TOWN OF LUNENBURG COUNCIL MEETING MINUTES

WEDNESDAY, JULY 28, 2021 AT 12:00 P.M.

LUNENBURG COUNCIL CHAMBER, 120 TOWNSEND STREET AND VIA ZOOM/YOUTUBE BROADCAST

PRESENT: Mayor Matt Risser
Deputy Mayor Peter Mosher
Councillor Jenni Birtles
Councillor Melissa Duggan
Councillor Stephen Ernst
Councillor Ed Halverson
Councillor Susan Sanford (via Zoom)

ALSO PRESENT: Paul Bracken, Facilities/Project Superintendent
Lisa Dagley, CPA, CGA, Finance Director
Dennis MacPherson, M. Eng., P. Eng., Town Engineer
Heather McCallum, Assistant Municipal Clerk
Bea Renton, Chief Administrative Officer
Ian Tillard, P.Eng., Consulting Municipal Engineer

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1. Call to Order

The Mayor called the meeting to order at 12:04 p.m.

2. Acknowledgement of Mi’kma’ki the ancestral and unceded territory of the Mi’kmaq People

The Mayor recognized Lunenburg’s location on the unceded territory of the Mi’kmaq people.

3. Agenda

Motion: moved and seconded approval of the agenda. Motion carried.

4. Council meeting minutes approval (defer to August 10, 2021 Council meeting)

5. Public Hearings, Presentations and Questions (Nil)

6. Correspondence, Petitions and Proclamations Consideration (Nil)

7. Business Arising from the Minutes/Unfinished Business

   a. Near Term Upgrades **and** Outfall Extension Reports plus Proposed Implementation Plan - Presentation by Sarah Ensslin, P.Eng. and Erica Hart, EIT, Nick Moriarty, B.Eng., and Allan MacAulay, P. Eng, CBCL Engineering

CBCL representatives presented the Wastewater Treatment Plant near term upgrades report first noting near term upgrade recommendation priorities (Schedule A) summarized below.

High Priority

- 1. Flood Control Berms
- 2. UV Disinfection
- 1.3. Polymer dosing pumps
- 4. Aeration blowers
- 5. Headworks screen and compactor

Medium Priority

- 6. Online Instrumentation in the Bioreactor
- 6.7. Standby generator
- 8. Mechanical upgrades (process room H_2S control, blower room temperature control, and service water to bioreactor)

Lower Priority

- 9.9. DAF manifolded manual weirs
- 10. DAF polymer makedown equipment
- 11. Compressor pipework

CBCL next presented their Wastewater Outfall Extension Pre-Design report (Schedule B). They noted that if there is increased densification within the Town there will be sufficient capacity with Option 3 included in their report.

The next Council meeting regarding wastewater initiatives as part of the CBCL project is scheduled for Wednesday, August 4 at 12:00 p.m. At that time, CBCL will present their reports on long term Wastewater Treatment Plant expansion, process assessment and optimization with the support of Dalhousie University.

8. Committee Meeting Minutes, Recommendations, Reports and Notices of Motion (Nil)

9. New Business (Nil)

10. Adjournment

The meeting was adjourned at 12:57 p.m. by the Mayor.

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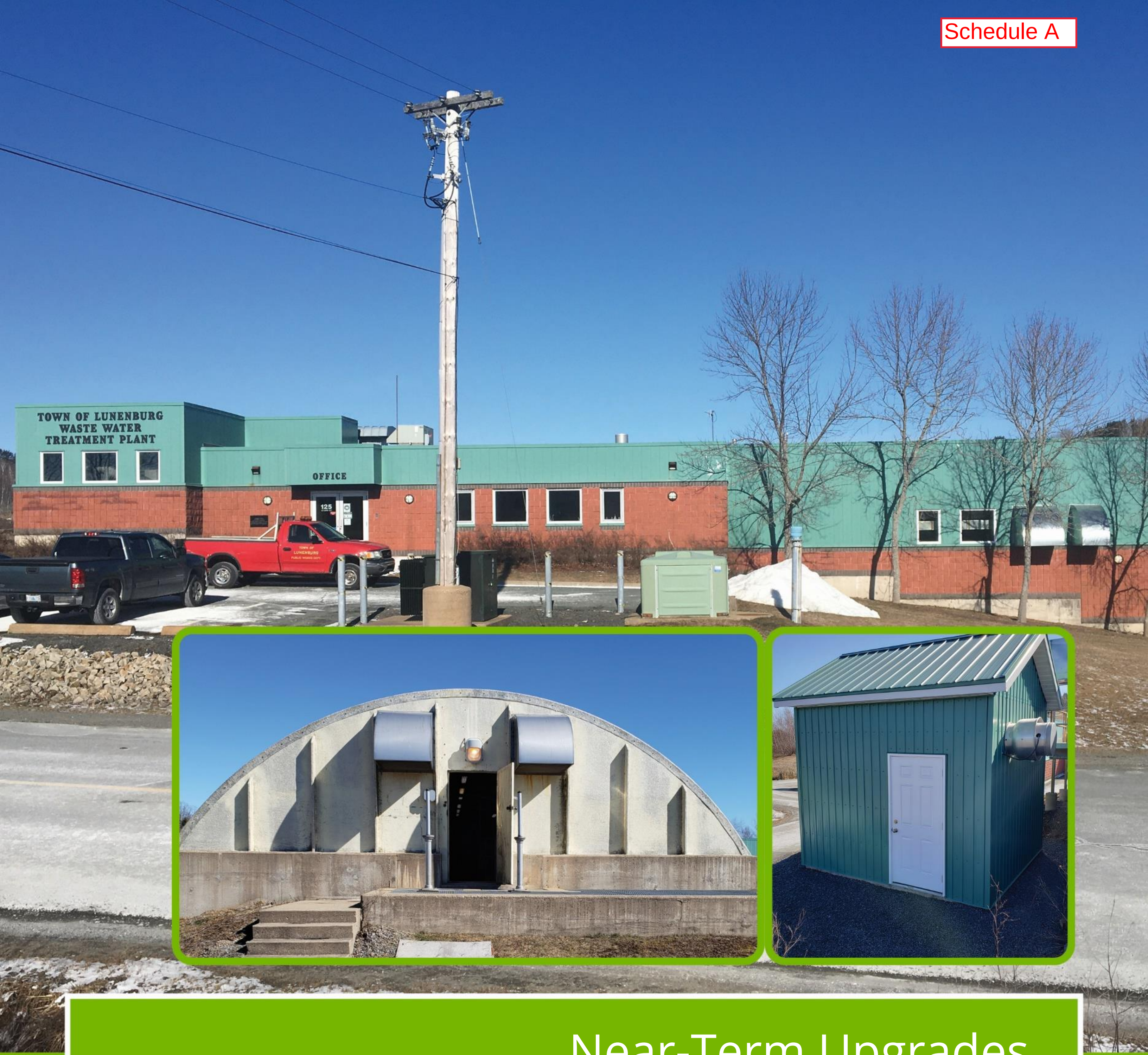
Bea Renton, CAO

Schedule A



Near-Term Upgrades

Town of Lunenburg

Wastewater Treatment Plant

Draft Report

CBCL

TOWN of LUNENBURG
A World Heritage Site

210803.01•July 2021

B	Reissued as Draft	D.T.	July 23, 2021	S.E.
A	Draft	D.T.	Jun16/21	S.E.
Issue or Revision		Reviewed By:	Date	Issued By:

CBCL

July 23, 2021

Dennis MacPherson, Town Engineer
Public Works, Town of Lunenburg
177 Cumberland Street
P.O. Box 129
Lunenburg, NS, B0J 2C0

Dear Mr. MacPherson:

RE: Town of Lunenburg – WWTP Near-Term Pre-Design Report

CBCL Limited (CBCL) was engaged by the Town of Lunenburg (the Town) to complete a preliminary design of the near-term capital upgrades required at the Lunenburg Wastewater Treatment Plant (WWTP). The near-term items are critical capital upgrades that will allow the plant to continue operating at its current capacity while improving functionality and reliability of the plant.

This report describes current issues including the aging process equipment, ventilation, and emergency preparedness. It outlines recommended solutions coupled with a discussion of alternatives considered, and construction sequencing. It has been revised as requested and is resubmitted for your approval.

Yours very truly,

CBCL Limited

DRAFT

Prepared by:
Erica Hart, EIT
Process Engineer in Training
E-Mail: ehart@cbcl.ca

Reviewed by:
David Trudel, P.Eng.
Process Engineer

Project No: 210803.01

Contents

Appendices

Table of Acronyms

Acronym	Definition
ACWGM	Atlantic Canada Wastewater Guidelines Manual for Collection, Treatment, and Disposal
ADF	Average Daily Flow
ATAD	Autothermal Thermophilic Aerobic Digesters
ATS	Automatic Transfer Switch
CBOD	Carbonaceous Biochemical Oxygen Demand
DAF	Dissolved Air Flotation
DO	Dissolved Oxygen
E. coli	Escherichia Coli
H_2S	Hydrogen Sulphide
MBBR	Moving Bed Bio-reactor
NSE	Nova Scotia Environment
NH_3	Ammonia Nitrogen
PDF	Peak Daily Flow
TBA	Temporary Bypass Authorization
TOL	Town of Lunenburg
TSS	Total Suspended Solids
UV	Ultraviolet
WWTP	Wastewater Treatment Plant
WSER	Wastewater Systems Effluent Regulations

Chapter 1 Introduction

1.1 Background

The Town of Lunenburg Wastewater Treatment Plant (WWTP) was constructed in 2002-2003 and is located on the South Shore of Nova Scotia, servicing the Town of Lunenburg (the Town). In the spring of 2021, a project was initiated by the Town for the Wastewater Treatment Plant and Outfall Pre-Design. The project includes four (4) elements: pre-design of the treatment plant outfall, pre-design of near-term capital upgrades at the WWTP, a building condition assessment report, and a conceptual design for the future expansion of the WWTP. This report focuses on the near-term capital upgrades required at the plant including capital maintenance on some of the original process equipment and structures, as well as some additional upgrades to address current standards and operational needs.

Currently, the WWTP receives and treats an Average Daily Flow (ADF) of approximately 766,000 US gallons per day (USgpd). The treatment train includes influent screening, grit removal, biological treatment using Moving Bed Bioreactors (MBBR), solids removal using Dissolved Air Flotation (DAF), and Ultraviolet (UV) disinfection. Treated effluent is pumped to an outfall that discharges at the shoreline in Lunenburg Front Harbour.

1.2 Scope and Objectives

As per RFP TOL2010001, the following items were identified as part of the near-term upgrades:

- Replacement of the headworks screen;
- Modification of the grit removal pipe work;
- Modification of the headworks water supply pipe work;
- Replacement of headworks grating and hatches;
- Replacement of the aeration blowers;
- Replacement of the compressed air pipe work;
- Addition of online instrumentation within the bioreactor;
- Improved process control of the polymer make down system;
- Replacement of the polymer dosing systems;
- Modifications to the DAF outlet control;
- Increase the UV disinfection dosage;

- Addition of a standby generator;
- Addition of Flood mitigation; and
- Improved HVAC in the process room and blower room.

The objectives of this report are to provide effective solutions to improve the ease of operation, process performance, and health & safety at the WWTP. The following Chapters of this report outline the current condition of the above items, along with our recommended upgrade options.

Chapter 2 Design Basis

2.1 Wastewater Flow Characteristics

Wastewater flows and influent characteristics were analyzed during the WWTP Evaluation and Option Identification Study (March 2019). At that time, the ADF was determined to be approximately 766,000 USgpd and the Peak Daily Flow (PDF) was 3,000,000 USgpd. Flow data is summarized in Figure 1. Influent data is summarized in Table 1. Flows vary from year to year, but the ADF has stayed consistent since the initial evaluation. Based on conversations with facility operators and Town personnel the above flow rates were agreed as acceptable for the design basis.

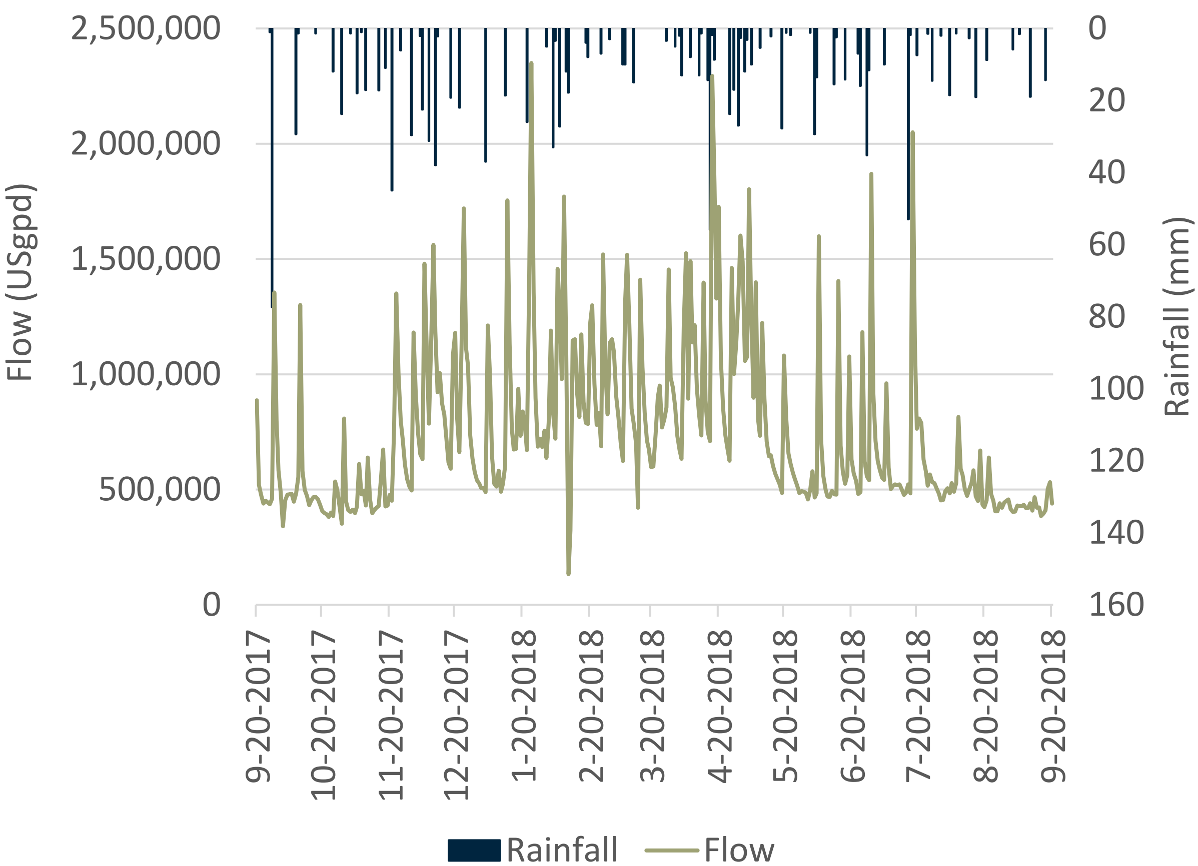


Figure 1: Wastewater Flows

Table 1: Influent Wastewater Characteristics

Parameters	Average	Peak
Population	2,263	
Flow (USgpd)	766,000	3,000,000
Carbonaceous Biochemical Oxygen Demand Load (CBOD), (kg/d)	160	320
Total Suspended Solids Load (kg/d))	300	600
NH_3 (kg/d)	38	74

The upgrades outlined in this report are required as part of the near-term improvements to allow the plant to perform to the best of its ability based on the current wastewater characteristics. The Town is predicting a growth in population over the next twenty years that would double the wastewater loadings to the plant. The increase in population along with the separation of the storm and sanitary sewers within the collection network is expected to result in a net zero increase in the overall flows to the plant. The increase in overall loading is not expected to alter the design basis for the equipment and upgrades included in this preliminary design report. The future loading to the plant have been considered when carrying out this preliminary design to ensure that the selected equipment is compatible (where practical) with potential future expansion works (i.e., long-term expansion options), but has not been sized to ensure that no equipment upgrades would be needed at that time.

2.1.1 Effluent Requirements

The effluent requirements are determined by a combination of the Federal Wastewater Systems Effluent Regulations (WSER) along with provincial effluent requirements as outlined in the Nova Scotia Environment (NSE) Approval to Operate for the WWTP.

The Lunenburg WWTP discharges to Lunenburg Front Harbour. The outfall location is being reviewed as part of this project but is covered under a separate report. There is no change anticipated to the effluent requirements at this time. The design effluent requirements are outlined in Table 2.

Table 2: Effluent Limits

Parameter	Limit	Notes
$CBOD_5$ (mg/L)	20	Quarterly average
TSS (mg/L)	20	Quarterly average
E. coli (count per 100 mL)	1000	Quarterly geometric average

Chapter 3 Evaluation of the Existing Facility

3.1 Overview of Existing Facility

The existing WWTP has had several upgrades over the past 10 years including replacement of the MBBR media and associated aeration system, upgrades to the grit removal pipe work, removal of the Autothermal Thermophilic Aerobic Digesters (ATADs), addition of a Fournier rotary press for sludge dewatering, and addition of a biofilter for odour control. Replacement of the sludge pumps is currently underway. Nonetheless, much of the equipment is original to the plant and is approaching the end of its useful life.

The existing treatment plant consists of the following:

- One (1) automatic inlet bar screen with 0.1" spacing;
- One (1) screenings compactor;
- Two (2) grit pumps;
- One (1) grit classifier;
- Three (3) positive displacement blowers (50hp, 1050 SCFM);
- One (1) compressed air dryer;
- Two (2) air compressors;
- Two (2) MBBR trains with four (4) stages in each, complete with media;
- One (1) equalization tank;
- One (1) sludge holding tank;
- One (1) polymer make down system and two (2) polymer storage tanks;
- Two (2) polymer dosing pumps;
- Two (2) DAF units;
- Two (2) sludge pumps;
- One (1) Rotary Sludge Press;
- One (1) UV disinfection unit;
- Two (2) Effluent pumps; and
- One (1) Odour Control system.

Flow from the catchment area is pumped to the headworks building and flows to the influent bar screen. An emergency by-pass channel is provided to direct influent to the MBBR in the event of a screen blockage. The influent is screened with a 0.1" automatically raked bar screen that collects the screenings and discharges them to a compactor for disposal offsite. Screened wastewater flows into the aerated grit tank where heavier particles are removed while the lighter organic particles remain. The wastewater then enters the MBBR for biological treatment. The MBBR contains microorganisms in a biofilm attached to the media within the tanks. These microorganisms break down the organic waste within the sewage. The MBBR is a two (2) train system with four (4) stages per train, each equipped with fine bubble aerators fed from the blowers. Both MBBR trains feed into the equalization tank, which acts as a batch tank ahead of the DAF. The equalization tank is equipped with coarse bubble aerators to avoid settling of solids and septicity. The wastewater flows from the equalization tank to the DAFs where it is dosed with polymer to enhance solids removal. Solids removal is achieved by dissolving air in the wastewater, under pressure, and releasing the air at atmospheric pressure in the DAF. The solids in the wastewater adhere to the bubbles, causing the solids to float to the top. These solids are then removed with a skimming device. Effluent from the DAF overtops a weir to the effluent channel where it is disinfected by the UV system. The disinfected effluent is then pumped to the outfall by two (2) effluent pumps.

The solids removed from the DAF units are pumped to the sludge holding tank located in the aeration building. The sludge holding tank is aerated to keep solids in suspension and avoid septicity. The sludge holding tank feeds the rotary press. The rotary press is used to dewater the sludge prior to hauling and is operated for about eight (8) hours per day, Monday through Friday. The dewatered sludge is then hauled off site for sludge disposal.

3.2 Operational Issues and Condition of Equipment

The focus of the operational upgrades will be based on the items identified for near-term upgrade in the RFP. Items were investigated during a site visit and discussions with the operations team were held to better understand the issues being experienced onsite (process, health & safety, etc.).

3.2.1 Headworks Inlet Screen and Compactor

The existing screen has been in service since the original construction of the plant. A 0.1” (3 mm) bar screen is installed in the inlet channel of the headworks building. Screenings collected from the wastewater are discharged to the screw compactor below the screen. The compacted screenings exit to a bin that is emptied periodically for disposal. The existing bar screen and compactor are nearing their end of useful life and are due for replacement. Additionally, the screen is reported to be passing large debris and small rocks that are causing blockages on the downstream equipment resulting in shutdowns and increased maintenance on the equipment. The operators installed a grate in the inlet channel ahead of the screen to prevent this. The grate is effective at preventing gravel from getting through but cannot be removed for cleaning.

3.2.2 Grit Removal Pipe Work and Grit Water Supply Pipe Work

The grit pipe work is part of the aerated grit chamber system which removes materials such as ash, sand, and other inorganic materials. The aerated grit chamber was out of service for several years but was upgraded in 2018. Included in the upgrade was the replacement of the grit pipe work. Although the pipe work was upsized at that time, the plant still frequently experiences blockages within the pipe work due to the large debris getting through the inlet screen. The existing pipework is 2½” diameter, where typical design standards would call for 3” diameter, or larger, pipe work in an aerated grit chamber. Short radius pipe bends are likely contributing to issues.

Figure 2 and 3: Existing Water Piping Headworks

The water supply pipe work is in poor condition and experiences freezing in the winter months which impedes the operation of the aerated grit system. The headworks room is unheated and frequently experiences freezing temperatures. It is not practical to heat this room due to the high volume of ambient air flushing through the room. The pipe work is not insulated, or heat traced. Improved protection from pipe freezing is required. Some pipes are not usable due to previous pipe bursts.

3.2.3 Hatches and Grating

Figure 4: Existing Bilco Hatch to be replaced (left) and example of grating to be replaced (right)

There are several areas within the plant that use access hatches or removable grating to reach equipment below. Within the headworks area, the access hatch for Grit Pump No. 2 no longer closes and poses a tripping hazard. The existing hatch is cordoned off as a precautionary measure and limits available space for movement in the headworks area. Figure 4 shows the existing hatch condition. The inlet and by-pass channels in the headworks area are covered with removable grating to access the channel for visual inspection and maintenance. Several portions of the grating were installed with cut outs for equipment or access to equipment that no longer exists. These cut outs adversely affect the structural integrity of the grating, as well as pose a tripping hazard.

3.2.4 Aeration

The aeration system consists of three (3) 50 hp blowers that supply air to four (4) unit processes within the WWTP. Aeration is required in the MBBR to enable microbial growth and decomposition of organic waste. Air from the blowers is also supplied to the equalization tank and sludge holding tank to avoid settling and septicity, and to the grit chamber for the separation of grit. The aeration demands of the plant are shown in Table 3 below.

Table 3: Air Requirements

Process	Air Flow Required (SCFM)
MBBR	960
Equalization Tank	100
Sludge Tank	350
Grit Chamber	100
Total	**1510**

Each of the existing blowers can provide 1050 SCFM at 7.5 psig, except for one which can provide somewhat more air following recent replacement of the sheaves. In this arrangement the blowers have sufficient capacity to operate in a two duty, one standby mode. This provides the plant with one blower as spare capacity. The existing blowers are sized appropriately for the aeration demands of the plant and are performing adequately though they are nearing their end of useful life and require replacement. The existing blowers are original to the plant and this model has been discontinued making spares for repairs difficult to obtain.

In the existing arrangement, air from blowers enters a common header that branches off to the various distribution lines for each process as indicated in Figure 5, below.

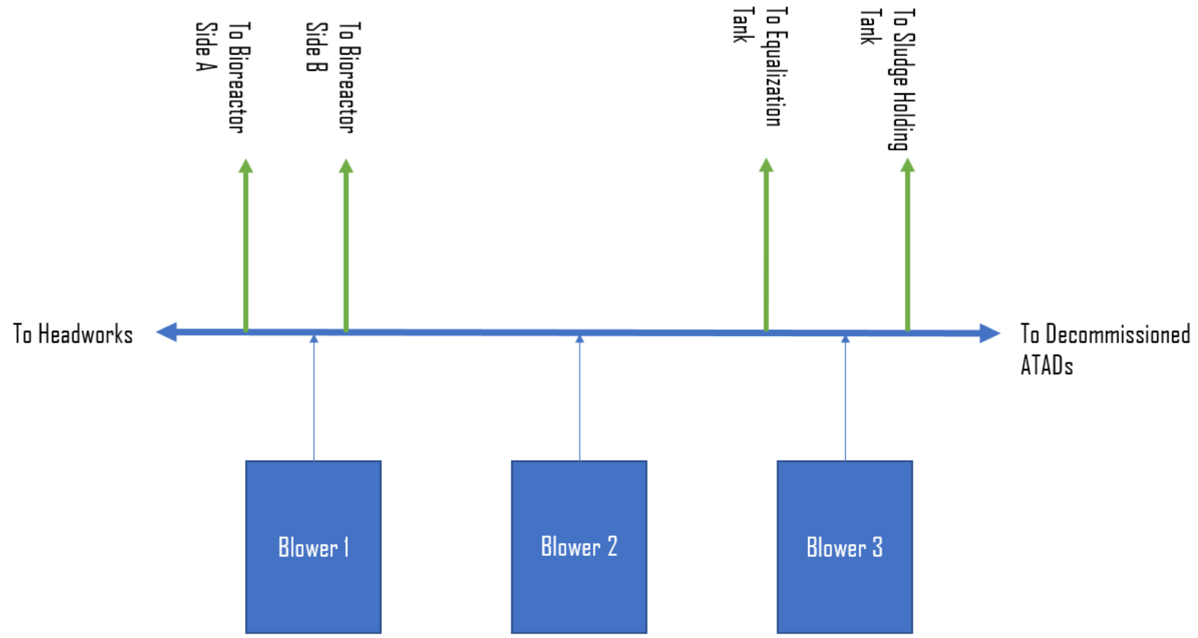


Figure 5: Existing Aeration Header Arrangement

Figure 6: Existing Blower Room

The existing arrangement does not allow for equalization of the air flow to specific processes and results in airflow that may not be sufficient for some processes. This problem has been highlighted specifically with air flow to the sludge holding tank, equalization tank, and bioreactor. The levels within the sludge holding tank and equalization tank vary throughout the treatment process. This changes the hydrostatic pressure the air flow needs to overcome to aerate the tanks. When the sludge tank and equalization tank are at lower liquid levels the hydrostatic pressure is reduced allowing for the direction of air flow to favour these tanks rather than the bioreactor, which has a greater hydrostatic pressure.

3.2.5 Polymer Make-Down and Dosing Systems

Polymer is used within the WWTP to provide enhanced suspended solids removal in the DAF. The plant is equipped with a dry polymer make-down system including a make down tank and two polymer batch tanks. The polymer is dosed into flow from the bioreactor through two polymer dosing pumps ahead of the DAF unit. The existing polymer make down and dosing systems pose issues due to end of useful life and lack of automation/control.


Figure 7 and 8: Existing Polymer Make-down System and Storage Tanks

The existing polymer make-down system lacks instrumentation that would allow for the verification of the polymer activation to ensure the polymer is at its most efficient state. The polymer dosing pumps are of an unknown capacity and are not equipped with instrumentation to verify the dosing rates. The polymer dosing pumps and make-down systems are critical to the operation of the DAF system.

3.2.6 Online Instrumentation

Polymer and solids carryover have been identified in the effluent of the WWTP. This contributes to foaming at the outlet of the DAF units and at the outfall. Foaming at the outlets of the DAF has adverse effects on the UV system and can lower the UV transmittance. Foam fills the effluent channels and flows onto the process room floor. This requires pumping by a vacuum truck every two weeks, which is a maintenance and a nuisance issue. Foaming at the outfall causes negative reactions from the public and brings negative attention to the outfall. Foam and solids carryover from the DAF units may be caused by excessive dosing of polymer ahead of the DAF unit, which is worsened by the lack of controls.

CBCL and Dalhousie University's Centre of Water Resources Studies are currently carrying out experimental work to identify the effect of polymer dose rates depending on salinity and TSS concentrations. The study started in November 2020 and includes jar testing various water quality conditions with polymer to optimize the DAF performance. Initial results from this work indicate that the performance of the polymer was significantly affected by both the influent TSS and salinity, and that there is potential to lower polymer concentrations dosed to the DAFs.

The current polymer dosing strategy is based solely on the influent flowrate and does not consider the solids content or the salinity of the influent, both of which can influence the required polymer dosage.

3.2.7 DAF Weir Level Control

The DAF uses flotation to remove solids from the effluent wastewater stream. Effluent from the weirs of the DAF flows to the UV system for disinfection. The effluent weirs are adjustable, but adjustment is extremely difficult, and so the operators do not change the weir levels, neither for maintenance nor for process optimization. This makes maintenance of the DAFs more difficult and prevents the operators from improving process performance.

3.2.8 UV Disinfection

Disinfection is provided by an ultraviolet (UV) system upstream of the effluent pumping station. The existing UV disinfection unit capacity is too small to be able to disinfect with the low UV transmittance (approximately 40%) that occurs in summer, and this results in insufficient UV dosing and underperformance. There is available space upstream of the existing UV bank to add an additional UV bank of similar size. The existing unit does not have an automatic cleaning system and the operators must take the bulbs out of the channel to clean them by hand.

3.2.9 Electrical

3.2.9.1 Power Distribution

The existing power distribution is generally original to the plant with subsequent changes to include the Rotary Press equipment, odour control system and HRV in the process room.

The 600V, 3 phase, 4 wire electrical service to the plant is underground from the utility padmount transformer. The main service switchboard is rated 600V, 800A, 3 phase, 4 wire with a main breaker having a 600A trip rating. The main service switchboard feeds process control panels, power panels and other equipment located throughout the plant. There is currently no up-to-date single line diagram for the plant.

The maximum plant demand for the past 12 months was 340kW in May 2021 based on the power utility bills. Based on the maximum plant demand at an assumed 0.8 power factor, the calculated current for the plant is 408A. Since the main breaker is not a 100% rated breaker, its continuous current rating is 80% of the 600A trip rating or 480A. Any significant electrical load addition to the plant should be reviewed to prevent nuisance tripping of the main breaker.

3.2.9.2 Standby Power

There is currently no standby power onsite at the plant leaving the plant vulnerable to power outages. Similarly, the pump stations that feed the plant are also not equipped with standby generators.

3.2.9.3 Hazardous Area Classification

The existing plant drawings indicate the following hazardous area classifications as defined by Section 18 and Appendix J of the Canadian Electrical code:

1. Headworks – Class 1, Div II.
2. Pump Station #8 wet well – Class 1, Div. II
3. Biofilter and Fan – Zone 2

Note that the division based hazardous area classification system has been updated to a zone based hazardous area classification system since the WWTP was originally constructed. Sections 18 and 22 of the Canadian Electrical Code specify electrical installation requirements in hazardous areas with Section 22 specific to sewage lift and pumping stations and to primary and secondary sewage treatment plants. Reference material for hazardous area classification can also be found in NFPA 820.

3.2.10 HVAC and Building Services

There are several HVAC and plumbing issues noted throughout the plant including excessive heat in the blower room, localized H_2S gas buildup in certain areas of the process room, and a lack of service water in the bioreactor building.

3.2.10.1 Excessive Heat in Blower Room

The existing blower room is equipped with a 5,300 CFM supply fan used to displace the heat rejected from the blowers and compressors out through a large louver on the north wall. Ambient air is drawn into the room from a rooftop intake penthouse.

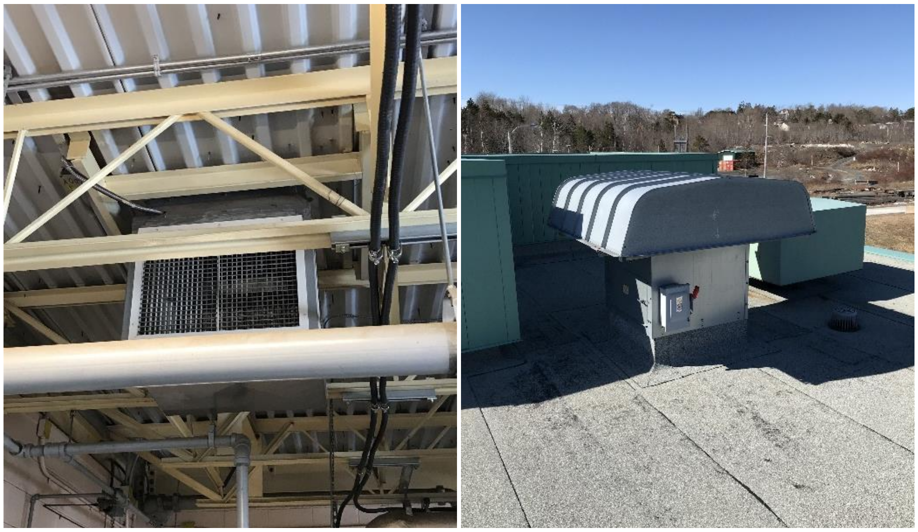


Figure 9 and 10: Existing HVAC equipment to service the blower room

This large volume of ambient air, even in summer, should be sufficient to displace the heat rejected from the equipment, but it has proven not to be effective. The operator has reported room temperatures in excess of 40°C during the summer months. This is approaching the upper limits for operating temperatures for the blowers and there are digital screens on some equipment that are affected by the high temperatures.

