	√	√	√	√	√	√	√	√	√	√	√			
	five-year comprehensive report													√	√	√

Notes:
[1] McL-McLoughlin, Mac-Macaulay, Clo-Clover.

Table 1.2 Monitoring Components of the 2023 McLoughlin, Macaulay and Clover Environmental Monitoring Program

McLoughlin Outfall	Parameter	Monitoring Frequency
Wastewater	Flow	Daily
	Compliance monitoring	Federal – Weekly, Provincial – Various frequencies
	Conventional parameters[1] and priority substances[1]	Monthly
	Enhanced priority substances[1]	Quarterly (January, April, July, October)
	Toxicity – acute	Monthly
	Toxicity – chronic	Annually
Surface Water & Water Column	Indicator bacteria (fecal coliform and enterococci) and CTD (dissolved oxygen, salinity, temperature) Conventional parameters[1] and metals[1]	Quarterly with 5 sampling events in 30 days during each quarter
Seafloor	Conventional parameters[1] and priority and high resolution substances[1]	Two times in a five-year cycle (2022 and 2024)
Macaulay Outfall	**Parameter**	**Monitoring Frequency**
Wastewater	Flow	Measured during bypasses and overflows
	Indicator bacteria and select conventional parameters	Measured during bypasses and overflows
Surface Water & Water Column	Indicator bacteria (fecal coliform and enterococci) and CTD (dissolved oxygen, salinity, temperature) Conventional parameters[1] and metals[1]	Measured during bypasses and overflows if coincident with routine McLoughlin surface water sampling
Clover Outfall	**Parameter**	**Monitoring Frequency**
Wastewater	Flow	Measured during bypasses and overflows
	Indicator bacteria and select conventional parameters	Measured during bypasses and overflows
Surface Water & Water Column	Indicator bacteria (fecal coliform and enterococci) and CTD (dissolved oxygen, salinity, temperature) Conventional parameters[1] and metals[1]	Measured during bypasses and overflows if coincident with routine McLoughlin surface water sampling
Seafloor		One time in a five-year cycle (2025) at Clover
Conveyance Overflows	**Parameter**	**Monitoring Frequency**
Shoreline	Indicator bacteria (fecal coliform and enterococci)	Measured during bypasses and overflows

Notes:
[1]Analyte lists can be found in Appendices B1 (wastewater), and C1 (water column).

CTD: Conductivity, temperature and density

2.0 WASTEWATER MONITORING

2.1 Introduction

Influent and final effluent monitoring is conducted regularly to assess compliance with the registration requirements under the Municipal Wastewater Regulation and the Federal Wastewater Systems Effluent Regulations (WSER). Regulated parameters include carbonaceous biochemical oxygen demand (CBOD), un-ionized ammonia, toxicity, total suspended solids (TSS) and pH. Table 2.2 presents the federal and provincial limits for these regulated parameters.

Monitoring is also conducted to profile the chemical and physical constituents of influent and effluent before they are released to the marine receiving environment. Assessment of influent and effluent provides information on the concentrations and loadings of contaminants released to the marine receiving environment and provides an indication of which substances may be of environmental concern. These results are then used to direct the efforts of the receiving environment monitoring program and the CRD's Regional Source Control Program.

Wastewater monitoring is also required at the Clover and Macaulay pump stations during conveyance system wet weather overflows or planned and approved maintenance bypass events. The objective of this monitoring is to assess equivalency to primary treatment and provide data to determine potential risk to the receiving environment. If these events happen concurrently with routine MPWWTP surface water sampling, then receiving environment sampling around the Macaulay and Clover outfalls is also required (discussed in Section 3.0).

The MPWWTP provincial registration allows the use of reclaimed water for operations use (i.e., wash down treatment works). The registration designates the use as "moderate exposure-frequent use", which stipulates criteria for reclaimed water quality to protect the environment and human health. The use of reclaimed water was discontinued in 2021 due to difficulty maintaining quality that was compliant with the registration. This challenge was due to frequency of use: the reclaimed system was designed to operate more frequently than it was, resulting in fouling and non-compliance. The reclaimed water system was subsequently shutdown.

2.2 Methods

Federal and Provincial Compliance Sampling

Both federal and provincial compliance monitoring of MPWWTP final effluent were conducted as 24-hour flow-based composite samples as required by regulations and registration. Flow-based sampling methods lead to samples taken proportional to the flow (recorded by the supervisory control and data acquisition system (SCADA). After collection, samples were immediately dispatched to two CALA certified laboratories to conduct chemical analyses (Bureau Veritas Laboratories [BV Labs, Burnaby, BC] and the in-house MPWWTP Laboratory).

Toxicity testing using rainbow trout and *Daphnia magna* was conducted monthly by Nautilus Environmental (Burnaby, BC) using final effluent grab samples. The rainbow trout test methods approved by regulators (provincial and federal) include both EPS 1/RM/50 and EPS 1/RM/13. Test method EPS 1/RM/13 does not use CO_2 aeration to adjust for pH drift while EPS 1/RM/50 does. To use test method EPS 1/RM/50, the discharger must demonstrate that any toxicity is caused by ammonia and pH drift in the test conditions. Final effluent was tested initially in 2021 using 1/RM/13 but was switched to pH stabilized 1/RM/50 after ammonia toxicity was demonstrated (discussed further in Section 2.3.4).

Influent and effluent flow volumes were measured continuously (every few minutes) by a SCADA system at the MPWWTP influent and effluent points. Final effluent flow measurements were compared to maximum daily and annual mean flow limits specified in the permits. Flow values were also used for the calculation of loadings of conventional and priority substances by multiplying daily flows against daily concentrations then extrapolating out to annual loadings to the marine receiving environment.

Wastewater Characterization

CRD staff conducted influent and effluent sampling at the MPWWTP for wastewater characterization and treatment plant performance. Samples were analysed daily, weekly, monthly, and/or quarterly for over 20 conventional parameters, such as total suspended solids and nutrients. A comprehensive list of up to 500 priority substances were analysed monthly or quarterly as described in Table 2.1 and Appendix B1. Acute toxicity was tested monthly and chronic toxicity was tested annually in autumn.

In 2023, MPWWTP influent and effluent samples were taken as 24-hour time-based composites (400 mL wastewater collected every 30 minutes for 24 hours and combined into one sample). Time-based composites, as opposed to flow-based were used for wastewater characterisation analysis as more predictable sample volumes are required to ensure sufficient sample volume for analysis.

The list of priority substances was originally adapted from the US Environmental Protection Agency (US EPA) National Recommended Water Quality Criteria; Priority Toxic Pollutants list (US EPA, 2002). The CRD's list is reviewed periodically to determine the need to remove or add substances depending on new developments in terms of analytical techniques, potential presence in wastewaters, and potential effects on the receiving environment. The list was most recently revised to align with Ocean Wise's Pollution Tracker Program.

After collection, samples were immediately dispatched to Canadian Association for Laboratory Accreditation Inc. (CALA) certified laboratories to conduct chemical analyses. Conventional and priority substance parameters were analysed by Bureau Veritas Laboratories (BV Labs, Burnaby, BC), and high-resolution analyses were conducted at SGS AXYS Analytical Services (Sidney, BC). Substances were analysed using methods capable of achieving method detection limits suitable for comparison to applicable water quality guidelines. Acute (Appendix B6) and chronic (Appendix B7) wastewater toxicity testing was conducted by Nautilus Environmental (Burnaby, BC), using standardized and Environment Canada approved protocols.

Overflow and Bypass Sampling

As required by ENV, any overflow or bypass event discharged from either the Clover or Macaulay pump station must be sampled by automated composite samplers. These samplers are programmed to trigger half hourly composite samples if an overflow or bypass event exceeds one hour of discharge out of either long outfall. After collection, composite samples are then dispatched to CALA certified laboratories for fecal coliform, enterococci, TSS and CBOD analysis. This sampling did not occur in 2023 as there was only one overflow event and the composite sampler did not trigger as planned. The program has been reviewed and tested for successful operation in 2024.

Table 2.1 Frequency of Wastewater Sampling by Analytical Group

(Appendix B1 provides a listing of individual analytes within each analytical group)

Parameter Group	Influent and Final Effluent Analytics			
	Daily/ Weekly	Monthly	Quarterly	Annual
Conventionals (nutrients, oxygen demand, pH, TSS)	√	√	√	
Metals, total		√	√	
Metals, speciated (MeHg and tributyltin (TBT)			√	
Metals, dissolved		√	√	
Aldehydes		√	√	
Phenolic compounds		√	√	
Chlorinated phenolics		√	√	
Non-chlorinated phenolics		√	√	
Polycyclic aromatic hydrocarbons		√	√	
Semi-volatile organics		√	√	
Miscellaneous semi-volatile organics		√	√	
Volatile organics		√	√	
Terpenes		√	√	
Acute Toxicity				
Rainbow trout 96-hr LC50 pH stabilized		√*		
Daphnia magna 48-hr LC50		√*		
Chronic Toxicity				
Ceriodaphnia seven-day (survival and reproduction)				√*
Rainbow trout alevin and embryo (EA) 30-day (survival and growth)				√*
Top smelt seven-day (survival and growth)				√*
Echinoderm fertilization (reproduction)				√*
High-Resolution Analyses				
Nonylphenols (NP)			√	
Organochlorine pesticides (OC Pest)			√	
Pharmaceuticals and personal care products (PPCP)			√	
Polychlorinated biphenyls (PCB)			√	
Polycyclic aromatic hydrocarbons (PAH)			√	
Polybrominated diphenyl ethers (PBDE)			√	
Polychlorinated dibenzodioxins (PCDD)			√	
Per- and poly-fluoroalkyl substances (PFAS)			√	

Notes: final effluent only

DATA QUALITY ASSESSMENT

CRD staff followed a rigorous quality assurance/quality control (QA/QC) assessment procedure for both field sampling procedures and laboratory analyses for the routine wastewater monitoring component. From each analytical batch (12 monthly batches in 2023), one sample was run as a laboratory triplicate analysis annually and one sample was randomly chosen for field triplicate analysis. In addition, one sample each month was analysed as a matrix spike. Trip and field blanks were tested once in 2023. The analytical laboratories also conducted internal QA/QC analyses, including method analyte spikes, method blanks and standard reference materials.

Any data that exhibited failures of QA/QC criteria were not included in any statistical analysis.

2.3 Results and Discussion

Table 2.2 presents the Federal and Provincial final effluent compliance limits.

Table 2.2 McLoughlin Point WWTP Provincial and Federal Compliance Limits – Final Effluent

Parameter	Unit	Provincial Limit		Federal Limit
		McLoughlin WWTP ≤216,000 m³/day	McLoughlin WWTP* >216,000 m³/day	McLoughlin WWTP ≤432,000 m³/day
CBOD	mg/L	25 (maximum) 10 (monthly average)	130 (maximum)	25 (monthly average)
Rainbow Trout Toxicity	pass/fail	pass	---	pass
TSS	mg/L	25 (maximum) 10 (monthly average)	130 (maximum)	25 (monthly average)
Unionized NH_3 @ 15°C	mg/L	---	---	1.25 (maximum)
pH	pH	6-9	---	---
Effluent Flow (maximum)	m³/day	432,000		---

Notes:
*Provincial registration allows only 70 days per year >216,000 m³/day.

2.3.1 Provincial Compliance Monitoring

Effluent monitoring is undertaken to ensure compliance with the provincial registration issued for MPWWTP; effluent quality limits vary depending on whether the facility is discharging solely tertiary effluent when flows are less than or equal to 216,000 m³/day (≤2ADWF), or blended (primary + tertiary) effluent when flows are greater than 216,000 m³/day (>2DWF). Table 2.2 presents these compliance limits. The MPWWTP is authorized to blend primary and tertiary flows for 70 days per year.

The average daily effluent flow from MPWWTP was 83,681 m³/day and the maximum was 174,431 m³/day on December 5, 2023, well below the limit of 432,000 m³/day. Flow information is presented in Figure 2.1, Appendix B2 (influent) and Appendix B3 (effluent).

Table 2.3 presents the compliance results for non-blended flow days (<216,000 m³/day). MPWWTP effluent was not compliant with provincial registration requirements on the following occasions:

Monthly Averages

- Monthly average TSS concentrations were out of compliance for 2 of the 12 monthly averages (March and April).

- Monthly average CBOD concentrations were out of compliance in 9 of the 12 monthly averages (March, April, May, June, July, August, October, November and December).

Maximum Values

- Individual maximum TSS were out of compliance 3 times in 2023 (October 24, December 4 and December 5).

- Individual maximum CBOD concentrations were out of compliance 3 times in 2023 (March 22, October 24 and December 4).

Maximum CBOD and TSS concentration exceedances mostly aligned with blended days but not during flows >216,000 m³/day. Therefore, relaxed limits are applied to these days and are presented in Table 2.4.

In 2023, there were 10 days when blending occurred, but none of the days were when total flows were greater than 216,000 m^3. These 10 days were technically out of compliance because full tertiary treatment capacity was not achieved prior to blending. Operators continue to refine the instantaneous flow control set points that resulted in the premature blending.

Table 2.4 presents flow measurements and compliance results for the 10 days that blending occurred and of these days when flows were <216,000 m^3/day, more than half the compliance results were below the normal non-blended maximum limits of 25 mg/L for TSS and CBOD.

All acute toxicity tests in 2023 passed.

2.3.2 Federal Compliance Monitoring

Table 2.3 presents results of compliance to WSER. The MPWWTP was compliant with WSER limits for TSS, unionized ammonia and CBOD in 2023.

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Figure 2.1 McLoughlin Point WWTP Tertiary Effluent Flows in 2023

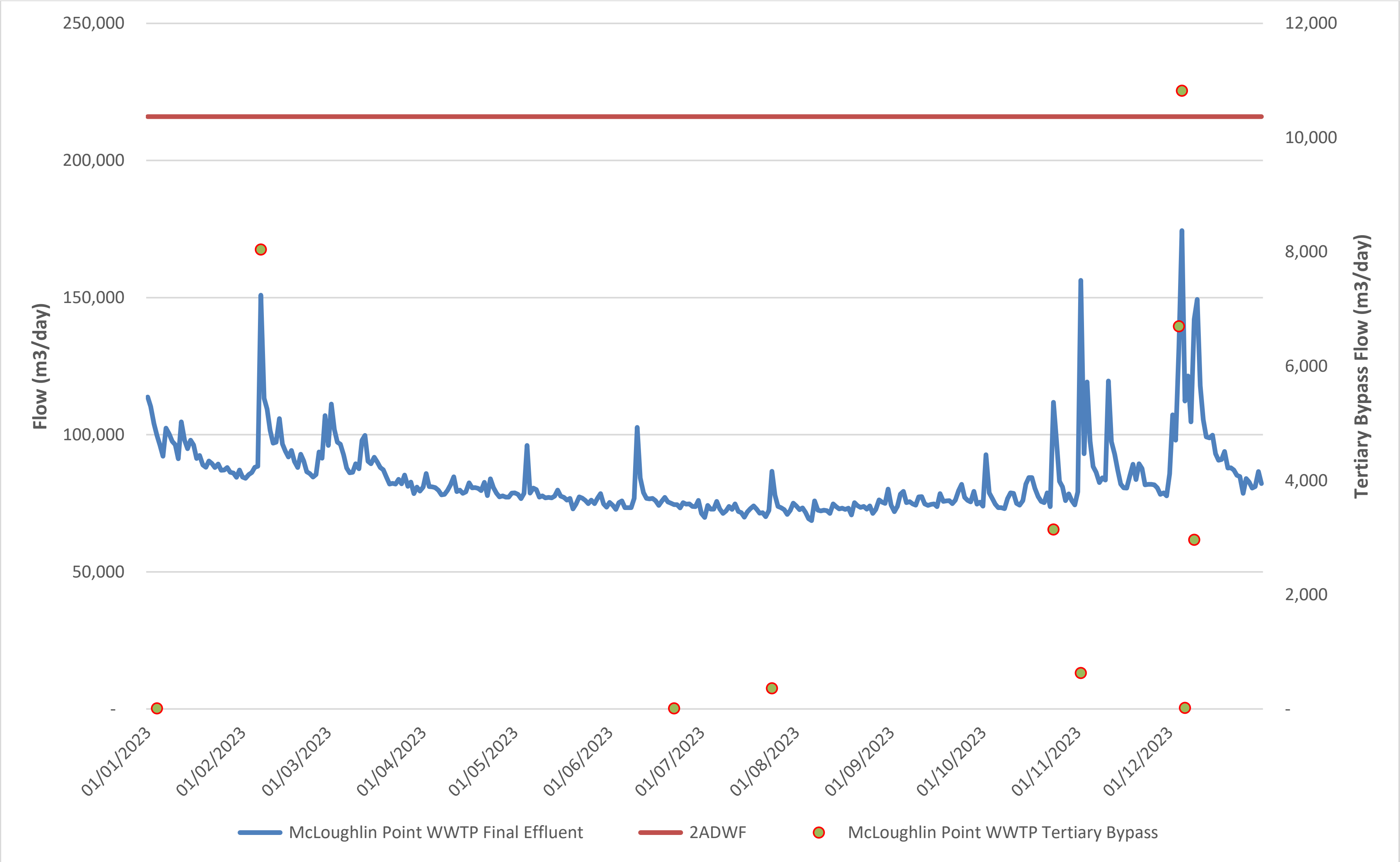


Table 2.3 McLoughlin Point WWTP Federal and Provincial Wastewater Compliance Results for 2023 (<2x ADWF*)

McLoughlin Point Wastewater Treatment Plant Final Effluent									
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
01/01/2023	113,766			7.3	9	0.1	23.8		
02/01/2023	110,234			6.7	8			37,000	6,700
03/01/2023	104,089			7.3	6	0.1	23.5		
04/01/2023	99,746	10		7.9	6				
05/01/2023	96,220			9	6	0.152	28.1		
06/01/2023	92,152								
07/01/2023	102,400								
08/01/2023	100,212			8.3	7	0.1	27.5		
09/01/2023	97,575			10	6				
10/01/2023	96,328			8.9	5	0.192	36.3	100,000	13,000
11/01/2023	91,259			9	7				
12/01/2023	104,665			12.8	12	0.145	32.2		
13/01/2023	98,046								
14/01/2023	94,868								
15/01/2023	97,992			8.9	7	0.1	32.9		
16/01/2023	96,234			9.2	6			80,000	7,400
17/01/2023	91,301			6.6	6	0.1	20.9		
18/01/2023	92,400			8.6	8				
19/01/2023	88,993		Pass	14	18	0.1	23.2	62,000	10,000
20/01/2023	88,142								
21/01/2023	90,407								
22/01/2023	89,536			9.9	8	0.1	23.5		
23/01/2023	88,088			9.6	8				

Table 2.3, cont'd

McLoughlin Point Wastewater Treatment Plant Final Effluent									
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
24/01/2023	89,293			8.4	7	0.1	25.2	81,000	12,000
25/01/2023	87,061			10.2	7				
26/01/2023	87,112			13.6	9	0.179	37.1		
27/01/2023	88,023								
28/01/2023	86,271			9.8	6				
29/01/2023	85,988			10.8	7	0.1	34.1		
30/01/2023	84,500			12.9	8				
31/01/2023	87,170			11.5	9	0.1	25.3	380,000	34,000
Average				**9.6**	**7.8**		**28.1**		**13,850**
01/02/2023	84,599			10.2	7				
02/02/2023	84,148			8.7	11	0.145	36.9		
03/02/2023	85,520								
04/02/2023	86,188								
05/02/2023	88,125			10.8	8	0.113	32.1		
06/02/2023	88,522			10.7	8				
07/02/2023	150,910	8,040		14.6	20	0.1	29.3	370,000	60,000
08/02/2023	113,313			7.3	6				
09/02/2023	109,365			7.9	7	0.1	16.8		
10/02/2023	101,546								
11/02/2023	96,926								
12/02/2023	97,327			7.1	6	0.1	19		
13/02/2023	105,926			8.8	6				
14/02/2023	96,685			8.6	7	0.1	23.1	280,000	22,000
15/02/2023	94,008			9	7				
16/02/2023	91,887		Pass	9.2	7	0.171	31.6	180,000	34,000

Table 2.3, cont'd

McLoughlin Point Wastewater Treatment Plant Final Effluent									
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
17/02/2023	94,287								
18/02/2023	90,267								
19/02/2023	88,054			5.9	9	0.116	31.6		
20/02/2023	92,898			8.2	9				
21/02/2023	90,398			10.9	8	0.1	25.3	280,000	19,000
22/02/2023	86,520			11.3	10				
23/02/2023	85,826			11.5	9	0.19	29.2		
24/02/2023	84,559								
25/02/2023	85,505								
26/02/2023	93,729			10.1	7	0.1	27.6		
27/02/2023	91,398			11.9	10				
28/02/2023	106,982			12.5	11	0.1	27.9	270,000	23,000
Average				**9.8**	**8.7**		**27.5**		**31,600**
01/03/2023	96,139			11.2	9				
02/03/2023	111,151			11.4	10.4	0.1	21.1		
03/03/2023	101,993								
04/03/2023	97,306								
05/03/2023	96,576			11.3	10	0.1	28.9		
06/03/2023	92,610			10.9	8				
07/03/2023	87,879			8.4	8.6	0.1	21.7	120,000	10,000
08/03/2023	86,108			9.1	9				
09/03/2023	86,308			10.2	11	0.1	23.9		
10/03/2023	89,449								
11/03/2023	87,573								
12/03/2023	97,899			12.7	11.6	0.1	27.7		

Table 2.3, cont'd

McLoughlin Point Wastewater Treatment Plant Final Effluent									
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
13/03/2023	99,786			9.4	9.4				
14/03/2023	90,365			10.2	8.2	0.1	24.4	300,000	38,000
15/03/2023	89,436			11	8.2				
16/03/2023	91,772			13.5	10	0.1	25		
17/03/2023	90,066								
18/03/2023	88,057								
19/03/2023	87,235			15.9	11	0.1	31.9		
20/03/2023	84,629			25	14				
21/03/2023	81,963			14.3	16	0.1	24.9	460,000	31,000
22/03/2023	82,264			26.2	21				
23/03/2023	82,016		Pass	13.7	10	0.1	27.9	390,000	54,000
24/03/2023	83,705								
25/03/2023	82,073								
26/03/2023	85,312			8.1	8	0.1	23.2		
27/03/2023	81,203			11	9				
28/03/2023	82,703			11.5	8	0.157	29.6	290,000	56,000
29/03/2023	78,491			10.6	9				
30/03/2023	80,885			12.3	10	0.143	25.8		
31/03/2023	79,412								
Average				**12.6**	**10.4**		**25.8**		**37,800**
01/04/2023	80,901								
02/04/2023	85,862			10.8	11	0.1	20.4		
03/04/2023	81,052			9.9	8				
04/04/2023	81,010			14	9	0.097	25.7	800,000	75,000
05/04/2023	80,732			16.7	13	0.142	36.2		

Table 2.3, cont'd

McLoughlin Point Wastewater Treatment Plant Final Effluent									
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
06/04/2023	79,714				8.2				
07/04/2023	78,077								
08/04/2023	78,224			11					
09/04/2023	79,701			10.9	9		28.6		
10/04/2023	81,721			13.5	9.4				
11/04/2023	84,706			12.3	9.8	0.073	23.9	360,000	51,000
12/04/2023	79,220			10.9	10				
13/04/2023	79,767			10.7	8	0.099	26.9		
14/04/2023	78,615								
15/04/2023	79,193			13					
16/04/2023	82,480			15	12	0.061	32.6		
17/04/2023	80,641			17.6	11				
18/04/2023	80,728			21.5	18	0.1	39.6	760,000	61,000
19/04/2023	80,472			15.7	13				
20/04/2023	79,596		Pass	13.9	9.6	0.106	40.6	100,000	70,000
21/04/2023	82,621								
22/04/2023	77,799								
23/04/2023	83,934			9.1	6	0.1	27.7		
24/04/2023	80,685			11.6	9.4				
25/04/2023	78,721			17.4	12	0.1	39.4	500,000	54,000
26/04/2023	77,368			15	8				
27/04/2023	77,721			15.4	13	0.1	28.3		
28/04/2023	77,294								
29/04/2023	77,218								
30/04/2023	78,741			12.3	9	0.1	23.1		

Table 2.3, cont'd

McLoughlin Point Wastewater Treatment Plant Final Effluent									
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
Average				**13.6**	**10.3**		**30.2**		**62,200**
01/05/2023	78,767			9.7	11				
02/05/2023	78,294			10.8	9	0.1	38.3	270,000	11,000
03/05/2023	76,723			11	6				
04/05/2023	78,665			15.5	8	0.1	37.9		
05/05/2023	96,126								
06/05/2023	78,749								
07/05/2023	80,565			10.6	10	0.11	26.1		
08/05/2023	79,977			13.4	11				
09/05/2023	77,246			11.9	9	0.1	28	320,000	26,000
10/05/2023	77,740			16.8	13				
11/05/2023	76,954			11.7	8	0.1	27.4		
12/05/2023	77,117								
13/05/2023	76,958								
14/05/2023	77,610			9.8	5	0.29	35.6		
15/05/2023	79,848			12.9	9				
16/05/2023	77,604			16.2	11	0.139	36.2	710,000	40,000
17/05/2023	77,161			15	7				
18/05/2023	76,138			15.1	9	0.133	26.2	53,000	18,000
19/05/2023	76,786		Pass						
20/05/2023	72,937								
21/05/2023	74,726			13	10	0.157	35.6		
22/05/2023	77,299			11.3	8				
23/05/2023	76,850			16.7	11	0.1	23.7	330,000	31,000
24/05/2023	76,056			16.6	13				

Table 2.3, cont'd

McLoughlin Point Wastewater Treatment Plant Final Effluent									
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
25/05/2023	74,863			14.3	10	0.119	25.1		
26/05/2023	76,108								
27/05/2023	74,839								
28/05/2023	76,893			19	15	0.1	38.8		
29/05/2023	78,548			16.3	10				
30/05/2023	74,811			14.5	12	0.1	39	630,000	43,000
31/05/2023	73,616			19.7	13				
Average				**14.0**	**9.9**		**32.1**		**28,167**
01/06/2023	75,284								
02/06/2023	74,202								
03/06/2023	72,757			10	9	0.1	28.5		
04/06/2023	75,282			11.3	7	0.1	34.8		
05/06/2023	75,898			12.2	8				
06/06/2023	73,419			8.8	8	0.1	33.5	290,000	22,000
07/06/2023	73,437			11.4	11				
08/06/2023	73,415			13.7	9	0.1	28.1		
09/06/2023	76,754								
10/06/2023	102,662			11.2	17				
11/06/2023	84,285			7.9	8	0.144	42.9		
12/06/2023	78,907			9	8				
13/06/2023	76,792			9.6	6	0.1	31.5	340,000	17,000
14/06/2023	76,612			12.7	8				
15/06/2023	76,789			13.5	8	0.1	28.8		
16/06/2023	75,973								
17/06/2023	74,257								

Table 2.3, cont'd

McLoughlin Point Wastewater Treatment Plant Final Effluent									
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
18/06/2023	75,777			4.7	5	0.1	29.9		
19/06/2023	77,130			5.2	7				
20/06/2023	75,488			11	8	0.1	32	910,000	49,000
21/06/2023	75,077			10.4	8				
22/06/2023	74,516	10		11.3	7	0.1	25.9	39,000	18,000
23/06/2023	74,479		Pass						
24/06/2023	73,325								
25/06/2023	75,245			11	7	0.105	32		
26/06/2023	74,715			13.8	9				
27/06/2023	74,804			22.5	16	0.1	31.4	880,000	54,000
28/06/2023	73,840			15.1	10				
29/06/2023	73,763			13.4	10	0.1	32.8		
30/06/2023	76,080								
Average				**11.4**	**8.8**		**31.7**		**32,000**
01/07/2023	71,290								
02/07/2023	69,880			6	5	0.113	35.3		
03/07/2023	74,252			6	4				
04/07/2023	72,874			5.7	6	0.1	31.1	60,000	5,000
05/07/2023	72,844			10.6	7				
06/07/2023	75,718			14.2	8	0.121	37.8		
07/07/2023	72,983								
08/07/2023	71,325								
09/07/2023	72,181			9.5	7	0.108	35.4		
10/07/2023	73,857			11.1	6				
11/07/2023	72,762			13.3	12	0.133	40.8	380,000	17,000

Table 2.3, cont'd

McLoughlin Point Wastewater Treatment Plant Final Effluent										
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
12/07/2023	74,804			11.5	9				
13/07/2023	72,080			11.2	9	0.1	27.2	190,000	14,000
14/07/2023	71,564		Pass						
15/07/2023	69,896								
16/07/2023	71,844			11.1	11	0.1	22.9		
17/07/2023	73,017			11.9	9				
18/07/2023	74,030			12.3	12	0.1	27.3	450,000	17,000
19/07/2023	72,886			15.8	10				
20/07/2023	71,438			12.1	10	0.1	26.6		
21/07/2023	71,615								
22/07/2023	70,141								
23/07/2023	72,396			5.6	6	0.189	28.4		
24/07/2023	86,645	360		15.3	15				
25/07/2023	77,949			11.7	10	0.243	48	760,000	81,0p00
26/07/2023	73,905			11.2	8				
27/07/2023	73,432			19.7	13	0.274	42.2		
28/07/2023	72,631								
29/07/2023	70,900								
30/07/2023	72,439			7.1	3	0.1	29.9		
31/07/2023	75,062			13.3	8				
Average				**11.2**	**8.5**		**33.3**		**26,800**
01/08/2023	74,042			13.4	9	0.171	39.8	87,000	4,500
02/08/2023	72,666			13.1	8				
03/08/2023	73,317			12.5	9	0.205	43.4		
04/08/2023	71,679								

Table 2.3, cont'd

McLoughlin Point Wastewater Treatment Plant Final Effluent									
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
05/08/2023	69,411								
06/08/2023	68,680			8.9	4	0.1	28.2		
07/08/2023	75,870			11.3	7				
08/08/2023	72,484				6	0.117	34	160,000	17,000
09/08/2023	72,233				5				
10/08/2023	72,496				18	0.1	26.9		
11/08/2023	72,272								
12/08/2023	71,313								
13/08/2023	74,807			11	6	0.124	42.4		
14/08/2023	73,817			11	4				
15/08/2023	72,934			12	5	0.1	23.3	340,000	24,000
16/08/2023	73,240			12	5				
17/08/2023	72,770			19	9	0.1	32.8	180,000	81,000
18/08/2023	73,246		Pass						
19/08/2023	70,752			8.1					
20/08/2023	75,223			8.1	5		29.9		
21/08/2023	74,159			7.9	5				
22/08/2023	73,479			7.9	5	0.1	31.4	510,000	24,000
23/08/2023	73,909			9	4				
24/08/2023	72,887			7.9	4	0.1	42		
25/08/2023	74,080								
26/08/2023	71,322								
27/08/2023	72,746			7.7	4	0.11	28.1		
28/08/2023	76,264			9.6	6				
29/08/2023	75,377			10.5	8	0.18	40.4	380,000	49,000

Table 2.3, cont'd

McLoughlin Point Wastewater Treatment Plant Final Effluent									
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
30/08/2023	74,956			11.9	5				
31/08/2023	80,158			12.7	10	0.19	47.7		
Average				**10.7**	**6.6**		**35.0**		**33,250**
01/09/2023	74,304								
02/09/2023	71,967								
03/09/2023	73,889			6.5	6	0.1	30.7		
04/09/2023	78,371			6.5	5				
05/09/2023	79,396			9.9	6	0.19	43.1	790,000	75,000
06/09/2023	75,197			8.6	6				
07/09/2023	75,579			9	5	0.128	34.1		
08/09/2023	74,779								
09/09/2023	74,331								
10/09/2023	77,375			5.9	7	0.115	40.2		
11/09/2023	77,472			10.4	6				
12/09/2023	74,780			13.2	13	0.1	28.9	640,000	47,000
13/09/2023	74,199			11	9				
14/09/2023	74,584			8.5	4	0.1	27.3	100,000	11,000
15/09/2023	74,795								
16/09/2023	73,734								
17/09/2023	78,496			7.4	5	0.1	35.4		
18/09/2023	75,724			6.2	4				
19/09/2023	75,921			8.6	4	0.1	31.6	60,000	3,500
20/09/2023	75,934			7.5	4				
21/09/2023	74,865			5.9	5	0.142	39.6		
22/09/2023	76,139								

Table 2.3, cont'd

McLoughlin Point Wastewater Treatment Plant Final Effluent									
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
23/09/2023	79,620		Pass						
24/09/2023	81,871			8.2	6	0.263	44.3		
25/09/2023	77,125			8.6	5				
26/09/2023	76,090			7.1	5	0.125	35	460,000	52,000
27/09/2023	75,489			8.8	6				
28/09/2023	79,354			12	7	0.189	40.9		
29/09/2023	74,693								
30/09/2023	75,377								
Average				**8.5**	**5.9**		**35.9**		**37,700**
01/10/2023	73,995			9.2	7	0.236	37.1		
02/10/2023	92,666			17.7	12				
03/10/2023	78,775			8.6	5	0.195	34.4	76,000	8,500
04/10/2023	76,761			15.8	9				
05/10/2023	74,730			12.1	3	0.315	40.3		
06/10/2023	73,369								
07/10/2023	73,445								
08/10/2023	73,013			11.2	9	0.157	27.7		
09/10/2023	76,699			12.3	9				
10/10/2023	78,843			13.8	9	0.204	32.8	260,000	34,000
11/10/2023	78,606			12.1	7				
12/10/2023	74,939			11.3	6	0.407	42.5		
13/10/2023	74,315								
14/10/2023	75,978								
15/10/2023	81,978			9.6	5	0.181	45		
16/10/2023	84,425			12.3	9				

Table 2.3, cont'd

McLoughlin Point Wastewater Treatment Plant Final Effluent									
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
17/10/2023	84,386			11	13	0.198	43.3	420,000	20,000
18/10/2023	80,418			9.6	7				
19/10/2023	77,388			6.7	4	0.248	40.9	96,000	25,000
20/10/2023	75,710								
21/10/2023	75,230								
22/10/2023	78,778		Pass	7.7	4	0.269	45.3		
23/10/2023	73,790			7.1	4				
24/10/2023	111,840	3,140		28.5	27	0.234	36.8	240,000	16,000
25/10/2023	97,924			5.6	6				
26/10/2023	82,969			4.9	3	0.1	34.8		
27/10/2023	80,999								
28/10/2023	76,003								
29/10/2023	78,444			10	4	0.047	25		
30/10/2023	76,005			10	5				
31/10/2023	74,379			13	7		29	70,000	28,000
Average				**11.3**	**7.6**		**36.8**		**21,917**
01/11/2023	79,170			12	5				
02/11/2023	156,280	630		28	38	0.1	27.9		
03/11/2023	93,097								
04/11/2023	119,269								
05/11/2023	97,629			11	7	0.292	34.3		
06/11/2023	88,426			11	6				
07/11/2023	86,299			11	5	0.15	30	150,000	22,000
08/11/2023	82,555			11	3				
09/11/2023	84,282				5				

Table 2.3, cont'd

McLoughlin Point Wastewater Treatment Plant Final Effluent									
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
10/11/2023	83,457								
11/11/2023	119,642								
12/11/2023	97,502			16	14	0.2	36		
13/11/2023	92,853			14	9				
14/11/2023	87,170			22	9	0.23	30	32,000	2,900
15/11/2023	81,965			15	7				
16/11/2023	80,620			14	8	0.054	26		
17/11/2023	80,513								
18/11/2023	84,869								
19/11/2023	89,271			12	8	0.23	34		
20/11/2023	83,612			12	6				
21/11/2023	89,390			15	12	0.14	43	130,000	19,000
22/11/2023	87,664			12	6		23.2		
23/11/2023	81,704			11	6	0.25		72,000	9,300
24/11/2023	81,883						23.1		
25/11/2023	81,883								
26/11/2023	81,704		Pass	13	5	0.33	28.2		
27/11/2023	80,653			14	6			430,000	80,000
28/11/2023	78,270			14	7	0.33			
29/11/2023	78,825			11	6		27.6		
30/11/2023	77,665			9.7	5	0.1			
Average				**13.7**	**8.3**		**30.3**		**26,640**
01/12/2023	85,792						36.4		
02/12/2023	107,288								
03/12/2023	97,997			12	11	0.12	32.16		

Table 2.3, cont'd

McLoughlin Point Wastewater Treatment Plant Final Effluent									
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
04/12/2023	132,018	6,700		27	41			130,000	24,000
05/12/2023	174,431	10,820		19	27	0.032			
06/12/2023	112,301	20		10	8		32.23		
07/12/2023	121,467			11	12	0.1			
08/12/2023	104,709						20.1		
09/12/2023	142,113	2,960							
10/12/2023	149,330			11	9	0.06	23.8		
11/12/2023	117,905			12	6				
12/12/2023	105,501			12	7	0.04		32,000	13,000
13/12/2023	99,245		Pass	13	12		23.11		
14/12/2023	98,831			11	6	0.13		94,000	46,000
15/12/2023	99,827						25.3		
16/12/2023	93,041								
17/12/2023	90,713				5	0.132	37.2		
18/12/2023	90,962				6				
19/12/2023	93,918			11.2	8	0.224		200,000	39,000
20/12/2023	87,907			13.9	6		34.2		
21/12/2023	87,942			11.9	6	0.114			
22/12/2023	87,085						25.4		
23/12/2023	85,228								
24/12/2023	84,757				3	0.1	36.1		
25/12/2023	78,661								
26/12/2023	84,003			8.5	5	0.101			
27/12/2023	82,741			9.3	6		32.2	65,000	12,000
28/12/2023	80,499			8.4	4	0.1			

Table 2.3, cont'd

McLoughlin Point Wastewater Treatment Plant Final Effluent									
	Total Daily Flow (<2ADWF)	Secondary Bypass Flow	Rainbow Trout Toxicity	CBOD	TSS	Unionized NH_3 @ 15°C	NH_3-N	Fecal Coliforms	Enterococci
	m^3/day	m^3/day	96-hour LC50	mg/L	mg/L	mg/L	mg/L	CFU/100 mL	CFU/100 mL
Provincial Registration 108831	<216,000	≤70 days per year	Pass/Fail	25 (maximum) 10 (monthly mean)	25 (maximum) 10 (monthly mean)	---	---	---	---
Wastewater Effluent Regulations	---	---	Pass (100% v/v%)	25 (monthly mean)	25 (monthly mean)	1.25 (maximum)	---	---	---
Water Quality Criteria	---	---	---	---	---	---	**BC WQG 58 (max), 8.7 (monthly mean)	---	**EC 35 (geomean) 70 (maximum)
29/12/2023	81,070						29.4		
30/12/2023	86,573								
31/12/2023	82,190			8.1	5	0.1	16.9		
Average				**12.3**	**9.7**		**28.9**		**26,800**
Annual Average	**83,681**	**3,269**		**12**	**9**	**0**	**31**	**297,125**	**31,106**

Notes:
Blue shading indicates that single values exceed the maximum limit.
Orange shading indicates that average values exceed the monthly average limit.
*ADWF – Average Dry Weather Flow.
LC50 – The concentration at which 50% of test organisms experience mortality after a 96-hour exposure.
** Environment Canada receiving environment – enterococci and ammonia are not part of compliance but inserted into table for informational purposes.

Table 2.4 McLoughlin Point WWTP Provincial Wastewater Compliance Results for 2023 Blended Effluent Days (>216,000 m³/day)

McLoughlin Point Wastewater Treatment Plant Final Effluent					
	Blended Days	Flow (not blended)	Flow (blended)	CBOD	TSS
		m^3/day	m^3/day	mg/L	mg/L
Provincial Limit				130 (maximum)	130 (maximum)
Registration	70				
04/01/2023	1	99,746	10	7.9	6
07/02/2023	2	150,910	8,040	14.6	20
22/06/2023	3	74,516	10	11.3	7
24/07/2023	4	86,645	360	15.3	15
24/10/2023	5	111,840	3,140	28.5	27
02/11/2023	6	156,280	630	28	38
04/12/2023	7	132,018	6,700	27	41
05/12/2023	8	174,431	10,820	19	27
06/12/2023	9	112,301	20	10	8
09/12/2023	10	142,113	2,960	---	---

Notes:
*2ADWF – Two times average dry weather flow.
--- no sample
Grey shading indicates non-compliant blending occurred.
Red shading indicates exceedance to provincial limit.
*** Technically out of compliance as the 130 mg/L TSS and 130 mg/L CBOD maximum value is not applicable when flows <216,000 m^3/day.

2.3.3 Priority Substances

McLoughlin Point WWTP final effluent was analysed for priority substances as listed in Table 2.1 and Appendix B1. There were more than 170 routine substances analysed and more than half of these were not detected in 2023 (at routine detection limits chosen for comparison to the applicable water quality guidelines). The high-resolution analyses resulted in higher frequency of detection relative to the routine resolution analysis for the same parameters due to the lower detection limits of the high-resolution methods. Frequency of detections were slightly less in effluent from McLoughlin WWTP than historical Clover and Macaulay screened discharges because of the higher levels of treatment (CRD, 2021-2022). The frequencies of detection of all substances analysed in wastewater are included in Appendix B5 (McLoughlin).

McLoughlin Point WWTP effluent had lower loadings than the combined historical Clover and Macaulay loadings (CRD, 2020-2022). Concentrations of substances that were frequently detected (greater than 50% of sampling events) in final effluent are presented in Table 2.5. Annual loadings to the marine environment are presented in Appendix B4 alongside influent loadings.

To determine the potential for effects of the wastewater discharges on the receiving environment, average and maximum wastewater concentrations of frequently detected substances (Table 2.5) were compared to the BC Approved and Working Water Quality Guidelines (https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality guidelines) (BCMoE&CCS 2021a; 2021b) and CCME Environmental Quality Guidelines (CCME, 2003) developed to protect aquatic life. Conservative estimates of the minimum initial dilution of the wastewaters in receiving waters off the outfalls (113:1 for McLoughlin; Lorax, 2019) were applied to maximum wastewater substance concentrations to predict maximum potential concentrations in the marine environment. These minimum initial dilution factors are predicted to occur at the edge of the initial dilution zone (IDZ; 100 meters around each outfall). The use of estimated minimum initial dilution factors allows for a conservative (i.e., highly protective) estimation of potential effects, because the predicted average (mean) initial dilution factors are much higher in the marine receiving environments around the outfall (711:1 [median] for McLoughlin).

Before application of minimum initial dilution factors, there were a few substances that exceeded applicable guidelines in undiluted final effluent prior to discharge (Table 2.5), including copper, zinc, total PCBs, ammonia, enterococci (Table 2.3) and weak acid dissociable cyanide (WAD).

After application of the minimum initial dilution factor, there were no substances exceeding applicable guidelines (except enterococci) in final effluent, indicating that receiving environment concentrations were unlikely to exceed guidelines beyond the initial dilution zone (i.e., the area that extends 100 m around the outfall diffusers), and the potential for effects on aquatic life were likely limited to within the initial dilution zone (IDZ).

In final effluent, the bacterial indicator enterococci (Table 2.3) routinely exceeded WQG protective of the public engaging in recreational activities such as swimming and shellfish collection (Health Canada, 2024). The enterococci average concentration was 31,106 CFU/100 mL. The modelled dilution of 113:1 (Lorax, 2019) indicated that environmental concentrations could be approximately 275 CFU/100 mL (Table 2.5). The MPWWTP does not use disinfection as part of tertiary treatment and as such, bacterial indicators will continue to exceed water quality criteria.

Table 2.6 presents removal efficiency of the treatment process in 2023. These values are based on 12 samples of influent and effluent over a year and calculation of loadings from these concentrations and effluent flows. Of the hundreds of parameters measured, 39% of them were undetectable after treatment including pharmaceuticals, hormones, dioxins, PCBs, pesticides and oil and grease. Fifteen percent of parameters had a >90% removal efficiency and 20% had a removal efficiency >80%.

Table 2.5 Concentrations of Frequently Detected Substances (>50% of the time) in McLoughlin Point WWTP Final Effluent – 2023

Parameter Grouping	Parameter	State	Unit	Frequency of Detection	Average Concentration	Maximum Concentration	Minimum Concentration	113:1 Dilution	CCME WQG	BC WQG
Metals - Metalloid	Arsenic	DISS	µg/L	100%	0.43	0.587	0.303	0.0038		
Metals - Transition	Cadmium	DISS	µg/L	100%	0.03	0.0543	0.0129	0.00022		
Metals - Transition	Chromium	DISS	µg/L	100%	1.58	4.9	0.47	0.014		
Metals - Transition	Cobalt	DISS	µg/L	100%	0.95	3.5	0.363	0.00839		
Metals - Transition	Copper	DISS	µg/L	100%	13.18	16.5	9.41	0.117		
Metals - Post transition metals	Lead	DISS	µg/L	100%	0.30	0.392	0.196	0.0027		
Metals - Transition	Mercury	DISS	µg/L	58%	0.01	0.038	0.0019	0.00005		
Metals - Transition	Molybdenum	DISS	µg/L	100%	1.55	2.14	1.03	0.0137		
Metals - Transition	Nickel	DISS	µg/L	100%	5.06	12.7	2.82	0.0447		
Metals - Reactive non-metal	Selenium	DISS	µg/L	100%	0.15	0.181	0.11	0.0013		
Metals - Transition	Vanadium	DISS	µg/L	100%	0.58	0.98	0.26	0.005		
Metals - Transition	Zinc	DISS	µg/L	100%	27.80	37.9	17.9	0.246		
Metals - Post transition metals	Aluminum	DISS	µg/L	100%	15.70	23.3	11.2	0.1		
Metals - Metalloid	Antimony	DISS	µg/L	100%	0.25	0.336	0.193	0.0022		
Metals - Alkaline earth	Barium	DISS	µg/L	100%	2.65	3.56	1.85	0.0235		
Metals - Post transition metals	Bismuth	DISS	µg/L	100%	0.19	0.248	0.115	0.00167		
Metals - Metalloid	Boron	DISS	µg/L	100%	203	268	154	1.8		
Metals - Alkaline earth	Calcium	DISS	mg/L	100%	17.26	23.1	13.6	0.153		
Metals - Transition	Iron	DISS	µg/L	100%	443	566	297	3.93		
Metals - Alkali	Lithium	DISS	µg/L	100%	2.24	2.53	2.02	0.02		
Metals - Alkaline earth	Magnesium	DISS	mg/L	100%	6.80	11.9	4.34	0.06		
Metals - Transition	Manganese	DISS	µg/L	100%	50.13	78.4	39.7	0.444		
Metals - Reactive non-metal	Phosphorus	DISS	µg/L	100%	3438	4990	2080	30.43		
Metals - Alkali	Potassium	DISS	mg/L	100%	15.98	18.9	13.6	0.1414		
Metals - Metalloid	Silicon	DISS	µg/L	100%	3663	4430	2840	32.4		
Metals - Transition	Silver	DISS	µg/L	100%	0.03	0.0482	0.0137	0.00027		
Metals - Alkali	Sodium	DISS	mg/L	100%	49.17	57.3	38.9	0.435		
Metals - Alkaline earth	Strontium	DISS	µg/L	100%	63.58	96.4	49	0.5627		
Metals - Reactive non-metal	Sulfur	DISS	mg/L	100%	8.31	12.2	5.9	0.07		
Metals - Post transition metals	Tin	DISS	µg/L	100%	0.61	0.95	0.4	0.005		
Metals - Transition	Titanium	DISS	µg/L	100%	1.22	2.67	0.55	0.011		
Metals - Transition	Zirconium	DISS	µg/L	100%	0.37	0.49	0.3	0.003		
Conventionals - Anions	Chloride	DISS	mg/L	100%	80.	150	63	0.71		
Conventionals - Major Ions	Hardness (as CaCO3)	DISS	mg/L	100%	71.0	97.6	51.9	0.629		

Table 2.5, cont'd

Parameter Grouping	Parameter	State	Unit	Frequency of Detection	Average Concentration	Maximum Concentration	Minimum Concentration	113:1 Dilution	CCME WQG	BC WQG
Conventionals - Major Ions	Sulphate	DISS	mg/L	100%	24.58	38	16	0.22		
Metals - Actinoids	Uranium	DISS	µg/L	100%	0.01	0.0321	0.0045	0.0001		
Metals - Metalloid	Arsenic	TOT	µg/L	100%	0.43	0.585	0.287	0.00384	12.5	12.5
Metals - Transition	Cadmium	TOT	µg/L	100%	0.04	0.0777	0.0223	0.0002	0.12	0.12a
Metals - Transition	Chromium	TOT	µg/L	100%	2.27	7.09	0.67	0.0201		
Metals - Transition	Cobalt	TOT	µg/L	100%	0.97	3.69	0.349	0.00861		
Metals - Transition	Copper	TOT	µg/L	100%	17.26	21.70	11.60	0.1527		2 (mean)/ 3 (max)
Metals - Post transition metals	Lead	TOT	µg/L	100%	0.52	0.71	0.389	0.0046		2 (mean)/ 140 (max)
Metals - Transition	Molybdenum	TOT	µg/L	100%	1.85	3.5	1.09	0.01641		
Metals - Transition	Nickel	TOT	µg/L	100%	6.21	13.40	2.63	0.055		
Metals - Reactive non-metal	Selenium	TOT	µg/L	100%	0.20	0.93	0.122	0.0004		2
Metals - Transition	Zinc	TOT	µg/L	100%	31.26	44.80	20.10	0.2766		10 (mean)/ 55 (max)
Metals - Post transition metals	Aluminum	TOT	µg/L	100%	28.77	40.1	18.2	0.2546		
Metals - Metalloid	Antimony	TOT	µg/L	100%	0.25	0.334	0.183	0.002		
Metals - Alkaline earth	Barium	TOT	µg/L	100%	3.92	4.85	2.56	0.03		
Metals - Alkaline earth	Calcium	TOT	mg/L	100%	17.29	22.8	12.9	0.153		
Metals - Transition	Iron	TOT	µg/L	100%	763.4	959	580	6.76		
Metals - Alkaline earth	Magnesium	TOT	mg/L	100%	6.77	11.6	4.02	0.0599		
Metals - Transition	Manganese	TOT	µg/L	100%	54.0	104	41.3	0.4782		100a
Metals - Reactive non-metal	Phosphorus	TOT	µg/L	100%	3170	3690	2240	28.05		
Metals - Alkali	Potassium	TOT	mg/L	100%	15.88	18.6	13.3	0.14		
Metals - Transition	Silver	TOT	µg/L	100%	0.04	0.065	0.019	0.004	7.5 (max)	1.5 (mean)/ 3 (max)
Metals - Alkali	Sodium	TOT	mg/L	100%	47.5	56.8	36.3	0.42		
Metals - Reactive non-metal	Sulfur	TOT	mg/L	100%	8.25	12.2	5.6	0.073		
Metals - Post transition metals	Tin	TOT	µg/L	100%	0.62	0.87	0.38	0.006		
POPs - PCDD	1,2,3,4,6,7,8-HPCDD	TOT	pg/L	100%	2.41	3.33	1.78	0.021		
Organics - Misc	1,7-Dimethylxanthine	TOT	ng/L	100%	3493	4360	3020	30.9		
POPs - PAH	1-Methylphenanthrene	TOT	ng/L	100%	4.46	11.8	1.85	0.039		
POPs - PAH	2,3,5-trimethylnaphthalene	TOT	ng/L	100%	7.42	19.8	2.94	0.066		
POPs - Pesticides	2,4-DDD	TOT	ng/L	100%	0.17	0.207	0.126	0.0015		

Table 2.5, cont'd

Parameter Grouping	Parameter	State	Unit	Frequency of Detection	Average Concentration	Maximum Concentration	Minimum Concentration	113:1 Dilution	CCME WQG	BC WQG
POPs - PAH	2,6-dimethylnaphthalene	TOT	ng/L	100%	5.00	13.5	1.25	0.044		
POPs - PPCPs	2-Hydroxy-Ibuprofen	TOT	ng/L	100%	2653	4380	1880	23.47		
POPs - Pesticides	4,4-DDE	TOT	ng/L	100%	0.28	0.593	0.113	0.0025		
POPs - Nonylphenols	4-Nonylphenol Diethoxylates	TOT	ng/L	75%	114	234	19.1	1.02		
POPs - Nonylphenols	4-Nonylphenol Monoethoxylates	TOT	ng/L	100%	809	1130	467	7.2		
POPs - PFAS	5:3 FTCA	TOT	ng/L	100%	40.40	54.1	25.3	0.4		
POPs - PFAS	6:2 FTS	TOT	ng/L	100%	3.66	4.44	2.57	0.03		
POPs - Pesticides	ABHC	TOT	ng/L	75%	0.08275	0.152	0.049	0.0007		
POPs - PAH	Acenaphthene	TOT	ng/L	75%	6.74	27.2	0.01	0.06		6000
POPs - PPCPs	Acetaminophen	TOT	ng/L	100%	26.53	42.4	12.1	0.23		
PHARMA	Androstenedione	TOT	ng/L	100%	2.49	3.14	1.07	0.02		
POPs - PPCPs	Azithromycin	TOT	ng/L	100%	248.	344	201	2.199		
POPs - PAH	Benzo[e]pyrene	TOT	ng/L	100%	1.50	2.05	1.07	0.013		
POPs - PAH	Benzo[J,K]Fluoranthenes	TOT	ng/L	100%	1.01	1.14	0.824	0.009		
POPs - Pesticides	Beta-Endosulfan	TOT	ng/L	100%	0.76	1.4	0.408	0.007		
POPs - Pesticides	Beta-Hch or Beta-Bhc	TOT	ng/L	100%	0.15	0.328	0.062	0.001		
POPs - PPCPs	Bisphenol A	TOT	ng/L	100%	477	795	72.1	4.22		
POPs - PPCPs	Caffeine	TOT	ng/L	100%	3163	4240	2030	27.99		
POPs - PPCPs	Carbamazepine	TOT	ng/L	100%	516	625	359	4.57		
Metals - Speciated	Chromium III	TOT	mg/L	58%	0.0001	0.0099	0.00099	0.000009	0.056	0.056a
POPs - PPCPs	Ciprofloxacin	TOT	ng/L	100%	161	178	140	1.425		
POPs - PPCPs	Clarithromycin	TOT	ng/L	100%	145.50	154	135	1.19		
POPs - PPCPs	Dehydronifedipine	TOT	ng/L	100%	3.14	4.28	2.6	0.028		
POPs - PAH	Dibenzothiophene	TOT	ng/L	100%	3.68	4.81	2.63	0.03254		
POPs - PCBs	Dichloro Biphenyls	TOT	pg/L	100%	265.30	451	137	2.34		
POPs - Pesticides	Dieldrin	TOT	ng/L	100%	0.30	0.555	0.17	0.003		
POPs - PPCPs	Diltiazem	TOT	ng/L	100%	194	228	168	1.72		
Ketones	Dimethyl Ketone	TOT	µg/L	92%	126	830	15	1.118		
POPs - PPCPs	Diphenhydramine	TOT	ng/L	100%	700	813	598	6.195		
POPs - PPCPs	Erythromycin-H2O	TOT	ng/L	100%	9.73	26.5	3.24	0.086		
POPs - PAH	Fluoranthene	TOT	ng/L	92%	5.11	16.7	0.01	0.05		
POPs - PAH	Fluorene	TOT	ng/L	92%	3.75	16.1	0.01	0.033		12000

Table 2.5, cont'd

Parameter Grouping	Parameter	State	Unit	Frequency of Detection	Average Concentration	Maximum Concentration	Minimum Concentration	113:1 Dilution	CCME WQG	BC WQG
POPs - PPCPs	Fluoxetine	TOT	ng/L	100%	33.63	41.3	28.9	0.298		
POPs - PPCPs	Furosemide	TOT	ng/L	100%	398.30	776	183	3.524		
POPs - PPCPs	Gemfibrozil	TOT	ng/L	100%	48.73	59.4	35.8	0.4312		
POPs - PPCPs	Glyburide	TOT	ng/L	100%	3.51	4.02	2.37	0.031		
Conventionals - Sulphide	H2S	TOT	mg/L	100%	0.08	0.081	0.081	0.0007		
Conventionals - Major Ions	Hardness (as CaCO3)	TOT	mg/L	100%	71.09	99.6	48.9	0.629		
POPs - Pesticides	HCH, Gamma	TOT	ng/L	100%	0.39	1.01	0.093	0.0008		
POPs - PCBs	Heptachloro Biphenyls	TOT	pg/L	100%	111.30	225	39.5	0.3496		
POPS - PCDD	HEPTA-DIOXINS	TOT	pg/L	100%	4.14	6.19	2.55	0.0366		
POPs - PCBs	Hexachloro Biphenyls	TOT	pg/L	100%	298.00	553	122	2.637		
POPs - Pesticides	Hexachlorobenzene	TOT	ng/L	100%	0.13	0.264	0.044	0.001		
POPs - PAH	High Molecular Weight PAH`s	TOT	µg/L	100%	0.05	0.083	0.025	0.0004		
POPs - PPCPs	Hydrochlorothiazide	TOT	ng/L	100%	1225	1560	951	10.84		
POPs - PPCPs	Ibuprofen	TOT	ng/L	100%	561	740	233	4.96		
POPs - PPCPs	Lincomycin	TOT	ng/L	100%	9.24	15.3	5.12	0.082		
POPs - PAH	Low Molecular Weight PAH`s	TOT	µg/L	100%	0.1206	0.24	0.047	0.001		
POPs - PFAS	MeFOSAA	TOT	ng/L	100%	2.00	2.75	1.46	0.017		
POPs - PPCPs	Miconazole	TOT	ng/L	100%	2.86	5.07	1.86	0.02533		
Metals - Speciated	Monobutyltin	TOT	µg/L	100%	0.01	0.012	0.007	0		
Metals - Speciated	Monobutyltin Trichloride	TOT	µg/L	100%	0.01	0.019	0.011	0		
POPS - PCDD	Monochloro Biphenyls	TOT	pg/L	100%	31.33	47.4	20.1	0.28		
POPs - PAH	Naphthalene	TOT	ng/L	83%	3.75	12.31	0.01	0.03	1,400	1,000
POPs - PPCPs	Naproxen	TOT	ng/L	100%	1525	1740	1230	13.5		
POPs - PFAS	N-EtFOSAA	TOT	ng/L	100%	1.09	1.49	0.814	0.01		
POPs - PCBs	Nonachloro Biphenyls	TOT	pg/L	100%	8.16	15.4	4.06	0.07		
POPs - Nonylphenols	NP	TOT	ng/L	100%	333.	663	145	1.3	700	
POPs - PCDD	OCDD	TOT	pg/L	100%	16.70	22.6	12.8	0.1478		
POPs - PCBs	Octachloro Biphenyls	TOT	pg/L	100%	16.50	21.2	8	0.15		
POPs - PPCPs	Ofloxacin	TOT	ng/L	100%	24.48	29.4	15.3	0.22		
Conventionals - Nutrients	Organic Carbon	TOT	mg/L	100%	23.75	33	18	0.21		
POPs - PBDE	PBDE 100	TOT	pg/L	100%	785.	1570	362	6.95		
POPs - PBDE	PBDE 119/120	TOT	pg/L	100%	12.51	23.8	6.53	0.11		
POPs - PBDE	PBDE 138/166	TOT	pg/L	100%	39.23	75.9	19.4	0.35		

Table 2.5, cont'd

Parameter Grouping	Parameter	State	Unit	Frequency of Detection	Average Concentration	Maximum Concentration	Minimum Concentration	113:1 Dilution	CCME WQG	BC WQG
POPs - PBDE	PBDE 140	TOT	pg/L	100%	12.37	22.7	5.61	0.11		
POPs - PBDE	PBDE 15	TOT	pg/L	100%	5.37	9.17	2.7	0.05		
POPs - PBDE	PBDE 153	TOT	pg/L	100%	356	697	165	3.15		
POPs - PBDE	PBDE 154	TOT	pg/L	100%	290	592	127	2.57		
POPs - PBDE	PBDE 155	TOT	pg/L	100%	22	42.6	12.8	0.2		
POPs - PBDE	PBDE 17/25	TOT	pg/L	100%	61	115	27.6	0.54		
POPs - PBDE	PBDE 183	TOT	pg/L	100%	66	127	24.5	0.6		
POPs - PBDE	PBDE 203	TOT	pg/L	100%	51	87	17.7	0.5		
POPs - PBDE	PBDE 206	TOT	pg/L	100%	302	523	95.1	3		
POPs - PBDE	PBDE 207	TOT	pg/L	100%	369	657	128	3.27		
POPs - PBDE	PBDE 208	TOT	pg/L	100%	223	386	80	1.97		
POPs - PBDE	PBDE 209	TOT	pg/L	100%	3263	6200	1230	28.8		
POPs - PBDE	PBDE 28/33	TOT	pg/L	100%	77.6	156	39.9	0.69		
POPs - PBDE	PBDE 47	TOT	pg/L	100%	4128	8250	1760	36.5		
POPs - PBDE	PBDE 49	TOT	pg/L	100%	134	295	62.2	1.19		
POPs - PBDE	PBDE 51	TOT	pg/L	100%	15.9	34.5	7.31	0.14		
POPs - PBDE	PBDE 66	TOT	pg/L	100%	75.4	122	39.8	0.67		
POPs - PBDE	PBDE 7	TOT	pg/L	100%	3.63	6.32	1.72	0.03		
POPs - PBDE	PBDE 71	TOT	pg/L	100%	14.42	24.3	9.9	0.13		
POPs - PBDE	PBDE 75	TOT	pg/L	100%	5.86	11.5	2.83	0.05		
POPs - PBDE	PBDE 85	TOT	pg/L	100%	150	294	66.1	1.3		
POPs - PBDE	PBDE 99	TOT	pg/L	100%	3808	7440	1740	33.6		
POPs - PCBs	PCBs	TOT	pg/L	100%	20.5	49.3	8.17	0.18		
POPs - PCB	PCB 10	TOT	pg/L	75%	2.21	5.23	0.823	0.02		
POPs - PCB	PCB 105	TOT	pg/L	100%	21.25	37.7	12.9	0.19		
POPs - PCB	PCB 107/124	TOT	pg/L	75%	2.47	4.41	1.49	0.02		
POPs - PCB	PCB 109	TOT	pg/L	100%	3.66	5.59	2.09	0.03		
POPs - PCB	PCB 11	TOT	pg/L	100%	141	226	80.2	1.25		
POPs - PCB	PCB 110/115	TOT	pg/L	100%	75.9	150	41.6	0.67		
POPs - PCB	PCB 118	TOT	pg/L	100%	55.1	105	31.6	0.49		
POPs - PCB	PCB 12/13	TOT	pg/L	100%	6.56	9.72	2.71	0.06		
POPs - PCB	PCB 123	TOT	pg/L	75%	2.56	4.83	1.39	0.023		
POPs - PCB	PCB 128/166	TOT	pg/L	100%	9.85	17.1	5.97	0.087		
POPs - PCB	PCB 129/138/160/163	TOT	pg/L	100%	67.8	124	31.3	0.6		
POPs - PCB	PCB 130	TOT	pg/L	100%	4.76	8.67	2.28	0.04		

Table 2.5, cont'd

Parameter Grouping	Parameter	State	Unit	Frequency of Detection	Average Concentration	Maximum Concentration	Minimum Concentration	113:1 Dilution	CCME WQG	BC WQG
POPs - PCB	PCB 132	TOT	pg/L	100%	22.68	43.2	10.9	0.2		
POPs - PCB	PCB 134/143	TOT	pg/L	75%	3.06	4.23	1.87	0.03		
POPs - PCB	PCB 135/151/154	TOT	pg/L	100%	22.49	44	8.85	0.2		
POPs - PCB	PCB 136	TOT	pg/L	100%	9.41	18.4	3.88	0.083		
POPs - PCB	PCB 137	TOT	pg/L	100%	3.47	4.73	2.05	0.03		
POPs - PCB	PCB 139/140	TOT	pg/L	75%	2.68	4.28	1.24	0.02		
POPs - PCB	PCB 141	TOT	pg/L	100%	10.44	18.5	5.3	0.09		
POPs - PCB	PCB 144	TOT	pg/L	100%	3.66	6.72	1.52	0.032		
POPs - PCB	PCB 146	TOT	pg/L	100%	11.40	18.7	4.79	0.101		
POPs - PCB	PCB 147/149	TOT	pg/L	100%	47.70	89.5	22	0.422		
POPs - PCB	PCB 15	TOT	pg/L	100%	21.15	32	7.41	0.187		
POPs - PCB	PCB 153/168	TOT	pg/L	100%	61.70	111	26.2	0.546		
POPs - PCB	PCB 155	TOT	pg/L	100%	6.46	11.7	3.9	0.057		
POPs - PCB	PCB 156157	TOT	pg/L	100%	8.38	14	5.11	0.074		
POPs - PCB	PCB 158	TOT	pg/L	100%	5.49	8.6	3.1	0.049		
POPs - PCB	PCB 16	TOT	pg/L	100%	21.08	45.2	9.12	0.187		
POPs - PCB	PCB 164	TOT	pg/L	100%	3.38	4.33	2.81	0.03		
POPs - PCB	PCB 167	TOT	pg/L	100%	3.06	5.96	1.26	0.027		
POPs - PCB	PCB 17	TOT	pg/L	100%	20.70	47.7	7.89	0.183		
POPs - PCB	PCB 170	TOT	pg/L	100%	13.28	27.7	4.79	0.118		
POPs - PCB	PCB 171/173	TOT	pg/L	100%	4.47	7.55	1.49	0.04		
POPs - PCB	PCB 177	TOT	pg/L	100%	7.88	14.3	3.15	0.07		
POPs - PCB	PCB 178	TOT	pg/L	100%	3.87	6.88	1.92	0.034		
POPs - PCB	PCB 179	TOT	pg/L	100%	7.15	13	2.93	0.063		
POPs - PCB	PCB 18/30	TOT	pg/L	100%	42.85	101	16.2	0.379		
POPs - PCB	PCB 180/193	TOT	pg/L	100%	33.15	64	11.5	0.293		
POPs - PCB	PCB 183/185	TOT	pg/L	100%	8.90	14.2	4.32	0.079		
POPs - PCB	PCB 184	TOT	pg/L	100%	10.61	20.8	4.85	0.094		
POPs - PCB	PCB 187	TOT	pg/L	100%	19.43	35.7	7.01	0.172		
POPs - PCB	PCB 19	TOT	pg/L	100%	10.19	24.8	3.14	0.09		
POPs - PCB	PCB 190	TOT	pg/L	100%	2.25	3.2	1.39	0.02		
POPs - PCB	PCB 194	TOT	pg/L	100%	8.50	15.1	1.94	0.075		
POPs - PCB	PCB 195	TOT	pg/L	100%	2.76	6.02	0.959	0.024		
POPs - PCB	PCB 196	TOT	pg/L	100%	3.81	6.87	1.05	0.034		
POPs - PCB	PCB 197/200	TOT	pg/L	100%	2.34	4.61	0.958	0.021		