3.2.10.2 H_2S Capture in Process Room
There were several areas identified within the Process Room where the capture of H_2S at the floor level is inadequate. The HVAC system (HRV-1) supplies 100% outside air into the room and exhausts that air from both upper and lower elevations within the room. There are seven (7) of these exhaust locations at high elevation, and six (6) down near the floor, each exhausting at a rate of 600 CFM or 7800 CFM in total. The exhaust locations near the floor are located around the perimeter of the room. However, there are two (2) areas of concern in the middle of the room and two (2) areas on the perimeter that need to be addressed as H_2S build up has been noted in these areas.

3.2.10.3 Service Water to Bioreactor Building
The existing bioreactor building has no service water inside the building or close by. The walkways and the walls in the bioreactor experience building up of debris and require periodic cleaning. Currently, the only method for washing down these areas is for the Town's Fire department to bring a truck to site and use the hose from the truck. This method, though effective, is very inefficient and is not the best use of resources.

3.2.10.4 Compressed Air Pipe work
The existing compressed air pipe work is original to the plant and was originally installed without a dryer. The compressed air pipe work experienced condensation that affected the use of the pneumatically actuated equipment. A dryer was installed, however the condensation within the lines is a continuing issue. Condensation can affect the downstream equipment as well as corrode the compressed air pipe work/network. The material of construction is typically suitable for this installation; however, it is difficult to prevent corrosion growth once it has started.

3.2.11 Flood Control
The floor of the process room is at 1.71 m (CGVD2013) (5.7 ft), which is nearly 2 ft lower than the peak floodwater elevation experienced during Tropical Storm Dorian, on September 7, 2019. This storm caused flooding of the process room and significant damage to equipment in the process room. Many pieces of equipment in the process room could not be operated and needed to be replaced following the storm, and the plant was not fully operational until mid-October. The plant is vulnerable to water collecting in the immediately adjacent tidally-influenced marsh area from a combination of storm surge in Lunenburg Back Harbour and heavy runoff from rainfall during extreme weather events. Last year, culvert plugs were put in place during Tropical Storm Teddy to exclude sea water from entering the marsh during high tide. This would be effective during some storms, but there still remains a risk of flooding from heavy rainfall and requires Public Works staff to gauge the timing of installing and removing the culvert plugs, as well as access the culverts several times during extreme weather events, so it is a temporary rather than long term solution, as there are health & safety as well as operational considerations.

Chapter 4 Technical Description of Upgrades

To solve the operational and technical issues described in Chapter 3, upgrades are required to maintain operation of the plant at its current flows and loading. The options for upgrade and preliminary design details for each item are described below.

4.1 Inlet Screening and Compactor

The screening process is the first step in the wastewater treatment process and involves the removal of large non-biodegradable solids that frequently enter the wastewater system such as wood, plastics, papers, rags, latex, etc. Effective removal of these items is critical to the downstream operation of the treatment plant providing protection from clogging of equipment, possible damage, wear and tear, and accumulation of unwanted material. The existing screen is allowing debris to pass and causes wear on downstream process units. There are a variety of preliminary treatment options available for screening that vary based on their size and arrangement of openings as well as their operation philosophy. The replacement of the existing screen with a new fine screen is the recommend option.

Fine screens provide increased solids capture compared to coarse screens and add increased protection to the downstream equipment. There are several options for fine screens including perforated plate, bar screens, step screens, and multi-rake screens that offer various capture efficiencies.

The selection for the new inlet screen was based upon the following:

- The current and expected plant flows;
- Capture efficiency;
- Head loss across the screen;
- Available space within the channel;
- Maintenance access;
- Wastewater characteristics; and
- Historical issues with the inlet screen.

In order to overcome the issues outlined in Chapter 3, an increased capture rate and improved screenings performance is required. The two screen types that were considered to improve the efficiency were a spiral screw screen and a perforated plate screen.

A spiral screw screen provides screening of solids with an improved solids removal efficiency compared to the existing screen, and automated cleaning. A screw type screen would require significant modifications to the inlet channel and the headworks building. It would also require additional hydraulic head differential (liquid level fall) across the screen to operate effectively, when compared to the available hydraulic differential. Screw type screens require significant footprint and the ability to remove the screw for periodic maintenance.

A perforated plate screen provides increased solids removal and is suitable for installation within the existing footprint with minimal modification for maintenance and operation. A perforated plate screen has been selected. The perforated plate screen will include 0.25" (6 mm) perforations to provide a screenings capture rate of approximately 75%, compared to a 50% capture rate for the existing screen. The new screen will be complimented by a new screw type washer and compactor that will remove organics from the screenings, as well as provide dewatered and compacted solids for disposal. The washings from the compactor will be returned to the main process flow for treatment. Table 4 outlines the proposed design details.

Table 4: Preliminary Design Details of Inlet Screen and Compactor

Parameter	Value
Perforation size (inches/mm)	0.25/6
Solids Capture Efficiency (%)	75
Screen Width (inches)	11
Peak Flow (USgpd)	3,000,000
Organics Removal (%)	90
Dewatering dryness (%)	60
Volume Reduction (%)	70

The proposed screen fits well within the existing channel with minor channel narrowing required and includes a pivot point. The existing channel width is approximately 18" in width and the proposed screen mount width is 11". Steel plating that is sealed to the channel walls will be installed to direct the flow toward the mouth of the screen. The pivot point provided enables maintenance accessibility as it allows the screen to be pivoted out of the channel while keeping the screen in its housing. This feature is consistent with the existing screen that was equipped with a pivot point for maintenance.

The new compactor will be aligned under the centerline of the screen and perpendicular to the channel. The compactor will receive the screenings, wash, compact, and discharge the screenings into a dumpster for disposal. See enclosed sketches in Appendix A for this arrangement.

4.2 Grit Removal and Water Supply Pipe work

The removal of grit prevents unnecessary abrasion and wear of mechanical equipment downstream of the headworks, as well as reducing buildup in tanks. The sizing and configuration of the grit pipe work is critical to the overall efficiency of the aerated grit chamber. To reduce the risk of clogging or abrasion the pipe work size is recommended to be at least 3" in diameter and have long radius 45° bends used in place of sharp 90° bends. The existing stainless steel grit pipe work is equipped with appropriate bends but is undersized at 2½" diameter. The increased size of the grit pipe work along with the improved screenings capture rate will reduce the risk of plugging and abrasion of the pipe work. The increase in pipe size also reduces the velocities within the pipework that in turn reduces the overall energy usage for the pumps. The existing grit pumps can continue to be used as they were replaced in 2018 and are in working order. It is proposed to replicate the existing pipe work arrangement, both above and below the floor level of the headworks room but using 3" schedule 10 stainless steel pipe work.

It is proposed that the existing water pipe work be removed, and new pipe work installed complete with heat tracing and insulation. Refer to mechanical sketch in Appendix A for the potable water pipe work layout.

4.3 Grating and Hatch Replacement

Grating that has cut-outs over the channels, which reduces its structural integrity, is to be replaced. The grating replacement will be of galvanized steel grating that is pedestrian rated to maintain a walkway above the channel. See enclosed sketches in Appendix A for this arrangement.

A Bilco-type hatch will be installed over Grit Pump #2, to replace the existing (non-locking) hatch. It will be provided with a channel frame to prevent liquids in the headworks area from entering through the hatch. The access hatch will have lift assistance for one-handed door operation and an automatic hold-open arm to lock the door in the open position and ensure safe egress. The hatch is constructed of corrosion resistant 316 stainless steel, appropriate for the wastewater treatment environment. The hatch is also fitted with a gas tight seal and a fall protection grid under the cover.

4.4 Aeration Upgrades

Aeration will be provided to the MBBR, equalization tank, sludge holding tank and aerated grit tank with three (3) new rotary lobe blowers via a common header that is capable of being separated into two (2) zones. The first zone will be feed the bioreactors with air from one dedicated blower. The second zone will serve the equalization tank and the sludge holding tank and be fed from a second dedicated blower. The third blower will be used as a standby and will be capable of feeding both zones. Figure 11 shows the proposed blower arrangement.

New valves on the aeration header will be at a height that is inaccessible for manual adjustment. To allow for ease of operation, these valves will be fitted with an electrically operated actuator. Throttling of the valves on the aeration header is not required as they are only used for on/off air control. The electrical actuators will be integrated with the existing SCADA system for operator control. The existing air intake header will be reused and the new intake to the blowers will be insulated to match.

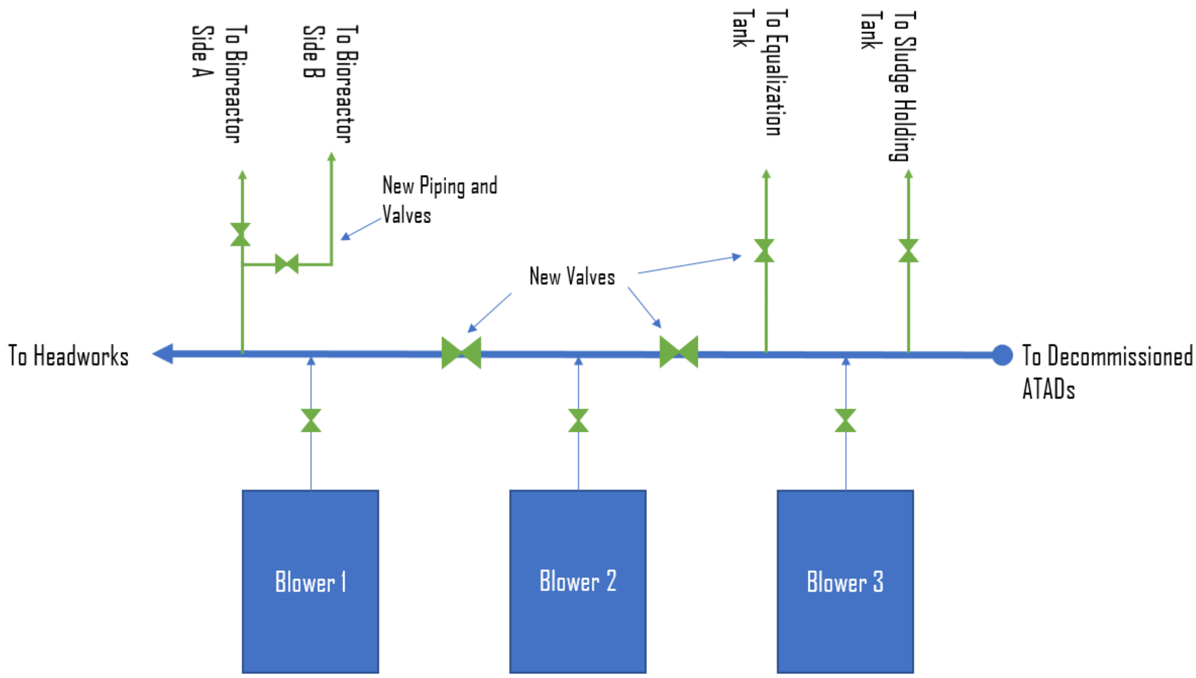


Figure 11: Proposed Aeration Header Modifications

The design values for the proposed blower replacement are shown below in Table 5.

Table 5: Preliminary Design Criteria for Blowers

Parameter	Design Value
Drive Motor size (hp)	50
Flow at inlet conditions (SCFM)	1050
Differential Pressure (psig)	7.5
Blower Speed (RPM)	2961
Total Power Required (hp)	48.9
Noise level with acoustic hood [dB(A)]	74

For maintenance, the new aeration blowers are accessed from their back and front ends and do not require access at their sides. To maximize space within the blower room, and provide access at the required areas, the blowers are to be placed in a side-by-side arrangement with at least 3.5ft of clearance at the front and back of the blowers. A new single structural pad will be provided for the blowers in the middle of the room and the existing air compressor and dryers will be relocated behind the blowers to allow for access to all equipment.

The existing blowers received power and controls from wiring that enters from their existing housekeeping pad (i.e., below the blower). The existing structural pads will be removed as part of the above works and the new blowers will be electrically fed from overhead via new conduit runs form the control panels. The new blowers will be wired from the ceiling, inline with the latest electrical code.

All aeration pipe work (air intake, blower outlets, aeration headers, and laterals) will be replaced. As noted above, the air intake will be insulated to match existing conditions. See enclosed sketches in Appendix A for this arrangement.

4.5 Process Instrumentation Upgrades

Additional instrumentation will be provided in the equalization tank and the bioreactor. The bioreactor will be equipped with two (2) dissolved oxygen (DO) probes; one in each bioreactor train, as well as one (1) in the equalization tank. The DO probes will confirm and monitor that the desired DO levels are being reached in the bioreactor to maintain biological activity and avoid septicity in the equalization tank. The equalization tank will additionally be provided with one (1) TSS meter for dissolved solids and (1) conductivity probe for salinity. The conductivity and TSS measurements will provide feed-forward control to the polymer dosing pumps, as described below. The sensors will be connected to the existing SCADA system for monitoring, logging, and system control.

The DO probe will provide continuous monitoring of the dissolved oxygen levels in the bioreactors and the equalization tank. The DO probe operates by measuring the electrical current generated from the oxygen molecules within the fluid and oxidation of silver in the instrument. The electrical current is converted to an oxygen concentration that will be displayed locally for operator information and also transmitted to the SCADA system for operations and data logging.

TSS will be monitored in the equalization tank by a TSS probe. To measure TSS, the probe operates by using a light beam directed through the wastewater and is deflected from its original direction by optically denser particles (i.e., suspended solids). The amount of salt in the wastewater will be determined by measuring the conductivity of the wastewater. These signals will be converted to TSS and salinity concentration readings, that will be displayed locally for operator information and transmitted to the SCADA system for operations and data logging.

All the instruments will be mounted within the tanks in a position that is easily accessible by the operator. All instruments will be equipped with local displays for troubleshooting and monitoring.

4.6 Polymer Make-Down System

Verification of the activation of the polymer from the make-down system can be provided by two different methods. The activation of the polymer can be verified from the addition of instrumentation downstream or by providing a new make-down system with enhanced instrumentation for control. There are several parameters that influence polymer activation and ultimately performance, including the aging time, effective mixing, and quality (temperature, contaminants) of the dilution water.

The option of providing additional instrumentation to verify the polymer activation was investigated. This option would use a particle charge detector to measure the charge of the colloidal dissolved substance in an aqueous sample. Polymers, when activated properly, produce ionic charges that are used to attract the solids present in the wastewater. The particle charge detector would be capable of detecting the electrical surface charge of the polymer within the polymer solution to verify the activation. This instrument has been typically used in the paper industry to characterize chemical additives but can also be employed in the wastewater treatment industry for the verification of activation. The limitation to using this method would be ensuring an appropriate calibration that correlates the polymer activation. Although a feasible solution, CBCL was unable to verify its effectiveness/accuracy at reference projects. This solution also involves adding costly instrumentation to an aging system that is nearing its end of useful life.

Improved consistency of polymer activation can also be provided with an upgraded make-down system that would include enhanced control of the polymer make-down. The existing polymer make-down system is in an adequate condition but is nearing the end of its useful life. A full replacement of the polymer make-down system is recommended within the next five to ten years. Although providing additional instrumentation offers a lower initial capital cost, a new make-down system is more cost-effective in the medium term. Providing a new make-down system paired with the additional instrumentation in the equalization tank should improve the efficiency of polymer dosing and reduce overall polymer use at the plant. The proposed make-down system is a batch system that ensures consistent polymer activation. The make-down system includes a twin-screw conveyor for accurate and repeatable discharge of polymer powder along with a metered water inlet pipe to ensure consistent mixing ratios. This option would provide a polymer make-down system able to reliably produce consistently activated polymer for the DAF system.

The polymer make-down system can be provided with a vacuum fill feed system that automatically fills the hopper directly from the dry polymer bag. Alternatively, a manual fill system could be used from an access platform, as per current arrangements. The vacuum system removes the need to lift bags up an access platform but introduces more operational complexity to the make-down system. The vacuum system can be easily upset by moisture in the dry polymer bags and creates another process for the operator to troubleshoot and maintain. As the operator is familiar with the manual bag dump arrangement, it will be carried forward. The design criteria are outlined in Table 6.

Table 6: Preliminary Design Criteria Polymer Make-Down System

Parameter	Design Criteria
Polymer Fill Feed	Manual Bag Fill from Access Platform.
Hopper Size (lbs)	150
Batch Size (gal)	235
Concentration (%)	0.25-0.5
Storage Capacity (gal)	470 (Two (2) 235 gal tanks)

The make down system would be made up of a dry polymer product hopper, a mixing tank, and two storage tanks. Each mixing and storage tank have a capacity of 235 USgal. The hopper is capable of holding 150 lbs of dry polymer (dependent on particle size and bulk density of the product). Based on standard make down concentrations and the ADF as outlined above a full hopper of dry product should last 2 to 3 days (i.e., the hopper would need to be refilled every 2 – 3 days during ADF conditions).

The hopper feeds the dry product to the mix tank, which is also supplied with water. The mixing is carried out using a low shear mixer to gently prepare the solution. Once the batch has matured it is released into one of two storage tanks. As the mix tank is situated on top of the storage tanks, this occurs by gravity. The solution is then stored, ready for use. Two storage tanks are provided to allow for redundancy; however, both tanks do not necessarily need to be continuously utilized. Normal operation during dry weather could allow for only one storage tank to be used, thus allowing each batch to be made up and used in a relatively short time, preventing the batch becoming "old" and reducing its effectiveness. When wet weather is anticipated the system could be switched to use both storage tanks, thus ensuring there is an adequate supply of polymer during high usage periods.

The make-down time for a batch of 235 USgal polymer is approximately one (1) hour. Based on a dosing rate of 3 mg/L and a concentration of 0.5%, a 235 USgal batch of polymer should accommodate approximately 3 hours at peak flow conditions, and about 6 hours at ADF conditions. Therefore, there is sufficient time to make the next batch in the mixing tank while the storage tank is suppling chemical to the polymer feed pumps. See enclosed sketches in Appendix A for this arrangement.

4.7 Polymer Dosing Pumps

The existing polymer dosing pumps are of unknown capacity with very limited controls and are reaching their end of useful life. The capacity of the existing pumps was approximated from historical data at the plant based on recording the calculated pump speed and the pump rate at the time. The outlet pressure of the pump was also approximated based the pressure of the flow into the DAFs from the equalization tank. The polymer dosing pumps are critical to DAF process operation and are to be replaced with new pumps with additional controls, controlled output, and of specified rated capacity.

Options for chemical metering pumps include progressive cavity metering pumps and solenoid driven metering pumps. Progressive cavity pumps are ideal for low flow and high accuracy pumping applications and are advantageous in pumping viscous liquids such as polymer. Progressive cavity pumps can accurately dose polymer over a wide range of flows. Solenoid driven metering pumps also offer accurate pumping output with a high turndown ratio. Costs for solenoid driven pumps are typically greater than progressive cavity pumps. Based on the chemical to be dosed and the cost-effectiveness, a progressive cavity pump is recommended for this application. The operators are familiar with these pumps, for this application.

The proposed system will include a polymer dosing skid, equipped with two (2) progressive cavity polymer dosing pumps. Each DAF will have its own dedicated polymer pump. The polymer dosing skid will include a calibration column for operator confirmation of dosing rates. It will also be provided with two (2) magnetic flow meters to accurately display dosing rates. A flow meter will be provided on each outlet stream from the skid, with one stream to either of the DAF influent lines. Table 7 outlines the design details for the polymer dosing system. The selected system allows for connection of carrier water so that alternative dry polymer products or concentrations can be used. This provides flexibility in the system to make changes in future.

Improved control of the dosing rate will allow the operators to accurately dose the DAFs according to the influent conditions. Foaming typically occurs from an overdosing of polymer which can be avoided with the enhanced control of the polymer pumps. See enclosed sketches in Appendix A for this arrangement.

Table 7: Preliminary Design Criteria for Polymer Dosing Pumps

Parameter	Design Value
Polymer Flow Rate (lph)	126-360
Discharge Pressure (psi)	30

4.8 DAF Weir Level Control

Each DAF unit will be modified to include a single hand wheel that will allow the operator to adjust the level of the weirs. This will allow easier cleaning of the DAFs (required every 3 - 6 months) and will also allow the operator to make process changes if needed, since the DAF level is a key process parameter in controlling the sludge thickness. The DAF units have adjustable weirs at both ends and thus will include one hand wheel at either end. The DAFs will also be provided with new telescopic overflow pipes, as well as rubber rings between the stationary pipe and the telescopic section. A site visit is required by the DAF manufacturer, SUEZ, to verify the design details and measurements when public health protocols allow.

The material of construction for the original DAFs is stainless steel. The materials used in the modification will also be of stainless steel with neoprene for the gaskets. Material choices are best suited for the applications where wear resistant in desirable (i.e., WWTPs). The hand wheel will be a geared handwheel to enable easy operator adjustment. The modifications to the existing DAF units will be completed with manufacturers approved equipment to ensure it is a vendor approved retrofit.

The site visit, when public health protocols allow, will permit the manufacturer to provide drawings, installation instructions, and guidance for the contractor to fit the handwheels and weirs. It is recommended that SUEZ return after installation to inspect the modifications. While on site they will also complete start-up/commissioning works on the weir controls as well as providing operator training.

4.9 UV Disinfection

Additional disinfection is required at the plant to consistently meet effluent limits. The current disinfection is not sufficient as the UV transmittance through the effluent is lower than required resulting in an insufficient dose of UV. UV transmittance is influenced by several factors including suspended solids, colour, foaming, or polymer carryover. The improvements to the upstream polymer dosing to reduce foaming could improve the UV transmittance. The UV transmittance at the plant is seasonally below the required 60%, even in instances of low effluent TSS.

An additional UV bank will be provided upstream of the existing UV bank and located in the same channel. To aid in cleaning of the UV bulbs an automated wiper system was contemplated for the new UV bank as well as for retrofit of the existing UV bank. The wiper system can prove to be an efficient method of bulb cleaning but based on the current foaming issues experienced with the DAFs, they are not currently recommended. An alternative to the automatic wiper system is to provide a UV hanger to enable efficient washing of the UV bulbs. The hangers allow each module of lamps to be lifted out of position and hang over the channel for wash down.

The location of the new UV bank will require the relocation of an existing hose reel to ensure proper installation and operator access for maintenance. There are no updates required to the PLC and no additional programming required to incorporate the second UV bank. The design details are shown in Table 8 below and a sketch of the system can be seen in Appendix A.

Table 8: Preliminary Design Parameters for UV Disinfection

Parameter	Design Value
Peak Design Flow (USgpd)	3,000,000
UV Transmittance	40%
Total Suspended Solids(mg/L)	20
Disinfection Limit (E.Coli/ 100mls)	1000
Channels	1 (Existing)
Number of Banks	2
Number of Modules per Bank	4
Number of Lamps per Module	8
Total Number of UV Lamps	64
Maximum Power Draw per bank (kW)	7.7

4.10 Electrical

4.10.1 Single Line Diagram

An up-to-date single line diagram was prepared as part of this report and is included in Appendix C. This single line diagram is based on equipment nameplate data, existing as-built drawings and field information provided by KRC Controls Ltd. Existing information should be field verified prior to isolation of equipment and lock out/tag out activities.

4.10.2 Standby Generator

Preliminary generator sizing calculations indicate that a 600V, 600kW, 3-phase standby generator will be required based on the following loads:

- Headworks equipment;
- Process blowers (2 running);
- DAF units;
- Air compressors;
- Chemical feed systems;
- UV disinfection system;
- Effluent pumping station (1 effluent pump running);
- Base building loads including heating, ventilation, receptacles, and lights;
- Sludge Dewatering equipment;
- Odour Control System; and
- Plant Control system.

Generator sizing also assumes that equipment start-up on generator power will be sequenced through PLC controls at the plant. The generator and automatic transfer switch operating status and alarms will be monitored by the WWTP PLC controls.

The new diesel generator will consist of a packaged exterior generator assembly mounted on a reinforced concrete pad. Specific components include the following:

- Diesel engine to ISO 3046/1;
- Alternator to NEMA MG1;
- Alternator control panel;
- Battery charger and battery;
- Fuel supply system;
- Ventilation system;
- Steel mounting base;
- Block heater;
- Line circuit breaker;
- Exhaust silencer;
- Control panel for controls, monitoring & alarming;
- Non-walk in sound attenuated weatherproof enclosure, minimum 70dB at 7m sound levels; and
- Sub-base diesel fuel tank (double walled) including all associated instrumentation (leakage detection and low level alarm). Fuel tank will be sized for a minimum 24 hours of operation at full load. If backup fuel longer than 24 hours is required, a separate diesel fuel tank may be necessary.

Vehicular protection such as bollards or fencing will be installed as required.

The proposed location of the new generator is indicated in Appendix A. The generator location was selected to avoid fresh air intakes to the WWTP, avoid existing known underground services, and to be accessible for maintenance and fuel delivery.

4.10.3 Power Distribution

4.10.3.1 Automatic Transfer switch (ATS)

For connection of the standby generator, a new 600V, 3-phase ATS will be installed complete with electronic controller for local diagnostics and alarming, in-phase monitor, isolation switch and bypass contacts, and solid neutral. The ATS will also include a programmable generator exerciser feature. The ATS rating will match the electrical output characteristics of the standby generator or service size whichever is higher. The isolation switch and bypass contactors will allow the WWTP to isolate and manually bypass the transfer switch in the event of a transfer switch failure or for transfer switch testing.

4.10.3.2 600V Main Switchboard

The existing main service switchboard is comprised of a main breaker/utility section internally connected to the branch breaker section and will require on-site modifications to separate the two sections to be able to connect the ATS. We propose that a new main service switchboard complete with an 800A main breaker and utility section be installed near the new transfer switch to make the switchover easier and minimize plant outages. The existing switchboard will be connected downstream of the new automatic transfer switch and will feed existing and any new plant loads. Final on-site modifications to the existing main service switchboard will need to be field verified with the equipment manufacturer. Due to the lack a space available in the existing electrical room, a new electrical room will be installed with a minimum 1-hour fire rating for the new equipment. The location of the new main electrical room is indicated on the sketches enclosed in Appendix A.

This approach will require a new electrical underground service to the plant. The existing utility padmount transformer could possibly be used but this would require further review with the utility and a longer plant outage to disconnect the old cables and reconnect/install the new cables. Project costing assumes that a new utility padmount transformer will be installed.

If the new standby generator and ATS are not installed, upgrading the existing plant main breaker to 800A to match the main switchboard ampere rating should be considered. This would provide additional spare load capacity for the WWTP as the existing demand is nearing the 80% rating of the existing main breaker. This change may require replacement of the existing service entrance cables, but this would require additional review to confirm.

4.10.4 Hazardous Area Classification

Any upgrade electrical work will comply with the latest applicable standards and codes for hazardous area classification.

4.11 HVAC Upgrades

4.11.1 Heat Relief in Blower Room

There are three (3) 50 hp blowers, two (2) 3 hp air compressors, and one (1) compressed air dryer all rejecting heat into the room when in operation. A significant heat gain to the space is produced from the 50 hp blowers, particularly when two of the three blowers operate concurrently. The heat rejected from the two blowers at full load is 34,000 BTU, or roughly 10 kW.

The primary cause of elevated temperatures in the room is the uninsulated discharge air pipe work from the blowers. There is approximately 160 ft² of exposed surface area of hot pipe work, operating as high as 155°F, or roughly 70°C. This exposed pipe work is estimated to reject nearly 136,000 BTU, or 40 kW, of heat into the room.

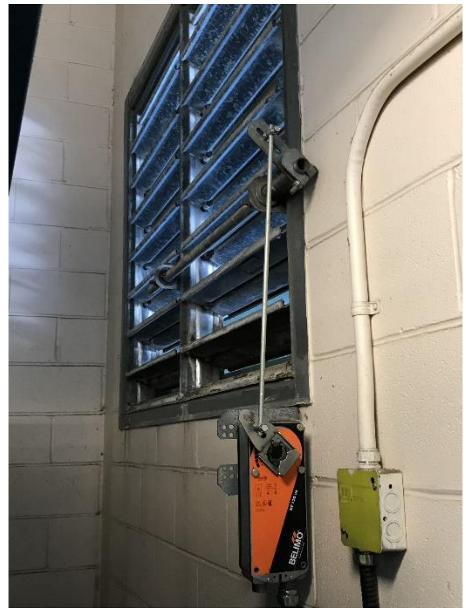


Figure 12 and 13: Existing Blower Room Layout and Louver

CBCL offers two practical recommendations for addressing the elevated temperatures. First, the discharge air pipe work off the blowers must be insulated to reduce the heat transfer into the room.

Second, the existing supply fan and intake penthouse should be replaced with a new exhaust fan, essentially reversing airflow such that heat is drawn out of the room. The existing louver complete with motorized damper is adequately sized with over 10 ft² of free area and will allow the required ambient make-up air into the room. This existing louver is well suited for this proposed arrangement as it is located on the north side of the building, frequently in the shade. The existing intake via the penthouse on the flat roof is not ideal and considered the hottest area for sourcing of "cooling air".

The new exhaust fan will be sized at 5,300 CFM to match existing and will be mounted on the existing roof curb supporting the intake penthouse. The new exhaust fan will be VFD controlled and operate more efficiently to maintain the indoor temperature set point.

4.11.2 Improved H_2S Capture in Process Room

In order to improve the H_2S capture within the process room it is recommended that re-routing of ductwork and capping of exhaust grilles be implemented. H_2S is heavier than air and therefore should be collected at the floor level. Improved capture can be achieved by capping a number of the exhaust grilles at the high elevation and routing new ductwork down to the areas of concern in the middle of the room. All of the exhaust air locations should also be rebalanced to ensure adequate capture throughout the room. This may result in a reduction of airflow at high elevations and an increase at the floor level. Refer to Appendix A for the proposed HVAC modifications.

4.11.3 Service Water Supply to the Bioreactor Building

Service water will be supplied to the bioreactor building via a new 3/4" buried water line, leading from the process room across the driveway to the bioreactor. Two (2) sources of service water with hose bibbs are recommended to be installed in the bioreactor building, one at each end. This will be a HDPE line, compete with heat tracing and insulation. The new water line will exit through the wall of the process room approximately 36" above grade and run tight to the wall down to a suitable elevation below the frost line. This vertical segment will be fully concealed in a weatherproof, stainless steel shroud to protect the water line from the elements. The water line will be routed across to the east end of the bioreactor, surfacing just under the stairs. An identical stainless steel shroud will also conceal this vertical segment.

The water line will enter the east end of the bioreactor building approximately 12" above the walkway and immediately branch off to the first hose bibb. The water line will run along the south perimeter of the bioreactor supported from the galvanized handrail structure and terminating at the second hose bibb near the west entrance. The new water line will be fully heat traced and insulated within the unheated bioreactor building. Refer to Appendix A for the proposed layout.

4.11.4 Compressed Air Pipe work

In order to remove corroded sections within the compressed air pipe work network, the pipe work is to be replaced where it is damaged. Much of the compressed air pipe route is exposed in the majority of areas and should be easy to replace as required, with the exception of the main line routed above the T-bar ceiling in the corridor. With the air dryer now installed on site future corrosion should not occur. For this reason, it is proposed use galvanizes pipe work for the new pipe runs. Refer to Appendix A for compressed air pipe work layout.

4.12 Flood Control

Hydrologic and hydraulic modelling was updated and has shown the following expected extreme design flood levels within the marsh:

- 1:100yr rainfall combined with a 1:2yr storm surge- 2.45m (CGVD_2013) (8.0ft)
- 1:100yr storm surge combined with a 1:2yr rainfall- 2.53m (CGVD_2013) (8.3ft)

Flood levels include Climate Change and Sea-level rise for 2070. As such, the recommended minimum height of flood protection elements around the WWTP is 2.6m (8.5ft). There are two ways which flooding can make its way to the WWTP: (1) the drainage ditch between the parking lot and marsh, and (2) from Starr St.

The construction of berms with top elevations above the expected high flood level was selected as the means to prevent ingress of flood waters to the low parking lot yard area.

These berms on shown in Appendix A. Cross sections through these berms are also shown. The berm in the drainage ditch is larger but this is to blend to the surrounding natural elevations at its top. The berm at the front of the WWTP is intended to be a more subtle feature blending to the existing lawn.

In addition to the lawn area in front of the WWTP requiring elevating, the plant's secondary driveway entrance also requires regrading to bring it to an elevation of 2.6m (8.5ft). A profile of the regrading is also shown Appendix A. As is noted on the drawing, the driveway needs to be built up by about 0.7m (2.3ft) at its crest. It is understood that occasionally trucks use this driveway to loop around the plant. The suitability of the proposed grade was checked using a WB-20 design truck. The proposed grades appear to allow the truck to travel along the driveway and over the crest without the fifth wheel connection exceeding its maximum deflection range (5 deg design vs. 10 deg max allowable).

There also appears to be about 0.5m (1.6ft) of clearance under the vehicle trailer. While a standard WB-20 truck/trailer appears to pass safely over the crest, trailers with aerodynamic skirting or "low-boy" trailers may bottom out as they have significantly less clearance. Signage could be erected warning of this.

While a berm across the drainage ditch will block flood waters from backing up into the low yard area, it will also prevent storm water that is collected in the yard area from flowing away. To prevent this, a culvert with a backflow prevention device is shown that will allow storm water to leave the yard. During extreme flooding events, the backflow prevention device would not allow flood water from the marsh to backup into the WWTP yard.

This will also mean that any storm water collected within the yard will need to be stored until the flood event outside the berm subsides. It is beneficial to try and reduce the amount of storm runoff the flows down into the lower part of the WWTP yard. To accomplish this, a trench drain is recommended to be installed across the back driveway that leads to the low yard. The trench drain would collect drainage from the upper yard as well as from roof leaders and be piped directly to the marsh area (pipe will also have backflow prevention device).

The available storm water storage volume in the yard is approximately 190m^3 (6,710 ft^3) A rough calculation of the amount storm water that would fall within the storm water collection area (details are included in Appendix B). With the reduction in collection area achieved by installing the trench drain, in a 1-in-100-year (24 hour) design storm, approximately 330m^3 (11,654 ft^3) of precipitation would be collected. Any amounts that cannot be stored, would have to be pumped over the berm when the backflow prevention device on the culvert is closed due to high water levels in the marsh.

Using the Rational Method to calculate peak runoff rates, a peak runoff rate of 126 L/min (33 gpm) was calculated. This rate is within the range of several trailer mounted pump systems which could be used to temporarily pump during flood conditions. A trailer pump system could be driven to the top of the new berm on its a north side and be used to pump storm water collected from within the yard area over the berm and into the marsh area.

The existing overflow from the WWTP (which combines with the overflow from the lift station) currently discharges to the drainage ditch. This will need to be re-routed directly to the marsh area beyond the proposed berm. This pipe will also have a backflow prevention device. The manhole located in the yard will need to have its cover replaced by a watertight cover anchored to the manhole structure itself. In heavy precipitation events, levels may build up in the lift station to higher elevations than the manhole cover. Hydraulic pressure would force a standard manhole cover off its frame and cause flooding in the yard. A watertight cover has bolts to connect the cover to the frame. The frame should also be anchored to the manhole structure to prevent the entire frame/cover unit from being lifted off under hydraulic pressure.

Chapter 5 Implementation Strategy

5.1 Construction Sequencing

The Lunenburg WWTP is an operating facility that must remain in operation throughout the upgrade process with as little downtime as possible. There are several critical pieces of infrastructure included in the planned upgrades that will require careful planning and construction sequencing to minimize or eliminate shutdowns during the construction process.

The following replacements will require careful planning:

- Installation of inlet screen and compactor;
- Installation of the new blower system;
- Relocation of the compressor and replacement of the compressor pipe work;
- Installation of the Polymer dosing and make-down systems; and
- Installation of new UV bank.

The installation of the inlet screen and compactor will require temporary bypassing of the headworks to remove the existing screen and compactor and install the new one. The existing bypass gate will be used to direct incoming wastewater to the MBBR system. The estimated bypass time is approximately one week. Bypassing of the headworks will have a negative impact on the biological treatment system. However, given the relatively short downtime, the biological process should self-correct after a few weeks.

The installation of the new blowers will require significant modification to the existing blower room that has limited space. The existing blower arrangement limits the construction sequencing such that the existing blowers must be removed before any of the new blowers can be installed. There is not an option to replace the blowers one by one, while maintaining two blowers at all times. To maintain the air flow to the plants processes, a temporary blower system must be provided. The ultimate construction sequencing will the responsibility of the contractor and must consider limiting the shutdown of the blower system. A temporary blower set up outside of the building is viable and would ease construction sequencing significantly. This temporary arrangement could feed the aeration system at the points where the pipes are accessible at the bioreactor building. The existing blowers could be use outdoors as part of the temporary system. The works in the blower room are expected to take three (3) weeks.

As part of the blower system and compressed air pipe work system replacement, the air dryer will also need to be relocated. The air compressors provide air to critical equipment operated pneumatically, such as the DAF scrapers and several valves throughout the plant. Significant consideration will be required by the contractor to limit the downtime of the compressed air system either by providing a temporary compressed air source or staging the upgrade efficiently. The compressed air pipe work could be replaced by running the new pipe work alongside the existing. Downtime of the system would then be reduced and only required when making modifications at the tie-in points. An anticipated downtime to connect the tie in points is approximately two (2) days.

The new polymer dosing skid can be installed beside the existing system and made operational prior to removal of the existing pumps. This should minimize downtime for polymer dosing. It may be possible to temporarily run the DAF systems without polymer during tie-ins. The new poly dosing skid would be fully commissioned and tested prior to removal of the existing system. The expected poly pump down time is 12 – 18 hours, over 2 or 3 shutdowns.

The new polymer make-down system will require downtime for replacement. The expected construction time is approximately three (3) weeks for the polymer make-down system. In the interim, totes of liquid polymer can be used for polymer supply to the dosing pumps. The footprint of the new equipment is slightly smaller than the existing system (make down and storage tanks). An alternative to totes would be to relocate one of the existing tanks temporarily to allow construction of the new system. The new equipment would then be installed in the location of the existing make down hopper and second storage tank. It should be possible to construct the new make down system while the existing system continues to operate. This allows for minimal downtime.

The additional UV bank will require some additional in-channel work to narrow the channel and direct flow through the UV bank. This will require a bypassing of the UV channel, and DAF, for a period of time. The exact construction methodology will be developed by the contractor but consideration for concrete that can cure in water should be taken to minimize the time for bypass. This bypass will require a Temporary Bypass Authorization (TBA). Due to the arrangement of the outlet channel from the DAF and the area of the proposed work the only option is to provide a temporary pumping system from the equalization tank to the effluent pump station. The alternative would be to have a complete bypass of the plant. A proposed bypass time for the DAF and UV is approximately one (1) week.

5.2 Priority of Upgrades

Included in this report are several areas identified for upgrade with varying benefits and criticality. In order to assign a priority ranking to the suggested items an evaluation matrix has been generated. The evaluation is based on the six categories; criticality, compatibility with long-term plans, health & safety, operational improvement, and process improvement. Each category is equally weighted and scored on a 1-5 system with five 5 being the greatest impact and 1 being the lowest. The categories are explained below:

- **Criticality**: This category reflects the urgency of proposed upgrade.
- **Compatibility with Long- Term Plans** – This category serves to evaluate whether the proposed upgrade aligns with the long-term expansion plan. (i.e., are we refurbishing equipment that will become obsolete based on long-term expansion plans?).
- **Cost Savings Potential:** This category identifies whether the upgrade would offer a cost savings through its implementation.
- **Health & Safety:** This option evaluates whether the proposed upgrade will improve health & safety conditions at the plant.
- **Operational Improvements:** This category evaluates if the proposed upgrade will allow the plant to operate more efficiently.
- **Process Improvements:** This category evaluates if the proposed upgrade will improve the process performance of the plant (i.e., improve effluent quality).

The resulting evaluation is shown below in Table 9.

Table 9: Priority Evaluation Matrix for Near Term Upgrades

Item	Criticality	Compatibility with Long-Term Expansion	Cost Savings Potential	Safety	Operation Improvements	Process Improvement	Total
Headworks Modifications (Screen, Compactor, Hatches, Grit Pipe Work)	4	5	3	5	5	2	24
Aeration Upgrades	5	5	3	3	4	4	24
Compressor Pipe Work	2	4	1	1	3	3	14
Online Instrumentation	3	3	4	2	5	5	22
Polymer Make Down System	3	3	2	1	4	2	15
Polymer Dosing System	5	4	4	2	5	5	25
DAF Weir Level Control	3	3	2	3	4	4	19
UV Upgrades	5	5	2	5	3	5	25
Standby Generator	5	5	1	5	4	2	22
Building Mechanical Upgrades (HVAC, H_2S Capture, and Service Water)	4	4	2	5	2	3	20
Flood Control	5	5	5	5	3	4	27

From the evaluation matrix we can determine that items receiving a score of 20 and above are identified as high priority items whereas items with a score below 20 are identified as lower priority. Based on this evaluation the high priority items should include:

- New Inlet Screen;
- New Grit Pipe work;
- Aeration Upgrades;
- Process Instrumentation;
- New Polymer Dosing Pumps;
- UV Disinfection Upgrades;
- Standby Power;
- Improved H_2S Capture;
- Replacement of grating and hatching; and
- Flood Protection.

Lower priority items that could be deferred include;

- New Polymer Make-Down System;
- DAF Weir Level Adjustment;
- Heat Relief in the Generator Room;
- Service Water to the Bioreactor Building; and
- New Compressed Air Pipe work.

Chapter 6 Estimate of Probable Costs

6.1 Opinion of Probable Capital Costs

The opinion of probable costs is presented based on experience, qualifications, and best judgement. It has been prepared in accordance with acceptable principles and practices. Market trends, non-competitive bidding situations, unforeseen site conditions, unforeseen labour, material adjustments, and the like are beyond the control of CBCL. As such, we cannot warrant or guarantee that actual costs will not vary from the opinion provided.

The costs associated with the recommended upgrades to the WWTP are shown below. The opinions of cost include allowances for engineering and contingencies for unforeseen changes during design and construction. The Engineering Contingency (fee allowance) provided is based on each individual elements being completed as separate packages. There may be economies of scale during detailed design with a larger scope of work. Engineering fees would be quoted based on the selected elements to be carried forward for detailed design. The costs below are indicative only and are not a formal quotation for these services. The summarized preliminary costs are presented in Table 10.

Table 10: Opinion of Probable Costs

Item	Cost	Design Development 20%	Construction Contingency 10%	Engineering Contingency 15%	Total
Headworks Modifications (Screen, Compactor, Hatches, Grit Pipe Work)	$437,000	$87,000	$44,000	$66,000	$634,000
Aeration Upgrades	$425,000	$85,000	$43,000	$64,000	$617,000
Compressor Pipe Work	$36,000	$7,000	$4,000	$5,000	$52,000
Online Instrumentation	$66,000	$13,000	$7,000	$10,000	$96,000
Polymer Make Down System	$221,000	$44,000	$22,000	$33,000	$320,000
Polymer Dosing System	$115,000	$23,000	$12,000	$17,000	$167,000
DAF Weir Level Control	$110,000	$22,000	$11,000	$17,000	$160,000
UV Upgrades	$150,000	$30,000	$15,000	$23,000	$218,000
Standby Generator	$720,000	$144,000	$72,000	$108,000	$1,044,000
Building Mechanical Upgrades (HVAC, H_2S Capture and Service Water)	$50,000	$10,000	$5,000	$8,000	$73,000
Flood Control	$146,000	$29,000	$15,000	$22,000	$212,000
				Total	**$3,593,000**

6.2 Opinion of Probable Operating Costs

Operating costs were developed for the equipment based on experience and operation of similar facilities, coupled with historical costs for the existing facility and details from equipment suppliers. The operational costs for the plant are not expected to change significantly with these proposed upgrades to the plant. There are no significant additional loads or process being added and no additional chemicals. The current polymer use is expected to be reduced with the implementation of the upstream instrumentation which would reduce the chemical costs to the plant. The additional UV bank, screen, blowers, dosing pumps, and make-down systems will not increase the electrical costs at the plant. There is no expected increase in labour costs with the additions to the plant.

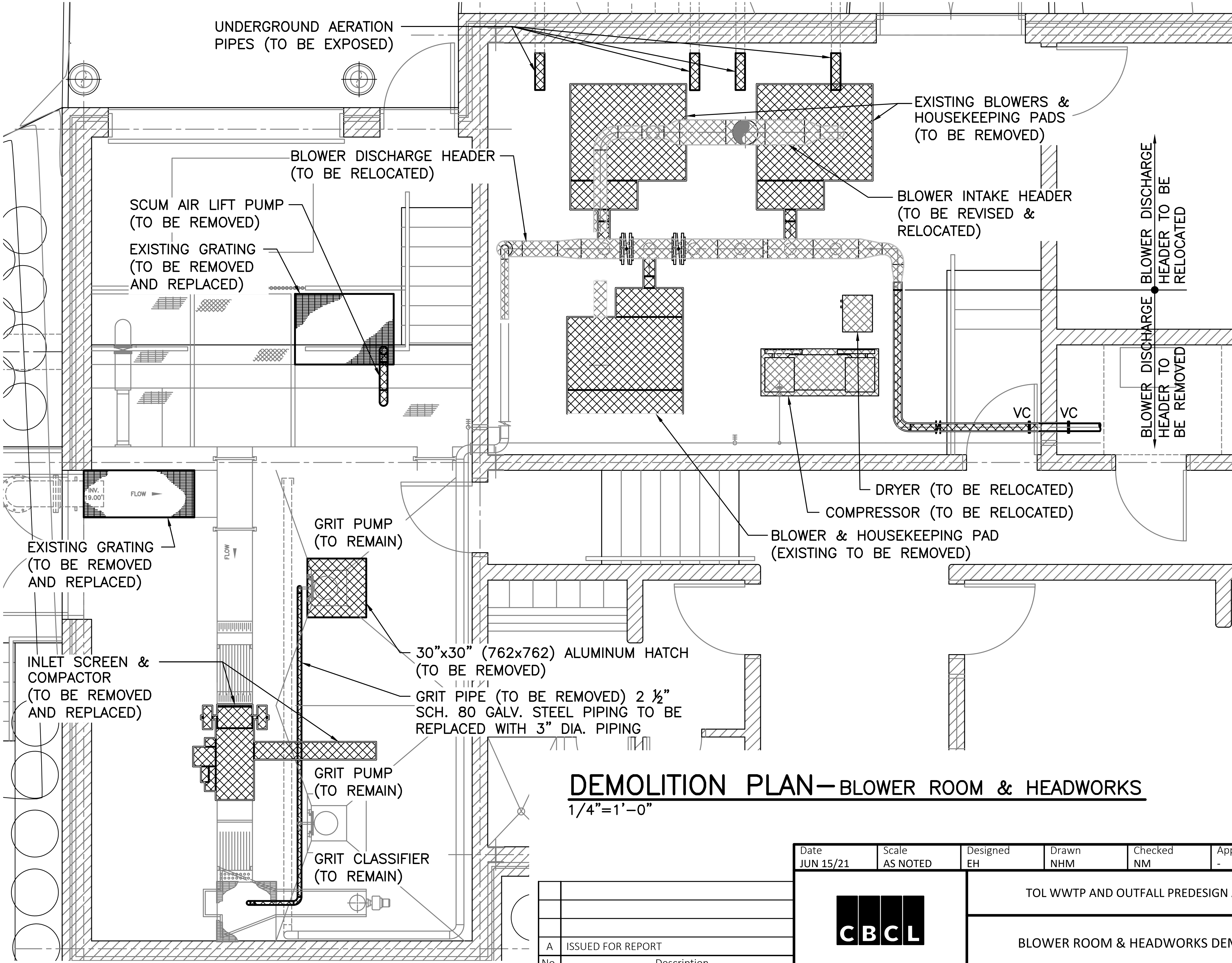
Chapter 7 Conclusions & Recommendations

Based on a review of the existing capacity and condition of the WWTP the capital upgrades outlined in this report are necessary to keep the plant in working condition and improve the current operation in the near-term, while improving operator health & safety.

The areas of the plant targeted for refurbishment have all been deemed necessary. However, the staging of these upgrades can be refined based on priority. It is recommended that the high priority items including a new inlet screen, new grit pipe work, aeration upgrades, process instrumentation, new polymer dosing pumps, an additional UV bank, the provision of standby power, HVAC upgrades, and flood protection be undertaken in the near-term. These items are highlighted based on their urgency, benefit to operations, health & safety, and/or improvement to the process. The remaining options are still important to maintaining a safe and operable plant in the short term but could be deferred as further information regarding the long-term expansion plans are developed.

APPENDIX A

Preliminary Design Sketches



DEMOLITION PLAN—BLOWER ROOM & HEADWORKS

1/4"=1'–0"

DEMOLITION NOTES:

1. PRIOR TO UNDERTAKING DEMOLITION AND CONSTRUCTION, CONTRACTOR SHALL SUBMIT A PLAN/SCHEDULE OUTLINING THE PROCESS.
2. EXISTING UTILITY/SITE SERVICES (PIPING, VALVES, FITTINGS, CONDUIT, ETC.) INFORMATION IS SHOWN AS APPROXIMATE ONLY.

REMOVALS/ALTERATIONS

Date	Scale	Designed	Drawn	Checked	Approved	CBCL No.	Contract
JUN 15/21	AS NOTED	EH	NHM	NM	-	210803.01	-

No.	Description
A	ISSUED FOR REPORT

CBCL

TOL WWTP AND OUTFALL PREDESIGN AND BCA

BLOWER ROOM & HEADWORKS DEMOLITION

Drawing

PSK01

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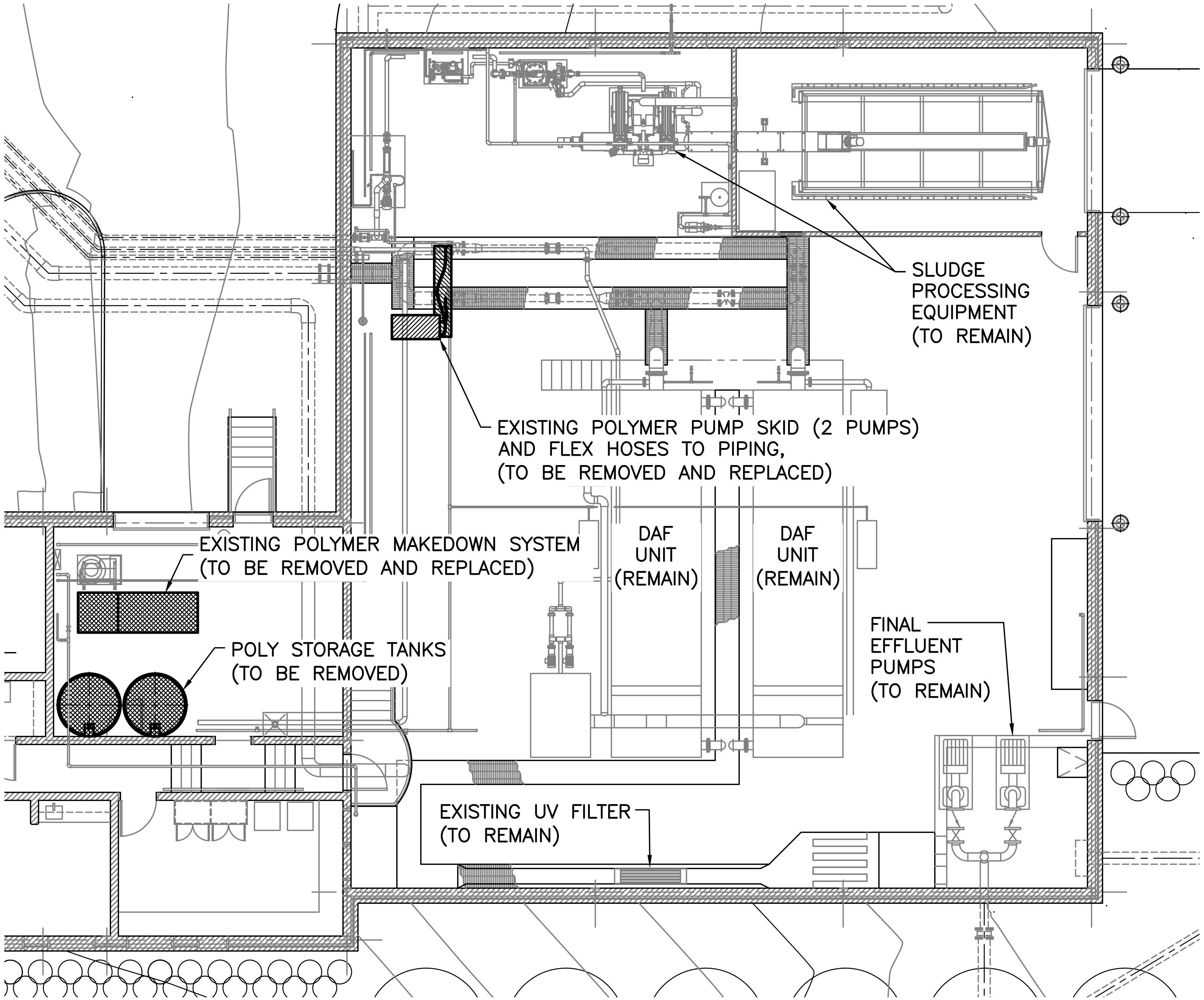

DEMOLITION NOTES:

1. PRIOR TO UNDERTAKING DEMOLITION AND CONSTRUCTION, CONTRACTOR SHALL SUBMIT A PLAN/SCHEDULE OUTLINING THE PROCESS.
2. EXISTING UTILITY/SITE SERVICES (PIPING, VALVES, FITTINGS, CONDUIT, ETC.) INFORMATION IS SHOWN AS APPROXIMATE ONLY.

REMOVALS/ALTERATIONS

Date	Scale	Designed	Drawn	Checked	Approved	CBCL No.	Contract
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CBCL

TOL WWTP AND OUTFALL PREDESIGN AND BCA

PROCESS ROOM & POLYMER ROOM DEMOLITION

Drawing
PSK02

No.	Description
A	ISSUED FOR REPORT

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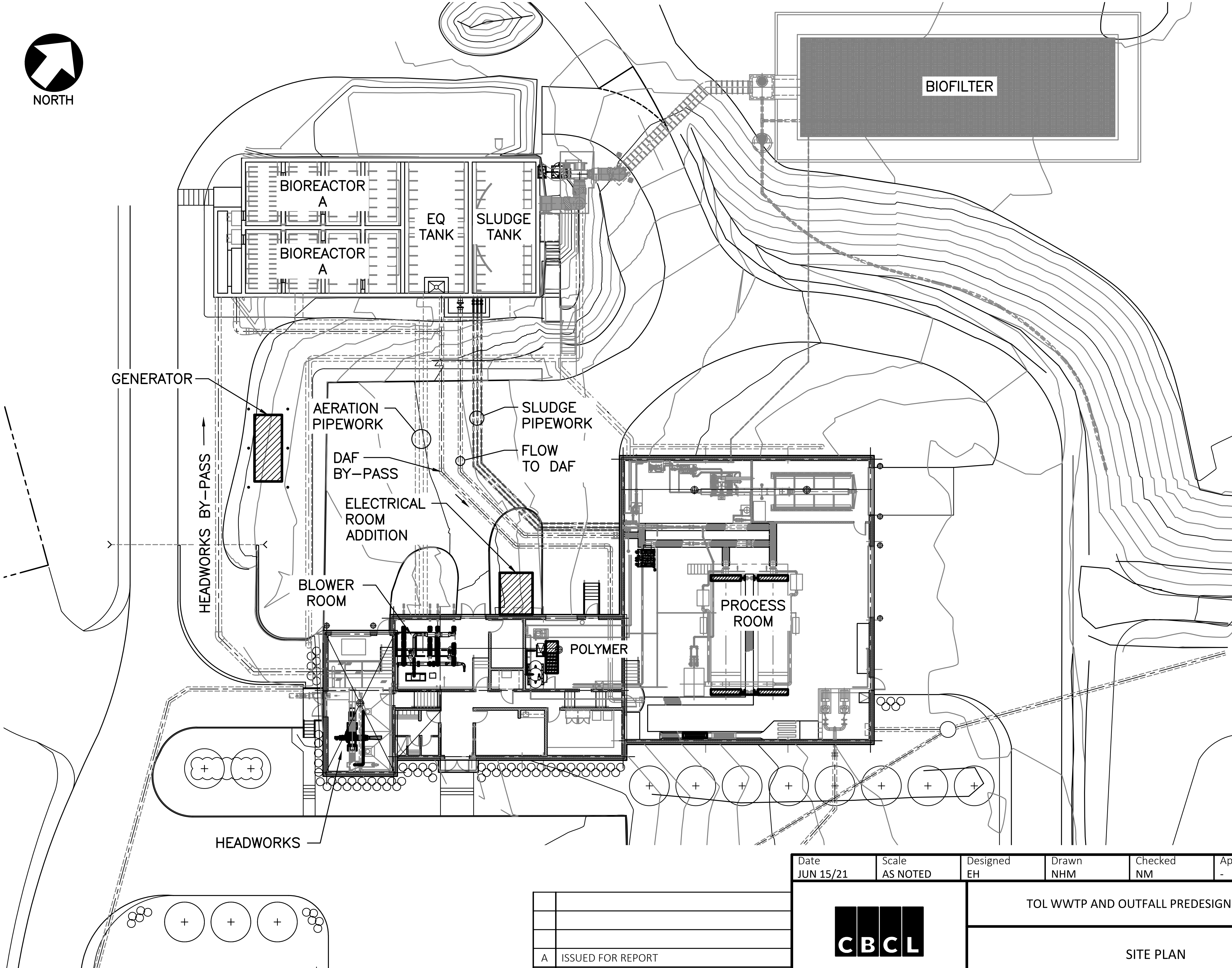

NOTES:

1. EXISTING UTILITY/SITE SERVICES (PIPING, VALVES, FITTINGS, CONDUIT, ETC.) INFORMATION IS SHOWN AS APPROXIMATE ONLY.

No.	Description
A	ISSUED FOR REPORT

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CBCL

TOL WWTP AND OUTFALL PREDESIGN AND BCA

SITE PLAN

Drawing

PSK03

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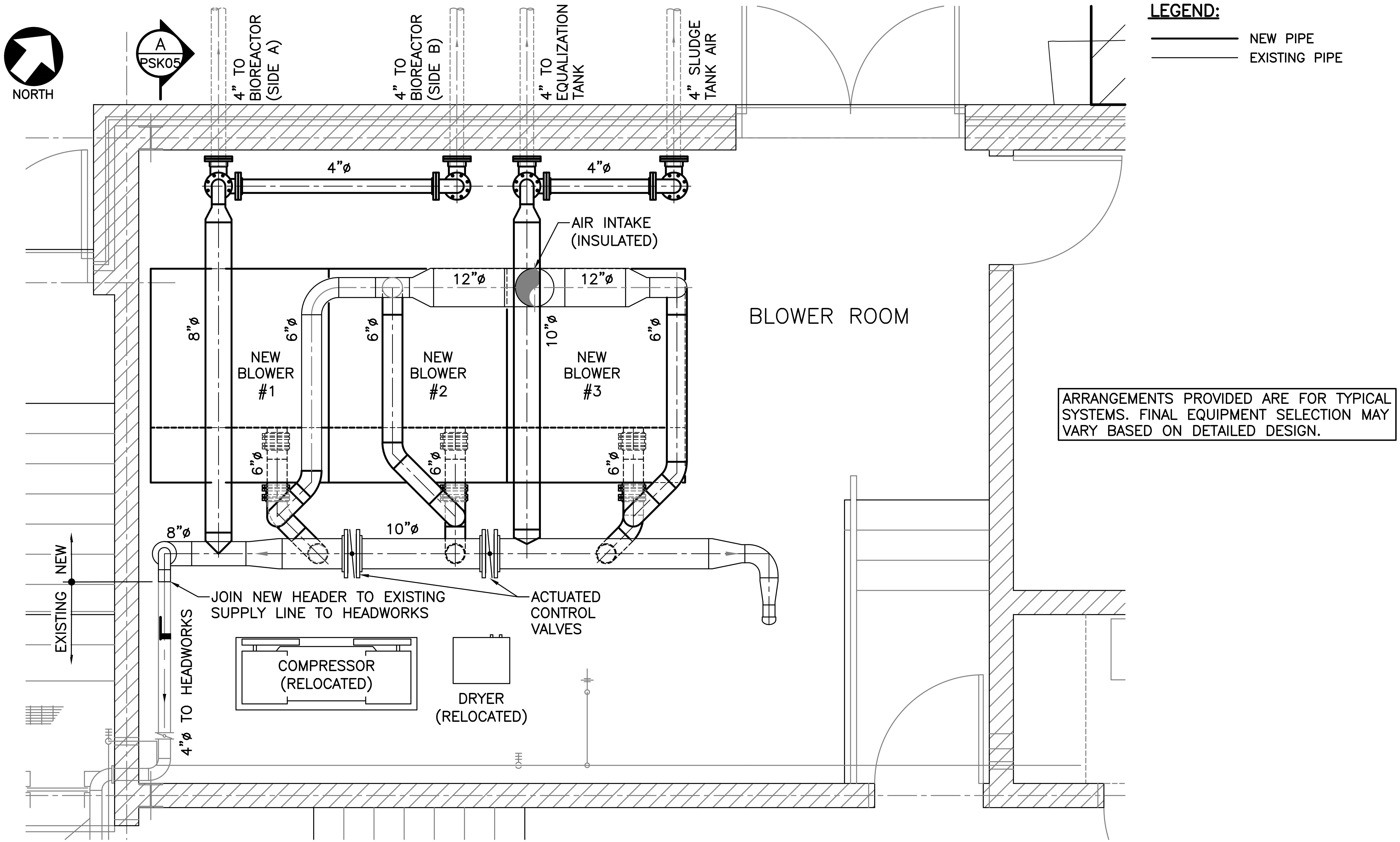

ARRANGEMENTS PROVIDED ARE FOR TYPICAL SYSTEMS. FINAL EQUIPMENT SELECTION MAY VARY BASED ON DETAILED DESIGN.

PARTIAL PLAN–BLOWER ROOM

3/8"=1'–0"

No.	Description
A	ISSUED FOR REPORT

Date	Scale	Designed	Drawn	Checked	Approved	CBCL No.	Contract
JUN 15/21	AS NOTED	EH	NHM	NM	-	210803.01	-

CBCL

TOL WWTP AND OUTFALL PREDESIGN AND BCA

BLOWER ROOM PLAN

Drawing

PSK04

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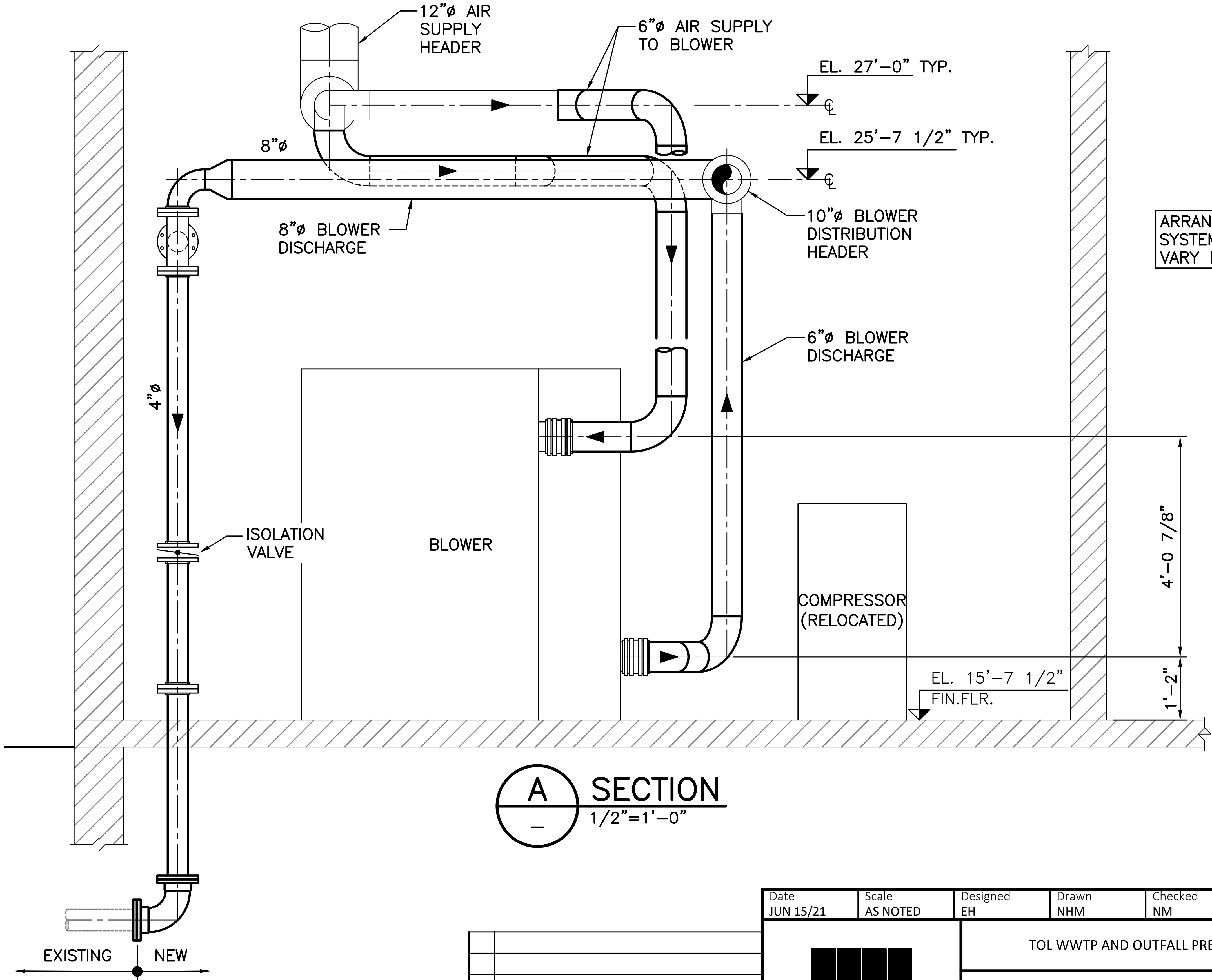
LEGEND:

NEW PIPE
EXISTING PIPE



A SECTION
1/2"=1'-0"

ARRANGEMENTS PROVIDED ARE FOR TYPICAL SYSTEMS. FINAL EQUIPMENT SELECTION MAY VARY BASED ON DETAILED DESIGN.