Table 2.5, cont'd

Parameter Grouping	Parameter	State	Unit	Frequency of Detection	Average Concentration	Maximum Concentration	Minimum Concentration	113:1 Dilution	CCME WQG	BC WQG
POPs - PCB	PCB 198/199	TOT	pg/L	100%	10.67	20.3	3.01	0.094		
POPs - PCB	PCB 2	TOT	pg/L	100%	7.63	12.2	4.88	0.067		
POPs - PCB	PCB 20/28	TOT	pg/L	100%	55.65	115	24.8	0.492		
POPs - PCB	PCB 202	TOT	pg/L	100%	3.01	4.13	1.27	0.027		
POPs - PCB	PCB 203	TOT	pg/L	100%	5.68	9.94	2.09	0.05		
POPs - PCB	PCB 206	TOT	pg/L	100%	7.40	13.3	2.31	0.066		
POPs - PCB	PCB 208	TOT	pg/L	100%	3.55	6.76	1.04	0.031		
POPs - PCB	PCB 209	TOT	pg/L	100%	8.23	13.2	3.18	0.073		
POPs - PCB	PCB 21/33	TOT	pg/L	100%	24.35	36.9	15.7	0.215		
POPs - PCB	PCB 22	TOT	pg/L	100%	21.28	42.8	10.8	0.188		
POPs - PCB	PCB 25	TOT	pg/L	100%	7.68	17.7	2.51	0.068		
POPs - PCB	PCB 26/29	TOT	pg/L	100%	13.78	30.6	5.15	0.122		
POPs - PCB	PCB 27	TOT	pg/L	100%	8.88	23.8	2.73	0.079		
POPs - PCB	PCB 3	TOT	pg/L	100%	11.65	21.1	7.01	0.103		
POPs - PCB	PCB 31	TOT	pg/L	100%	53.68	115	21.6	0.475		
POPs - PCB	PCB 32	TOT	pg/L	100%	15.15	36.1	4.93	0.13		
POPs - PCB	PCB 35	TOT	pg/L	100%	4.82	8.72	2.24	0.04		
POPs - PCB	PCB 37	TOT	pg/L	100%	13.68	24.3	6.61	0.12		
POPs - PCB	PCB 4	TOT	pg/L	100%	56.10	134	16.8	0.5		
POPs - PCB	PCB 40/41/71	TOT	pg/L	100%	25.63	52.1	13.7	0.23		
POPs - PCB	PCB 42	TOT	pg/L	100%	14.49	32.2	6.21	0.128		
POPs - PCB	PCB 43	TOT	pg/L	75%	2.62	6.73	0.737	0.023		
POPs - PCB	PCB 44/47/65	TOT	pg/L	100%	112.6	199	39.5	0.996		
POPs - PCB	PCB 46	TOT	pg/L	100%	3.56	9.22	1.28	0.032		
POPs - PCB	PCB 48	TOT	pg/L	100%	9.06	18.8	3.37	0.08		
POPs - PCB	PCB 49/69	TOT	pg/L	100%	38.18	83.7	17	0.338		
POPs - PCB	PCB 5	TOT	pg/L	75%	1.65	2.44	1.22	0.015		
POPs - PCB	PCB 50/53	TOT	pg/L	100%	11.49	28.4	3.48	0.102		
POPs - PCB	PCB 52	TOT	pg/L	100%	101.9	241	37.7	0.902		
POPs - PCB	PCB 56	TOT	pg/L	100%	17.77	37.3	9.42	0.157		
POPs - PCB	PCB 59/62/75	TOT	pg/L	100%	4.65	9.02	2.2	0.041		
POPs - PCB	PCB 6	TOT	pg/L	100%	6.46	9.3	4.94	0.057		
POPs - PCB	PCB 60	TOT	pg/L	100%	9.82	19.3	5.31	0.087		
POPs - PCB	PCB 61/70/74/76	TOT	pg/L	100%	80.7	160	43.3	0.714		
POPs - PCB	PCB 63	TOT	pg/L	100%	1.64	3.06	0.916	0.015		

Table 2.5, cont'd

Parameter Grouping	Parameter	State	Unit	Frequency of Detection	Average Concentration	Maximum Concentration	Minimum Concentration	113:1 Dilution	CCME WQG	BC WQG
POPs - PCB	PCB 64	TOT	pg/L	100%	21.28	44.2	11.1	0.188		
POPs - PCB	PCB 66	TOT	pg/L	100%	33.9	67.3	18.1	0.3		
POPs - PCB	PCB 68	TOT	pg/L	100%	12.03	19.1	3.01	0.106		
POPs - PCB	PCB 7	TOT	pg/L	100%	6.1	10.2	2.04	0.054		
POPs - PCB	PCB 77	TOT	pg/L	100%	3.6	7.53	1.81	0.032	40	
POPs - PCB	PCB 8	TOT	pg/L	100%	18.5	21.8	13.4	0.16		
POPs - PCB	PCB 82	TOT	pg/L	100%	7.8	14.1	4.97	0.07		
POPs - PCB	PCB 83/99	TOT	pg/L	100%	40.0	78.3	21.9	0.354		
POPs - PCB	PCB 84	TOT	pg/L	100%	20.0	41.1	11	0.177		
POPs - PCB	PCB 85/116/117	TOT	pg/L	100%	11.86	22.4	6.42	0.105		
POPs - PCB	PCB 86/87/97/108/119/125	TOT	pg/L	100%	49.	90.4	29.9	0.437		
POPs - PCB	PCB 88/91	TOT	pg/L	100%	9.78	19.3	5.61	0.087		
POPs - PCB	PCB 9	TOT	pg/L	100%	2.38	3.3	1.08	0.021		
POPs - PCB	PCB 90/101/113	TOT	pg/L	100%	75.25	144	38.9	0.666		
POPs - PCB	PCB 92	TOT	pg/L	100%	14.24	28	7.65	0.126		
POPs - PCB	PCB 93/95/98/100/102	TOT	pg/L	100%	66.83	128	39.3	0.5914		
POPs - PCB TEQ	PCB Teq 3	TOT	pg/L	100%	0.05	0.0615	0.02748	0.0004		
POPs - PCB TEQ	PCB Teq 4	TOT	pg/L	100%	1.34	1.9478	0.9729	0.012		
POPs - PCB	PCB174	TOT	pg/L	100%	11.22	21.5	4.1	0.09931		
POPs - PCB	PCB45/51	TOT	pg/L	100%	20.69	38.5	6.87	0.18		
POPs - PCB Total	PCBs Total	TOT	pg/L	100%	1985	3900	1070	17.57	100	100
POPs - PCBs	Pentachloro Biphenyls	TOT	pg/L	100%	452.70	864	239	4.006		
Organics - Misc	Pentachlorobenzene	TOT	ng/L	100%	0.11	0.185	0.051	0.00101		
Organics - Misc	Perfluorobutanoic acid	TOT	ng/L	100%	42.93	67.2	24.5	0.38		
POPs - PAH	Perylene	TOT	ng/L	75%	0.38	0.441	0.296	0.003		
POPs - PFAS	PFBS	TOT	ng/L	100%	19.33	28.8	11.5	0.17		
POPs - PFAS	PFDA	TOT	ng/L	100%	1.36	1.55	1.2	0.01		
POPs - PFAS	PFHpA	TOT	ng/L	100%	9.40	13.2	6.71	0.08		
POPs - PFAS	PFHxA	TOT	ng/L	100%	49.9	65.1	31	0.44		
POPs - PFAS	PFHxS	TOT	ng/L	100%	12.6	19.2	9.05	0.112		
POPs - PFAS	PFNA	TOT	ng/L	100%	1.57	1.95	1.24	0.01		
POPs - PFAS	PFOA	TOT	ng/L	100%	22.0	31.2	16.5	0.195		
POPs - PFAS	PFOS	TOT	ng/L	100%	4.42	5.38	2.75	0.04		
POPs - PFAS	PFPeA	TOT	ng/L	100%	34.1	50.3	22.7	0.302		

Table 2.5, cont'd

Parameter Grouping	Parameter	State	Unit	Frequency of Detection	Average Concentration	Maximum Concentration	Minimum Concentration	113:1 Dilution	CCME WQG	BC WQG
POPs - PAH	Phenanthrene	TOT	ng/L	100%	5.9	21.219	0.02	0.053		
PHARMA	Progesterone	TOT	ng/L	100%	1.41	1.79	0.942	0.012		
POPs - PAH	Pyrene	TOT	ng/L	100%	5.50	25.118	0.012	0.05		
POPs - PPCPs	Roxithromycin	TOT	ng/L	100%	2.07	2.75	1.35	0.02		
POPs - PPCPs	Sulfamerazine	TOT	ng/L	75%	1.56	2.68	0.609	0.01		
POPs - PPCPs	Sulfamethazine	TOT	ng/L	75%	1.10	1.63	0.609	0.009		
POPs - PPCPs	Sulfamethoxazole	TOT	ng/L	100%	502	748	284	4.442		
POPs - PPCPs	Sulfanilamide	TOT	ng/L	100%	95	119	49.5	0.837		
Conventionals - Sulphide	Sulfide	TOT	mg/L	75%	0.04	0.076	0.018	0.00031		
POPs - PCBs	Tetrachloro Biphenyls	TOT	pg/L	100%	534	1070	210	4.726		
POPs - PPCPs	Thiabendazole	TOT	ng/L	100%	28	34.4	22.6	0.2518		
POPs - PAH	Total PAH	TOT	µg/L	100%	0.17	0.27	0.12	0.002		
PHENO	Total Phenols	TOT	mg/L	83%	0.01	0.0075	0.0018	0.00009		
Conventionals - Cyanide	Total/SAD Cyanide	TOT	mg/L	100%	0.01	0.00256	0.00158	0.002		
POPs - PCBs	Trichloro Biphenyls	TOT	pg/L	100%	341	670	130	3.02		
POPs - PPCPs	Triclocarban	TOT	ng/L	100%	1.4	1.86	1.07	0.01		
POPs - PPCPs	Triclosan	TOT	ng/L	100%	15.	20.2	12.2	0.13		
POPs - PPCPs	Trimethoprim	TOT	ng/L	100%	227	258	199	2.015		
POPs - PPCPs	Tylosin	TOT	ng/L	100%	3.5	5.77	1.81	0.031		
POPs - PPCPs	Warfarin	TOT	ng/L	100%	3.22	4.05	1.82	0.03		

Notes:
*Dilution calculated from maximum concentration.
BC WQG = British Columbia Water Quality Guidelines for protection of marine aquatic life.
CCME WQG = Canadian Council of Ministers of the Environment water quality guidelines for protection of marine aquatic life.
Guidelines are approved unless otherwise stated.
a. working guideline
*Guidelines are maximum concentrations unless otherwise stated.
Red shading indicates exceedance to BC WQG or CCME WQG.

Table 2.6 Removal Efficiencies – 2023 Samples (*n*=12)

Chemical Category	Parameter	State	Influent Load (kg)	Effluent Load (kg)	Percent Removal
Metals - Lanthanoids	Thallium	TOT	0.1580	---	100%
POPs - PCDD	1,2,3,4,6,7,8-HPCDF	TOT	0.0000	---	100%
POPs - PCDD	1,2,3,6,7,8-HXCDD	TOT	0.0000	---	100%
POPs - Hormones and Sterols	17 beta-Estradiol	TOT	0.4576	---	100%
POPs - Pesticides	2,4-DDT	TOT	0.0034	---	100%
POPs - PAH	2-Methylnaphthalene	TOT	0.6864	---	100%
POPs - Pesticides	4,4-DDD	TOT	0.00257	---	100%
POPs - Pesticides	4,4-DDT	TOT	0.00694	---	100%
POPs - Pesticides	Alpha Chlordane	TOT	0.00	---	100%
Organics - Terpenes	Alpha-Terpineol	TOT	245	---	100%
POPs - PAH	Anthracene	TOT	0.1581	---	100%
POPs - PAH	Benzo(B&J)Fluoranthene	TOT	1.6660	---	100%
POPs - PAH	Benzo(K)Fluoranthene	TOT	1.0324	---	100%
POPs - PAH	Benzo[a]anthracene	TOT	0.1379	---	100%
POPs - PAH	Benzo[a]pyrene	TOT	0.001	---	100%
POPs - PAH	Benzo[b]fluoranthene	TOT	0.15	---	100%
POPs - Phthalates	Bis(2-Ethylhexyl)Phthalate	TOT	247	---	100%
POPs - PAH	Chrysene	TOT	0.17	---	100%
Metals - Speciated	Dibutyltin	TOT	0.16	---	100%
Metals - Speciated	Dibutyltin Dichloride	TOT	0.21	---	100%
POPs - Phthalates	Diethyl Phthalate	TOT	40.59	---	100%
POPs - Hormones and Sterols	Estriol	TOT	6.0	---	100%
POPs - Hormones and Sterols	Estrone	TOT	1.22	---	100%
POPs - PCDD	Hepta-Furans	TOT	0.0001	---	100%
POPs - PCDD	Hexa-Dioxins	TOT	0.0002	---	100%
Metals - Speciated	Methyl Mercury	TOT	0.0073	---	100%
POPs - PCDD	OCDF	TOT	0.0001	---	100%
Conventionals - Oil and Grease	Oil & Grease, total	TOT	426,163	---	100%
POPs - PBDE	PBDE 12/13	TOT	0.0003	---	100%
POPs - PBDE	PBDE 126	TOT	0.0002	---	100%
POPs - PBDE	PBDE 35	TOT	0.0001	---	100%
POPs - PBDE	PBDE 37	TOT	0.0003	---	100%
POPs - PBDE	PBDE 77	TOT	0.0001	---	100%
POPs - PBDE	PBDE 8/11	TOT	0.00021	---	100%

Table 2.6, cont'd

Chemical Category	Parameter	State	Influent Load (kg)	Effluent Load (kg)	Percent Removal
POPs - PCB - Conje	PCB 103	TOT	0.00007	---	100%
POPs - PCB - Conje	PCB 104	TOT	0.00004	---	100%
POPs - PCB - Conje	PCB 114	TOT	0.00015	---	100%
POPs - PCB - Conje	PCB 122	TOT	0.00006	---	100%
POPs - PCB - Conje	PCB 131	TOT	0.00010	---	100%
POPs - PCB - Conje	PCB 133	TOT	0.00012	---	100%
POPs - PCB - Conje	PCB 14	TOT	0.00004	---	100%
POPs - PCB - Conje	PCB 148	TOT	0.00004	---	100%
POPs - PCB - Conje	PCB 150	TOT	0.00004	---	100%
POPs - PCB - Conje	PCB 172	TOT	0.00020	---	100%
POPs - PCB - Conje	PCB 175	TOT	0.00006	---	100%
POPs - PCB - Conje	PCB 176	TOT	0.00020	---	100%
POPs - PCB - Conje	PCB 189	TOT	0.00005	---	100%
POPs - PCB - Conje	PCB 191	TOT	0.00006	---	100%
POPs - PCB - Conje	PCB 201	TOT	0.00010	---	100%
POPs - PCB - Conje	PCB 204	TOT	0.00005	---	100%
POPs - PCB - Conje	PCB 205	TOT	0.00003	---	100%
POPs - PCB - Conje	PCB 207	TOT	0.00009	---	100%
POPs - PCB - Conje	PCB 24	TOT	0.00005	---	100%
POPs - PCB - Conje	PCB 36	TOT	0.00012	---	100%
POPs - PCB - Conje	PCB 54	TOT	0.00009	---	100%
POPs - PCB - Conje	PCB 55	TOT	0.00007	---	100%
POPs - PCB - Conje	PCB 57	TOT	0.00005	---	100%
POPs - PCB - Conje	PCB 67	TOT	0.00014	---	100%
POPs - PCB - Conje	PCB 79	TOT	0.00007	---	100%
POPs - PCB - Conje	PCB 89	TOT	0.00007	---	100%
POPs - PCB - Conje	PCB 94	TOT	0.00005	---	100%
POPs - PCB - Conje	PCB 96	TOT	0.00005	---	100%
POPs - PCDD	Penta-Dioxins	TOT	0.00003	---	100%
Phenols - Non-chlorinated phenols	Phenol	TOT	331	---	100%
PHARMA	Testosterone	TOT	1.6	---	100%
Organics - BTEX	Toluene	TOT	58	---	100%
Organics - Misc	Trans-Chlordane	TOT	0.0034	---	100%
Organics - Misc	Trans-Nonachlor	TOT	0.00298	---	100%
Organics - Misc	Trichloromethane	TOT	84	---	100%

Table 2.6, cont'd

Chemical Category	Parameter	State	Influent Load (kg)	Effluent Load (kg)	Percent Removal
POPs - PPCPs	Acetaminophen	TOT	3,487	0.56	100%
PHARMA	Androstenedione	TOT	4	0.05	99%
Conventionals - Sulphide	Sulfide	TOT	34,607	970	97%
POPs - PPCPs	Caffeine	TOT	2,185	70	97%
POPs - PPCPs	Ibuprofen	TOT	361	12	97%
Conventionals - Sulphide	H2S	TOT	55,071	2,207	96%
POPs - PAH	Benzo[J,K]Fluoranthenes	TOT	0.46	0.02	95%
POPs - PAH	2,6-dimethylnaphthalene	TOT	0.9	0.05	95%
PHARMA	Progesterone	TOT	0.6	0.04	94%
POPs - PAH	Perylene	TOT	0.1	0.01	94%
POPs - PAH	Benzo[e]pyrene	TOT	0.4	0.03	93%
POPs - PAH	Naphthalene	TOT	1.24	0.09	93%
POPs - PCDD	Hepta-Dioxins	TOT	0.001	0.0001	92%
PHENO	Total Phenols	TOT	1,221	101	92%
POPs - PCB TEQ	PCB Teq 3	TOT	0.00001	0.000001	91%
POPs - PAH	High Molecular Weight PAH`s	TOT	14.2	1.25	91%
POPs - PCDD	1,2,3,4,6,7,8-HPCDD	TOT	0.001	0.00005	91%
POPs - PAH	Phenanthrene	TOT	1.4	0.13	90%
POPs - PCDD	OCDD	TOT	0.004	0.0004	90%
Organics - Misc	1,7-Dimethylxanthine	TOT	776	79.5	90%
Metals - Post transition metals	Aluminum	TOT	7,384	820	89%
POPs - PAH	Total PAH	TOT	41	4.7	88%
POPs - PPCPs	Bisphenol A	TOT	117	13.6	88%
POPs - PPCPs	2-Hydroxy-Ibuprofen	TOT	394	48	88%
POPs - PBDE	PBDE 209	TOT	1	0.08	87%
POPs - PAH	Low Molecular Weight PAH`s	TOT	26	3.45	87%
POPs - PAH	Dibenzothiophene	TOT	1	0.08	86%
POPs - Nonylphenols	4-Nonylphenol Diethoxylates	TOT	24	3.30	86%
POPs - PAH	Fluoranthene	TOT	1	0.11	86%
POPs - PAH	Fluorene	TOT	0.52	0.08	85%
Conventionals - Nutrients	Organic Carbon	TOT	4,544,467	660,954	85%
POPs - PAH	2,3,5-trimethylnaphthalene	TOT	0.54	0.08	85%
POPs - PFAS	5:3 FTCA	TOT	6.54	0.98	85%
POPs - PCB - Conje	PCB 6	TOT	0.001	0.0002	84%
Metals - Post transition metals	Lead	TOT	92.75	14.7	84%
POPs - PBDE	PBDE 119/120	TOT	0.002	0.0003	84%

Table 2.6, cont'd

Chemical Category	Parameter	State	Influent Load (kg)	Effluent Load (kg)	Percent Removal
POPs - PAH	Pyrene	TOT	0.64	0.105	84%
POPs - PCB - Conje	PCB 134/143	TOT	0.0004	0.0001	83%
POPs - PCB - Conje	PCB 8	TOT	0.003	0.0005	83%
POPs - PBDE	PBDE 15	TOT	0.001	0.00014	83%
POPs - PAH	Acenaphthene	TOT	0.96	0.2	83%
POPs - PAH	1-Methylphenanthrene	TOT	0.27	0.05	82%
Metals - Alkaline earth	Barium	TOT	597	111.0	81%
Metals - Transition	Cadmium	TOT	5.9	1.2	81%
POPS - PCB	Octachloro Biphenyls	TOT	0.0015	0.0003	80%
POPs - PCB - Conje	PCB 164	TOT	0.0004	0.0001	80%
POPs - Nonylphenols	4-Nonylphenol Monoethoxylates	TOT	87	18.0	79%
POPs - PPCPs	Naproxen	TOT	167	35	79%
POPs - PCB - Conje	PCB 158	TOT	0.001	0.0001	79%
POPs - PBDE	PBDE 66	TOT	0.0091	0.00195	79%
POPS - PCB	Nonachloro Biphenyls	TOT	0.0009	0.00020	78%
POPs - PCB - Conje	PCB 21/33	TOT	0.003	0.001	78%
POPs - PCB - Conje	PCB 25	TOT	0.001	0.0002	78%
POPs - PCB - Conje	PCB 137	TOT	0.0004	0.000082	78%
POPs - PCB - Conje	PCB 141	TOT	0.001	0.00025	78%
POPs - PBDE	PBDE 49	TOT	0.0154	0.0035	77%
POPs - PBDE	PBDE 155	TOT	0.0025	0.001	77%
POPs - Nonylphenols	NP	TOT	30.5362	7.1	77%
POPs - PCB - Conje	PCB 109	TOT	0.00037	0.0001	76%
POPs - PCB - Conje	PCB 35	TOT	0.0005	0.0001	76%
POPs - PCB - Conje	PCB174	TOT	0.001	0.0003	76%
POPs - PCB - Conje	PCB 107/124	TOT	0.000	0.0001	76%
POPs - PBDE	PBDE 153	TOT	0.038	0.009	76%
POPs - PCB - Conje	PCB 147/149	TOT	0.00471	0.0012	75%
POPs - PCB - Conje	PCB 129/138/160/163	TOT	0.00658	0.0016	75%
POPs - PBDE	PBDE 75	TOT	0.0006	0.00015	75%
POPs - PCB - Conje	PCB 183/185	TOT	0.00086	0.00021	75%
POPs - PCB - Conje	PCB 156157	TOT	0.001	0.0002	75%
POPs - PBDE	PBDE 140	TOT	0.0012	0.0003	75%
POPs - PCB - Conje	PCB 153/168	TOT	0.0059	0.0015	75%
POPs - PCB - Conje	PCB 128/166	TOT	0.00092	0.00023	75%

Table 2.6, cont'd

Chemical Category	Parameter	State	Influent Load (kg)	Effluent Load (kg)	Percent Removal
POPs - PBDE	PBDE 85	TOT	0.015	0.0039	74%
POPs - PBDE	PBDE 154	TOT	0.029	0.0074	74%
POPs - PCB - Conje	PCB 63	TOT	0.0002	0.00004	74%
POPs - PCB - Conje	PCB 132	TOT	0.0021	0.0005	74%
POPs - PBDE	PBDE 99	TOT	0.37	0.097	74%
POPs - PBDE	PBDE 47	TOT	0.40	0.10	74%
POPs - PBDE	PBDE 100	TOT	0.076	0.0201	74%
POPs - PCB - Conje	PCB 206	TOT	0.00072	0.00019	73%
POPs - PCB - Conje	PCB 179	TOT	0.0006	0.0002	73%
POPs - PCB - Conje	PCB 177	TOT	0.001	0.00018	73%
Metals - Transition	Zinc	TOT	3,327	901	73%
POPs - PCB - Conje	PCB 26/29	TOT	0.001	0.0004	73%
POPs - PCB - Conje	PCB 202	TOT	0.0003	0.0001	73%
POPs - PCB - Conje	PCB 135/151/154	TOT	0.002	0.0005	73%
POPs - PCB	Hexachloro Biphenyls	TOT	0.025	0.0068	73%
POPs - PBDE	PBDE 138/166	TOT	0.004	0.001	73%
POPs - PCB - Conje	PCB 118	TOT	0.005	0.0014	72%
POPs - PCB - Conje	PCB 180/193	TOT	0.0029	0.00081	72%
POPs - PBDE	PBDE 183	TOT	0.0062	0.0017	72%
POPs - PCB - Conje	PCB 178	TOT	0.0003	0.00009	72%
POPs - PCB	Heptachloro Biphenyls	TOT	0.0095	0.0026	72%
POPs - PCB - Conje	PCB 66	TOT	0.0031	0.0009	72%
POPs - PBDE	PBDE 28/33	TOT	0.0071	0.0020	72%
POPs - PCB - Conje	PCB 171/173	TOT	0.0004	0.0001	72%
POPs - PCB - Conje	PCB 46	TOT	0.00034	0.00010	72%
POPs - PCB - Conje	PCB 167	TOT	0.0002	0.0001	71%
POPs - PCB - Conje	PCB 105	TOT	0.0018	0.0005	71%
POPs - PCB - Conje	PCB 155	TOT	0.0006	0.0002	71%
POPs - PCB - Conje	PCB 19	TOT	0.0010	0.00028	71%
POPs - PBDE	PBDE 206	TOT	0.027	0.008	71%
POPs - PCB - Conje	PCB 187	TOT	0.0016	0.00045	71%
POPs - PCB - Conje	PCB 170	TOT	0.0011	0.0003	71%
POPs - PCB - Conje	PCB 209	TOT	0.00073	0.0002	71%
POPs - PCB - Conje	PCB 50/53	TOT	0.0011	0.0003	71%
POPS - PCB	PCB	TOT	0.0019	0.0005	71%
POPs - PCB - Conje	PCB 61/70/74/76	TOT	0.0071	0.0021	71%

Table 2.6, cont'd

Chemical Category	Parameter	State	Influent Load (kg)	Effluent Load (kg)	Percent Removal
POPs - PCB - Conje	PCB 184	TOT	0.0009	0.0003	70%
POPs - PCB - Conje	PCB 88/91	TOT	0.00082	0.0002	70%
POPs - PBDE	PBDE 51	TOT	0.0014	0.0004	70%
POPs - PCB - Conje	PCB 82	TOT	0.0007	0.0002	70%
POPs - PCB - Conje	PCB 92	TOT	0.0012	0.0004	70%
POPs - PCB - Conje	PCB 60	TOT	0.00084	0.0003	70%
POPs - PCB Total	PCBs Total	TOT	0.17	0.0511	70%
POPs - PCB - Conje	PCB 22	TOT	0.0018	0.0006	70%
POPs - PCB - Conje	PCB 146	TOT	0.00086	0.0003	70%
POPs - PCB - Conje	PCB 194	TOT	0.0007	0.0002	70%
POPs - PCB - Conje	PCB 86/87/97/108/119/125	TOT	0.0041	0.0012	70%
POPs - PBDE	PBDE 71	TOT	0.0012	0.00035	70%
POPs - PCB - Conje	PCB 49/69	TOT	0.0033	0.0010	69%
POPs - PCB - Conje	PCB 110/115	TOT	0.0063	0.0019	69%
POPs - PCB - Conje	PCB 85/116/117	TOT	0.00099	0.0003	69%
POPs - PCB	Pentachloro Biphenyls	TOT	0.036	0.0112	69%
POPs - PCB - Conje	PCB 130	TOT	0.0004	0.0001	69%
POPs - PCB - Conje	PCB 196	TOT	0.0003	0.0001	69%
POPs - PCB - Conje	PCB 144	TOT	0.0003	0.0001	69%
POPs - PCB - Conje	PCB 90/101/113	TOT	0.0063	0.0019	69%
POPs - PCB - Conje	PCB 77	TOT	0.0003	0.0001	69%
POPs - PCB - Conje	PCB 27	TOT	0.00079	0.00024	69%
POPs - PCB - Conje	PCB 56	TOT	0.0015	0.00046	69%
POPs - PCB - Conje	PCB 20/28	TOT	0.0048	0.0015	69%
POPs - PBDE	PBDE 7	TOT	0.0003	0.0001	69%
POPs - PCB - Conje	PCB 190	TOT	0.00016	0.00005	69%
POPs - PCB - Conje	PCB 37	TOT	0.00116	0.00036	69%
POPs - PCB - Conje	PCB 136	TOT	0.0007	0.0002	69%
POPs - PCB - Conje	PCB 93/95/98/100/102	TOT	0.0053	0.0017	68%
POPs - PCB - Conje	PCB 203	TOT	0.00043	0.00014	68%
POPs - PCB - Conje	PCB 84	TOT	0.0016	0.00051	68%
Metals - Transition	Iron	TOT	63,465	20,847	67%
POPs - PCB - Conje	PCB 4	TOT	0.0048	0.0016	67%
POPs - PCB - Conje	PCB 83/99	TOT	0.0031	0.0010	67%
POPs - PCB - Conje	PCB 208	TOT	0.00027	0.00009	67%
POPs - PCB - Conje	PCB 31	TOT	0.0043	0.0014	67%

Table 2.6, cont'd

Chemical Category	Parameter	State	Influent Load (kg)	Effluent Load (kg)	Percent Removal
POPs - PCB - Conje	PCB 11	TOT	0.01	0.0036	67%
POPs - PCB - Conje	PCB 40/41/71	TOT	0.0020	0.0007	67%
POPs - PCB - Conje	PCB 32	TOT	0.0012	0.0004	67%
POPs - PCB - Conje	PCB 64	TOT	0.0016	0.0006	66%
POPs - PCB - Conje	PCB 195	TOT	0.0002	0.0001	66%
POPs - PCB - Conje	PCB 198/199	TOT	0.0008	0.0003	66%
Metals - Transition	Copper	TOT	1,415.5166	490	65%
POPs - PCB - Conje	PCB 42	TOT	0.0011	0.0004	65%
POPs - PCB - Conje	PCB 9	TOT	0.0002	0.0001	65%
POPS - PCB	Dichloro Biphenyls	TOT	0.01905	0.0068	64%
POPs - PCB - Conje	PCB 197/200	TOT	0.00014	0.0001	64%
POPs - PCB - Conje	PCB 139/140	TOT	0.0002	0.0001	64%
POPs - Pesticides	4,4-DDE	TOT	0.0188	0.0068	64%
POPs - PCB - Conje	PCB 17	TOT	0.00153	0.0006	63%
POPs - PCB - Conje	PCB 59/62/75	TOT	0.0003	0.0001	63%
POPs - PFAS	N-EtFOSAA	TOT	0.0737	0.0271	63%
POPs - PCB - Conje	PCB 48	TOT	0.00066	0.0002	63%
POPs - Homologe	Trichloro Biphenyls	TOT	0.0245	0.0091	63%
Metals - Reactive non-metal	Phosphorus	TOT	181,757	67,535	63%
POPs - PPCPs	Sulfamethoxazole	TOT	29.6	11.0	63%
POPs - PCB - Conje	PCB 12/13	TOT	0.00047	0.0002	62%
POPs - PCB - Conje	PCB 52	TOT	0.007	0.0027	61%
POPs - PCB	Tetrachloro Biphenyls	TOT	0.036	0.014	61%
POPs - PBDE	PBDE 207	TOT	0.02	0.0098	60%
POPs - PCB - Conje	PCB 10	TOT	0.0001	0.00006	58%
POPs - PCB - Conje	PCB 15	TOT	0.0014	0.0006	58%
POPs - PCB - Conje	PCB 18/30	TOT	0.0028	0.001	58%
POPs - PCB - Conje	PCB 16	TOT	0.0013	0.001	58%
POPs - PFAS	MeFOSAA	TOT	0.1172	0.05	57%
Metals - Alkaline earth	Barium	DISS	177	76	57%
POPs - Pesticides	2,4-DDD	TOT	0.0081	0.003	57%
POPs - PCB - Conje	PCB 44/47/65	TOT	0.0071	0.003	57%
POPS - PCB	Monochloro Biphenyls	TOT	0.0019	0.001	57%
POPs - PCB - Conje	PCB45/51	TOT	0.0013	0.001	56%
Metals - Transition	Chromium	TOT	149	66	56%
POPs - PCB - Conje	PCB 5	TOT	0.0001	0.00004	55%

Table 2.6, cont'd

Chemical Category	Parameter	State	Influent Load (kg)	Effluent Load (kg)	Percent Removal
Metals - Actinoids	Uranium	DISS	0.73	0.333	55%
POPs - PBDE	PBDE 208	TOT	0.013	0.006	54%
POPs - PBDE	PBDE 17/25	TOT	0.0034	0.002	54%
POPs - Pesticides	Dieldrin	TOT	0.017	0.008	54%
Metals - Post transition metals	Aluminum	DISS	935	447	52%
Metals - Transition	Nickel	TOT	378	181	52%
Metals - Transition	Silver	DISS	1.76	0.86	51%
POPs - PCB - Conje	PCB 123	TOT	0.0001	0.0001	50%
POPs - PFAS	PFOS	TOT	0.223	0.11	49%
Metals - Transition	Copper	DISS	723	373	48%
Metals - Transition	Cadmium	DISS	1	0.7	48%
POPs - PCB - Conje	PCB 43	TOT	0.00	0.0001	48%
POPs - PCB - Conje	PCB 7	TOT	0.00022	0.00011	47%
Metals - Post transition metals	Lead	DISS	16.1	8.5	47%
POPs - PBDE	PBDE 203	TOT	0.002	0.001	46%
POPs - PPCPs	Furosemide	TOT	17.4	9.4	46%
POPs - PCB - Conje	PCB 68	TOT	0.00063	0.0003	46%
POPs - PCB - Conje	PCB 3	TOT	0.00057	0.0003	45%
Metals - Transition	Zirconium	DISS	18	10	45%
Metals - Transition	Titanium	DISS	58	32	44%
Metals - Speciated	Chromium III	TOT	164	91	44%
POPs - PFAS	PFNA	TOT	0.0601	0.034	44%
Metals - Post transition metals	Tin	TOT	30	17.3	42%
POPs - PPCPs	Ciprofloxacin	TOT	6	4	41%
Metals - Transition	Iron	DISS	20,605	12,187	41%
Metals - Post transition metals	Tin	DISS	28	17	40%
Metals - Transition	Molybdenum	TOT	85.3	51	40%
Metals - Transition	Silver	TOT	2	1.3	39%
POPs - PFAS	PFDA	TOT	0.05	0.03	38%
Metals - Reactive non-metal	Phosphorus	DISS	147,032	92,292	37%
Metals - Transition	Chromium	DISS	71	46	36%
POPs - Pesticides	Hexachlorobenzene	TOT	0.006	0.004	35%
POPs - PPCPs	Miconazole	TOT	0.10	0.1	35%
Metals - Reactive non-metal	Selenium	DISS	6.4	4.2	34%
Metals - Metalloid	Arsenic	TOT	18	12	33%
POPs - PPCPs	Trimethoprim	TOT	8	5	33%

Table 2.6, cont'd

Chemical Category	Parameter	State	Influent Load (kg)	Effluent Load (kg)	Percent Removal
POPs - PCB - Conje	PCB 2	TOT	0.0003	0.0002	32%
POPs - PPCPs	Ofloxacin	TOT	0.81	0.547	32%
Conventionals - Cyanide	WAD Cyanide	TOT	38	26	32%
Metals - Reactive non-metal	Selenium	TOT	9	6	31%
Metals - Transition	Cobalt	TOT	42	29	30%
POPs - Pesticides	HCH, Gamma	TOT	0.015	0.0106	29%
POPs - PPCPs	Triclosan	TOT	0.51	0.36	28%
Metals - Post transition metals	Bismuth	DISS	7	5.2	26%
Metals - Transition	Manganese	TOT	2,075.3	1,550	25%
Metals - Metalloid	Antimony	TOT	9.2	6.9	25%
POPs - PPCPs	Roxithromycin	TOT	0.059	0.04	25%
Metals - Metalloid	Antimony	DISS	9.03	6.8	24%
Organics - Misc	Pentachlorobenzene	TOT	0.004	0.003	24%
Conventionals - Cyanide	Total/SAD Cyanide	TOT	70	53	24%
POPs - PCB TEQ	PCB Teq 4	TOT	0.00004	0.00003	23%
Metals - Metalloid	Arsenic	DISS	15	11.7	23%
Metals - Transition	Nickel	DISS	191	148	23%
POPs - PPCPs	Gemfibrozil	TOT	1.4	1.1	20%
POPs - PPCPs	Diltiazem	TOT	5.7	5	20%
Metals - Alkaline earth	Calcium	TOT	605,607	489,313	19%
POPs - PPCPs	Diphenhydramine	TOT	20	17	19%
Ketones	Dimethyl Ketone	TOT	4,203	3,465	18%
POPs - PFAS	PFHxS	TOT	0.37	0.30	17%
Conventionals - Major Ions	Hardness (as CaCO3)	TOT	2,414,677	2,013,405	17%
POPs - PPCPs	Clarithromycin	TOT	4	3	16%
Metals - Transition	Cobalt	DISS	34	28	16%
Metals - Transition	Vanadium	DISS	18	15	15%
Metals - Alkaline earth	Strontium	DISS	2,045	1,740	15%
POPs - PPCPs	Carbamazepine	TOT	13	11	13%
Metals - Alkaline earth	Magnesium	TOT	219,160	191,992	12%
Metals - Reactive non-metal	Sulfur	TOT	287,420	253,100	12%
POPs - PPCPs	Lincomycin	TOT	0.2	0	11%
POPs - PPCPs	Glyburide	TOT	0.09	0	10%
Metals - Alkali	Sodium	TOT	1,587,319	1,434,057	10%
Metals - Transition	Molybdenum	DISS	47	42.3	10%
Metals - Alkali	Potassium	TOT	480,689	435,659	9%

Table 2.6, cont'd

Chemical Category	Parameter	State	Influent Load (kg)	Effluent Load (kg)	Percent Removal
POPs - PFAS	PFHpA	TOT	0.20	0.19	9%
Metals - Alkali	Sodium	DISS	1,438,480	1,312,820	9%
Metals - Alkaline earth	Magnesium	DISS	210,185	192,399	8%
POPs - PFAS	PFBS	TOT	0.5	0.45	8%
POPs - PFAS	PFOA	TOT	0.6	0.5	7%
Metals - Alkali	Potassium	DISS	472,052	438,148	7%
Conventionals - Major Ions	Hardness (as CaCO3)	DISS	2,140,126	2,005,430	6%
Metals - Metalloid	Silicon	DISS	104,066	98,679	5%
POPs - PPCPs	Thiabendazole	TOT	0.7	0.68	5%
Metals - Alkaline earth	Calcium	DISS	509,950	486,149	5%
Metals - Reactive non-metal	Sulfur	DISS	237,672	226,596	5%
Metals - Alkali	Lithium	DISS	62	60	4%
POPs - PPCPs	Erythromycin-H2O	TOT	0.3	0.3	4%
Metals - Metalloid	Boron	DISS	5,542	5,378	3%
POPs - PPCPs	Azithromycin	TOT	5.8	5.7	2%
POPs - PPCPs	Fluoxetine	TOT	0.8	0.8	0%
Metals - Transition	Manganese	DISS	1,417	1,425	-1%
Conventionals - Major Ions	Sulphate	DISS	691,669	700,149	-1%
POPs - PPCPs	Hydrochlorothiazide	TOT	29	29	-1%
POPs - PFAS	PFHxA	TOT	1.1	1.1	-3%
Conventionals - Anions	Chloride	DISS	2,193,144	2,262,726	-3%
POPs - Pesticides	Beta-Hch or Beta-Bhc	TOT	0.004	0.004	-4%
POPs - PPCPs	Warfarin	TOT	0.06	0.07	-14%
Metals - Transition	Zinc	DISS	685	802	-17%
Organics - Misc	Perfluorobutanoic acid	TOT	0.7	0.8	-19%
POPs - PFAS	PFPeA	TOT	0.5	0.7	-23%
Metals - Speciated	Monobutyltin	TOT	0.219	0.271	-23%
Metals - Speciated	Monobutyltin Trichloride	TOT	0.35	0.431	-24%
POPs - PPCPs	Triclocarban	TOT	0.02	0.03	-32%
POPs - PPCPs	Sulfanilamide	TOT	1.45	1.95	-34%
POPs - PPCPs	Dehydronifedipine	TOT	0.05	0.08	-39%
POPs - Pesticides	Beta-Endosulfan	TOT	0.012	0.02	-69%
Metals - Transition	Mercury	DISS	---	0.15	-100%
POPs - PFAS	6:2 FTS	TOT	---	0.08	-100%
POPs - Pesticides	ABHC	TOT	---	0.00	-100%
POPs - PPCPs	Sulfamerazine	TOT	---	0.04	-100%

Table 2.6, cont'd

Chemical Category	Parameter	State	Influent Load (kg)	Effluent Load (kg)	Percent Removal
POPs - PPCPs	Sulfamethazine	TOT	---	0.03	-100%
POPs - PPCPs	Tylosin	TOT	---	0.09	-100%

Notes:
*negative percent removals indicate that average concentrations were higher in effluent than influent.

2.3.4 Acute Toxicity Testing

Acute toxicity describes the adverse effects of a substance that results either from a single exposure or from multiple exposures in a short period of time (usually less than 24 hours). To be described as acutely toxic, the adverse effects should occur within 14 days of the administration of the test substance. Acute toxicity results for the McLoughlin final effluent are reported as the LC50, which is the effluent concentration that will cause mortality in 50% of the organisms within the specified test period. An LC50 result that is less than 100% effluent is a failed test. Refer to Appendix B6 for acute toxicity reports.

Table 2.7 presents the results from 2023 acute toxicity testing. Results indicated MPWWTP final effluent was not acutely toxic (i.e., did not kill 50% or more in 96 hours) to trout in 2023.

Daphnia magna toxicity testing is not required by regulations but is conducted as part of expanded EMP commitments. There was no toxicity in any sample tested in 2023.

Table 2.7 McLoughlin Point WWTP Acute Toxicity Test Results – 2023

Sample Date	Rainbow Trout LC50	Daphnia Magna
	96-hour % pH Stabilized	48-hour % Survival in 100% Effluent
January 19	>100	>100
February 16	>100	>100
March 23	>100	>100
April 20	>100	>100
May 18	>100	>100
June 22	>100	>100
July 13	>100	>100
August 18	>100	>100
September 21	>100	>100
October 19	>100	>100
November 23	>100	>100
December 14	>100	>100

Notes: Test pass = >100%.
Results are presented as v/v%.
Shaded cells indicated test failure.
--- Test not conducted.

2.3.5 Chronic Toxicity Testing

Chronic toxicity is described as adverse health effects from repeated or continuous exposures to a substance, often at lower levels over a longer time (weeks or years). Chronic toxicity results are reported as the LC50, which is the concentration that will result in mortality of 50% of the organisms in the specified test period, or as EC50, EC25 (effective concentration), IC50 or IC25 (inhibition concentration) which are the concentrations that will have a sub-lethal negative effect upon 50% or 25%, respectively, of the organisms in the specified test period (e.g., decreased fertilization or growth). Refer to Appendix B7 for chronic toxicity reports.

Chronic toxicity testing was conducted using McLoughlin Point WWTP final effluent from mid-November to mid-December 2023. Several species were tested, including Topsmelt (*Atherinops affinis*), Ceriodaphnia, Echinoids (*Strongylocentrotus purpuratus*) and a 30-day Rainbow trout (*Oncorhynchus mykiss*) embryo/alevin viability test.

The Rainbow trout embryo/alevin viability test is based on assessing non-viable alevins or failure to reach the alevin stage with timely and expected development, due to deterioration at any previous stage, including failure of egg fertilization, mortality of embryo or alevin, failure to hatch by test end, or abnormal development. One or both of the following two endpoints are obtained for the same effect: (1) effective concentration for failure of 25% of individuals to develop normally to the alevin stage (EC25); and (2) median effective concentration for failure of 50% of individuals to develop normally to the alevin stage (EC50).

Table 2.8 presents the results from chronic toxicity testing of McLoughlin Point WWTP effluent. Final effluent was not toxic to *Ceriodaphnia* survival and reproduction and echinoderm fertilization in 100% effluent concentration.

Topsmelt chronic toxicity (survival) occurred at a wastewater concentration of 70.4% (LC50), with sub-lethal effects) (dry biomass and weight) (IC50) at wastewater concentrations of 68.6 and >50% respectively. Rainbow trout embryo-alevin chronic toxicity survival and viability (LC50) occurred at wastewater concentrations of 75.9% and 73.5% respectively.

Chronic toxicity concentrations were substantially higher than the predicted wastewater concentrations in the marine receiving environment at the edge of the initial dilution zone (i.e., 0.9% at McLoughlin based on a minimum initial dilution of 113:1) (Lorax, 2019). Marine life is unlikely to be exposed to the chronically toxic wastewater concentrations unless exposure occurs close to the outfall diffusers within the initial dilution zone and the organisms spend a prolonged time exposed to the sewage plume.

Table 2.8 McLoughlin Point WWTP Chronic Toxicity Test Results – 2023

Chronic Toxicity Test	% v/v (CI)
Six-day Topsmelt	
Survival - LC50	70.4 (69.4-71.5)
Dry Biomass - IC25	56.8 (49.8-59.6)
Dry Biomass - IC50	68.6 (62.9-70.8)
Dry Weight - IC25	>50
Dry Weight - IC50	>50
Seven-day Ceriodaphnia	
Survival - LC50	>100
Reproduction - IC25	>100
Reproduction - IC50	>100
Echinoid Fertilization	
IC25	>100
IC50	>100
Rainbow Trout Embryo-Alevin	
Embryo Survival - LC25	41.0 (17.6-78.1)
Embryo Survival - LC50	75.9 (28.3-N/A)
Embryo Viability - EC25	41.6 (18.2-76.5)
Embryo Viability - EC50	73.5 (24.6-N/A)

Notes: CI = 95% confidence limits.

2.3.6 Overall Assessment

The 2023 McLoughlin Point WWTP wastewater monitoring results are qualitatively an improvement from historical Macaulay and Clover results (CRD, 2020), indicating that from an operational and regulatory compliance perspective, wastewater quality has improved substantively since the installation of treatment. Tertiary effluent quality was achieved for the bulk of the year, despite some non-compliant effluent days and months as treatment process optimization was ongoing throughout 2023. Effluent quality was less variable in 2023, but ongoing process optimization work is needed to be fully compliant with provincial and federal wastewater regulations in the future. It is anticipated that the McLoughlin treatment processes could take up to two years to fully optimize (estimated as the end of 2024), with occasional non-compliance events expected throughout this time. In addition, there is potential that highly variable centrate return flows from the Hartland Residuals Treatment Facility may be impacting the treatment plant's ability to achieve effluent quality limits at all times.

All effluent quality parameters were predicted to be below applicable water quality guidelines in the marine receiving environment at the edge of the initial dilution zone, except for bacteriological indicators. The use of estimated minimum initial dilution factors allows for a conservative (i.e., highly protective) estimation of potential effects in the marine receiving environment. However, predicted average initial dilution factors are much higher around the outfall (711:1 median for McLoughlin Point), so overall risk to human health and the environment is lower than predictions indicate. These bacteriological indicator guideline exceedances will continue as disinfection has not been installed as part of the new McLoughlin treatment process, and disinfection is also not feasible at Macaulay or Clover during rain events. However, with tertiary treatment at McLoughlin, even without disinfection, the magnitude of the bacteriological exceedances has been greatly reduced.

As designed, the treatment plant is removing substances effectively from final effluent. Effluent quality has improved significantly with high removal efficiencies for most measured substances.

3.0 SURFACE WATER MONITORING

3.1 Introduction

CRD staff have been monitoring receiving waters around the Macaulay and Clover outfalls for fecal bacteria indicator concentrations since the early 1980s. This indicator is used as a surrogate to assess the potential for human health impacts from exposure to wastewaters in the marine receiving environment during recreational activities such as kite surfing, diving and swimming. Observed impacts at the shoreline have been attributed to stormwater discharges, which are currently monitored by the CRD's Stormwater Quality Program.

The McLoughlin Point WWTP commenced operation in August 2020. Since the beginning of 2021, surface water and initial dilution zone (IDZ) sampling shifted from Clover and Macaulay receiving environments to the McLoughlin receiving environment. The IDZ is defined by BC ENV as a 100-metre area around the end of the outfall and the area most impacted by wastewater discharge.

The Clover and Macaulay Point outfalls have been converted to screening and pump stations that now only discharge sewage out their respective long outfalls during very heavy rain events or planned overflow and bypass events during maintenance. In the event of an overflow out either Clover or Macaulay outfalls, surface water sampling is attempted, conditional on vessel availability and weather conditions. However, overflow events often occur during storms which makes sampling dangerous to staff and vessel crew.

3.2 Methods

Staff collected 5 samples in 30 days ("5-in-30") in each quarter (i.e., January, April, July, and October) at the IDZ and at the surface of the receiving environment at stations around the McLoughlin outfall (Figure 3.1). Sampling was conducted using the University of Victoria's 16-metre science vessel, the MSV John Strickland.

Surface water and IDZ sampling parameters are presented in Appendix C1. For surface water sampling, CRD staff collected samples at a depth of 1 m using a sampling pole. For IDZ sampling, staff collected samples using a Seabird ECO55 rosette sampler with a SBE19PlusV2 conductivity-temperature-depth (CTD) instrument. The CTD instrument was also equipped with a SBE43 dissolved oxygen sensor. Water column instrument profiles were taken at each IDZ station and water column samples were taken at the top (at a depth of 5 m), middle (middle of predicted plume trapping depth), and bottom (5 m above the seafloor, approximately 55 m) of the water column. CTD casts were captured at each IDZ sample station and measured the depth, conductivity, salinity, temperature and dissolved oxygen.

Surface water sampling stations are presented in Figure 3.1 and Appendix C2. The surface sampling grid, consisting of a total of 13 stations, was used to ensure good spatial coverage of the receiving environment where plume surfacing is most likely to occur. In addition, samples were collected at the location at which a drift drogue was retrieved each day (see Appendix C2, sample D1). Surface samples were collected in sterile, wide-mouth bottles by rapidly submerging open, upright bottles to a depth of 1 m using a sampling pole. Reference stations were also sampled at Parry Bay, Metchosin and at Constance Bank (Figure 3.1).

IDZ stations are presented in Figure 3.1. For each sampling event, the predicted current direction and plume trapping depth were determined using the CRD's hydrodynamic C3 model. The model incorporates local conditions (historical instrument data and current and tide tables) to estimate current direction and effluent trapping depth (Hodgins, 2006). The model is also updated on an annual basis to incorporate the previous year's analytical data. Four stations and the "middle" sampling depth were then selected to ensure that they fell within the plume's model-predicted direction of travel and trapping depth for that specific day and time. Samples were collected with a Seabird ECO55 rosette sampler, decanted into sample bottles and preserved for analysis of metals, various conventional parameters and nutrients (Appendix C1). Bacteriological indicators, ammonia, hardness, metals, total suspended solids and pH samples were analysed for each of the "5-in-30" sampling events, with additional analysis of oil and grease, phosphorus, sulfide and total organic carbon on samples collected from only one day per quarter (usually the first of the "5-in-30" cruise days).

The surface and IDZ water column samples were analysed for two bacteriological indicators (fecal coliforms and enterococci) by BV Labs (Victoria, BC).

Bacteriological results were evaluated against the historical human health guidelines BC ENV (BCMoE&CCS 2021a; 2021b) for recreational primary contact (for informational purposes only) and to Health Canada (2012) guidelines for recreational water quality. The Health Canada guidelines for enterococci are:

- The geometric mean of 5 samples collected in 30 days should not exceed 35 CFU/100 mL.
- Single enterococci values should not exceed 70 CFU/100 mL.

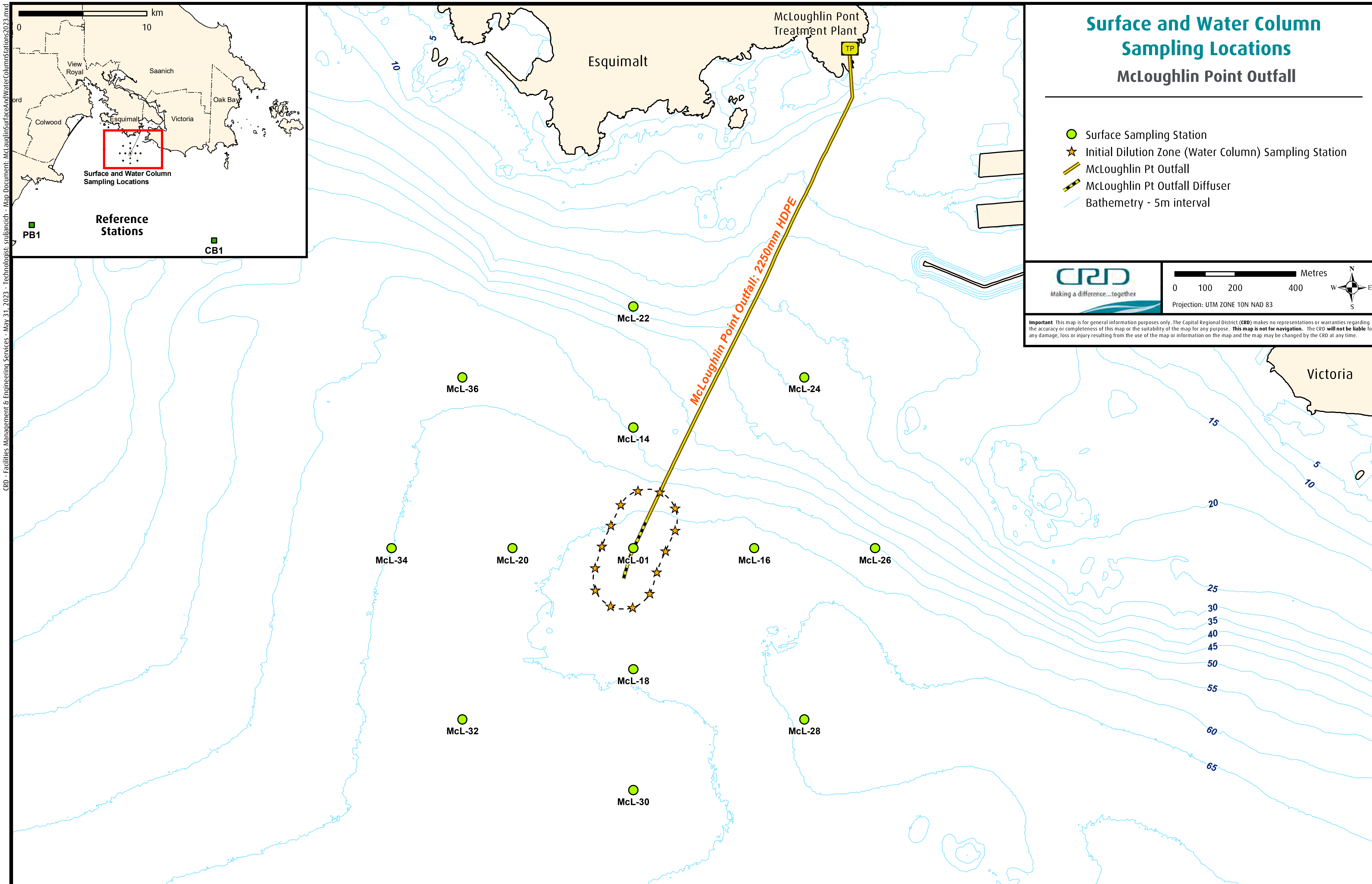
All other IDZ water column results were evaluated against approved BC Water Quality Guidelines for the Protection of Aquatic Life (BCMoE&CCS 2021a; 2021b).

The registration under the Municipal Wastewater Regulation (MWR), Authorization #RE108831, requires plume dispersion and dilution modelling using concurrent effluent and receiving environment water quality samples at the edge of the IDZ at McLoughlin Point outfall, far-field sites (Haystock Islets, Ogden Point, Cook Street, Chatham and Discovery Islands, Trial Island) and at Clover (CPS) and Macaulay pump stations (MPS) during potential overflow events, for modelled scenarios 1, 2 and 3 (Lorax, 2019).

The three modelled scenarios are based on the influent flow hydrographs prepared by Lorax (2019) representing typical conditions expected up to the year 2030.

- Scenario 1 represents summer conditions with flows of about 80% of the average dry weather flow (ADWF) for MPWWTP (ADWF of 108,000 m3/day) of tertiary-treated effluent.
- Scenario 2 represents wet weather conditions providing discharge through only the MPWWTP outfall (flows 0.5 x to 2.9 x ADWF when MPWWTP is discharging primary + tertiary blended effluent).
- Scenario 3 represents wet weather storm conditions(flows >4 x ADWF) providing discharge through both the MPWWTP (primary + tertiary blended effluent) and CPS (screened effluent) deep outfalls.

Model validation sampling was not conducted in 2023. It was not possible to capture the remaining scenarios and staff availability limited the ability to repeat previous scenarios. Staff will continue to watch for an opportunity to sample during Scenario 2 and 3.



CRD - Facilities Management & Engineering Services - May 31, 2023 - Technologist: sruljancich - Map Document: McLauglinSurfaceAndWaterColumnStations2023.mxd

3.3 Results and Discussion

3.3.1 Surface Water Sampling

CRD staff collected 320 surface water samples at McLoughlin's WWTP marine receiving environment in 2023.

Fecal coliform results for each sampling event (including seasonal geometric means) are presented in Appendix C3 and Table 3.1. Station seasonal geometric means were one or two orders of magnitude below the historical provincial guideline of 200 CFU/100 mL (Table 3.1). From the 320 samples, there were five individual fecal coliform measurements that were above the historical guideline value of 200 CFU/100 mL (Appendix C3). The maximum fecal coliform concentration measured in 2023 was 970 CFU/100 mL which occurred on week four in the autumn at the drogue station.

Enterococci results for each sampling event (including seasonal station geometric means) are presented in Table 3.2. All seasonal geometric means were below the federal guideline of a geomean of 35 CFU/100 mL (Table 3.2). From the 320 samples, seven individual enterococci measurements were above the federal single value guideline of 70 CFU/100 mL (Appendix C4).

The frequency and location of exceedances from McLoughlin WWTP are much less than results from historical Clover and Macaulay receiving environment monitoring (CRD, 2020). Surface water sampling results indicate that treatment has substantively reduced bacteria concentrations in effluent by up to two orders of magnitude. Subsequently, the surface water results in the receiving environment show lower concentrations of bacteria when surfacing occurs. (CRD, 2021-2022)

Overall, results indicate that the McLoughlin WWTP effluent plume was mostly trapped below the surface, as predicted by the CRD's hydrodynamic C3 model. Therefore, the outfall diffuser was achieving adequate dilution. Had the effluent plume not been predominantly trapped, more frequent high fecal coliform and enterococci concentrations would have been observed, particularly at stations approximately 100 m from the outfall, where the model predicts the plume is most likely to surface (Hodgins, 2006).

Table 3.1 McLoughlin Point WWTP Surface Water (1 m depth) Fecal Coliform Seasonal Geometric Means

Fecal Coliforms	Winter						Spring						Summer						Autumn					
	1	2	3	4	5	Geomean	1	2	3	4	5	Geomean	1	2	3	4	5	Geomean	1	2	3	4	5	Geomean
McL-01	2	1	38	1	5	3	71	<1	<1	<1	<1	2	<1	<1	<1	1	1	1	5	2	2	53	2	5
McL-14	1	3	25	3	7	4	20	<1	<1	<1	<1	2	<1	3	<1	3	<1	2	2	1	9	19	8	5
McL-16	11	2	32	2	3	5	<1	<1	<1	<1	1	1	<1	---	<1	2	---	1	<1	<1	5	2	3	2
McL-18	63	3	32	1	78	14	<1	<1	<1	<1	93	2	<1	<1	<1	12	<1	2	3	2	7	500	3	9
McL-20	4	2	26	1	1	3	<43	<1	<1	<2	<4	3	---	<1	<1	54	<1	3	17	7	3	110	5	11
McL-22	3	4	57	4	7	7	<1	<1	1	1	<1	1	<1	<1	<1	<1	<1	1	2	8	2	4	4	3
McL-24	1	5	37	7	3	5	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	5	9	4	8	1	4
McL-26	1	4	10	2	1	2	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	1	2	5	16	2	3
McL-28	<3	8	6	<1	2	3	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	<1	<1	2	1	4	2
McL-30	83	6	42	4	1	10	<1	1	<1	<1	2	1	---	<1	<1	<1	<1	1	2	<1	1	<1	2	1
McL-32	2	3	30	2	4	4	<1	3	1	<1	21	2	<1	<1	<1	<1	<1	1	2	1	2	33	5	4
McL-34	2	3	31	1	2	3	<1	<1	<1	<1	1	1	<1	<1	<1	<1	<1	1	7	5	4	59	3	8
McL-36	2	5	30	4	77	10	58	<1	<1	<1	12	4	<1	2	<1	200	<1	3	<1	3	<1	230	2	4
McL-D1	<40	8	119	3	270	31	22	<1	<1	<1	32	4	<1	<1		240	<1	4	1	4	<5	970	11	12
Ref-PB	<1	<1	<1	1	<1	1	1	<1	2	<1	1	1	<1	<1	<1	<1	<1	1	3	4	3	<1	<1	2
Ref-CB	<1	1	1	<1	<1	1	<1	1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	1	<1	<1	<1	<1	1

Notes: Shaded cells indicate exceedance to historical BC WQG Geomean of 200 CFU/100 mL.
Geomean = Geometric Mean
--- denotes sample not taken due to weather issues.

Table 3.2 McLoughlin Point WWTP Surface Water (1 m depth) Enterococci Seasonal Geometric Means

Enterococci	Winter						Spring						Summer						Autumn					
	1	2	3	4	5	Geomean	1	2	3	4	5	Geomean	1	2	3	4	5	Geomean	1	2	3	4	5	Geomean
McL-01	1	2	16	<1	2	2	16	<1	<1	<1	<1	2	<1	<1	<1	<1	<1	1	6	1	<1	54	3	4
McL-14	1	1	10	<1	2	2	3	<1	<1	<1	<1	1	<1	<2	<1	1	<1	1	6	<1	<2	10	<3	3
McL-16	4	1	18	<1	2	3	<1	<1	<1	<1	<1	1	<1	---	<1	<1	---	1	1	<1	1	<1	<1	1
McL-18	55	2	19	<1	30	9	<1	<1	<1	<1	49	2	1	<1	<1	6	<1	1	<1	<1	1	160	1	3
McL-20	1	3	27	<1	1	2	8	<1	<1	<1	<1	2	---	1	<1	18	<1	2	5	<1	1	100	2	4
McL-22	2	1	13	1	1	2	1	<1	<1	<1	2	1	<1	<1	<1	<1	<1	1	<1	3	<1	4	3	2
McL-24	1	<1	17	<2	1	2	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	12	2	2	1	3	3
McL-26	1	<1	5	<1	1	1	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<2	1	6	<1	<1	7	4	3
McL-28	4	<7	3	2	1	3	<1	<1	<2	<1	<1	1	<1	<1	<1	<1	<1	1	2	1	<1	<1	1	1
McL-30	46	<1	26	<1	<1	4	<1	<1	<1	<1	2	1	---	<1	<1	<1	<1	1	<1	<1	<1	<1	1	1
McL-32	1	1	9	<1	1	2	<1	<1	<1	<1	21	2	<1	<1	<1	1	<1	1	1	<1	<1	53	1	2
McL-34	<1	1	8	1	27	3	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	2	<1	<1	77	3	3
McL-36	1	4	15	3	1	3	15	<1	<1	<1	14	3	<1	<1	<1	87	<1	2	<1	<1	<1	81	<1	2
McL-D1	29	1	57	<1	115	11	7	<1	<1	<1	5	2	<1	<1	---	100	<1	3	1	2	2	580	<3	6
Ref-PB	<1	<1	<1	1	<1	1	<1	<1	<1	2	<1	1	<1	<1	<1	<1	<1	1	<1	2	<1	4	<1	2
Ref-CB	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	<1	<1	<1	1	<1	1

Notes: Shaded cells indicate exceedance to Environment Canada maximum guideline of 70 CFU/100 mL (blue) and geomean of 35 CFU/100 mL (red).
--- denotes sample not taken due to weather issues.

3.3.2 Initial Dilution Zone Water Column Sampling

Analytical results for each round of IDZ water column sampling are presented in Appendices C3-C16. CTD and dissolved oxygen plots for each sampling event are presented in Appendix C17.

Only samples for which results were above detection limits, and have BC approved recreational water quality guidelines are presented (Appendices C5-C16) (arsenic, boron, cadmium, copper, enterococci, lead, manganese, nickel, silver and zinc).

The geometric means of the “5-in-30” fecal coliform water column results did not exceed guidelines during any season (historical guideline) (Appendix C5).

The geometric means of the “5-in-30” enterococci water column results did not exceed guidelines. Twelve single values exceeded federal maximum single enterococci guidelines of 70 CFU/100 mL in the winter, spring and autumn at various depths sampled (Appendix C6).

There were no exceedances of provincial or federal guidelines for any of the metals that were analysed in the IDZ samples, except for boron and cadmium. Concentrations of total boron exceeded the provincial guideline of 1.2 mg/L in all samples, with values ranging from 3.21 to 9.13 mg/L including the reference station (Appendix C10). However, ambient boron concentrations, as demonstrated at the reference station, are approximately 4.0 mg/L in southern Vancouver Island marine waters (BCMoE, 2006). Therefore, it is inevitable that guidelines are exceeded. Cadmium had several exceedances in the spring, summer and autumn, which is inconsistent with previous years (Appendix C11). The CRD recently changed methodology for seawater metals analysis and cadmium will be closely monitored in the marine environment to determine if these exceedances trend over time or are a result of the revised analytical method.

These results indicate an improvement of IDZ water quality since sewage treatment has been installed. Past bacteria results at depth (CRD, 2020), showed effluent at middle and bottom depths consistently exceeded guidelines whereas bacteria results since treatment commenced rarely exceeds guidelines at depth. The treatment process has reduced the concentration of bacterial indicators, heavy metals, and nutrients in the water column as well as on the water surface by up to an order of magnitude or more. Additional years of sampling are needed to determine any long-term reductions.

Water column profiles of temperature, salinity and dissolved oxygen (Appendix C17) generally followed expected seasonal patterns for the Strait of Georgia (well mixed in winter and stratified in summer). It appears that the plume was only occasionally detected by the CTD sensors as expected due to rapid mixing in the IDZ. A master’s thesis (Krogh *et al.*, 2018) examining vertical profiles of dissolved oxygen between 2011 and 2016 confirmed that of the approximately 850 CTD casts conducted in the IDZ, only six profiles showed any evidence of a sewage plume layer, using decreases in dissolved oxygen as the primary indicator. This study confirms that bacteria concentrations are a reliable indicator of sewage plume, will continue as the main monitoring tool for plume detection.

CTD profiling will continue as part of the routine Environmental Monitoring Program. The data will be regularly fed into the oceanographic plume dispersion and dilution modelling to maintain an up-to-date database of background conditions.

3.3.3 Overall Assessment

Overall, the 2023 surface fecal coliform and enterococci results indicate that the McLoughlin WWTP is operating as designed. The treated effluent plume was trapped well below the ocean surface most of the time and the diffusers were working as expected, as indicated by low bacteria concentrations on the sea surface. There were no exceedances on the surface at any time of the year for enterococci. Seven single enterococci values exceeded federal maximum single enterococci guidelines at multiple depths and times in winter, summer and autumn.

There were no detectable heavy metals, oil and grease or elevated nutrients in any of the 320 samples taken in 2023, except boron, which is naturally elevated and cadmium which exceeded a few times, possibly due to a different lab method. Cadmium exceedances are a new occurrence and will be closely monitored for any emerging trend. Cadmium could also be originating from the sampling vessel.

In summary, the new McLoughlin WWTP treatment processes have substantively reduced potential impacts to human health and the marine receiving environment, particularly from a bacteriological perspective, relative to the historical Macaulay and Clover discharges.

4.0 OVERFLOW AND BYPASS MONITORING

4.1 Introduction

During high volume storm events, the input to the Core Area conveyance system (Figure 1.1) may exceed system capacity, resulting in overflows at combined sewer overflow (CSO) and sanitary sewer overflow (SSO) relief points. There are also periodic bypass events to allow for planned maintenance to the treatment works or following unexpected non-routine or emergency events.

There are multiple relief points in the system (Table 4.2), but most are never used and are only in place for emergencies. The relief points expected to overflow in rain events, and their historical and predicted future overflow frequencies, are presented in Table 4.1.

The new McLoughlin Wastewater Treatment Plant, and the conveyance system upgrades, have reduced the frequency of overflows from most SSO points. These additions include the 5,000 m^3 underground Arbutus Attenuation Tank, that temporarily stores wastewater flows during high volume storm events, and moderates release into the downstream system. The frequency of overflows at the Humber and Rutland CSO locations, however, will remain unchanged until the District of Oak Bay completes separation of wastewater and stormwater systems in the Uplands neighborhood.

In the event of an overflow or bypass, sampling may be required at adjacent beaches and/or stormwater outputs (Table 4.2, Appendix D1). Protocols were developed in consultation with Island Health and approved by ENV. The purpose of shoreline monitoring is to assess risk for people engaged in recreational activities on beaches adjacent to the overflows by comparing bacterial results to recreational guidelines (Health Canada (2012 and 2024).

During the spring and summer (May 1 to September 14), the CRD monitors all overflow events. Monitoring occurs both during and after overflow events if possible and safe. CRD staff post temporary beach advisory signs, contact Emergency Management BC (EMBC) and Island Health.

For the remainder of the year (September 15 to April 30), the response varies. For the Humber and Rutland CSO locations, permanent signage has been posted at all potentially affected beaches advising beach users to stay out of the water for 48 hours after any weather event, and no sampling is undertaken for routine wet weather overflows. For the remaining SSO locations, and any unexpected non-routine or emergency CSO discharges, CRD staff conduct shoreline monitoring .

In the event of a planned or unplanned bypass at the McLoughlin WWTP, the CRD notifies ENV and analyzes, the effluent composite sample.

Table 4.1 Overflow Frequency Pre- and Post-Treatment Plant/Conveyance System Upgrade

Location	Pre-Upgrade	Post-Upgrade
Finnerty	3-4 times/year	>25-year frequency storm
Humber	7-10 times/year	7-10 times/year
Rutland	7-10 times/year	7-10 times/year
McMicking	3-4 times/year	>25-year frequency storm
Clover Long Outfall	continuous	61 hours/year
Clover Short Outfall	3-4 times/year	>100-year frequency storm
Macaulay	continuous	>10-year frequency storm
McLoughlin	n/a	Planned or unplanned bypass due to maintenance, equipment malfunctions or high flow.

4.2 Methods

A network of shoreline and stormwater sampling stations cover the beach area around the CSO/SSO locations. Shoreline stations are named based on their proximity to the overflow/relief point in the conveyance system, (e.g., HUM-H for Humber H). Storm drains are numbered, with stormwater stations named using that number in combination with "SW".

When sampling is required, CRD staff select sampling stations based on the location of the overflow/bypass event(s) (Appendix D1) and collect a sample approximately 48 hours after the event occurs. Samples are collected concurrently at adjacent stormwater discharges.

Staff collect samples by submerging a sterile 500 mL plastic bottle into the marine surface waters as far as the sampling technician can reach from the shoreline, or by holding the bottle in the stormwater discharge flow Samples are sent to Bureau Veritas (Burnaby, BC) for analysis for enterococci. Results are compared to Health Canada (2012) limit of 70 CFU/100 mL for a single sample.

4.3 Results and Discussion

There were multiple overflow and unplanned bypass events in 2023, as listed in Table 4.2. Based on time of year and overflow location, no shoreline sampling was required for any of these events.

4.4 Overall Assessment

Previous overflow and bypass sampling conducted in the Core Area has reaffirmed that the wastewater signal in the vicinity of the overflow or bypass has generally dissipated by 48 hours following the events, therefore the risk to humans recreating on nearby beaches is highest in the immediate 48 hours after rain events. Effluent flows from the MPWWTP were non-detectable at far-field monitoring stations. Overflow and bypass sampling will continue to be conducted as required in 2024.

Table 4.2 Sanitary Sewer Overflow and Combined Sewer Overflow Locations

Outfall	Discharge Site	Location*		Treatment Equipment	Diffusers	Discharge Type
		Latitude	Longitude			
Clover Point Pump Station Long Outfall	Marine Outfall	48.394	-123.346	Travelling Panel Screen	Yes	Screened overflows
Humber Pump Station	Marine Outfall	48.449	-123.291	Bar Screen	N/A	Screened overflows
Rutland Pump Station	Marine Outfall	48.441	-123.291	Bar Screen	N/A	Screened overflows
Arbutus Trunk at Finnerty Cove	Marine Outfall	48.473	-123.286	N/A	N/A	Unscreened
Currie Major Pump Station (through McMicking Outfall)	Marine Outfall	48.409	-123.306	Travelling Bar Screen	N/A	Screened overflows from Currie
Currie Minor Pump Station (through McMicking Outfall)	Marine Outfall	48.409	-123.306	N/A	N/A	Unscreened from Currie
Penrhyn Minor Pump Station	Local Storm Sewer	48.459	-123.292	N/A	N/A	Unscreened
Hood Pump Station (through McMicking Outfall)	Marine Outfall	48.409	-123.306	N/A	N/A	Unscreened
East Coast Interceptor at Broom	Local Storm Sewer (Marine Discharge)	48.428	-123.307	N/A	N/A	Unscreened
Bowker Trunk to Bowker Creek at Monterey Avenue	Creek/River	48.429	-123.314	N/A	N/A	Unscreened
Northeast Trunk-B at Broom	Local Storm Sewer (Marine Discharge)	48.428	-123.308	N/A	N/A	Unscreened
Harling Pump Station	Local Storm Sewer (Marine Discharge)	48.407	-123.324	N/A	N/A	Unscreened
Clover Point Pump Station Emergency Bypass Outfall	Marine Outfall	48.404	-123.348	Travelling Panel Screen	N/A	Can be screened and unscreened
Clover Point Pump Station Short Outfall	Marine Outfall	48.402	-123.347	Travelling Panel Screen	N/A	Can be screened and unscreened
Macaulay Point Pump Station Long Outfall	Marine Outfall	48.403	-123.410	Travelling Panel Screen	Yes	Screened overflows
Macaulay Point Pump Station Short Outfall	Marine Outfall	48.416	-123.407	Travelling Panel Screen	N/A	Can be screened and unscreened
Head Street Northwest	Local Storm Sewer	48.427	-123.399	N/A	N/A	Unscreened
Sea Terrace Northwest Trunk	Local Storm Sewer	48.431	-123.394	N/A	N/A	Unscreened
Harriet Siphon Northwest Trunk to Gorge	Marine Outfall	48.443	-123.392	N/A	N/A	Unscreened
Gorge Siphon to Gorge	Marine Outfall	48.440	-123.388	N/A	N/A	Unscreened
Craigflower Pump Station at manhole S0560 on Shoreline Trunk	Marine Outfall	48.453	-123.425	N/A	N/A	Unscreened
Langcove Pump Station	Local Storm Sewer	48.433	-123.419	N/A	N/A	Unscreened
Marigold Pump Station to local storm sewer and into Colquitz Creek	Creek/River	48.468	-123.399	N/A	N/A	Unscreened

Table 4.3 2023 Core Area Overflow and Bypass Events

Date	Location	DGIR Number (Dangerous Good Incident Report)	Type of Event	Monitoring Conducted
Jan 04	McLoughlin	230031	Unplanned primary bypass	none
Jan 28	McLoughlin	230376	Unplanned tertiary bypass	none
Jun 10	McLoughlin	232169	Unplanned tertiary bypass	none
Jun 22	McLoughlin	232344	Unplanned secondary bypass	none
Jul 07	McLoughlin		Ongoing tertiary unplanned bypasses as a result of disc filter failure	none
Jul 24	Rutland	232756	Heavy rain overflow	none
Sep 24	McLoughlin	233670	Unplanned tertiary bypass	none
Oct 16	Humber, Rutland	223995 223996	Heavy rain overflow	none
Oct 24	Humber, Rutland	234132 234138	Heavy rain overflow	none
Oct 24	McLoughlin	234131	Unplanned tertiary bypass	none
Nov 02	Humber, Rutland	234250 234251	Heavy rain overflow	none
Dec 04	Humber, Rutland, Clover PS	234735 234736 234738	Heavy rain overflow	none
Dec 06	McLoughlin	234781	Unplanned primary bypass	none

5.0 ADDITIONAL INVESTIGATIONS

CRD staff conduct additional investigations to address focused or emerging issues, clarify aspects of the program, and provide concurrent data for the assessment of environmental effects. The Society of Ecotoxicology and Chemistry (SETAC) review of the program agreed that one-time investigations are appropriate to fill information gaps, as needed (SETAC, 2006).

In 2006, the MMAG completed a comprehensive review of the list of additional investigations. Table 5.1 presents the studies that were recommended based on a risk assessment framework: contaminant source, pathways (ways in which contaminants can reach receptors), and receptors (e.g., fish, invertebrates and human health, etc.). For each of these categories, studies were ranked as high, medium or low priority. In 2013, following the move to advance treatment, the MMAG was tasked with reviewing and reprioritizing the list, as well as adding any additional potential new studies. This review was put on hold in 2015 at the last meeting of the MMAG.

Investigations that deal with new emerging scientific issues are best undertaken under collaborative research programs. For example, when emerging concerns around pharmaceuticals and personal care products (PPCP) were identified, routine laboratory analytical techniques for quantifying these substances had only recently been developed and there were no commercial laboratories in Canada that could analyze for these compounds. As such, these substances were best assessed in research programs where collaborative resources from academia and government could be used. Since then, commercial laboratories have developed standardized methods and PPCP analyses are now a routine part of the EMP.

Studies that were underway in 2006 have since been completed or are continuing, but new investigations from Table 5.1 have not been initiated. However, several opportunistic collaborative opportunities have come up in recent years. Section 5.1 summarizes investigations that were ongoing, completed or initiated in 2023.

Table 5.1 Core Area Additional Investigations Prioritization by MMAG (2006)

Category	Investigation	Description and Characteristics	2006 Rating	Status/ Anticipated Initiation Date	Anticipated Completion Date
Contaminant Source	Study to address the presence of endocrine disrupting compounds and PPCP in wastewater and the potential effects on the receiving environment.	The first part of an overall phased approach to study these substances will be to measure the concentrations of a group of substances in wastewater. This is an area of emerging concern related to human health and potential environmental effects (from the chemical, biological and toxicological aspects).	High	Initiated in 2004.	Completed in 2010.
	Assessment of contaminants associated with oil and grease.	Determination of contaminants associated with oil and grease originating from the outfalls. Relates to the potential human health and environmental effects issues (e.g., windsurfers, seagulls, etc.). The first phase of this investigation will be to undertake a literature review.	Medium	No dates (study will be re-evaluated in the advisory group additional investigation review).	
	Identification of pathogens in wastewater and the presence of these in surface waters around the outfalls.	Analysis of wastewater for different types of pathogens that have the potential to affect human health and determine if these pathogens are present in the receiving environment around the outfalls (related to die-offs, etc., in marine waters).	Low	Enterococci was added to the bacteriological target analyte list in 2011. Consideration of additional pathogens will be re-evaluated in the advisory group additional investigation review.	
	Bacteria source identification.	Determine the different sources of fecal coliform to differentiate between various mammals, such as cows, dogs and humans.	Low	Conducted at near and far-field sites.	Completed in 2021.
Pathways	Sediment transport/deposition/ re-suspension.	The first step in this investigation would include a determination of the different particle size fractions in wastewater (this could be conducted through a literature review and/or through laboratory experiments). The second phase would include the determination of the settling of particles from the discharge onto sediments. Results from these analyses would be used in the overall assessment of sediment particle deposition and the subsequent movement of sediments around the outfalls.	High	Initiated in 2005 (study is on hold – will be re-evaluated as part of the advisory group additional investigation review).	

Category	Investigation	Description and Characteristics	2006 Rating	Status/ Anticipated Initiation Date	Anticipated Completion Date
Pathways, *cont'd*	Conduct a sediment core sampling program.	Determination of sedimentation and mixing rates and the fluxes of contaminants near the outfalls and at reference sites. A mass balance approach could be used where rates of contaminant accumulation in sediments are compared with the rate of contaminant discharge from the outfalls in an attempt to determine the proportion of each contaminant captured by and stored in the sediments. A sediment trap study could be added to study contaminant transport in the near bottom nepheloid layer.	Medium	Initiated in 2006 in conjunction with the Institute of Ocean Sciences.	Completed in 2011.
Receptors and Potential Effects	Effects of endocrine disrupting compounds and PPCP on the receiving environment.	As part of a phased approach to study effects of endocrine disrupting compounds, laboratory exposures, bioassay and/or caged studies (or an organism found around the outfall) could be conducted to assess the potential effects of these substances on the receiving environment around the outfalls.	High	Collaborative study with UVic on toxicogenomic effects to benthic invertebrates was initiated in 2007.	Funding not secured and project was shelved.
	Assessment of chemical concentrations in tissue of different trophic level organisms (including higher trophic levels).	Measurement of contaminants in crab, finfish or other organisms near the outfalls would provide a basis for a food-ingestion human health risk assessment. This information could also be used to model bioconcentration and biomagnification of contaminants to higher trophic levels near the outfalls.	High	A finfish sampling program was added to the five-year monitoring cycle.	Results were presented in the 2019 annual report. Study will be repeated in 2025.
	Identification of biological resources.	Identification of the harvestable organisms around the outfalls.	Low	No dates (study will be re-evaluated in the advisory group additional investigation review).	
	Clover mussel population biology.	Conduct some additional studies on the mussel population around the Clover outfall (e.g., reproductive cycle, health, etc.). Additional data relates to the current monitoring and to potential studies on emerging chemicals.	Low	No dates (study will be re-evaluated in the advisory group additional investigation review).	
	Levels of pathogens in biota. (e.g., epibenthic, etc.)	Assess the presence and concentration of pathogens in biota near the outfalls.	Low	No dates (study will be re-evaluated in the advisory group additional investigation review).	
	Assess potential risks associated with pathogens/antibacterial resistance.	A literature review, risk assessment or a pilot study could be conducted to study antibiotic bacteria and the relevance as a potential emerging concern to human health, wildlife and domestic animals.	Low	No dates (study will be re-evaluated in the advisory group additional investigation review).	
	Investigate the structure of algal plankton communities.	Assess the potential effects of the wastewater discharges on algal communities (planktonic and benthic).	Low	No dates (study will be re-evaluated in the advisory group additional investigation review).	

5.1 Investigations Completed or Underway from 2021 - 2023

The EMP completed or participated in the following additional investigations:

- continued participation in the Ocean Wise Conservation Association's SSAMEx and Pollution Tracker programs.
- continuation of a collaborative project with the OceanWise Conservation Association to develop methods for microplastic analyses in wastewater, biosolids and environmental samples.
- continuation of a collaborative project with Biologica Environmental Services Ltd. (Victoria, BC) and the University of Chicago to assess live versus dead benthos assemblages around the Macaulay outfall.
- continuation of a collaborative project with Biologica Environmental Services Ltd., UVIC, and Metro Vancouver to develop benthic invertebrate toxicogenomic monitoring tools.
- continuation of a BC Centre for Disease Control and Public Health Canada collaboration to assess COVID-19 and influenza presence in BC wastewaters. Probability for expansion of testing scope into the near future.
- participation in a University of British Columbia and industry collaborative project to develop a handheld device to monitor and detect microorganisms in wastewater.
- Contracting a microplastic research firm to conduct a mass balance of microplastic concentrations at the MPWWTP. The assessment will examine microplastic concentrations and speciation along the treatment process from influent to primary to secondary effluent to biosolids.

5.1.1 Ocean Wise Conservation Association's SSAMEx and Pollution Tracker Programs

The Ocean Wise Conservation Association's SSAMEx program is a trans-boundary initiative with the aim to build on current monitoring initiatives, enable data sharing to fill gaps for the Salish Sea, and provide a platform for discussion and dialogue. The primary objective of SSAMEx is to facilitate the generation of a cross-jurisdictional trans-boundary dataset that focuses on ambient background conditions in the Salish Sea, such that other monitoring activities (e.g., municipal wastewater outfall monitoring) have a greater ability to determine whether observed shifts in results are associated with natural factors (e.g., climate related) or anthropogenic influences (e.g., wastewater outfalls). One of the main ways that SSAMEx achieves its objective is by developing harmonized sampling methodologies that can be adapted by the various organizations undertaking monitoring throughout the Salish Sea.

The objective of the Ocean Wise Conservation Association's Pollution Tracker program is to assess contaminant levels and profiles along the BC coast, via the collection of surface sediments and shellfish, both near and far from pollution sources. The program supports new and existing sampling efforts through coordinating laboratory analyses. Data generated is used to produce "state of the coastal environment" reports for partners and the general public, produce scientific publications, and populate the SSAMEx with data from background sample locations. Results can be found at https://pollutiontracker.org/.

In 2023, the CRD continued to analyze an expanded contaminant list in Core Area wastewaters that aligns with the Pollution Tracker target analyte list. Staff also partially funded and assisted with the collection of Pollution Tracker samples in Victoria Harbour and other areas in the region in 2022.

5.1.2 Microplastic Analytical Methodology Development

The Ocean Wise Conservation Association is working to assess microplastics in the ocean waters and sea life of the Salish Sea. The Vancouver Island University was also undertaking similar work, though their program has since stopped. The CRD provided Clover mussel samples collected in 2015 to Vancouver Island University to help them develop methods that will be used to determine if plastics are accumulating in sea life tissues. It is doubtful that any results will be received due to the program shutting down. In addition, the CRD provided the Ocean Wise Conservation Association with wastewater samples from 2016 and sediment samples from 2017 from Clover and Macaulay and, in conjunction with the Regional Source Control Program, samples from a residential wastewater catchment area upstream in the sewage system. The Ocean Wise Conservation Association has been using these samples to develop analytical methodologies that determine both quantity and type of plastics in wastewater and environmental samples.

In addition, Ocean Diagnostics was contracted to conduct a mass balance snapshot of microplastics at the MPWWTP. Ocean Diagnostics is developing and/or refining methodologies for microplastics separation from complex matrix such as influent and biosolids. A final report is expected in late 2024.

5.1.3 Benthos Death Assemblages

In 2016, the CRD contracted taxonomist (Biologica Environmental Services Ltd.) and a University of Chicago researcher asked the CRD to provide archived Macaulay benthic sample debris for further assessment. The researcher was interested in comparing the “death assemblages” of molluscs and bivalves contained within the archived debris to the “live” communities that are assessed by Biologica in routine environmental monitoring program sediment samples. Such live-dead comparisons have been used elsewhere to assess anthropogenic stressors over time.

The monitoring program staff provided debris from 2010, 2014 and 2017 to the University of Chicago. The 2005-2017 “live” Macaulay community data were pooled to establish average bivalve species composition per site and the 2014 and 2017 debris samples were picked for “dead” individuals.

The live-dead comparisons generally matched the spatial patterns observed in the other monitoring program seafloor monitoring components (sediment chemistry, etc.) and were indicative of the already known outfall nutrification impacts. Pollution and organic enrichment-tolerant bivalves were found in higher abundance in the debris samples collected close to the outfall and decreased with distance from the outfall. There were also differences in live-dead taxa abundances that varied with proximity to the outfall. Overall, the results suggest a nutrient footprint that extends greater than one kilometre away from the Macaulay diffuser, slightly farther than what the routine environmental monitoring program stations would capture. These results are being further assessed.

The preliminary findings were presented at the Geological Society of America Annual Meeting in Seattle in October 2017, with more complete findings presented at the 2020 Salish Sea Ecosystem Conference. Findings are currently being compiled for publication.

5.1.4 Benthos Toxicogenomic Tool Development

Benthic taxonomy is a useful tool for the assessment of anthropogenic stressors and determining the environmental impacts of the Macaulay outfall. Taxonomic assessments, however, are labour- and time-intensive and can be costly. In addition, the revised monitoring program five-year monitoring cycle has a reduced frequency of benthos assessments compared to programs that took place pre-2011. This has resulted in a loss of temporal and spatial resolution for the program.

In 2016, Biologica Environmental Services Ltd. and a UVIC researcher presented CRD staff with a research project that would result in the development of a benthos toxicogenomic tool that would be inexpensive relative to a full taxonomic assessment. This tool could be used in years when seafloor sampling does not take place and at historical monitoring stations that have been abandoned. The CRD collaborated on developing similar toxicogenomic tools for the Clover Point horse mussels (Veldhoen et al., 2009; Veldhoen et al., 2011; CRD, 2011); development of these tools was put on hold following the provincial order to install further treatment.

Biologica is the financial driver of the research and development project, in collaboration with the UVIC researcher that historically developed Clover mussel eDNA tools. To date, CRD monitoring program staff have provided benthos samples collected in 2017, 2019 and 2022, as well as access to the archived Macaulay taxonomic reference collection. These were used to identify taxa to prioritize for further toxicogenomic work-up and by various UVIC co-op students for preliminary method development.

In 2019, Biologica and UVIC were successful in obtaining a grant application to fully implement the project and a five-year project was initiated. The CRD and Metro Vancouver were both financial supporters of the project and will continue to provide sampling vessel and sample access throughout the project’s duration.

The team has confirmed the best field sample collection methods to optimize eDNA signals and has since developed assays for several positive, negative and control benthic species to assess wastewater effects around marine outfalls in the Salish Sea. Work is progressing on isolating eDNA from additional indicator species using sediment samples collected during the September 2022 seafloor sampling program around the McLoughlin and Macaulay outfalls.

Results have been presented at the SETAC North America 42nd Annual Meeting (Acharya-Patel, 2021a), the 47th Canadian Ecotoxicity Workshop (Acharya-Patel, 2021b), and the 4th International Council for the Exploration of the Sea (ICES)/North Pacific Marine Science Organization (PICES) Early Career Conference (Acharya-Patel, 2022). Journal articles will be prepared as the project wraps up.

5.1.5 COVID-19 in Wastewater

Throughout the world, researchers have been investigating ways to predict timing of COVID-19 outbreaks to inform health care planning. One promising technique is wastewater epidemiology, which has been used elsewhere in the world to detect COVID-19 in wastewater systems, sometimes as much as a week or two before patients started presenting with widespread symptoms in health care facilities.

In April 2020, the CRD was asked to provide weekly wastewater samples from Macaulay, Clover and the Saanich Peninsula wastewater treatment plants by a consortium of researchers from UVIC and Pani Energy Inc. (Victoria, BC). McLoughlin samples were provided once the new plant was commissioned in early 2021. Results from this study can be found in Masri *et. al*., (2022).

In 2022, the CRD started providing the BC Centre for Disease control with McLoughlin wastewater samples for COVID-19 and influenza analyses, along with other treatment plants throughout the province. Results can be found via an online data dashboard at https://bccdc.shinyapps.io/respiratory_wastewater/.

5.1.6 Handheld Microorganism Detection Device

A researcher at the University of British Columbia and Harbour Resource Partners, the consortium that built the McLoughlin Point WWTP, began a project to develop a novel handheld DNA sequencing device to monitor and detect microorganisms in wastewater. The aim is to provide utility operators with an easy-to-use screening tool that can provide a qualitative assessment of pathogen presence in wastewaters. Results could then be used to inform health agencies of any changes in pathogen presence over time. The contractor began providing McLoughlin wastewater and sludge samples during commissioning and the CRD continued to provide samples after taking over plant operation in January 2021. Results are not yet available.

5.1.7 Investigations Planned for 2024

The University of British Columbia approached the CRD to discuss support for the Natural Sciences and Engineering Research Council of Canada (NSERC) funding a project assessing airborne microplastics. The project is yet to be defined and will be reported in the 2024 Core Area annual report.

6.0 CONCLUSIONS

2023 continued to be a transitional year for sewage treatment in the Core Area and the Environmental Monitoring Program (EMP) as treatment continued to be optimized. The MPWWTP began commissioning in August 2020, with flows gradually diverted from Macaulay and Clover pump stations to the new facility. In 2022, all core area flows were treated at MPWWTP. EMP monitoring requirements still exist for Macaulay and Clover but the focus is on bypass/overflow events. Regardless of discharge location, the different routine monitoring components of the program, and the additional investigations were effective tools to assess the effects of the McLoughlin, Macaulay, and Clover discharges on the marine receiving environment.

CRD staff conducted MPWWTP influent and effluent sampling throughout 2023 to assess regulatory compliance and to determine contaminant removal efficiency of the tertiary treatment processes.

In 2023, EMP staff conducted routine receiving environment monitoring of surface water and the water column at McLoughlin. No sampling at Macaulay or Clover took place as overflow events were not coincident with the routine McLoughlin sampling.

No seafloor sampling was conducted in 2023, seafloor sampling is scheduled near Macaulay and McLoughlin outfalls in 2024 and Clover in 2025.

Additional research and investigations were ongoing in 2022 and 2023. These investigations continue to address gaps in the routine monitoring program or emerging environmental and human health concerns related to the discharge of wastewater to the marine environment.

It is expected that the MPWWTP processes will be stable at the end of 2023, with a further one or two years (i.e., 2024-2025) before enough influent and effluent data will have been collected to make definitive statements about the efficacy of treatment and resulting reductions of effects to the marine environment. The installation of tertiary treatment is expected to substantively reduce overall contaminant loading to the environment and reduce the footprint of impact. The CRD is committed to continuing the EMP to assess these improvements both spatially and temporally.

6.1 Wastewater

Wastewater regulatory compliance results indicated that the quality of the wastewater from McLoughlin achieved tertiary standards for most of the year. Federal compliance limits were met the entire year. Provincial regulatory limits were intermittently exceeded from March to December when compared to low compliance limits of 10 mg/L monthly average for TSS and CBOD. Monthly averages were marginally over permit limits with the highest exceedance (14 mg/L) for CBOD in May. The CRD is in discussions with ENV to allow a monthly average of 25 mg/L for TSS and CBOD for McLoughlin effluent, which is consistent with the federal limit. If the limit is relaxed, the MPWWTP is expected to be 100% compliant.

The CRD is investigating the potential that highly variable centrate return flows from the Hartland Residuals Treatment Facility may be impacting the treatment plant's ability to consistently achieve such conservative effluent quality limits.

Wastewater priority substance monitoring results confirmed the efficacy of the tertiary treatment plant to substantively reduce concentrations and loadings of contaminants to the marine receiving environment relative to historical untreated discharges out of Macaulay and Clover. Except for bacteriological indicators, the estimated receiving environment concentrations (based on applying predicted minimum initial dilution factors to wastewater concentrations) did not exceed applicable provincial and federal water quality guidelines for the protection of human health and aquatic life. Most were below guidelines in wastewater even before discharge. More detailed concentration and loading assessments will be undertaken in 2024.

Tertiary treatment at McLoughlin has also improved acute toxicity with all McLoughlin acute rainbow trout and invertebrate toxicity tests passed. This represents a substantive improvement over historical Macaulay and Clover discharge practices, when effluent was regularly acutely lethal to fish and sometimes to invertebrates. McLoughlin effluent was also much less chronically toxic than historical Macaulay and Clover effluents, further affirming the value of advanced treatment to reduce potential for adverse effects to organisms around the outfall.

Chronic toxicity results indicated that the predicted wastewater concentrations at the edge of the McLoughlin IDZ would have little to no effect on organism health.

The bacteriological guideline exceedances will continue at McLoughlin, as disinfection was not included as part of the treatment processes. However, the magnitude and duration of the exceedances has decreased substantially relative to historical Macaulay and Clover flows, as bacterial levels in McLoughlin final effluent are an order of magnitude lower. In addition, overflows out of the Clover long outfall will now only occur during significant rain events. Future consideration of the need to disinfect effluent will be subject to ongoing monitoring of the impact of the treated McLoughlin effluent and wet weather overflows. Wet weather discharges will be further reduced through the ongoing implementation of CRD and municipal inflow and infiltration reduction programs.

There are many newer and emerging substances that the CRD monitors and for which guidelines have yet to be developed. The potential influence of these chemicals on the environment is therefore relatively unknown. The CRD attempts to assess the risk of these newer chemicals through additional investigations as described in Section 5.0.

6.2 Reclaimed Water

The reclaimed water system was disconnected and decommissioned in 2021 due to operational challenges. As such, no reclaimed water samples were collected for analysis in 2023.

6.3 Surface Water

In 2023, surface water fecal coliform and enterococci results indicated that the outfall plume was predominantly trapped below the ocean surface. The potential for human exposure to high fecal coliform and enterococci concentrations around the outfall was very low, as fecal coliform and enterococci surface water geometric mean results were only infrequently above thresholds used to assess risk to human health, as expected based on effluent quality and outfall design. These exceedances occurred mostly during the autumn sampling period when surfacing events are more frequently predicted.

The 2023 water column monitoring (at depths of 5 m or greater) confirmed that bacteriological indicators rarely exceeded either provincial or federal guidelines at the edge of the IDZ around the McLoughlin outfall. Magnitude and frequency of exceedances were much lower than historical observations around the Clover and Macaulay outfalls, affirming the environmental improvement of tertiary treatment at McLoughlin. These minor exceedances were expected, based on the wastewater concentrations of the bacteriological indicators (in the hundreds of thousands of bacteria per 100 mL) and the intended design of the outfall diffusers, even with tertiary treatment and the lack of disinfection. The diffusers were designed specifically to ensure that the wastewater plumes were predominantly trapped below the surface.

Overall, the fecal coliform and enterococci results were within the concentrations predicted by plume dispersion model. The moderately high bacterial counts in the receiving environment can be attributed to higher wastewater flows in winter, coupled with the oceanography of this area during the winter months (i.e., relative lack of water column stratification due to wind and relatively cool surface waters). Summer plume surfacing events are also predicted to occur occasionally at both outfalls, associated with the morning flush in the wastewater system, weak water column stratification and slack tide. Events are predicted to be much less frequent in summer than in winter.

Boron routinely exceeded guidelines throughout the water column at both the outfall and reference stations. These exceedances cannot be attributed to the outfall, as natural background concentrations of boron in the Salish Sea are routinely higher than guidelines.

While the plume was predominantly trapped below the surface, with low risk to human health, there is potential for higher risk to organisms that live in the water column. The 2023 water column monitoring results for metals were all low or at background levels (e.g., boron) indicating that risk to organisms was also likely low. However, the monitoring program has few definitive assessments of organisms living in the water column, except for the finfish monitoring component of the EMP. Assessing this potential risk is challenging, as organisms living in the water column may move in and out of the plume and, therefore, potential effects cannot be easily attributed to the outfalls. This is why the EMP focuses on sessile organisms living on the seafloor around the outfall.

Overall, the bacteriological monitoring results indicated that the surface water effects of the outfall were limited and substantively lower than the signals observed historically around the Clover and Macaulay outfalls. The McLoughlin plume was predominantly trapped at depth (below 40 m) for most of the year, and substantially diluted wastewater only occasionally reached the surface.

6.4 Overflow and Bypass Monitoring

The conveyance system is designed with numerous shoreline sanitary and combined sewer overflow and relief points that discharge during heavy rains, planned maintenance activities or following unexpected non-routine or emergency events. Shoreline monitoring is required to assess human health risk for people engaged in recreational activities on beaches adjacent to the overflows. No overflow monitoring was conducted in 2023 as there were no events that triggered the commitments to do so. Previous monitoring confirmed that wastewater overflow signals typically dissipate within 48-hours, but adjacent municipal stormwater discharge signals persist longer, sometimes continuously. Overall, risk to human health is short-lived following bypass and overflow events.

6.5 Seafloor Monitoring

Seafloor monitoring is required every two to three years around the Macaulay and McLoughlin outfalls and every five years around the Clover outfall. Sediment will be sampled at MPWWTP outfall in 2024.

6.6 Additional Investigations

Additional investigations are important elements of the program that address specific questions or issues pertaining to the monitoring program, clarify aspects of the program and provide concurrent data for the assessment of environmental effects.

The CRD's ongoing participation in the Ocean Wise Conservation Association initiatives included ensuring the monitoring program's samples were collected using harmonized methodologies, thereby benefitting both the CRD when assessing monitoring results, as well as others doing similar monitoring elsewhere in the Salish Sea. In addition, participation in these initiatives provided access to other Salish Sea datasets for comparison to monitoring program results. By providing various types of samples to the Ocean Wise Conservation Association, the monitoring program has helped facilitate the development of new analytical methodologies for microplastics in wastewater and environmental samples, including working with a private contractor to develop methods for microplastics in commercial laundry and compost facility effluents. A mass balance of microplastics at the McLoughlin WWTP was sampled and results will be available in 2024. The death assemblage assessments are ongoing, and it is hoped that the development of the benthos toxicogenomic tools will provide the CRD and Metro Vancouver with a useful and inexpensive monitoring tool for filling in spatial and temporal gaps in the routine benthos programs. Ongoing submission of samples to the BC Centre for Disease Control will continue to give health authorities an advanced notice of local COVID-19 and influenza outbreaks prior to widespread increases in patient hospitalization. Finally, the CRD continues to provide McLoughlin wastewater samples to UBC which will hopefully result in an easy-to-use, handheld device that will allow operators to detect microorganisms in wastewater and ultimately inform health authorities.

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APPENDIX A-1

ENVIRONMENTAL MONITORING PROGRAM HISTORY

Program History

CRD staff have conducted monitoring of wastewater discharges, surface waters and the seafloor environment in the vicinity of the Macaulay and Clover outfalls since the late 1980s. The program has undergone several changes over the years. Monitoring of wastewater, marine surface waters close to the outfalls, and benthic communities were conducted in the 1970s and 1980s in collaboration with the University of Victoria (UVIC) and independent consultants. Additional investigations were undertaken to more clearly define the effects of the outfalls on the receiving environment. In 1992, a detailed investigation of effects related to the outfalls was conducted by EVS Environment Consultants Ltd. (1992). This study included the analysis of wastewater and sediment chemistry, sediment toxicity, and the assessment of the health of biological communities near the outfalls. The 1992 study results were used to design a regular monitoring and assessment program, in collaboration with an advisory group made up of academics and other experts in environmental effects assessment and monitoring (Marine Monitoring Advisory Group (MMAG))

From 1992 until 1999, the program consisted of monthly wastewater analysis for conventional parameters, quarterly wastewater analysis for priority substances, monthly surface water (<1 m depth) sampling for indicator bacteria, yearly sediment chemistry analysis and seafloor organism monitoring on a three-year cycle. Starting in 2000, the program was again revised in consultation with MMAG, with changes primarily in increased frequency of monitoring. Special investigations continued to supplement the routine monitoring as necessary.

Toxicity testing also used to be a component of the monitoring program for both wastewater and sediment. Wastewater toxicity testing invariably failed, primarily due to the high ammonia concentrations in the Macaulay and Clover wastewaters. Because ammonia is not typically a concern in the marine environment, it was agreed in consultation with MMAG and ENV that wastewater toxicity testing be dropped from the program. Sediment toxicity testing was also a component of the program and was dropped following the 1992 EVS study (EVS, 1992) due to confounding total organic carbon concentrations. Both sediment and wastewater toxicity testing, using updated methodologies, were reintroduced to the monitoring program in 2011 as part of a revised monitoring program for which more details are provided below.

The Society of Environmental Toxicology and Chemistry (SETAC) completed a review of the CRD Core Area LWMP in 2006 (SETAC, 2006). This review panel commented that the monitoring program was substantial and well designed, and that continuing it would be appropriate for assessing the CRD wastewater discharge in the future. However, the panel made several recommendations to enhance the monitoring program, including considering more extensive monitoring with better spatial and temporal resolution in the far-field to provide a better understanding of the fate of the surfaced sewage plume. Since the SETAC review, the decision to move to advanced treatment was made.

In 2008, CRD and ENV staff initiated a review of the objectives and design of the monitoring program, considering the SETAC review and plans to install additional treatment for the Macaulay and Clover wastewaters. As a result of this review, a revised monitoring program based on a five-year cycle was implemented in 2011. Both the MMAG and consultants familiar with the monitoring program data reviewed the new program (Golder, 2011) and provided recommendations. There is also a commitment within the five-year monitoring program that CRD and ENV staff will meet on an annual basis to review the results of the previous monitoring year.

The monitoring program design for Cycle 3 and beyond has been revised based on these annual collaborative reviews, comments from the advisory group and other external expert reviews, and the transition to treatment at McLoughlin in 2020. Since 2020, EMP revisions have primarily included shifting most of the wastewater and surface water monitoring effort to McLoughlin and adding new stations to the seafloor monitoring to encompass the predicted impact footprint of the new McLoughlin outfall. Monitoring of the new seafloor locations began in 2019, along with effluent quality monitoring once the MPWWTP commissioning began in 2020. In addition, the bulk of the wastewater monitoring effort at Macaulay and Clover was dropped effective December 31, 2020, aligning with cancellation of the Federal Transitional Authorizations for the two facilities, and shifted instead to the McLoughlin facility. As such, the overall monitoring shift to McLoughlin effectively started in 2021, which aligns with Cycle 3, Year 1 of the EMP.

With the commissioning of the MPWWTP came the need to manage sludge and produce biosolids, which are produced at the Residuals Treatment Facility (RTF) at the Hartland Landfill. As noted previously, the RTF is under a separate provincial authorization and monitoring results are presented in other reports (CRD, 2024 and HRMG, 2024).

APPENDIX A2
GUIDANCE MANUAL FOR
ASSESSMENT AND ANALYSIS OF EMP DATA

Available upon request.

Contact: CRD's Environmental Monitoring Program, 250.360.3296

APPENDIX B
2023 WASTEWATER MONITORING

Appendix B1 Priority Substance List and Sampling Frequency

Substance	McLoughlin WWTP Influent and Effluent	
	(full list)	(modified list)
	Quarterly	Monthly
CONVENTIONALS		
alkalinity	√	√
biochemical oxygen demand (BOD)	√	√
carbonaceous biochemical oxygen demand (CBOD)	√	√
chemical oxygen demand (COD)	√	√
chloride	√	√
conductivity	√	√
cyanide-SAD	√	√
cyanide-WAD	√	√
enterococci	√	√
fecal coliforms	√	√
hardness, total	√	√
nitrogen, ammonia	√	√
nitrogen, nitrate	√	√
nitrogen, nitrite	√	√
nitrogen, total Kjeldahl	√	√
oil and grease, mineral	√	√
oil and grease, total	√	√
organic carbon, total	√	√
pH	√	√
sulphate	√	√
sulphide	√	√
suspended solids, total	√	√
METALS		
Total Metals		
aluminum	√	√
antimony	√	√
arsenic	√	√
barium	√	√
beryllium	√	√
cadmium	√	√
calcium	√	√
chromium	√	√
chromium VI	√	√
cobalt	√	√
copper	√	√
iron	√	√
lead	√	√
magnesium	√	√
manganese	√	√
mercury	√	√
molybdenum	√	√
nickel	√	√
phosphorus	√	√
potassium	√	√
selenium	√	√
silver	√	√

Appendix B1, cont'd

Substance	McLoughlin WWTP Influent and Effluent	
	(full list)	(modified list)
	Quarterly	Monthly
thallium	√	√
tin	√	√
zinc	√	√
Dissolved Metals		
aluminum	√	√
antimony	√	√
arsenic	√	√
barium	√	√
beryllium	√	√
cadmium	√	√
calcium	√	√
chromium	√	√
cobalt	√	√
copper	√	√
iron	√	√
lead	√	√
magnesium	√	√
manganese	√	√
mercury	√	√
molybdenum	√	√
nickel	√	√
phosphorus	√	√
potassium	√	√
selenium	√	√
silver	√	√
thallium	√	√
tin	√	√
zinc	√	√
Speciated Metals		
dibutyltin	√	
dibutyltin dichloride	√	
methyl mercury	√	
monobutyltin	√	
monobutyltin trichloride	√	
tributyltin	√	
tributyltin dichloride	√	
ALDEHYDES		
acrolein	√	√
PHENOLIC COMPOUNDS		
total phenols	√	√
CHLORINATED PHENOLICS		
2,4,6-trichlorophenol	√	√
2,4/2,5-dichlorophenol	√	√
2-chlorophenol	√	√
4-chloro-3-methylphenol	√	√
pentachlorophenol	√	√
NON-CHLORINATED PHENOLICS		
2,4-dimethylphenol	√	√
2,4-dinitrophenol	√	√

Appendix B1, cont'd

Substance	McLoughlin WWTP Influent and Effluent	
	(full list)	(modified list)
	Quarterly	Monthly
2-methyl-4,6-dinitrophenol	√	√
2-nitrophenol	√	√
4-nitrophenol	√	√
phenol	√	√
ORGANOCHLORINE PESTICIDES		
2,4-DDD	√*	
2,4-DDE	√*	
2,4-DDT	√*	
4,4-DDD	√*	
4,4-DDE	√*	
4,4-DDT	√*	
aldrin	√*	
alpha chlordane	√*	
alpha-endosulfan	√*	
alpha-BHC	√*	
beta-endosulfan	√*	
beta-BHC	√*	
chlordane	√*	
delta-BHC	√*	
dieldrin	√*	
endosulfan sulfate	√*	
endrin	√*	
endrin aldehyde	√*	
gamma chlordane	√*	
heptachlor	√*	
heptachlor epoxide	√*	
gamma BHC	√*	
methoxyclor	√*	
mirex	√*	
octachlorostyrene	√*	
toxaphene	√*	
POLYCHLORINATED BIPHENYLS		
PCB-1	√*	
PCB-3	√*	
PCB-4/10	√*	
PCB-5/8	√*	
PCB-15	√*	
PCB-18	√*	
PCB-19	√*	
PCB-23/34	√*	
PCB-28	√*	
PCB-31	√*	
PCB-37	√*	
PCB-40	√*	
PCB-44	√*	
PCB-43/49	√*	
PCB-52/73	√*	
PCB-54	√*	
PCB-56/60	√*	

Appendix B1, cont'd

Substance	McLoughlin WWTP Influent and Effluent	
	(full list)	(modified list)
	Quarterly	Monthly
PCB-66/80	√*	
PCB-77	√*	
PCB-81	√*	
PCB-87/115/116	√*	
PCB-89/90/101	√*	
PCB-93/95	√*	
PCB-99	√*	
PCB-104	√*	
PCB-105/127	√*	
POLYCYCLIC AROMATIC HYDROCARBONS		
dibenzo(a,h)anthracene	√*	√
fluoranthene	√*	√
fluorene	√*	√
indeno(1,2,3-c,d)pyrene	√*	√
naphthalene	√*	√
phenanthrene	√*	√
pyrene	√*	√
total high molecular weight - PAH	√*	√
total low molecular weight - PAH	√*	√
total PAH	√*	√
SEMIVOLATILE ORGANICS		
Phthalates		
bis(2-ethylhexyl)phthalate	√	√
butylbenzyl phthalate	√	√
diethyl phthalate	√	√
dimethyl phthalate	√	√
di-n-butyl phthalate	√	√
di-n-octyl phthalate	√	√
MISCELLANEOUS SEMIVOLATILE ORGANICS		
1,2,4-trichlorobenzene	√	
1,2-diphenylhydrazine	√	√
2,4-dinitrotoluene	√	√
2,6-dinitrotoluene	√	√
3,3-dichlorobenzidine	√	√
4-bromophenyl phenyl ether	√	
4-chlorophenyl phenyl ether	√	
benzidine	√	√
bis(2-chloroethoxy)methane	√	
bis(2-chloroethyl)ether	√	
bis(2-chloroisopropyl)ether	√	
hexachlorobenzene	√	
hexachlorobutadiene	√	
hexachlorocyclopentadiene	√	
hexachloroethane	√	
isophorone	√	√
nitrobenzene	√	√
N-nitrosodimethylamine	√	√
N-nitrosodi-n-propylamine	√	√
N-nitrosodiphenylamine	√	√

Appendix B1, cont'd

Substance	McLoughlin WWTP Influent and Effluent	
	(full list)	(modified list)
	Quarterly	Monthly
VOLATILE ORGANICS		
Monocyclic Aromatic Hydrocarbons		
benzene	√	√
chlorobenzene	√	√
1,2-dichlorobenzene	√	√
1,3-dichlorobenzene	√	√
1,4-dichlorobenzene	√	√
ethylbenzene	√	√
m & p xylenes	√	√
o-xylene	√	√
styrene	√	√
toluene	√	√
xylenes	√	√
Aliphatic		
acrylonitrile	√	√
methyl tertiary butyl ether	√	√
Chlorinated Aliphatic		
1,1,1,2-tetrachloroethane	√	√
1,1,1-trichloroethane	√	√
1,1,2,2-tetrachloroethane	√	√
1,1,2-trichloroethane	√	√
1,1-dichloroethane	√	√
1,1-dichloroethene	√	√
1,2-dichloroethane	√	√
1,2-dichloropropane	√	√
bromomethane	√	√
chloroethane	√	√
chloroethene	√	√
chloromethane	√	√
cis-1,2-dichloroethene	√	√
cis-1,3-dichloropropene	√	√
dibromoethane	√	√
dibromomethane	√	√
dichloromethane	√	√
tetrabromomethane	√	√
tetrachloroethene	√	√
tetrachloromethane	√	√
trans-1,2-dichloroethene	√	√
trans-1,3-dichloropropene	√	√
trichloroethene	√	√
trichlorofluoromethane	√	√
Trihalomethanes		
bromodichloromethane	√	√
chlorodibromomethane	√	√
tribromomethane	√	√
trichloromethane	√	√
Ketones		
dimethyl ketone	√	√
methyl ethyl ketone	√	√

Appendix B1, cont'd

Substance	McLoughlin WWTP Influent and Effluent	
	(full list)	(modified list)
	Quarterly	Monthly
methyl isobutyl ketone	√	√
alpha-terpineol	√	√
High Resolution Analysis		
Nonylphenols (NP)	√	
Polybrominated Diphenyl Ethers (PBDE)	√	
Polycyclic Aromatic Hydrocarbons (PAH)	√	
Per and Polyfluoroalkyl Substances (PFOS)	√	
Pharmaceuticals and Personal Care Products (PPCP)	√	
Dioxins and Furans (PCDD)	√	
Polychlorinated Biphenyls (PCB)	√	
TOXICITY-ACUTE		
96-hr Rainbow Trout - pH stabilized		√
48-hr Daphnia magna		√
TOXICITY-CHRONIC (Annual)		
Rainbow Trout Avelin and Egg Test (EA)	√**	
Ceriodaphnia 7-day	√**	
Top smelt 7-day	√**	
Echinoderm fertilization	√**	

Notes:
√* Analyses were conducted at a higher resolution (i.e., at SGS AXYS Analytics), **annually.

Appendix B2 McLoughlin Wastewater Treatment Plant Influent Flow (m^3/day)

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	115,270	86,070	97,570	82,240	80,020	74,640	77,290	76,190	75,670	75,840	80,280	79,810
2	111,690	85,520	112,600	87,150	80,030	73,670	72,370	75,210	81,460	76,450	77,810	80,520
3	105,710	86,960	103,310	82,180	79,480	75,300	70,970	73,860	75,660	75,140	76,050	79,230
4	101,340	87,650	98,670	82,240	77,840	73,850	75,260	74,470	73,190	93,820	80,770	87,410
5	97,970	89,550	97,840	81,650	79,780	76,530	73,990	72,720	75,290	79,930	158,410	109,120
6	93,670	90,060	94,000	80,710	97,330	77,040	73,880	70,390	79,710	77,780	94,940	99,650
7	103,850	152,810	89,010	79,500	80,050	74,610	76,780	69,670	80,700	75,980	121,260	133,620
8	101,580	114,910	87,620	79,680	81,840	74,640	74,000	76,930	76,670	74,630	99,430	176,430
9	98,960	110,930	87,920	80,930	81,140	74,770	72,420	135,360	76,800	74,790	90,220	113,880
10	97,800	103,180	90,790	83,020	77,930	78,030	73,390	73,310	75,860	74,390	88,130	123,130
11	92,690	98,440	88,900	86,070	78,980	104,200	74,980	73,450	75,380	78,090	84,060	106,070
12	106,280	98,850	99,160	80,510	78,010	85,320	73,850	73,300	78,420	80,360	85,760	143,820
13	99,560	107,580	101,410	81,040	78,280	80,020	75,840	72,310	78,500	79,980	85,010	151,100
14	96,410	97,990	92,060	79,970	78,120	77,950	73,320	75,910	75,840	76,380	121,530	119,450
15	99,580	95,720	90,790	80,540	78,890	77,750	72,840	74,790	75,380	76,000	99,100	107,420
16	98,150	93,420	93,010	83,730	81,080	77,990	71,100	74,020	75,880	77,440	94,580	101,090
17	92,610	95,820	91,180	82,050	78,700	77,100	73,040	74,380	75,980	83,430	88,620	100,490
18	93,920	92,750	89,490	82,040	78,330	75,340	73,900	73,850	74,830	85,950	83,860	101,260
19	90,160	89,520	88,490	81,890	77,250	76,850	74,900	126,590	79,600	86,060	82,430	94,580
20	90,120	94,240	85,720	80,750	77,960	78,160	73,940	74,740	76,720	82,180	82,300	92,440
21	92,120	90,680	83,170	83,830	74,090	76,700	72,500	72,060	76,930	115,460	86,480	92,640
22	91,090	87,930	83,310	78,930	75,970	76,280	72,760	76,380	77,040	79,120	90,900	95,520
23	89,550	87,450	83,310	85,070	78,460	75,780	71,110	75,310	75,950	77,280	85,260	89,500
24	90,800	86,020	85,210	81,820	77,960	75,750	73,500	74,740	77,200	76,850	91,170	89,620
25	88,370	86,670	83,470	79,850	77,210	74,590	87,640	75,060	80,660	80,250	89,390	88,800
26	88,390	95,250	86,580	78,510	75,910	76,330	79,000	74,130	83,060	75,560	83,360	86,940
27	89,440	92,880	82,420	79,170	76,700	75,810	75,110	75,310	78,240	113,410	83,550	86,480
28	87,530	108,510	83,930	119,970	75,540	76,040	74,780	72,360	77,000	99,920	83,550	80,180
29	87,600		79,780	78,600	77,920	75,260	73,730	73,660	76,670	84,460	83,260	85,720
30	86,030		81,960	78,540	79,930	74,960	72,010	77,170	80,540	82,740	82,360	84,400
31	88,720		80,560		76,020		73,660	76,570		77,890		82,220
Average	95,708	96,691	90,105	82,739	78,927	77,375	74,318	77,877	77,361	82,179	91,128	102,017
Maximum	86,030	85,520	79,780	78,510	74,090	73,670	70,970	69,670	73,190	74,390	76,050	79,230
Minimum	115,270	152,810	112,600	119,970	97,330	104,200	87,640	135,360	83,060	115,460	158,410	176,430
											Annual Average	**85,481**

Appendix B3 McLoughlin Wastewater Treatment Plant Effluent Flow (m^3/day)

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	113,766	84,599	96,139	80,901	78,767	75,284	71,290	74,042	74,304	73,995	79,170	85,792
2	110,234	84,148	111,151	85,862	78,294	74,202	69,880	72,666	71,967	92,666	156,280	107,288
3	104,089	85,520	101,993	81,052	76,723	72,757	74,252	73,317	73,889	78,775	93,097	97,997
4	99,746	86,188	97,306	81,010	78,665	75,282	72,874	71,679	78,371	76,761	119,269	132,018
5	96,220	88,125	96,576	80,732	96,126	75,898	72,844	69,411	79,396	74,730	97,629	174,431
6	92,152	88,522	92,610	79,714	78,749	73,419	75,718	68,680	75,197	73,369	88,426	112,301
7	102,400	150,910	87,879	78,077	80,565	73,437	72,983	75,870	75,579	73,445	86,299	121,467
8	100,212	113,313	86,108	78,224	79,977	73,415	71,325	72,484	74,779	73,013	82,555	104,709
9	97,575	109,365	86,308	79,701	77,246	76,754	72,181	72,233	74,331	76,699	84,282	142,113
10	96,328	101,546	89,449	81,721	77,740	102,662	73,857	72,496	77,375	78,843	83,457	149,330
11	91,259	96,926	87,573	84,706	76,954	84,285	72,762	72,272	77,472	78,606	119,642	117,905
12	104,665	97,327	97,899	79,220	77,117	78,907	74,804	71,313	74,780	74,939	97,502	105,501
13	98,046	105,926	99,786	79,767	76,958	76,792	72,080	74,807	74,199	74,315	92,853	99,245
14	94,868	96,685	90,365	78,615	77,610	76,612	71,564	73,817	74,584	75,978	87,170	98,831
15	97,992	94,008	89,436	79,193	79,848	76,789	69,896	72,934	74,795	81,978	81,965	99,827
16	96,234	91,887	91,772	82,480	77,604	75,973	71,844	73,240	73,734	84,425	80,620	93,041
17	91,301	94,287	90,066	80,641	77,161	74,257	73,017	72,770	78,496	84,386	80,513	90,713
18	92,400	90,267	88,057	80,728	76,138	75,777	74,030	73,246	75,724	80,418	84,869	90,962
19	88,993	88,054	87,235	80,472	76,786	77,130	72,886	70,752	75,921	77,388	89,271	93,918
20	88,142	92,898	84,629	79,596	72,937	75,488	71,438	75,223	75,934	75,710	83,612	87,907
21	90,407	90,398	81,963	82,621	74,726	75,077	71,615	74,159	74,865	75,230	89,390	87,942
22	89,536	86,520	82,264	77,799	77,299	74,516	70,141	73,479	76,139	78,778	87,664	87,085
23	88,088	85,826	82,016	83,934	76,850	74,479	72,396	73,909	79,620	73,790	81,704	85,228
24	89,293	84,559	83,705	80,685	76,056	73,325	86,645	72,887	81,871	111,840	81,883	84,757
25	87,061	85,505	82,073	78,721	74,863	75,245	77,949	74,080	77,125	97,924	81,883	78,661
26	87,112	93,729	85,312	77,368	76,108	74,715	73,905	71,322	76,090	82,969	81,704	84,003
27	88,023	91,398	81,203	77,721	74,839	74,804	73,432	72,746	75,489	80,999	80,653	82,741
28	86,271	106,982	82,703	77,294	76,893	73,840	72,631	76,264	79,354	76,003	78,270	80,499
29	85,988		78,491	77,218	78,548	73,763	70,900	75,377	74,693	78,444	78,825	81,070
30	84,500		80,885	78,741	74,811	76,080	72,439	74,956	75,377	76,005	77,665	86,573
31	87,170		79,412		73,616		75,062	80,158		74,379		82,190
Average	94,196	95,194	88,786	80,150	77,631	76,365	73,182	73,309	76,048	79,574	89,604	100,840
Minimum	84,500	84,148	78,491	77,218	72,937	72,757	69,880	68,680	71,967	73,013	77,665	78,661
Maximum	113,766	150,910	111,151	85,862	96,126	102,662	86,645	80,158	81,871	111,840	156,280	174,431
											Annual Average	**83,681**

Notes: Shaded cells indicate exceedance to maximum daily flow = 432,000 m^3/day (comprising 216,000 m^3/day tertiary treated and 216,000 m^3/day primary treatment during wet weather).