No.	Description
A	ISSUED FOR REPORT

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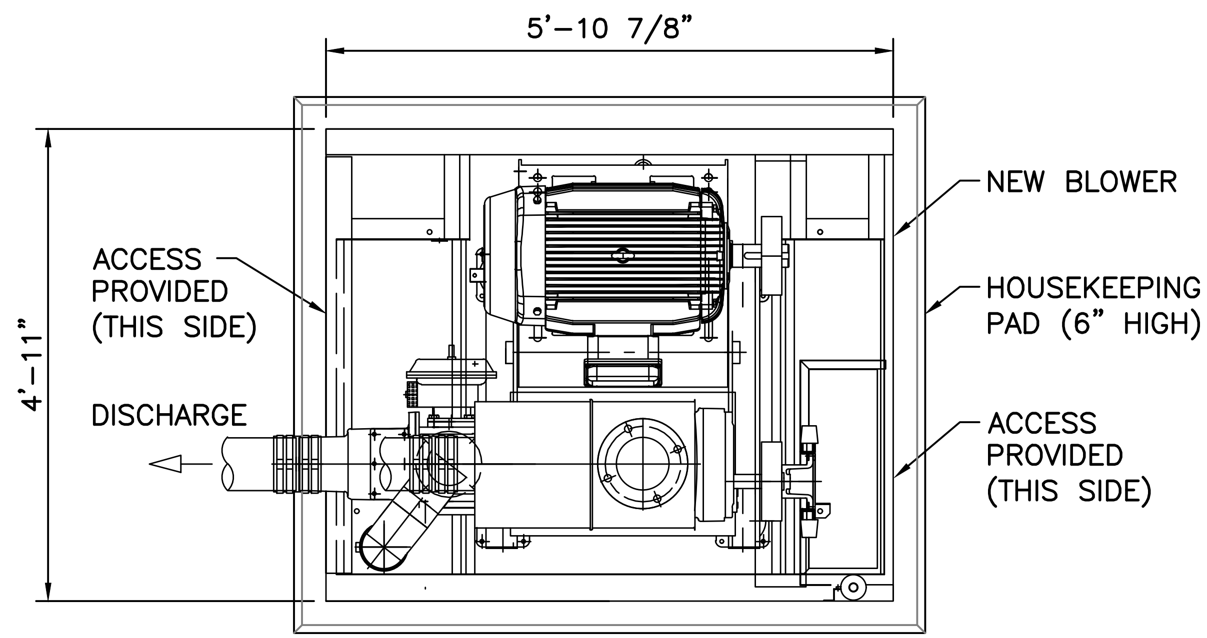
CBCL

TOL WWTP AND OUTFALL PREDESIGN AND BCA

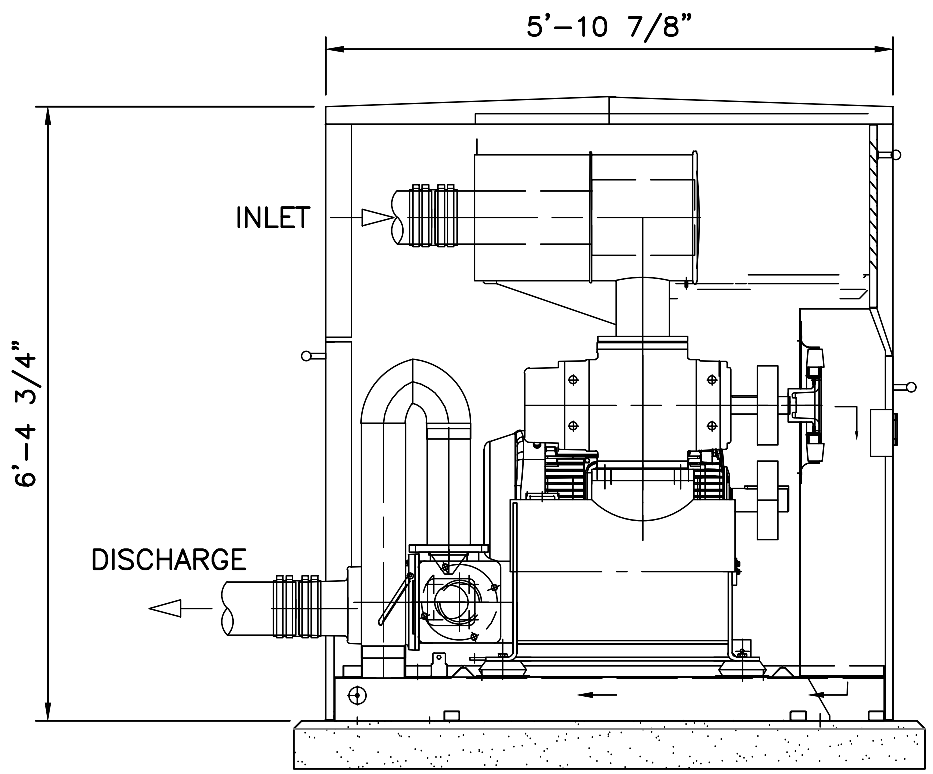
BLOWER ROOM SECTION

Drawing
PSK05

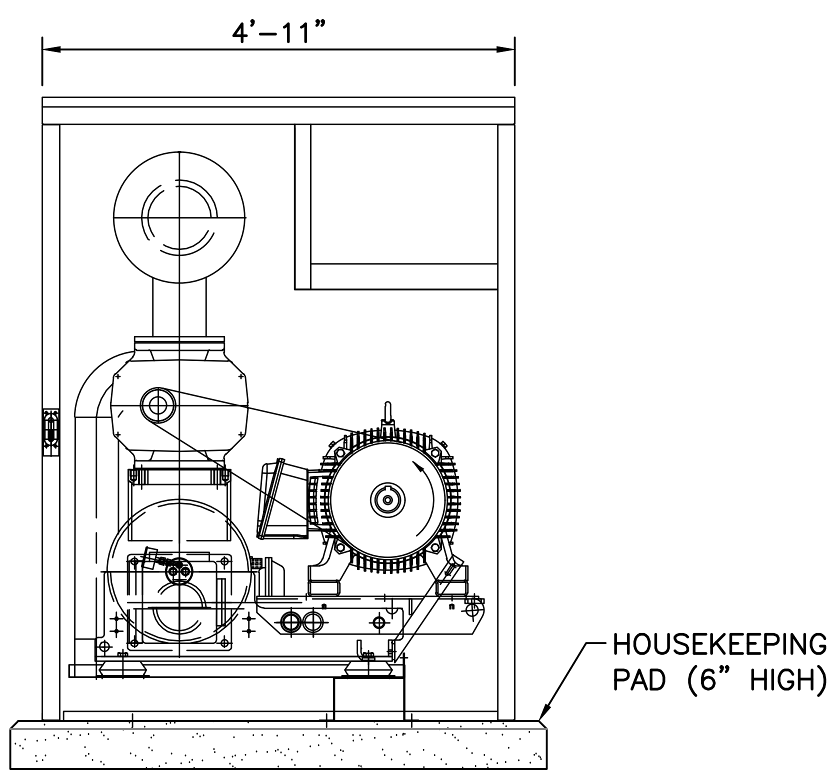
ARRANGEMENTS PROVIDED ARE FOR TYPICAL SYSTEMS. FINAL EQUIPMENT SELECTION MAY VARY BASED ON DETAILED DESIGN.



PLAN



ELEVATION



ELEVATION

BLOWER
1/2"=1'–0"

Date	Scale	Designed	Drawn	Checked	Approved	CBCL No.	Contract
JUN 15/21	AS NOTED	EH	NHM	NM	-	210803.01	-

CBCL

TOL WWTP AND OUTFALL PREDESIGN AND BCA

BLOWER PLAN & SECTIONS

Drawing
PSK06

No.	Description
A	ISSUED FOR REPORT

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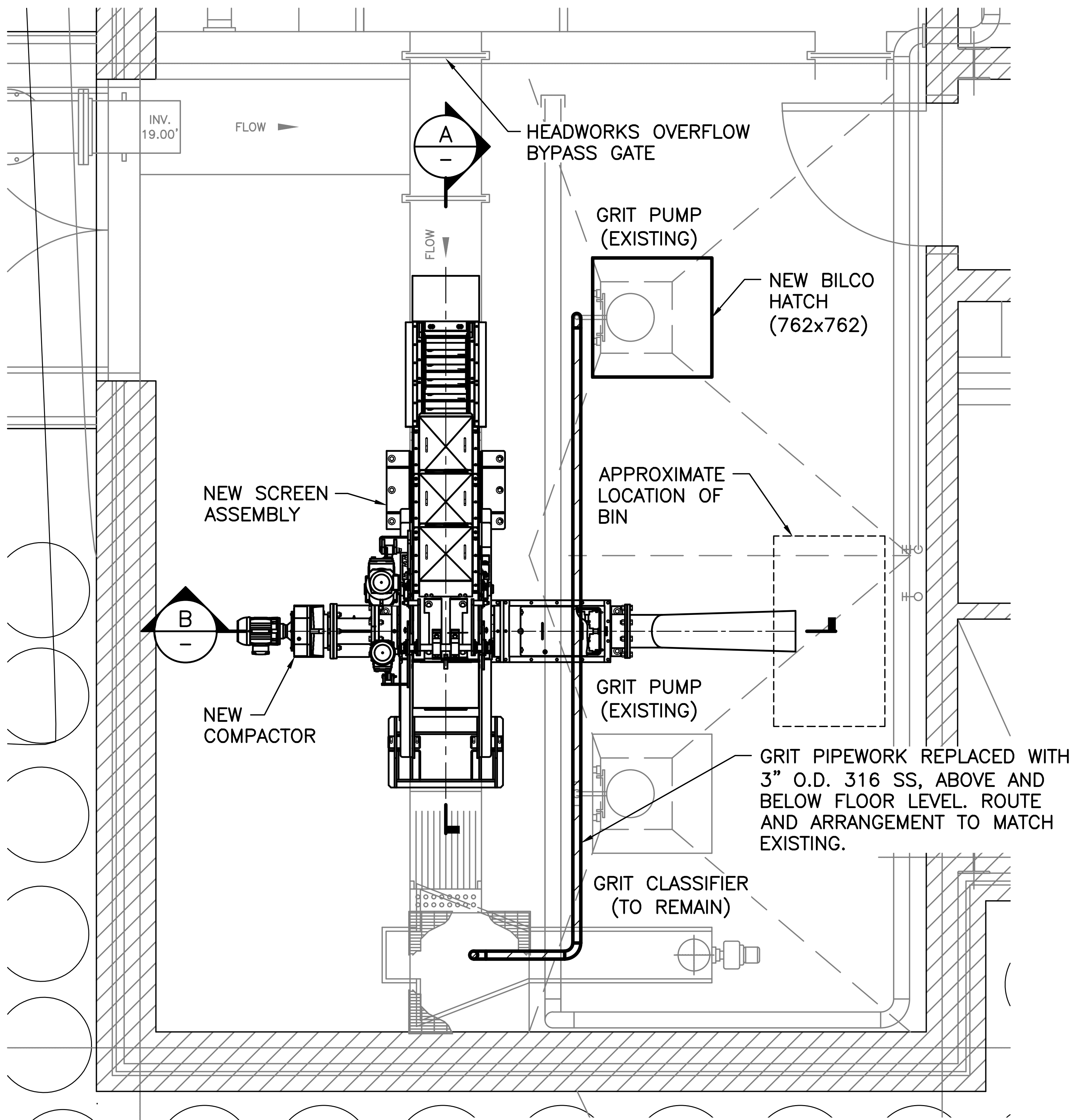

PARTIAL PLAN–HEADWORKS
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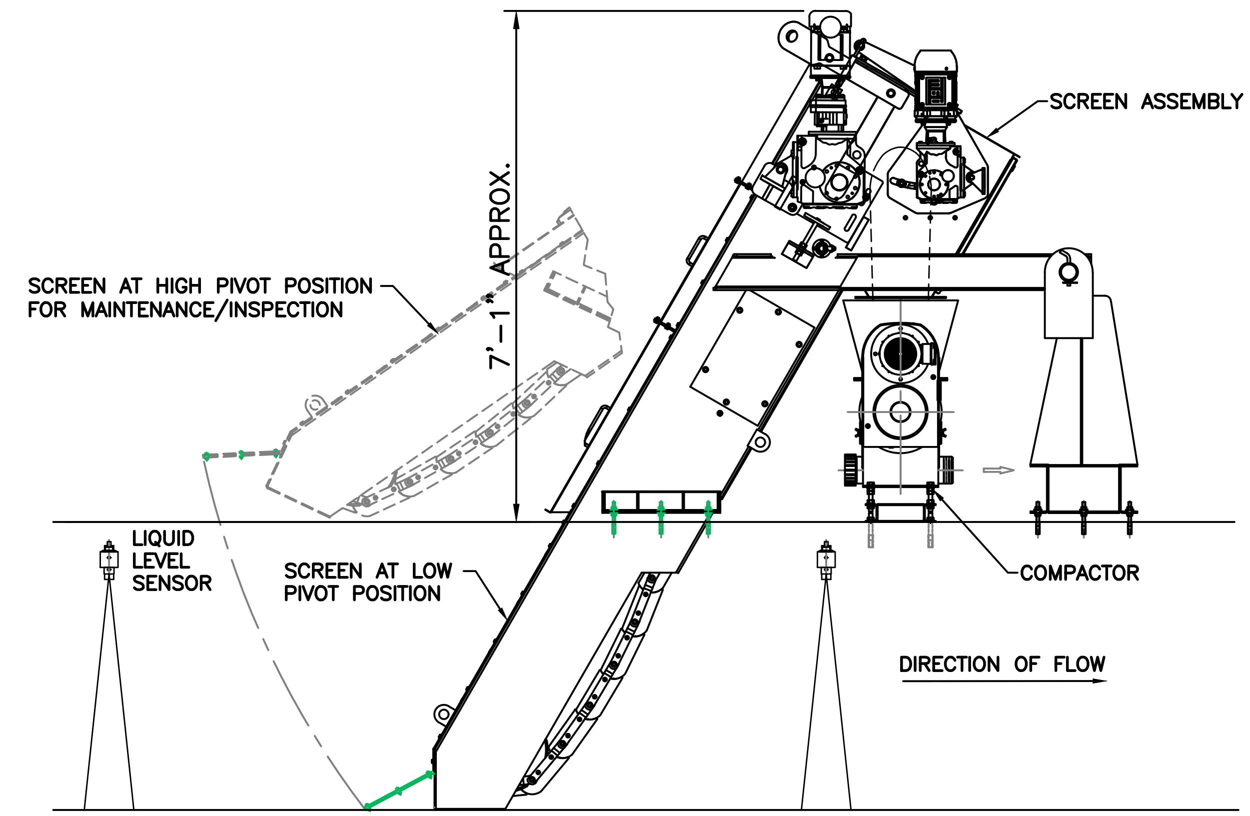

A
–
SECTION– SCREEN ASSEMBLY
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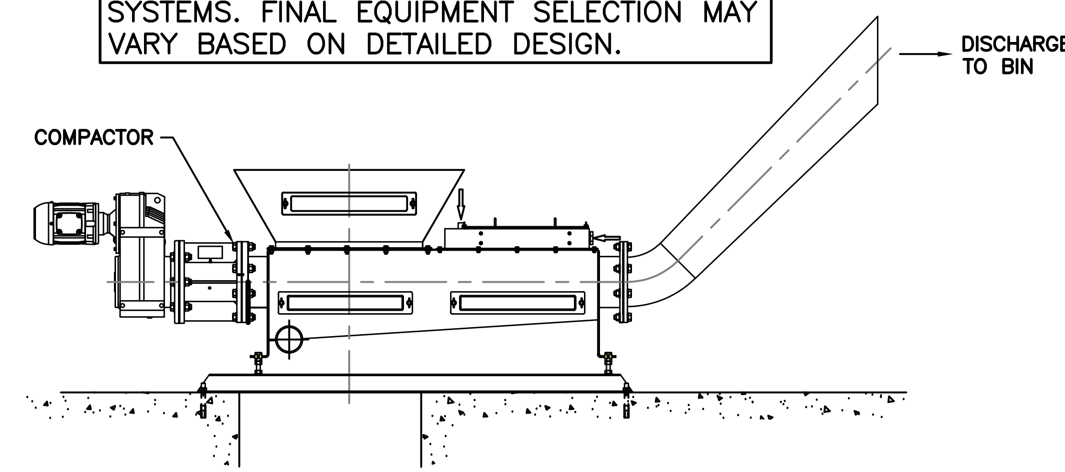


B
–
SECTION– COMPACTOR
3/8"=1'–0"

No.	Description
A	ISSUED FOR REPORT

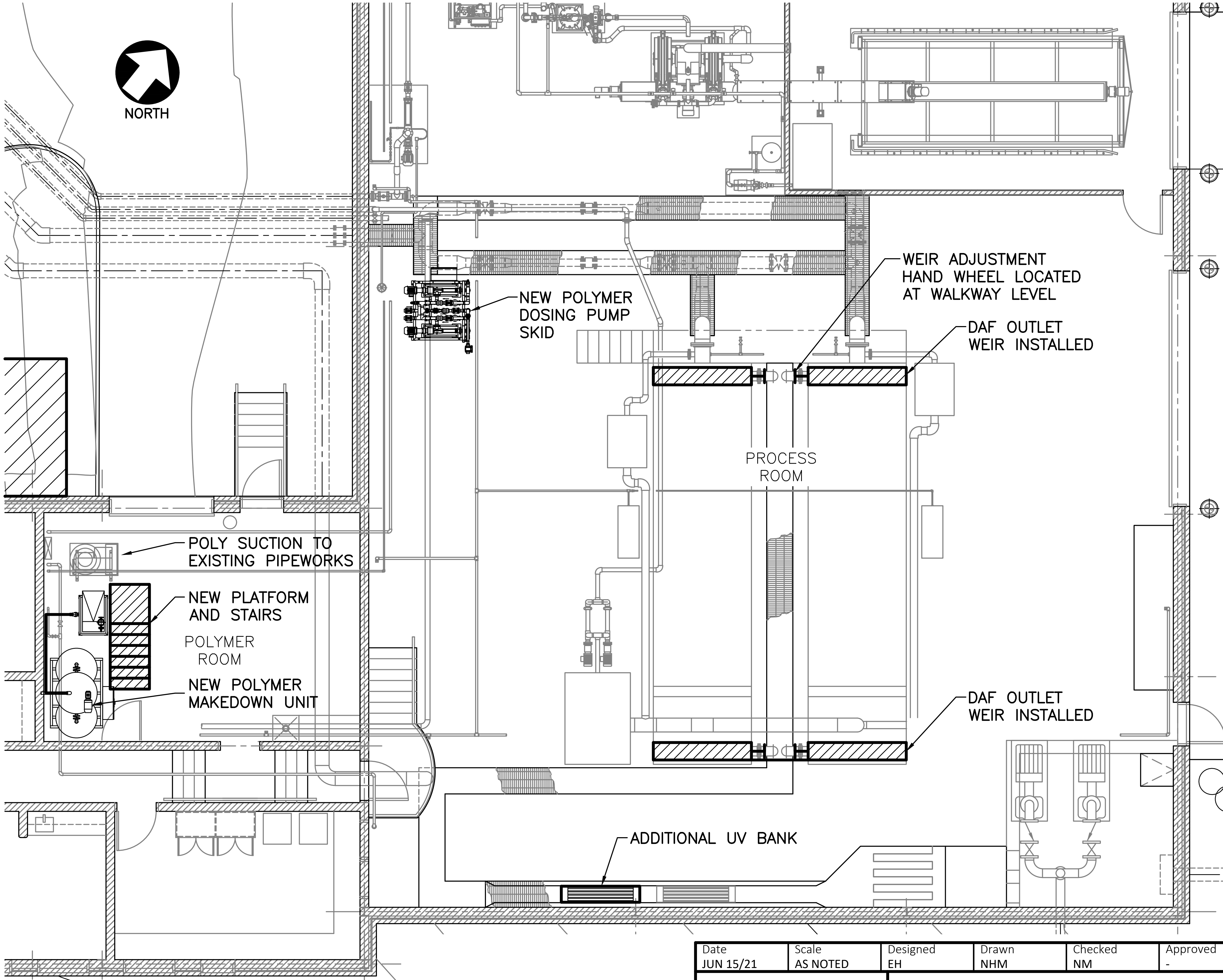
Date	Scale	Designed	Drawn	Checked	Approved	CBCL No.	Contract
JUN 15/21	AS NOTED	EH	NHM	NM	-	210803.01	-

CBCL

TOL WWTP AND OUTFALL PREDESIGN AND BCA

HEADWORKS PLAN & SECTIONS

Drawing
PSK07



PLAN– PROCESS ROOM

1/8"=1'–0"

No.	Description
A	ISSUED FOR REPORT

Date	Scale	Designed	Drawn	Checked	Approved	CBCL No.	Contract
JUN 15/21	AS NOTED	EH	NHM	NM	-	210803.01	-

CBCL

TOL WWTP AND OUTFALL PREDESIGN AND BCA

PROCESS ROOM & POLYMER ROOM PLAN

Drawing

PSK08

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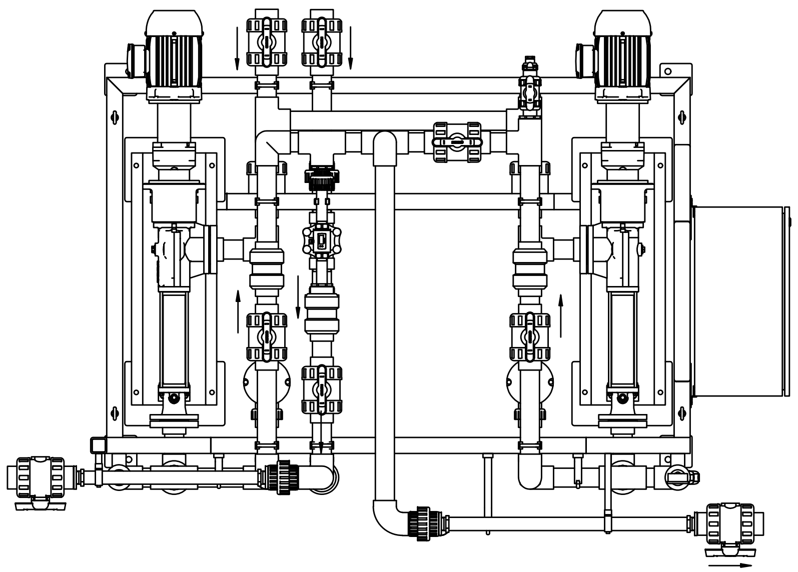
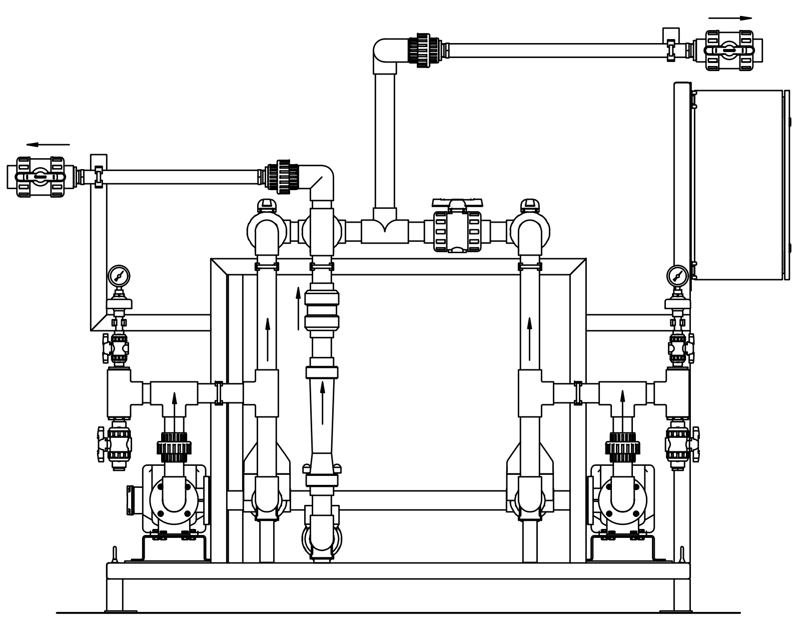
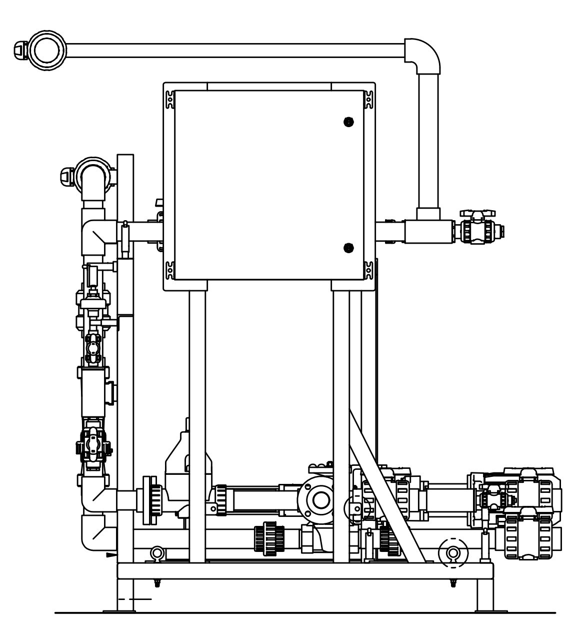


PLAN



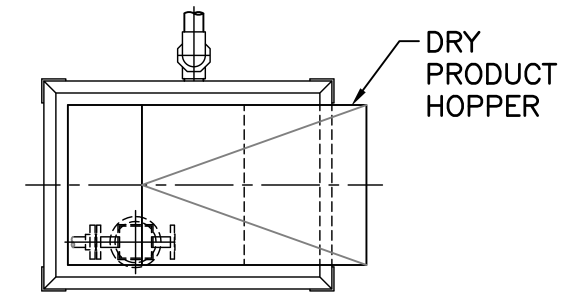
ELEVATION



ELEVATION

POLYMER DOSING SYSTEM

1/2"=1'–0"



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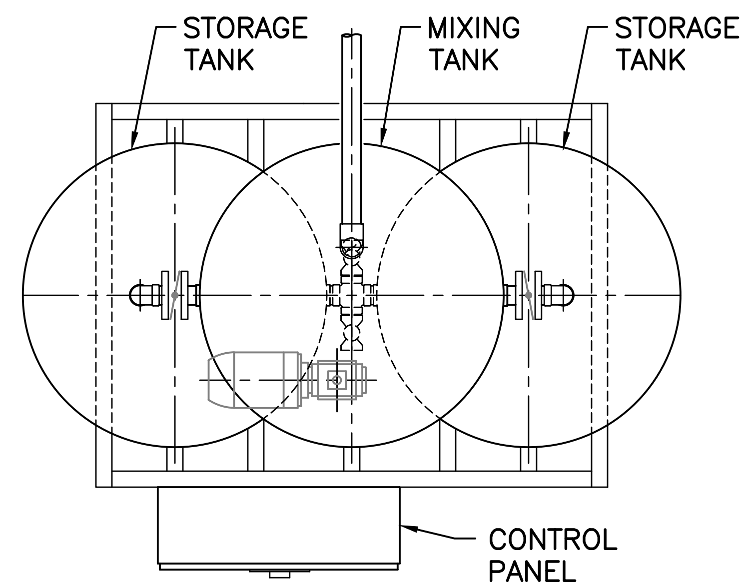

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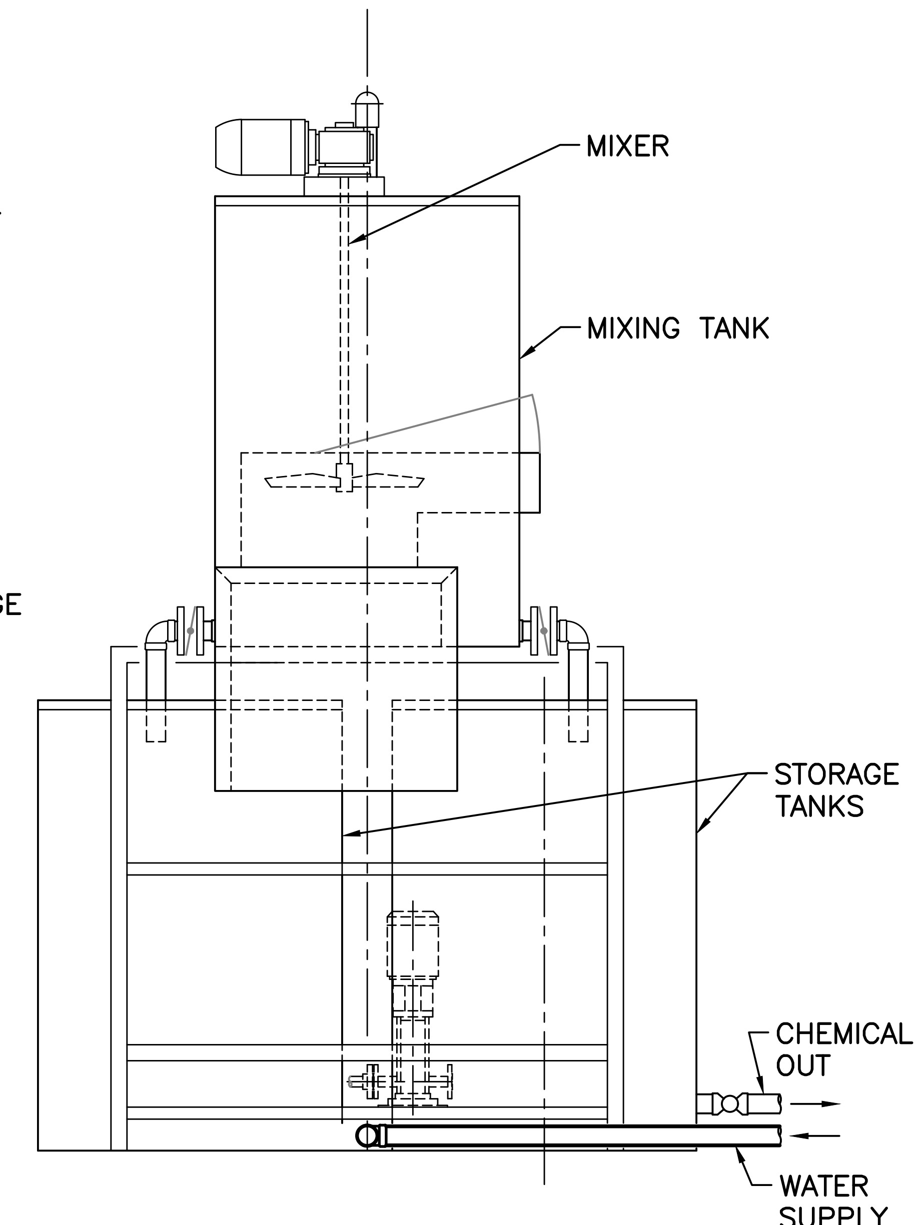

ELEVATION

POLYMER MAKE DOWN ASSEMBLY

1/2"=1'–0"

No.	Description
A	ISSUED FOR REPORT

Date	Scale	Designed	Drawn	Checked	Approved	CBCL No.	Contract
JUN 15/21	AS NOTED	EH	NHM	NM	-	210803.01	-