Appendix B4 McLoughlin Point Wastewater Treatment Plant Bypassed Flow

Date of Bypass	Volume of Bypass (m^3/day)
04/01/2023	10
07/02/2023	8,040
22/06/2023	10
24/07/2023	360
24/10/2023	3,140
02/11/2023	630
04/12/2023	6,700
05/12/2023	10,820
06/12/2023	20
09/12/2023	2,960

Appendix B5 Frequency of Detection, Loadings and Percent Removal of Substances in McLoughlin Influent and Final Effluent

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
Chloride	DISS	mg/L	100%	71.83	2193144	100%	80	2262726	-3%
Total/SAD Cyanide	TOT	mg/L	92%	0.00	70	100%	0.0019	53.1	24%
WAD Cyanide	TOT	mg/L	75%	0.00	38.2	100%	0	26.0	32%
Hardness (as CaCO3)	DISS	mg/L	100%	69.26	2140126	100%	71.05	2005430	6%
Sulphate	DISS	mg/L	100%	21.75	691669	100%	24.58	700149	-1%
Hardness (as CaCO3)	TOT	mg/L	100%	79.15	2414677	100%	71.09	2013405	17%
Organic Carbon	TOT	mg/L	100%	155.00	4544467	100%	23.75	660954	85%
Oil & Grease, Mineral	TOT	mg/L	33%	---	---	0%	---	---	---
Oil & grease, total	TOT	mg/L	100%	14.33	426163	33%	---	---	---
H2S	TOT	mg/L	100%	2.00	55071	100%	0.081	2207	96%
Sulfide	TOT	mg/L	100%	1.29	34607	75%	0.03558	970	97%
Tetrabromomethane	TOT	µg/L	8%	---	---	0%	---	---	---
4-Methyl-2-Pentanone	TOT	µg/L	0%	---	---	0%	---	---	---
Dimethyl Ketone	TOT	µg/L	100%	154.40	4203	92%	126.3	3465	18%
Endrin Ketone	TOT	ng/L	0%	---	---	0%	---	---	---
Isophorone	TOT	µg/L	0%	---	---	0%	---	---	---
Uranium	DISS	µg/L	100%	0.02	0.7	100%	0.01109	0.3	55%
Lithium	DISS	µg/L	100%	2.15	62	100%	2.244	60	4%
Potassium	DISS	mg/L	100%	16.02	472052	100%	15.98	438148	7%
Sodium	DISS	mg/L	100%	49.30	1438480	100%	49.17	1312820	9%
Potassium	TOT	mg/L	100%	16.49	480689	100%	15.88	435659	9%
Sodium	TOT	mg/L	100%	47.76	1587319	100%	47.5	1434057	10%
Barium	DISS	µg/L	100%	5.83	177.4	100%	2.653	76	57%
Beryllium	DISS	µg/L	0%	---	---	0%	---	---	---
Calcium	DISS	mg/L	100%	16.46	509950	100%	17.26	486149	5%
Magnesium	DISS	mg/L	100%	6.83	210185	100%	6.795	192399	8%
Strontium	DISS	µg/L	100%	66.80	2045	100%	63.58	1740	15%
Barium	TOT	µg/L	100%	20.36	597	100%	3.92	111.0	81%
Beryllium	TOT	µg/L	17%	---	---	8%	---	---	---
Calcium	TOT	mg/L	100%	19.83	605607	100%	17.29	489313	19%
Magnesium	TOT	mg/L	100%	7.20	219160	100%	6.769	191992	12%
Thallium	DISS	µg/L	0%	---	---	0%	---	---	---
Thallium	TOT	µg/L	100%	0.01	0	17%	---	---	---

Appendix B5, cont'd

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
Arsenic	DISS	µg/L	100%	0.50	15.2	100%	0.4287	11.7	23%
Antimony	DISS	µg/L	100%	0.30	9.0	100%	0.2467	7	24%
Boron	DISS	µg/L	100%	194.40	5542	100%	203.1	5378	3%
Silicon	DISS	µg/L	100%	3464.00	104066	100%	3663	98679	5%
Arsenic	TOT	µg/L	100%	0.58	17.6	100%	0.4339	11.8	33%
Antimony	TOT	µg/L	100%	0.31	9	100%	0.249	6.9	25%
Lead	DISS	µg/L	100%	0.55	16.1	100%	0.3018	8.5	47%
Aluminum	DISS	µg/L	100%	30.60	935.0	100%	15.7	447	52%
Bismuth	DISS	µg/L	100%	0.25	7.0	100%	0.1882	5.2	26%
Tin	DISS	µg/L	100%	0.93	28	100%	0.605	17	40%
Lead	TOT	µg/L	100%	3.26	93	100%	0.5214	14.7	84%
Aluminum	TOT	µg/L	100%	240.30	7384	100%	28.77	820.5	89%
Tin	TOT	µg/L	100%	0.98	30	100%	0.622	17	42%
Selenium	DISS	µg/L	100%	0.21	6.4	100%	0.1509	4.2	34%
Phosphorus	DISS	µg/L	100%	5135.00	147032	100%	3438	92292	37%
Sulfur	DISS	mg/L	100%	7.82	237672	100%	8.31	226596	5%
Selenium	TOT	µg/L	100%	0.32	9	100%	0.2	6.5	31%
Phosphorus	TOT	µg/L	100%	6723.00	181757	100%	3170	67535	63%
Sulfur	TOT	mg/L	100%	8.31	287420	100%	8.25	253100	12%
Chromium III	TOT	mg/L	75%	0.01	164	58%	0	91	44%
Chromium VI	TOT	mg/L	8%	---	---	0%	---	---	---
Dibutyltin	TOT	µg/L	67%	0.01	0.2	33%	---	---	---
Dibutyltin Dichloride	TOT	µg/L	67%	0.01	0.2	33%	---	---	---
Methyl Mercury	TOT	ng/L	75%	0.37	0.01	50%	---	---	---
Monobutyltin	TOT	µg/L	100%	0.01	0.2	100%	0.009	0.3	-23%
Monobutyltin Trichloride	TOT	µg/L	100%	0.01	0.3	100%	0.01	0.4	-24%
Tributyltin	TOT	µg/L	0%	---	---	0%	---	---	---
Tributyltin Chloride	TOT	µg/L	0%	---	---	0%	---	---	---
Cadmium	DISS	µg/L	100%	0.05	1.4	100%	0.02516	0.7	48%
Chromium	DISS	µg/L	100%	2.26	71.1	100%	1.576	46	36%
Cobalt	DISS	µg/L	100%	0.90	33.7	100%	0.9483	28	16%
Copper	DISS	µg/L	100%	24.5	723.4	100%	13.18	373	48%
Mercury	DISS	µg/L	50%	---	---	58%	0.00546	0.2	---
Molybdenum	DISS	µg/L	100%	1.6	46.8	100%	1.553	42.3	10%
Nickel	DISS	µg/L	100%	5.8	190.9	100%	5.055	147.6	23%

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
Vanadium	DISS	µg/L	90%	0.6	18.2	100%	0.579	15	15%
Zinc	DISS	µg/L	100%	23.0	684.9	100%	27.8	802	-17%
Iron	DISS	µg/L	100%	720.1	20605	100%	443.8	12187	41%
Manganese	DISS	µg/L	100%	43.7	1417	100%	50.13	1425	-1%
Silver	DISS	µg/L	100%	0.1	1.8	100%	0.0301	1	51%
Titanium	DISS	µg/L	100%	1.9	58	100%	1.217	32	44%
Zirconium	DISS	µg/L	100%	0.6	18	100%	0.371	10	45%
Cadmium	TOT	µg/L	100%	0.2	5.9	100%	0.041	1.2	81%
Chromium	TOT	µg/L	100%	4.9	149	100%	2.269	66.2	56%
Cobalt	TOT	µg/L	100%	1.2	42	100%	0.9728	29.3	30%
Copper	TOT	µg/L	100%	48.0	1416	100%	17.26	489.6	65%
Mercury	TOT	µg/L	0%	---	---	50%	---	---	---
Molybdenum	TOT	µg/L	100%	2.88	85	100%	1.854	51.3	40%
Nickel	TOT	µg/L	100%	12	378	100%	6.213	181.1	52%
Zinc	TOT	µg/L	100%	114	3327	100%	31.26	900.8	73%
Iron	TOT	µg/L	100%	2213	63465	100%	763.4	20847	67%
Manganese	TOT	µg/L	100%	66	2075	100%	54.03	1550	25%
Silver	TOT	µg/L	100%	0.07	2	100%	0.044	1.3	39%
1,1,1,2-Tetrachloroethane	TOT	µg/L	0%	---	---	0%	---	---	---
Dichlorodifluoromethane	TOT	µg/L	0%	---	---	0%	---	---	---
Nitrobenzene	TOT	µg/L	0%	---	---	0%	---	---	---
N-nitrosodimethylamine	TOT	µg/L	0%	---	---	0%	---	---	---
N-Nitrosodi-N-Propylamine	TOT	µg/L	8%	---	---	0%	---	---	---
Benzene	TOT	µg/L	0%	---	---	0%	---	---	---
Ethylbenzene	TOT	µg/L	42%	---	---	0%	---	---	---
Toluene	TOT	µg/L	92%	1.95	58	8%	---	---	---
Xylenes	TOT	µg/L	33%	---	---	0%	---	---	---
Acrolein	TOT	µg/L	0%	---	---	0%	---	---	---
1,2,3,4-Tetrachlorobenzene	TOT	ng/L	50%	---	---	0%	---	---	---
1,3,5-Trichlorobenzene	TOT	ng/L	25%	---	---	0%	---	---	---
1,4-Dioxane	TOT	µg/L	25%	---	---	50%	---	---	---
1,7-Dimethylxanthine	TOT	ng/L	100%	33200.00	776	100%	3493	79	90%
Acrolein	TOT	µg/L	0%	---	---	0%	---	---	---
Acrylonitrile	TOT	µg/L	0%	---	---	0%	---	---	---
Delta-Hch Or Delta-Bhc	TOT	ng/L	0%	---	---	0%	---	---	---

Appendix B5, cont'd

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
Dibromomethane	TOT	µg/L	0%	---	---	0%	---	---	---
Pentachlorobenzene	TOT	ng/L	100%	0.16	0.004	100%	0.1138	0.0032	24%
Perfluorobutanoic acid	TOT	ng/L	100%	28.78	0.7	100%	42.93	0.8	-19%
Tetrachloromethane	TOT	µg/L	0%	---	---	0%	---	---	---
Trans-Chlordane	TOT	ng/L	75%	0.16	0.003	50%	---	---	---
Trans-Nonachlor	TOT	ng/L	75%	0.14	0.003	25%	---	---	---
Tribromomethane	TOT	µg/L	0%	---	---	0%	---	---	---
Trichloromethane	TOT	µg/L	100%	2.86	83.6	25%	---	---	---
1,2-diphenylhydrazine	TOT	µg/L	0%	---	---	0%	---	---	---
2,4-dinitrotoluene	TOT	µg/L	0%	---	---	0%	---	---	---
2,6-dinitrotoluene	TOT	µg/L	0%	---	---	0%	---	---	---
3,3-dichlorobenzidine	TOT	µg/L	0%	---	---	0%	---	---	---
4-Bromophenyl Phenyl Ether	TOT	µg/L	0%	---	---	0%	---	---	---
4-Chlorophenyl Phenyl Ether	TOT	µg/L	0%	---	---	0%	---	---	---
Hexachlorocyclopentadiene	TOT	µg/L	0%	---	---	0%	---	---	---
Hexachloroethane	TOT	µg/L	0%	---	---	0%	---	---	---
Alpha-Terpineol	TOT	µg/L	100%	8.27	245	0%	---	---	---
1,1,1-trichloroethane	TOT	µg/L	0%	---	---	0%	---	---	---
1,1,2,2-tetrachloroethane	TOT	µg/L	0%	---	---	0%	---	---	---
1,1,2-trichloroethane	TOT	µg/L	0%	---	---	0%	---	---	---
1,1-dichloroethane	TOT	µg/L	0%	---	---	0%	---	---	---
1,1-dichloroethene	TOT	µg/L	0%	---	---	0%	---	---	---
1,2,3-Trichlorobenzene	TOT	ng/L	25%	---	---	25%	---	---	---
1,2,4,5-/1,2,3,5-Tetrachlorobenzene	TOT	ng/L	25%	---	---	0%	---	---	---
1,2,4-trichlorobenzene	TOT	µg/L	0%	---	---	0%	---	---	---
1,2-dibromoethane	TOT	µg/L	0%	---	---	0%	---	---	---
1,2-dichlorobenzene	TOT	ng/L	0%	---	---	0%	---	---	---
1,2-dichloroethane	TOT	µg/L	0%	---	---	0%	---	---	---
1,2-dichloropropane	TOT	µg/L	0%	---	---	0%	---	---	---
1,3-dichlorobenzene	TOT	µg/L	0%	---	---	0%	---	---	---
1,4-dichlorobenzene	TOT	µg/L	0%	---	---	0%	---	---	---
Bromodichloromethane	TOT	µg/L	0%	---	---	0%	---	---	---
Bromomethane	TOT	µg/L	0%	---	---	0%	---	---	---
Chlorobenzene	TOT	µg/L	0%	---	---	0%	---	---	---

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
Chlorodibromomethane	TOT	µg/L	0%	---	---	0%	---	---	---
Chloroethane	TOT	µg/L	0%	---	---	0%	---	---	---
Chloroethene	TOT	µg/L	0%	---	---	0%	---	---	---
Chloromethane	TOT	µg/L	0%	---	---	0%	---	---	---
Cis-1,2-Dichloroethene	TOT	µg/L	0%	---	---	0%	---	---	---
Cis-1,3-dichloropropene	TOT	µg/L	0%	---	---	0%	---	---	---
Hexachlorobutadiene	TOT	ng/L	0%	---	---	0%	---	---	---
M & P Xylenes	TOT	µg/L	33%	---	---	0%	---	---	---
Methyl Ethyl Ketone	TOT	µg/L	0%	---	---	0%	---	---	---
Methyl Tertiary Butyl Ether	TOT	µg/L	0%	---	---	0%	---	---	---
O-Xylene	TOT	µg/L	0%	---	---	0%	---	---	---
Styrene	TOT	µg/L	50%	---	---	8%	---	---	---
Tetrachloroethene	TOT	µg/L	0%	---	---	0%	---	---	---
Trans-1,2-Dichloroethene	TOT	µg/L	0%	---	---	0%	---	---	---
Trans-1,3-dichloropropene	TOT	µg/L	0%	---	---	0%	---	---	---
Trichloroethene	TOT	µg/L	0%	---	---	0%	---	---	---
Trichlorofluoromethane	TOT	µg/L	0%	---	---	0%	---	---	---
17 beta-Estradiol 3-benzoate	TOT	ng/L	0%	---	---	0%	---	---	---
Allyl Trenbolone	TOT	ng/L	25%	---	---	0%	---	---	---
Androstenedione	TOT	ng/L	100%	170.10	4.5	100%	2.49	0.1	99%
Androsterone	TOT	ng/L	25%	---	---	25%	---	---	---
Desogestrel	TOT	ng/L	25%	---	---	0%	---	---	---
Mestranol	TOT	ng/L	0%	---	---	0%	---	---	---
Norethindrone	TOT	ng/L	0%	---	---	0%	---	---	---
Norgestrel	TOT	ng/L	50%	---	---	0%	---	---	---
Progesterone	TOT	ng/L	100%	24.58	0.6	100%	1.408	0.04	94%
Testosterone	TOT	ng/L	100%	65.20	1.6	25%	---	---	---
Total Phenols	TOT	mg/L	92%	0.04	1221	83%	0	101.4	92%
2,4 + 2,5 Dichlorophenol	TOT	µg/L	0%	---	---	0%	---	---	---
2-Chlorophenol	TOT	µg/L	0%	---	---	0%	---	---	---
4-Chloro-3-Methylphenol	TOT	µg/L	0%	---	---	0%	---	---	---
Pentachlorophenol	TOT	µg/L	0%	---	---	0%	---	---	---
2,4-dimethylphenol	TOT	µg/L	0%	---	---	0%	---	---	---
2,4-dinitrophenol	TOT	µg/L	8%	---	---	0%	---	---	---
2-Methyl-4,6-Dinitrophenol	TOT	µg/L	0%	---	---	0%	---	---	---

Appendix B5, cont'd

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
2-Nitrophenol	TOT	µg/L	0%	---	---	0%	---	---	---
Phenol	TOT	µg/L	100%	11.69	331	0%	---	---	---
2,4,6-trichlorophenol	TOT	µg/L	0%	---	---	0%	---	---	---
17 alpha-Dihydroequilin	TOT	ng/L	50%	---	---	0%	---	---	---
17 alpha-Estradiol	TOT	ng/L	25%	---	---	25%	---	---	---
17 alpha-Ethinyl-Estradiol	TOT	ng/L	0%	---	---	0%	---	---	---
17 beta-Estradiol	TOT	ng/L	100%	22.40	0.5	0%	---	---	---
Equilenin	TOT	ng/L	0%	---	---	0%	---	---	---
Equilin	TOT	ng/L	0%	---	---	0%	---	---	---
Estriol	TOT	ng/L	100%	238.30	5.8	0%	---	---	---
Estrone	TOT	ng/L	100%	51.95	1.2	50%	---	---	---
4-Nitrophenol	TOT	µg/L	0%	---	---	0%	---	---	---
4-n-Octylphenol	TOT	ng/L	0%	---	---	0%	---	---	---
4-Nonylphenol Diethoxylates	TOT	ng/L	100%	1016.00	24	75%	115	3.3	86%
4-Nonylphenol Monoethoxylates	TOT	ng/L	100%	3935.00	87	100%	810	18.0	79%
Np	TOT	ng/L	100%	1379.00	30.5	100%	333.3	7.1	77%
1-Methylphenanthrene	TOT	ng/L	100%	15.24	0.3	100%	4.463	0.05	82%
2,3,5-trimethylnaphthalene	TOT	ng/L	100%	33.93	0.5	100%	7.415	0.1	85%
2,6-dimethylnaphthalene	TOT	ng/L	100%	53.38	0.9	100%	5	0.1	95%
2-Chloronaphthalene	TOT	µg/L	0%	---	---	0%	---	---	---
2-Methylnaphthalene	TOT	ng/L	100%	34.05	0.7	25%	---	---	---
Acenaphthene	TOT	ng/L	92%	39.82	1.0	75%	6.74	0.2	83%
Acenaphthylene	TOT	ng/L	42%	---	---	0%	---	---	---
Anthracene	TOT	ng/L	92%	7.05	0.2	33%	---	---	---
Benzo(B)Fluoranthene + Benzo(J)Fluoranthene	TOT	µg/L	83%	0.05	1.7	17%	---	---	---
Benzo(K)Fluoranthene	TOT	µg/L	67%	0.03	1.0	0%	---	---	---
Benzo[a]anthracene	TOT	ng/L	92%	7.21	0.1	8%	---	---	---
Benzo[a]pyrene	TOT	ng/L	92%	8.46	0.2	8%	---	---	---
Benzo[b]fluoranthene	TOT	ng/L	83%	6.88	0.1	8%	---	---	---
Benzo[e]pyrene	TOT	ng/L	100%	20.40	0.4	100%	1.498	0.03	93%
Benzo[ghi]perylene	TOT	ng/L	17%	---	---	0%	---	---	---
Benzo[J,K]Fluoranthenes	TOT	ng/L	100%	21.35	0.5	100%	1.005	0.02	95%
Chrysene	TOT	ng/L	92%	8.92	0.2	0%	---	---	---
Dibenzo(a,h)anthracene	TOT	ng/L	8%	---	---	0%	---	---	---

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
Dibenzothiophene	TOT	ng/L	100%	27.35	0.6	100%	3.678	0.1	86%
Fluoranthene	TOT	ng/L	100%	38.10	0.8	92%	5.11	0.1	86%
Fluorene	TOT	ng/L	92%	22.45	0.5	92%	3.748	0.1	85%
High Molecular Weight PAHs	TOT	µg/L	100%	0.46	14	100%	0.047	1.3	91%
Indeno(1,2,3-C,D)Pyrene	TOT	ng/L	17%	---	---	0%	---	---	---
Low Molecular Weight PAHs	TOT	µg/L	100%	0.84	26	100%	0	3.4	87%
Naphthalene	TOT	ng/L	100%	55.20	1.2	83%	3.75	0.1	93%
Perylene	TOT	ng/L	100%	6.23	0.1	75%	0.383	0.01	94%
Phenanthrene	TOT	ng/L	100%	68.44	1.4	100%	5.984	0.13	90%
Pyrene	TOT	ng/L	100%	28.91	0.6	100%	5.5	0.10	84%
Quinoline	TOT	µg/L	0%	---	---	0%	---	---	---
Total PAH	TOT	µg/L	100%	1.30	41	100%	0.17	4.7	88%
Pbde 10	TOT	pg/L	0%	---	---	25%	---	---	---
Pbde 100	TOT	pg/L	100%	3258.00	0.1	100%	785.5	0.0201	74%
Pbde 105	TOT	pg/L	50%	---	---	0%	---	---	---
Pbde 116	TOT	pg/L	25%	---	---	50%	---	---	---
Pbde 119/120	TOT	pg/L	100%	69.28	0.0021	100%	12.51	0.0003	84%
Pbde 12/13	TOT	pg/L	100%	12.07	0.0003	50%	---	---	---
Pbde 126	TOT	pg/L	75%	8.52	0.0002	0%	---	---	---
Pbde 128	TOT	pg/L	25%	---	---	25%	---	---	---
Pbde 138/166	TOT	pg/L	100%	153.00	0.0037	100%	39.23	0.0010	73%
Pbde 140	TOT	pg/L	100%	56.03	0.0012	100%	12.37	0.0003	75%
Pbde 15	TOT	pg/L	100%	32.38	0.0008	100%	5.37	0.0001	83%
Pbde 153	TOT	pg/L	100%	1580.00	0.0376	100%	356.5	0.0092	76%
Pbde 154	TOT	pg/L	100%	1228.00	0.0291	100%	290	0.0074	74%
Pbde 155	TOT	pg/L	100%	124.30	0.0025	100%	22.4	0.0006	77%
Pbde 17/25	TOT	pg/L	100%	136.50	0.0034	100%	61.5	0.0016	54%
Pbde 181	TOT	pg/L	0%	---	---	0%	---	---	---
Pbde 183	TOT	pg/L	100%	264.80	0.0062	100%	66.1	0.0017	72%
Pbde 190	TOT	pg/L	25%	---	---	0%	---	---	---
Pbde 203	TOT	pg/L	100%	106.20	0.0024	100%	51.9	0.0013	46%
Pbde 206	TOT	pg/L	100%	1038.00	0.0268	100%	302	0.0077	71%
Pbde 207	TOT	pg/L	100%	864.30	0.0246	100%	369.3	0.0098	60%
Pbde 208	TOT	pg/L	100%	490.80	0.0128	100%	223	0.0059	54%
Pbde 209	TOT	pg/L	100%	29080.00	0.6333	100%	3263	0.0794	87%

Appendix B5, cont'd

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
Pbde 28/33	TOT	pg/L	100%	289.50	0.0071	100%	77.68	0.0020	72%
Pbde 30	TOT	pg/L	0%	---	---	0%	---	---	---
Pbde 32	TOT	pg/L	50%	---	---	0%	---	---	---
Pbde 35	TOT	pg/L	75%	3.10	0.0001	0%	---	---	---
Pbde 37	TOT	pg/L	100%	9.49	0.0003	50%	---	---	---
Pbde 47	TOT	pg/L	100%	17100.00	0.399	100%	4128	0.10	74%
Pbde 49	TOT	pg/L	100%	641.30	0.015	100%	134.8	0.0035	77%
Pbde 51	TOT	pg/L	100%	60.03	0.001	100%	15.99	0.0004	70%
Pbde 66	TOT	pg/L	100%	364.30	0.009	100%	75.45	0.0020	79%
Pbde 7	TOT	pg/L	100%	10.57	0.0003	100%	3.63	0.0001	69%
Pbde 71	TOT	pg/L	100%	45.60	0.001	100%	14.42	0.0004	70%
Pbde 75	TOT	pg/L	100%	26.38	0.001	100%	5.86	0.0001	75%
Pbde 77	TOT	pg/L	100%	2.88	0.0001	0%	---	---	---
Pbde 79	TOT	pg/L	50%	---	---	25%	---	---	---
Pbde 8/11	TOT	pg/L	75%	8.59	0.0002	25%	---	---	---
Pbde 85	TOT	pg/L	100%	620.30	0.015	100%	150.5	0.0039	74%
Pbde 99	TOT	pg/L	100%	15950.00	0.369	100%	3808	0.097	74%
Decachloro Biphenyl	TOT	pg/L	33%	---	---	33%	---	---	---
PCB 10	TOT	pg/L	100%	5.56	0.0001	75%	2.213	0.0001	58%
PCB 103	TOT	pg/L	75%	2.90	0.0001	25%	---	---	---
PCB 104	TOT	pg/L	75%	1.51	0.00004	25%	---	---	---
PCB 105	TOT	pg/L	100%	78.33	0.002	100%	21.25	0.0005	71%
PCB 106	TOT	pg/L	0%	---	---	0%	---	---	---
PCB 107/124	TOT	pg/L	100%	9.90	0.0002	75%	2.47	0.0001	76%
PCB 109	TOT	pg/L	100%	15.28	0.0004	100%	3.66	0.0001	76%
PCB 11	TOT	pg/L	100%	455.30	0.011	100%	141.8	0.0036	67%
PCB 110/115	TOT	pg/L	100%	268.80	0.006	100%	75.9	0.0019	69%
PCB 111	TOT	pg/L	0%	---	---	0%	---	---	---
PCB 112	TOT	pg/L	0%	---	---	0%	---	---	---
PCB 114	TOT	pg/L	100%	6.27	0.0002	50%	---	---	---
PCB 118	TOT	pg/L	100%	211.30	0.0050	100%	55.15	0.0014	72%
PCB 12/13	TOT	pg/L	100%	19.00	0.0005	100%	6.56	0.0002	62%
PCB 120	TOT	pg/L	0%	---	---	0%	---	---	---
PCB 121	TOT	pg/L	50%	---	---	0%	---	---	---
PCB 122	TOT	pg/L	100%	2.28	0.0001	0%	---	---	---

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
PCB 123	TOT	pg/L	75%	5.06	0.0001	75%	2.56	0.0001	50%
PCB 126	TOT	pg/L	0%	---	---	0%	---	---	---
PCB 127	TOT	pg/L	0%	---	---	0%	---	---	---
PCB 128/166	TOT	pg/L	100%	40.65	0.0009	100%	9.845	0.0002	75%
PCB 129/138/160/163	TOT	pg/L	100%	284.50	0.0066	100%	67.85	0.0016	75%
PCB 130	TOT	pg/L	100%	16.05	0.0004	100%	4.76	0.0001	69%
PCB 131	TOT	pg/L	100%	4.86	0.0001	0%	---	---	---
PCB 132	TOT	pg/L	100%	91.08	0.0021	100%	22.68	0.0005	74%
PCB 133	TOT	pg/L	100%	5.27	0.0001	25%	---	---	---
PCB 134/143	TOT	pg/L	100%	18.75	0.0004	75%	3.06	0.0001	83%
PCB 135/151/154	TOT	pg/L	100%	85.43	0.0020	100%	22.49	0.0005	73%
PCB 136	TOT	pg/L	100%	32.55	0.0007	100%	9.408	0.0002	69%
PCB 137	TOT	pg/L	100%	15.20	0.0004	100%	3.47	0.0001	78%
PCB 139/140	TOT	pg/L	100%	7.94	0.0002	75%	2.68	0.0001	64%
PCB 14	TOT	pg/L	75%	1.63	0.00004	25%	---	---	---
PCB 141	TOT	pg/L	100%	48.05	0.0011	100%	10.44	0.0002	78%
PCB 142	TOT	pg/L	0%	---	---	0%	---	---	---
PCB 144	TOT	pg/L	100%	13.45	0.0003	100%	3.663	0.0001	69%
PCB 145	TOT	pg/L	0%	---	---	0%	---	---	---
PCB 146	TOT	pg/L	100%	37.78	0.0009	100%	11.4	0.0003	70%
PCB 147/149	TOT	pg/L	100%	203.30	0.0047	100%	47.7	0.0012	75%
PCB 148	TOT	pg/L	100%	1.79	0.00004	0%	---	---	---
PCB 15	TOT	pg/L	100%	56.98	0.0014	100%	21.15	0.0006	58%
PCB 150	TOT	pg/L	75%	1.59	0.00004	0%	---	---	---
PCB 152	TOT	pg/L	0%	---	---	0%	---	---	---
PCB 153/168	TOT	pg/L	100%	244.30	0.0059	100%	61.7	0.0015	75%
PCB 155	TOT	pg/L	100%	23.95	0.0006	100%	6.458	0.0002	71%
PCB 156157	TOT	pg/L	100%	34.73	0.0008	100%	8.378	0.0002	75%
PCB 158	TOT	pg/L	100%	27.45	0.0006	100%	5.493	0.0001	79%
PCB 159	TOT	pg/L	50%	---	---	0%	---	---	---
PCB 16	TOT	pg/L	100%	56.08	0.0013	100%	21.08	0.0006	58%
PCB 161	TOT	pg/L	0%	---	---	0%	---	---	---
PCB 162	TOT	pg/L	25%	---	---	0%	---	---	---
PCB 164	TOT	pg/L	100%	16.90	0.0004	100%	3.375	0.0001	80%
PCB 165	TOT	pg/L	0%	---	---	0%	---	---	---

Appendix B5, cont'd

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
PCB 167	TOT	pg/L	100%	10.48	0.0002	100%	3.06	0.0001	71%
PCB 169	TOT	pg/L	0%	---	---	0%	---	---	---
PCB 17	TOT	pg/L	100%	63.25	0.0015	100%	20.7	0.0006	63%
PCB 170	TOT	pg/L	100%	47.60	0.0011	100%	13.28	0.0003	71%
PCB 171/173	TOT	pg/L	100%	15.83	0.0004	100%	4.47	0.0001	72%
PCB 172	TOT	pg/L	100%	8.80	0.0002	50%	---	---	---
PCB 175	TOT	pg/L	75%	2.48	0.0001	0%	---	---	---
PCB 176	TOT	pg/L	100%	8.32	0.0002	50%	---	---	---
PCB 177	TOT	pg/L	100%	29.48	0.0007	100%	7.883	0.0002	73%
PCB 178	TOT	pg/L	100%	14.38	0.0003	100%	3.873	0.0001	72%
PCB 179	TOT	pg/L	100%	26.95	0.0006	100%	7.15	0.0002	73%
PCB 18/30	TOT	pg/L	100%	114.10	0.0028	100%	42.85	0.0012	58%
PCB 180/193	TOT	pg/L	100%	122.30	0.0029	100%	33.15	0.0008	72%
PCB 181	TOT	pg/L	25%	---	---	0%	---	---	---
PCB 182	TOT	pg/L	50%	---	---	0%	---	---	---
PCB 183/185	TOT	pg/L	100%	36.50	0.0009	100%	8.898	0.0002	75%
PCB 184	TOT	pg/L	100%	38.48	0.0009	100%	10.61	0.0003	70%
PCB 186	TOT	pg/L	0%	---	---	0%	---	---	---
PCB 187	TOT	pg/L	100%	66.65	0.0016	100%	19.43	0.0005	71%
PCB 188	TOT	pg/L	25%	---	---	0%	---	---	---
PCB 189	TOT	pg/L	75%	2.11	0.0001	0%	---	---	---
PCB 19	TOT	pg/L	100%	37.05	0.0010	100%	10.19	0.0003	71%
PCB 190	TOT	pg/L	75%	8.24	0.0002	100%	2.248	0.0001	69%
PCB 191	TOT	pg/L	75%	2.16	0.0001	0%	---	---	---
PCB 192	TOT	pg/L	0%	---	---	0%	---	---	---
PCB 194	TOT	pg/L	100%	27.33	0.0007	100%	8.503	0.0002	70%
PCB 195	TOT	pg/L	100%	8.66	0.0002	100%	2.762	0.0001	66%
PCB 196	TOT	pg/L	100%	13.18	0.0003	100%	3.805	0.0001	69%
PCB 197/200	TOT	pg/L	100%	6.09	0.0001	100%	2.337	0.0001	64%
PCB 198/199	TOT	pg/L	100%	32.95	0.0008	100%	10.67	0.0003	66%
PCB 2	TOT	pg/L	100%	12.06	0.0003	100%	7.625	0.0002	32%
PCB 20/28	TOT	pg/L	100%	200.00	0.0048	100%	55.65	0.0015	69%
PCB 201	TOT	pg/L	100%	4.24	0.0001	50%	---	---	---
PCB 202	TOT	pg/L	100%	10.61	0.0003	100%	3.01	0.0001	73%
PCB 203	TOT	pg/L	100%	17.70	0.0004	100%	5.68	0.0001	68%

Appendix B5, cont'd

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
PCB 204	TOT	pg/L	75%	1.66	0.00005	0%	---	---	---
PCB 205	TOT	pg/L	75%	1.25	0.00003	0%	---	---	---
PCB 206	TOT	pg/L	100%	27.83	0.0007	100%	7.403	0.0002	73%
PCB 207	TOT	pg/L	100%	3.69	0.0001	50%	---	---	---
PCB 208	TOT	pg/L	100%	10.17	0.0003	100%	3.55	0.0001	67%
PCB 209	TOT	pg/L	100%	27.20	0.0007	100%	8.233	0.0002	71%
PCB 21/33	TOT	pg/L	100%	120.00	0.0028	100%	24.35	0.0006	78%
PCB 22	TOT	pg/L	100%	77.73	0.0018	100%	21.28	0.0006	70%
PCB 23	TOT	pg/L	25%	---	---	25%	---	---	---
PCB 24	TOT	pg/L	100%	2.18	0.0001	0%	---	---	---
PCB 25	TOT	pg/L	100%	37.70	0.0010	100%	7.68	0.0002	78%
PCB 26/29	TOT	pg/L	100%	54.68	0.0014	100%	13.78	0.0004	73%
PCB 27	TOT	pg/L	100%	30.43	0.0008	100%	8.883	0.0002	69%
PCB 3	TOT	pg/L	100%	23.10	0.0006	100%	11.65	0.0003	45%
PCB 31	TOT	pg/L	100%	180.50	0.0043	100%	53.68	0.0014	67%
PCB 32	TOT	pg/L	100%	51.03	0.0012	100%	15.15	0.0004	67%
PCB 34	TOT	pg/L	50%	---	---	25%	---	---	---
PCB 35	TOT	pg/L	100%	22.35	0.0005	100%	4.82	0.0001	76%
PCB 36	TOT	pg/L	100%	5.22	0.0001	0%	---	---	---
PCB 37	TOT	pg/L	100%	49.23	0.0012	100%	13.68	0.0004	69%
PCB 38	TOT	pg/L	0%	---	---	0%	---	---	---
PCB 4	TOT	pg/L	100%	177.30	0.0048	100%	56.1	0.0016	67%
PCB 40/41/71	TOT	pg/L	100%	85.53	0.0020	100%	25.63	0.0007	67%
PCB 42	TOT	pg/L	100%	47.38	0.0011	100%	14.49	0.0004	65%
PCB 43	TOT	pg/L	100%	5.99	0.0001	75%	2.619	0.0001	48%
PCB 44/47/65	TOT	pg/L	100%	296.30	0.0071	100%	112.6	0.0030	57%
PCB 46	TOT	pg/L	100%	13.93	0.0003	100%	3.56	0.0001	72%
PCB 48	TOT	pg/L	100%	28.45	0.0007	100%	9.058	0.0002	63%
PCB 49/69	TOT	pg/L	100%	135.30	0.0033	100%	38.18	0.0010	69%
PCB 5	TOT	pg/L	100%	3.65	0.0001	75%	1.648	0.00004	55%
PCB 50/53	TOT	pg/L	100%	43.20	0.0011	100%	11.49	0.0003	71%
PCB 52	TOT	pg/L	100%	294.80	0.0071	100%	101.9	0.0027	61%
PCB 54	TOT	pg/L	100%	3.22	0.0001	50%	---	---	---
PCB 55	TOT	pg/L	75%	2.35	0.0001	0%	---	---	---
PCB 56	TOT	pg/L	100%	63.05	0.0015	100%	17.77	0.0005	69%

Appendix B5, cont'd

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
PCB 57	TOT	pg/L	75%	3.54	0.0000	25%	---	---	---
PCB 58	TOT	pg/L	25%	---	---	0%	---	---	---
PCB 59/62/75	TOT	pg/L	100%	13.88	0.0003	100%	4.648	0.0001	63%
PCB 6	TOT	pg/L	100%	39.25	0.0010	100%	6.455	0.0002	84%
PCB 60	TOT	pg/L	100%	36.35	0.0008	100%	9.82	0.0003	70%
PCB 61/70/74/76	TOT	pg/L	100%	301.30	0.0071	100%	80.7	0.0021	71%
PCB 63	TOT	pg/L	100%	6.77	0.0002	100%	1.641	0.00004	74%
PCB 64	TOT	pg/L	100%	69.33	0.0016	100%	21.28	0.0006	66%
PCB 66	TOT	pg/L	100%	130.90	0.0031	100%	33.9	0.0009	72%
PCB 67	TOT	pg/L	75%	4.70	0.0001	50%	---	---	---
PCB 68	TOT	pg/L	100%	25.28	0.0006	100%	12.03	0.0003	46%
PCB 7	TOT	pg/L	100%	8.99	0.0002	100%	6.105	0.0001	47%
PCB 72	TOT	pg/L	50%	---	---	25%	---	---	---
PCB 73	TOT	pg/L	25%	---	---	0%	---	---	---
PCB 77	TOT	pg/L	100%	12.80	0.0003	100%	3.6	0.0001	69%
PCB 78	TOT	pg/L	0%	---	---	0%	---	---	---
PCB 79	TOT	pg/L	100%	2.95	0.0001	50%	---	---	---
PCB 8	TOT	pg/L	100%	109.20	0.0028	100%	18.55	0.0005	83%
PCB 80	TOT	pg/L	25%	---	---	0%	---	---	---
PCB 81	TOT	pg/L	50%	---	---	0%	---	---	---
PCB 82	TOT	pg/L	100%	28.48	0.0007	100%	7.885	0.0002	70%
PCB 83/99	TOT	pg/L	100%	130.80	0.0031	100%	40.03	0.0010	67%
PCB 84	TOT	pg/L	100%	68.28	0.0016	100%	20	0.0005	68%
PCB 85/116/117	TOT	pg/L	100%	42.13	0.0010	100%	11.86	0.0003	69%
PCB 86/87/97/108/119/125	TOT	pg/L	100%	173.50	0.0041	100%	49.33	0.0012	70%
PCB 88/91	TOT	pg/L	100%	35.68	0.0008	100%	9.775	0.0002	70%
PCB 89	TOT	pg/L	75%	2.67	0.0001	0%	---	---	---
PCB 9	TOT	pg/L	100%	7.32	0.0002	100%	2.383	0.0001	65%
PCB 90/101/113	TOT	pg/L	100%	258.80	0.0063	100%	75.25	0.0019	69%
PCB 92	TOT	pg/L	100%	49.63	0.0012	100%	14.24	0.0004	70%
PCB 93/95/98/100/102	TOT	pg/L	100%	232.30	0.0053	100%	66.83	0.0017	68%
PCB 94	TOT	pg/L	75%	2.27	0.0001	0%	---	---	---
PCB 96	TOT	pg/L	100%	2.14	0.0000	25%	---	---	---
PCB Teq 3	TOT	pg/L	100%	0.53	0.0000	100%	0.05	0.000001	91%
PCB Teq 4	TOT	pg/L	100%	1.72	0.0000	100%	1.344	0.00003	23%

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
PCBs Total	TOT	pg/L	100%	7128.00	0.2	100%	1985	0.0511	70%
Dichloro Biphenyls	TOT	pg/L	100%	812.70	0.02	100%	265.3	0.007	64%
Heptachloro Biphenyls	TOT	pg/L	100%	433.70	0.010	100%	111.3	0.0026	72%
Hexachloro Biphenyls	TOT	pg/L	100%	1153.00	0.025	100%	298	0.0068	73%
Monochloro Biphenyls	TOT	pg/L	100%	73.50	0.0	100%	31.33	0.001	57%
Nonachloro Biphenyls	TOT	pg/L	100%	36.53	0.001	100%	8.16	0.00020	78%
Octachloro Biphenyls	TOT	pg/L	100%	76.20	0.0015	100%	16.5	0.0	80%
PCB	TOT	pg/L	100%	68.43	0.002	100%	20.59	0.0005	71%
PCB174	TOT	pg/L	100%	46.68	0.0011	100%	11.22	0.0003	76%
PCB39	TOT	pg/L	50%	---	---	0%	---	---	---
PCB45/51	TOT	pg/L	100%	55.03	0.001	100%	20.69	0.0006	56%
Pentachloro Biphenyls	TOT	pg/L	100%	1617.00	0.036	100%	452.7	0.0112	69%
Tetrachloro Biphenyls	TOT	pg/L	100%	1620.00	0.037	100%	534	0.012	61%
Trichloro Biphenyls	TOT	pg/L	100%	1073.00	0.025	100%	341.3	0.0	63%
1,2,3,4,6,7,8-HPCDD	TOT	pg/L	100%	24.83	0.00053	100%	2.413	0.00005	91%
1,2,3,4,6,7,8-HPCDF	TOT	pg/L	100%	2.09	0.00005	25%	---	---	---
1,2,3,4,7,8,9-HPCDF	TOT	pg/L	25%	---	---	25%	---	---	---
1,2,3,4,7,8-HXCDD	TOT	pg/L	0%	---	---	25%	---	---	---
1,2,3,4,7,8-HXCDF	TOT	pg/L	25%	---	---	0%	---	---	---
1,2,3,6,7,8-HXCDD	TOT	pg/L	100%	0.94	0.00002	25%	---	---	---
1,2,3,6,7,8-HXCDF	TOT	pg/L	25%	---	---	0%	---	---	---
1,2,3,7,8,9-HXCDD	TOT	pg/L	0%	---	---	0%	---	---	---
1,2,3,7,8,9-HXCDF	TOT	pg/L	25%	---	---	25%	---	---	---
1,2,3,7,8-PECDD	TOT	pg/L	0%	---	---	0%	---	---	---
1,2,3,7,8-PECDF	TOT	pg/L	25%	---	---	25%	---	---	---
2,3,4,6,7,8-HXCDF	TOT	pg/L	0%	---	---	0%	---	---	---
2,3,4,7,8-PECDF	TOT	pg/L	0%	---	---	0%	---	---	---
2,3,7,8-TCDD	TOT	pg/L	0%	---	---	0%	---	---	---
2,3,7,8-TCDF	TOT	pg/L	0%	---	---	0%	---	---	---
OCDD	TOT	pg/L	100%	151.00	0.0037	100%	16.7	0.0004	90%
OCDF	TOT	pg/L	100%	4.14	0.0001	50%	---	---	---
Penta-Dioxins	TOT	pg/L	75%	2.01	0.00003	0%	---	---	---
Penta-Furans	TOT	pg/L	25%	---	---	0%	---	---	---
Tetra-Dioxins	TOT	pg/L	0%	---	---	0%	---	---	---
Tetra-Furans	TOT	pg/L	0%	---	---	0%	---	---	---

Appendix B5, cont'd

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
2,4-DDD	TOT	ng/L	100%	0.48	0.008	100%	0.17	0.003	57%
2,4-DDE	TOT	ng/L	0%	---	---	0%	---	---	---
2,4-DDT	TOT	ng/L	75%	0.14	0.003	25%	---	---	---
4,4-DDD	TOT	ng/L	100%	0.12	0.003	25%	---	---	---
4,4-DDE	TOT	ng/L	100%	0.84	0.019	100%	0.2845	0.007	64%
4,4-DDT	TOT	ng/L	75%	0.33	0.007	0%	---	---	---
ABHC	TOT	ng/L	50%	---	---	75%	0	0.002	---
Aldrin	TOT	ng/L	0%	---	---	0%	---	---	---
Alpha Chlordane	TOT	ng/L	75%	0.14	0.003	25%	---	---	---
Beta-Endosulfan	TOT	ng/L	100%	0.46	0.01	100%	0.759	0.02	-69%
Beta-Hch or Beta-Bhc	TOT	ng/L	100%	0.17	0.004	100%	0.153	0.004	-4%
Bis(2-Chloroethoxy)Methane	TOT	µg/L	0%	---	---	0%	---	---	---
Bis(2-Chloroethyl)Ether	TOT	µg/L	0%	---	---	0%	---	---	---
Bis(2-Chloroisopropyl)Ether	TOT	µg/L	0%	---	---	0%	---	---	---
Cis-Nonachlor	TOT	ng/L	25%	---	---	0%	---	---	---
Dieldrin	TOT	ng/L	100%	0.70	0.02	100%	0.3	0.008	54%
Endosulfan Sulfate	TOT	ng/L	0%	---	---	0%	---	---	---
Endrin	TOT	ng/L	0%	---	---	0%	---	---	---
Endrin Aldehyde	TOT	ng/L	0%	---	---	0%	---	---	---
HCH, Gamma	TOT	ng/L	100%	0.57	0.015	100%	0.3898	0.01	29%
Heptachlor	TOT	ng/L	0%	---	---	0%	---	---	---
Heptachlor Epoxide	TOT	ng/L	25%	---	---	0%	---	---	---
Hexachlorobenzene	TOT	ng/L	100%	0.24	0.006	100%	0.132	0.0039	35%
Methoxyclor	TOT	ng/L	50%	---	---	0%	---	---	---
Mirex	TOT	ng/L	0%	---	---	0%	---	---	---
Octachlorostyrene	TOT	ng/L	0%	---	---	0%	---	---	---
Oxychlordane	TOT	ng/L	0%	---	---	50%	---	---	---
3:3 FTCA	TOT	ng/L	0%	---	---	25%	---	---	---
4:2 FTS	TOT	ng/L	0%	---	---	0%	---	---	---
5:3 FTCA	TOT	ng/L	100%	283.80	6.5	100%	40.4	1.0	85%
6:2 FTS	TOT	ng/L	50%	---	---	100%	3.66	0.1	---
7:3 FTCA	TOT	ng/L	25%	---	---	0%	---	---	---
8:2 FTS	TOT	ng/L	0%	---	---	0%	---	---	---
ADONA	TOT	ng/L	0%	---	---	0%	---	---	---
HFPO-DA	TOT	ng/L	0%	---	---	0%	---	---	---

Appendix B5, cont'd

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
MeFOSAA	TOT	ng/L	100%	4.52	0.1	100%	2	0.1	57%
N-EtFOSA	TOT	ng/L	0%	---	---	0%	---	---	---
N-EtFOSAA	TOT	ng/L	100%	3.04	0.1	100%	1.085	0.027	63%
N-EtFOSE	TOT	ng/L	0%	---	---	0%	---	---	---
NFDHA	TOT	ng/L	0%	---	---	0%	---	---	---
N-MeFOSA	TOT	ng/L	25%	---	---	25%	---	---	---
N-MeFOSE	TOT	ng/L	0%	---	---	0%	---	---	---
PFBS	TOT	ng/L	100%	19.43	0.5	100%	19.33	0.5	8%
PFDA	TOT	ng/L	75%	2.01	0.1	100%	1.36	0.03	38%
PFDoA	TOT	ng/L	0%	---	---	0%	---	---	---
PFDoS	TOT	ng/L	25%	---	---	0%	---	---	---
PFDS	TOT	ng/L	25%	---	---	0%	---	---	---
PFEESA	TOT	ng/L	0%	---	---	0%	---	---	---
PFHpA	TOT	ng/L	100%	8.00	0.2	100%	9.4	0.2	9%
PFHpS	TOT	ng/L	25%	---	---	0%	---	---	---
PFHxA	TOT	ng/L	100%	42.35	1.1	100%	49.95	1.1	-3%
PFHxS	TOT	ng/L	100%	14.49	0.4	100%	12.66	0.3	17%
PFMBA	TOT	ng/L	0%	---	---	0%	---	---	---
PFMPA	TOT	ng/L	0%	---	---	0%	---	---	---
PFNA	TOT	ng/L	75%	2.21	0.1	100%	1.57	0.03	44%
PFNS	TOT	ng/L	0%	---	---	0%	---	---	---
PFOA	TOT	ng/L	100%	22.10	0.6	100%	22	0.5	7%
PFOS	TOT	ng/L	100%	8.17	0.2	100%	4.42	0.1	49%
PFOSA	TOT	ng/L	0%	---	---	0%	---	---	---
PFPeA	TOT	ng/L	100%	21.80	0.5	100%	34.13	0.7	-23%
PFPeS	TOT	ng/L	0%	---	---	50%	---	---	---
PFTeDA	TOT	ng/L	0%	---	---	0%	---	---	---
PFTrDA	TOT	ng/L	0%	---	---	0%	---	---	---
PFUnA	TOT	ng/L	0%	---	---	0%	---	---	---
Bis(2-Ethylhexyl)Phthalate	TOT	µg/L	92%	8.29	247	0%	---	---	---
Butylbenzyl Phthalate	TOT	µg/L	0%	---	---	0%	---	---	---
Diethyl Phthalate	TOT	µg/L	100%	1.52	41	33%	---	---	---
Dimethyl Phthalate	TOT	µg/L	8%	---	---	0%	---	---	---
Di-N-Butyl Phthalate	TOT	µg/L	50%	---	---	33%	---	---	---
Di-N-Octyl Phthalate	TOT	µg/L	8%	---	---	0%	---	---	---

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
2-Hydroxy-Ibuprofen	TOT	ng/L	100%	23870.00	394	100%	2653	48.1	88%
Acetaminophen	TOT	ng/L	100%	150500.00	3487	100%	26.53	0.6	100%
Azithromycin	TOT	ng/L	100%	261.30	5.8	100%	248.5	5.7	2%
Bisphenol A	TOT	ng/L	100%	4381.00	117	100%	477	13.6	88%
Caffeine	TOT	ng/L	100%	95800.00	2185	100%	3163	69.7	97%
Carbadox	TOT	ng/L	25%	---	---	0%	---	---	---
Carbamazepine	TOT	ng/L	100%	574.30	12.9	100%	516.8	11.2	13%
Cefotaxime	TOT	ng/L	0%	---	---	0%	---	---	---
Ciprofloxacin	TOT	ng/L	100%	275.00	6.3	100%	161	3.7	41%
Clarithromycin	TOT	ng/L	100%	165.30	4.0	100%	145.5	3.3	16%
Clinafloxacin	TOT	ng/L	0%	---	---	0%	---	---	---
Cloxacillin	TOT	ng/L	0%	---	---	0%	---	---	---
Dehydronifedipine	TOT	ng/L	100%	2.14	0.1	100%	3.135	0.1	-39%
Digoxigenin	TOT	ng/L	0%	---	---	0%	---	---	---
Digoxin	TOT	ng/L	0%	---	---	0%	---	---	---
Diltiazem	TOT	ng/L	100%	239.30	5.7	100%	194	4.5	20%
Diphenhydramine	TOT	ng/L	100%	837.30	20	100%	700	16.5	19%
Enrofloxacin	TOT	ng/L	0%	---	---	50%	---	---	---
Erythromycin-H2O	TOT	ng/L	75%	10.05	0.3	100%	9.733	0.3	4%
Flumequine	TOT	ng/L	0%	---	---	0%	---	---	---
Fluoxetine	TOT	ng/L	100%	33.75	0.8	100%	33.63	0.8	0%
Furosemide	TOT	ng/L	100%	828.00	17.4	100%	398.3	9.4	46%
Gemfibrozil	TOT	ng/L	100%	72.33	1.4	100%	48.73	1.1	20%
Glipizide	TOT	ng/L	0%	---	---	0%	---	---	---
Glyburide	TOT	ng/L	100%	4.82	0.1	100%	3.508	0.1	10%
Hydrochlorothiazide	TOT	ng/L	100%	1517.00	29	100%	1225	29.1	-1%
Ibuprofen	TOT	ng/L	100%	17670.00	361	100%	561	12.2	97%
Lincomycin	TOT	ng/L	100%	9.70	0.2	100%	9.235	0.2	11%
Lomefloxacin	TOT	ng/L	0%	---	---	0%	---	---	---
Miconazole	TOT	ng/L	100%	4.42	0.1	100%	2.863	0.1	35%
Naproxen	TOT	ng/L	100%	8367.00	167	100%	1525	35.0	79%
Norfloxacin	TOT	ng/L	0%	---	---	25%	---	---	---
Norgestimate	TOT	ng/L	0%	---	---	0%	---	---	---
Ofloxacin	TOT	ng/L	100%	35.58	0.8	100%	24.48	0.5	32%
Ormetoprim	TOT	ng/L	0%	---	---	0%	---	---	---

	State	Unit	Influent			Effluent			% Removal
			% Freq	Average Concentration	Load kg/year	% Freq	Average Concentration	Load kg/year	
Oxacillin	TOT	ng/L	0%	---	---	0%	---	---	---
Oxolinic Acid	TOT	ng/L	0%	---	---	0%	---	---	---
Penicillin G	TOT	ng/L	25%	---	---	50%	---	---	---
Penicillin V	TOT	ng/L	0%	---	---	0%	---	---	---
Roxithromycin	TOT	ng/L	100%	2.76	0.1	100%	2.07	0.04	25%
Sarafloxacin	TOT	ng/L	0%	---	---	0%	---	---	---
Sulfachloropyridazine	TOT	ng/L	0%	---	---	0%	---	---	---
Sulfadiazine	TOT	ng/L	0%	---	---	0%	---	---	---
Sulfadimethoxine	TOT	ng/L	0%	---	---	0%	---	---	---
Sulfamerazine	TOT	ng/L	50%	---	---	75%	1.56	0.04	---
Sulfamethazine	TOT	ng/L	50%	---	---	75%	1.1	0.03	---
Sulfamethizole	TOT	ng/L	0%	---	---	0%	---	---	---
Sulfamethoxazole	TOT	ng/L	100%	1228.00	29.6	100%	502	11.0	63%
Sulfanilamide	TOT	ng/L	100%	66.30	1.5	100%	94.63	1.9	-34%
Sulfathiazole	TOT	ng/L	25%	---	---	0%	---	---	---
Thiabendazole	TOT	ng/L	100%	29.35	0.7	100%	28.45	0.7	5%
Triclocarban	TOT	ng/L	100%	1.46	0.02	100%	1.36	0.0	-32%
Triclosan	TOT	ng/L	100%	26.63	0.5	100%	15.1	0.4	28%
Trimethoprim	TOT	ng/L	100%	328.00	7.8	100%	227.8	5.3	33%
Tylosin	TOT	ng/L	50%	---	---	100%	3.508	0.1	---
Virginiamycin	TOT	ng/L	0%	---	---	25%	---	---	---
Warfarin	TOT	ng/L	100%	3.40	0.1	100%	3.22	0.1	-14%
11Cl-PF3OUdS	TOT	ng/L	0%	---	---	0%	---	---	---
9Cl-PF3ONS	TOT	ng/L	0%	---	---	0%	---	---	---
HEPTA-DIOXINS	TOT	pg/L	100%	47.10	0.0011	100%	4.14	0.0001	92%
Hepta-Furans	TOT	pg/L	100%	2.96	0.0001	25%	---	---	---
HEXA-DIOXINS	TOT	pg/L	100%	8.24	0.0002	25%	---	---	---
HEXA-FURANS	TOT	pg/L	50%	---	---	0%	---	---	---

Appendix B6 Acute Toxicity Test Results and Bench Sheets

Acute Toxicity Test Results and Bench Sheets available upon request
Contact: CRD's Environmental Monitoring Program, 250.360.3261

Appendix B7 Chronic Toxicity Test Results and Bench Sheets

Chronic Toxicity Test Results and Bench Sheets available upon request
Contact: CRD's Environmental Monitoring Program, 250.360.3261

APPENDIX C
2023 SURFACE WATER MONITORING

Appendix C1 Parameter List

Parameter	Edge of IDZ (3 depths top, middle, bottom)*	Surface Water (1 m depth)
CONVENTIONAL VARIABLES		
conductivity	x	
enterococci	x	x
fecal coliform	x	x
hardness (as $CaCO_3$)	x	
ammonia (NH^3)	x	
total Kjeldahl nitrogen	x*	
nitrate	x	
nitrite	x	
nitrogen, total	x	
oil & grease, mineral	x*	
oil & grease, total	x*	
organic carbon, total	x*	
pH	x	
phosphate, dissolved	x*	
phosphate, total	x*	
salinity	x	
sulphate	x	
sulphide	x	
suspended solids, total	x	
temperature	x	
CTD parameters	x	
METALS TOTAL		
aluminum	x	
antimony	x	
arsenic	x	
barium	x	
beryllium	x	
bismuth	x	
cadmium	x	
calcium	x	
chromium	x	
chromium VI	x	
cobalt	x	
copper	x	
iron	x	
lead	x	
lithium	x	
magnesium	x	
manganese	x	
mercury	x	
molybdenum	x	
nickel	x	
phosphorus	x	
potassium	x	
selenium	x	
silver	x	
sodium	x	

Appendix C1, cont'd

Parameter	Edge of IDZ (3 depths top, middle, bottom)*	Surface Water (1 m depth)
strontium	x	
thallium	x	
tin	x	
titanium	x	
vanadium	x	
zinc	x	

Notes: IDZ – initial dilution zone, *Top=5 m depth, middle=in predicted plume, bottom=5 m off bottom, x* sampled once in each 5 in 30 sample quarter.

Appendix C2   Surface Water Stations

McLoughlin Point	Latitude 48º	Longitude 123º
McL-01	24.299	24.409
McL-14	24.515	24.411
McL-16	24.300	24.085
McL-18	24.083	24.407
McL-20	24.298	24.733
McL-22	24.731	24.412
McL-24	24.606	23.953
McL-26	24.302	23.760
McL-28	23.996	23.948
McL-30	23.867	24.405
McL-32	23.992	24.865
McL-34	24.297	25.057
McL-36	24.603	24.870
Sample D1	Variable location depending on wind and current	
+ four dynamic edge of IDZ stations at 3 depths (5 m, middle of predicted plume and 5 m above bottom depth)		
Macaulay Point	**Latitude 48˚**	**Longitude 123˚**
Mac-01	24.186	24.616
Mac-14	24.402	24.616
Mac-16	24.186	24.290
Mac-18	23.970	24.616
Mac-20	24.186	24.941
Mac-22	24.617	24.616
Mac-24	24.491	24.155
Mac-26	24.186	23.965
Mac-28	23.880	24.155
Mac-30	23.754	24.616
Mac-32	23.880	25.076
Mac-34	24.186	25.266
Mac-36	24.491	25.076
+ four dynamic edge of IDZ stations at 3 depths (5 m, middle of predicted plume and 5 m above bottom depth)		
Clover Point	**Latitude 48˚**	**Longitude 123˚**
Clo-01	23.701	20.764
Clo-14	23.916	20.764
Clo-16	23.701	20.438
Clo-18	23.485	20.764
Clo-20	23.701	21.089
Clo-22	24.132	20.764
Clo-24	24.006	20.304
Clo-26	23.701	20.113
Clo-28	23.395	20.304
Clo-30	23.269	20.764
Clo-32	23.395	21.224
Clo-34	23.701	21.414
Clo-36	24.006	21.224
+ four dynamic edge of IDZ stations at 3 depths (5 m, middle of predicted plume and 5 m above bottom depth)		

Appendix C2, cont'd

Reference		
Constance Bank	20.640	19.080
Parry Bay	21.258	30.647

Appendix C3   McLoughlin Point Surface Results 5 Sampling Events in 30 Days - Fecal Coliforms

Fecal Coliforms	Winter						Spring						Summer						Autumn					
	1	2	3	4	5	Geomean	1	2	3	4	5	Geomean	1	2	3	4	5	Geomean	1	2	3	4	5	Geomean
McL-01	2	1	38	1	5	3	71	<1	<1	<1	<1	2	<1	<1	<1	1	1	1	5	2	2	53	2	5
McL-14	1	3	25	3	7	4	20	<1	<1	<1	<1	2	<1	3	<1	3	<1	2	2	1	9	19	8	5
McL-16	11	2	32	2	3	5	<1	<1	<1	<1	1	1	<1	---	<1	2	---	1	<1	<1	5	2	3	2
McL-18	63	3	32	1	78	14	<1	<1	<1	<1	93	2	<1	<1	<1	12	<1	2	3	2	7	500	3	9
McL-20	4	2	26	1	1	3	<43	<1	<1	<2	<4	3	---	<1	<1	54	<1	3	17	7	3	110	5	11
McL-22	3	4	57	4	7	7	<1	<1	1	1	<1	1	<1	<1	<1	<1	<1	1	2	8	2	4	4	3
McL-24	1	5	37	7	3	5	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	5	9	4	8	1	4
McL-26	1	4	10	2	1	2	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	1	2	5	16	2	3
McL-28	<3	8	6	<1	2	3	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	<1	<1	2	1	4	2
McL-30	83	6	42	4	1	10	<1	1	<1	<1	2	1	---	<1	<1	<1	<1	1	2	<1	1	<1	2	1
McL-32	2	3	30	2	4	4	<1	3	1	<1	21	2	<1	<1	<1	<1	<1	1	2	1	2	33	5	4
McL-34	2	3	31	1	2	3	<1	<1	<1	<1	1	1	<1	<1	<1	<1	<1	1	7	5	4	59	3	8
McL-36	2	5	30	4	77	10	58	<1	<1	<1	12	4	<1	2	<1	200	<1	3	<1	3	<1	230	2	4
McL-D1	<40	8	119	3	270	31	22	<1	<1	<1	32	4	<1	<1		240	<1	4	1	4	<5	970	11	12
Ref-PB	<1	<1	<1	1	<1	1	1	<1	2	<1	1	1	<1	<1	<1	<1	<1	1	3	4	3	<1	<1	2
Ref-CB	<1	1	1	<1	<1	1	<1	1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	1	<1	<1	<1	<1	1

Notes: Red shaded cells indicate exceedance to historical BC WQG Geomean of 200 CFU/100 mL, Geomean = Geometric Mean --- denotes sample not taken due to weather issues

Appendix C4 McLoughlin Point Surface Results 5 Sampling Events in 30 Days - Enterococci

Enterococci	Winter						Spring						Summer						Autumn					
	1	2	3	4	5	Geomean	1	2	3	4	5	Geomean	1	2	3	4	5	Geomean	1	2	3	4	5	Geomean
McL-01	1	2	16	<1	2	2	16	<1	<1	<1	<1	2	<1	<1	<1	<1	<1	1	6	1	<1	54	3	4
McL-14	1	1	10	<1	2	2	3	<1	<1	<1	<1	1	<1	<2	<1	1	<1	1	6	<1	<2	10	<3	3
McL-16	4	1	18	<1	2	3	<1	<1	<1	<1	<1	1	<1	---	<1	<1	---	1	1	<1	1	<1	<1	1
McL-18	55	2	19	<1	30	9	<1	<1	<1	<1	49	2	1	<1	<1	6	<1	1	<1	<1	1	160	1	3
McL-20	1	3	27	<1	1	2	8	<1	<1	<1	<1	2	---	1	<1	18	<1	2	5	<1	1	100	2	4
McL-22	2	1	13	1	1	2	1	<1	<1	<1	2	1	<1	<1	<1	<1	<1	1	<1	3	<1	4	3	2
McL-24	1	<1	17	<2	1	2	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	12	2	2	1	3	3
McL-26	1	<1	5	<1	1	1	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<2	1	6	<1	<1	7	4	3
McL-28	4	<7	3	2	1	3	<1	<1	<2	<1	<1	1	<1	<1	<1	<1	<1	1	2	1	<1	<1	1	1
McL-30	46	<1	26	<1	<1	4	<1	<1	<1	<1	2	1	---	<1	<1	<1	<1	1	<1	<1	<1	<1	1	1
McL-32	1	1	9	<1	1	2	<1	<1	<1	<1	21	2	<1	<1	<1	1	<1	1	1	<1	<1	53	1	2
McL-34	<1	1	8	1	27	3	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	2	<1	<1	77	3	3
McL-36	1	4	15	3	1	3	15	<1	<1	<1	14	3	<1	<1	<1	87	<1	2	<1	<1	<1	81	<1	2
McL-D1	29	1	57	<1	115	11	7	<1	<1	<1	5	2	<1	<1	---	100	<1	3	1	2	2	580	<3	6
Ref-PB	<1	<1	<1	1	<1	1	<1	<1	<1	2	<1	1	<1	<1	<1	<1	<1	1	<1	2	<1	4	<1	2
Ref-CB	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	<1	<1	<1	1	<1	1

Notes: Red shaded cells indicate exceedance to Health Canada's Geomean of 35 CFU/100 mL Blue shaded cells indicate exceedance to Health Canada (2012) WQG of 70 CFU/100 mL, Geomean = Geometric Mean. --- not sampled due to weather issues

Appendix C5 McLoughlin Point IDZ Results - 5 Sampling Events in 30 Days - Fecal Coliforms (CFU/100mL)

Fecal Coliforms	Historical BC WQG GeoMean 200 CFU/100 mL						
Winter							**GeoMean**
Station 1	Top	93	9	24	4	130	25
	Middle	98	1	21	<1	51	10
	Bottom	<1	38	11	<1	3	4
Station 2	Top	110	2	37	3	43	16
	Middle	<1	8	29	2	15	6
	Bottom	1	22	39	<1	39	8
Station 3	Top	78	1	11	5	37	11
	Middle	1	2	26	3	45	6
	Bottom	<1	1	9	<1	17	3
Station 4	Top	94	7	46	2	7	13
	Middle	8	2	28	<1	24	6
	Bottom	8	1	7	1	2	3
Ref-CB	Top	1	<1	4	1	4	2
	Middle	<1	<1	2	1	<1	1
	Bottom	<1	<1	2	<1	<1	1
Ref-PB	Top	<1	<1	<1	2	<1	1
	Middle	<1	<1	<1	1	<1	1
	Bottom	<1	<1	<1	2	<1	1
Spring							**GeoMean**
Station 1	Top	12	1	1	<1	35	3
	Middle	59	15	3	83	20	21
	Bottom	<1	7	5	27	12	6
Station 2	Top	3	7	1	<1	77	4
	Middle	43	84	22	<1	1	10
	Bottom	23	64	170	56	1	27
Station 3	Top	150	13	2	<1	88	13
	Middle	28	110	45	38	1	22
	Bottom	15	66	150	43	4	30
Station 4	Top	110	16	<1	1	120	12
	Middle	100	17	180	<1	140	34
	Bottom	35	3	140	<1	1	7
Ref-CB	Top	11	<1	4	<1	1	2
	Middle	4	<1	3	2	1	2
	Bottom	6	1	3	4	1	2
Ref-PB	Top	<1	1	<1	<1	<1	1
	Middle	<1	<1	<1	<1	1	1
	Bottom	<1	1	<1	<1	1	1
Summer							**GeoMean**
Station 1	Top	<1	6	<1	<1	<1	1
	Middle	<1	46	2	3	3	4
	Bottom	<1	73	6	6	80	12
Station 2	Top	4	1	<1	110	<1	3
	Middle	<1	110	2	18	100	13
	Bottom	4	100	1	5	87	11
Station 3	Top	1	<1	<1	160	<1	3
	Middle	<1	22	4	37	56	11
	Bottom	6	62	1	15	120	15

Appendix C5, cont'd

Fecal Coliforms	Historical BC WQG GeoMean 200 CFU/100 mL						
Station 4	Top	1	<1	10	200	<1	5
	Middle	4	<1	8	69	1	5
	Bottom	6	71	<1	23	2	7
Ref-CB	Top	1	1	<1	<1	<1	1
	Middle	<1	1	2	<1	<1	1
	Bottom	<1	1	2	1	4	2
Ref-PB	Top	<1	<1	<1	1	<1	1
	Middle	<1	<1	<1	<1	<1	1
	Bottom	<1	<1	<1	1	<1	1
Autumn							**GeoMean**
Station 1	Top	6	10	5	440	5	15
	Middle	7	2	<1	12	22	5
	Bottom	14	2	<1	<1	6	3
Station 2	Top	1	9	2	460	2	7
	Middle	10	7	<1	180	72	16
	Bottom	11	2	<1	5	73	6
Station 3	Top	2	6	5	390	1	7
	Middle	10	6	100	310	100	45
	Bottom	3	9	17	65	69	18
Station 4	Top	1	17	2	270	3	8
	Middle	7	190	74	<1	5	14
	Bottom	5	46	54	1	1	7
Ref-CB	Top	2	14	<1	---	<1	2
	Middle	2	2	<1	<1	<1	1
	Bottom	2	1	<1	1	<1	1
Ref-PB	Top	3	---	1	1	<1	1
	Middle	2	---	<1	<1	3	2
	Bottom	<1	---	<1	<1	2	1

Notes:
Orange shaded cells indicate exceedance to BC WQG Geomean of 200 CFU/100 mL, Geomean = Geometric Mean, --- not sampled due to weather issues

Appendix C6 - McLoughlin Point IDZ Results - 5 Sampling Events in 30 Days – Enterococci (CFU/100mL)

Enterococci	Health Canada Geometric Mean 35 CFU/100 mL and Maximum 70 CFU/100mL						
Winter							**GeoMean**
Station 1	Top	70	6	18	2	63	16
	Middle	42	1	20	<1	38	8
	Bottom	<1	27	6	<1	2	3
Station 2	Top	74	2	20	<1	41	10
	Middle	<1	6	14	<1	15	4
	Bottom	1	15	8	1	3	3
Station 3	Top	53	<1	25	3	26	10
	Middle	<1	<1	13	1	19	3
	Bottom	1	4	3	<1	6	2
Station 4	Top	72	1	28	<1	2	5
	Middle	5	4	25	1	18	6
	Bottom	4	1	4	<1	2	2
Ref-CB	Top	1	2	1	<1	1	1
	Middle	<1	<1	1	<1	<1	1
	Bottom	<1	<1	1	1	<1	1
Ref-PB	Top	<1	<1	1	1	1	1
	Middle	<1	1	<1	<1	<1	1
	Bottom	<1	<1	1	<1	<1	1
Spring							**GeoMean**
Station 1	Top	3	<1	1	<1	10	2
	Middle	12	2	1	63	16	8
	Bottom	<1	3	1	16	2	2
Station 2	Top	<1	2	<1	<1	22	2
	Middle	9	45	8	<1	2	6
	Bottom	8	32	58	51	3	19
Station 3	Top	78	4	<1	<1	36	6
	Middle	9	43	24	43	4	17
	Bottom	7	51	60	52	1	16
Station 4	Top	46	2	<1	<1	190	7
	Middle	50	1	60	<1	87	12
	Bottom	17	<1	54	1	4	5
Ref-CB	Top	2	<1	1	<1	<1	1
	Middle	1	<1	1	<1	1	1
	Bottom	<1	<1	<1	2	<1	1
Ref-PB	Top	<1	<1	<1	<1	<1	1
	Middle	<1	<1	<1	<1	<1	1
	Bottom	<1	<1	<1	<1	<1	1
Summer							**GeoMean**
Station 1	Top	<1	1	<1	1	1	1
	Middle	<1	13	<1	<1	<1	2
	Bottom	<1	47	<1	2	17	4
Station 2	Top	<1	<1	<1	26	<1	2
	Middle	<1	55	<1	6	26	6
	Bottom	<1	57	1	2	21	5
Station 3	Top	<1	<1	<1	38	<1	2
	Middle	<1	14	<1	13	10	4
	Bottom	<1	39	2	2	16	5

Appendix C6, cont'd

Enterococci	Health Canada Geometric Mean 35 CFU/100 mL and Maximum 70 CFU/100mL						
Station 4	Top	<1	<1	1	64	<1	2
	Middle	<1	<1	<1	25	<1	2
	Bottom	1	33	<1	3	<1	3
Ref-CB	Top	<1	<1	<1	<1	<1	1
	Middle	1	<1	<1	<1	<1	1
	Bottom	<1	<1	1	<1	1	1
Ref-PB	Top	<1	<1	<1	<1	<1	1
	Middle	1	<1	<1	1	<1	1
	Bottom	<1	<1	<1	<1	<1	1
Autumn							**GeoMean**
Station 1	Top	<1	2	<1	140	1	3
	Middle	4	<1	<1	5	5	3
	Bottom	8	2	<1	7	2	3
Station 2	Top	1	3	<1	100	1	3
	Middle	4	<1	<1	78	24	6
	Bottom	8	<1	<1	2	28	3
Station 3	Top	<1	3	2	140	2	4
	Middle	4	<1	33	73	40	13
	Bottom	<1	6	3	23	23	6
Station 4	Top	1	3	2	100	<1	4
	Middle	10	47	32	<1	2	8
	Bottom	2	16	27	<1	1	4
Ref-CB	Top	15	2	1	---	1	2
	Middle	1	<1	<1	1	<1	1
	Bottom	1	<1	<1	<1	<1	1
Ref-PB	Top	<1	---	<1	<1	<1	1
	Middle	<1	---	<1	<1	1	1
	Bottom	<1	---	<1	<1	<1	1

Notes:
Orange Shaded cells indicate exceedance to Health Canada (2012) Geomean of 35 CFU/100 mL, Blue Shaded cells indicate exceedances to Health Canada (2012) single sample WQG of 70 CFU/100 mL, *Geomean = Geometric Mean, --- not sampled due to weather issues.

Appendix C7 McLoughlin Point IDZ Results - 5 Sampling Events in 30 Days – NH3 (mg/L N)

NH3	BC Approved WQG = 20 mg/L N (average over 5 samples) or 148 mg/L N (max) for the protection of aquatic life						
Winter							**Average**
Station 1	Top	0.084	0.058	0.067	0.061	0.092	0.0724
	Middle	0.088	0.045	0.11	0.029	0.072	0.0688
	Bottom	0.031	0.097	0.047	0.065	0.052	0.0584
Station 2	Top	0.11	0.079	0.041	0.067	0.083	0.076
	Middle	0.26	0.074	0.063	0.062	0.071	0.106
	Bottom	0.15	0.17	0.044	0.063	0.059	0.0972
Station 3	Top	0.097	0.067	0.05	0.057	0.068	0.0678
	Middle	0.031	0.066	0.055	0.051	0.061	0.0528
	Bottom	0.14	0.071	0.049	0.062	0.05	0.0744
Station 4	Top	0.054	0.073	0.072	0.054	0.047	0.06
	Middle	0.038	0.071	0.062	0.076	0.063	0.062
	Bottom	0.09	0.082	0.052	0.058	0.051	0.0666
Ref-CB	Top	0.037	0.041	0.047	0.055	0.054	0.0468
	Middle	0.045	0.052	0.049	0.063	0.062	0.0542
	Bottom	0.037	0.038	0.038	0.053	0.052	0.0436
Ref-PB	Top	0.086	0.047	0.087	0.109	0.084	0.0826
	Middle	0.033	0.043	0.054	0.051	0.05	0.0462
	Bottom	0.034	0.048	0.056	0.052	0.051	0.0482
Spring							**Average**
Station 1	Top	0.026	0.11	0.071	0.066	0.079	0.0704
	Middle	0.039	0.053	0.074	0.11	0.075	0.0702
	Bottom	0.034	0.063	0.063	0.086	0.082	0.0656
Station 2	Top	0.028	0.042	0.062	0.07	0.094	0.0592
	Middle	0.035	0.091	0.054	0.79	0.072	0.2084
	Bottom	0.051	0.072	0.11	0.084	0.07	0.0774
Station 3	Top	0.084	0.071	0.065	0.06	0.09	0.074
	Middle	0.044	0.063	0.062	0.079	0.055	0.0606
	Bottom	0.025	0.073	0.11	0.099	0.074	0.0762
Station 4	Top	0.066	0.051	0.053	0.074	0.12	0.0728
	Middle	0.044	0.062	0.12	0.064	0.1	0.078
	Bottom	0.04	0.065	0.1	0.058	0.083	0.0692
Ref-CB	Top	0.034	0.049	0.058	0.082	0.079	0.0604
	Middle	0.055	0.06	0.05	0.065	0.068	0.0596
	Bottom	0.041	0.059	0.067	0.074	0.071	0.0624
Ref-PB	Top	0.074	0.122	0.128	0.08	0.149	0.1106
	Middle	0.044	0.059	0.025	0.077	0.074	0.0558
	Bottom	0.036	0.046	0.058	0.071	0.072	0.0566
Summer							**Average**
Station 1	Top	0.06	0.04	0.048	0.065	0.055	0.0536
	Middle	0.059	0.056	0.054	0.06	0.049	0.0556
	Bottom	0.053	0.096	0.052	0.062	0.084	0.0694
Station 2	Top	0.054	0.059	0.052	0.088	0.071	0.0648
	Middle	0.058	0.13	0.043	0.073	0.083	0.0774
	Bottom	0.051	0.12	0.046	0.117	0.087	0.0842
Station 3	Top	0.067	0.045	0.044	0.11	0.038	0.0608
	Middle	0.069	0.063	0.054	0.069	0.047	0.0604
	Bottom	0.055	0.089	0.06	0.062	0.11	0.0752

Appendix C7, cont'd

NH3	BC Approved WQG = 20 mg/L N (average over 5 samples) or 148 mg/L N (max) for the protection of aquatic life						
Station 4	Top	0.055	0.052	0.041	0.13	0.08	0.0716
	Middle	0.057	0.051	0.05	0.083	0.047	0.0576
	Bottom	0.058	0.11	0.048	0.063	0.038	0.0634
Ref-CB	Top	0.054	0.065	0.052	0.063	0.053	0.0574
	Middle	0.059	0.041	0.04	0.052	0.043	0.047
	Bottom	0.067	0.036	0.046	0.056	0.042	0.0494
Ref-PB	Top	0.137	0.088	0.088	0.064	0.134	0.1022
	Middle	0.067	0.044	0.045	0.058	0.051	0.053
	Bottom	0.061	0.05	0.056	0.073	0.054	0.0588
Autumn							**Average**
Station 1	Top	0.074	0.038	0.028	0.091	0.033	0.0528
	Middle	0.064	0.036	0.021	0.036	0.05	0.0414
	Bottom	0.06	0.04	0.022	0.026	0.035	0.0366
Station 2	Top	0.056	0.036	0.022	0.067	0.047	0.0456
	Middle	0.055	0.034	0.026	0.062	0.1	0.0554
	Bottom	0.065	0.03	0.034	0.037	0.095	0.0522
Station 3	Top	0.07	0.041	0.032	0.091	0.033	0.0534
	Middle	0.068	0.044	0.05	0.071	0.13	0.0726
	Bottom	0.069	0.044	0.022	0.027	0.085	0.0494
Station 4	Top	0.055	0.035	0.04	0.073	0.047	0.05
	Middle	0.07	0.12	0.042	0.024	0.038	0.0588
	Bottom	0.072	0.063	0.043	0.032	0.033	0.0486
Ref-CB	Top	0.065	0.073	0.033	---	0.039	0.0525
	Middle	0.064	0.028	0.026	0.031	0.037	0.0372
	Bottom	0.07	0.023	0.016	0.0059	0.031	0.02918
Ref-PB	Top	0.147	---	0.065	0.043	0.081	0.084
	Middle	0.065	---	0.0083	0.0071	0.037	0.02935
	Bottom	0.068	---	0.02	0.025	0.036	0.03725

Notes:
Shaded cells indicate exceedance to BC WQG, --- not sampled due to weather issues, Approved Guideline is based on Salinity = 30 g/kg, Temperature = 10ºC and pH = 7.0

Appendix C8 McLoughlin Point IDZ Results - 5 Sampling Events in 30 Days – Silver (mg/L)

Silver	BC Approved WQG for protection of marine aquatic life = 3 u/L (geometric mean over 5 samples) or 1.5 mg/L (max)						
Winter							Geomean
Station 1	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 2	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 3	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 4	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-CB	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-PB	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Spring							Geomean
Station 1	Top	0.057	<0.05	<0.05	<0.05	<0.05	0.051
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 2	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 3	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 4	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-CB	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-PB	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Summer							Geomean
Station 1	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 2	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 3	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Appendix C8, cont'd

Silver	BC Approved WQG = 0.003 mg/L (geometric mean over 5 samples) or 0.00015 mg/L (max) for the protection of aquatic life						
Station 4	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-CB	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-PB	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Autumn						**Geomean**
Station 1	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 2	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 3	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	0.052	<0.05	<0.05	0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 4	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-PB	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-CB	Top	<0.05	---	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	---	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	---	<0.05	<0.05	<0.05	<0.05

Notes:
Shaded cells indicate exceedance to BC WQG, --- not sampled due to weather issues, Geomean = Geometric Mean, Detection limit was used in calculations of average values.

Appendix C9 McLoughlin Point IDZ Results - 5 Sampling Events in 30 Days – Arsenic (ug/L)

Arsenic	BC Approved WQG = 12.5 ug/L (max) for the protection of aquatic life					
Winter						
Station 1	Top	1.84	2.22	1.74	2.62	1.82
	Middle	2	2.26	2.05	1.94	1.96
	Bottom	1.76	2.19	2	2.24	1.75
Station 2	Top	1.95	2.05	2.12	2.39	1.96
	Middle	2.1	2.18	1.95	2.21	2.04
	Bottom	1.69	2.11	2.11	2.23	1.91
Station 3	Top	1.8	2.21	2.1	1.95	1.94
	Middle	1.98	2.01	2.47	2.48	1.93
	Bottom	1.83	2.08	2.49	2.33	1.91
Station 4	Top	1.65	2.22	2.33	2.65	1.8
	Middle	1.86	2.13	2.25	2.67	2.02
	Bottom	1.82	2.6	2.24	2.37	4.31
Ref-CB	Top	1.77	2.12	1.97	3.43	1.94
	Middle	1.88	2.44	1.82	2.56	1.81
	Bottom	2.04	2.23	2.1	2.36	1.71
Ref-PB	Top	2.73	3.98	1.76	2.42	1.85
	Middle	2.06	1.95	3.17	2.41	2.13
	Bottom	1.69	2.25	1.85	2.63	1.9
Spring						
Station 1	Top	1.54	1.66	1.7	1.54	1.54
	Middle	1.64	1.7	1.56	1.51	1.47
	Bottom	1.74	1.53	1.6	1.33	1.37
Station 2	Top	1.73	1.86	1.69	1.63	1.45
	Middle	1.54	1.59	1.71	1.62	1.67
	Bottom	1.7	1.49	1.49	1.47	1.67
Station 3	Top	1.65	1.64	1.64	1.47	1.68
	Middle	1.58	1.72	1.89	1.37	1.81
	Bottom	1.5	1.64	1.52	1.63	1.59
Station 4	Top	1.72	1.58	1.63	1.57	2.27
	Middle	1.85	1.63	1.52	1.45	2
	Bottom	1.86	3.09	1.67	1.61	4.65
Ref-CB	Top	1.48	1.51	1.64	1.43	1.53
	Middle	1.53	1.46	1.58	1.58	1.55
	Bottom	1.76	1.74	3.27	1.64	1.3
Ref-PB	Top	3.15	1.59	1.52	2.6	1.54
	Middle	1.66	1.55	1.95	1.47	1.32
	Bottom	1.48	1.57	1.8	1.57	1.4
Summer						
Station 1	Top	1.67	1.39	1.52	1.48	1.63
	Middle	1.3	1.38	1.75	1.21	1.5
	Bottom	1.45	1.82	1.57	1.17	1.88
Station 2	Top	1.16	1.58	1.54	1.21	1.64
	Middle	1.28	1.55	1.57	1.17	1.58
	Bottom	1.21	1.35	1.65	1.25	1.56
Station 3	Top	1.39	1.37	1.62	1.23	1.62
	Middle	1.53	1.55	1.49	1.4	1.5
	Bottom	1.54	1.55	1.51	1.38	1.46

Appendix C9, cont'd

Arsenic	BC Approved WQG = 12.5 ug/L (max) for the protection of aquatic life					
Station 4	Top	1.45	1.6	1.4	1.51	1.55
	Middle	1.69	1.62	1.66	1.23	1.5
	Bottom	1.54	1.62	1.87	1.48	3.1
Ref-CB	Top	1.29	1.71	1.65	1.58	1.6
	Middle	1.24	1.53	1.92	1.18	1.85
	Bottom	1.15	1.66	1.31	1.41	1.45
Ref-PB	Top	3.07	2.71	3.16	2.75	1.41
	Middle	1.23	1.47	1.36	1.53	1.49
	Bottom	1.3	1.38	1.64	1.31	1.54
Autumn						
Station 1	Top	1.64	2.23	1.51	1.79	2.47
	Middle	1.75	2.38	1.63	1.81	2.18
	Bottom	1.47	2.91	1.73	1.78	2.19
Station 2	Top	1.64	2.38	2.91	1.78	2.34
	Middle	1.77	2.59	1.42	1.91	2.52
	Bottom	1.94	2.43	1.45	1.83	2.54
Station 3	Top	1.94	2.35	1.66	1.75	2.52
	Middle	1.65	2.6	1.38	1.74	2.34
	Bottom	1.57	2.52	1.34	1.75	2.54
Station 4	Top	1.5	2.62	1.46	1.91	2.92
	Middle	1.74	2.38	1.5	1.64	2.54
	Bottom	1.53	2.49	1.58	1.67	2.84
Ref-CB	Top	1.67	2.16	1.58	---	2.25
	Middle	1.43	4.66	1.68	2.08	2.32
	Bottom	1.7	2.31	1.86	1.96	2.44
Ref-PB	Top	3.24	---	1.71	1.67	3.45
	Middle	1.66	---	1.67	1.72	2.34
	Bottom	1.41	---	1.55	1.9	2.19

Notes:
Shaded cells indicate exceedance to BC WQG, --- not sampled due to weather issues, *Guideline is interim.

Appendix C10 McLoughlin Point IDZ Results - 5 Sampling Events in 30 Days – Boron (ug/L)

Boron	BC Approved WQG = 1200 ug/L (max) for the protection of aquatic life					
Winter						
Station 1	Top	4170	4630	4370	5800	4170
	Middle	4370	4660	4530	5150	4250
	Bottom	4210	4730	4270	5500	4440
Station 2	Top	4320	4560	4500	6040	4280
	Middle	4440	4510	4320	5710	4510
	Bottom	4210	4640	4500	5580	4400
Station 3	Top	4310	4630	4380	4590	4190
	Middle	4440	4700	4380	6060	4470
	Bottom	4390	4420	4830	5690	4280
Station 4	Top	4340	4730	4430	5960	4380
	Middle	4430	4660	4660	6190	4520
	Bottom	4370	4740	4610	5710	8600
Ref-PB	Top	4260	4630	4430	9060	4490
	Middle	4420	4670	4560	5760	4350
	Bottom	4410	4560	4540	5650	4150
Ref-CB	Top	8310	9130	4230	4630	4110
	Middle	4430	4440	8860	4700	4440
	Bottom	4250	4800	4460	4850	4240
Spring						
Station 1	Top	3880	4260	4110	4440	3910
	Middle	4100	4160	3980	4520	4080
	Bottom	4010	4390	4300	4230	4100
Station 2	Top	4040	4420	4440	4160	4070
	Middle	3980	4470	3950	4390	4570
	Bottom	4030	4300	4250	4560	4160
Station 3	Top	3900	4450	4200	4150	4560
	Middle	3930	4170	4270	4150	4860
	Bottom	3940	4510	4300	4040	4090
Station 4	Top	3910	4460	4290	4170	4000
	Middle	4120	4300	3980	4220	3960
	Bottom	4250	8530	3940	4260	7790
Ref-PB	Top	3930	3960	4150	4060	3820
	Middle	3930	4020	4150	4340	3980
	Bottom	4140	4390	7900	4140	3830
Ref-CB	Top	7850	3990	3950	7350	4130
	Middle	4000	4010	4250	4290	3880
	Bottom	4110	4260	4120	4220	3940
Summer						
Station 1	Top	3630	4070	3880	4460	3980
	Middle	3570	3740	4370	4420	3690
	Bottom	3740	3810	4060	4410	3720
Station 2	Top	3750	3990	3960	4360	3780
	Middle	3640	3900	4020	4290	4010
	Bottom	3780	3690	4010	4240	3920
Station 3	Top	3700	3690	3690	4400	3880
	Middle	3660	3760	3810	4280	3940
	Bottom	3710	3730	3930	4220	4240

Appendix C10, cont'd

Boron	BC Approved WQG = 1200 ug/L (max) for the protection of aquatic life					
Station 4	Top	3600	3660	3840	4280	3990
	Middle	4000	3880	3780	4320	3720
	Bottom	3750	3860	4300	4480	7080
Ref-PB	Top	3620	4240	4090	4300	3730
	Middle	3610	3990	4570	4160	3790
	Bottom	3570	4030	3870	4400	3830
Ref-CB	Top	7030	7400	8230	8150	3620
	Middle	3740	3820	3840	4310	4030
	Bottom	3600	3830	4250	4160	3860
Autumn						
Station 1	Top	4120	3780	3730	4000	3920
	Middle	4230	3490	3740	4090	3940
	Bottom	4210	3640	3990	4130	4180
Station 2	Top	4150	3390	6940	4170	3850
	Middle	4220	3480	3490	4110	3900
	Bottom	4190	3870	3480	4000	4000
Station 3	Top	4180	3570	3420	4050	3970
	Middle	4290	3520	3620	4120	3910
	Bottom	4220	3500	3410	4090	3940
Station 4	Top	4210	3720	3720	4140	4170
	Middle	4240	3680	3800	4090	3940
	Bottom	4270	3410	3850	4080	4290
Ref-PB	Top	4180	3380	3690	---	3840
	Middle	4150	7360	3640	4100	3950
	Bottom	4210	3690	3870	4200	3910
Ref-CB	Top	8210	---	3700	4220	7680
	Middle	4170	---	3830	4380	3980
	Bottom	4160	---	3210	4360	3910

Notes:
Shaded cells indicate exceedance to BC WQG for protection of marine aquatic life, --- not sampled due to weather issues. Note that the BC WQG is above background levels for boron in this area which are around 4.0 mg/L.

Appendix C11 McLoughlin Point IDZ Results - 5 Sampling Events in 30 Days – Cadmium (ug/L)

Cadmium	BC Working WQG = 0.12 ug/L (max) For the protection of shellfish consumers.					
Winter						
Station 1	Top	0.035	0.035	0.048	0.057	0.098
	Middle	0.016	0.041	0.078	0.074	0.042
	Bottom	0.058	0.046	0.055	0.103	0.081
Station 2	Top	0.035	0.048	0.051	0.099	0.057
	Middle	0.059	0.017	0.032	0.089	0.043
	Bottom	0.046	0.025	0.061	0.115	0.091
Station 3	Top	0.045	0.024	0.074	0.156	0.039
	Middle	0.051	0.043	0.045	0.111	0.043
	Bottom	0.048	0.016	0.058	0.1	0.038
Station 4	Top	0.076	<0.01	0.042	0.099	0.099
	Middle	0.037	0.076	0.065	0.118	0.072
	Bottom	0.045	0.084	0.074	0.085	0.142
Ref-PB	Top	0.077	0.011	0.065	0.127	0.081
	Middle	0.069	0.022	0.063	0.089	0.063
	Bottom	0.055	0.035	0.08	0.131	0.081
Ref-CB	Top	0.115	0.897	0.057	0.048	0.033
	Middle	<0.01	0.031	0.102	0.052	0.077
	Bottom	0.074	0.045	0.056	0.048	0.049
Spring						
Station 1	Top	0.039	0.038	0.034	0.014	0.066
	Middle	0.055	0.032	0.05	0.011	0.096
	Bottom	0.071	0.041	0.047	<0.01	0.048
Station 2	Top	0.025	0.031	0.044	<0.01	0.078
	Middle	0.055	0.037	0.019	0.041	0.134
	Bottom	0.079	0.049	0.037	0.017	0.07
Station 3	Top	0.042	0.041	0.045	<0.01	0.06
	Middle	0.07	0.041	<0.01	0.015	0.057
	Bottom	0.053	0.03	0.034	0.011	0.042
Station 4	Top	0.077	0.031	0.056	<0.01	0.059
	Middle	0.044	0.028	0.032	0.031	0.046
	Bottom	0.085	0.074	0.03	0.014	0.067
Ref-PB	Top	0.079	0.052	0.054	0.016	0.042
	Middle	0.052	0.032	0.058	0.016	0.049
	Bottom	0.109	0.062	<0.04	0.028	0.051
Ref-CB	Top	0.167	0.038	0.026	<0.028	0.053
	Middle	0.067	0.038	0.061	0.022	0.072
	Bottom	0.063	0.077	0.06	<0.01	0.042
Summer						
Station 1	Top	<0.01	0.046	0.084	0.032	0.087
	Middle	0.033	0.067	0.149	<0.01	0.061
	Bottom	0.02	0.059	0.067	<0.01	0.056
Station 2	Top	0.021	0.069	0.066	<0.01	0.043
	Middle	0.019	0.052	0.038	0.036	0.045
	Bottom	0.04	0.028	0.071	<0.01	0.038
Station 3	Top	<0.01	0.046	0.031	0.021	0.019
	Middle	0.011	0.076	0.037	0.026	0.05
	Bottom	0.025	0.031	0.064	<0.01	0.064

Appendix C11, cont'd

Cadmium	BC Working WQG = 0.12 ug/L (max) to protect of consumers of shellfish					
Station 4	Top	<0.01	0.051	0.083	0.026	0.069
	Middle	0.031	0.045	0.08	<0.01	<0.01
	Bottom	0.012	0.039	0.075	<0.01	0.064
Ref-PB	Top	0.014	0.067	0.061	0.021	0.101
	Middle	0.023	0.045	0.067	<0.01	0.05
	Bottom	0.02	0.045	0.097	0.022	0.053
Ref-CB	Top	0.039	0.16	0.126	0.065	0.054
	Middle	0.028	0.021	0.117	0.017	0.04
	Bottom	<0.01	0.091	0.077	<0.01	0.079
Autumn						
Station 1	Top	0.057	0.015	0.049	0.233	0.09
	Middle	0.072	0.011	0.066	0.059	0.071
	Bottom	0.043	0.226	0.046	0.078	0.072
Station 2	Top	0.076	0.03	0.09	0.092	0.073
	Middle	0.052	0.065	0.07	0.089	0.092
	Bottom	0.048	0.021	0.075	0.089	0.08
Station 3	Top	0.082	0.036	0.06	0.064	0.066
	Middle	0.069	0.057	0.052	0.09	0.066
	Bottom	0.064	0.019	0.057	0.182	0.068
Station 4	Top	0.046	0.04	0.031	0.077	0.071
	Middle	0.028	0.026	0.058	0.03	0.049
	Bottom	0.1	0.017	0.054	0.058	0.125
Ref-PB	Top	0.084	0.016	0.118	---	0.129
	Middle	0.047	<0.021	0.094	0.611	0.078
	Bottom	0.054	0.042	0.043	0.129	0.084
Ref-CB	Top	0.165	---	0.05	0.763	0.029
	Middle	0.067	---	0.06	0.089	0.166
	Bottom	0.072	---	0.051	0.066	0.111

Notes: Shaded cells indicate exceedance to BC WQG, --- not sampled due to weather issues

Appendix C12 McLoughlin Point IDZ Results - 5 Sampling Events in 30 Days – Copper (ug/L)

Copper	**BC Approved WQG = 2 ug/L (average over 5 samples) or 3 ug/L (max)**						
Winter							**Average**
Station 1	Top	<0.5	<0.5	<0.5	<0.5	0.76	0.6
	Middle	<0.5	1.48	<0.5	<0.5	<0.5	0.7
	Bottom	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Station 2	Top	<0.5	<0.5	2.41	<0.5	<0.5	0.9
	Middle	<0.5	1.21	<0.5	<0.5	<0.5	0.6
	Bottom	<0.5	1.16	1.29	<0.5	0.6	0.8
Station 3	Top	<0.5	0.95	<0.5	<0.5	<0.5	0.6
	Middle	<0.5	0.55	<0.5	<0.5	<0.5	0.5
	Bottom	<0.5	0.9	0.65	1.17	<0.5	0.7
Station 4	Top	<0.5	1.31	<0.5	<0.5	<0.5	0.7
	Middle	0.55	1.24	0.94	<0.5	0.58	0.8
	Bottom	<0.5	0.68	<	<0.5	<0.5	0.5
Ref-PB	Top	<0.5	0.65	<0.5	<0.5	<0.5	0.5
	Middle	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
	Bottom	<0.5	0.91	0.53	<0.5	<0.5	0.6
Ref-CB	Top	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
	Middle	<0.5	0.67	<1.1	<0.5	<0.5	0.7
	Bottom	<0.5	0.58	0.71	<0.5	<0.5	0.6
Spring							**Average**
Station 1	Top	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Middle	0.55	<0.5	<0.5	<0.5	<0.5	0.5
	Bottom	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Station 2	Top	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Middle	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Bottom	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Station 3	Top	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Middle	1.05	<0.5	<0.5	<0.5	<0.5	0.6
	Bottom	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Station 4	Top	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Middle	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Bottom	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ref-PB	Top	<0.5	<0.5	<0.5	0.65	<0.5	0.5
	Middle	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Bottom	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ref-CB	Top	<1.01	<0.5	<0.5	<0.5	<0.5	0.6
	Middle	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Bottom	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Summer							**Average**
Station 1	Top	<0.5	1.98	0.83	<0.5	0.7	0.9
	Middle	<0.5	0.55	0.61	<0.5	<0.5	0.5
	Bottom	<0.5	0.84	0.73	<0.5	0.64	0.6
Station 2	Top	<0.5	0.88	0.79	0.53	<0.5	0.6
	Middle	<0.5	0.73	0.77	<0.5	<0.5	0.6
	Bottom	<0.5	2.12	0.7	<0.5	<0.5	0.9
Station 3	Top	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Middle	2.2	0.53	<0.5	0.63	<0.5	0.9
	Bottom	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Appendix C12, cont'd

Copper	BC Approved WQG = 2 ug/L (average over 5 samples) or 3 ug/L (max)						
Station 4	Top	<0.5	<0.5	2.01	<0.5	<0.5	0.8
	Middle	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Bottom	<0.5	<0.5	3.81	<0.5	<1.02	1.3
Ref-PB	Top	<0.5	1.21	0.69	<0.5	<0.5	0.7
	Middle	<0.5	1.28	0.59	0.97	<0.5	0.8
	Bottom	<0.5	2.28	1.01	<0.5	<0.5	1.0
Ref-CB	Top	<0.5	6.59	<0.5	<0.5	<0.5	1.7
	Middle	<0.5	4.74	0.69	<0.5	<0.5	1.4
	Bottom	<0.5	1.42	0.56	<0.5	<0.5	0.7
Autumn							**Average**
Station 1	Top	<0.5	0.92	<0.5	0.76	<0.5	0.6
	Middle	<0.5	1.01	<0.5	<0.5	<0.5	0.6
	Bottom	0.52	1.27	<0.5	<0.5	<0.5	0.7
Station 2	Top	0.59	1.03	<0.5	<0.5	<0.5	0.6
	Middle	0.6	1.03	<0.5	0.55	<0.5	0.6
	Bottom	0.54	1.22	<0.5	<0.5	<0.5	0.7
Station 3	Top	0.84	<1	<0.5	<0.5	<0.5	0.7
	Middle	<0.5	0.95	<0.5	3.51	<0.5	1.2
	Bottom	<0.5	0.93	<0.5	<0.5	<0.5	0.6
Station 4	Top	<0.5	1.04	0.64	<0.5	<0.5	0.6
	Middle	<0.5	1.1	<0.5	1.78	<0.5	0.9
	Bottom	<0.5	0.96	<0.5	1.42	<0.5	0.8
Ref-PB	Top	<0.5	0.98	<0.5	---	<0.5	0.6
	Middle	<0.5	2.14	<0.5	<0.5	<0.5	0.8
	Bottom	<0.5	0.87	<0.5	<0.5	<0.5	0.6
Ref-CB	Top	<0.5	---	<0.5	0.56	<0.5	0.5
	Middle	0.58	---	<0.5	<0.5	<0.5	0.5
	Bottom	1.36	---	<0.5	0.68	<0.5	0.8

Notes:
Shaded cells indicate exceedance to BC WQG, --- not sampled due to weather issues, Detection limit was used in calculations of average values.

Appendix C13 McLoughlin Point IDZ Results - 5 Sampling Events in 30 Days – Lead (ug/L)

Lead	BC Approved WQG = 2 ug/L (average of 5 samples) or 140 ug/L (max)						
Winter							**Average**
Station 1	Top	<0.05	<0.05	<0.05	0.171	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 2	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	0.102	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	0.073	<0.05
Station 3	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 4	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-CB	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-PB	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Spring							**Average**
Station 1	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 2	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 3	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 4	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-CB	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-PB	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Summer							**Average**
Station 1	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 2	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 3	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Lead	BC Approved WQG = 2 ug/L (average of 5 samples) or 140 ug/L (max)						
Station 4	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-CB	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-PB	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Autumn							**Average**
Station 1	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 2	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 3	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Station 4	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-CB	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ref-PB	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Middle	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Notes:
Shaded cells indicate exceedance to BC WQG, --- not sampled due to weather issues, Detection limit was used in calculations of average values.

Appendix C14 McLoughlin Point IDZ Results - 5 Sampling Events in 30 Days – Manganese (ug/L)

Manganese	BC Approved WQG = 100 ug/L (max)					
Winter						
Station 1	Top	1.75	1.69	1.8	1.91	1.93
	Middle	1.82	2.18	1.89	1.82	1.97
	Bottom	1.9	2.24	2.05	2.3	2.17
Station 2	Top	1.8	1.69	1.76	2.07	2.69
	Middle	1.75	1.76	1.88	2.15	2.03
	Bottom	1.73	2.55	2.04	2.48	3.27
Station 3	Top	1.59	2.01	2	1.81	2.09
	Middle	1.91	1.75	1.78	2.73	2.03
	Bottom	2.03	1.95	2.37	2.92	1.98
Station 4	Top	1.77	2	1.88	2.26	1.75
	Middle	1.81	1.93	2.28	2.35	2.12
	Bottom	2.03	2.26	2.1	2.3	2.96
Ref-CB	Top	1.44	2.01	1.98	4.13	1.51
	Middle	1.84	1.6	1.82	2.74	2.5
	Bottom	2.58	1.96	2.41	2.35	1.81
Ref-PB	Top	3.48	3.18	1.62	1.82	2.02
	Middle	1.66	1.67	3.52	2.17	2.4
	Bottom	1.88	2.23	1.79	1.89	2.03
Spring						
Station 1	Top	1.14	0.95	1.1	0.95	1.25
	Middle	1.36	1.09	0.67	1.36	1.12
	Bottom	1.34	1.14	1.09	1.19	1.3
Station 2	Top	1.11	1.27	1.15	0.83	1.22
	Middle	1.21	1.4	0.79	0.85	1.22
	Bottom	1.08	1.18	1.52	1.13	1.29
Station 3	Top	1.25	0.94	0.87	1.25	1.12
	Middle	1.16	1.15	1.02	0.91	1.45
	Bottom	1.34	1.39	1.25	1.12	1.21
Station 4	Top	1.07	1.21	1.25	0.84	0.96
	Middle	1.33	1.11	1.12	0.95	1.05
	Bottom	1.51	2.48	1.28	1.46	1.95
Ref-CB	Top	1.1	1.08	1	0.98	0.93
	Middle	1	1.03	1.36	0.88	1.21
	Bottom	1.73	1.23	1.68	1.08	1.46
Ref-PB	Top	2.85	1.22	2.15	2.05	1.52
	Middle	1.67	1.25	1.94	1.19	1.29
	Bottom	1.85	1.21	1.83	1.28	1.05
Summer						
Station 1	Top	1.07	1.74	1.67	1.78	1.67
	Middle	0.79	1.57	1.85	2.03	1.71
	Bottom	1.53	1.84	1.96	1.88	2.12
Station 2	Top	1.07	1.49	1.56	1.84	1.5
	Middle	1.3	1.9	1.61	1.62	2.02
	Bottom	1.23	1.78	1.73	1.64	1.69
Station 3	Top	0.82	1.58	1.33	1.93	1.4
	Middle	1.05	1.77	1.63	1.76	1.3
	Bottom	1.16	2.17	1.52	1.82	2.19

Appendix C14, cont'd

Manganese	BC Approved WQG = 100 ug/L (max)					
Station 4	Top	0.95	1.93	1.66	1.77	1.72
	Middle	2.41	1.62	1.71	1.79	1.68
	Bottom	0.82	1.8	1.76	1.97	4.48
Ref-CB	Top	0.62	1.78	1.6	2.05	1.49
	Middle	1.27	1.59	2.02	1.73	1.96
	Bottom	1.15	1.4	2.22	1.79	1.81
Ref-PB	Top	2.95	3.3	5.05	3.64	1.84
	Middle	2.85	2.3	1.67	1.47	2.32
	Bottom	1.47	1.66	1.76	1.66	1.98
Autumn						
Station 1	Top	2.03	1.45	1.88	2.01	0.83
	Middle	2.02	1.53	1.37	1.67	0.92
	Bottom	2.07	2.46	1.76	1.89	0.77
Station 2	Top	2.05	1.61	3.89	2.12	1.02
	Middle	2.5	1.66	1.79	1.73	0.89
	Bottom	2.27	2.35	1.58	1.71	0.71
Station 3	Top	1.79	1.62	1.65	1.56	0.83
	Middle	1.81	1.65	1.34	1.86	0.9
	Bottom	2.14	1.84	1.32	1.29	1.15
Station 4	Top	2.11	1.75	1.78	1.77	1.03
	Middle	2	1.72	2.19	2.06	0.76
	Bottom	1.89	1.73	1.27	1.82	1.06
Ref-CB	Top	1.87	1.61	1.51	---	0.51
	Middle	2.12	3.6	2.41	2.19	0.96
	Bottom	2.22	1.8	2.45	12.1	0.7
Ref-PB	Top	4.22	---	1.34	1.76	3.95
	Middle	2	---	2.09	1.2	1.26
	Bottom	2.42	---	1.25	4.46	1.07

Notes:
Shaded cells indicate exceedance to BC WQG, --- not sampled due to weather issues.

Appendix C15 McLoughlin Point IDZ Results - 5 Sampling Events in 30 Days – Nickel (ug/L)

Nickel	BC Working WQG = 8.3 ug/L (max)					
Winter						
Station 1	Top	0.8	0.4	1	0.5	1.1
	Middle	0.9	2.3	0.8	0.2	0.3
	Bottom	0.6	0.7	0.9	0.2	0.3
Station 2	Top	0.7	0.5	0.9	0.5	0.4
	Middle	1	0.7	0.5	0.5	0.6
	Bottom	0.7	1.7	1.5	<0.2	0.4
Station 3	Top	0.4	1	0.6	<0.2	0.3
	Middle	0.6	0.5	0.6	<0.2	<0.2
	Bottom	0.6	0.8	1.5	1.3	<0.2
Station 4	Top	0.4	1.2	1.2	0.3	0.4
	Middle	0.5	1.6	1.1	<0.2	0.4
	Bottom	0.5	0.8	1.6	<0.2	0.6
Ref-CB	Top	0.6	1.2	1.2	<0.2	0.4
	Middle	0.5	0.9	1	<0.2	0.5
	Bottom	0.8	2.3	2.2	<0.2	0.7
Ref-PB	Top	1.1	<0.4	0.7	22	5.4
	Middle	0.9	1	2.4	1.9	0.9
	Bottom	0.7	0.8	1.9	1.1	0.3
Spring						
Station 1	Top	7.1	0.3	<0.2	0.4	0.6
	Middle	1.2	0.3	<0.2	<0.2	0.6
	Bottom	0.9	0.3	<0.2	<0.2	0.3
Station 2	Top	1	0.4	<0.2	<0.2	0.5
	Middle	0.6	0.8	<0.2	<0.2	0.6
	Bottom	1.3	1	<0.2	<0.2	0.4
Station 3	Top	1.6	1.7	<0.2	0.4	0.6
	Middle	1	31	0.8	<0.2	0.7
	Bottom	0.9	0.3	<0.2	<0.2	0.4
Station 4	Top	0.7	0.7	<0.2	<0.2	<0.2
	Middle	0.9	0.5	<0.2	<0.2	0.4
	Bottom	1.3	1.2	1.4	<0.2	0.8
Ref-CB	Top	0.5	0.5	<0.2	<0.2	0.7
	Middle	0.6	<0.2	0.9	0.3	0.7
	Bottom	1.5	0.3	0.8	0.5	0.7
Ref-PB	Top	14	0.4	<0.2	0.5	0.7
	Middle	1.2	0.7	<0.2	<0.2	0.5
	Bottom	0.8	1	<0.2	0.3	0.4
Summer						
Station 1	Top	<0.2	0.3	0.8	<0.2	0.3
	Middle	4	0.4	0.4	<0.2	<0.2
	Bottom	<0.2	0.3	0.5	<0.2	<0.2
Station 2	Top	<0.2	0.3	0.6	2.5	<0.2
	Middle	<0.2	0.3	0.5	<0.2	<0.2
	Bottom	<0.2	<0.2	0.9	<0.2	0.3
Station 3	Top	<0.2	<0.2	0.3	<0.2	<0.2
	Middle	<0.2	0.3	0.6	<0.2	<0.2
	Bottom	<0.2	0.5	0.7	<0.2	<0.2

Appendix C15, cont'd

Nickel	BC Working WQG = 8.3 ug/L (max)					
Station 4	Top	0.2	0.59	10.7	0.2	0.2
	Middle	4.55	0.27	0.44	0.2	0.2
	Bottom	0.2	1.17	1.85	0.2	3.1
Ref-CB	Top	0.2	0.2	0.64	0.2	0.2
	Middle	0.2	0.26	0.64	0.2	0.2
	Bottom	0.2	0.31	0.92	0.2	0.2
Ref-PB	Top	74.7	0.77	0.88	35.3	10.7
	Middle	1.34	0.46	0.57	1.17	0.53
	Bottom	0.2	0.74	0.44	0.2	0.2
Autumn						
Station 1	Top	<0.2	<0.2	<0.2	<0.2	1.2
	Middle	<0.2	0.4	<0.2	<0.2	<0.2
	Bottom	1.2	0.4	<0.2	<0.2	<0.2
Station 2	Top	0.6	0.3	<0.2	<0.2	<0.2
	Middle	0.7	0.3	<0.2	0.3	0.3
	Bottom	0.5	0.4	0.3	<0.2	<0.2
Station 3	Top	1.3	0.4	<0.2	<0.2	<0.2
	Middle	<0.2	0.3	<0.2	<0.2	<0.2
	Bottom	0.8	<0.2	<0.2	<0.2	<0.2
Station 4	Top	<0.2	0.3	1.6	<0.2	<0.2
	Middle	<0.2	0.4	<0.2	<0.2	<0.2
	Bottom	<0.2	<0.2	<0.2	<0.2	<0.2
Ref-CB	Top	0.4	<0.2	<0.2	---	<0.2
	Middle	<0.2	0.7	<0.2	<0.2	0.4
	Bottom	<0.2	<0.2	1.3	<0.2	<0.2
Ref-PB	Top	0.5	---	<0.2	<0.2	<0.2
	Middle	0.5	---	<0.2	<0.2	0.3
	Bottom	1.8	---	0.8	4.8	<0.2

Notes:
Shaded cells indicate exceedance to BC WQG, --- not sampled due to weather issues.

Appendix C16 McLoughlin Point IDZ Results - 5 Sampling Events in 30 Days – Zinc (ug/L)

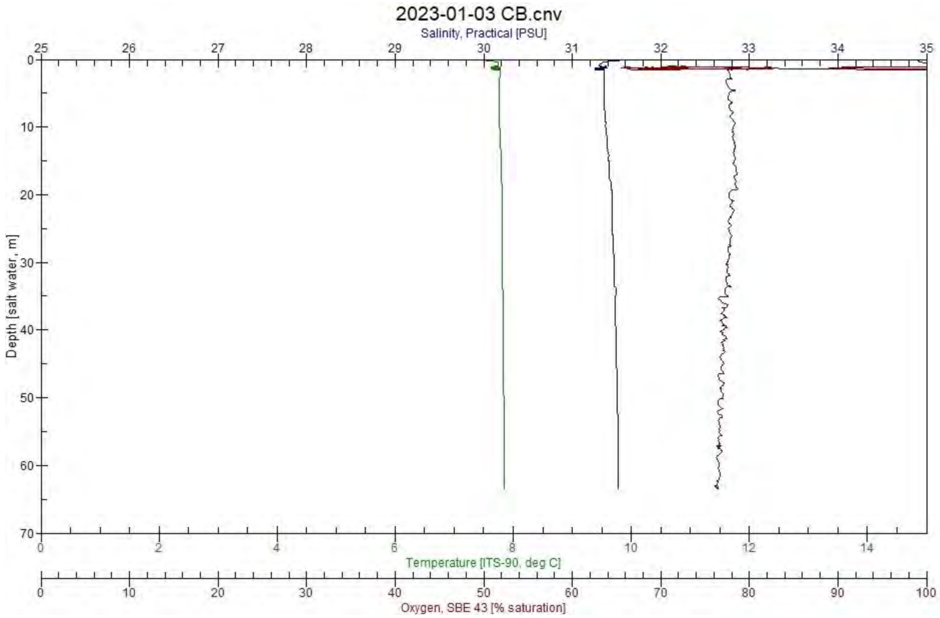
Zinc	**BC Approved WQG = 10 ug/L (average of 5 samples)**						
Winter							**Average**
Station 1	Top	18.7	<3	<3	<3	3.3	6
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3
Station 2	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	3.2	<3
	Bottom	<3	<3	<3	<3	<3	<3
Station 3	Top	<3	<3	<3	14.7	<3	5
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	3.5	<3	<3	<3	<3
Station 4	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3
Ref-CB	Top	<3	<3	<3	<3	3.4	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3
Ref-PB	Top	<3	<3	<3	<3	3.1	<3
	Middle	<3	<3	<3	<3	3.7	<3
	Bottom	<3	<3	<3	<3	<3	<3
Spring							**Average**
Station 1	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3
Station 2	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3
Station 3	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3
Station 4	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3
Ref-CB	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3
Ref-PB	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3
Summer							**Average**
Station 1	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3
Station 2	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3
Station 3	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3

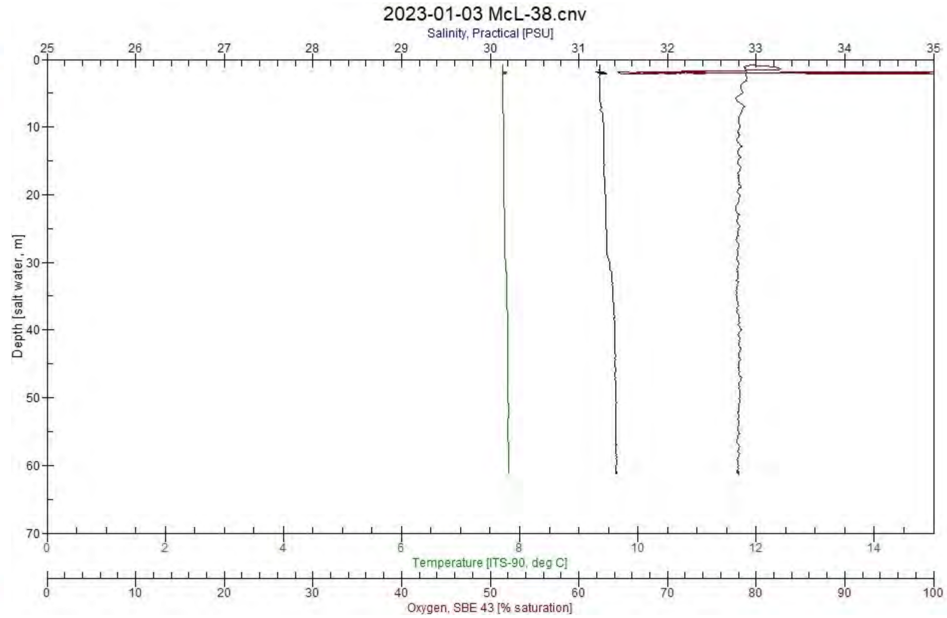
Appendix C16, cont'd

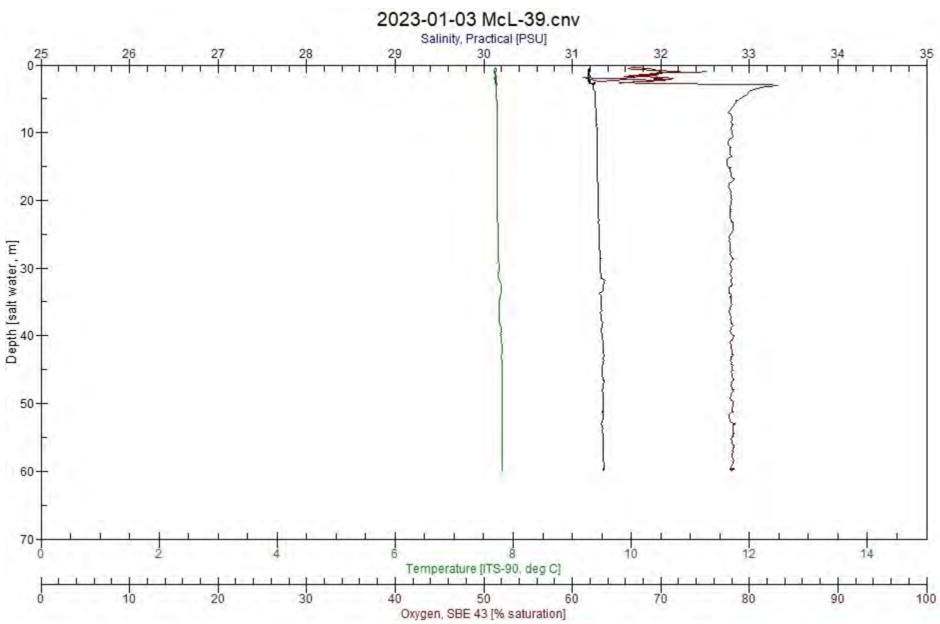
Zinc	BC Approved WQG = 10 ug/L (average of 5 samples)						
Station 4	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3
Ref-CB	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	3.5	<3	<3	<3	<3
Ref-PB	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3
Autumn							
Station 1	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	3.1	<3	<3	<3	<3	<3
Station 2	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	4.1	<3	<3	<3	<3	<3
Station 3	Top	12.3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3
Station 4	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	<3	<3	<3	<3	<3
	Bottom	<3	<3	<3	<3	<3	<3
Ref-CB	Top	<3	<3	<3	<3	<3	<3
	Middle	<3	6	<3	<3	<3	4
	Bottom	<3	3	<3	<3	<3	<3
Ref-PB	Top	<3	---	<3	<3	<3	<3
	Middle	<3	---	<3	<3	<3	<3
	Bottom	8.8	---	<3	<3	<3	4

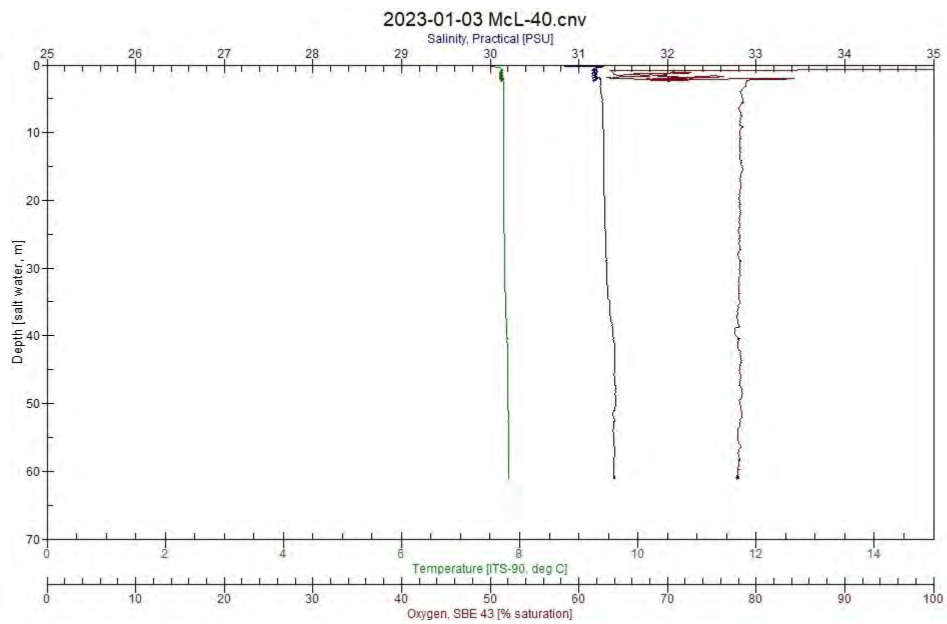
Notes:
Shaded cells indicate exceedance to BC WQG, --- not sampled due to weather issues, Detection limit was used in calculations of average values.

Appendix C17 CTD Plots

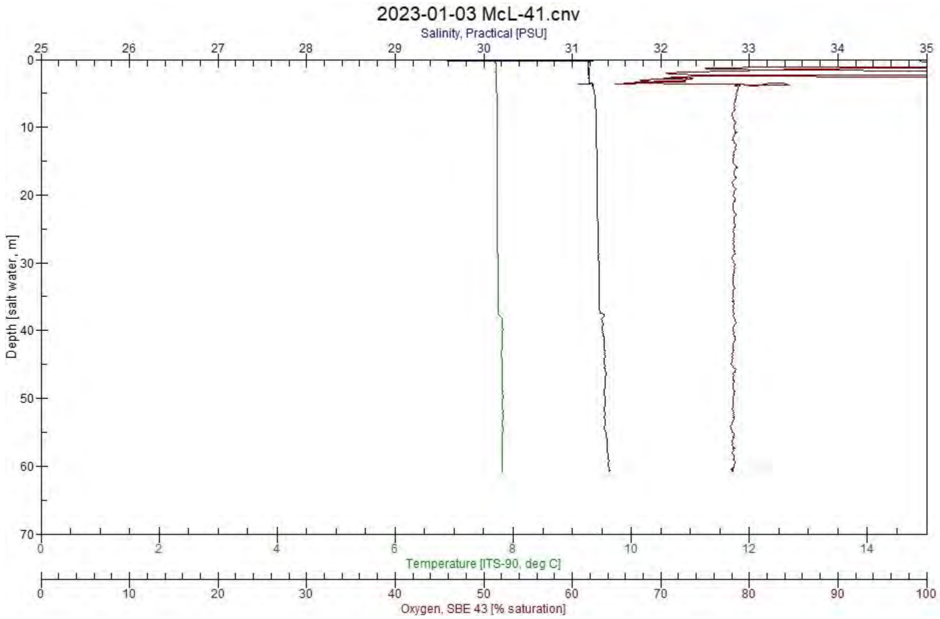


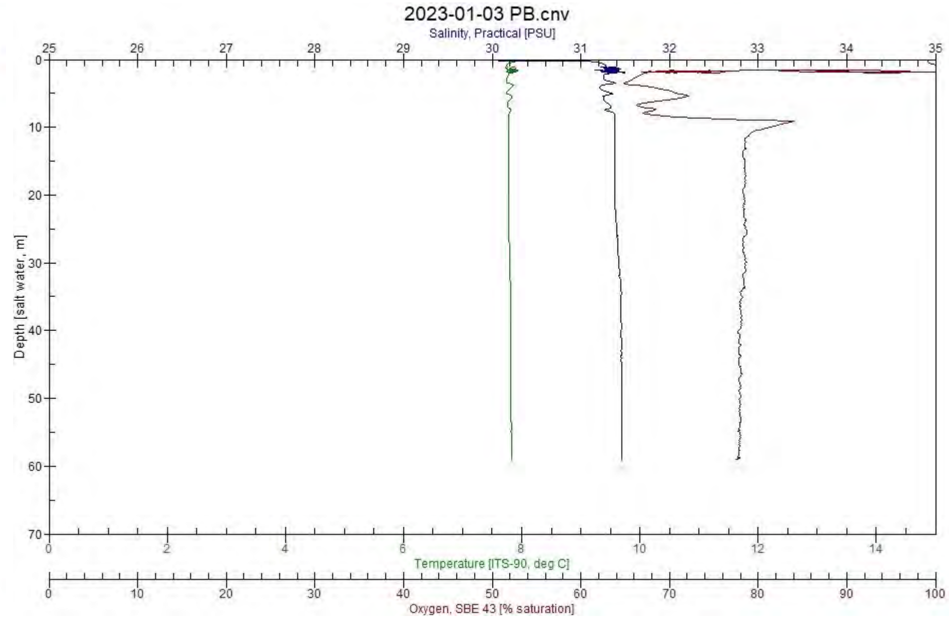


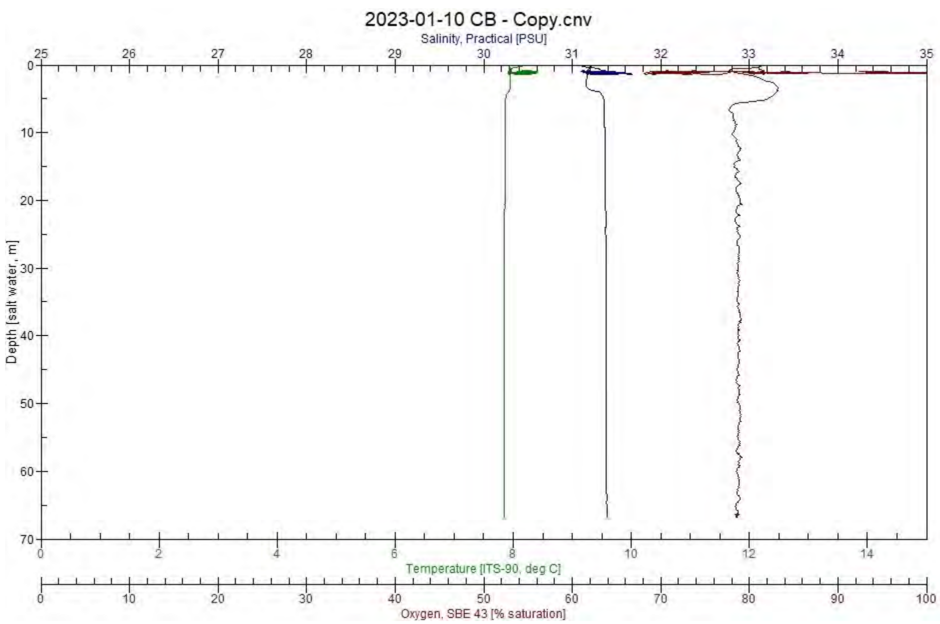


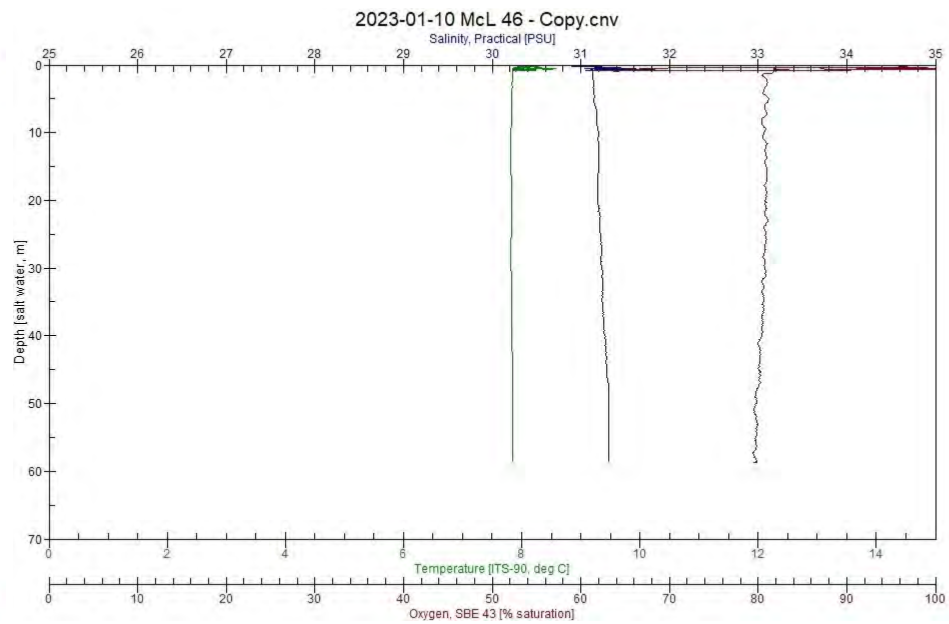


Appendix C17 Cont'd









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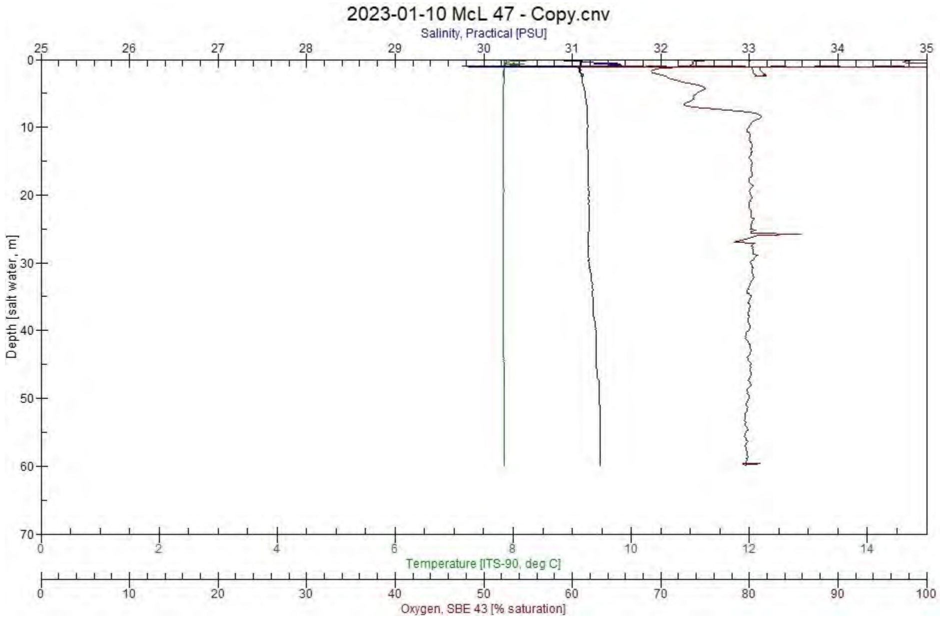

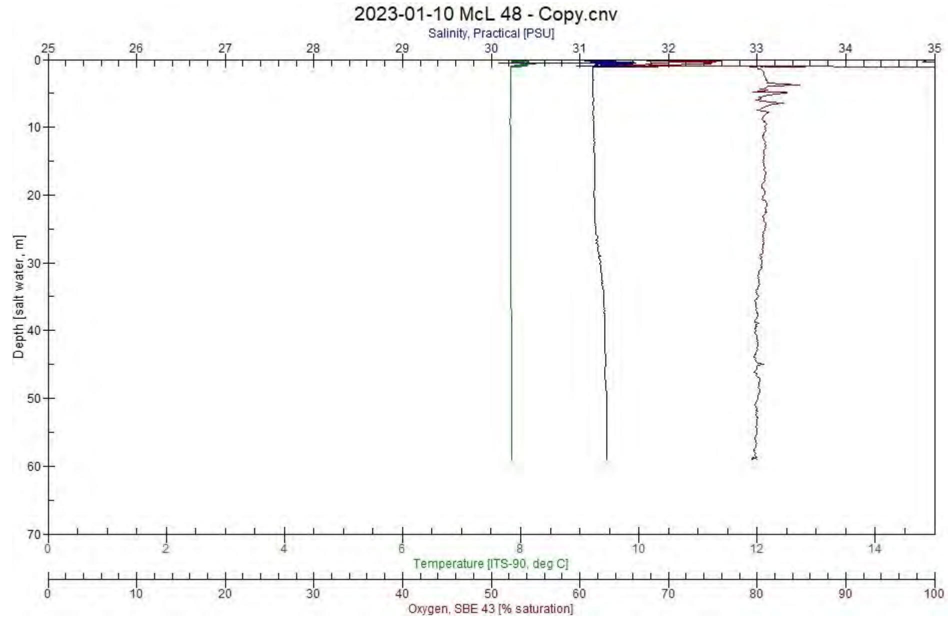

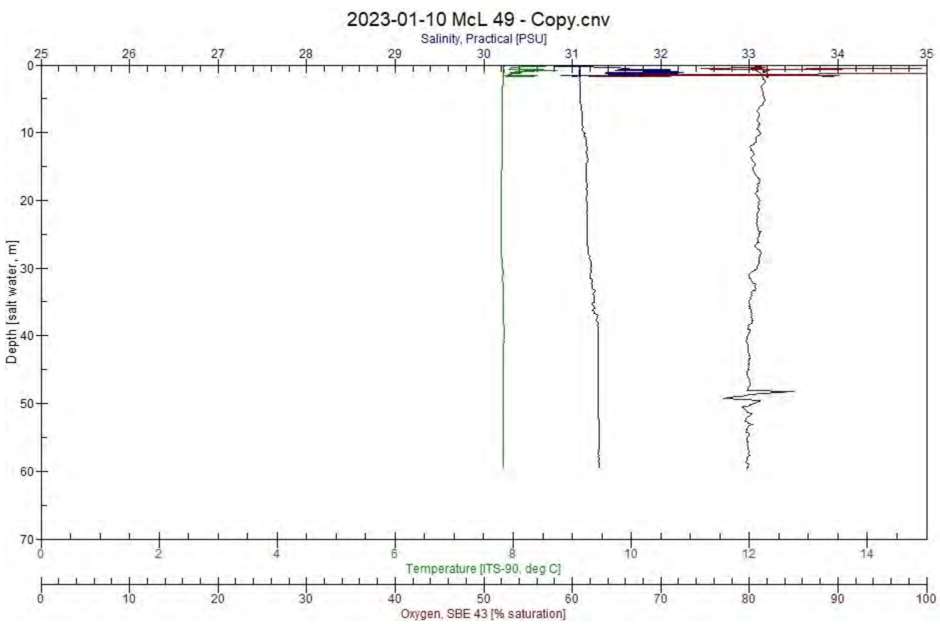

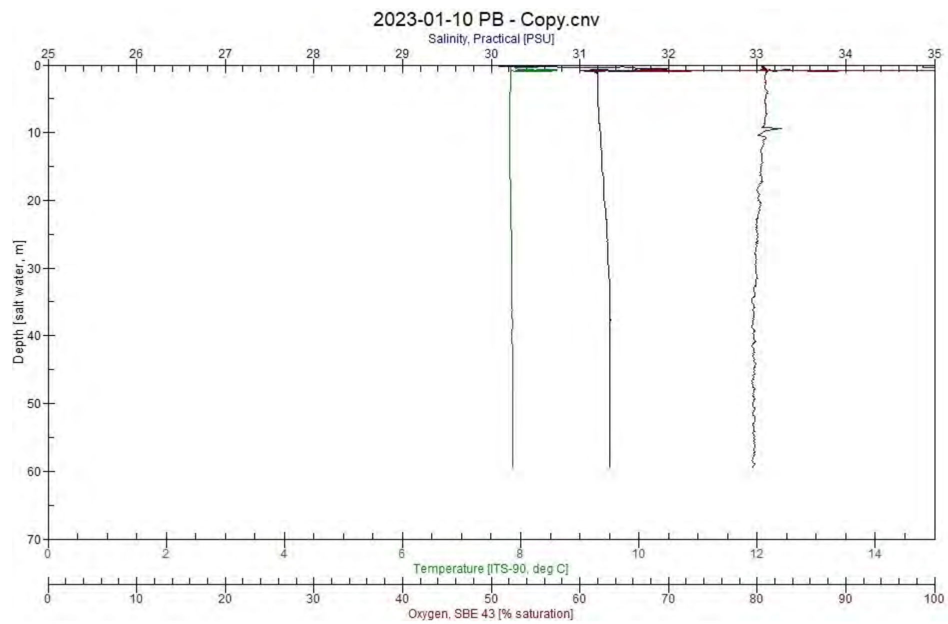

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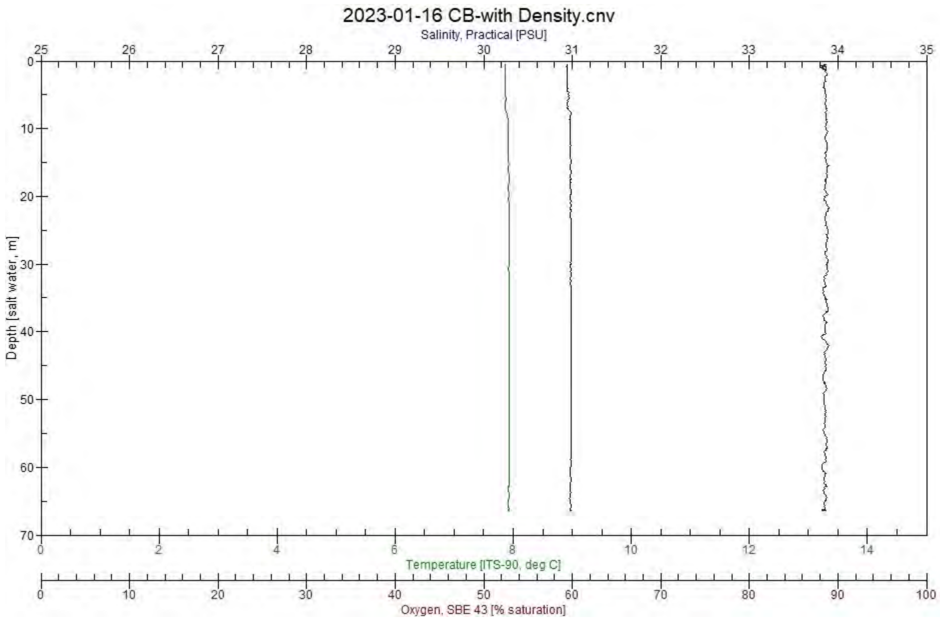