CBCL

TOL WWTP AND OUTFALL PREDESIGN AND BCA

POLYMER DOSING SYSTEM & POLYMER MAKE DOWN ASSEMBLY

Drawing

PSK09

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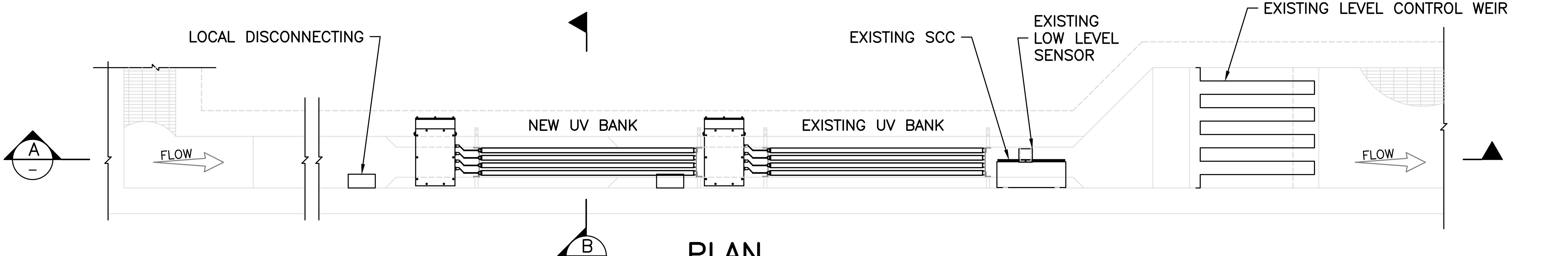
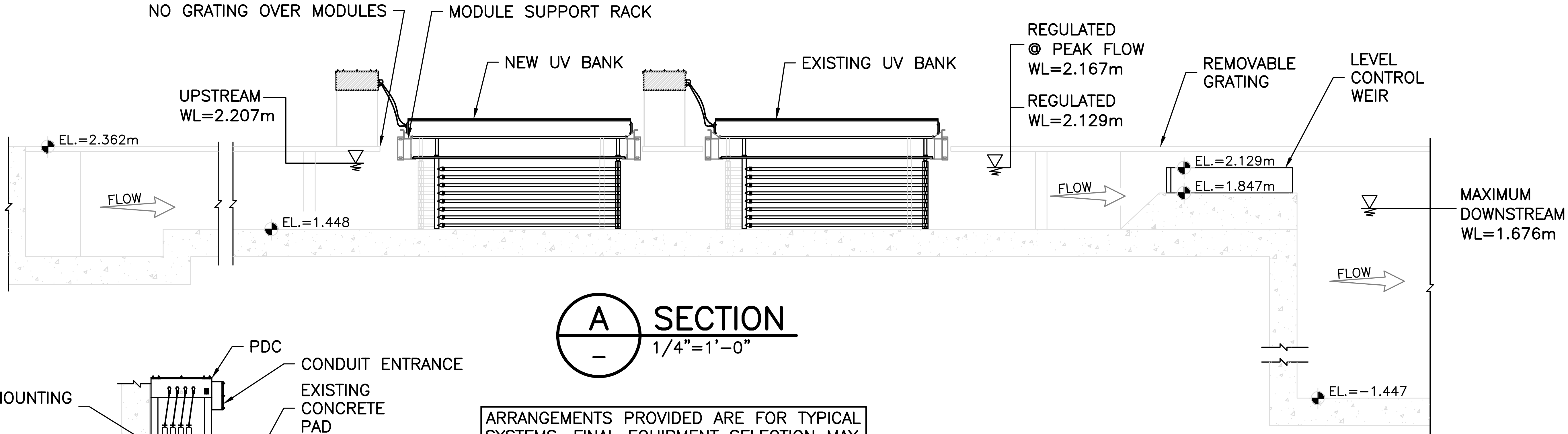
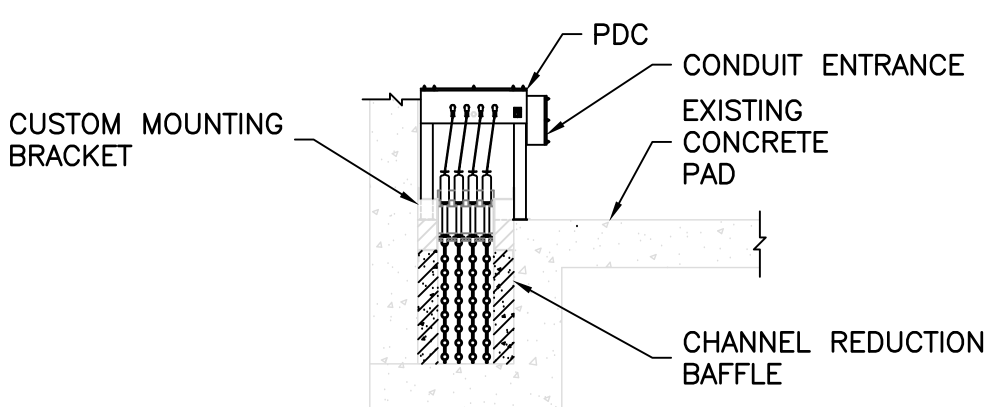


PLAN
1/4"=1'-0"



A SECTION
1/4"=1'-0"

ARRANGEMENTS PROVIDED ARE FOR TYPICAL SYSTEMS. FINAL EQUIPMENT SELECTION MAY VARY BASED ON DETAILED DESIGN.



B SECTION
1/4"=1'-0"

No.	Description
A	ISSUED FOR REPORT

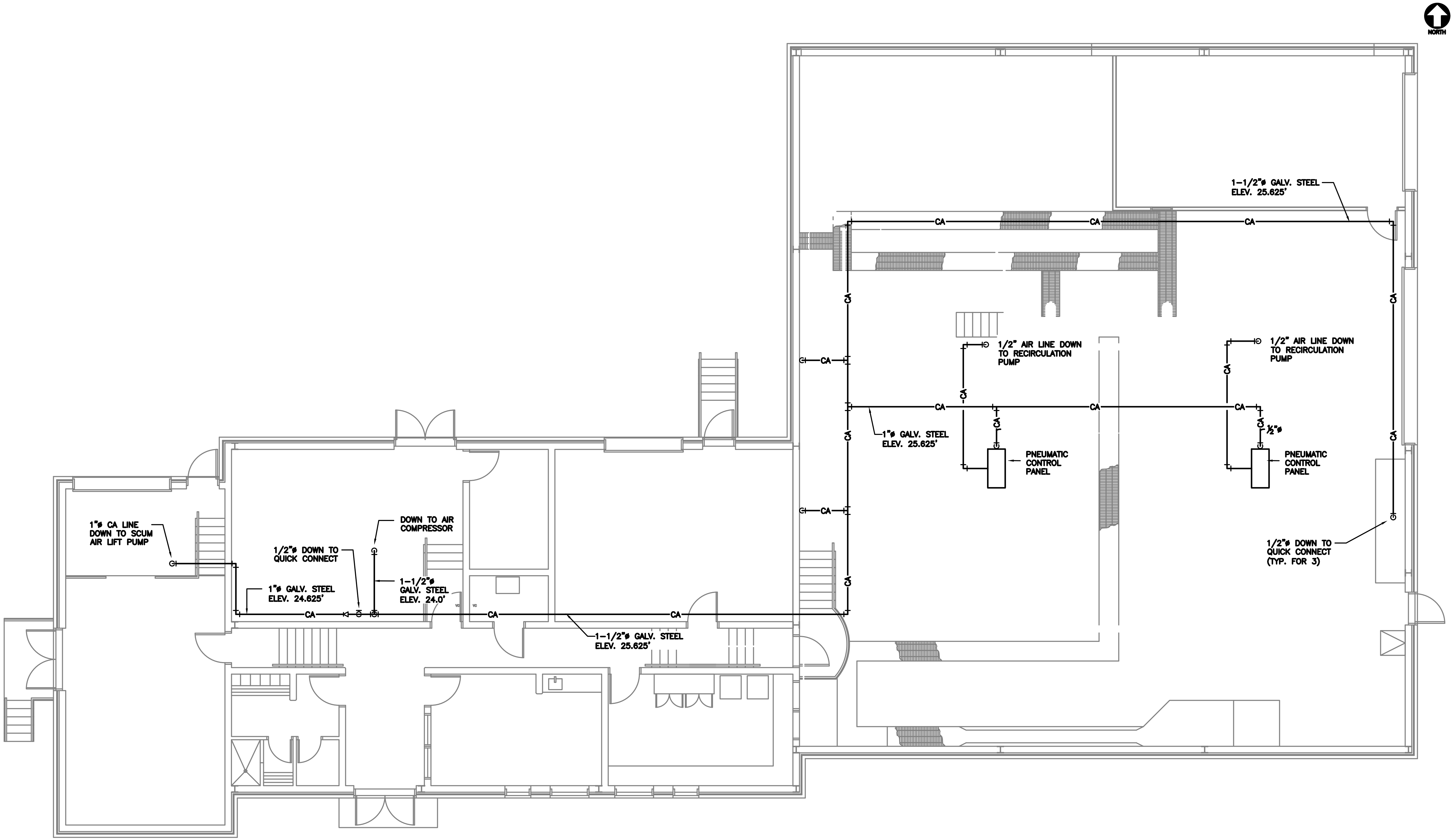
Date	Scale	Designed	Drawn	Checked	Approved	CBCL No.	Contract
JUN 15/21	AS NOTED	EH	NHM	NM	-	210803.01	-

CBCL

TOL WWTP AND OUTFALL PREDESIGN AND BCA

IN CHANNEL UV UNIT

Drawing
PSK10



NOTES:

1. LINE 1
2. LINE 2

No.	Description	Date	By

Revision or Issue

File No.

TOWN OF LUNENBURG

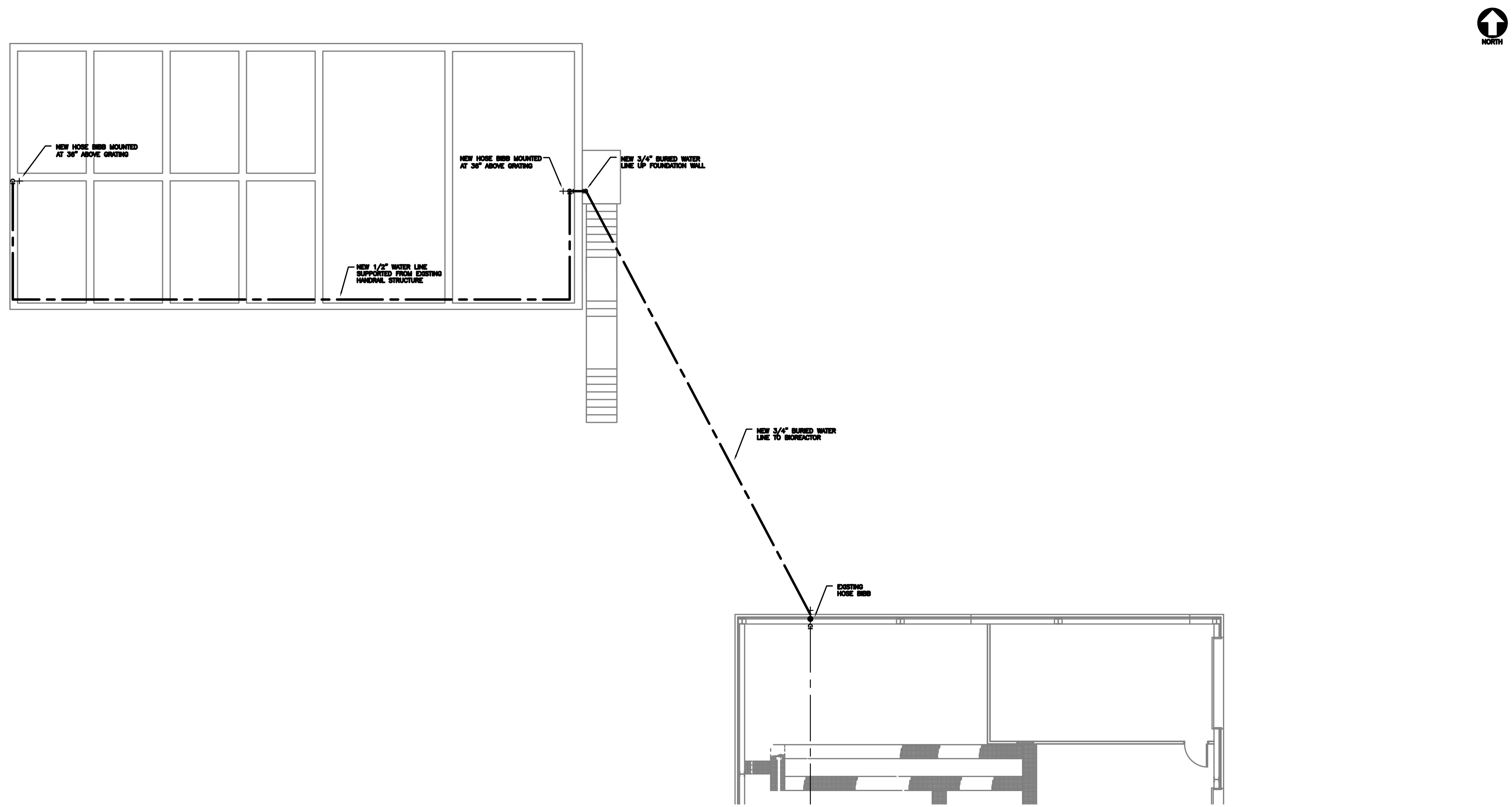
TOL WWTP AND OUTFALL PREDESIGN AND BCA

MECHANICAL

PROPOSED COMPRESSED AIR LAYOUT

CBCL

CBCL No 210803.01	Contract No
Date MAY 10,21	Scale AS SHOWN
Designed ####	Drawn JSJ
Checked AM	Approved
Sheet No 1 of 1	
Drawing No MSK1	



NOTES:

1. LINE 1
2. LINE 2

1" DCW

No.	Description	Date	By

Revision or Issue

File No.

TOWN OF LUNENBURG

TOL WWTP AND OUTFALL PREDESIGN AND BCA

MECHANICAL

PROPOSED DCW LAYOUT

CBCL

CBCL No 210803.01	Contract No
Date MAY 10,21	Scale AS SHOWN
Designed ####	Drawn JSJ
Checked AM	Approved
Sheet No 1 of 1	
Drawing No MSK2	

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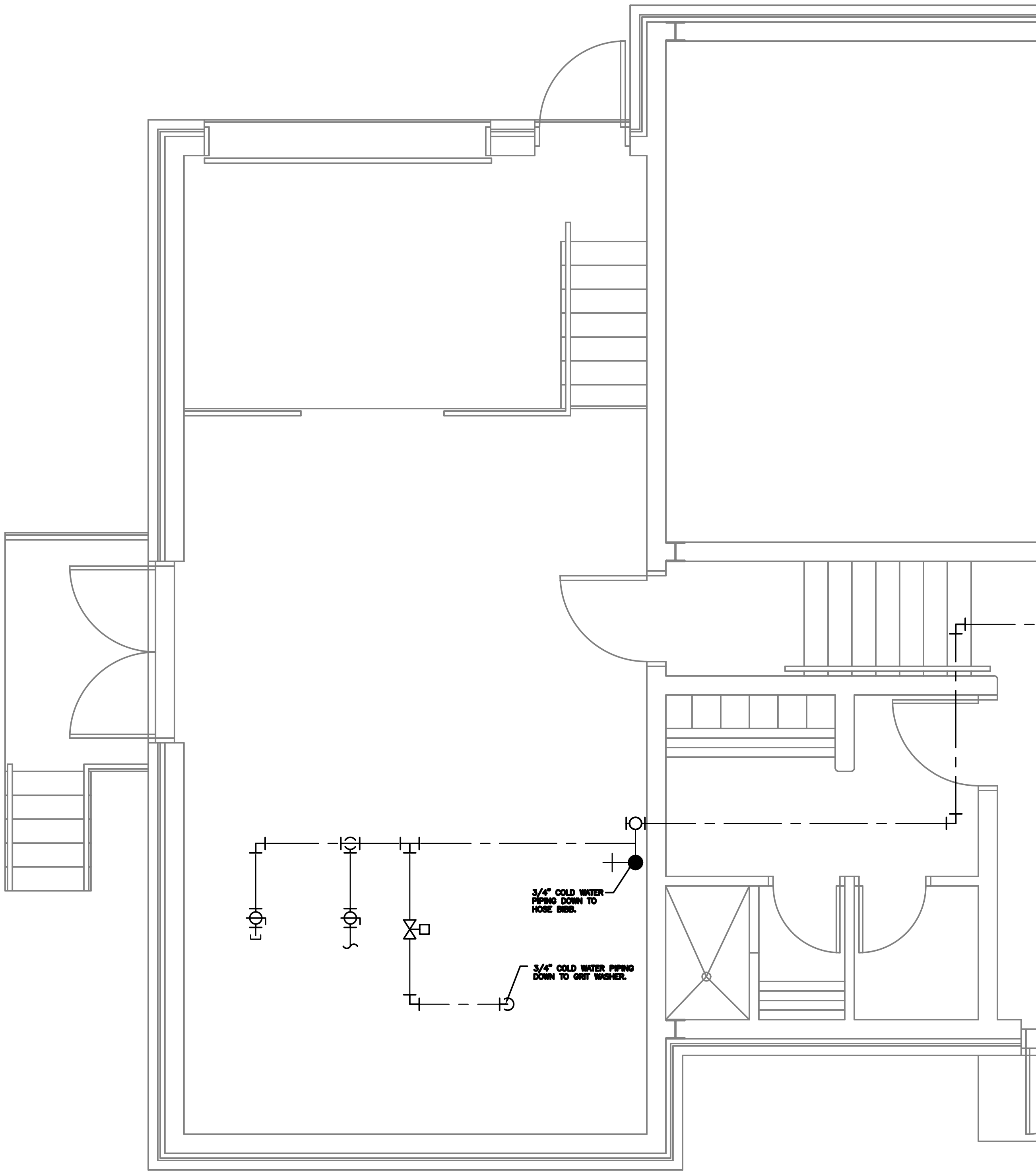
CBCL-22x34 TITLE SHEET (ANSI D)



No.	Description	No.	Description	No.	Description

Date	Scale	Designed	Drawn	Checked	Approved	CBCL No.	Contract
2020-10-13	N.T.S	CJR	RDC	-	-	170600.03	-

CBCL

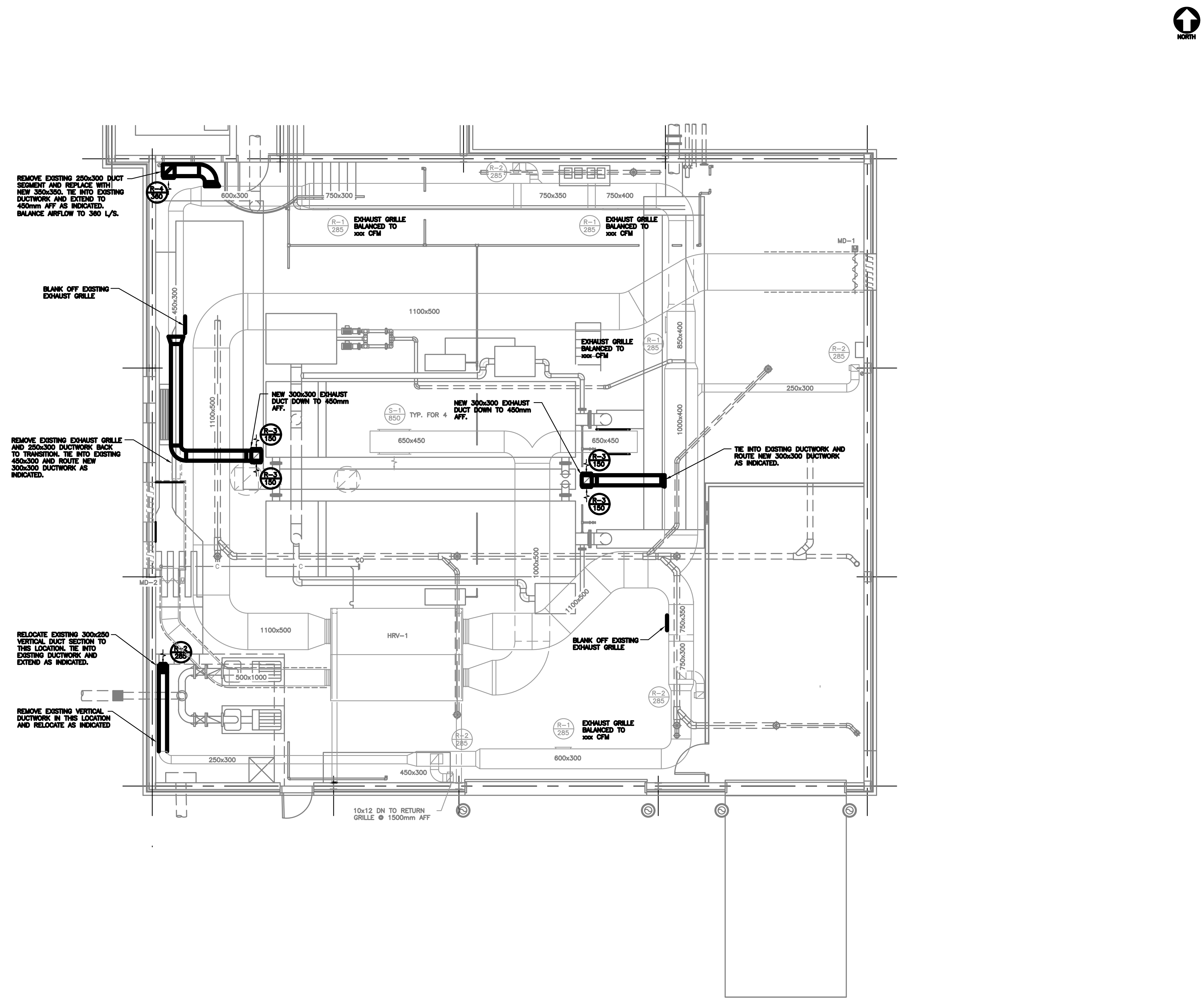
TOWN OF LUNENBURG

WASTE WATER TREATMENT PLANT

POTABLE WATER PIPING
HEADWORKS

Drawing
MSK-03

DRAWING NAME: Y:\HALIFAX\DATA\PROJECTS\210803.01 TOL WWTP & OUTFALL PREDESIGN AND BCA\44 CAD\04 MECH\MSK3.DWG LAYOUT NAME: MSK1 PLOT DATE:June 15, 2021 4:13:31 PM CAD OPERATOR: RCLARKE



NOTES:

1. LINE 1
2. LINE 2

No.	Description	Date	By

Revision or Issue

File No.

TOWN OF LUNENBURG

TOL WWTP AND OUTFALL PREDESIGN AND BCA

MECHANICAL

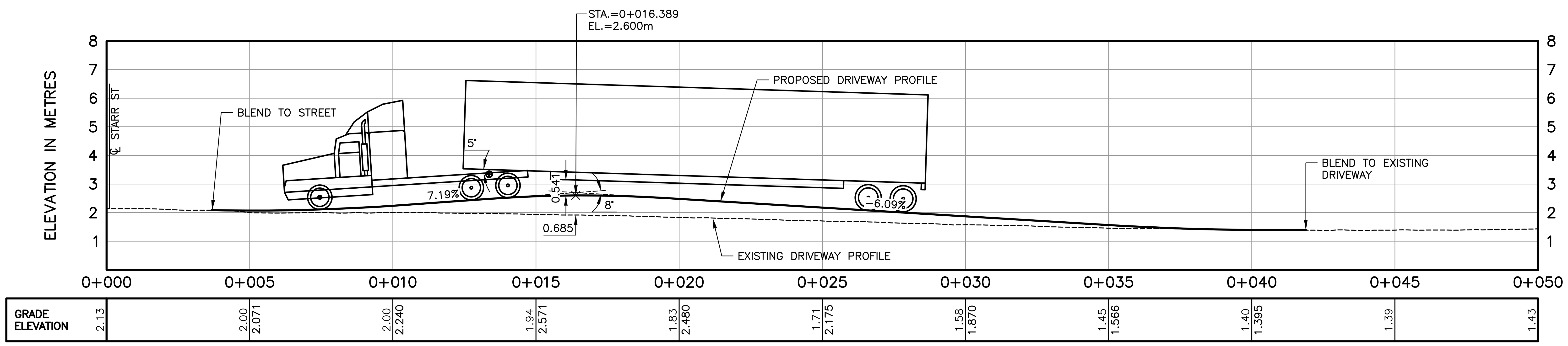
PROPOSED COMPRESSED AIR LAYOUT

CBCL

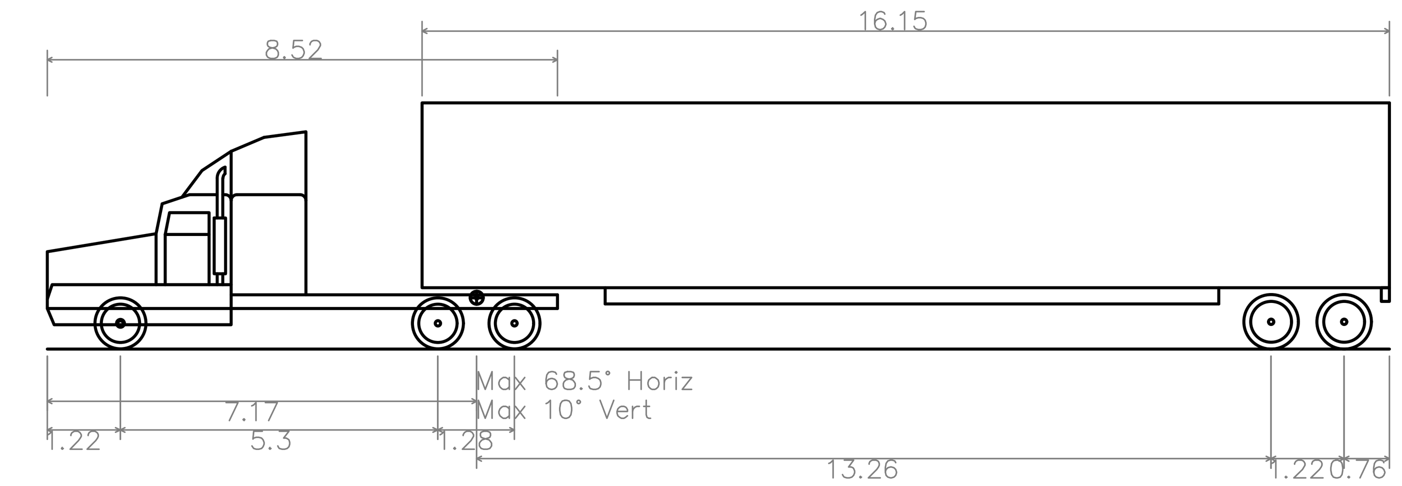
CBCL No 210803.01	Contract No
Date MAY 10,21	Scale AS SHOWN
Designed ####	Drawn JSJ
Checked AM	Approved
Sheet No 1 of 1	
Drawing No MSK4	

DRAWING NAME: Y:\HALIFAX\DATA\PROJECTS\210803.01 TOL WWTP & OUTFALL PREDESIGN AND BCA\44 CAD\04 MECH\MSK4.DWG LAYOUT NAME: MSK4 PLOT DATE: June 15, 2021 4:13:36 PM CAD OPERATOR: RCLARKE

CBCL-22x34 TITLE SHEET (ANSI D)

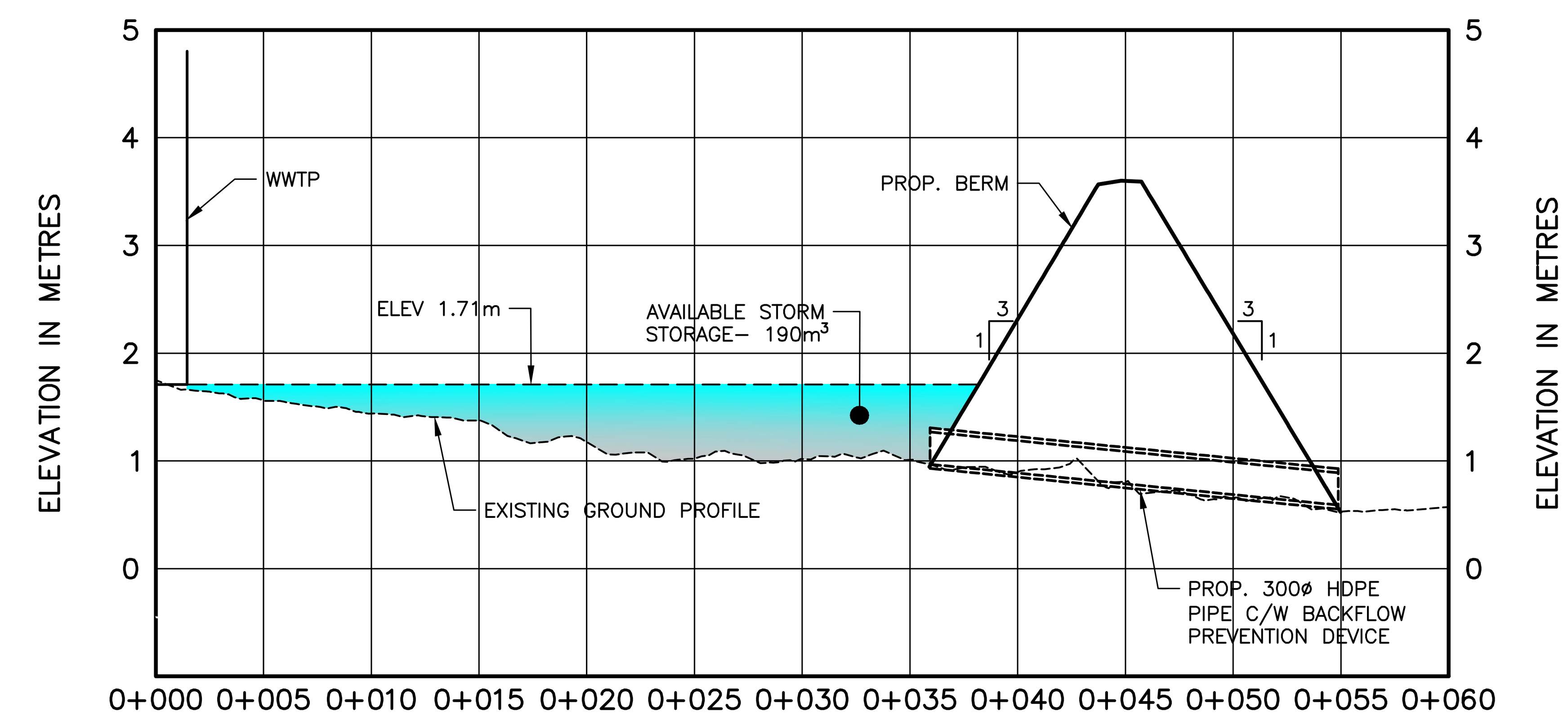


PROFILE— DRIVEWAY
HORZ. 1:250 VERT. 1:250

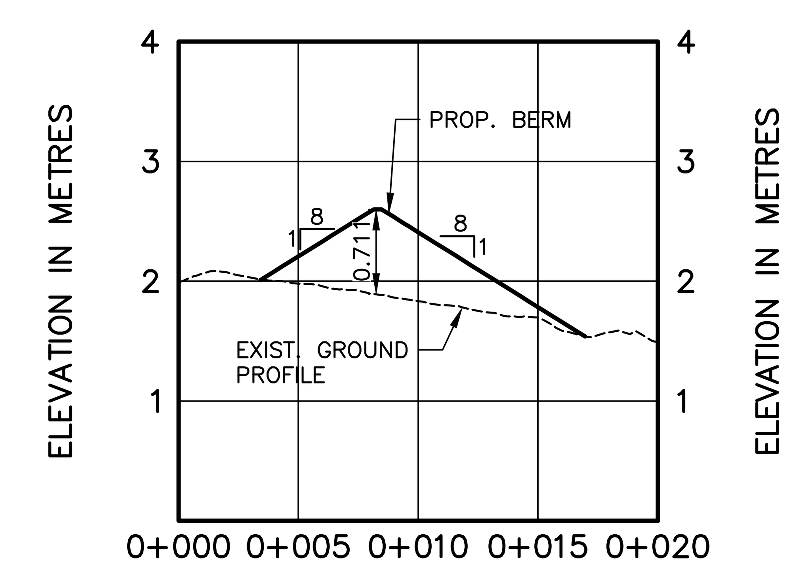


WB-20 – Interstate Semi-Trailer	
Overall Length	22.410m
Overall Width	2.590m
Overall Body Height	4.110m
Min Body Ground Clearance	0.407m
Max Track Width	2.590m
Lock-to-lock time	6.00s
Max Steering Angle (Virtual)	28.40°

PLAN— WWTP SITE WORK
1:250



A SECTION
C01 HORZ. 1:250 VERT. 1:50



B SECTION
C01 HORZ. 1:250 VERT. 1:50

No.	Description	Date	By
A	ISSUED WITH REPORT	JUN 11/21	SE

Revision or Issue

TOWN OF LUNENBURG

WWTP & OUTFALL PRE-DESIGN AND BCA

CIVIL

WWTP FLOOD PROTECTION

CBCL

CBCL No 210803.01	Contract No -
Date JUN 2021	Scale AS NOTED
Designed AMA	Drawn AMA
Checked SE	Approved SE
Sheet No 1 of 1	
Drawing No C01	

APPENDIX B

Flood Protection Calculations

Project Name:	TOL WWTP Upgrades
Project #:	210803.01

Table A-1 - Storm Water Drainage Area Runoff Volume Calculation

Runoff Coeffients:		***Precipitation Amounts:***	
Surface Type	***Runoff Coefficient (C)***	***1 in 100 year 24hr rainfall (mm):***	***190***
Impermeable Surfaces	1.00		
Semi-Permeable Surfaces	0.40	***Storm Water Drainage Area Flow***	
Permeable Surfaces	0.20		

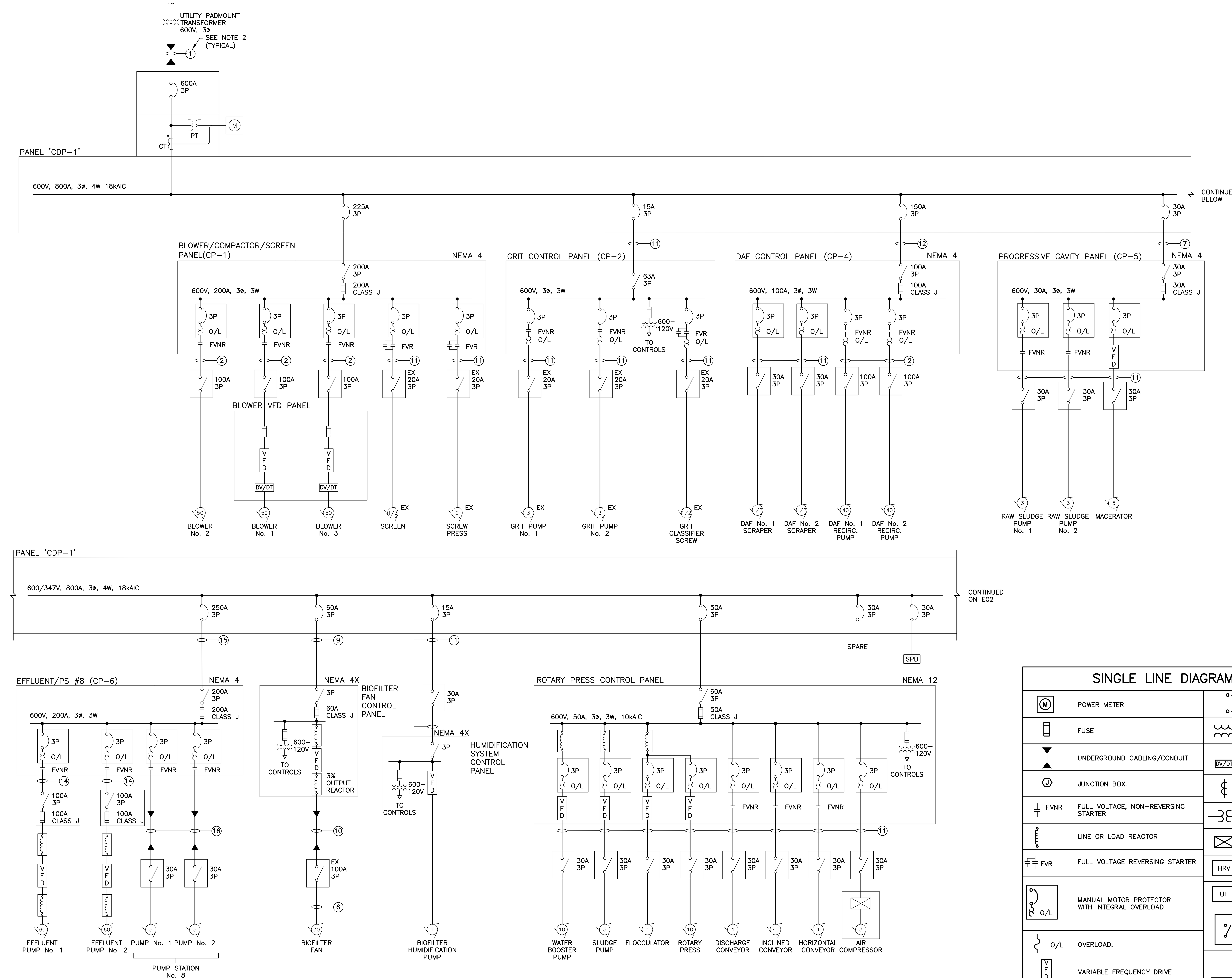
Storm Water Drainage Collection		**Total Stormwater Drainage Area (m^2)**	**Impermeable Surface (Paved/Flooded) Drainage Area (m^2)**	**Semi-Permeable Surface (Bare/Gravel) Drainage Area (m^2)**	**Permeable Surface (Lawns/Grassy) Drainage Area (m^2)**	**Weighted Runoff Coefficient**	**Total Annual Storm Water Volume Captured by Drainage Area (m^3)**
Low Area		3,338	1,250	419	1,669	0.52	333
Totals		**3,338**					**333**

APPENDIX C

Updated Single Line Diagram for Existing System

NOTES:

1. THIS DRAWING IS BASED ON EQUIPMENT NAMEPLATE DATA AND EXISTING "AS-BUILT" DRAWINGS. EXISTING INFORMATION IS TO BE FIELD VERIFIED.
2. REFER TO CABLE SCHEDULE ON DRAWING E02.



SINGLE LINE DIAGRAM LEGEND

M	POWER METER		CIRCUIT BREAKER
	FUSE		TRANSFORMER
	UNDERGROUND CABLING/CONDUIT	DV/DT	DV/DT FILTER
J	JUNCTION BOX.		CURRENT TRANSFORMER
FVNR	FULL VOLTAGE, NON-REVERSING STARTER		POTENTIAL TRANSFORMER
	LINE OR LOAD REACTOR		CONTROL PANEL
FVR	FULL VOLTAGE REVERSING STARTER	HRV	HEAT RECOVERY VENTILATOR
O/L	MANUAL MOTOR PROTECTOR WITH INTEGRAL OVERLOAD	UH	ELECTRIC UNIT HEATER
O/L	OVERLOAD.		DISCONNECT SWITCH
VFD	VARIABLE FREQUENCY DRIVE	XXXA XXX/XXXV XP, XW 'XXX' XX CKTS	PANELBOARD
SPD	SURGE PROTECTIVE DEVICE		
	THREE PHASE MOTOR		
	SINGLE PHASE MOTOR		

PRELIMINARY
NOT FOR CONSTRUCTION

No.	Description	Date	By
A	ISSUED FOR REPORT	JUN 15/21	LH

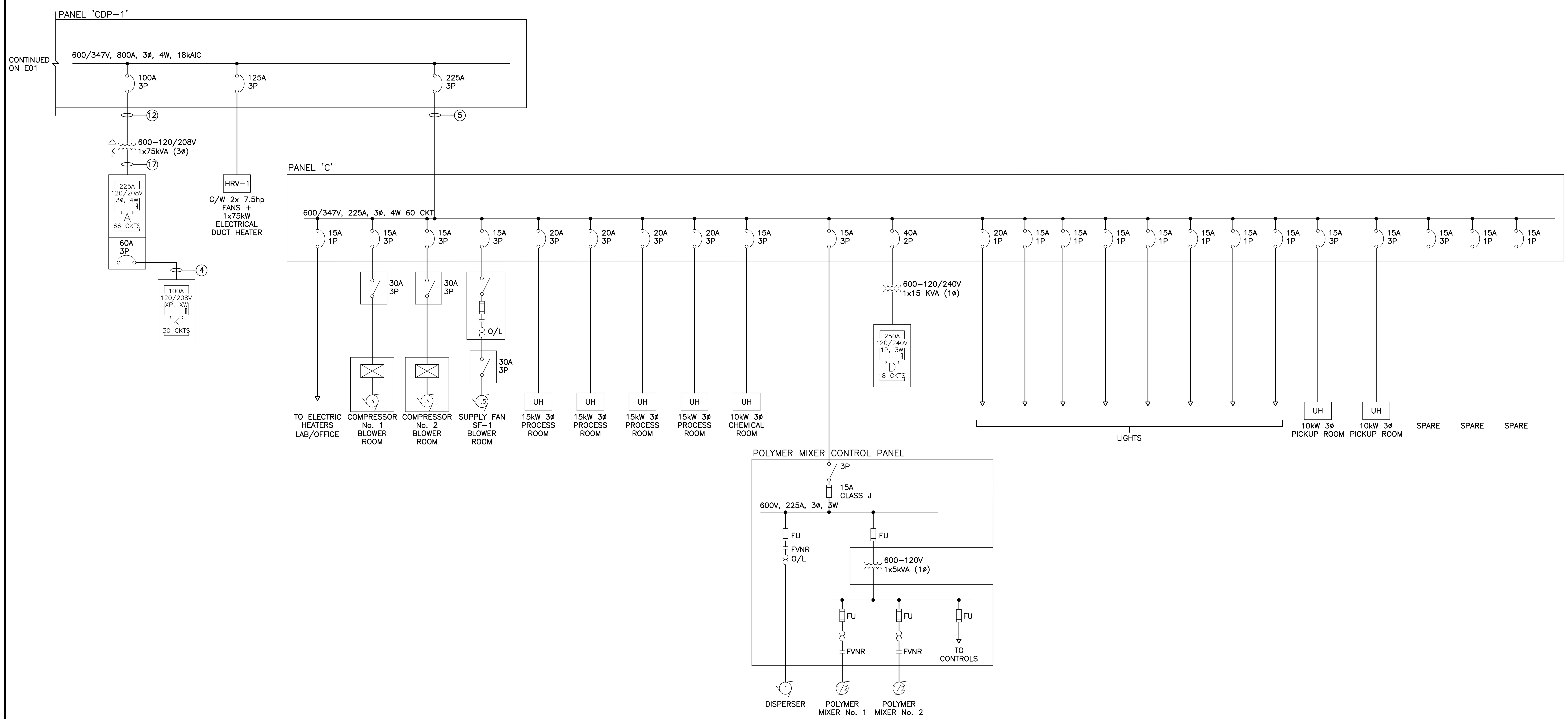
TOWN OF LUNENBURG

LUNENBURG WASTEWATER TREATMENT PLANT

ELECTRICAL

EXISTING SINGLE LINE DIAGRAM SHEET 1 OF 2

CBCL No 210803.01	Contract No -
Date MAY 2021	Scale AS NOTED
Designed LTH	Drawn TCS
Checked XX	Approved XX
Sheet No 1 of 2	
Drawing No E01	



NOTES:

1. THIS DRAWING IS BASED ON EQUIPMENT NAMEPLATE DATA AND EXISTING "AS-BUILT" DRAWINGS. EXISTING INFORMATION IS TO BE FIELD VERIFIED.
2. NOT ALL CONDUIT AND CONDUCTOR SIZES HAVE BEEN FIELD VERIFIED.

CABLE SCHEDULE (SEE NOTE 2)

(1) 4 RUNS OF 4x1C 300kCMIL IN 2x4-1/2" PVC CONDUIT
(2) 3x1C #6 + BOND IN 1-1/4" PVC CONDUIT
(3) 4x1C #3/0 AWG + BOND IN 2-1/2" PVC CONDUIT
(4) 4x1C #6 AWG + BOND IN 1-1/4" PVC CONDUIT
(5) 4x1C #4/0 + BOND IN 2-1/2" PVC CONDUIT
(6) 3x1C #8 AWG RA90(VFD CABLE)
(7) 3x1C #10 + BOND IN 3/4" PVC CONDUIT
(8) 3x1C #1/0 + BOND IN 1-1/2" PVC CONDUIT
(9) 3x1C #6 AWG + BOND IN 1" CONDUIT
(10) 3C #8 AWG VFD CABLE + BOND IN 1-1/2" CONDUIT
(11) 3x1C #12 AWG + BOND IN ¾" PVC CONDUIT
(12) 3x1C #2 AWG + BOND IN 1-1/2" PVC CONDUIT
(13) 3x1C #2/0 AWG + BOND IN 2-1/2" PVC CONDUIT
(14) 3x1C #3 AWG + BOND IN 1-1/4" PVC CONDUIT
(15) 3x1C #3/0 AWG + BOND IN 2-1/2" PVC CONDUIT
(16) 6x1C #10 AWG + BOND IN 1-1/4" PVC CONDUIT
(17) 4x1C #250kCMIL + BOND IN 3" PVC CONDUIT

PRELIMINARY
NOT FOR CONSTRUCTION

No.	Description	Date	By
A	ISSUED FOR REPORT	JUN 15/21	LH

TOWN OF LUNENBURG

LUNENBURG WASTEWATER TREATMENT PLANT

ELECTRICAL

EXISTING SINGLE LINE DIAGRAM SHEET 2 OF 2

CBCL No 210803.01	Contract No -
Date MAY 2021	Scale AS NOTED
Designed LTH	Drawn TCS
Checked XX	Approved XX
Sheet No 2 of 2	
Drawing No E02	

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Schedule B

Town of Lunenburg Wastewater Outfall Extension Pre-Design

Draft Report

CBCL

TOWN of LUNENBURG
A World Heritage Site

210803.01 • July 2021

B	Reissued for Review		July 26, 2021	
A	Issued for Review	KJM	July 5, 2021	SHE
Issue or Revision		Reviewed By:	Date	Issued By:

CBCL

July 26, 2021

Dennis MacPherson, P.Eng.
Town Engineer
Town of Lunenburg
177 Cumberland Street
Lunenburg, NS B0J 2C0

Dear Mr. MacPherson:

RE: Town of Lunenburg Wastewater Outfall Extension Pre-design: Draft Report

Please find enclosed CBCL Limited's (CBCL) Draft Report for the above-noted project, for your approval, following revisions based on the initial comments.. We thank you for the opportunity to work with you on this project.

Yours very truly,

CBCL Limited

DRAFT

Prepared by:	Reviewed by:
Allan MacAulay, P.Eng.	Kevin Murphy, P.Eng.
Civil Engineer	Senior Project Manager
Direct: 902-539-1330	
E-Mail: amacaulay@cbcl.ca	

Project No.: 210803.01

Contents

Appendices

A	Coastal Dispersion Modelling of WWTP Outfall Locations Technical Note
B	Outfall Options Technical Memo
C	Plan and Profile Drawings
D	Option 3 and 4 Routing Sketch with Property Boundaries
E	Regulatory Review Table
F	Opinion of Probable Capital Cost Tables

Table of Acronyms

Acronym	Definition
ACWGM	Atlantic Canada Wastewater Guidelines Manual for Collection, Treatment, and Disposal
ARIA	Archaeological Resource Impact Assessment
DFO	Fisheries and Oceans Canada
DI	Ductile Iron
H_2S	Hydrogen Sulphide
HDPE	High-Density Polyethylene
HW	Halifax Water
IAA	*Impact Assessment Act*
MODL	Municipality of the District of Lunenburg
NNL	No Net Loss
NSCCH	Nova Scotia Department of Communities, Culture and Heritage
NSECC	Nova Scotia Environment and Climate Change
NSLF	Nova Scotia Lands and Forestry
NSTAT	Nova Scotia Transportation and Active Transit
PDF	Peak Daily Flow
PVC	Poly Vinyl Chloride
RCP	Reinforced Concrete
TOL	Town of Lunenburg
US EPA	United States Environmental Protection Agency
WWTP	Wastewater Treatment Plant

Chapter 1 Introduction & Background

1.1 Introduction

In early 2021 the Town of Lunenburg (the Town) initiated a project for Wastewater Treatment and Outfall Pre-design. The project includes four (4) elements including the pre-design of the Wastewater Treatment Plant (WWTP) outfall, a Building Condition Assessment report for the WWTP, pre-design of near-term capital upgrades at the WWTP and a conceptual design for the expansion of the WWTP. This report will focus on the pre-design of the WWTP outfall relocation.

The purpose of this report is to inform and further discuss the selected options for the relocation of the existing sanitary outfall from its current location. This discussion includes technical, regulatory, and cost factors, as well as key constraints identified during the project. This report concludes with a recommendation of which outfall extension option is the most favourable to pursue, as well as an outline of next steps to further the implementation of this project. The purpose of this report is to inform and further discuss the selected options for the relocation of the existing sanitary outfall from its current location.

1.2 Background

The existing outfall for the Lunenburg WWTP is in Lunenburg Front Harbour directly under the Inshore Fishermen's Wharf. This is a very public and visible location for an outfall. All treated effluent has been pumped to this point since the WWTP was constructed in 2002-03, when the Town's wastewater collection system was converted from one that discharged directly to the Front Harbour to one that fed the new WWTP.

The effluent quality from the WWTP is usually good and has recently improved. It can be classified as "secondary" effluent quality, and it is frequently compliant with federal and provincial regulatory standards. Unfortunately, the location of the existing outfall has low potential for mixing and dispersion and direct public contact with the undiluted effluent is possible. Two additional issues, that worsen present conditions, are that the effluent quality does not reliably meet provincial bacterial effluent standards in the summer, and that polymer and foam can be released in the effluent. Polymer release is a significant nuisance to waterfront users.

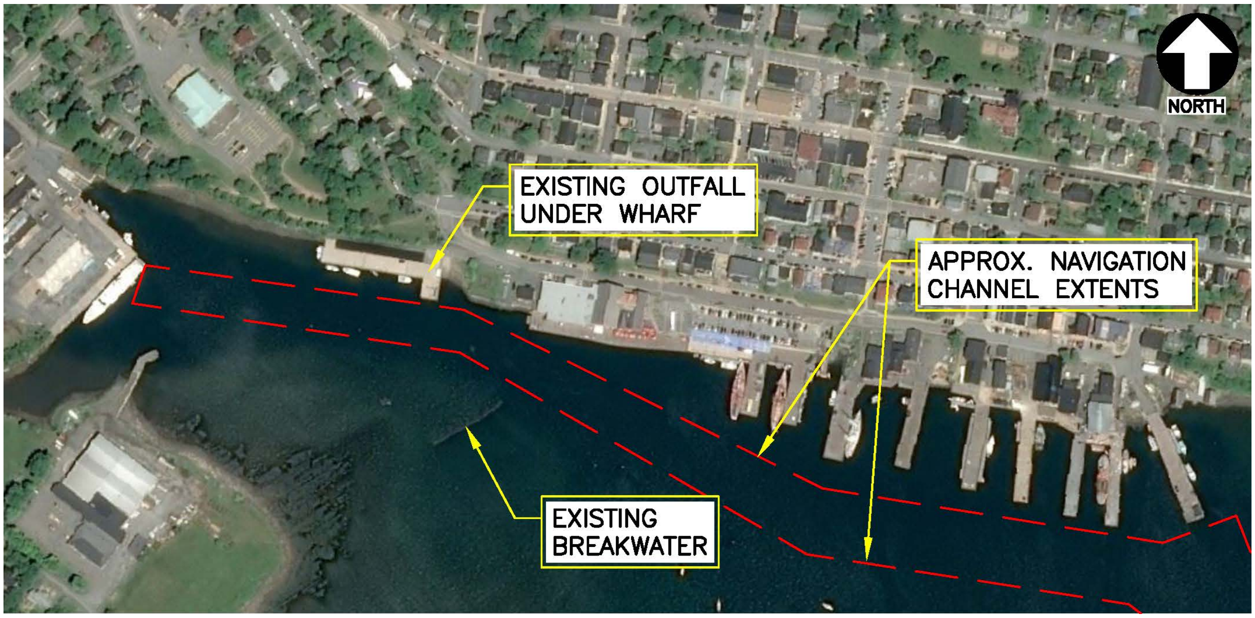


Figure 1.2: Existing Outfall location

The treated, wastewater effluent quality should be improved, and ways to implement this have been identified in the parallel report titled Near-Term Upgrades: Town of Lunenburg Wastewater Treatment Plant. Nonetheless, improving the effluent quality will not resolve the poor mixing that is unavoidable with the outfall in its current location and configuration (See Figure 1.1.)

Relocating the outfall away from public access and further out into the harbour will improve hydrodynamic mixing potential, and further reduce bacterial concentrations, nuisance, and negative public perceptions.

Figure 1.1: Existing effluent outfall (round pipe at right). Photo taken approximately 1 hour before low tide (2021-03-11 12:35).

Between March and May 2021, CBCL and Town staff met on several occasions to identify potential alternatives to the current outfall configuration as options for the outfall future outfall location. The challenge became to find an economical route to transport the effluent from the WWTP to a safe and acceptable location. Six locations were identified and evaluated. Each location had a depth of at least 2 m of water and were 100 m from shore. A Coastal Dispersion Model was built to compare the mixing potential of each location, and high-level technical and regulatory assessment was completed, to be able to weigh the relative merits of each of the six options.

Key information on each of these options is detailed in the Coastal Dispersion Modelling Technical Note (attached in Appendix A) and the Outfall Options Technical Memo (attached in Appendix B). The process of comparison included undertaking a detailed team-based decision-making process called a Kepner-Tregoe Decision Analysis, facilitated by the Town Engineer and including key project team members. This led to the decision to proceed with further analysis of Option 3 and Option 4 as identified in the Outfall Options Technical Memo.

Building on the findings of the Coastal Dispersion Modelling Technical Note and the Outfall Options Technical Memo, of we have completed pre-design assessments of both Option 3 and Option 4, and the design considerations and costs of each can be found in the following sections.

Chapter 2 Design Parameters & Standards

2.1 General Overview

The development of a system design is dependent upon the selection of appropriate and current design parameters. We have reviewed applicable design standards and have developed the preliminary design of the new treated effluent forcemain, gravity sewer, and outfall to be consistent with these design standards.

2.2 Outfall Design Flows

The design Peak Daily Flow (PDF) to the WWTP is 3,000,000 USgpd (11,356 m^3/d), while the effluent pumps are each rated for 2,300 USgpm (12,537 m^3/d). The key design flow affecting outfall design is the maximum pumped flow rate. Flow records have remained relatively consistent over the past four years, and show that Peak Daily Flow is rarely seen.

The Town is currently planning for population growth of 50% over the next 40 years. This will require expansion of the existing WWTP, as discussed in the parallel report titled Long-Term Expansion: Town of Lunenburg Wastewater Treatment Plant. Currently, much of the Town is served by combined sewers, and average wastewater flows are higher than typical, per person. There is good potential to accommodate increased population in the Town while maintaining existing flows by proactively removing stormwater from the sanitary sewers. The expansion plan design assumes that sanitary sewer separation and inflow and infiltration reduction undertaken as the population grows will not only allow average flows to remain constant but will also maintain peak flows at the same level as they are now. Seawater exclusion is also a key part of the required work to control flows.

Based on conversations with facility operators and Town personnel the current peak pumped effluent flow rates (2,300 USgpm, or 12,537 m^3/d) was agreed as acceptable for the design basis of the relocated Outfall. The effluent flow meter being installed shortly will allow pumped flow data to be analysed prior to detailed design, in order to confirm the peak pumped flow value.

2.3 Design Standards

The design of forcemain and gravity sewer systems has been based on the following reference documents and standards:

- Atlantic Canada Wastewater Guidelines Manual for Collection, Treatment, and Disposal (ACWGM) (2020)
- US EPA Wastewater Technology Fact Sheet Sewers, Force Main (USEPA) (2000)
- Halifax Water Design Specifications & Supplementary Standard Specifications for Water, Wastewater & Stormwater Systems (HW)(2020)

Design Attribute	Unit	Design Criteria	Source	Comment
Forcemain minimum velocity	m/s	0.6	ACWGM, USEPA	Maintaining self scouring*
Forcemain maximum velocity	m/s	2.4	USEPA	Higher velocities= higher friction losses = more energy
Forcemain minimum bury depth	m	1.6-1.8	ACWGM HW	Ground frost cover** HW- 1.6 ACWGM- 1.8
Forcemain hydraulics		Hazen-Williams	ACWGM	C=120 (PVC)
Gravity sewer minimum velocity	m/s	0.6	ACWGM	Maintaining self scouring
Gravity sewer maximum velocity	m/s	4.5	ACWGM	
Gravity sewer hydraulics		Manning	ACWGM	n=0.013

* Note: While ACWGM manual recommends a minimum forcemain velocity of 0.6 m/s, CBCL typically designs forcemains to have a minimum velocity of 0.9m/s as an added measure to ensure thorough self scouring.

**Note: In most parts of Nova Scotia, 1.5m of cover is typically sufficient for frost penetration protection.

Chapter 3 Sewer System Upgrades

3.1 Linear Infrastructure

The general routing for each option is summarized on the figure below. Also shown is the routing of the existing outfall for information.

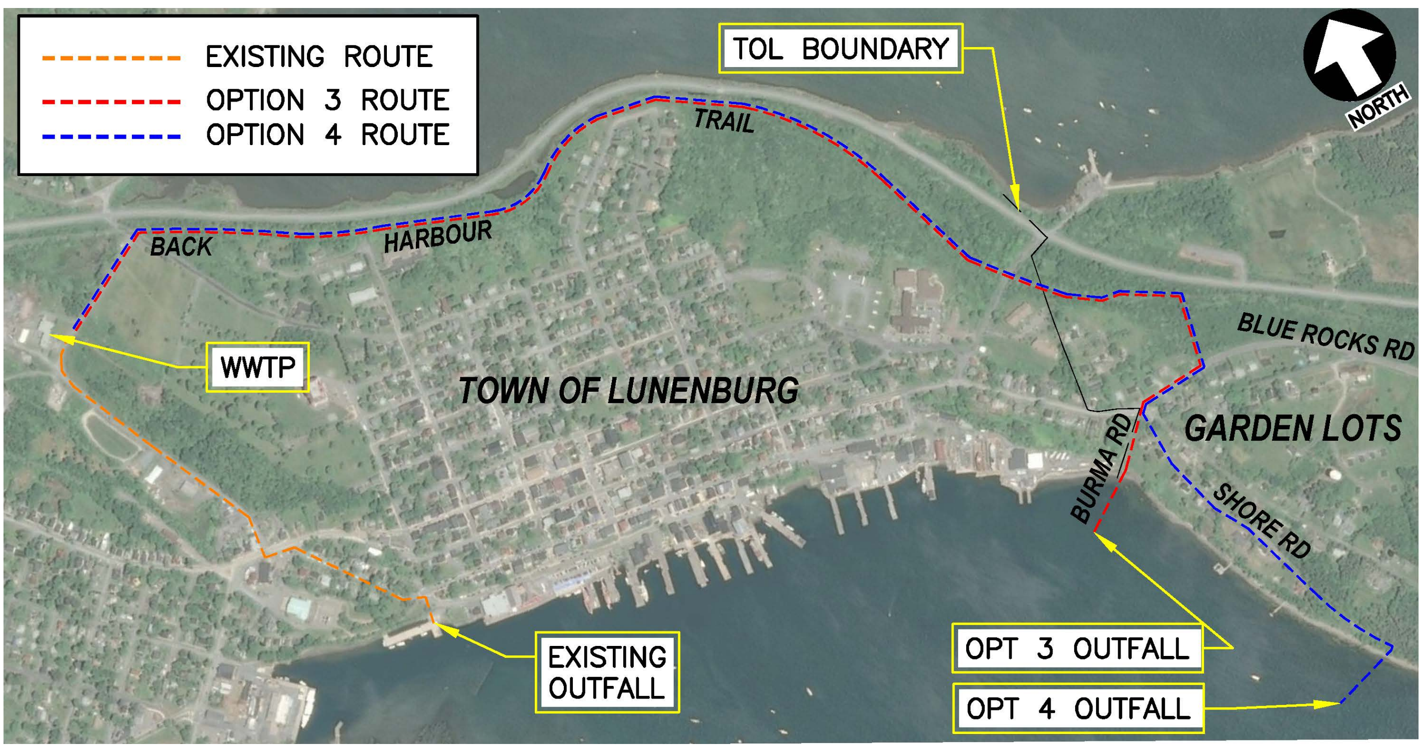


Figure 3.1: Outfall Routing

Detailed Plan/Profile drawings included in Appendix C summarize the selected routing and configurations. Both Options 3 and 4 have the same configuration between the WWTP and Sta 2+035.

3.1.1 Option 3

Starting at the WWTP, effluent would be pumped in a buried forcemain along the Back Harbour Trail east towards the Blue Rocks Road. After following the trail right-of-way for approximately 2 km, the route would connect to Blue Rocks Rd and then onto Burma Road where it would discharge into the Front Harbour.

Preliminary sizing of the new 2000m long forcemain is 350mm PVC DR25. The forcemain will begin at the WWTP and discharge to a new manhole on the Back Harbour Trail. Effluent would then flow through a gravity sewer to and along Blue Rocks Road, then down Burma Road and into the harbour via a new outfall with diffusers.

The gravity portion of pipe between the Back Harbour Trail and outfall in the harbour is designed as a typical gravity sewer with manholes. Beyond the last manhole on Burma Road, the outfall will extend approximately 100m out into the harbour where effluent will be discharged through a diffuser system for dispersion of the effluent into the marine environment.

This configuration requires an air/vacuum release valve at an intermediate high point (Sta 0+512). Two drains will be located at low points to empty the forcemain of effluent should maintenance be required on the forcemain. These drains are connected to existing sanitary sewer infrastructure.

Figure 3.2: Installation of sewer outfall in Sydney Harbour. Pipe is HDPE and has concrete collar weights for ballast similar to what is proposed for the TOL outfall

3.1.2 Option 4

Similar to Option 3, starting at the WWTP, effluent would be pumped in a buried forcemain along the Back Harbour Trail east towards the Blue Rocks Road. After following the trail right-of-way for approximately 2 km, the new forcemain would connect to Blue Rocks Rd and then onto Shore Road where it would discharge into the Front Harbour.

Preliminary sizing of the new 2500m long forcemain is 350mm PVC DR25. The forcemain will begin at the WWTP and discharge to a new manhole on the Shore Road. Effluent would then flow through a gravity sewer along Shore Road, then into the harbour via a new outfall with diffusers.

The gravity portion of pipe along Shore Road and the outfall in the harbour is designed as a typical gravity sewer with manholes. Beyond the last manhole, the outfall will extend approximately 100m out into the harbour where effluent will be discharged through a diffuser system for dispersion of the effluent into the marine environment.

This configuration requires two air/vacuum release valves at intermediate high points (Sta 0+512 and 2+035). Three drains will be located at low points to empty the forcemain of effluent should maintenance be required on the forcemain. These drains are connected to existing sanitary sewer infrastructure.

3.2 Outfall Diffusers

Initial hydrodynamic modelling of both Option 3 and 4 discharge locations considered a single point discharge of the effluent. Those modelling results showed sufficient hydrodynamic mixing at both sites. To further improve mixing, the last 10−15m of the outfall pipe outfall is designed to have multiple small diameter pipes with one-way flow valves along it. This spreads out the discharge across a larger area than a single point discharge and so improves mixing and dispersion of the effluent. Diffusers also help to reduce the appearance of boils on the surface of the water caused by high volumes of effluent being discharged beneath the water surface.

Diffusers would need to be inspected regularly (suggested annually) to ensure proper functionality. It is understood TOL already has a diver inspect their water treatment plant intake annually. Inspections of outfall diffusers could be included in this maintenance routine.

These systems are routinely used throughout Nova Scotia including for the Town of Mahone Bay which was designed by CBCL.