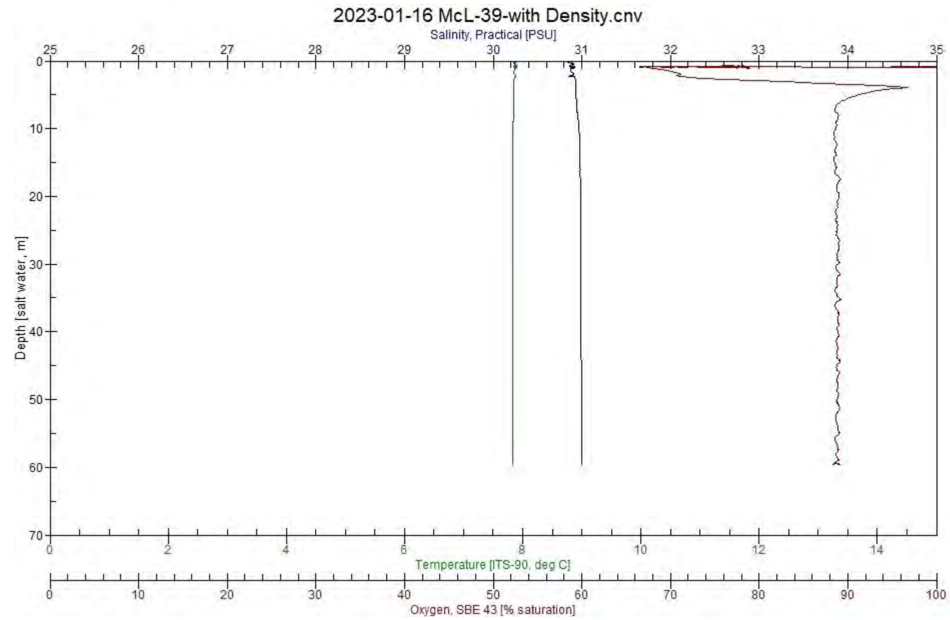

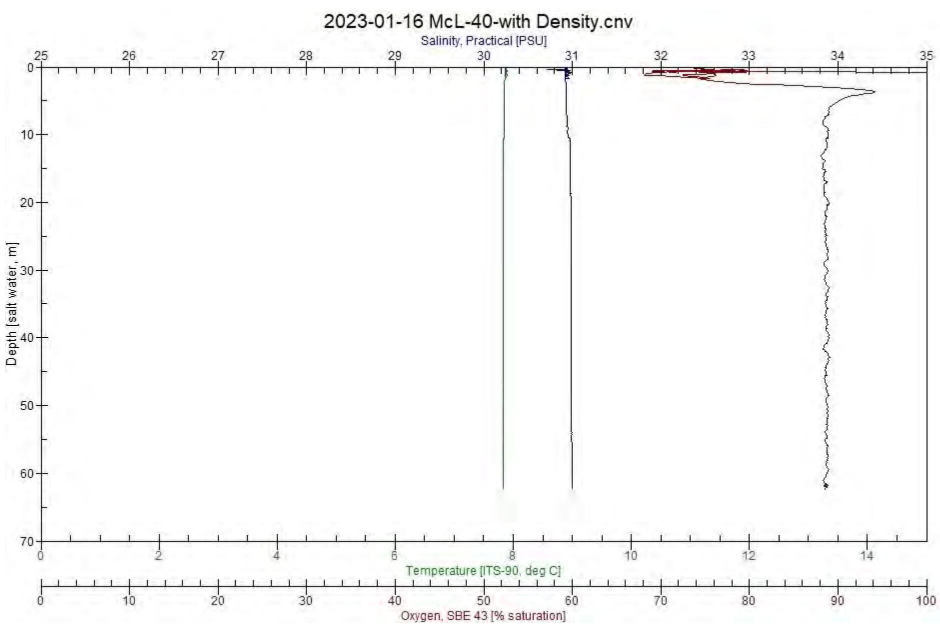

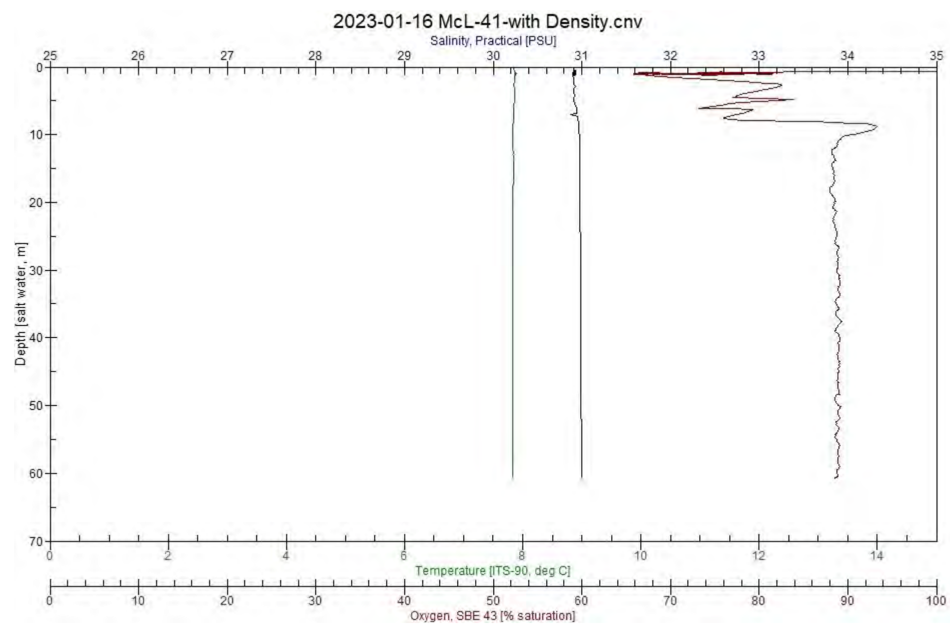

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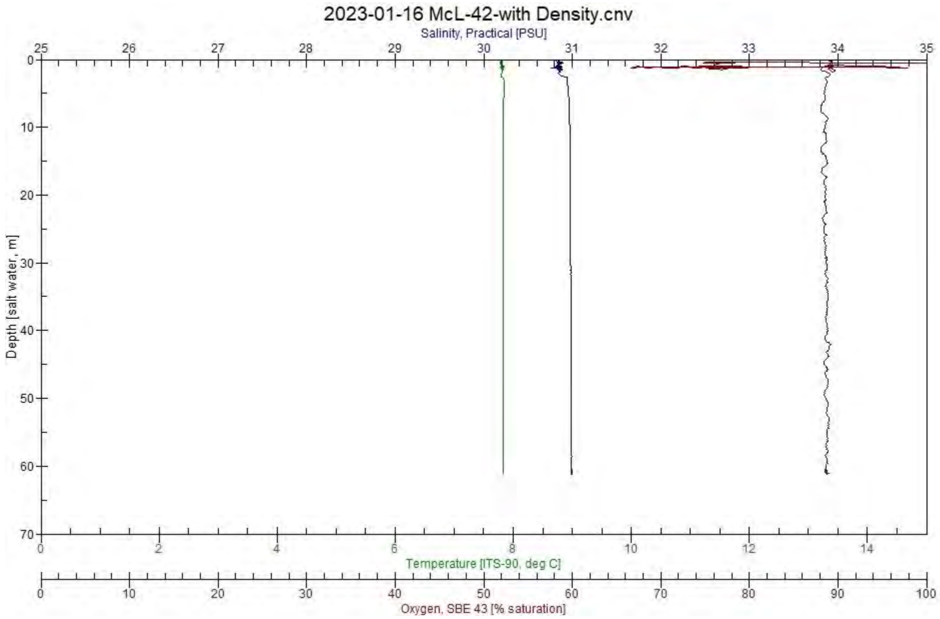

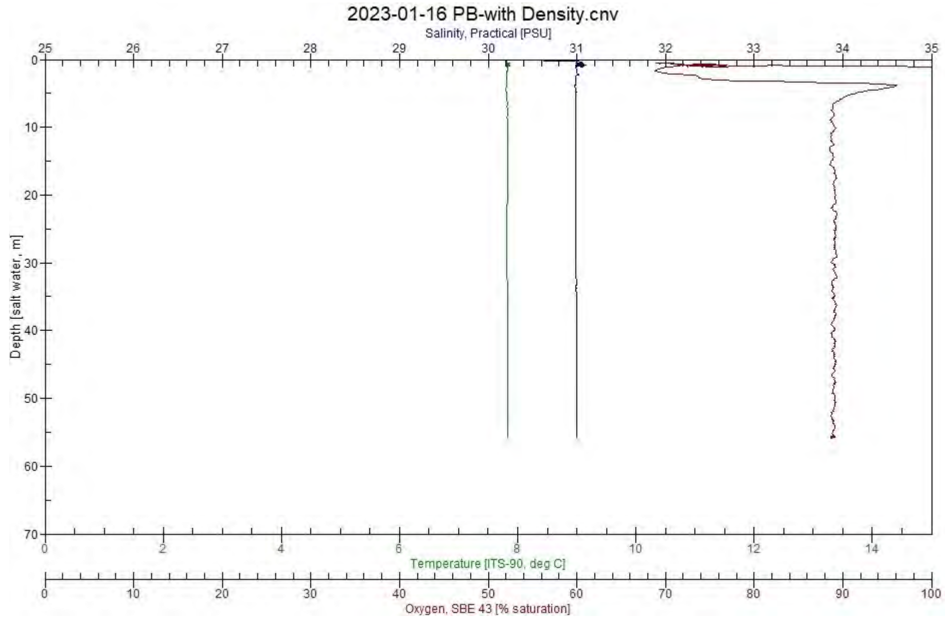

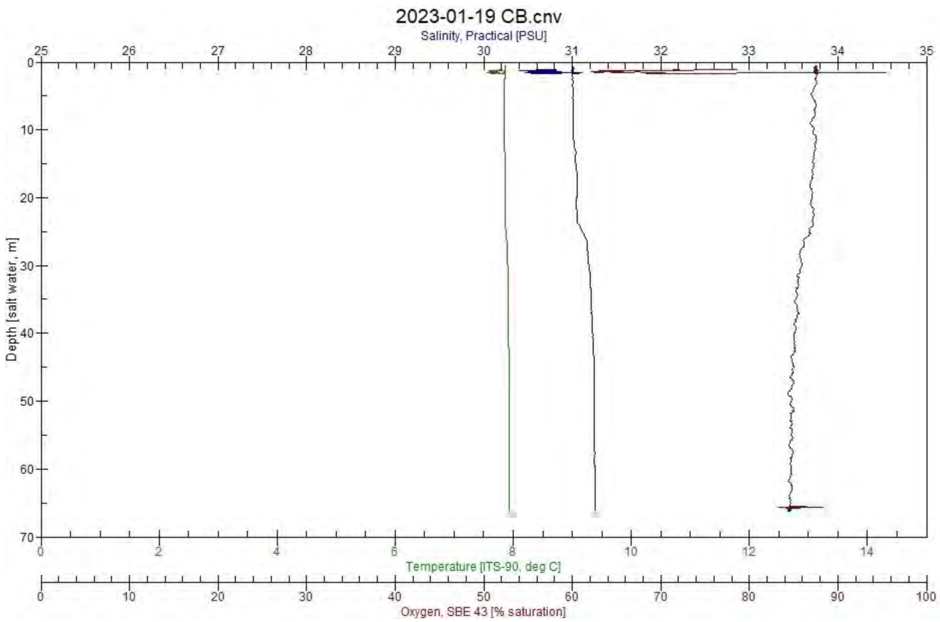

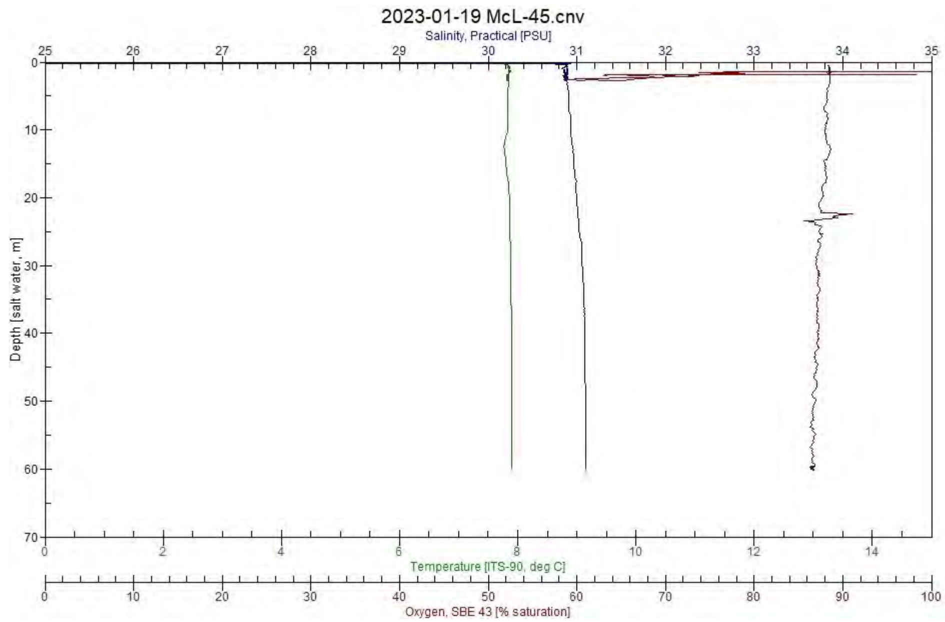

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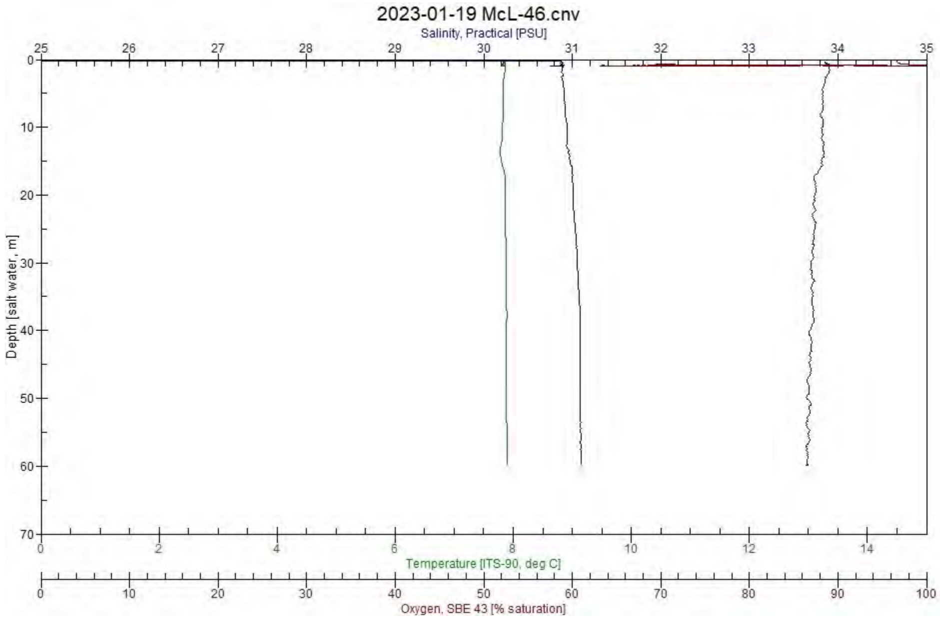

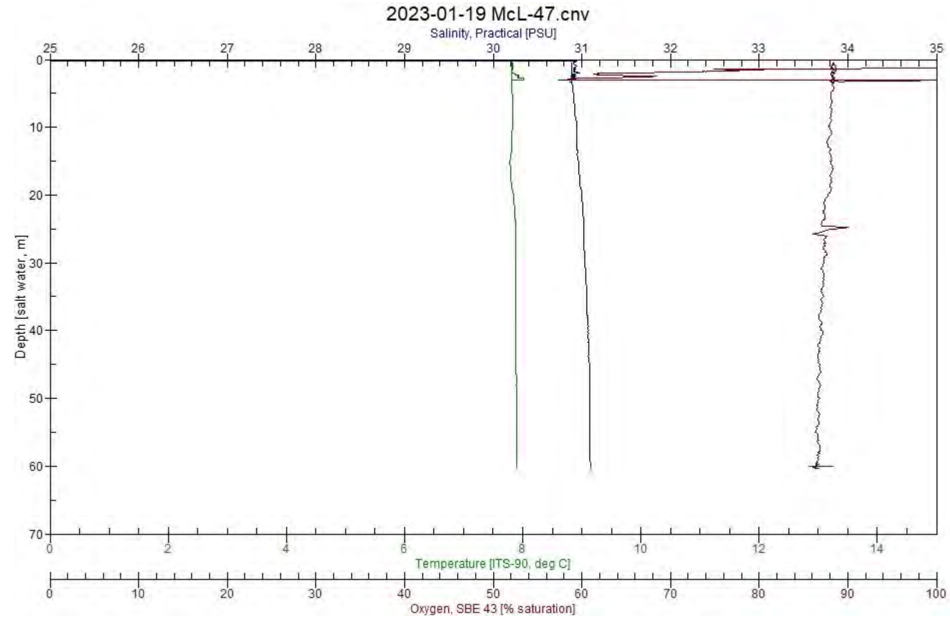

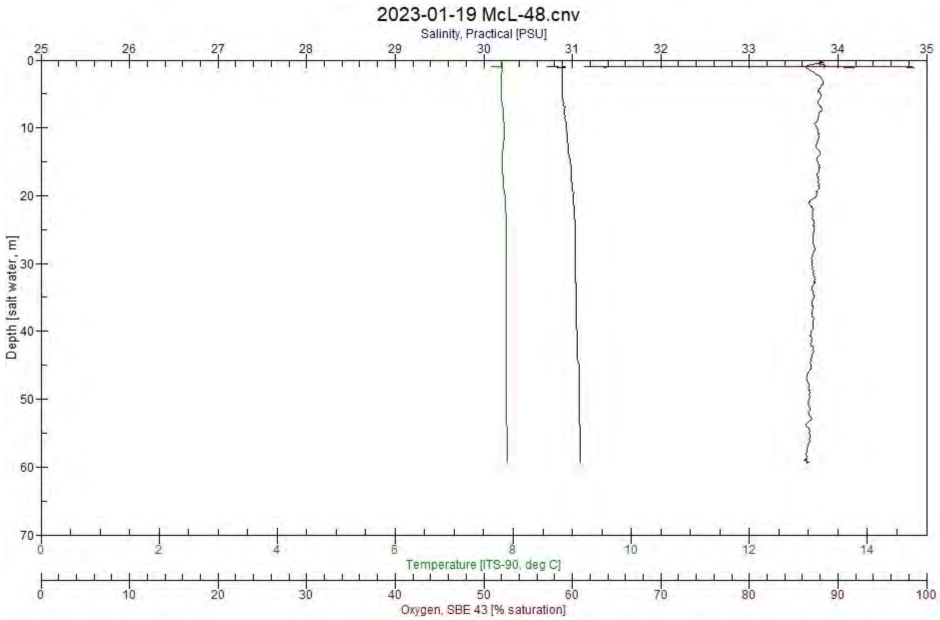

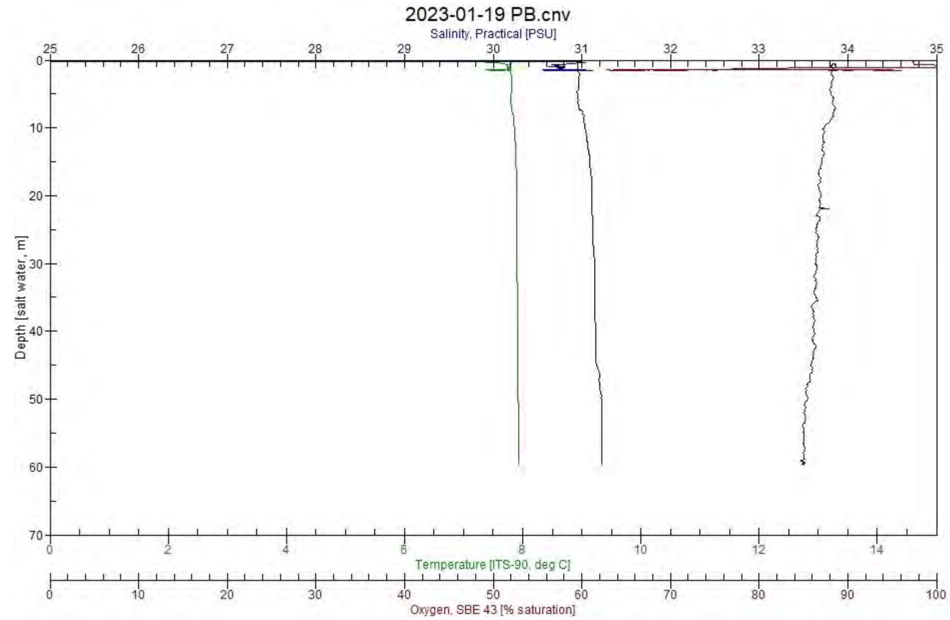

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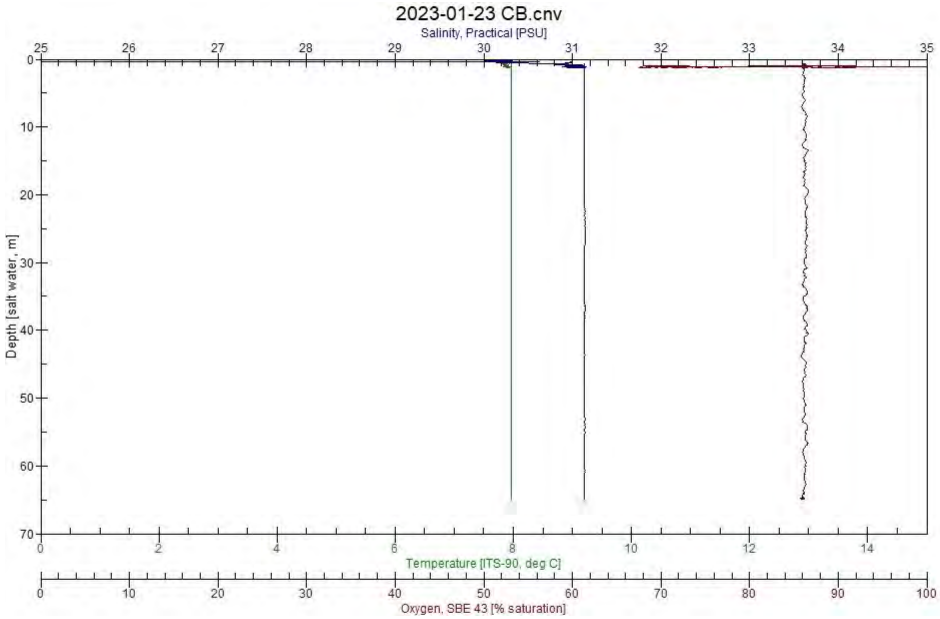

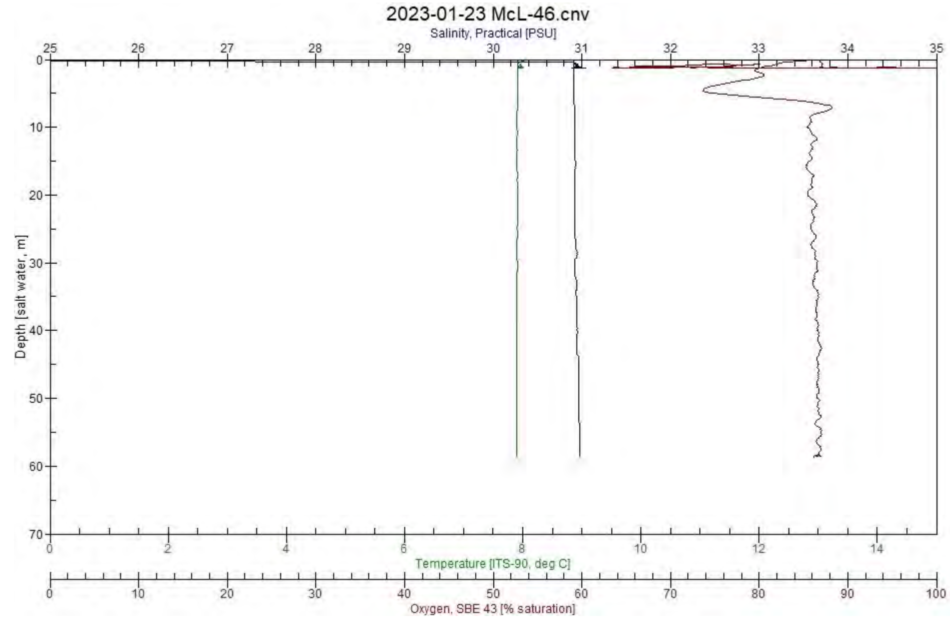

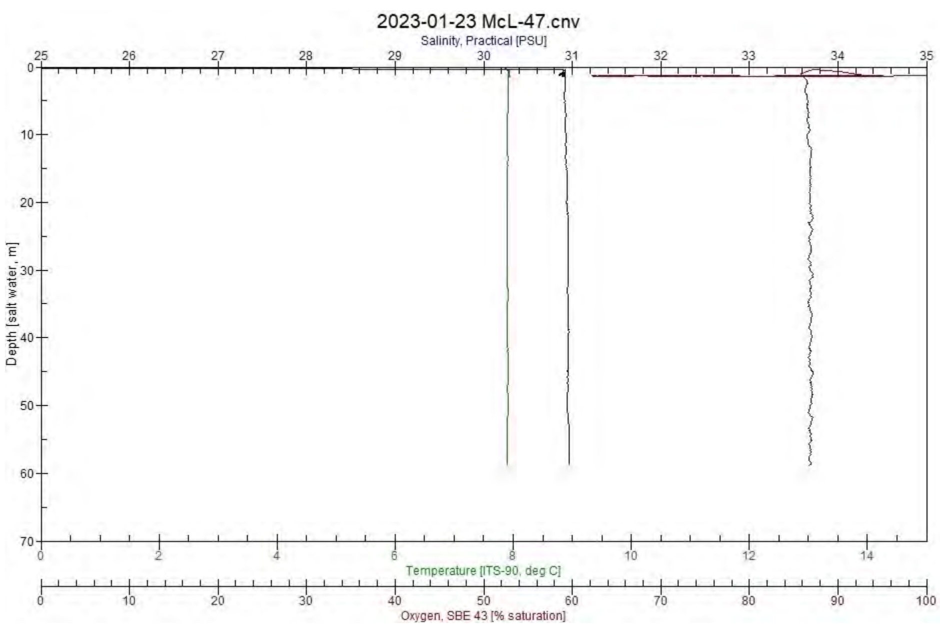

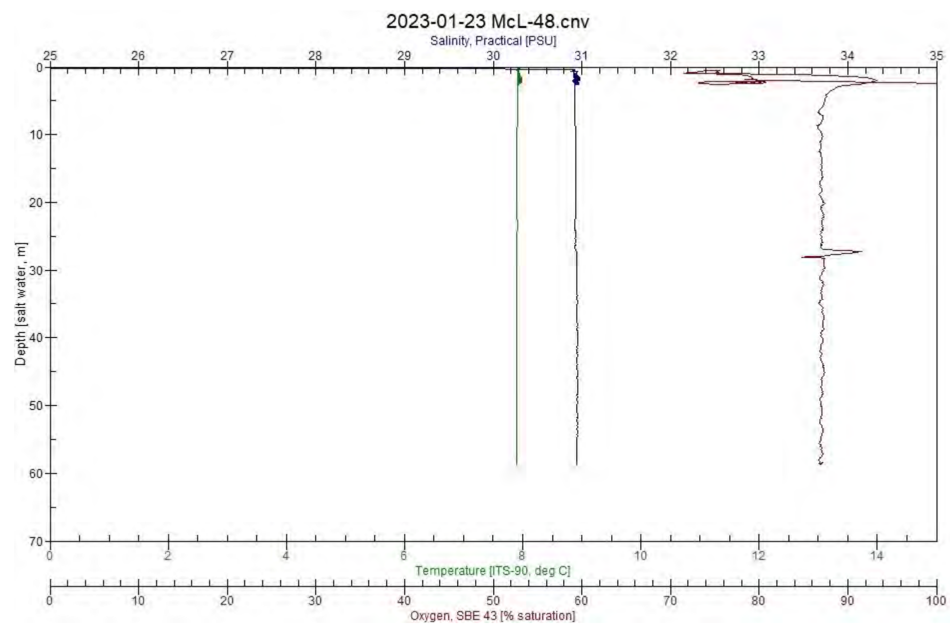

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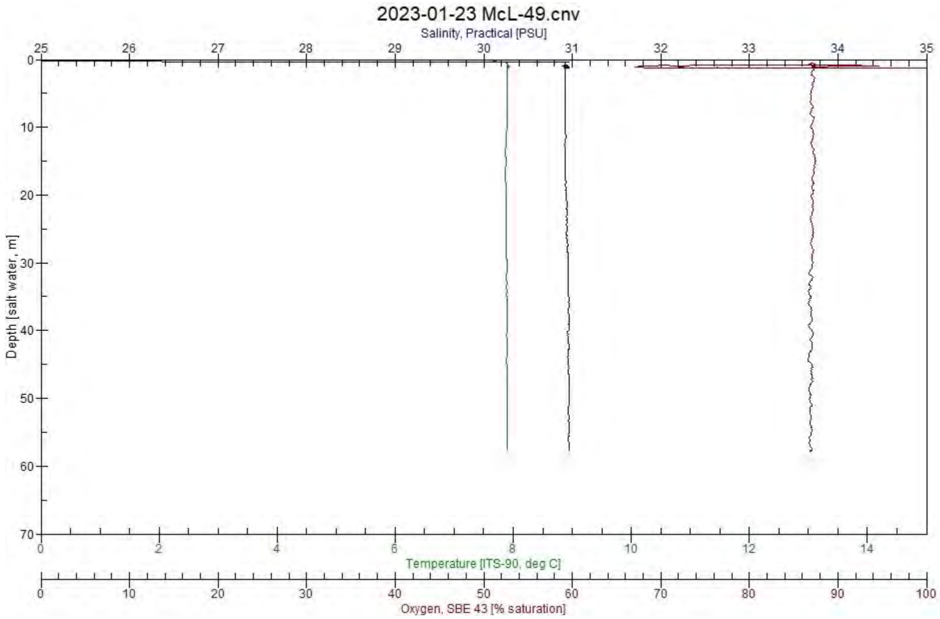

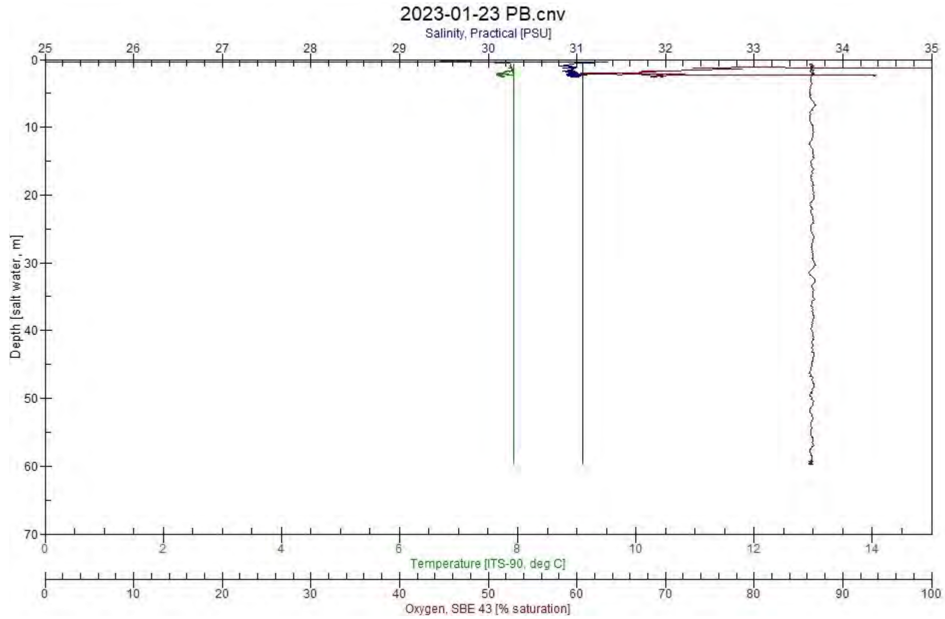

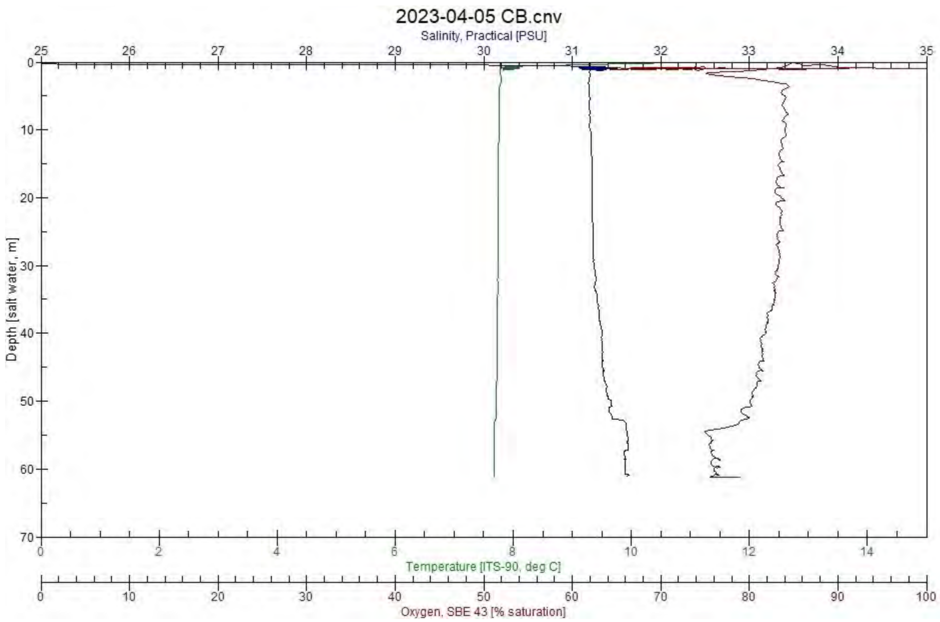

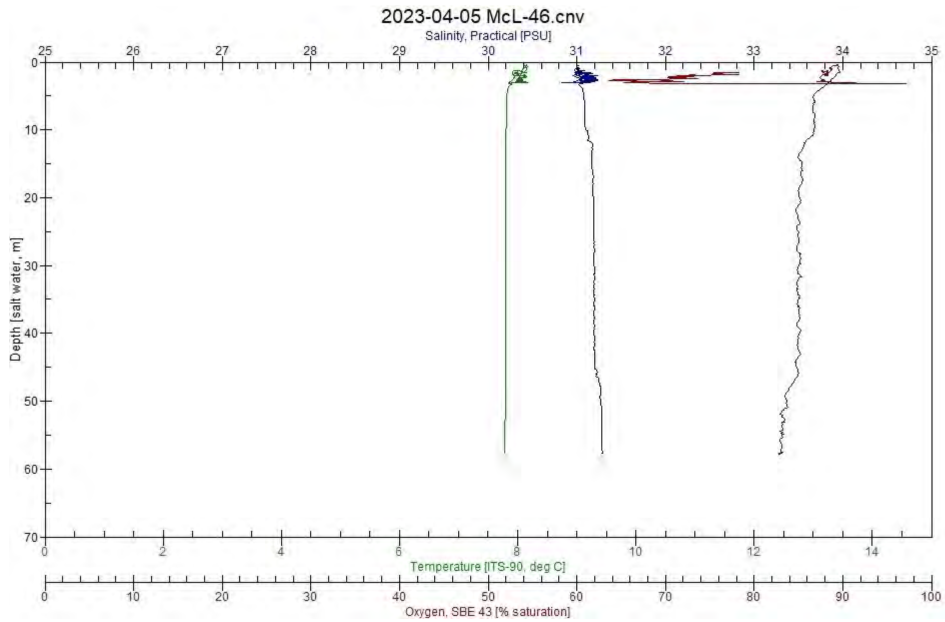

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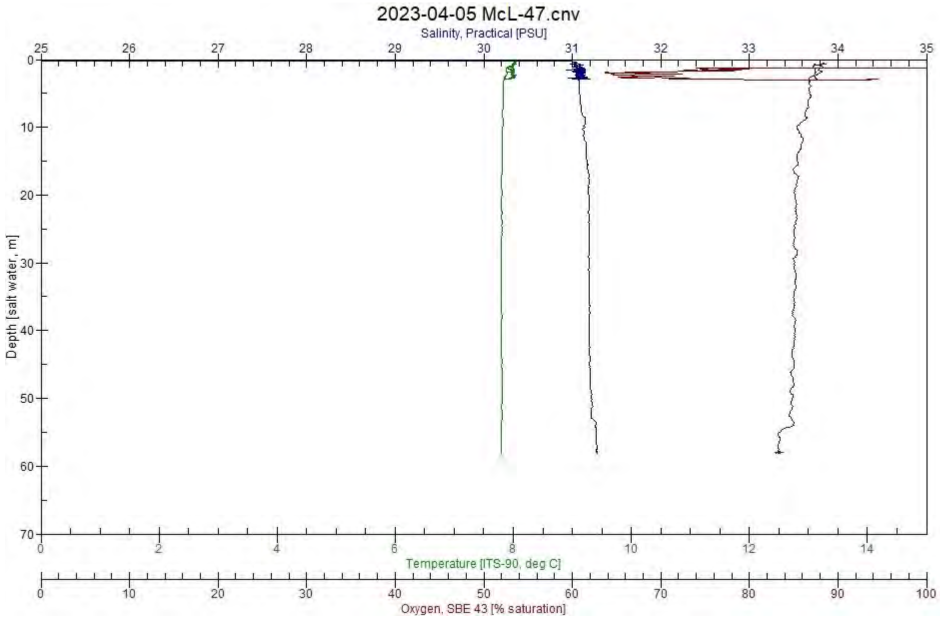

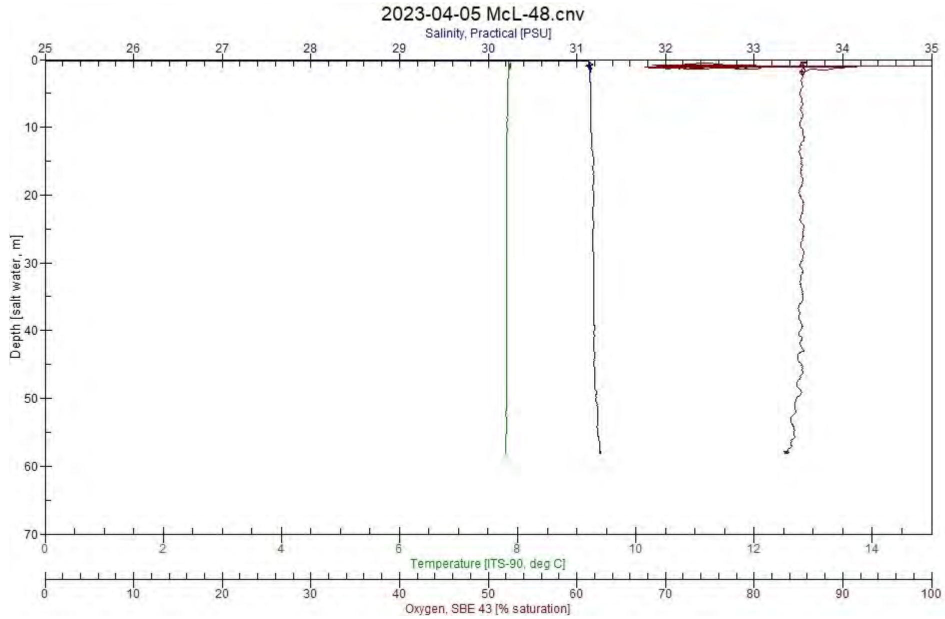

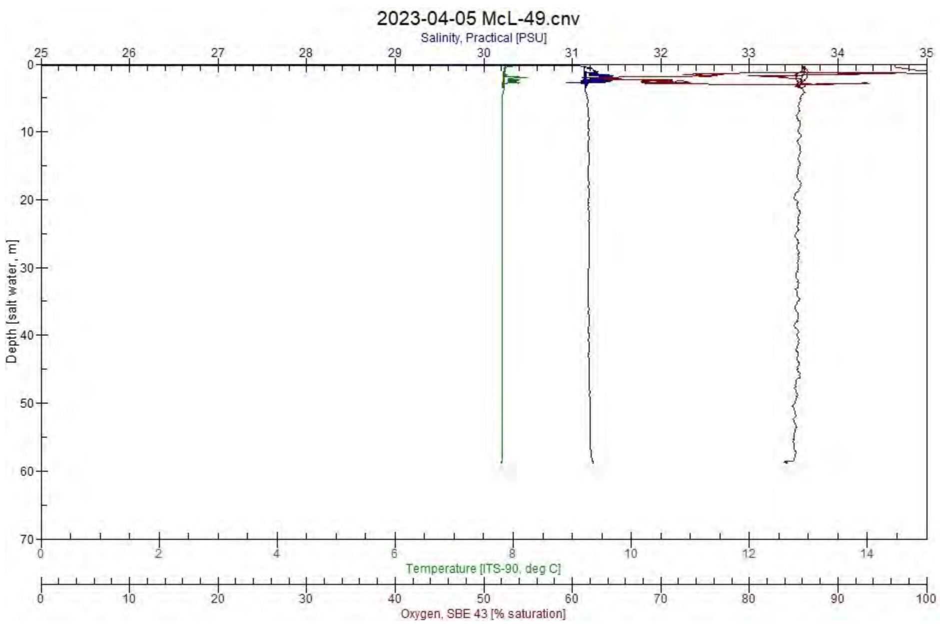

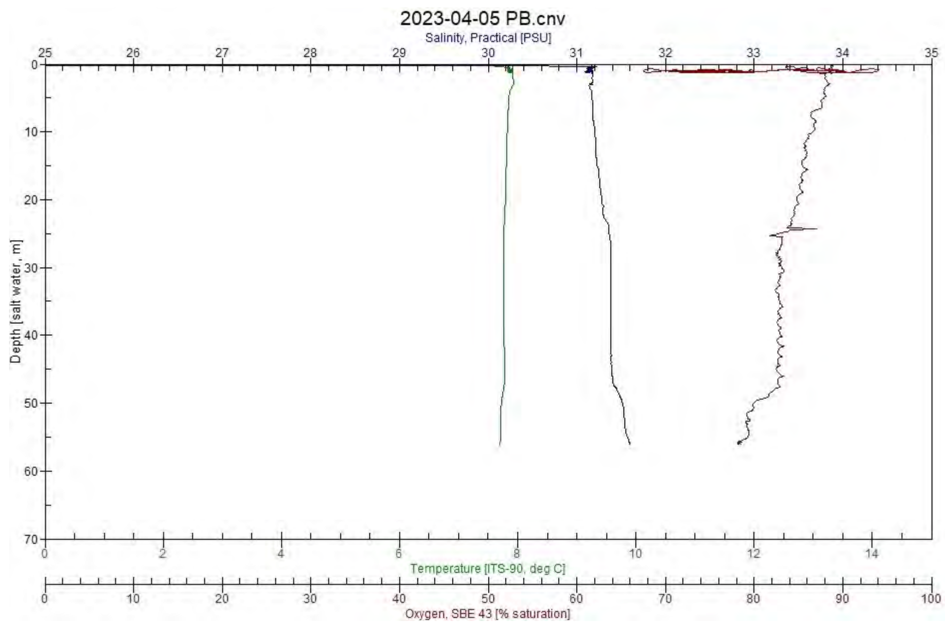

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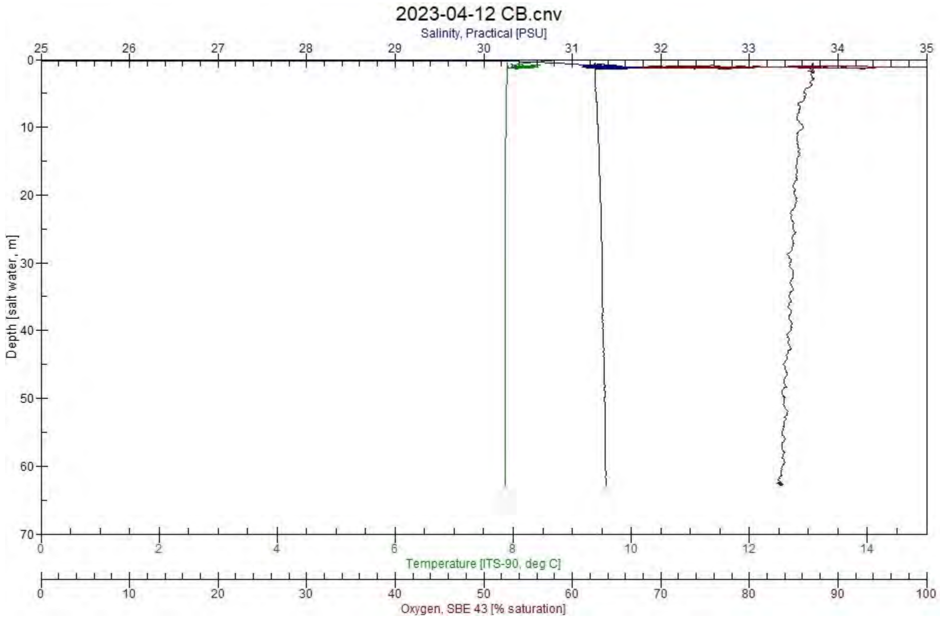

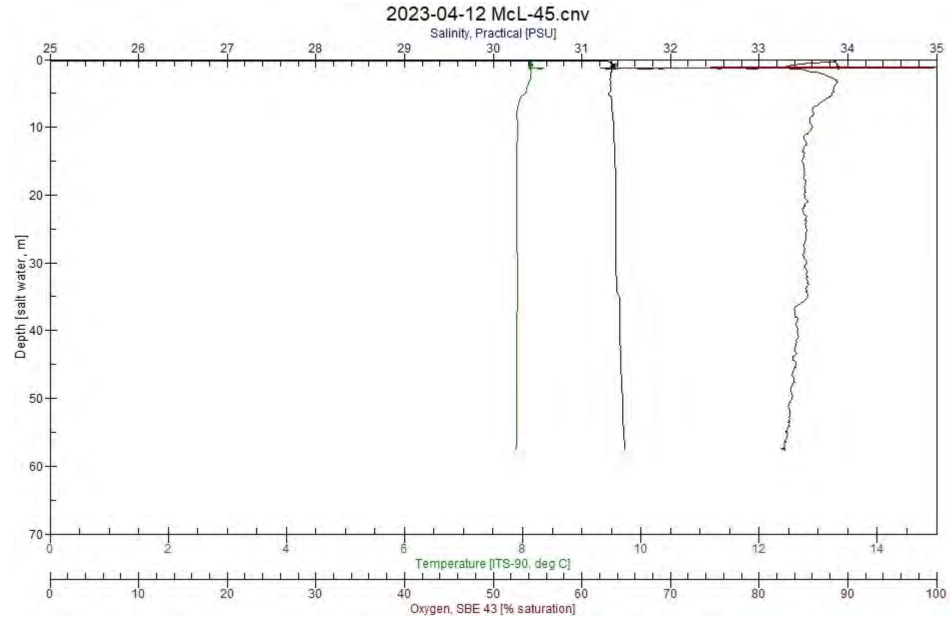

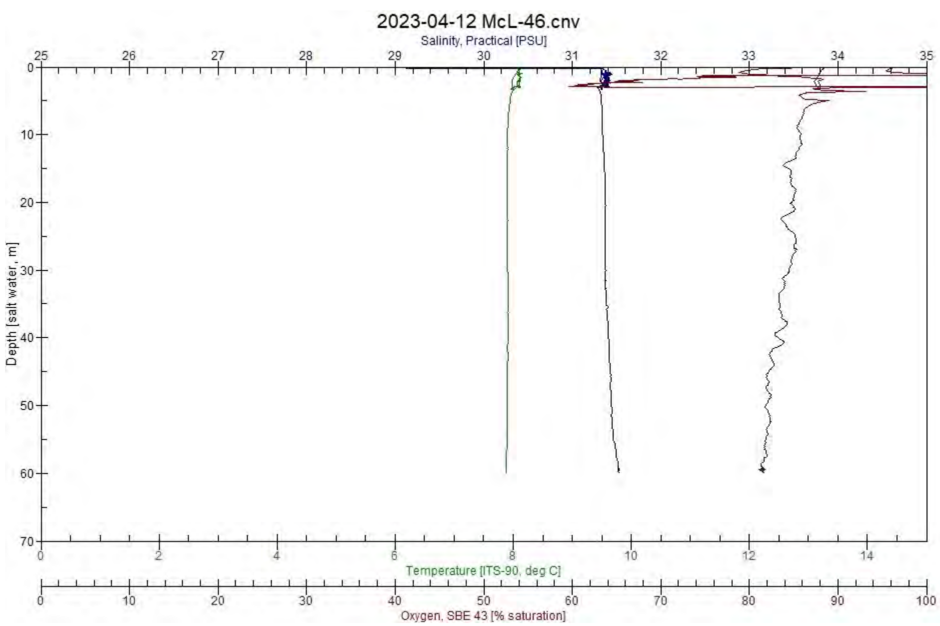

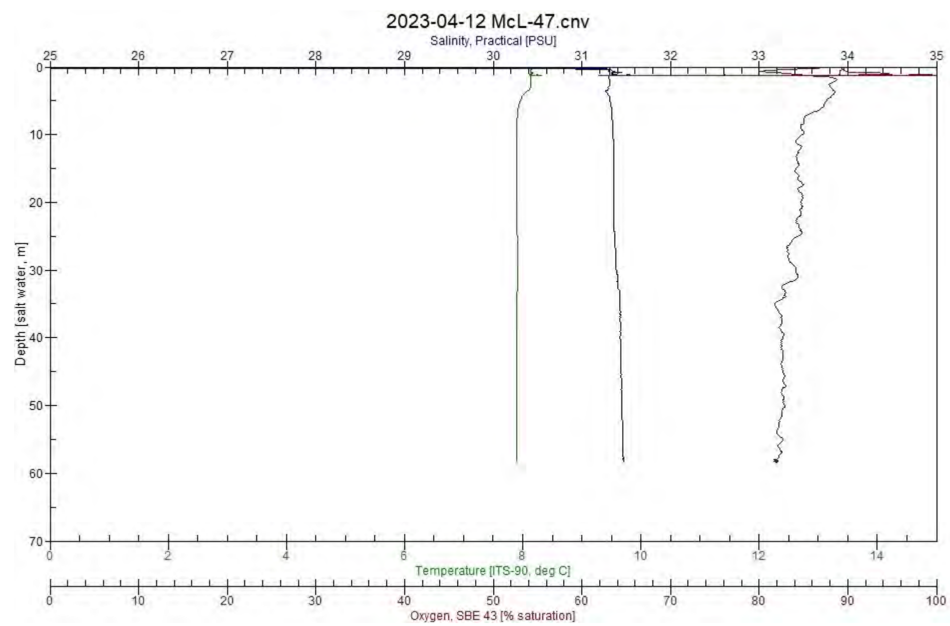

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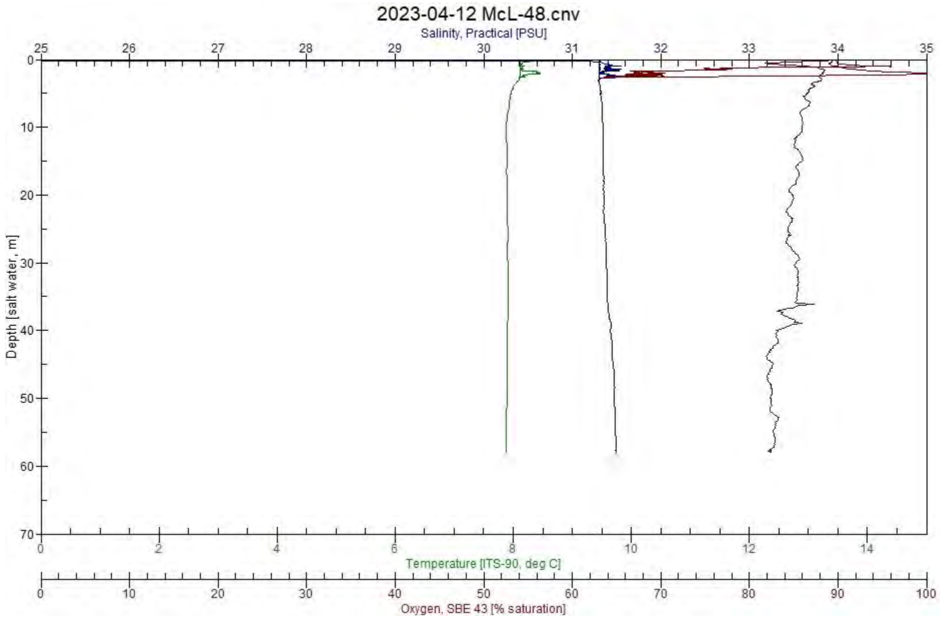

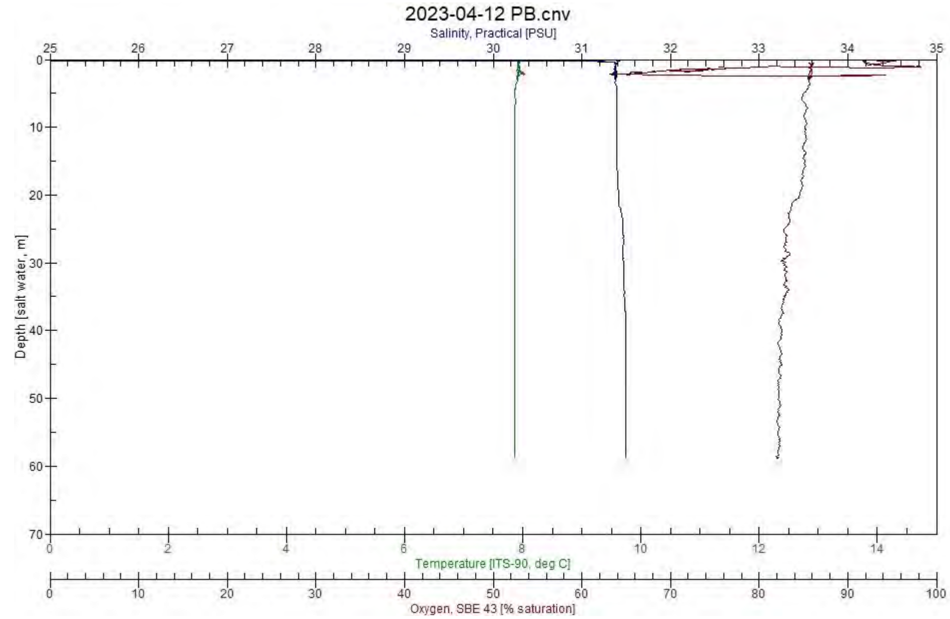

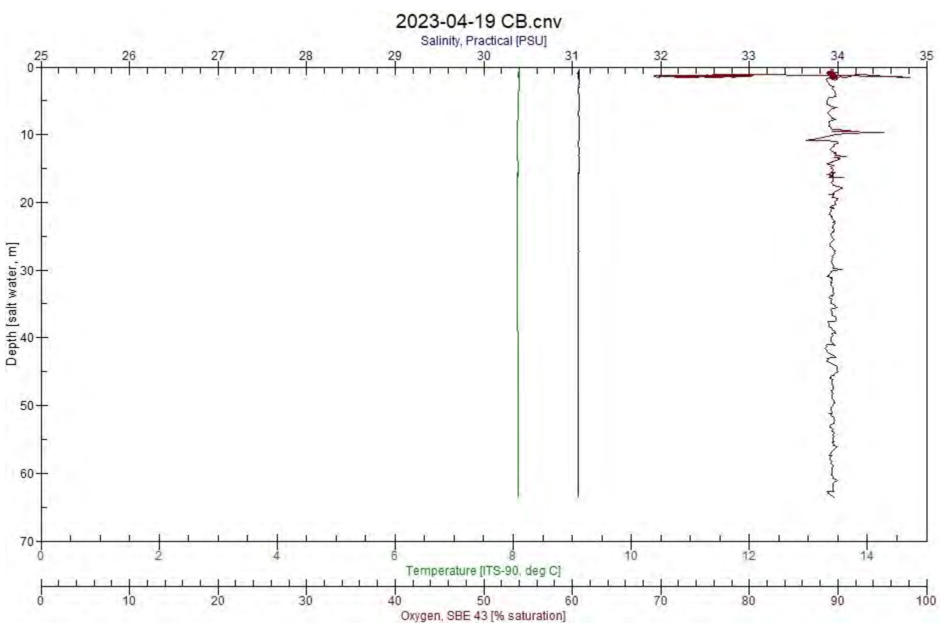

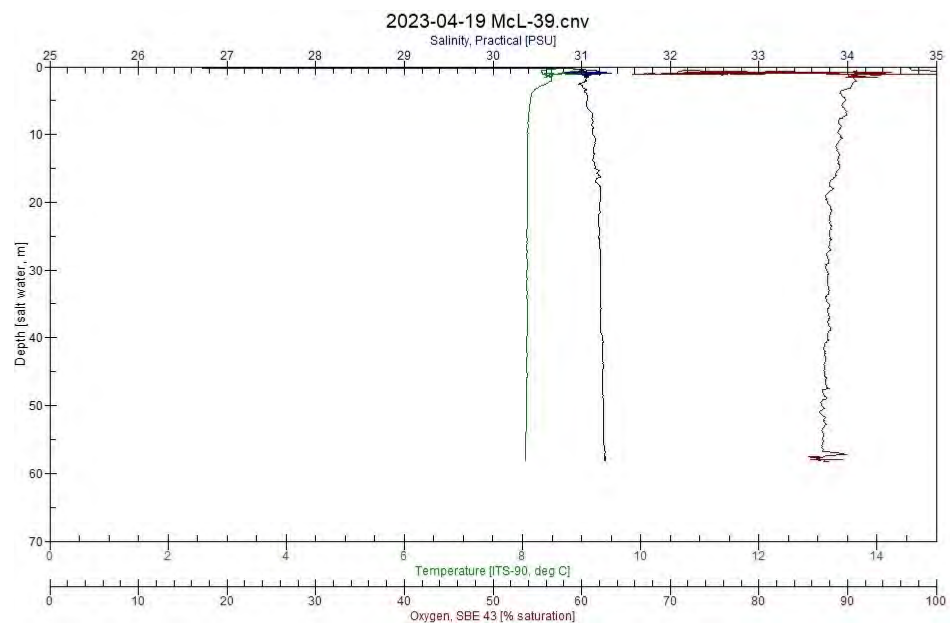

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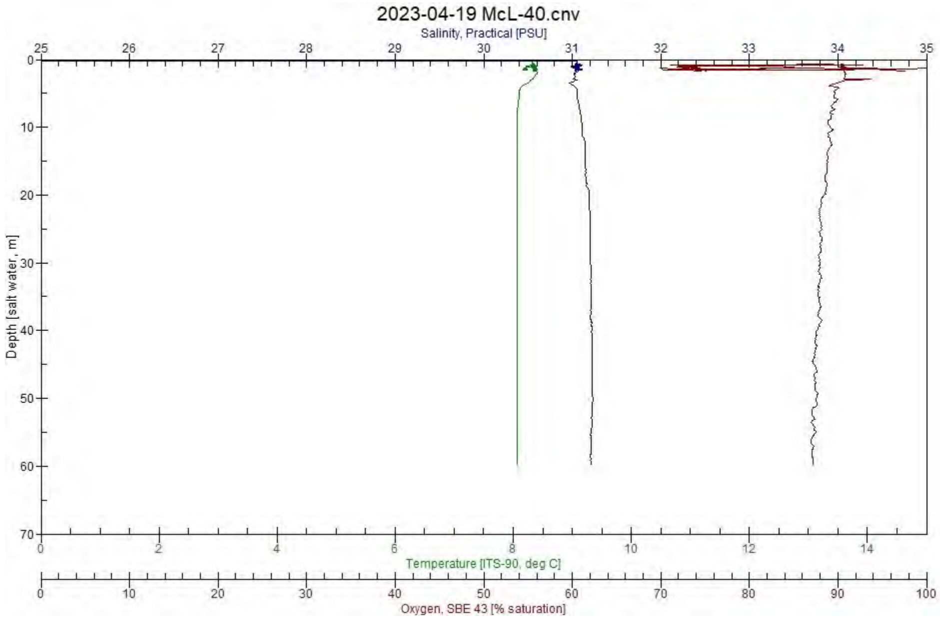

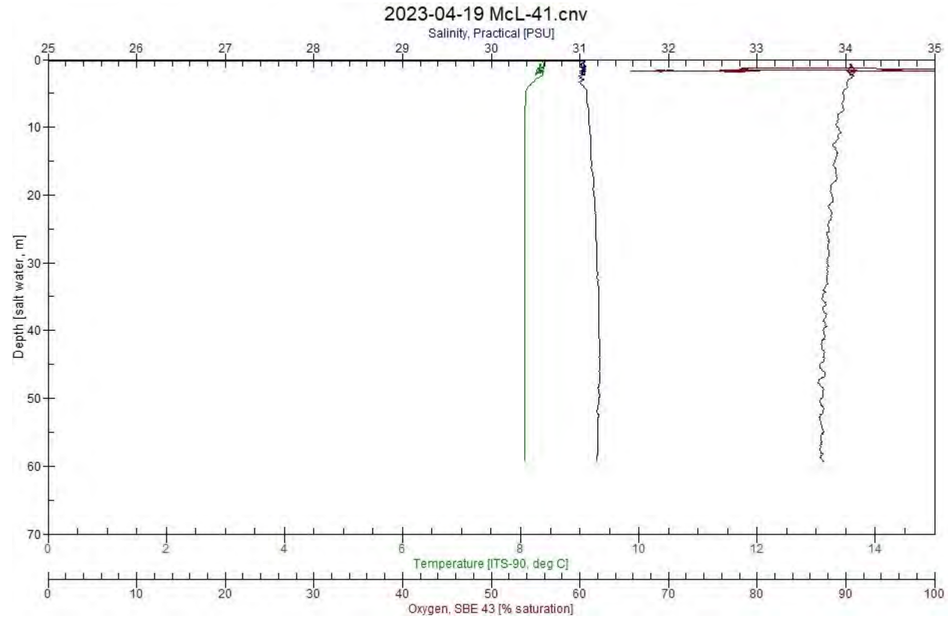

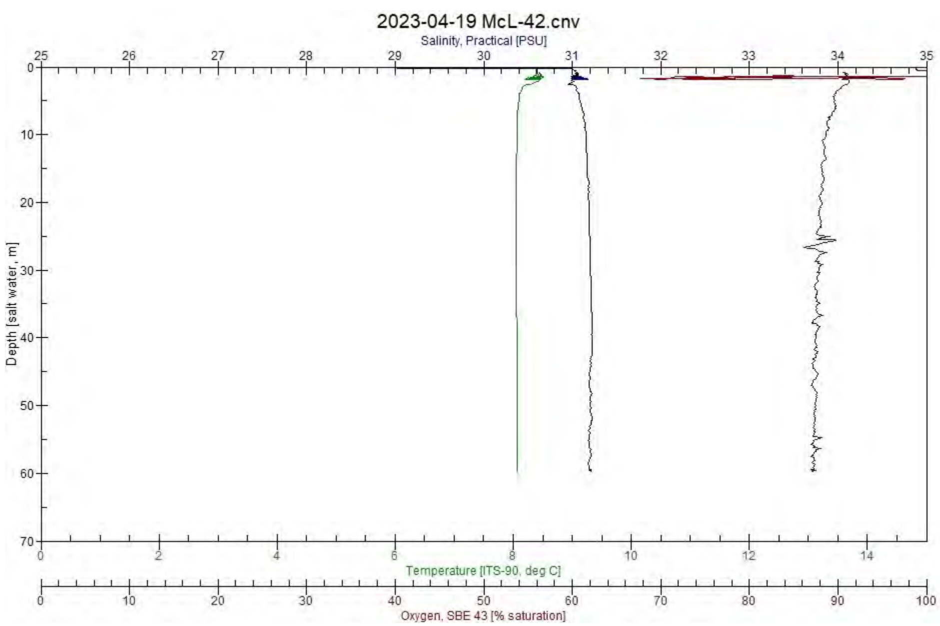

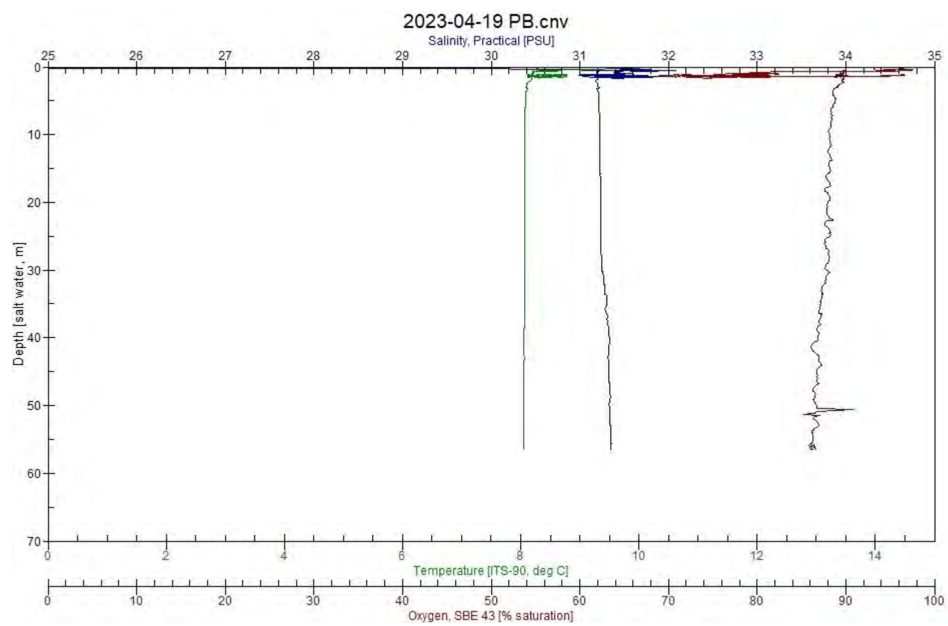

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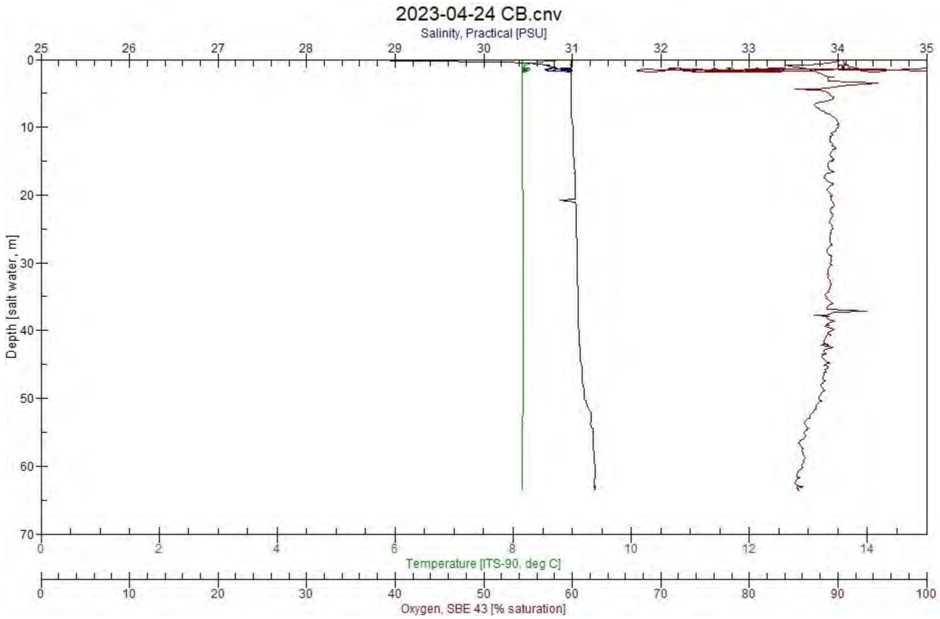