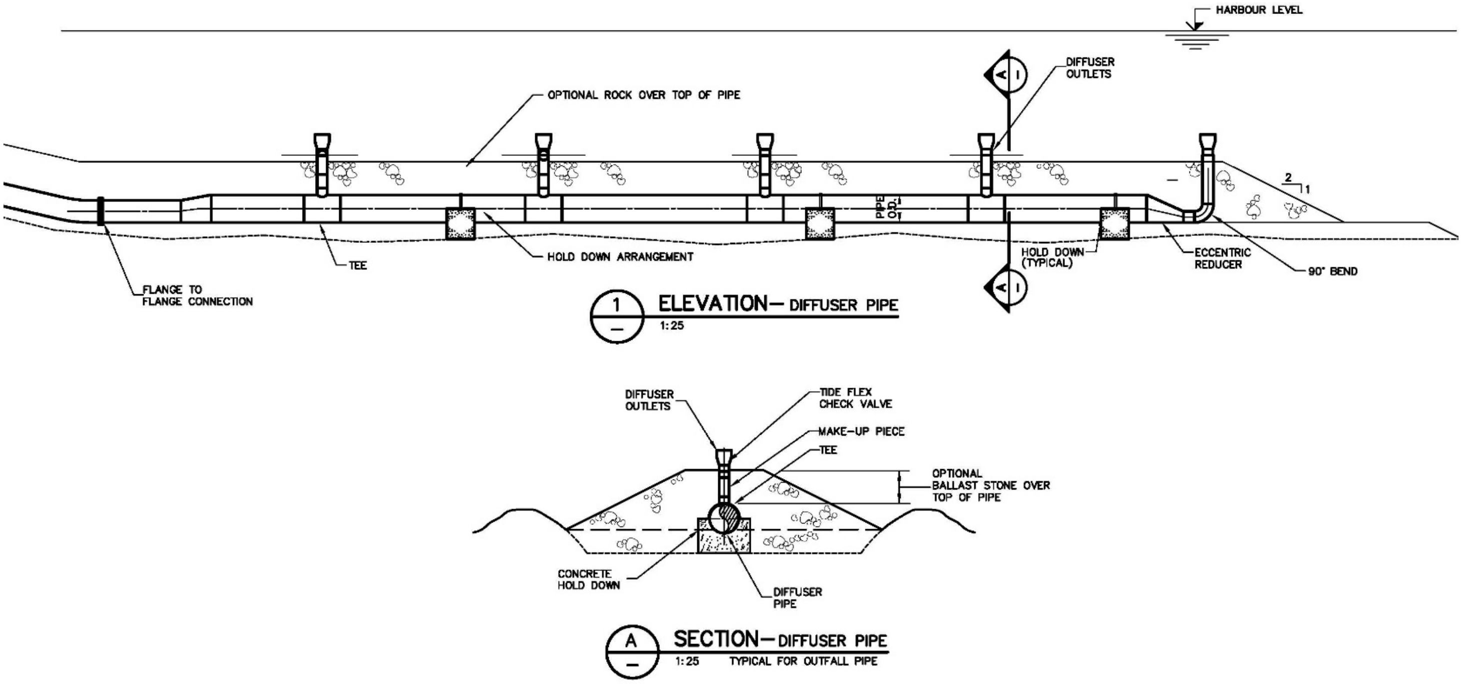


Figure 3.3: Schematic of a typical diffuser system

The sizing and arrangement of these diffusers will be determined during detailed design.

3.3 WWTP Effluent Lift Station

The existing effluent pumps at the WWTP are understood to be Gorman-Rupp T10A3S-B. These pumps were originally selected for the hydraulic conditions associated with the existing outfall. Based on a review of their pump curves, they appear to be rated to deliver 2300 USgpm at 67' of head. Preliminary calculations have shown the following pumping requirements for Option 3 and 4:

Configuration	Required Head (ft) @ 2300 USgpm
Option 3	120
Option 4	135

In consideration of the proposed forcemain layouts in Options 3 and 4, The requirements of both Options are beyond the operating range of the existing pumps. As such, the existing pumps are required to be upgraded or replaced at the Town's discretion. Through conversations with pump suppliers and manufacturers it appears that the existing pumps could be upgraded by increasing the motor size and replacing belts and sheaves.

It should be noted that the static head conditions are based on the forcemain discharging at an elevation well above sea-level. CBCL investigated the potential for direct discharge to the proposed outfall location. This would remove the gravity sewer portion of the pipeline and effectively use a siphon effect to help draw the effluent over the elevated portion of the pipeline route. Unfortunately, the elevation of the high point was too high and vacuum pressures too high to make this option viable.

Chapter 4 Pipe Material Selection & Design

4.1 Pipe Material

There are four pipe common pipe materials used in sanitary sewer applications. They are:

- Ductile Iron (DI)
- High Density Polyethylene (HDPE)
- Polyvinyl Chloride (PVC)
- Reinforced Concrete (RCP)

Table 4.1 on the next page summarizes each material against multiple factors.

Table 4.1: Summary of each material against multiple factors

Material	Application	Advantages	Disadvantages
DI	Forcemain	• High strength and durability • Commonly used material in water/wastewater projects so contractors are familiar with installation	• Pipe lengths are heavy • High Installation cost • Pipe/fittings are susceptible to corrosion
HDPE	Forcemain	• Material displays excellent resistance to corrosion • Pipes come in long laying lengths so long sections can be installed quickly. • Lightweight and relatively easy to handle	• Properly constructed bedding is critical • Pipe lengths are required to be fused together • Careful handling is required • Vacuums developing in pipe may cause it to collapse • Long lengths may be difficult to install in areas where other buried infrastructure needs to be worked around
PVC	Forcemain/ Gravity	• Material displays excellent resistance to corrosion • Lightweight and relatively easy to handle • High impact strength • Commonly used material in water/wastewater projects so contractors are familiar with installation • Cost effective	• Properly constructed bedding is critical • Care in handling is required in freezing conditions • Typical fittings used (cast-iron) are susceptible to corrosion. Fittings made of PVC are available but are costly.
RCP	Gravity	• High strength and durability • Commonly used material in water/wastewater projects so contractors are familiar with installation	• Pipe lengths are heavy • Short laying lengths • Proper installation and bedding are critical to avoid cracking. • Susceptible to corrosion from hydrogen sulfide (H_2S) and acids if not properly coated.

Ductile iron is a technically viable option for the forcemain and polyethylene is also viable for both the forcemain and gravity portions of the pipeline. However, in consideration of the of above noted factors, it is recommended that forcemain sections be constructed of PVC and gravity sections also be constructed of PVC. The outfall portion should be constructed of HDPE due to its inherent flexibility and lack of required joints.

As mentioned previously, HDPE is a viable pipe material option. During the detailed design and tendering portion for the new outfall, the Town may wish to tender this material as an option along with PVC to compare both prices and then decide which material is most cost effective for the Town’s needs.

Chapter 5 Land & Easement Requirements

5.1 Linear Infrastructure

Most of the route would be along the Back Harbour Trail portion which is owned by TOL but after leaving the Town limits, the route is on portions of the Trail owned by the provincial Department of Lands and Forestry (formerly Natural Resources) and road rights-of-way within MODL. As well, both Option 3 and 4 require access through lands designated as “Common” with owner not listed. Agreements may be required where TOL does not own the lands or water lots required. Below is a list of properties which are affected by the proposed routes.

Non-Tol-Owned Properties			
Parcel	**PID**	**Owner**	**Option**
1	60526340	NS Department of Natural Resources Her Majesty the Queen in right of the Province of Nova Scotia	3 and 4
2	60386703	NS Department of Natural Resources Her Majesty the Queen in right of the Province of Nova Scotia	3 and 4
3	60401981	NS Department of Natural Resources Her Majesty the Queen in right of the Province of Nova Scotia	3 and 4
4	60401999	NS Department of Natural Resources Her Majesty the Queen in right of the Province of Nova Scotia	3 and 4
5	60386695	Local common	3
6	60386612	Municipality of the District of Lunenburg	3
7	60401809	Trustees of the common land	4

A figure outlining these properties is included in Appendix D.

Chapter 6 Site Specific Issues

As part of the preliminary design of the outfall routing, we have reviewed the pipe routing for potential constraints. Constraints reviewed included construction constraints, environmental constraints, and access requirements.

6.1 Construction Constraints

Both Options will require access to the Back Harbour trail for a significant portion of time while the new forcemain is installed. It is understood that this is a well-used nature trail and that use of the trail for construction purposes during tourist season may not be desirable to the Town. Construction could be pushed to the shoulder seasons (spring/fall), however weather during seasons can often be less than ideal for earthworks. Reinstatement of this trail will also be required after the forcemain is installed.

Both Options will be installed along paved portions of streets (Blue Rocks Road and Shore Road) which will require significant amounts of asphalt roadway reinstatement after the forcemain is installed.

There is also existing buried infrastructure at the Blue Rocks Road/Shore Road/ Pelham Street intersection that will need to be avoided during the installation of the new forcemain. One piece of infrastructure of note is a 12" transite watermain which appears to be the main supply line to the town reservoir. In the case of Option 3, infrastructure near the Rouse's Brook (Burma Road) lift station will need to be avoided.

In the case of Option 4, TOL staff inform that there is an existing forcemain running along Shore Road from High Liner Seafoods. This piece of infrastructure coupled with a narrow road right-of-way will make design and construction more complicated. As well, there is a very steep (approx. 79%) slope from the Shore Road down to the harbour edge. Deep excavations would be required here along with slope stabilization measures to secure the slope after construction activities have disturbed it.

6.2 MODL Garden Lots Municipal Servicing

It is understood the Municipality of the District of Lunenburg (MODL) is in the process of developing a plan and design for the potential installation of municipal services (water and sewer) to service the homes in Garden Lots. Options 3 and 4 pass through the edge of the Garden Lots area before terminating in the harbour (see Figure 6.1). Option 3 is routed along the Back Harbour Trail and a portion of the Blue Rocks Road. Option 4 is also routed along the same portion of the Trail and Blue Rocks Road as well as Shore Road. All infrastructure will be below ground. Design and construction of both Options should be coordinated with MODL to ensure an overall solution that is beneficial for all.

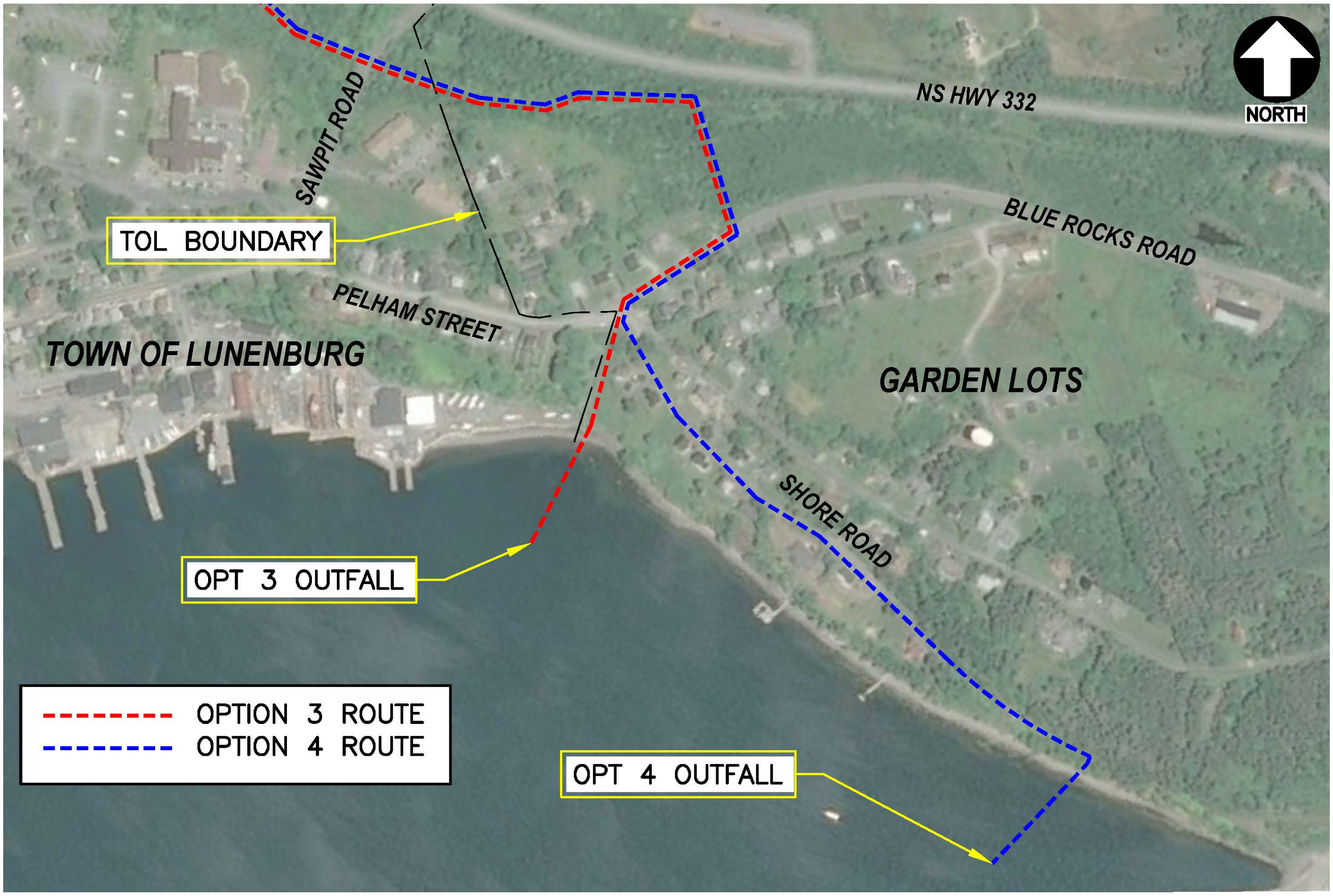


Figure 6.1: Outfall routing through Garden Lots

6.3 Access Requirements

Option 4 will pass along an unmaintained section of Shore Road before turning and discharging into the harbour. TOL may require an access road to the outfall location for maintenance activities. This access road (which would be along the route of the forcemain) would come with construction as well as maintenance costs.

Chapter 7 Regulatory Review

Federal, provincial, and municipal environmental legislation, regulations, and guidelines were reviewed to determine applicability to the Project based on the current scope. Key information on the legislation, regulations, and guidelines reviewed was consolidated into a regulatory review table, which is provided as Appendix E to this report.

The table includes the following:

- Title of the applicable Act, Regulation, guideline or other legislative document reviewed;
- Regulatory Authority having jurisdiction over the corresponding Act, Regulation, or guideline;
- Specific permit, approval, or authorization issued under the legislation, regulations, and guidelines;
- Context of requirements and what they govern;
- Relevance of the requirements to the Project;
- Recommendations on how to confirm requirements or meet requirements;
- Application details such as processing time[1];
- Guidance on supporting documentation required for submission of applications; and
- Regulatory Authority Contact Information.

After receiving permission from the Town, initial consultation with select regulators including Nova Scotia Environment and Climate Change (NSECC) and Nova Scotia Lands and Forestry (NSLF) occurred to confirm requirements. NSECC was contacted to confirm if an amendment to the approval issued under the *Environment Act* (Approval no. 2012-082710-02) for Municipal Sewage Works was required. NSECC indicated that a new approval is required, though it will be linked to the existing approval. NSLF was engaged to discuss permitting requirements under the *Beaches Act*. NSLF also indicated that the seabed is administered by the federal authority within the discharge area of outfall option 4 as its footprint would not fall within a designated water lot claim like option 3 does.

Submerged Crown land along the coast of Nova Scotia from the mean high-water mark to the seabed is typically owned by the Province unless the land is a federally or privately owned water lot ; however, Lunenburg Harbour is a federally-owned harbour with portions

[1] It should be noted that typical review timelines identified by each Regulatory Authority may be subject to delays as a result of COVID-19.

of the harbour under lease by the province. The federal authority who administers the land within the footprint of option 4 is not verifiable by publicly available mapping resources. Further attempts were made to verify the federal authority for Option 4 by contacting the Harbour Master. While both NSLF and the Harbour Master indicated that the federal authority is likely Fisheries and Oceans Canada (DFO), if outfall Option 4 is selected, it is recommended that the Town speak directly to Fisheries and Oceans Canada (DFO) to confirm if they are the federal authority who administers the seabed outside of a water lot claim in Lunenburg Harbour. The other potential Federal authority would be Transport Canada, as it is known that at least a portion of the seabed outside of designated water lot claims are controlled by Transport Canada based on other project experience in Lunenburg Harbour. Verification of who the federal authority is can also be determined by speaking with Transport Canada.

It is important to note that the scoping of environmental regulatory considerations and the consultation process typically move in parallel with the engineering and design phases of a project, as the latter plays an important role in the regulatory requirements of a project. Changes to project design, and the results of future site surveys and investigations, may further influence the regulatory requirements of the Project. The regulatory requirements identified within this report should be reviewed with the regulatory authorities and updated, as needed, as the Project progresses through the design phase, following the completion of surveys, or pending changes to the scope of work, legislation, regulations, or guidelines.

7.1 Legislative Framework

The regulatory review was categorized by federal, provincial, and municipal legislation, regulations and guidelines and is presented in this format in the regulatory review table (Appendix E).

Table 7.1 summarizes the key legislation, approvals, permits, and authorizations that may be applicable to the Options 3 and 4 according to the current scope. Further context and recommendations concerning Table 7.1 and the regulatory review table is also included below. Information pertaining to other legislation that was consulted as part of this review is included in Appendix E. If the existing outfall is chosen to be improved through maintenance and upgrades, or extended, these activities are still likely to require a regulatory review. Any proposed extensions or modifications to the outfall would require an amendment to the existing NSECC Approval for Sewage Works.

Applications provided to NSECC are also provided to DFO for in-water works as part of their ‘one window’ approach, though it is proactive of the Town to consult with DFO in advance of application submission. Construction implications to species at risk and migratory birds would need to be considered too. The requirements of the Canadian Navigable Waters Act apply to a modification, extension, or relocation of the outfall.

Table 7.1: Summary of Key Legislation, Approvals, Permits, and Authorizations

Legislation	Authorization, Permit, or Approval	Authority	Supporting Documentation	Timeline**
Federal				
Impact Assessment Act (IAA) (Section 82)	Environmental Effects Determination for Outfall 4 Only	DFO and/or Transport Canada (to be determined)	See regulatory review table	Unknown
Fisheries Act	Request for Review / Authorization	DFO	Request for Review Form: Fish and Fish Habitat Assessment. Authorization*: Offsetting plan, See also Applicant's Guide Supporting the "Authorizations Concerning Fish and Fish Habitat Protection Regulations".	DFO Review of Form: Up to 60 days DFO Review: ~150 days Authorization (if required)***
Provincial				
Environment Act	Approval for Sewage Works	NSECC	Section 6 of application form* • Proof of Ownership/ Agreement/Legal right for Project lands • Site Plan or Survey • Detailed Plans/Specs • Engineering drawings, plans and specifications • Substance Descriptions and Controls • Explanation of Substances Released • Contingency plan	60 business days or less

Legislation	Authorization, Permit, or Approval	Authority	Supporting Documentation	Timeline**
Environment Act	Wetland Alteration Approval	NSECC	Section 6 of the form* • Details of Site Suitability and Sensitivity • Detailed Description of Activity • Public Consultation Description	Approx. 60 business days
Public Highways *Act*	Work within a Highway Right-of-Way Permit	NSTAT	• Sketch Plan	Up to 10 days
Municipal				
Municipal Government Act	Development Permit	Municipality of the District of Lunenburg	• Site Plan showing distances to lot lines • Photographs of existing conditions • Grading drawings	Up to 6 weeks

*For more comprehensive applications, confirm supporting documentation requirements with the regulator.
**Application preparation should occur following sufficient engineering design.
***Indigenous consultation efforts required for the DFO Fisheries Act Authorization (should an Authorization be required), may be delayed as a result of COVID-19. It should also be noted that the regulatory agency provided review times are provided in the table; however, there is no set time limit if the application is found to be incomplete, the regulatory clock is stopped due to information requests, for the development of a DFO accepted Offsetting Plan, or for secondary reviews, such as that undertaken by the Aboriginal Consultation Unit of Transport Canada or DFO.

If the outfall will extend into the seabed on federal land (option 4) then both Transport Canada (as land administrator and as regulator under the CNWA) and DFO (as regulator under the Fisheries Act, if an Authorization under this act is required) will have obligations under the IAA; neither can issue an approval or interest in land until they determine that the project will not result in a significant environmental effect.

To provide further context to Heritage Research Permits and Archaeological Resource Impact Assessments (ARIA) included in Appendix E, a Heritage Research Permit is not an approval of the Project, but rather a permit that is needed to conduct an ARIA. Heritage Research Permits are issued by the Nova Scotia Department of Communities, Culture and Heritage (NSCCH) according to the type of archaeological work completed. Category C Heritage Research Permits authorize the completion of an ARIA for a project area, which involves an inventory and evaluation of archaeological resources and assessments of impacts in connection with development proposals which will potentially disturb or alter the landscape, thereby endangering archeological sites (NSCCH 2014). The completion of an ARIA is not a regulatory requirement, though is considered proactive. ARIAs can be completed as a best practice when proposing construction in greenfield (previously undisturbed) areas that could contain archaeological resources or when there is little known information with respect to archaeological significance in a disturbed area. If an artifact, archaeological, or paleontological resource is encountered during construction, there may be implications to the project schedule as construction would need to cease until a qualified archaeologist investigates the area. Outfall option 4 would require an environmental effects determination under Section 82 of the IAA as it would be constructed within a seabed administered by a federal authority. Archaeological or historical sites and traditional land use are valued components that must be considered for this evaluation.

Projects that result in the harmful alteration, disruption, or destruction of fish habitat or alteration of wetlands are likely to result in the need for offsetting or habitat compensation.

If a DFO authorization is required, an offsetting plan would need to be prepared. DFO has developed a Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act (2019) which provides guidance to determining suitable offsetting measures.

Although the proposed predesign does not require wetlands or watercourses to be transected, if design changes occur that would result in wetlands being transected, the following information would be important to consider. The federal government has developed a policy of no net loss of wetland function on federal lands (Government of Canada, 1991). Additionally, Nova Scotia has also developed a wetland conservation policy which aims to promote No Net Loss (NNL) of wetland area and function (Nova Scotia Wetland Conservation Policy, 2011). These policies are intended to provide protective approaches to wetlands and watercourses. If wetlands are determined to be present within the project area, avoiding alteration of wetlands should be considered first, followed by minimizing effects to wetlands during design. If avoidance cannot occur, a proponent would be required to address wetland lost through the compensation process. Compensation is determined on a case-by-case basis. Compensation could include providing funding or conducting the work to replace wetland lost.

Chapter 8 Opinion of Probable Costs

8.1 Opinion of Probable Costs

The opinion of probable costs is presented based on experience, qualifications, and best judgement. It has been prepared in accordance with acceptable principles and practices. Market trends, non-competitive bidding situations, unforeseen site conditions, unforeseen labour, material adjustments, and the like are beyond the control of CBCL. As such, we cannot warrant or guarantee that actual costs will not vary from the opinion provided.

The costs associated with the recommended upgrades are shown below. The opinions of cost include allowances for engineering and contingencies for unforeseen changes during design and construction.

Options	Estimated Cost (Exclusive of HST)
Option 3	$2,551,500
Option 4	$3,098,250

In the detailed breakdown of costs (Appendix F), a 25% Design Contingency has been applied to these cost estimates (as opposed to 20% in the WWTP Near Term Pre-Design Report). The change in this factor is to account for the current volatility in pricing and supply observed across the plastic (PVC/HDPE) pipe industry.

The Engineering Contingency (fee allowance) noted on the detailed cost estimates is a general allowance. There may be economies that can be realized once a more detailed scope is developed. The costs shown on the cost estimates are indicative only and are not a formal quotation for these services.

Costs for full pump upgrades were included in the cost estimates. As noted in the detailed breakdowns, an allowance of $150,000 was utilized which includes replacement of both pumps. Should detailed design confirm that the existing pumps are only required to be upgraded, preliminary pricing received from suppliers indicates a current material cost of $25,000. An installed amount could be around $35,000 (exclusive of HST).

Chapter 9 Recommendations

Both outfall Options appear feasible at the Pre-Design Stage. However, **it is recommended that the Town proceed with further detailed design development of Option 3**. This option requires the least amount new infrastructure and appears to be able to be constructed more easily than Option 4. We feel that Option 4 is still a viable alternative should issues arise that prevent the implementation of Option 3. Land access needs to be confirmed for both sites and geotechnical investigations as well as further environment studies should be undertaken to confirm site suitability.

Chapter 10 References

- Atlantic Canada Wastewater Guidelines Manual for Collection, Treatment, and Disposal (ACWGM) (2020)
- US EPA Wastewater Technology Fact Sheet Sewers, Force Main (USEPA) (2000)
- Halifax Water Design Specifications & Supplementary Standard Specifications for Water, Wastewater & Stormwater Systems (HW)(2020)

APPENDIX A

Coastal Dispersion Modelling of WWTP Outfall Locations Technical Note

Technical Note

Date	15 April, 2021
Note to	Sarah Ensslin
Project name	200308.01 – TOL WWTP & OUTFALL PREDESIGN AND BCA
Subject	Coastal Dispersion Modelling of WWTP Outfall Locations
From	Tom Kozlowski
Copies to	Vincent Leys

1 Introduction

This technical memo provides the results of an initial 2-dimensional far-field modeling assessment of tidally-driven dispersion of five (5) potential locations for a wastewater treatment plant outfall in Lunenburg harbour, NS. The model also includes the location of the existing outfall for comparison purposes.

The objectives are to assess the far-field effluent dispersion patterns for the following five (5) scenarios:

- Baseline condition with the existing outfall;
- Extending the existing outfall from its current location in the inner harbour; and
- Three (3) locations for the siting of a new outfall around the Harbour.

Each scenario considers both the average and peak effluent discharge scenarios over the course of a 720-hour simulation period. Model results are depicted in a two-dimensional format depicting the far-field plume extents and modelled tracer concentrations after 72 hours (3 days) as well as after 720 hours (30 days).

The project location is depicted in Figure 1-1, showing the existing outfall location as well as four potential outfall locations.

Figure 1-1: Project Location, Lunenburg, NS. Existing and Proposed Outfall Locations.

2 Background Data

This section describes the existing data that is available, which was used in the analysis. This information includes:

- Bathymetry data
- Water level data
- Assumed outfall flow rates

2.1 Bathymetry data

Bathymetry for this numerical simulation was sourced from the Canadian Hydrographic Service Non-Navigational (NONNA) bathymetric data portal[1].

The NONNA bathymetry in the full model domain is shown in Figure 2-1, with the NONNA bathymetry in Lunenburg harbour shown in Figure 2-2. There is a lack of bathymetry data in the southeast of the harbour, in the vicinity of the High Liner Foods plant. This bathymetry was interpreted from the Canadian Hydrographic Service nautical chart for Lunenburg Harbour (Figure 2-3) and manually added to the model.

[1] https://open.canada.ca/data/en/dataset/d3881c4c-650d-4070-bf9b-1e00aabf0a1d

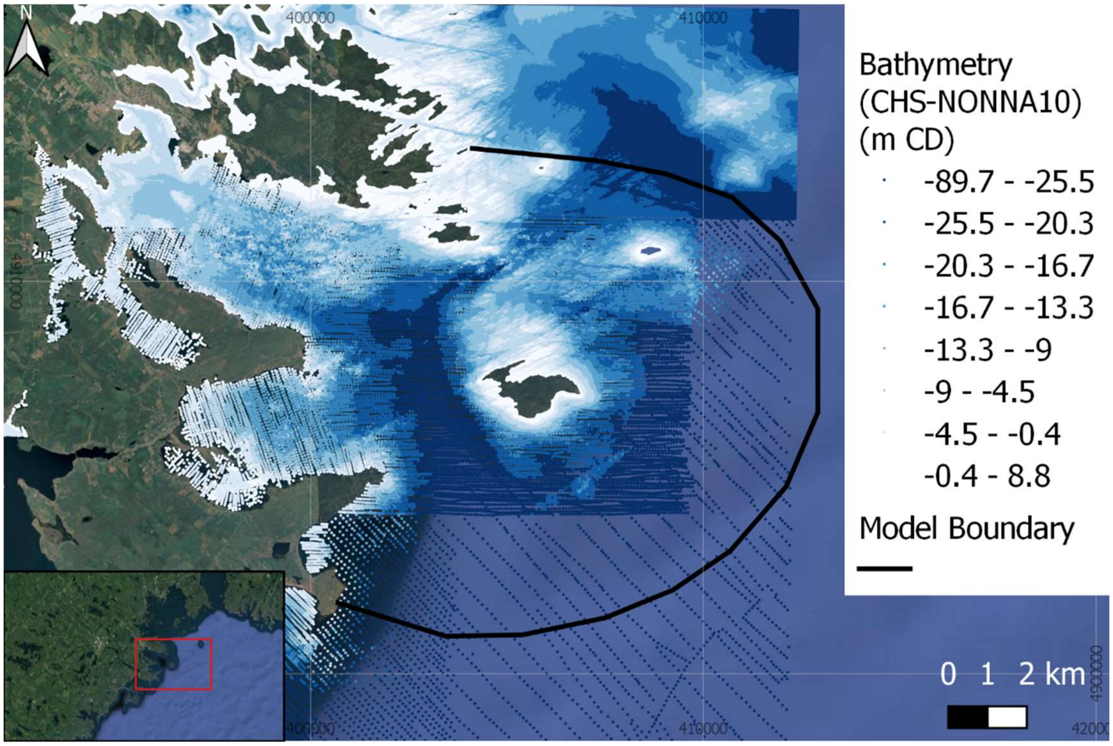


Figure 2-1: NONNA10 Bathymetry and Dispersion Model Extent

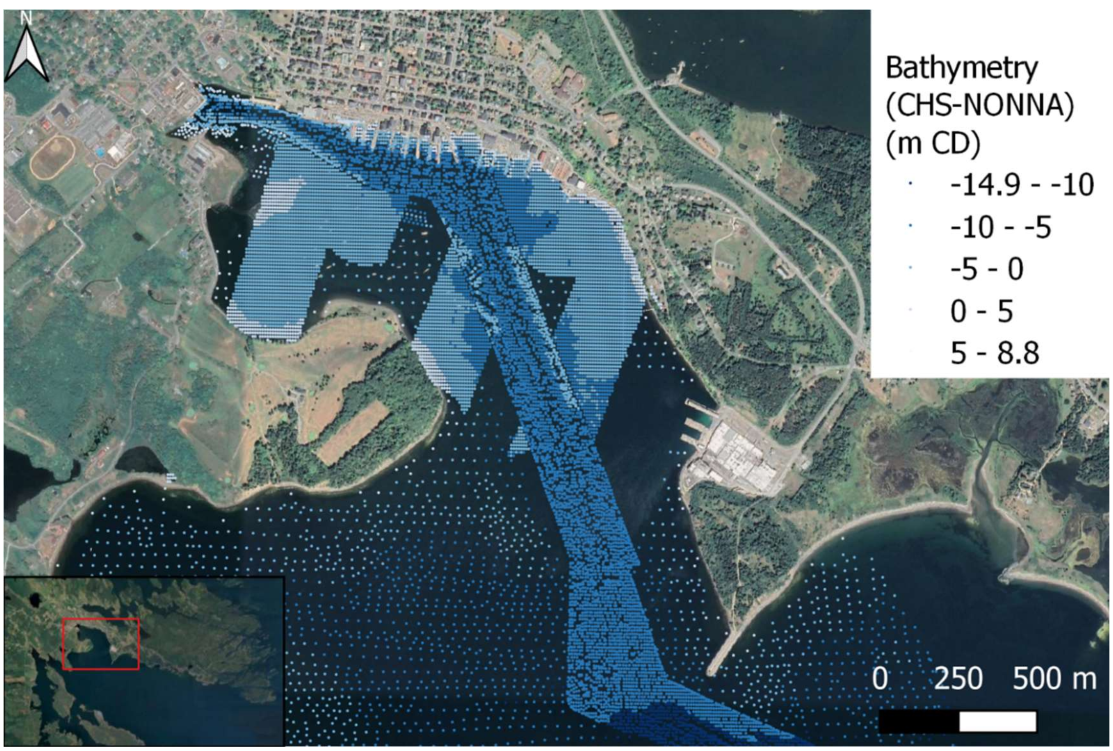


Figure 2-2: NONNA10 Bathymetry, Lunenburg Harbour.