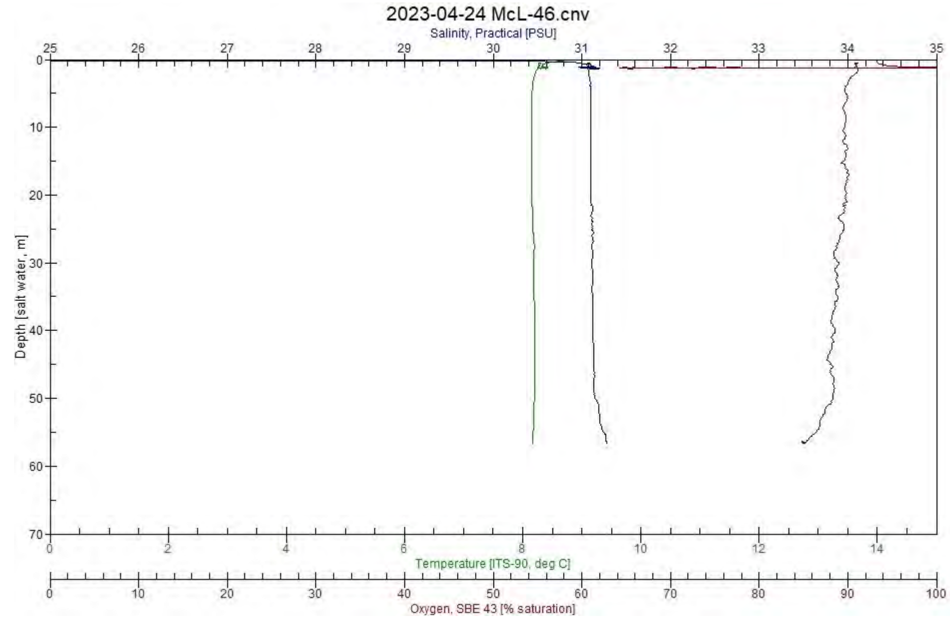

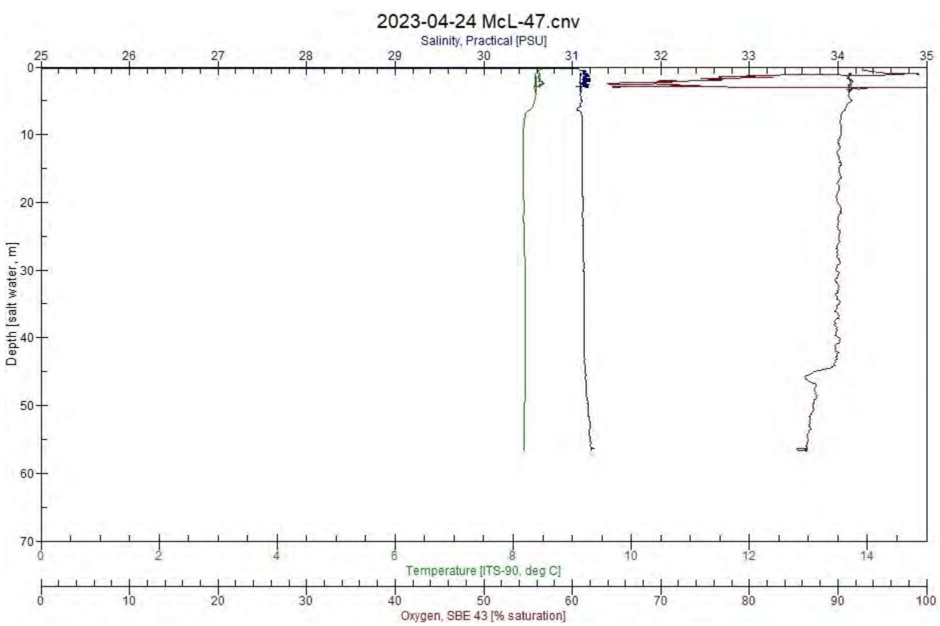

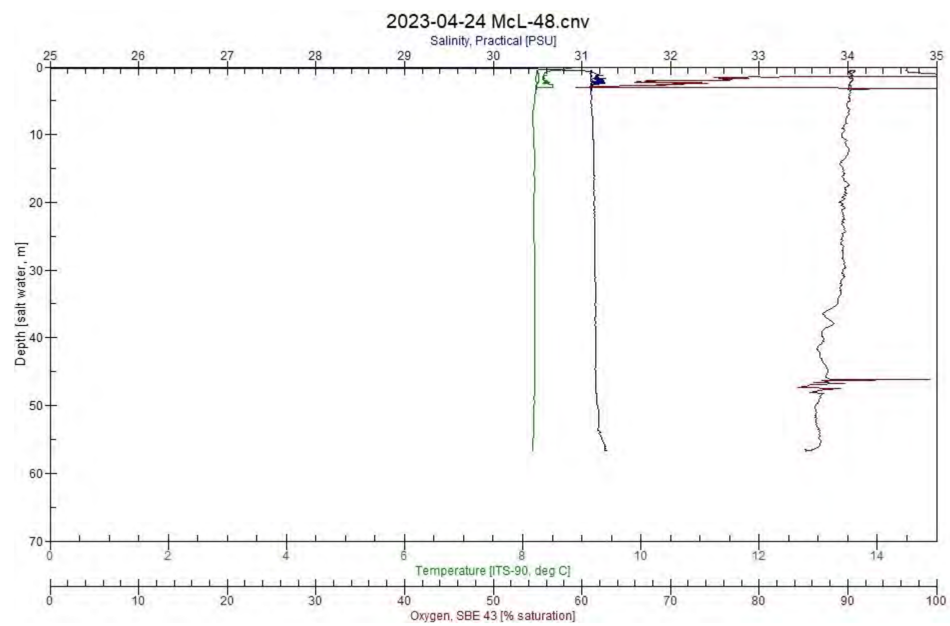

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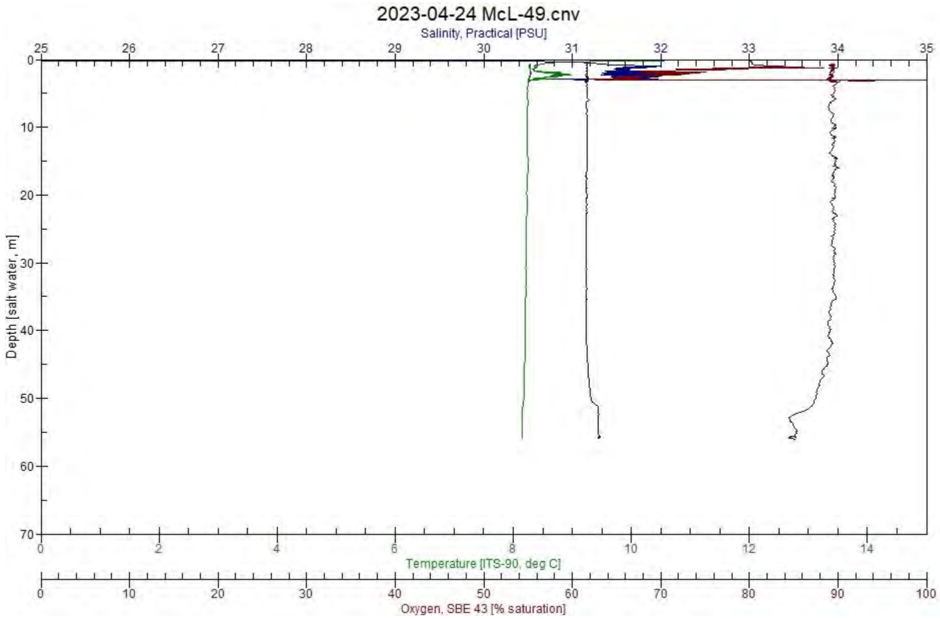

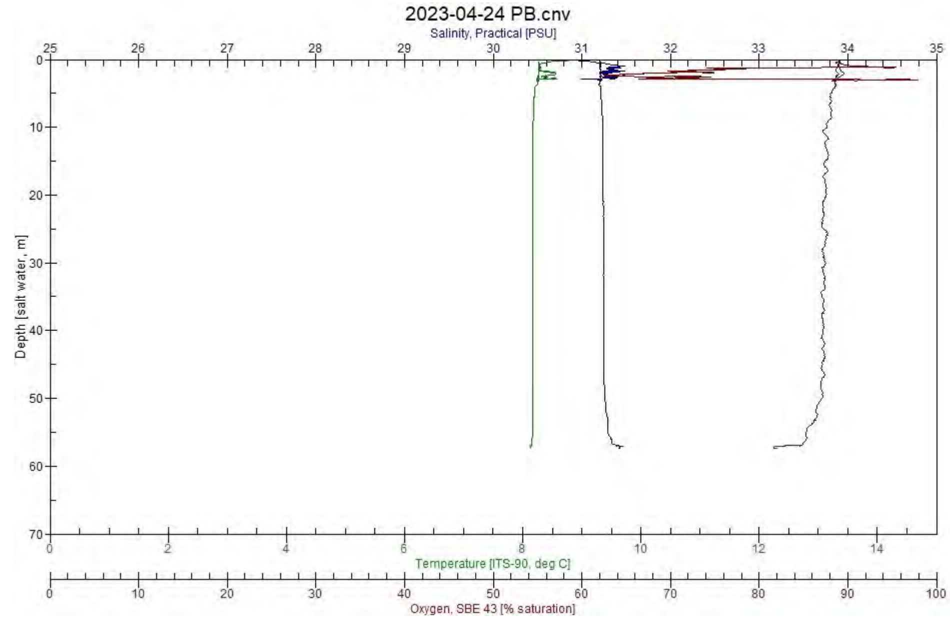

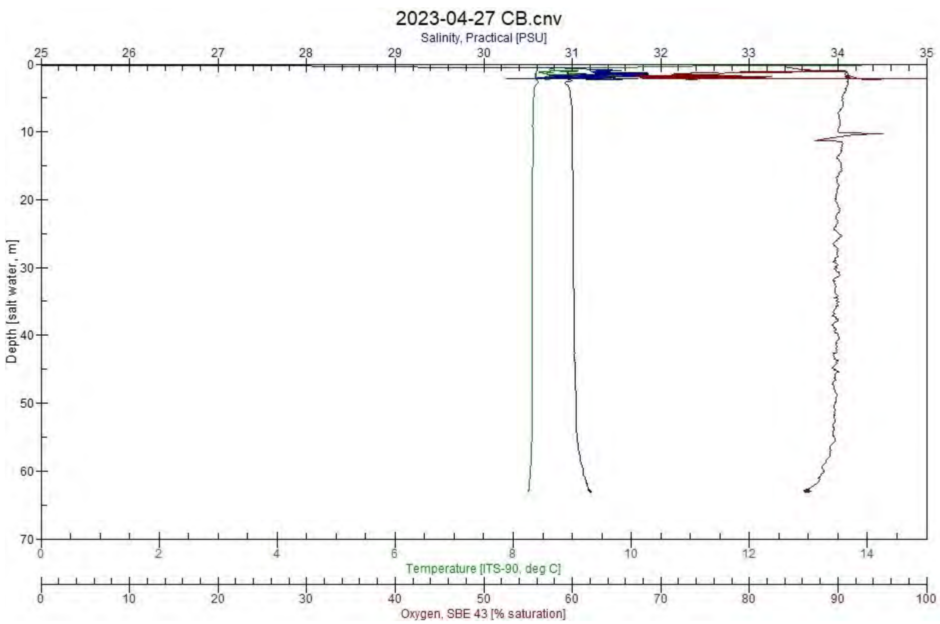

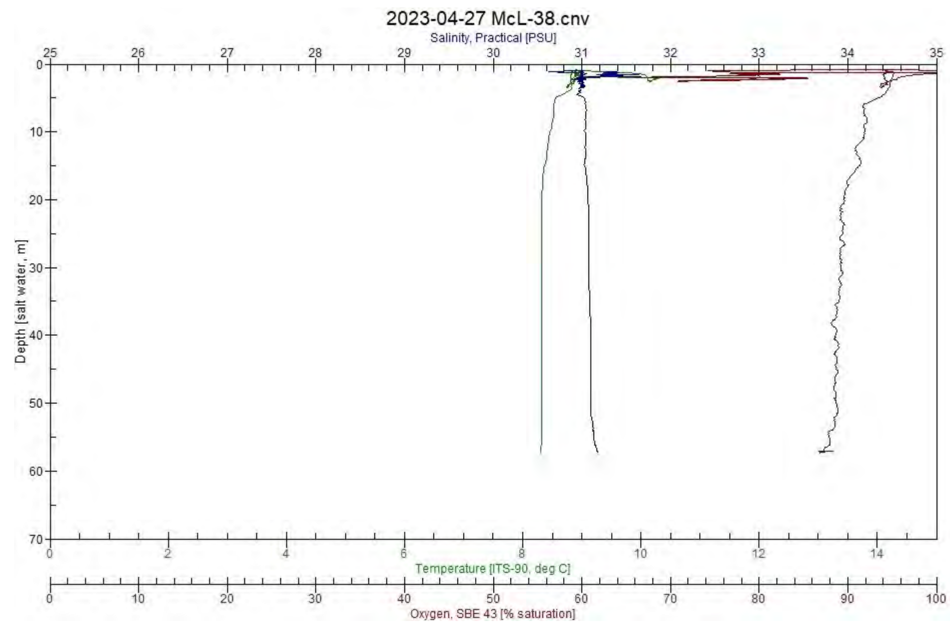

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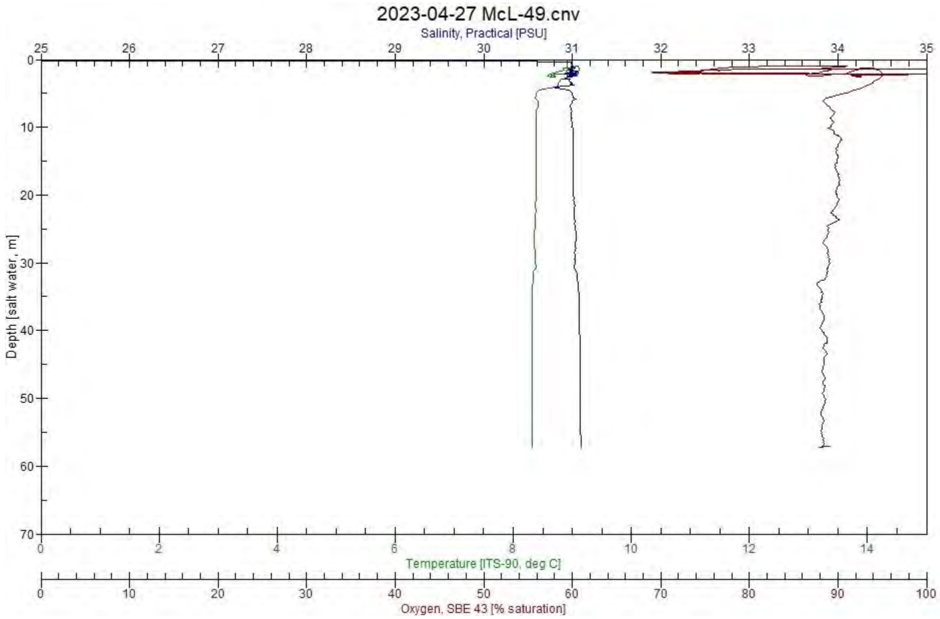

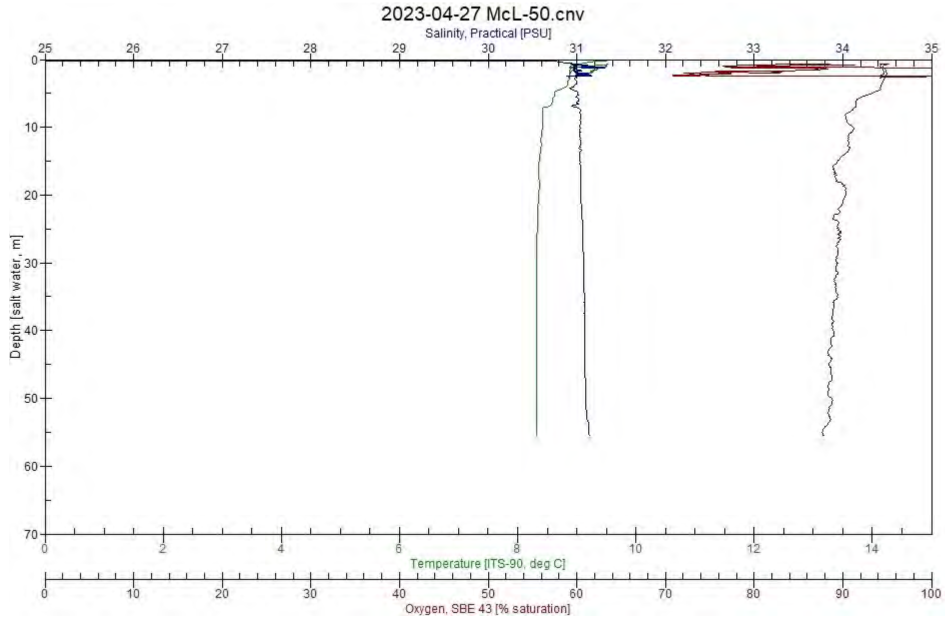

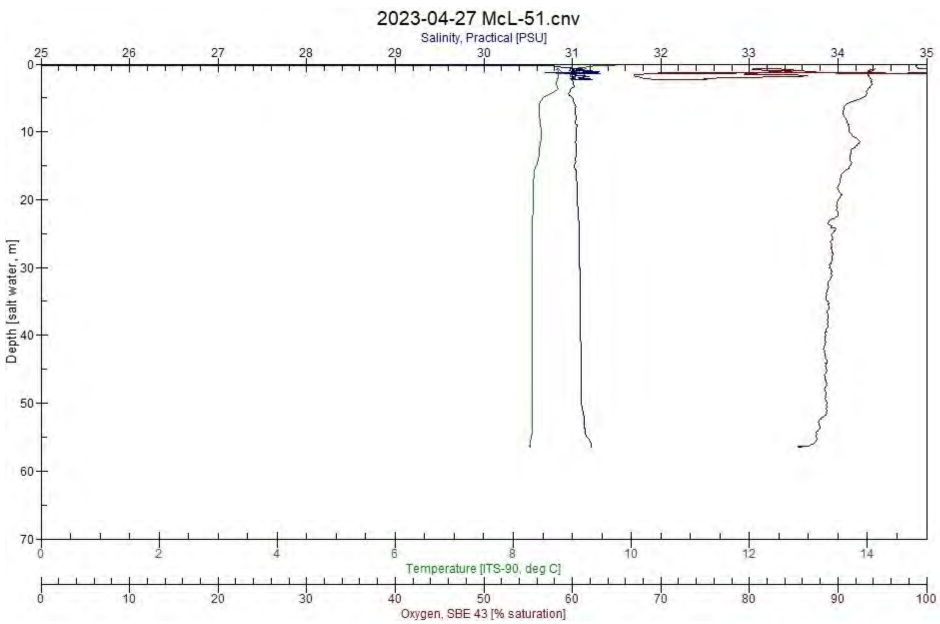

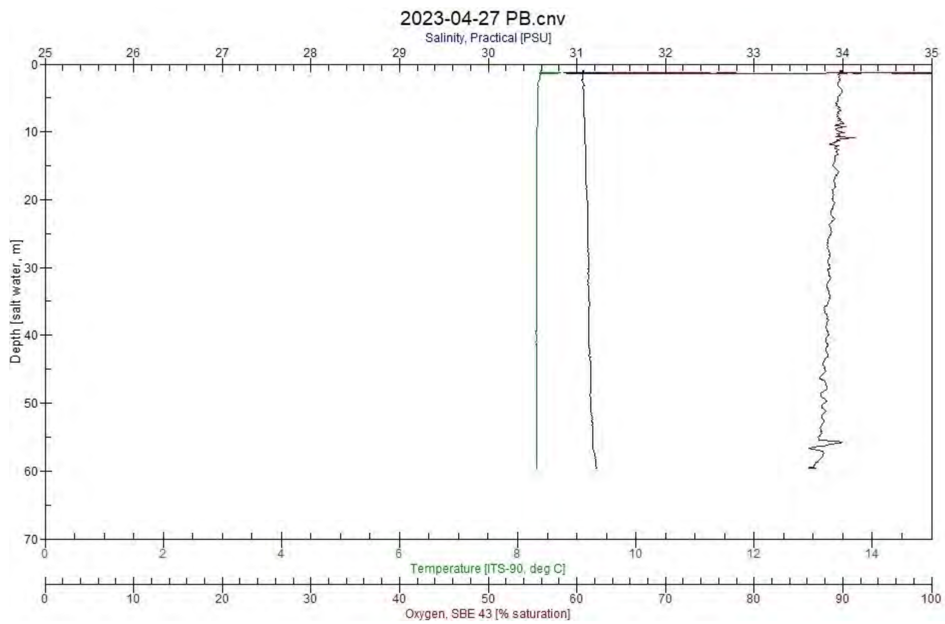

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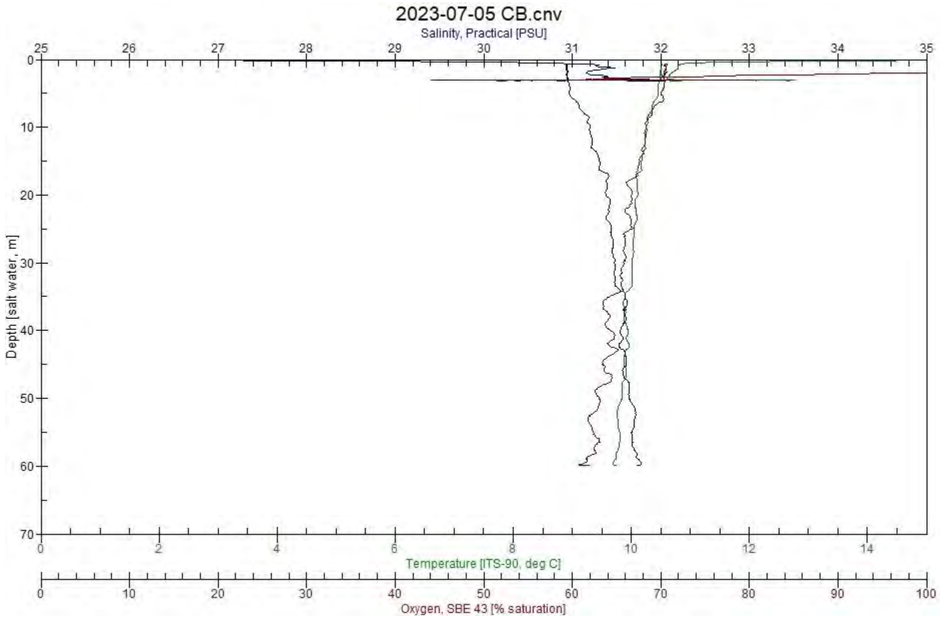

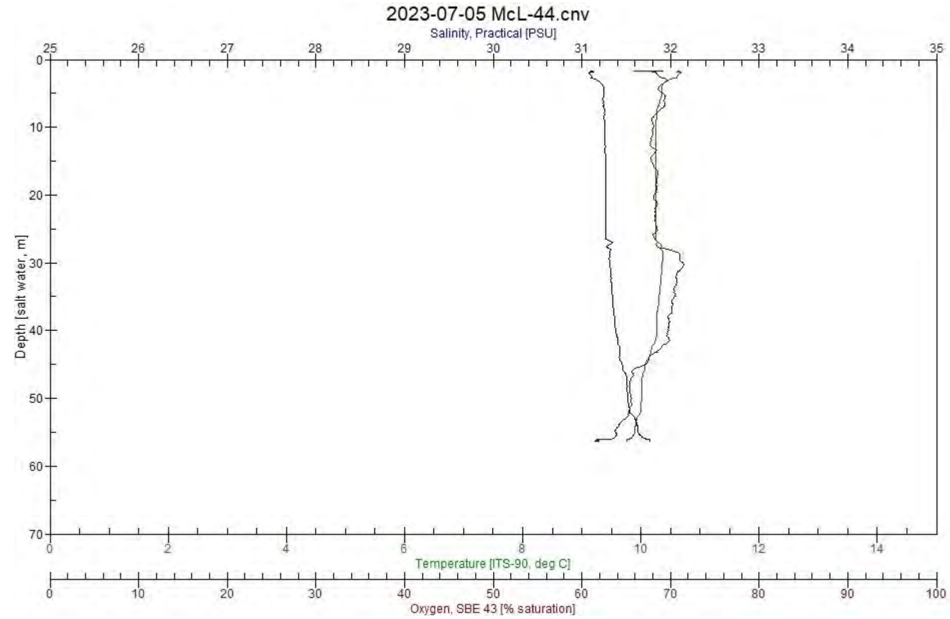

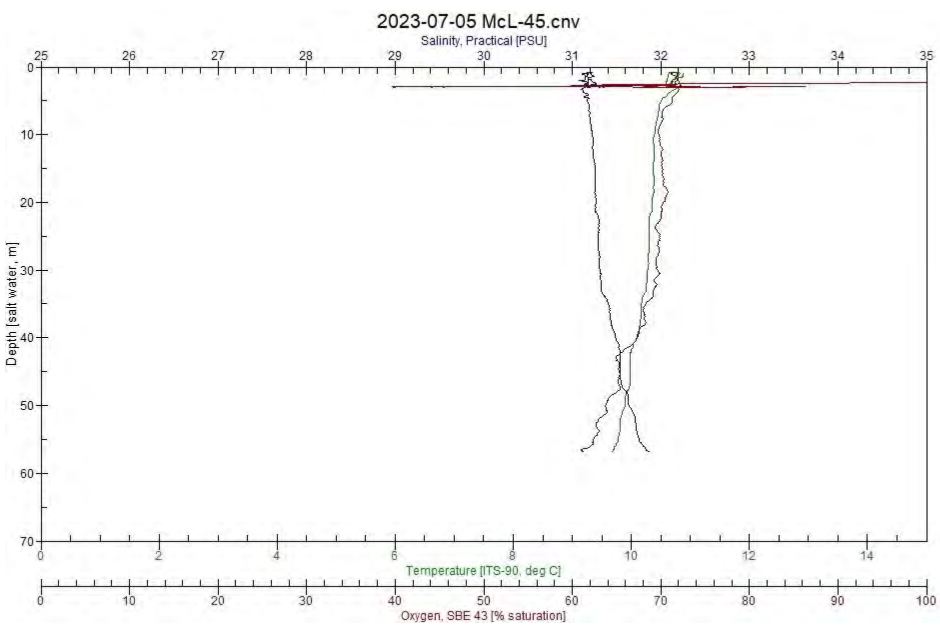

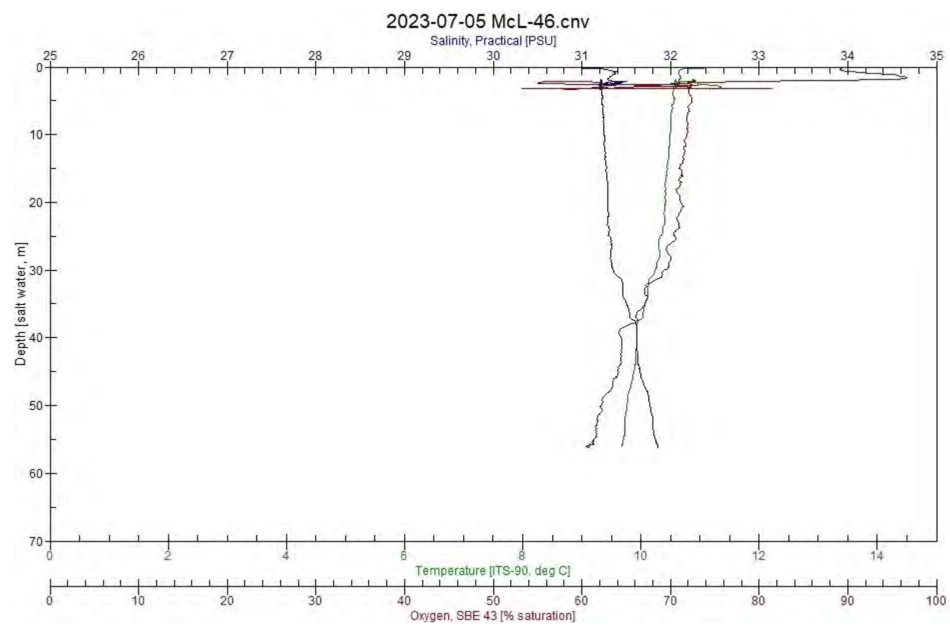

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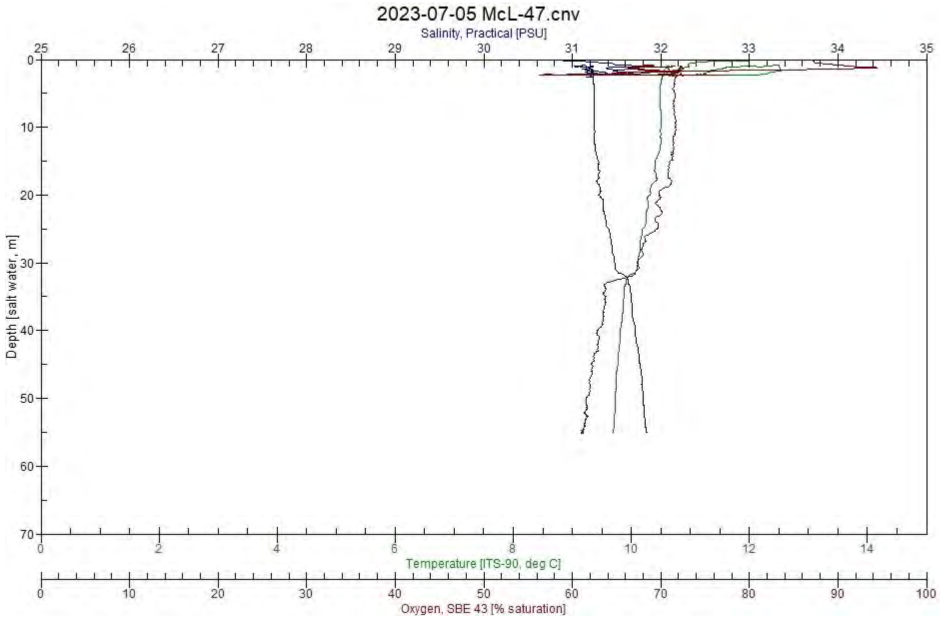

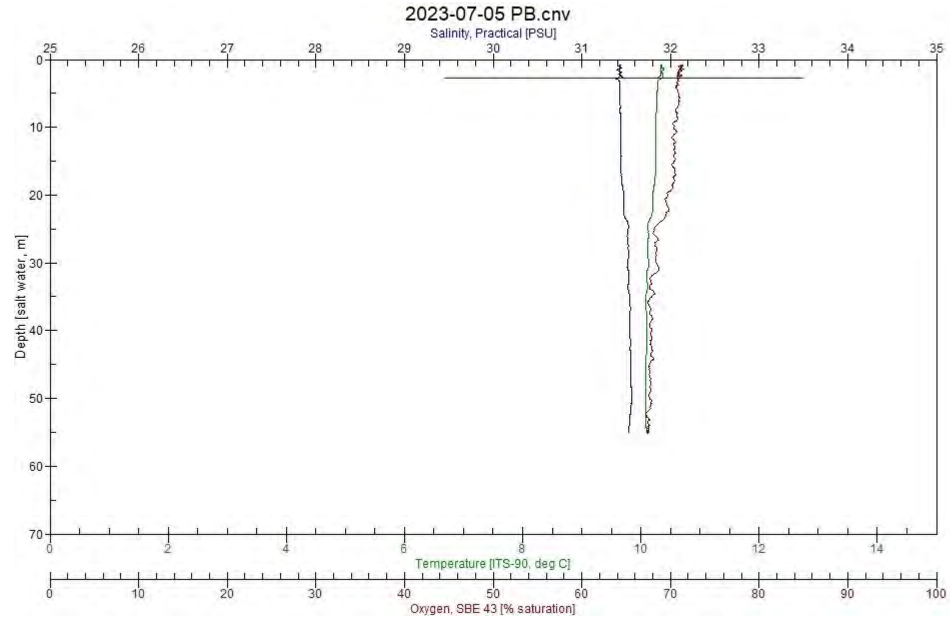

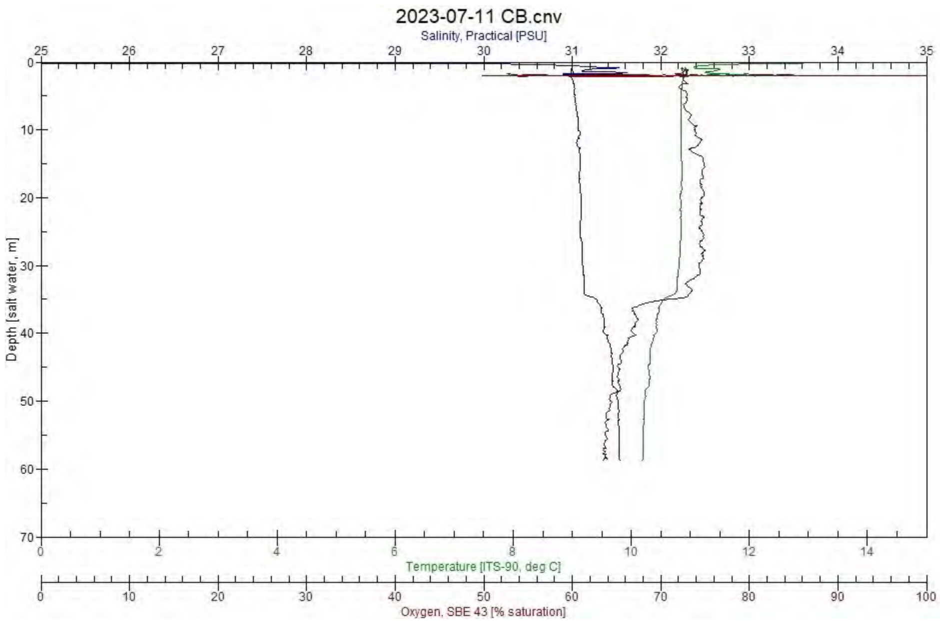

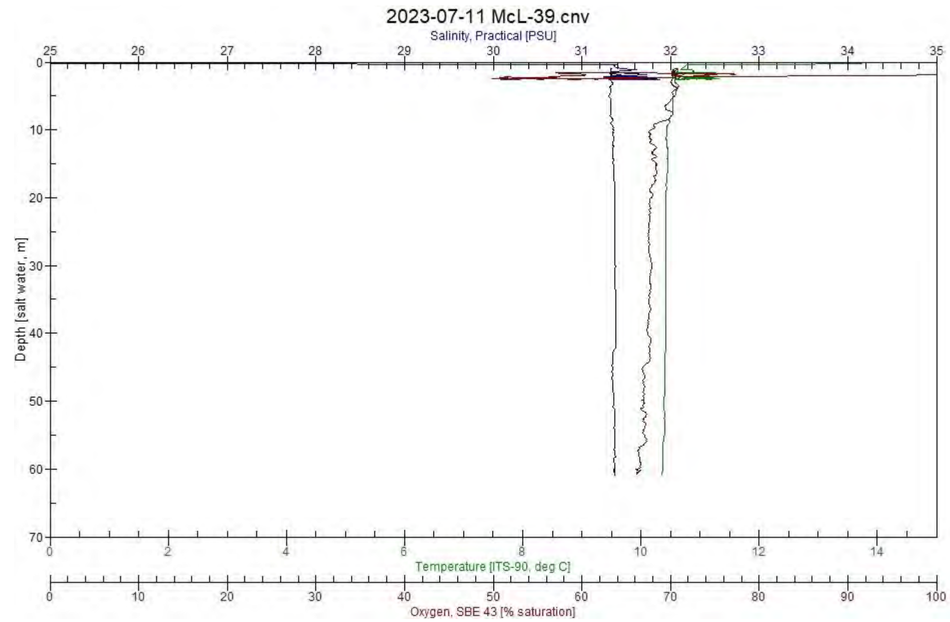

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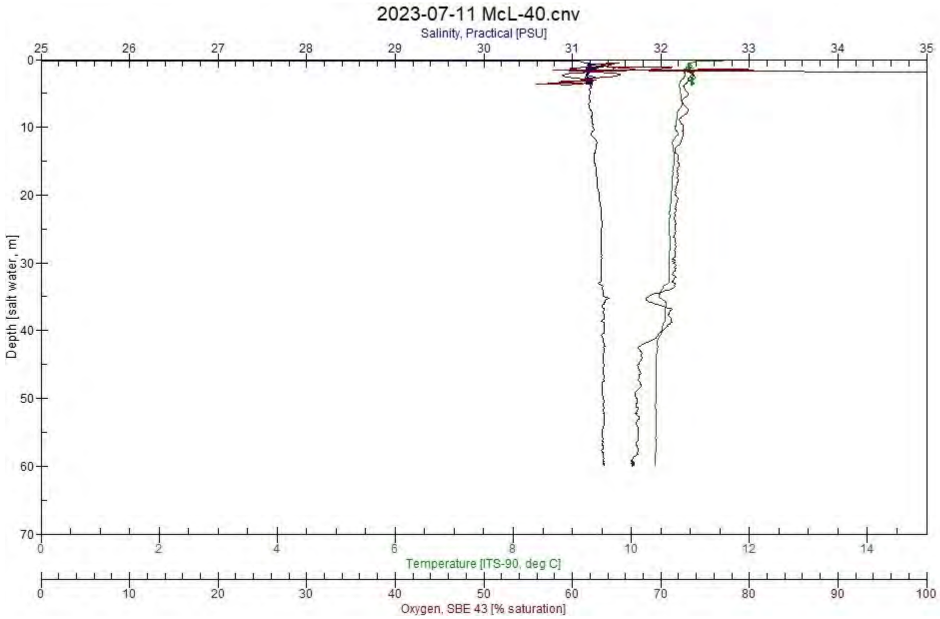

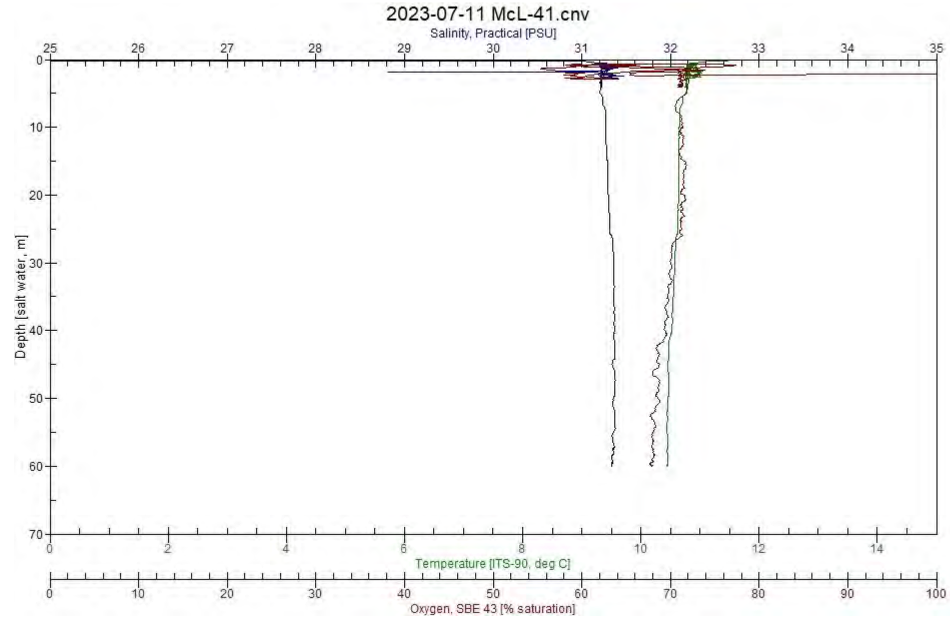

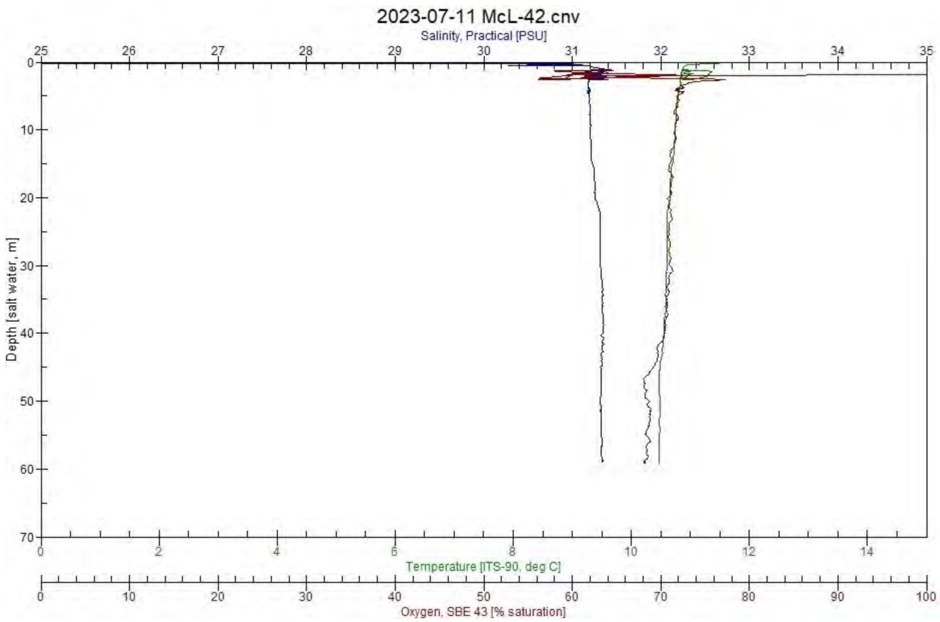

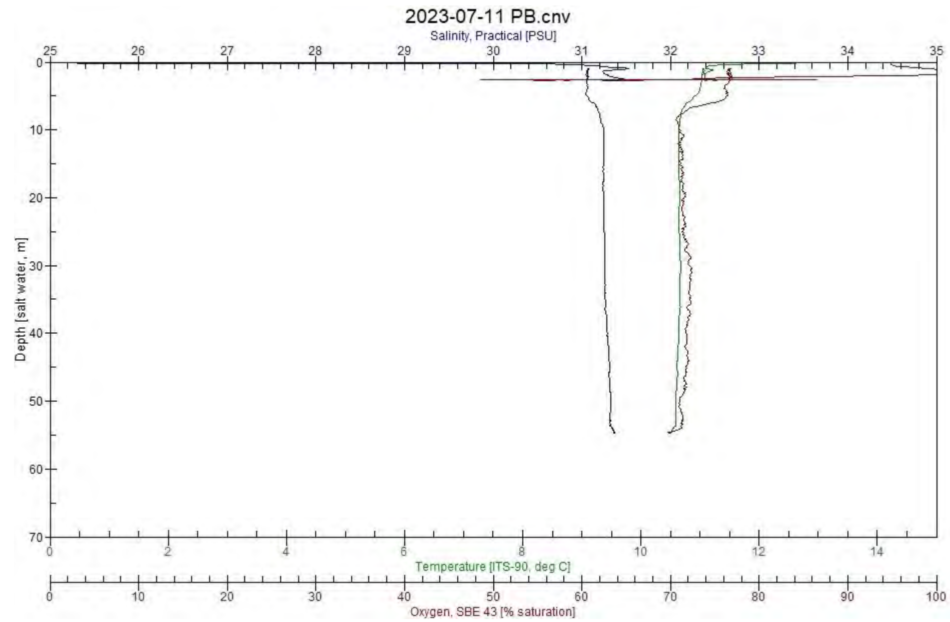

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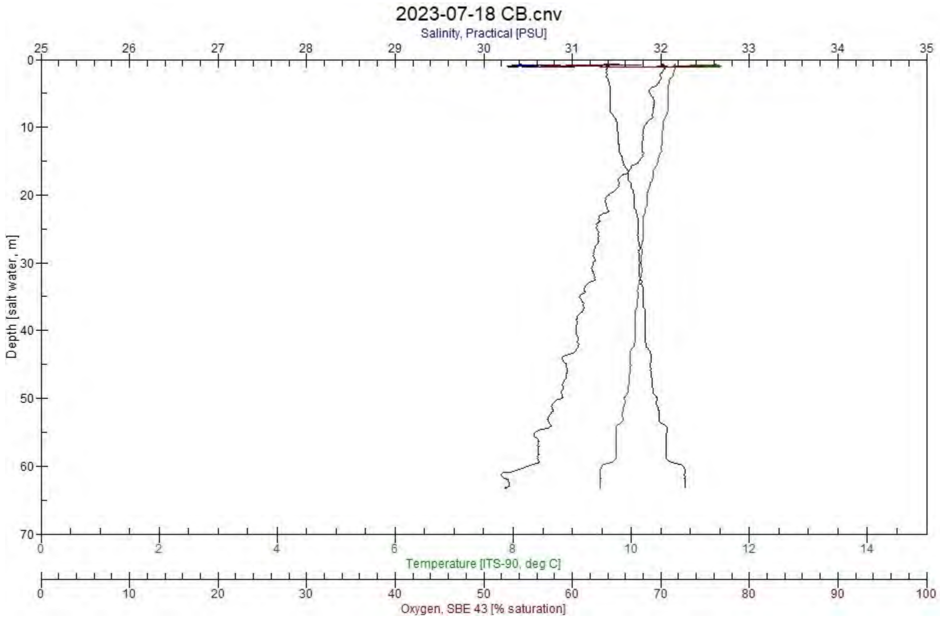

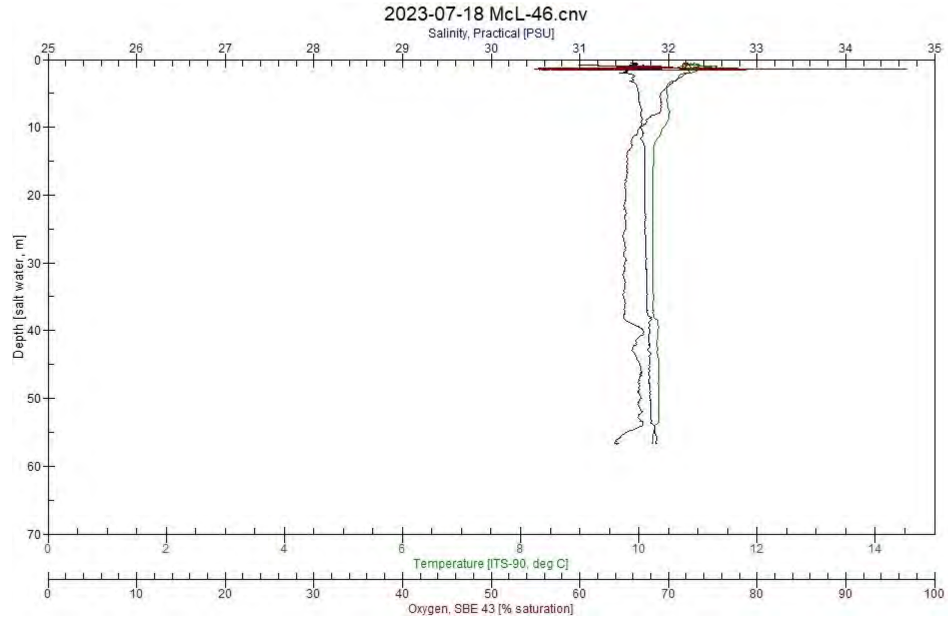

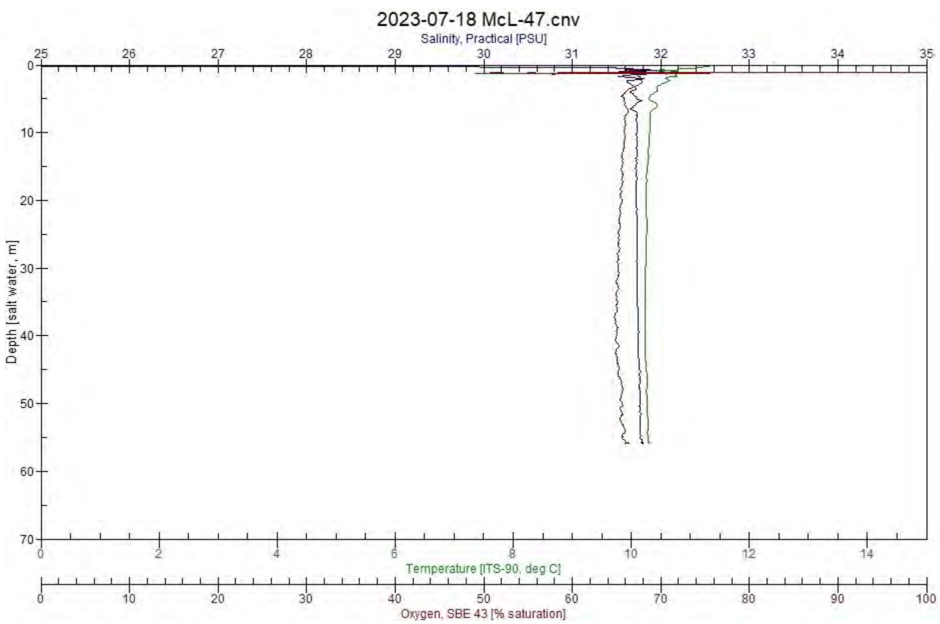

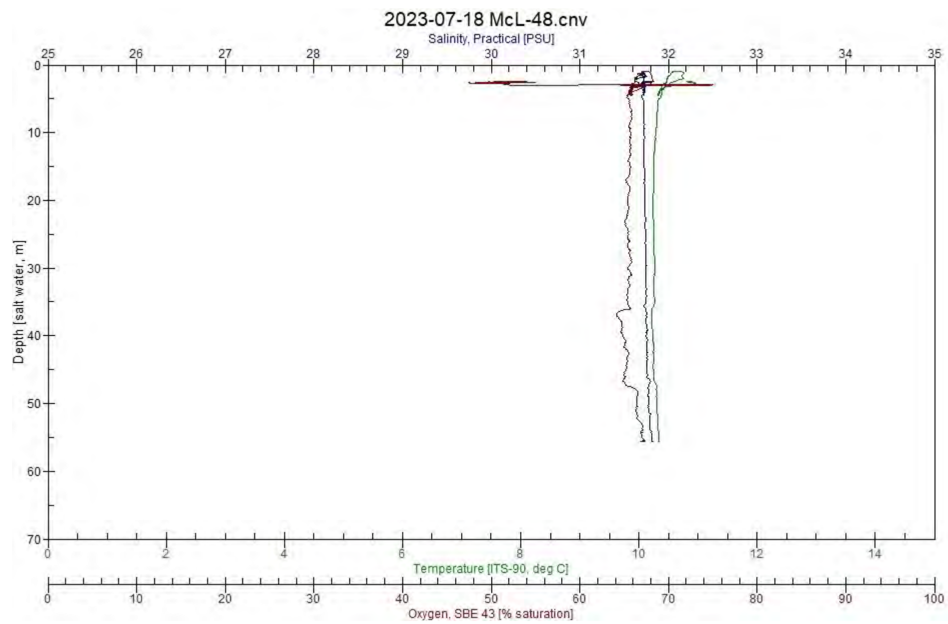

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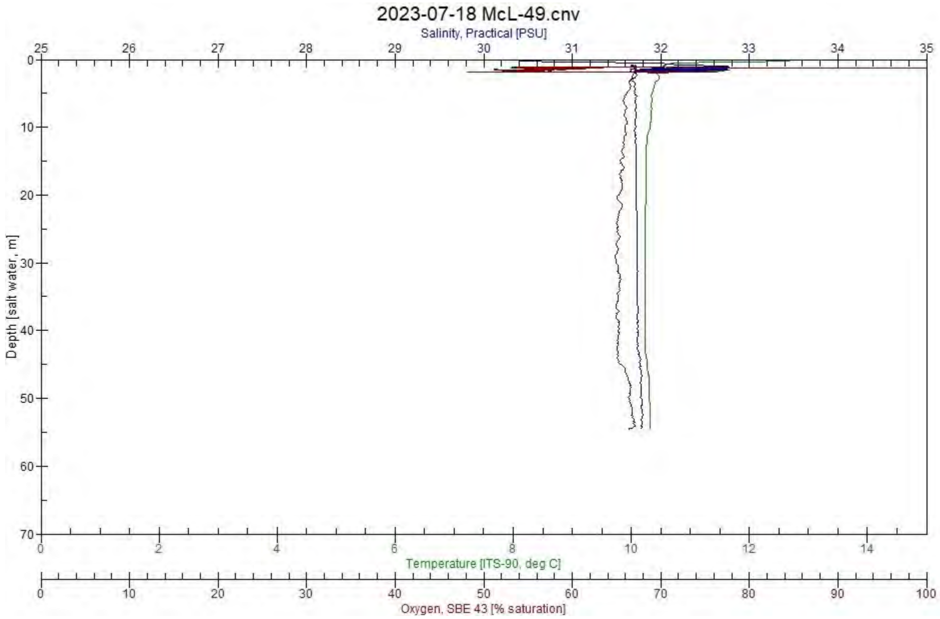

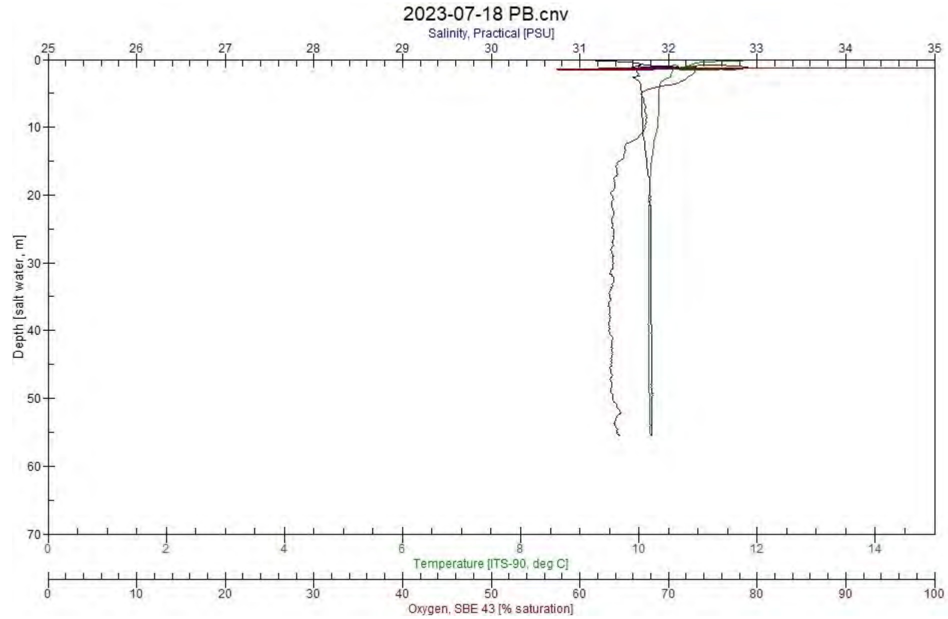

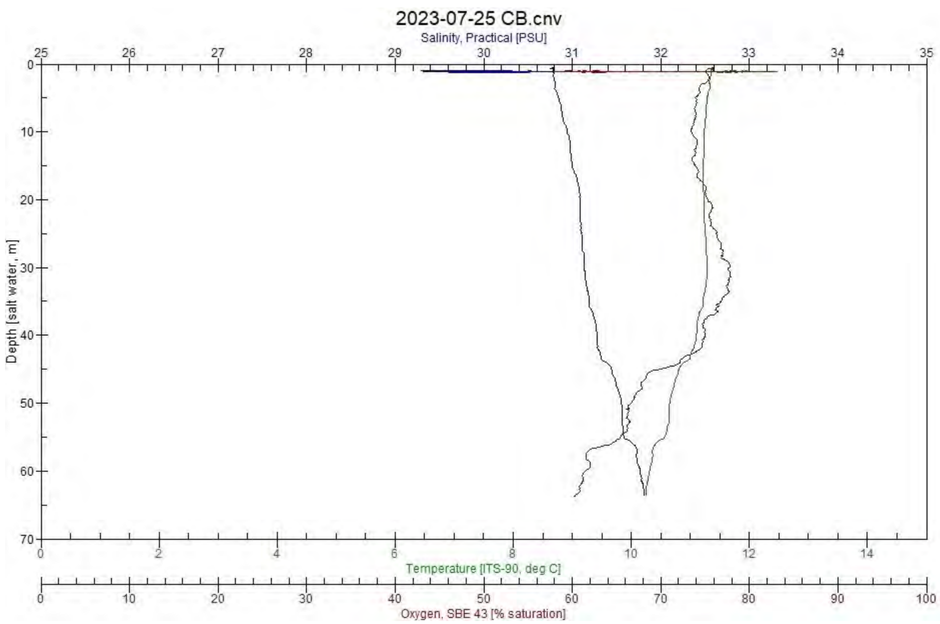

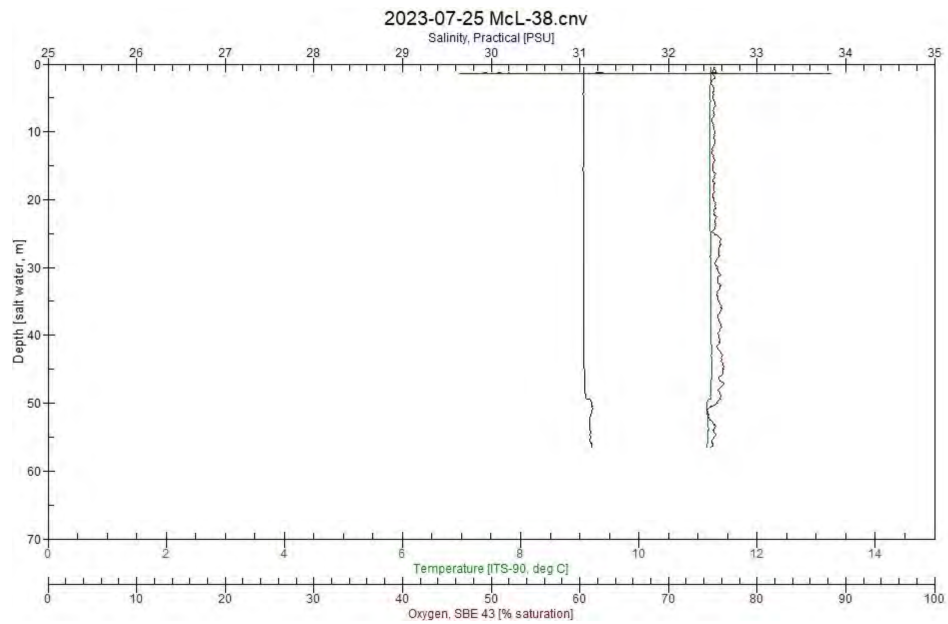

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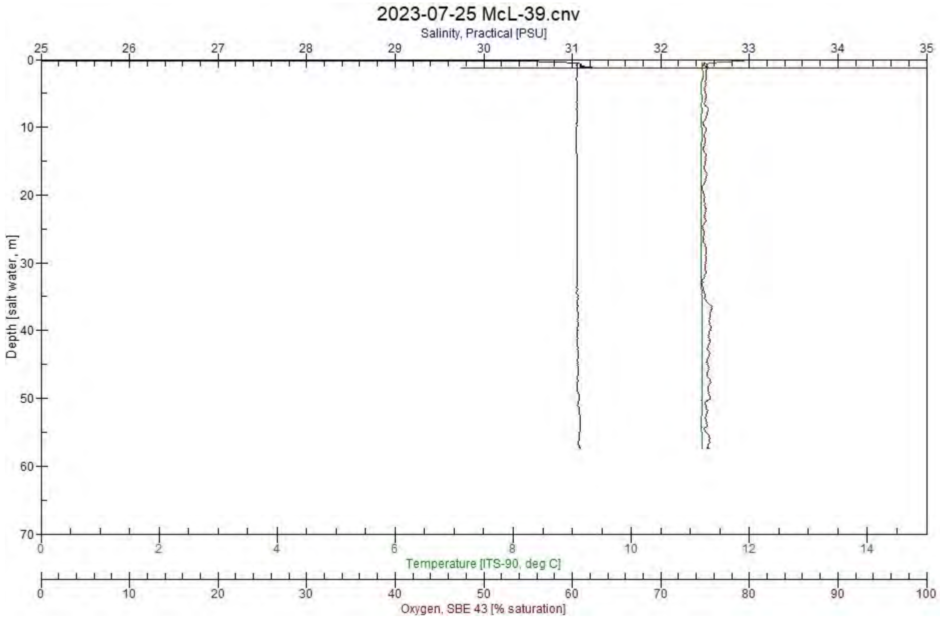

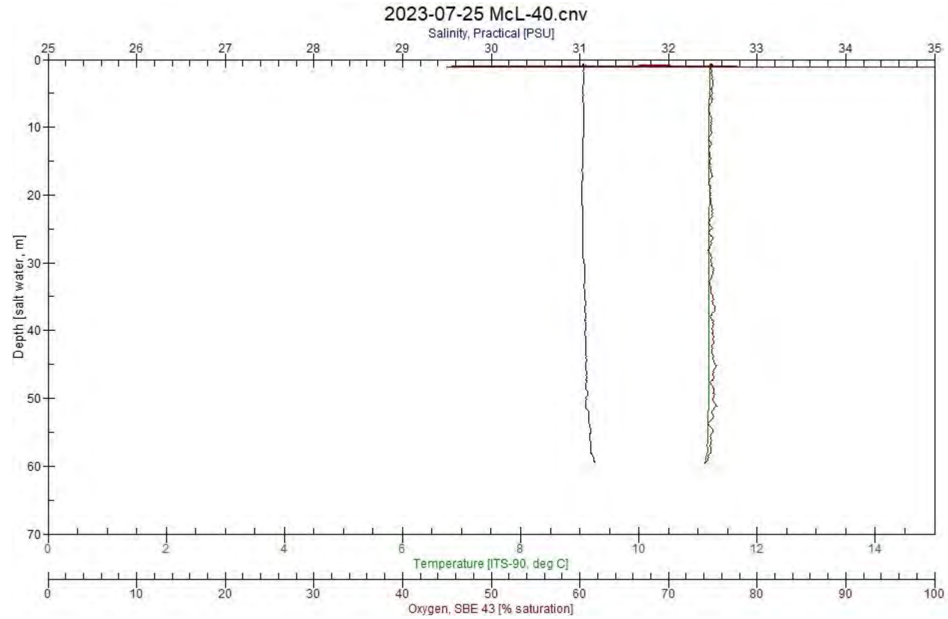

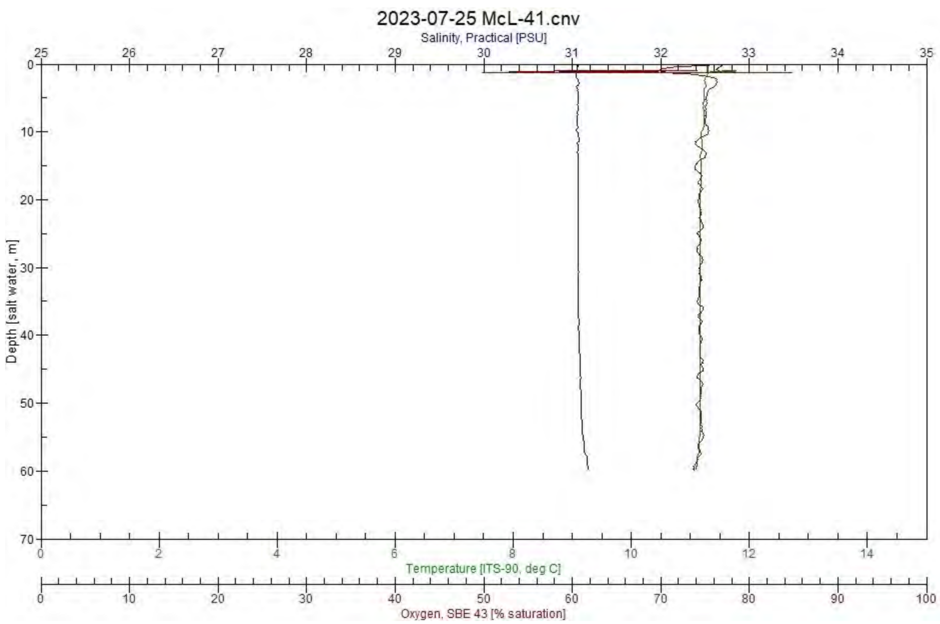

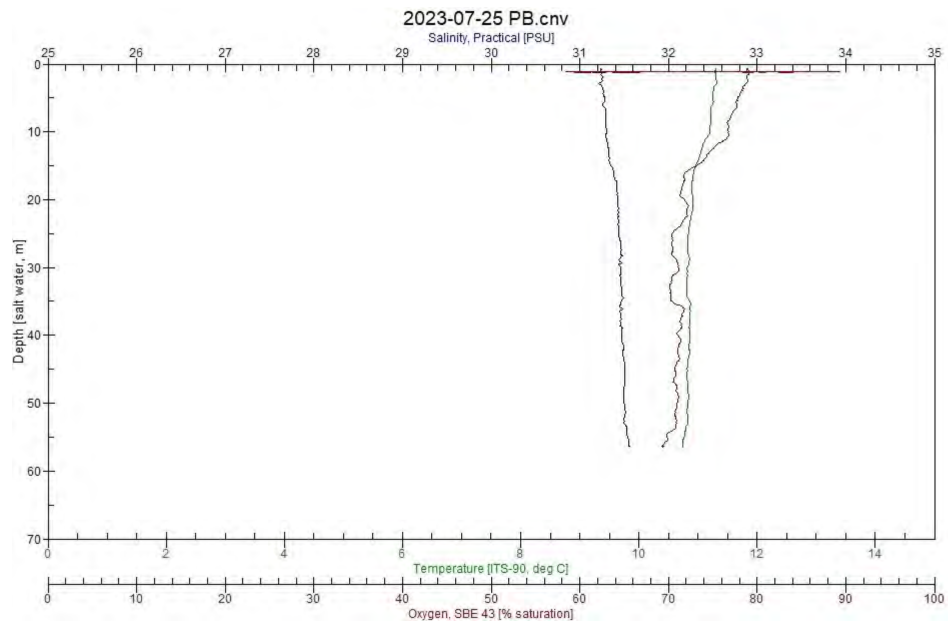

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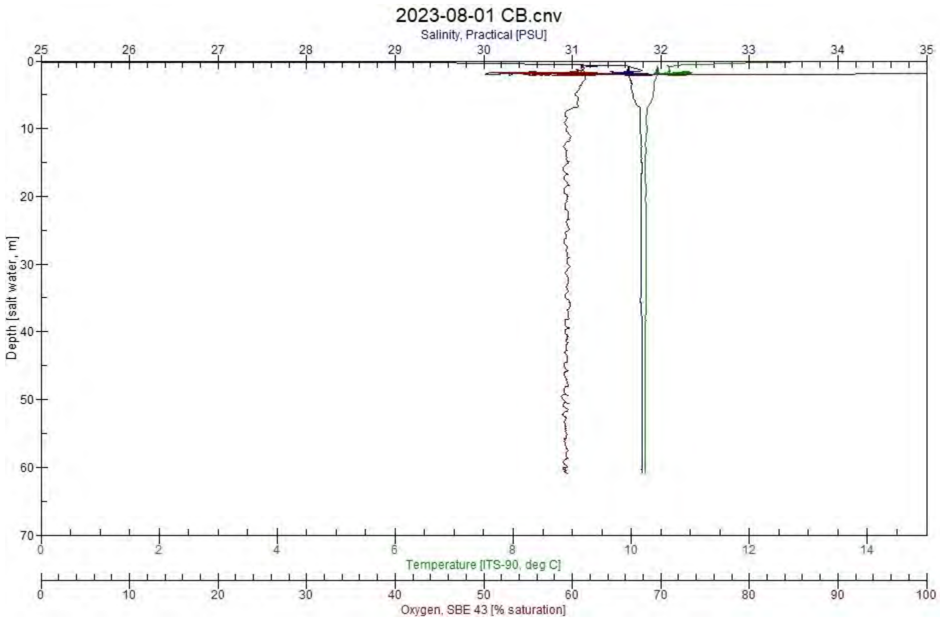

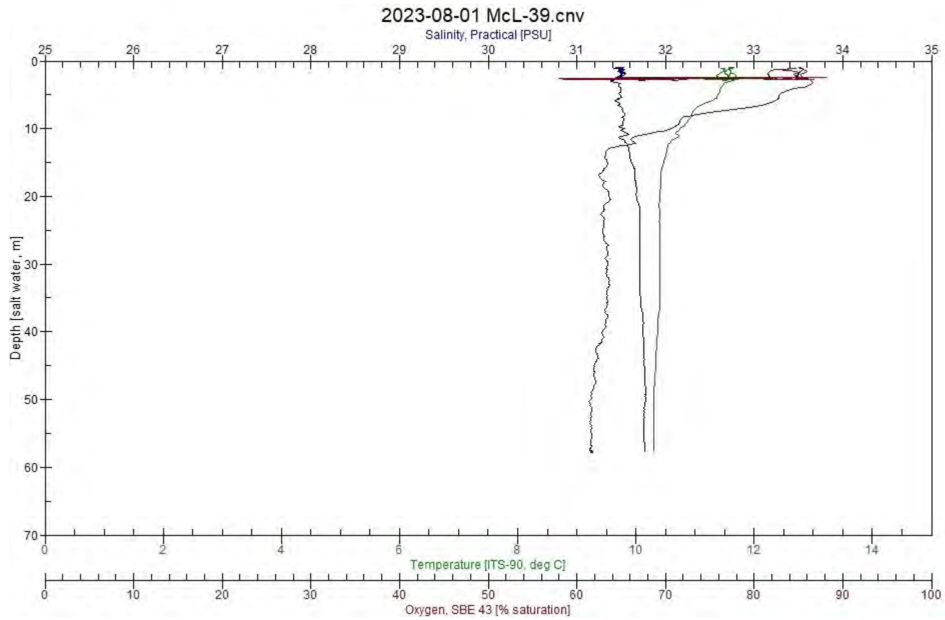

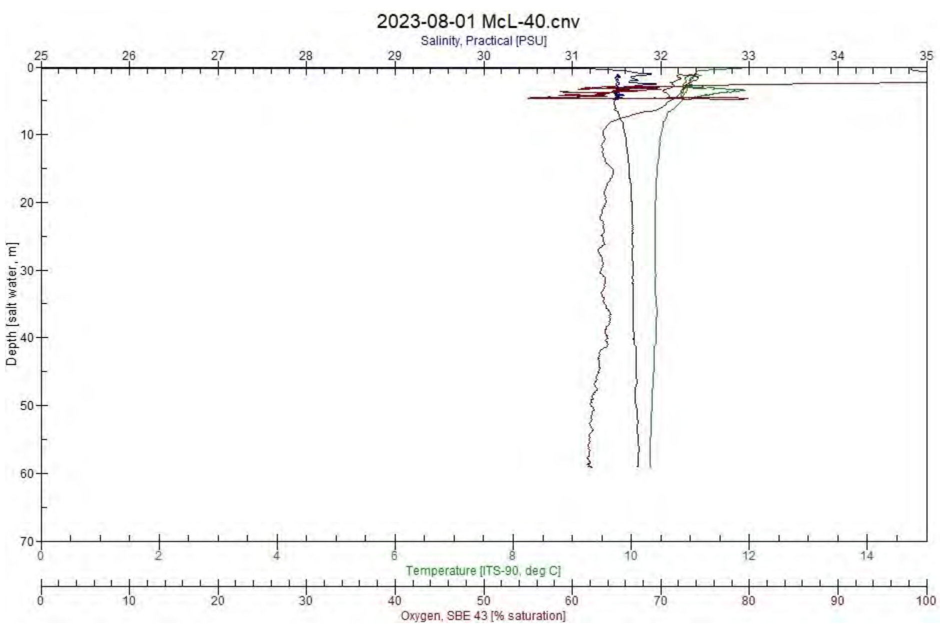

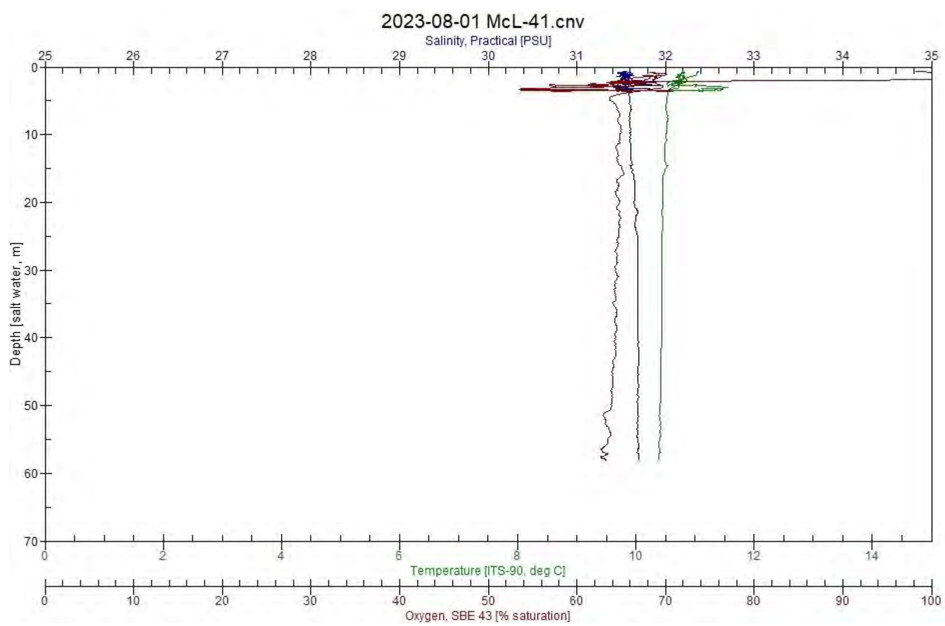

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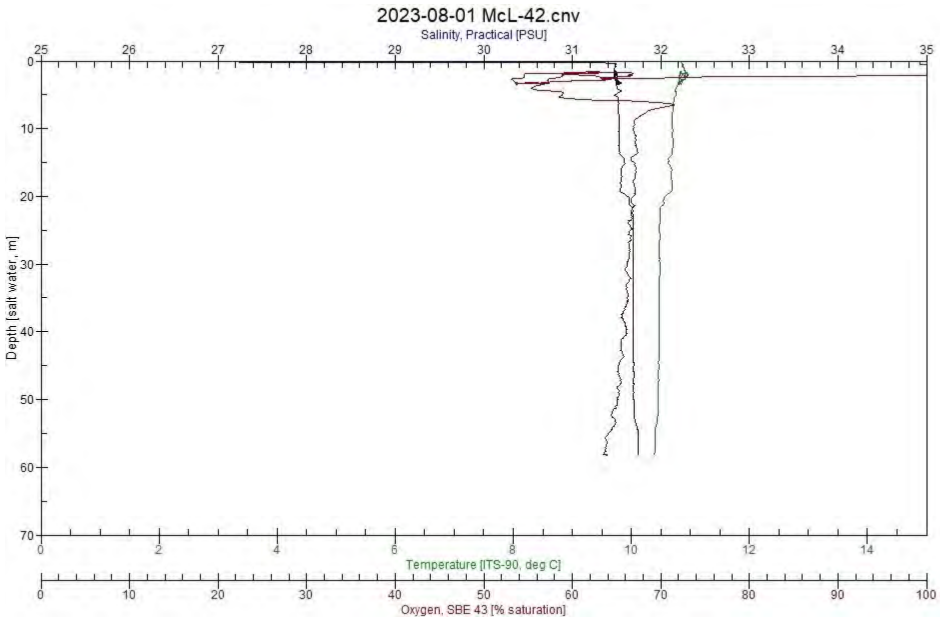

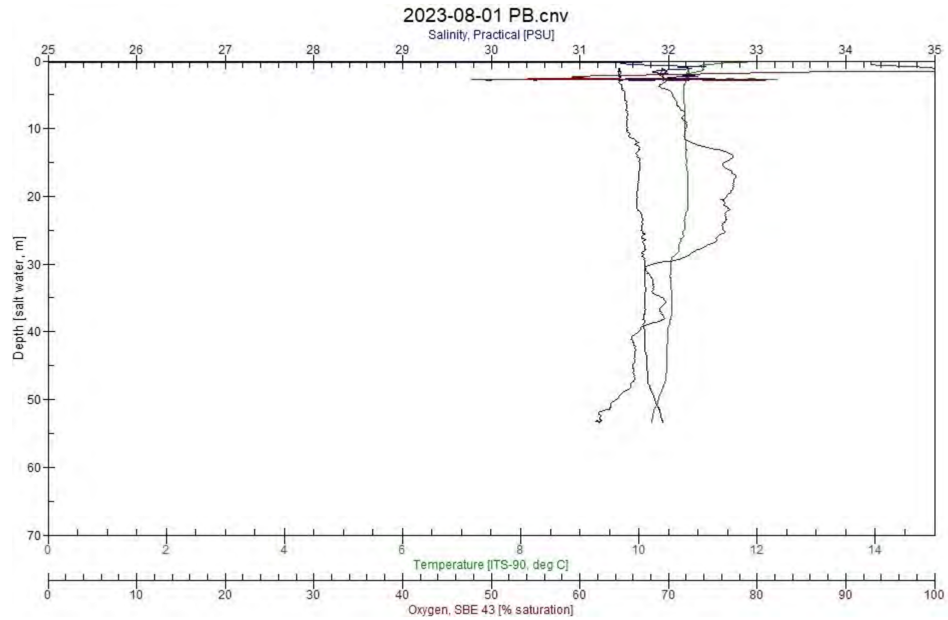

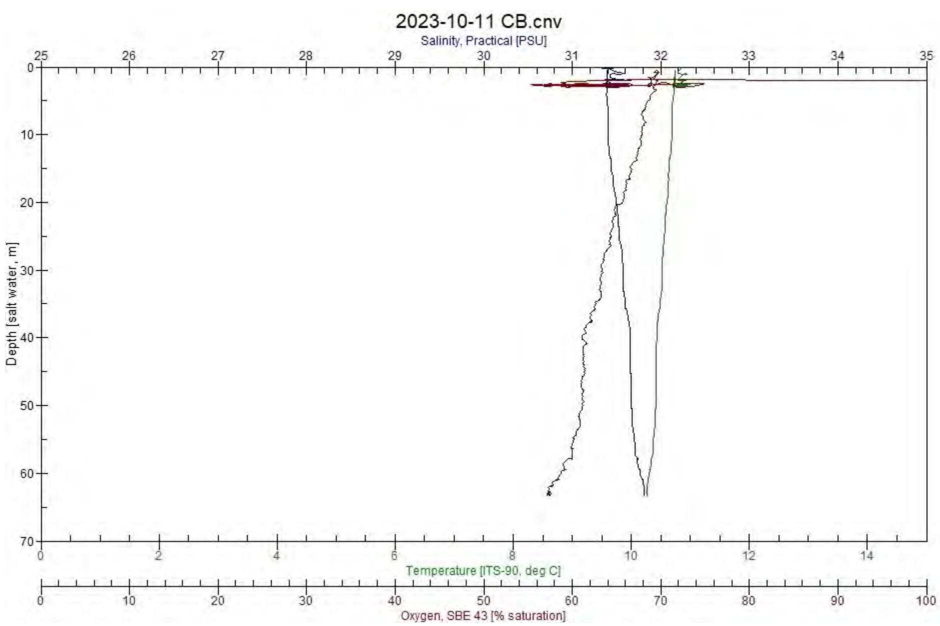

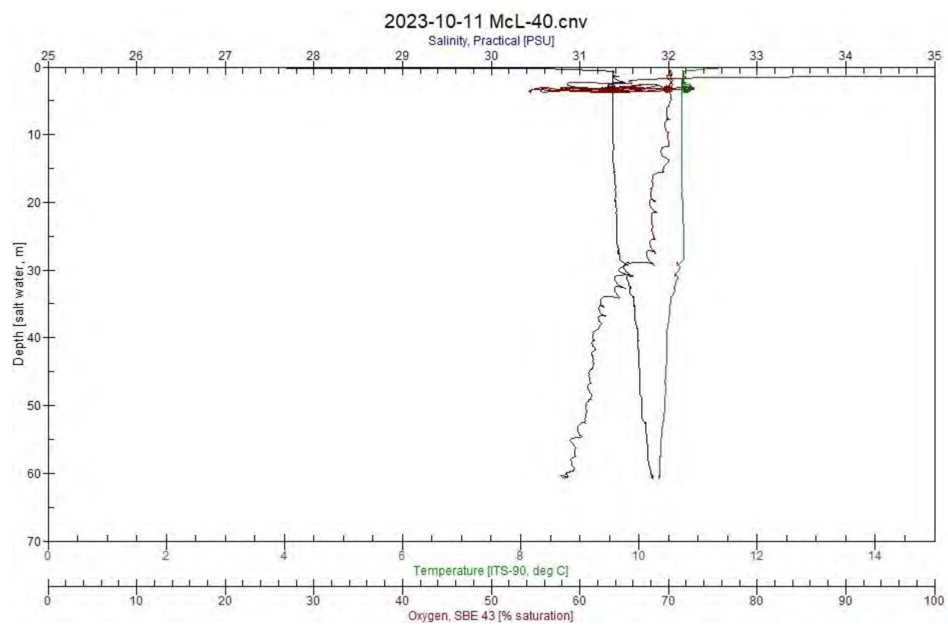

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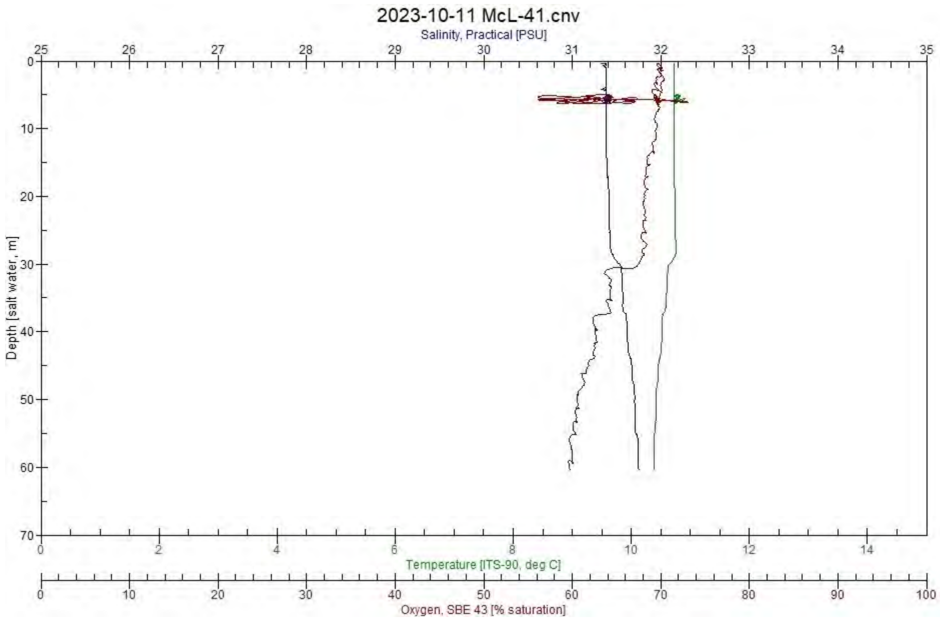

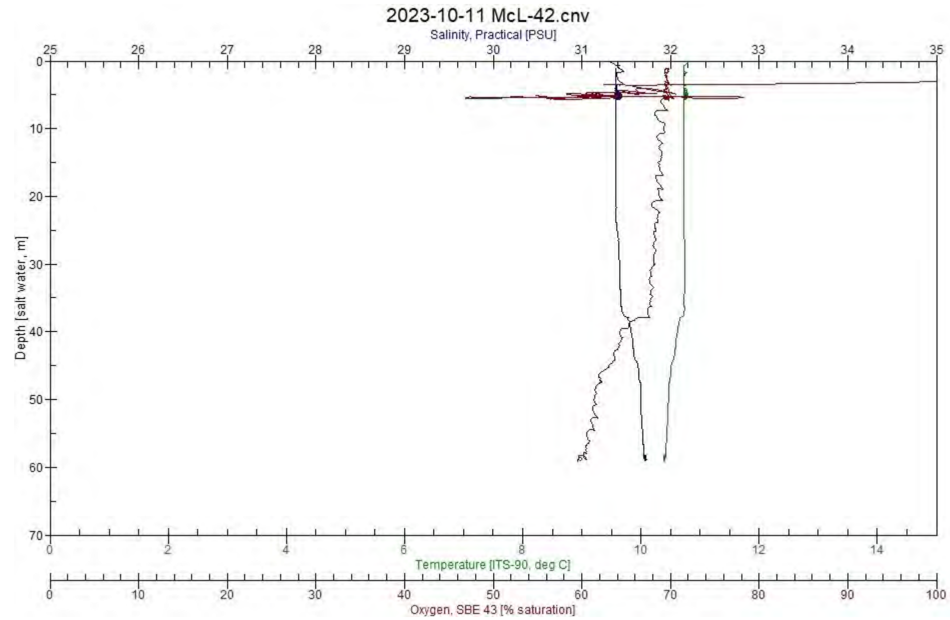

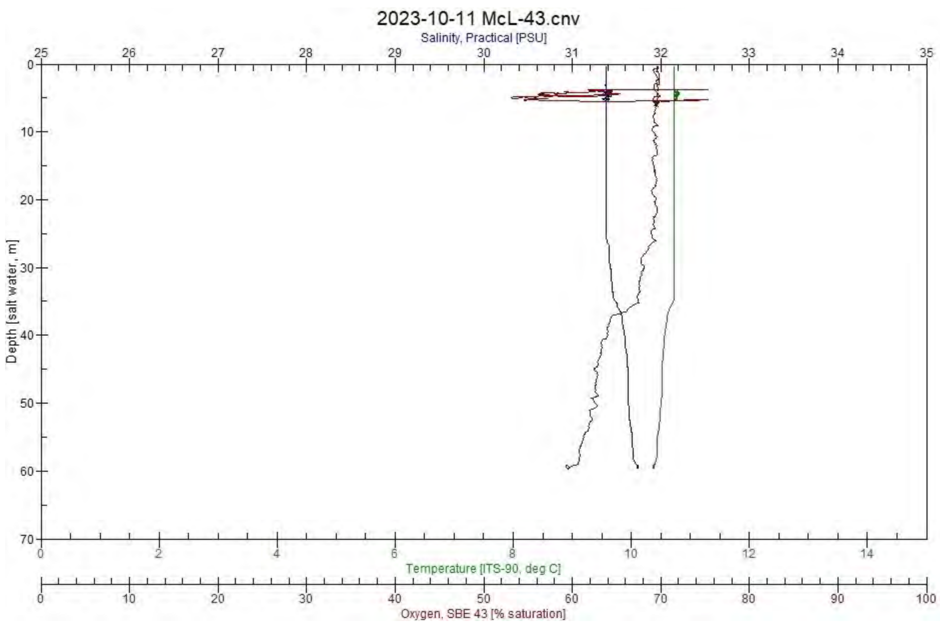

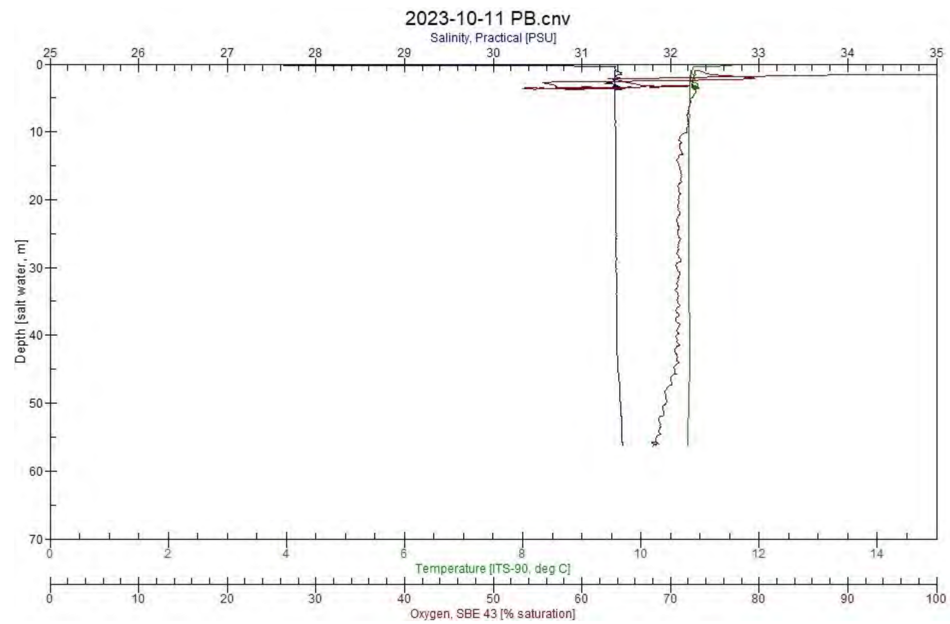

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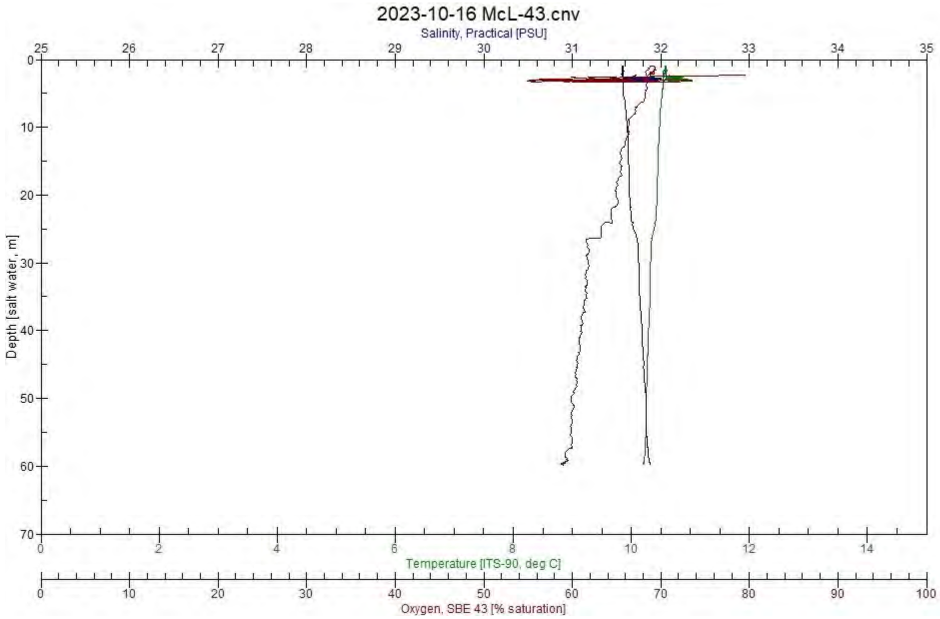

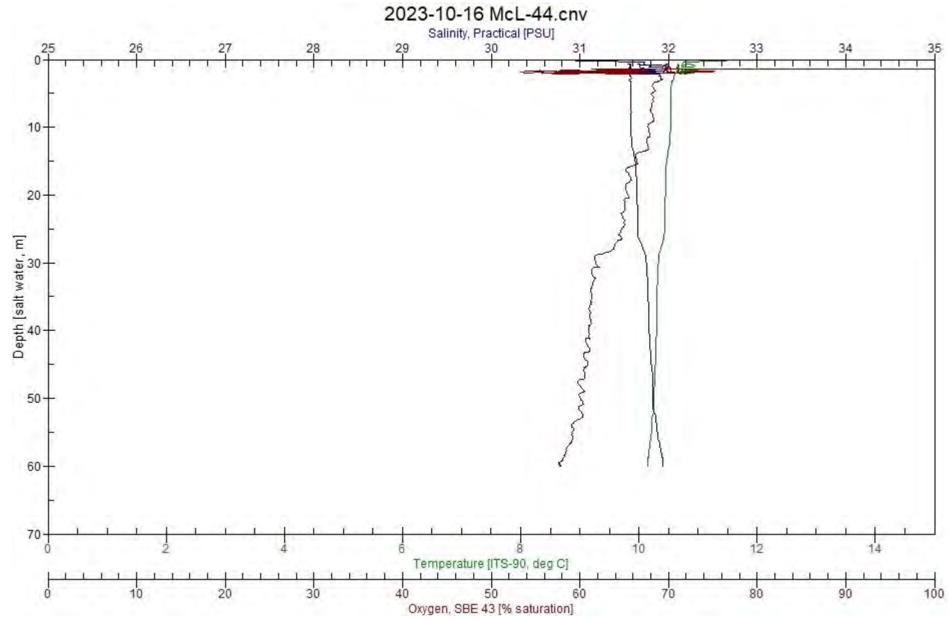

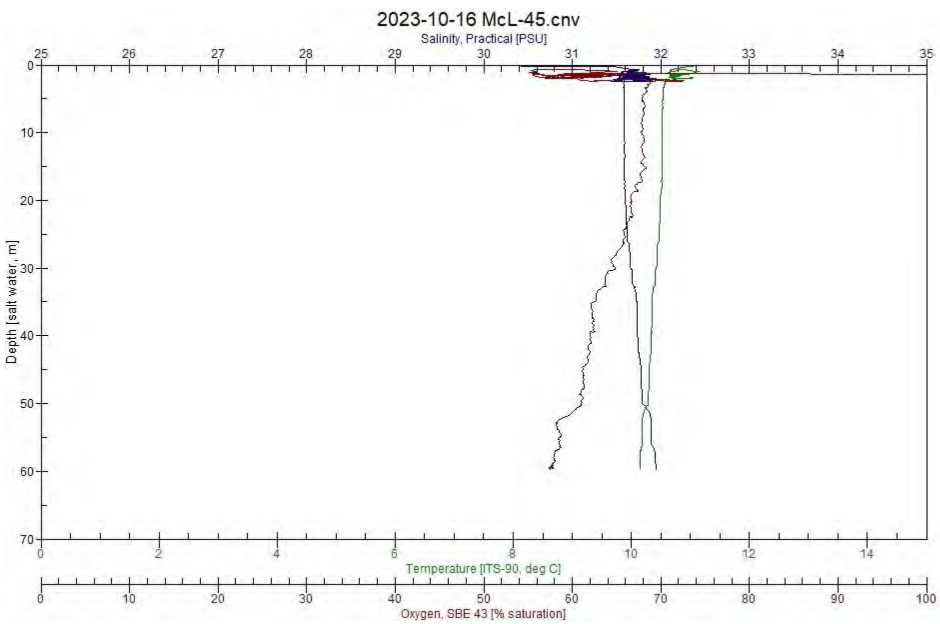

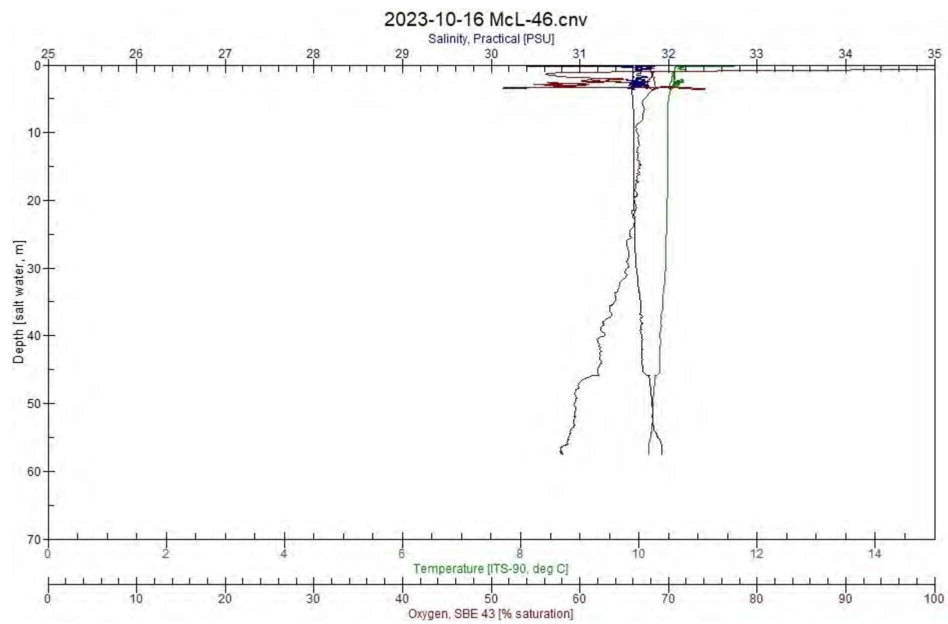

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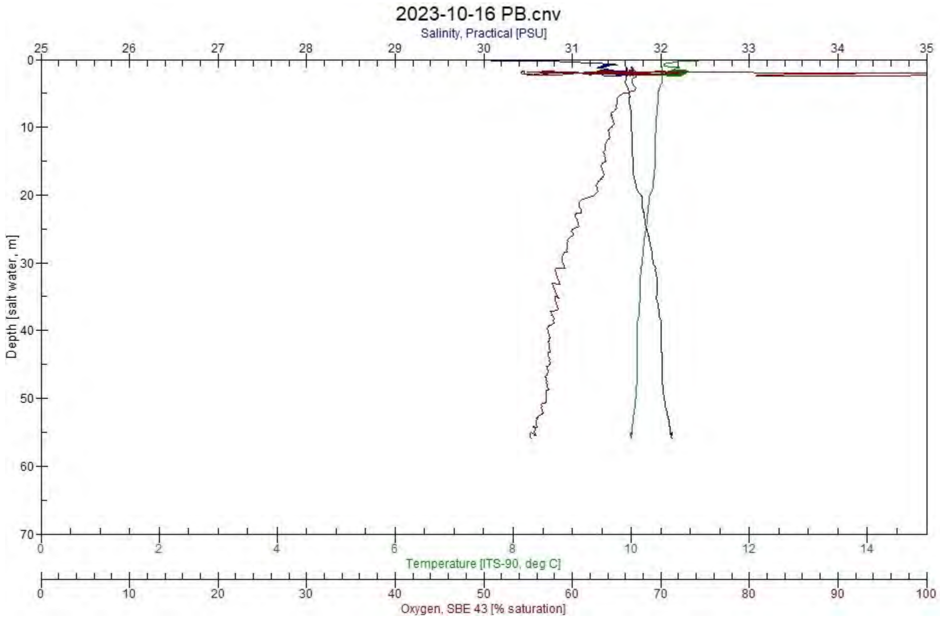

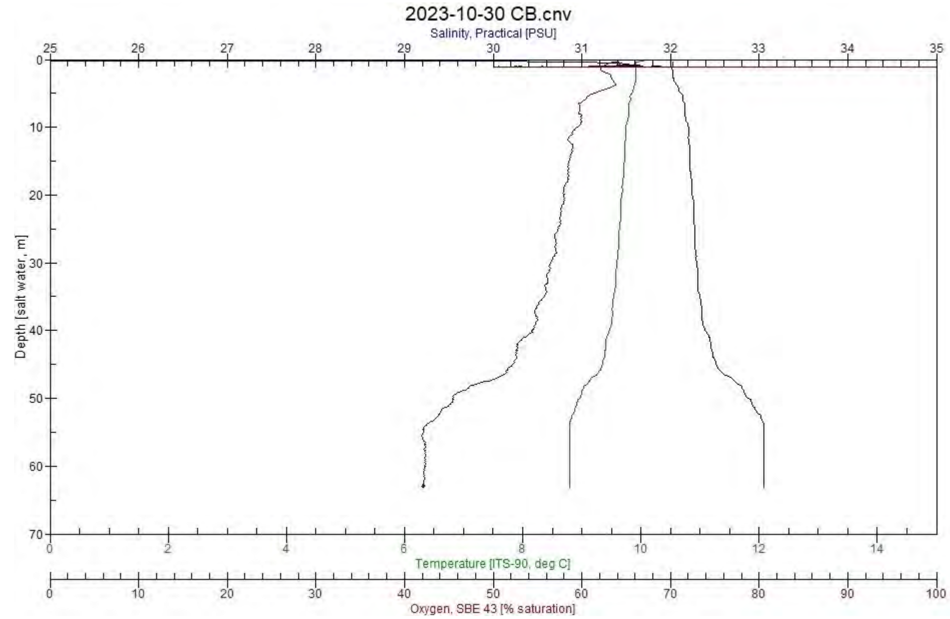

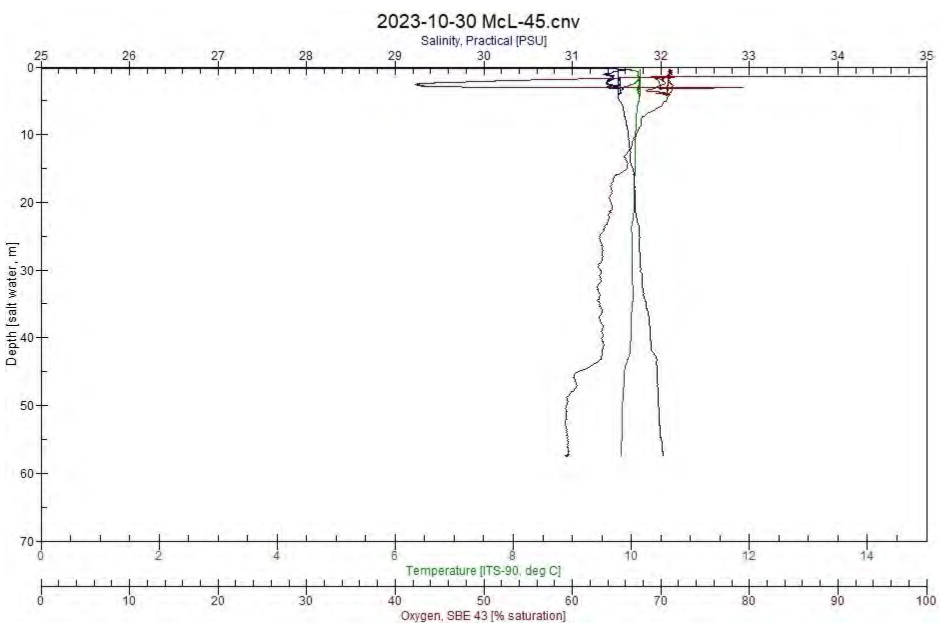

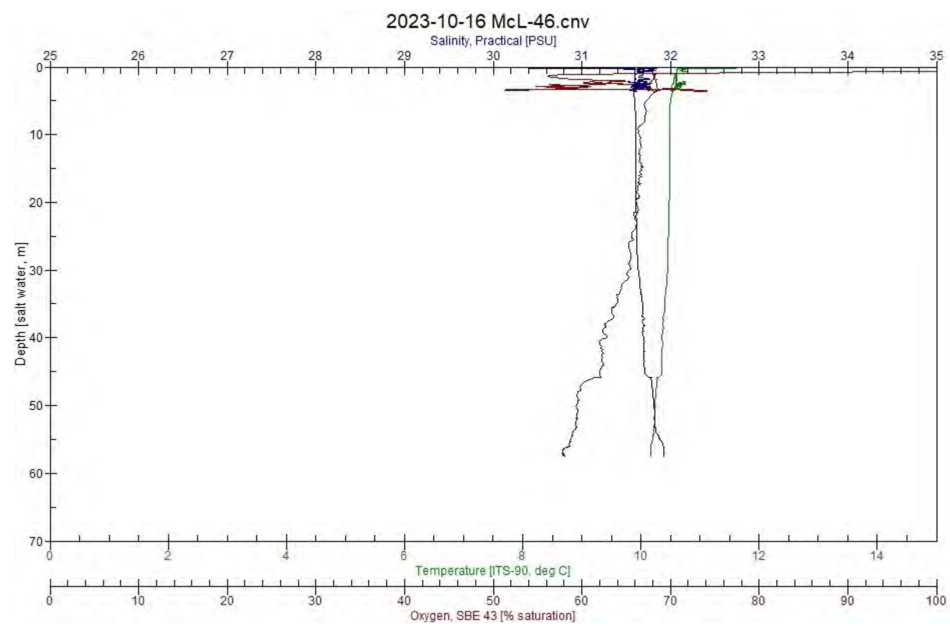

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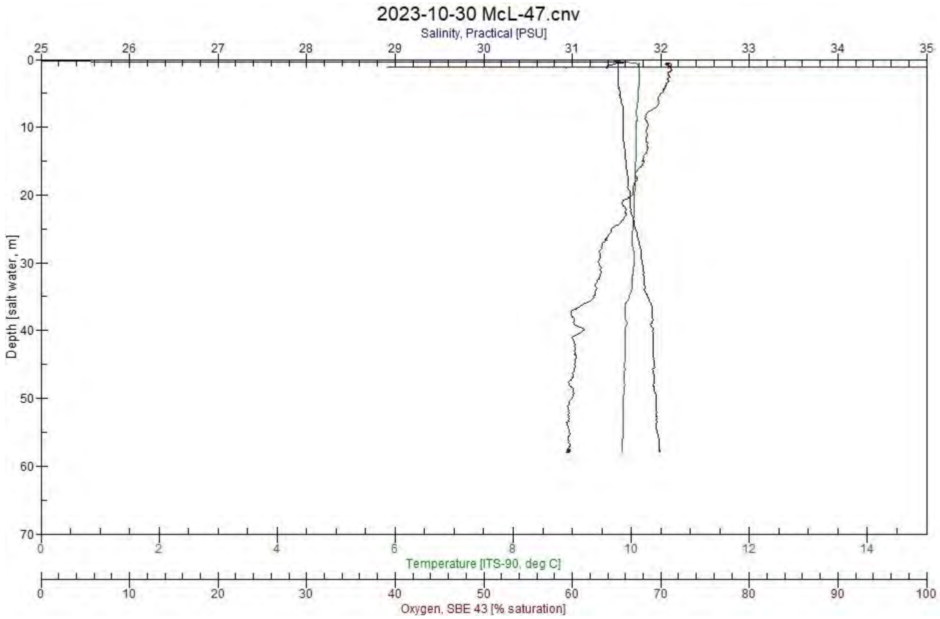

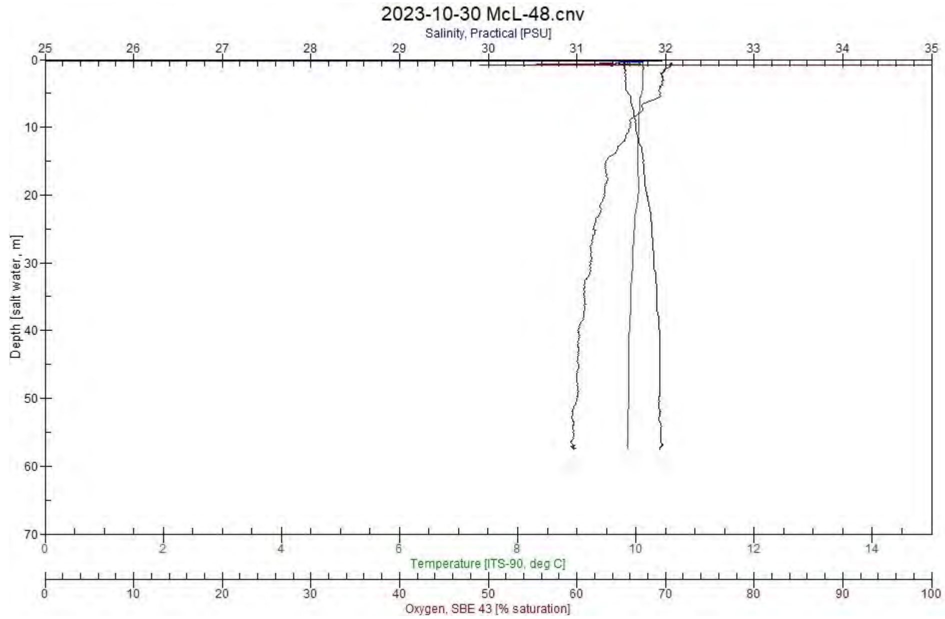

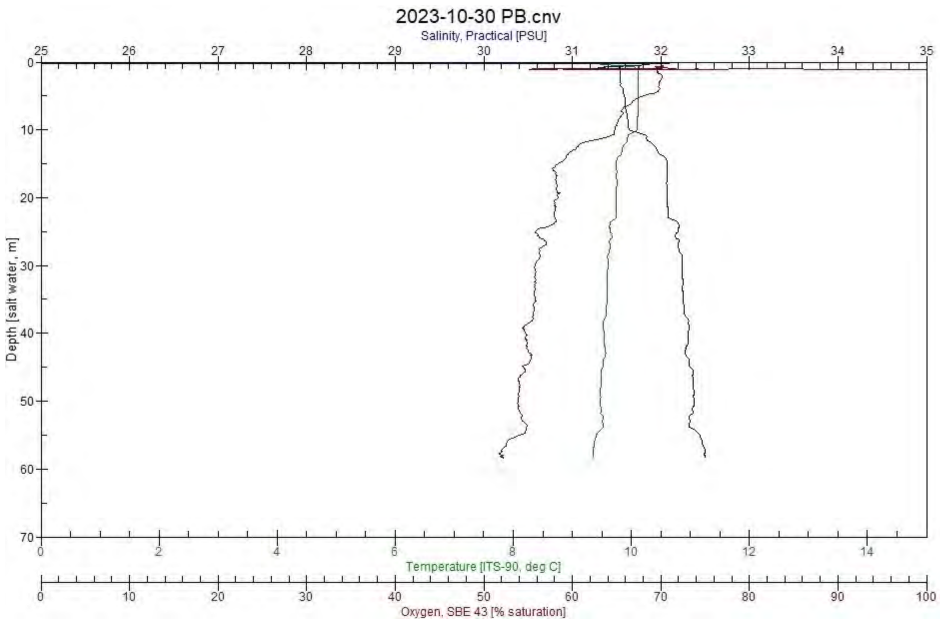

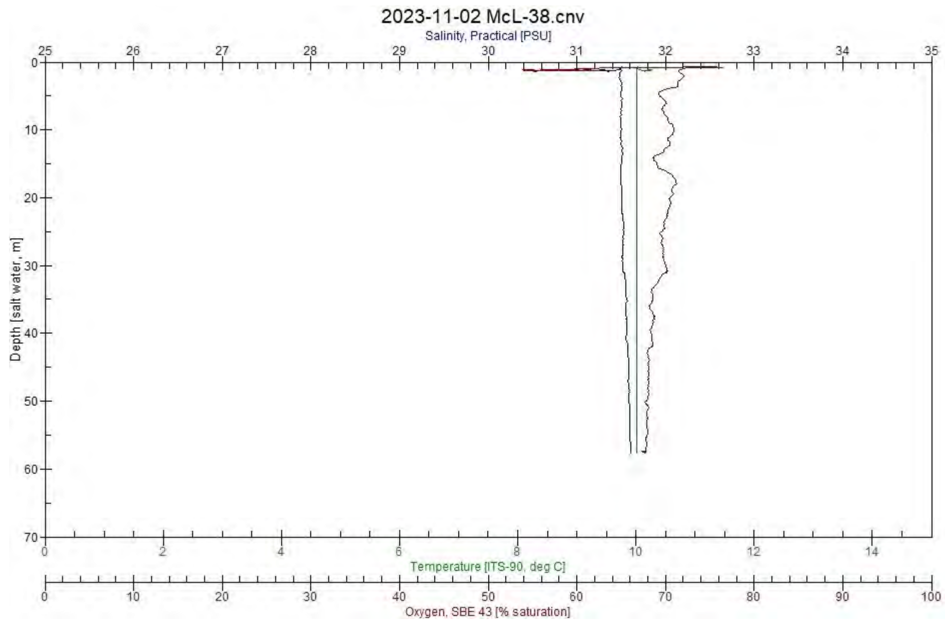

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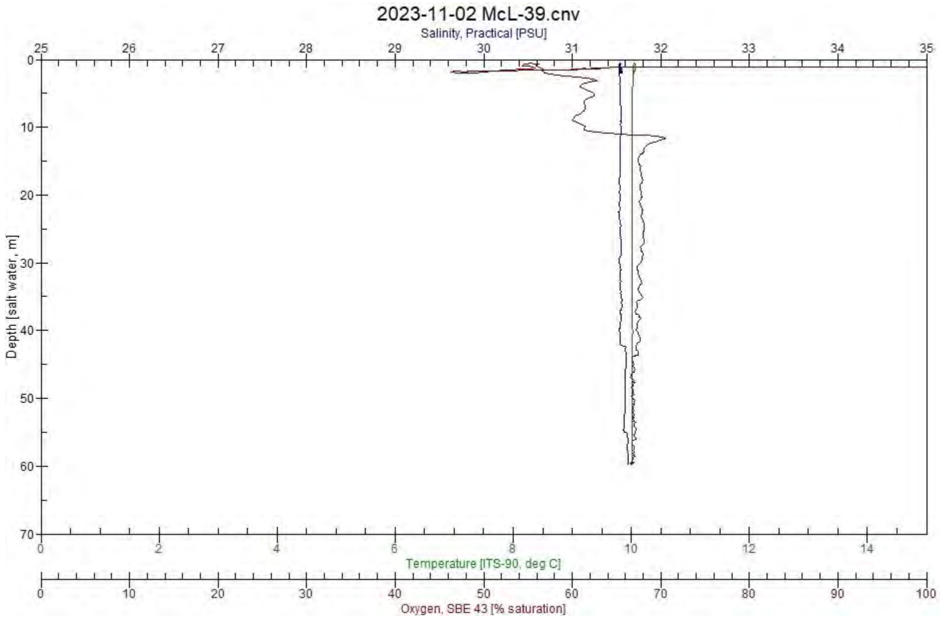

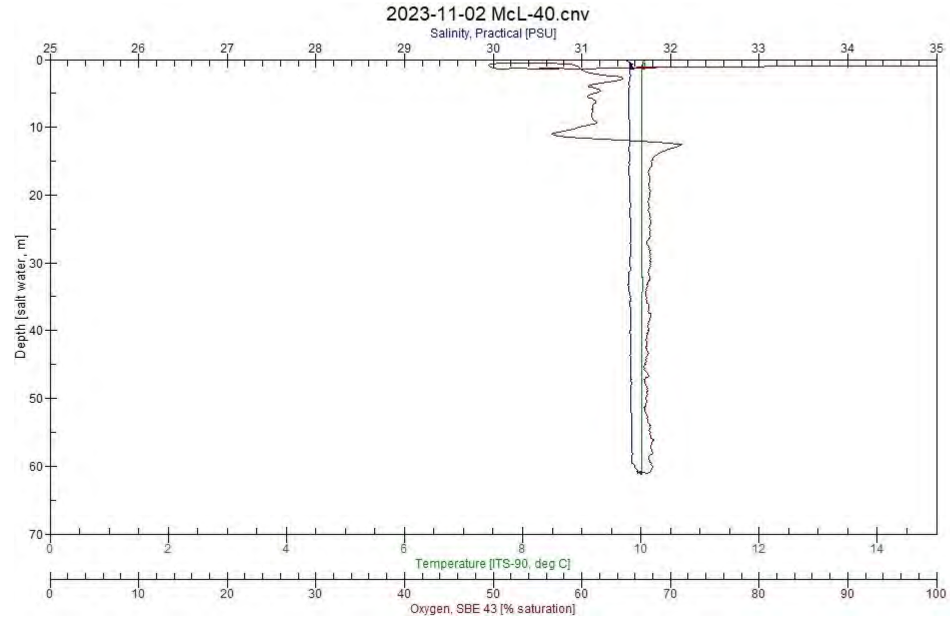

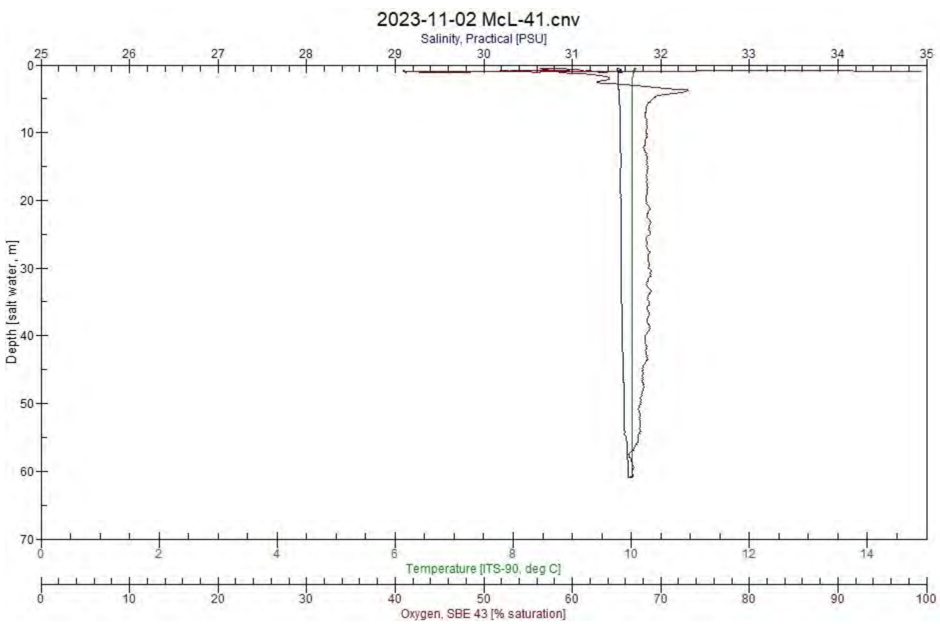

APPENDIX D
2023 SHORELINE, OVERFLOW AND BYPASS MONITORING

CRD - Parks & Environmental Services - Environmental Engineering - Mar 16, 2020 - Technologist: srulijancich - Map Document: EmergencyOverflowSampSites2020.mxd

Making a difference...together

Metres
0 50 100 200 300

Projection: UTM ZONE 10N NAD 83

Important This map is for general information purposes only. The Capital Regional District (CRD) makes no representations or warranties regarding the accuracy or completeness of this map or the suitability of the map for any purpose. This map is not for navigation. The CRD will not be liable for any damage, loss or injury resulting from the use of the map or information on the map and the map may be changed by the CRD at any time.

- Emergency Overflow Sampling Site
- !! Denotes potentially unsafe access during certain conditions

Stormwater Discharge Location

- End of Pipe/Manhole, High Impact
- End of Pipe, High Impact
- End of Pipe, Low Impact
- Manhole, High Impact
- Manhole, Low Impact
- Marine, High Impact
- Marine, Low Impact
- Upstream, High Impact
- CRD Pump Station
- Sanitary Emergency Overflow Outfall
- Sanitary Outfall
- Stream/Ditch
- Stormwater Culvert/Drain Pipe
- Lake/Pond/Reservoir/Storage Basin
- Lot Line

EMERGENCY OVERFLOW SAMPLING SITES
CLOVER

CRD
Making a difference...together

Metres
0 50 100 200 300

Projection: UTM ZONE 10N NAD 83

- Emergency Overflow Sampling Site
- !! Denotes potentially unsafe access during certain conditions

Stormwater Discharge Location

- End of Pipe/Manhole, High Impact
- End of Pipe, High Impact
- End of Pipe, Low Impact
- Manhole, High Impact
- Manhole, Low Impact
- Marine, High Impact
- Marine, Low Impact
- Upstream, High Impact
- PS CRD Pump Station
- Sanitary Emergency Overflow Outfall
- Sanitary Outfall
- Stream/Ditch
- Stormwater Culvert/Drain Pipe
- Lake/Pond/Reservoir/Storage Basin
- Lot Line

EMERGENCY OVERFLOW SAMPLING SITES
MACAULAY

EMERGENCY OVERFLOW SAMPLING SITES
MCMICKING

Metres
0 25 50 100
Projection: UTM ZONE 10N NAD 83

- Emergency Overflow Sampling Site
- !! Denotes potentially unsafe access during certain conditions

Stormwater Discharge Location

- End of Pipe/Manhole, High Impact
- End of Pipe, High Impact
- End of Pipe, Low Impact
- Manhole, High Impact
- Manhole, Low Impact
- Marine, High Impact
- Marine, Low Impact
- Upstream, High Impact
- PS CRD Pump Station
- Sanitary Emergency Overflow Outfall
- Sanitary Outfall
- Stream/Ditch
- Stormwater Culvert/Drain Pipe
- Lake/Pond/Reservoir/Storage Basin
- Lot Line

CRD - Parks & Environmental Services - Environmental Engineering - Apr 16, 2020 - Technologist: sruljancich - Map Document: EmergencyOverflowSampSites2020.mxd

CRD - Parks & Environmental Services - Environmental Engineering - Mar 16, 2020 - Technologist: sruljancich - Map Document: EmergencyOverflowSampSites2020.mxd

EMERGENCY OVERFLOW SAMPLING SITES
HUMBER & RUTLAND

Making a difference...together

Metres: 0 50 100 200 300

Projection: UTM ZONE 10N NAD 83

- Emergency Overflow Sampling Site
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Stormwater Discharge Location

- End of Pipe/Manhole, High Impact
- End of Pipe, High Impact
- End of Pipe, Low Impact
- Manhole, High Impact
- Manhole, Low Impact
- Marine, High Impact
- Marine, Low Impact
- Upstream, High Impact
- CRD Pump Station
- Sanitary Emergency Overflow Outfall
- Sanitary Outfall
- Stream/Ditch
- Stormwater Culvert/Drain Pipe
- Lake/Pond/Reservoir/Storage Basin
- Lot Line

CRD Making a difference...together

Metres
0 25 50 100 150
Projection: UTM ZONE 10N NAD 83

Emergency Overflow Sampling Site
!! Denotes potentially unsafe access during certain conditions

Stormwater Discharge Location

End of Pipe/Manhole, High Impact
End of Pipe, High Impact
End of Pipe, Low Impact
Manhole, High Impact
Manhole, Low Impact
Marine, High Impact
Marine, Low Impact
Upstream, High Impact
CRD Pump Station
Sanitary Emergency Overflow Outfall
Sanitary Outfall
Stream/Ditch
Stormwater Culvert/Drain Pipe
Lake/Pond/Reservoir/Storage Basin
Lot Line

EMERGENCY OVERFLOW SAMPLING SITES
HARLING

CRD - Parks & Environmental Services - Environmental Engineering - Mar 16, 2020 - Technologist: sruljancich - Map Document: EmergencyOverflowSampSites2020.mxd

CRD
Making a difference...together

Metres
0 25 50 100 150
Projection: UTM ZONE 10N NAD 83

- Emergency Overflow Sampling Site
- !! Denotes potentially unsafe access during certain conditions

Stormwater Discharge Location

- End of Pipe/Manhole, High Impact
- End of Pipe, High Impact
- End of Pipe, Low Impact
- Manhole, High Impact
- Manhole, Low Impact
- Marine, High Impact
- Marine, Low Impact
- Upstream, High Impact
- PS CRD Pump Station
- Sanitary Emergency Overflow Outfall
- Sanitary Outfall
- Stream/Ditch
- Stormwater Culvert/Drain Pipe
- Lake/Pond/Reservoir/Storage Basin
- Lot Line

EMERGENCY OVERFLOW SAMPLING SITES
FINNERTY

CRD - Parks & Environmental Services - Environmental Engineering - Mar 16, 2020 - Technologist: sruljancich - Map Document: EmergencyOverflowSampSites2020.mxd

CRD
Making a difference...together

Metres
0 25 50 100

Projection: UTM ZONE 10N NAD 83

- Emergency Overflow Sampling Site
  !! Denotes potentially unsafe access during certain conditions

Stormwater Discharge Location

- End of Pipe/Manhole, High Impact
- End of Pipe, High Impact
- End of Pipe, Low Impact
- Manhole, High Impact
- Manhole, Low Impact
- Marine, High Impact
- Marine, Low Impact
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- PS CRD Pump Station
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- Sanitary Outfall
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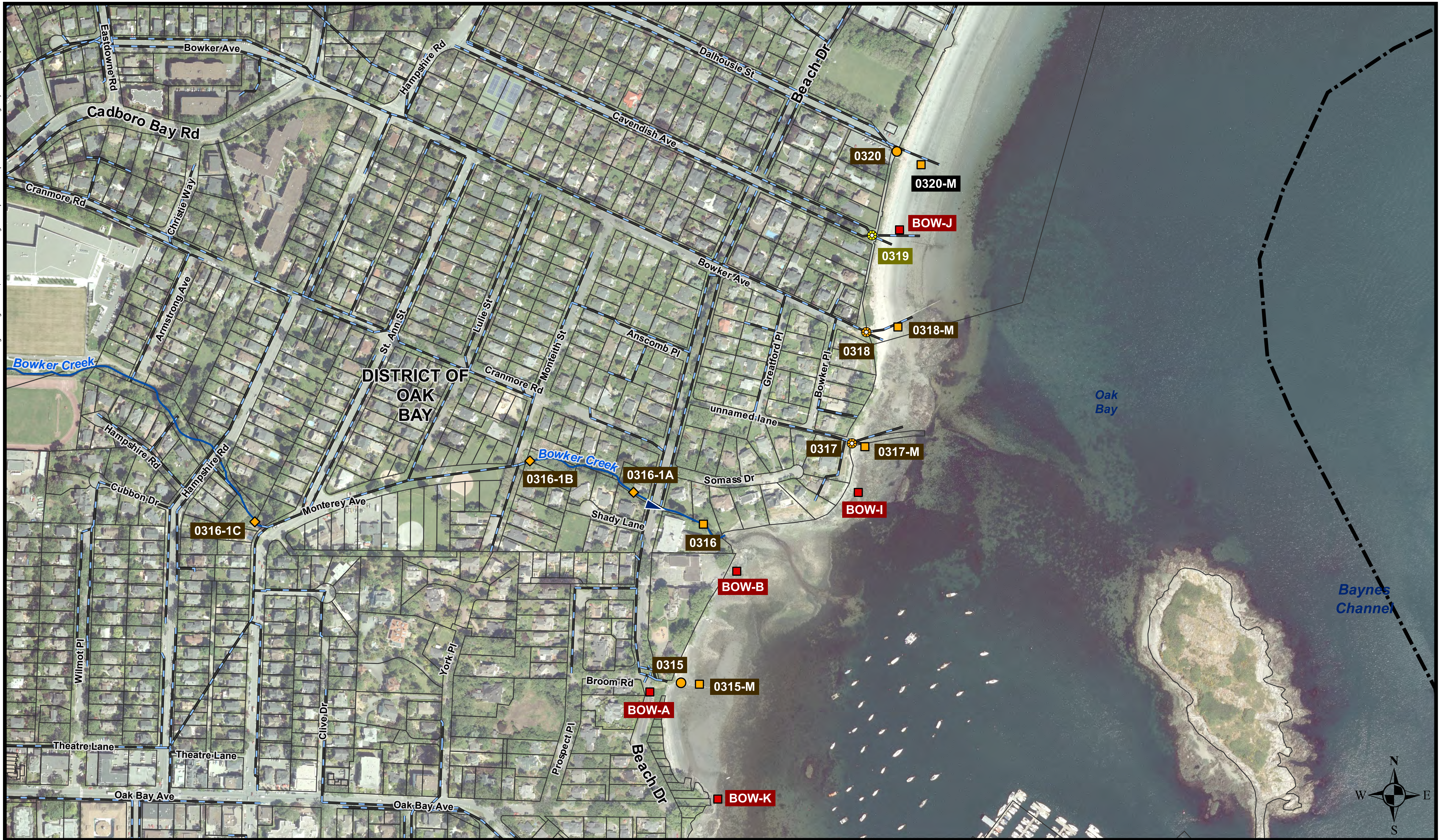
- Lake/Pond/Reservoir/Storage Basin
- Lot Line

EMERGENCY OVERFLOW SAMPLING SITES

BROOM ROAD

CRD - Parks & Environmental Services - Environmental Engineering - Mar 16, 2020 - Technologist: sruljancich - Map Document: EmergencyOverflowSampSites2020.mxd



Making a difference...together

Metres

0 25 50 100 150

Projection: UTM ZONE 10N NAD 83

- Emergency Overflow Sampling Site
- !! Denotes potentially unsafe access during certain conditions

Stormwater Discharge Location

- End of Pipe/Manhole, High Impact
- End of Pipe, High Impact
- End of Pipe, Low Impact
- Manhole, High Impact
- Manhole, Low Impact
- Marine, High Impact
- Marine, Low Impact
- Upstream, High Impact
- PS CRD Pump Station
- Sanitary Emergency Overflow Outfall
- Sanitary Outfall
- Stream/Ditch
- Stormwater Culvert/Drain Pipe
- Lake/Pond/Reservoir/Storage Basin
- Lot Line

EMERGENCY OVERFLOW SAMPLING SITES
BOWKER