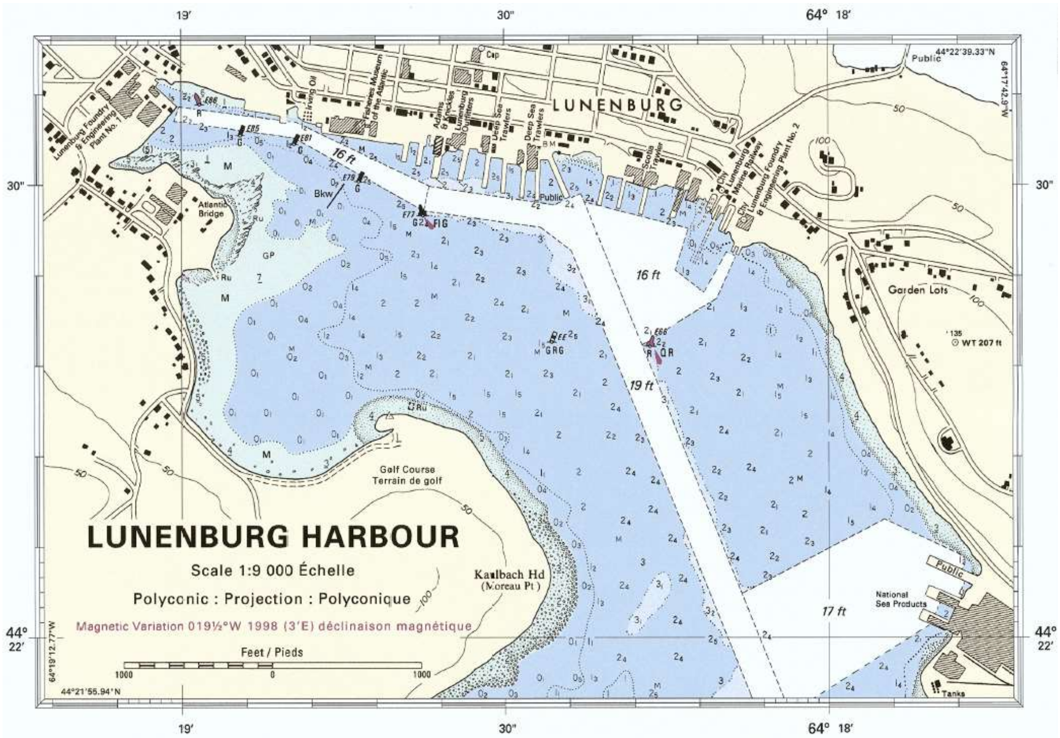


Figure 2-3: Navigation Chart, Lunenburg Harbour

2.2 Water Level Data

This hydrodynamic model is driven by changes in water level at the boundary. Water levels were derived offshore of Lunenburg Bay using the Bedford Institute of Oceanography's WebTide tidal prediction model[2]. Conversion between WebTide's output and chart datum (CD) were completed with a factor of +1.3 m, derived from the Fisheries and Oceans Canada Canadian Tide and Current Tables[3]. The first 144 hours used for model spin-up and model runs are depicted in Figure 2-4.

[2] https://www.bio.gc.ca/science/research-recherche/ocean/webtide/index-en.php
[3] https://charts.gc.ca/documents/publications/tables/TCWL_2021_Volume1.pdf

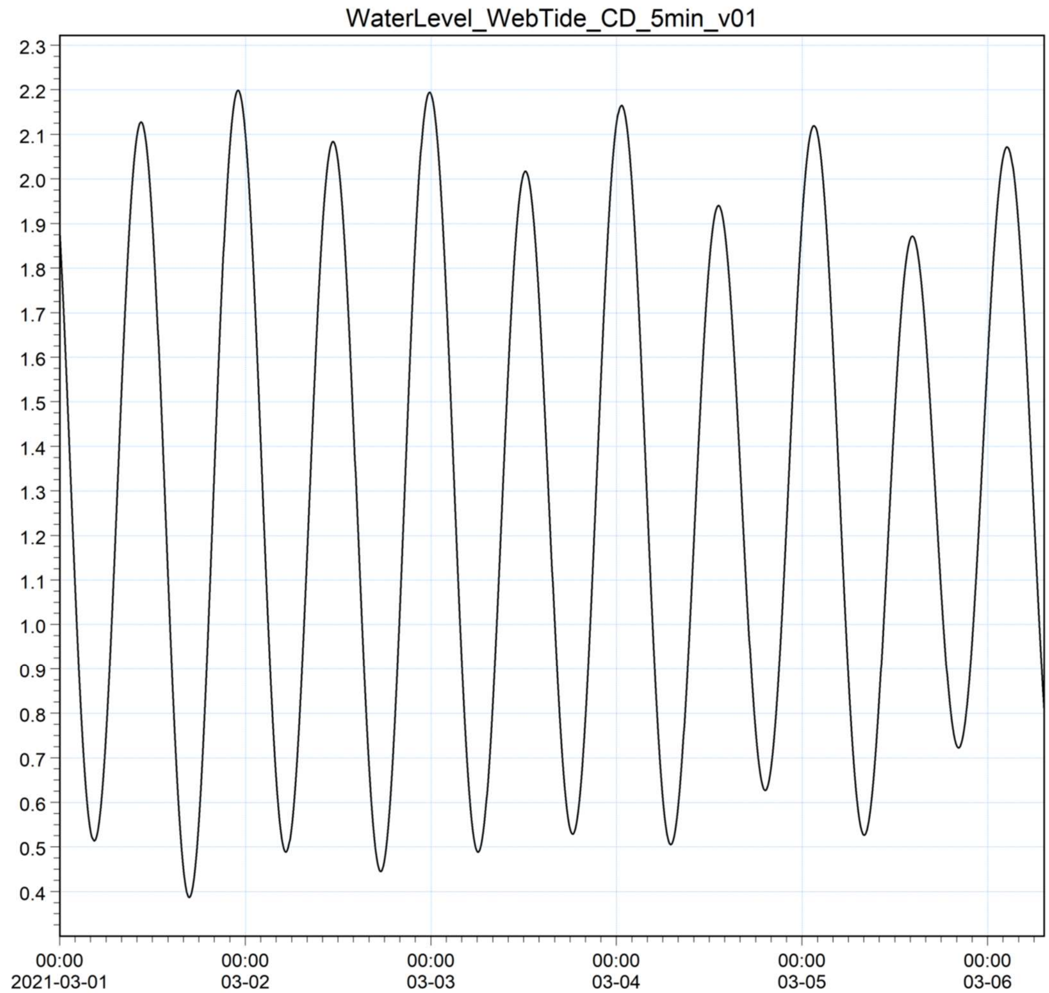


Figure 2-4: Sample Water level boundary condition (m CD) – WebTide

2.3 Assumed Outfall Flow Rates

Each of the outfalls was assumed to have the same flow rate. The assumed mean flow rate is 2,900 m^3/day, and the assumed peak flow rate is 11,360 m^3/day.

3 Far-Field Dispersion Model

This section describes the dispersion model that was used in the analysis. This information includes:

- Model description
- Computational mesh
- Interpolated bathymetry
- Model initial conditions
- Model parameters

3.1 Description of 2D Hydrodynamic Far-Field Dispersion Model

In this study we use the Danish Hydraulic Institute (DHI) 2020 model release of the MIKE 21 modelling suite. The computationally efficient MIKE 21Flexible Mesh (FM) was used for this analysis, coupling the Hydrodynamic (HD) and Transport Modules. The model was used in 2-dimensional mode (2D) with higher order algorithms for time integration and space discretization, with a CFL number of 0.8. The model was run for an initial 72-hour "spin-up" period to generate water surface elevation and current velocities that were used as initial conditions for the dispersion model.

The model simulates the following physical phenomena:

- Tidal variations in water surface elevations (not including wind effects or large-scale oceanic circulation)
- Tidal current velocities and direction.
- Far-field dispersion of conservative tracer elements – discharged from each outfall at a constant rate. The model is 2-dimensional, i.e. effluent concentrations are averaged within the model cell over the entire water column. The near-field dilution of the buoyant freshwater effluent plume in the immediate vicinity of the outfall is not resolved, which can be assessed at the detailed design of the outfall.
- Dissipation due to bottom friction (a typical bottom Manning's roughness coefficient of 0.032 was assumed)
- Dissipation due to turbulence (Smagorinsky formulation eddy type, with a minimum eddy viscosity of 1.8×10^{-6})

The MIKE21 SW model uses a triangular unstructured mesh, which has the advantage of resolving nearshore areas of interest with very high levels of detail and precision, whereas deeper offshore areas are resolved at a lower resolution. Such a model configuration is computationally more efficient, yet doesn't compromise the resolution needed for smaller scale nearshore features.

3.2 Model Limitations

Hydrodynamic models are well suited to provide nearshore design water surface elevations and current velocities, both of which are vital to modelling dispersion, which is the goal of this study. However, these models do not consider several other potential causes of dispersion, such as wind, waves or vessel traffic. Similarly, biological processes such as the decay of material is not considered. The outputs of this model represent a conservative schematization of the complex hydrodynamics of Lunenburg Harbour and is well suited to compare the relative dilution of different outfall locations, but it is not intended as a detailed analysis of precise expected concentration values.

It is best practice to calibrate numerical models to measured data. For example, when developing a model for contaminant dispersion, it is advisable to record water surface elevations for a suitable period of time and to conduct a tracer testing campaign to calibrate numerical parameters and to ensure that the model is transforming well across its domain. In this instance, due to the pre-design stage of the project, field data was not gathered for the calibration of the model. Experience with other projects in the area, and across Atlantic Canada, have shown that the application of WebTide tidal elevations as boundary conditions to the coupled HD model, using regionally tuned settings and input parameters, yields satisfactory results for the schematization of a regional hydrodynamic model used in a dispersion study of this nature. Nonetheless, it should be cautioned that more accurate results can be obtained if measured water level data over a period of several months is available at the site, along with a tracer testing campaign.

3.3 <u>Computational Mesh</u>

The computational mesh for this project is based on the flexible unstructured mesh approach. The full extent of the model domain is shown in Figure 3-1, and the detail of the mesh in the vicinity of Lunenburg Harbour is shown in Figure 3-2.

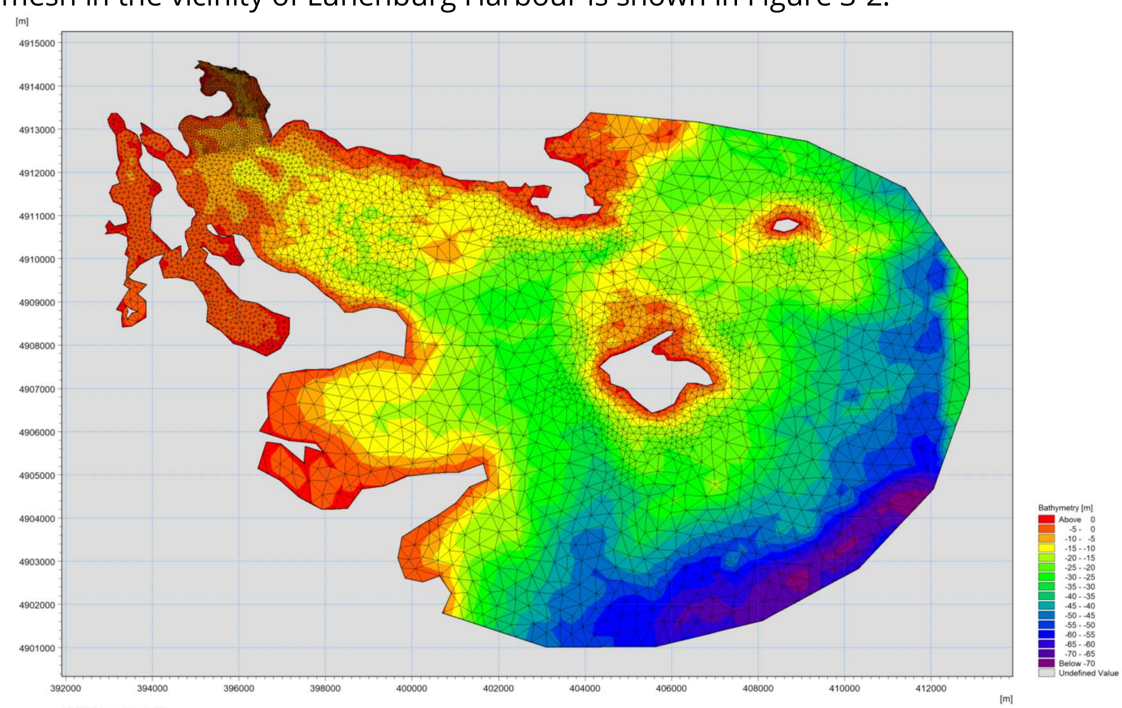


Figure 3-1: Numerical Model Interpolated Bathymetry, Model Extent

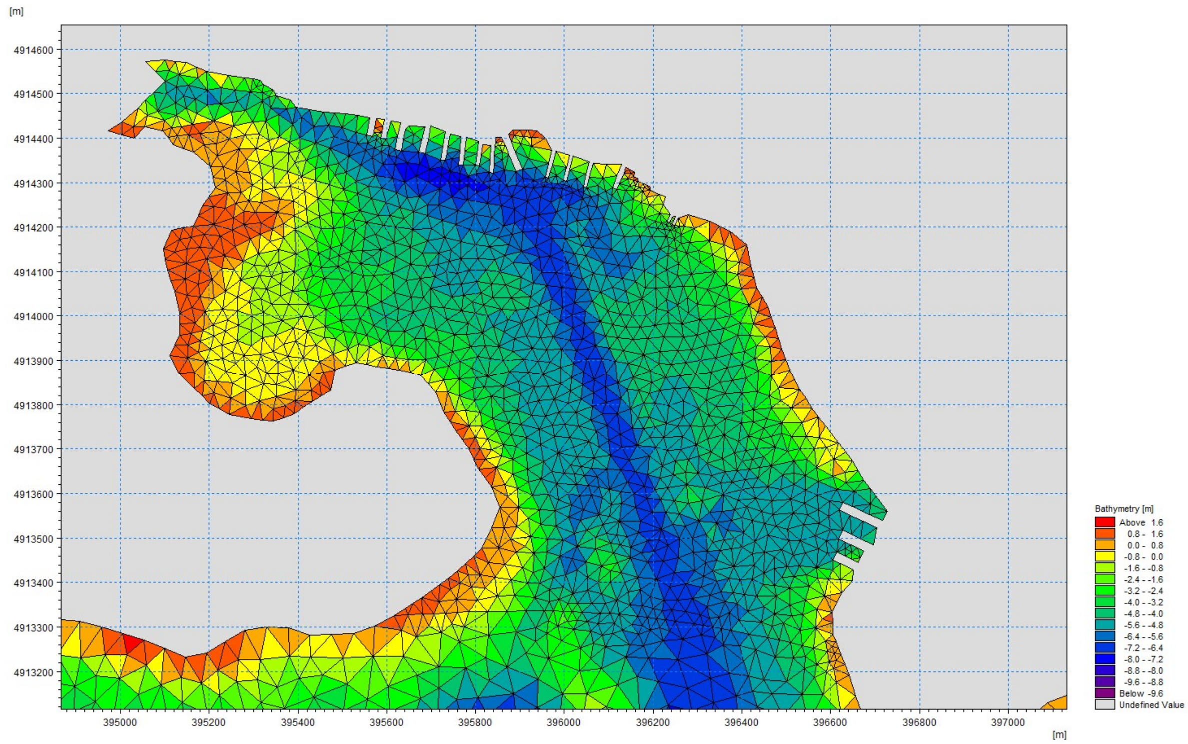


Figure 3-2: Numerical Model Interpolated Bathymetry, Lunenburg Harbour

4 Model Results

This section describes the results and output of the dispersion model. This information includes:

- Tracer concentration results after 72 hours (3 days) of model time (Figure 4-1), averaged over a 24-hour period
- Tracer concentration results after 720 hours (30 days) of model time (Figure 4-2), averaged over a 24-hour period
- Composite map of maximum tracer concentrations, showing the maximum value for each mesh element over the model run duration (Figure 4-3) and with zoomed-in detail in the harbour (Figure 4-4).

The dispersion model was run for a 720-hour period, after a spin-up time of 72 hours. Model results are depicted in the following figures. These two figures are outputs of the model after three (3) days (Figure 4-1) and thirty (30) days (Figure 4-2). To smooth out the temporal variability of modelled concentrations, the model output has been averaged over a 24-hour period. Tracer concentrations are displayed for each outfall location.

Figure 4-3 depicts the composite maximum hourly concentrations modelled at each location (the maximum concentrations do not necessarily occur simultaneously). An additional figure (Figure 4-4) is included to show detail of concentration patterns within the northwest area of Lunenburg Harbour under existing conditions. Note: this figure does not use the same colour scale as the previous figures.

These figures provide snapshots for comparison of modeled far-field dispersion patterns. Although mean outfall flow and peak outfall flow will have different total concentrations, the dispersion pattern is not expected to change between these flow regimes, as the difference in flow volume is not significant when compared with the incoming and outgoing tidal volume. Thus, the scaled modeled dispersion patterns are expected to be a valid representation of both scenarios.

4.1 Modelled Concentration Results At Each Outfall Location

4.1.1 Existing Conditions

The existing conditions show the highest concentrations of tracer within the inner harbour and relatively limited flushing to Lunenburg Bay.

4.1.2 Inner Harbour

The dispersion maps after 72 hours indicate that although the local concentrations of tracer are modelled to be slightly higher in the existing condition than the Inner Harbour scenario, the extent of the tracer plume extends to a similar distance in both cases. The 30-day model results show that the change in outflow location does not make a significant difference in modelled tracer dispersion. Therefore, the proposed inner harbour outfall location would result in dispersion patterns comparable to those from the existing outfall. Modelled concentrations of effluent within the northwest area of Lunenburg Harbour exhibit moderate local decrease.

4.1.3 East Harbour (Burma Road)

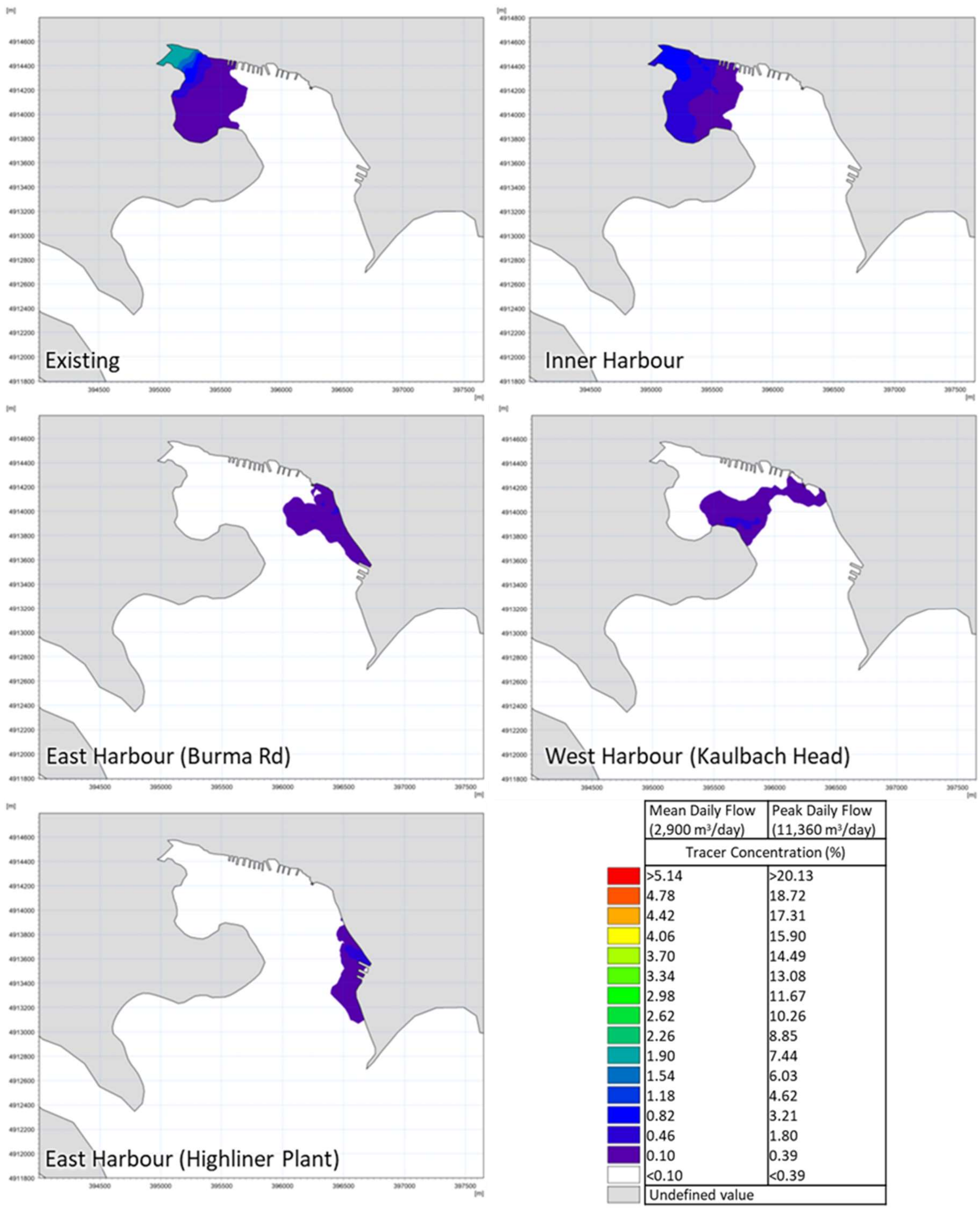
The east harbour outfall (Burma Rd) location shows significantly improved effluent dispersion when compared to the existing or inner harbour outfall locations. The dispersion at this location is also greater than the west harbour (Kaulbach Head) location. Of the modelled options, this option would represent the second best alternative and significantly greater dispersion over existing conditions.

4.1.4 West Harbour (Kaulbach Head)

The west harbour (Kaulbach Head) location is an improvement over existing conditions. Some of the effluent plume is recirculated into the inner harbour on the flood tide to a more significant degree than in either of the east harbour outfall locations.

4.1.5 East Harbour (Highliner Plant)

The east harbour (Highliner plant) location displayed the best performance in the dispersion model of the options investigated. Significantly more exchange between the vicinity of the outfall and Lunenburg Bay was modelled at this location, allowing the effluent to dilute into much larger volumes of water and disperse. This option also showed the least modelled concentration of tracer within the inner harbour itself.



Mean Daily Flow (2,900 m³/day)	Peak Daily Flow (11,360 m³/day)
Tracer Concentration (%)	
>5.14	>20.13
4.78	18.72
4.42	17.31
4.06	15.90
3.70	14.49
3.34	13.08
2.98	11.67
2.62	10.26
2.26	8.85
1.90	7.44
1.54	6.03
1.18	4.62
0.82	3.21
0.46	1.80
0.10	0.39
<0.10	<0.39
Undefined value	

Figure 4-1: Modelled initial dispersion patterns after 72 hours (3 days) of simulation time, averaged over a 24-hour period.

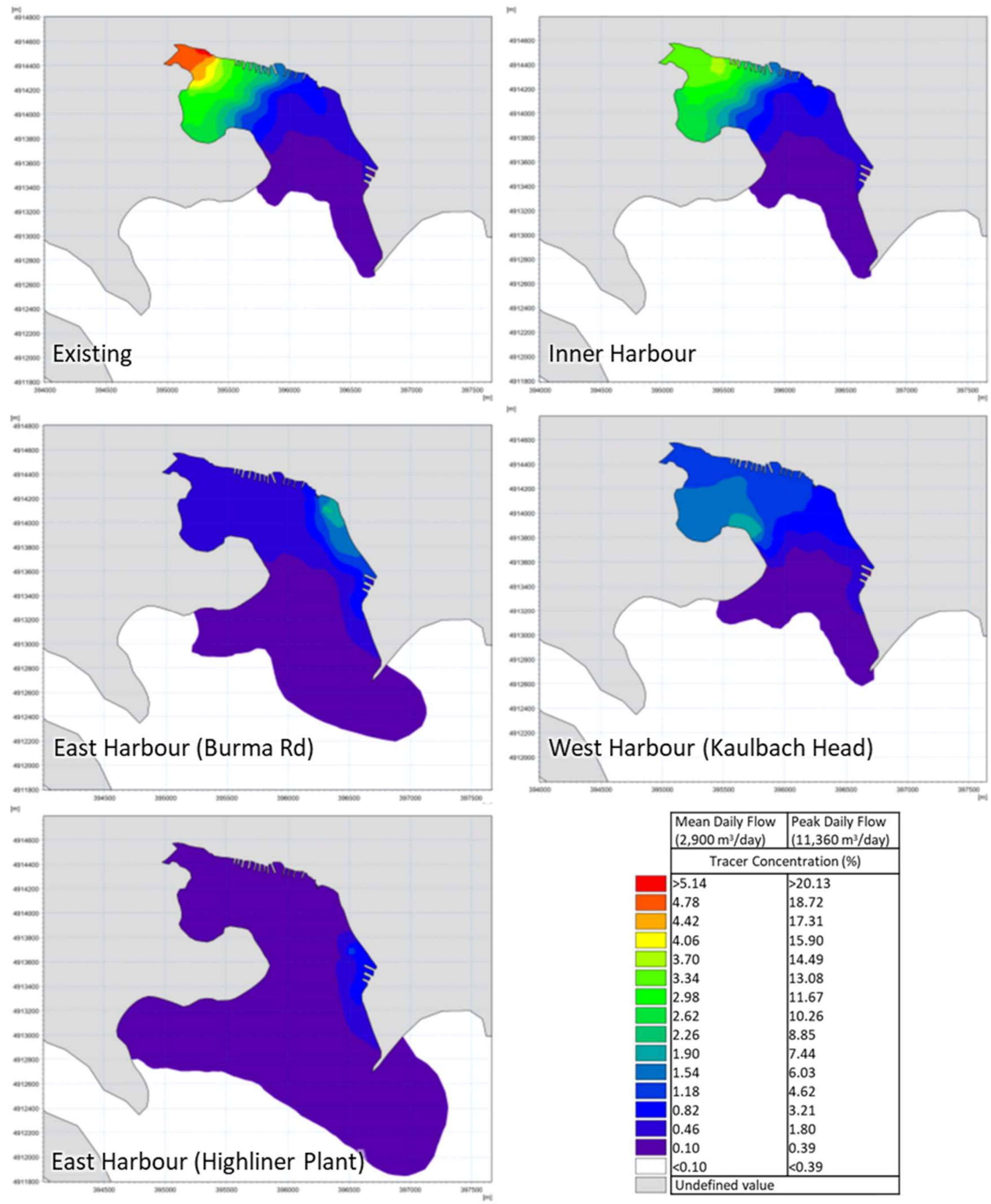


Figure 4-2: Modelled dispersion patterns after 720 hours (30 days) of simulation time, averaged over a 24-hour period.

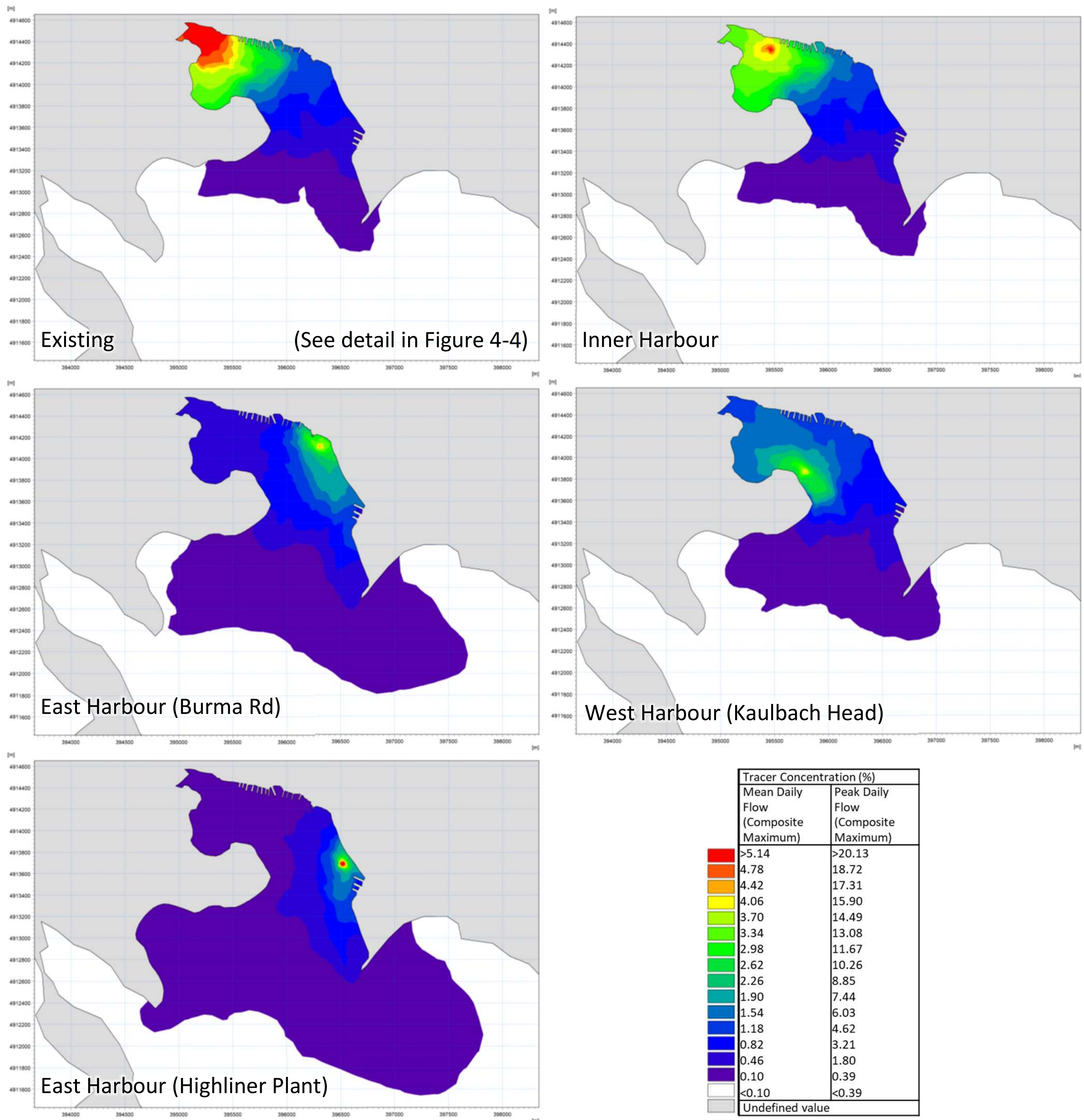


Figure 4-3: Composite image of maximum concentrations over modelled area. (Note that maximum concentrations for existing conditions exceed the colour scale– see detail in Figure 4-4)

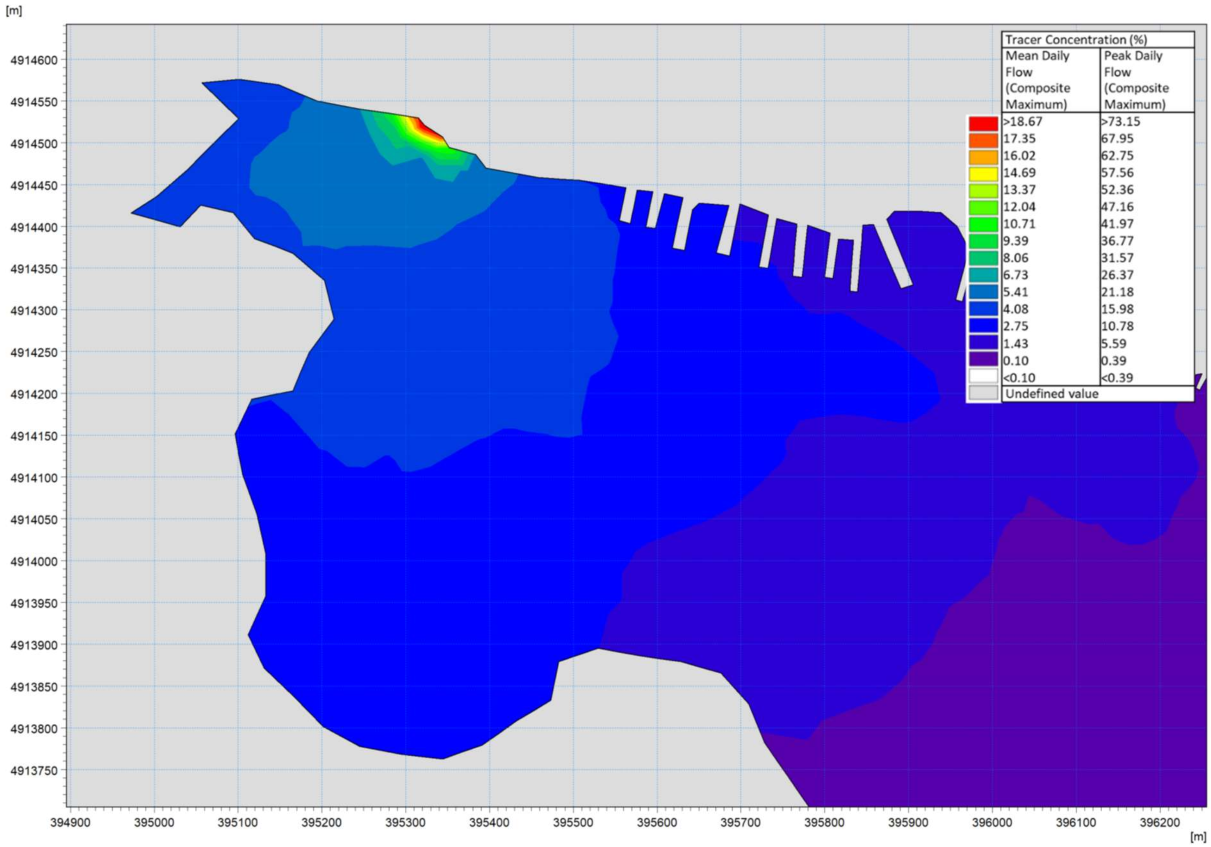


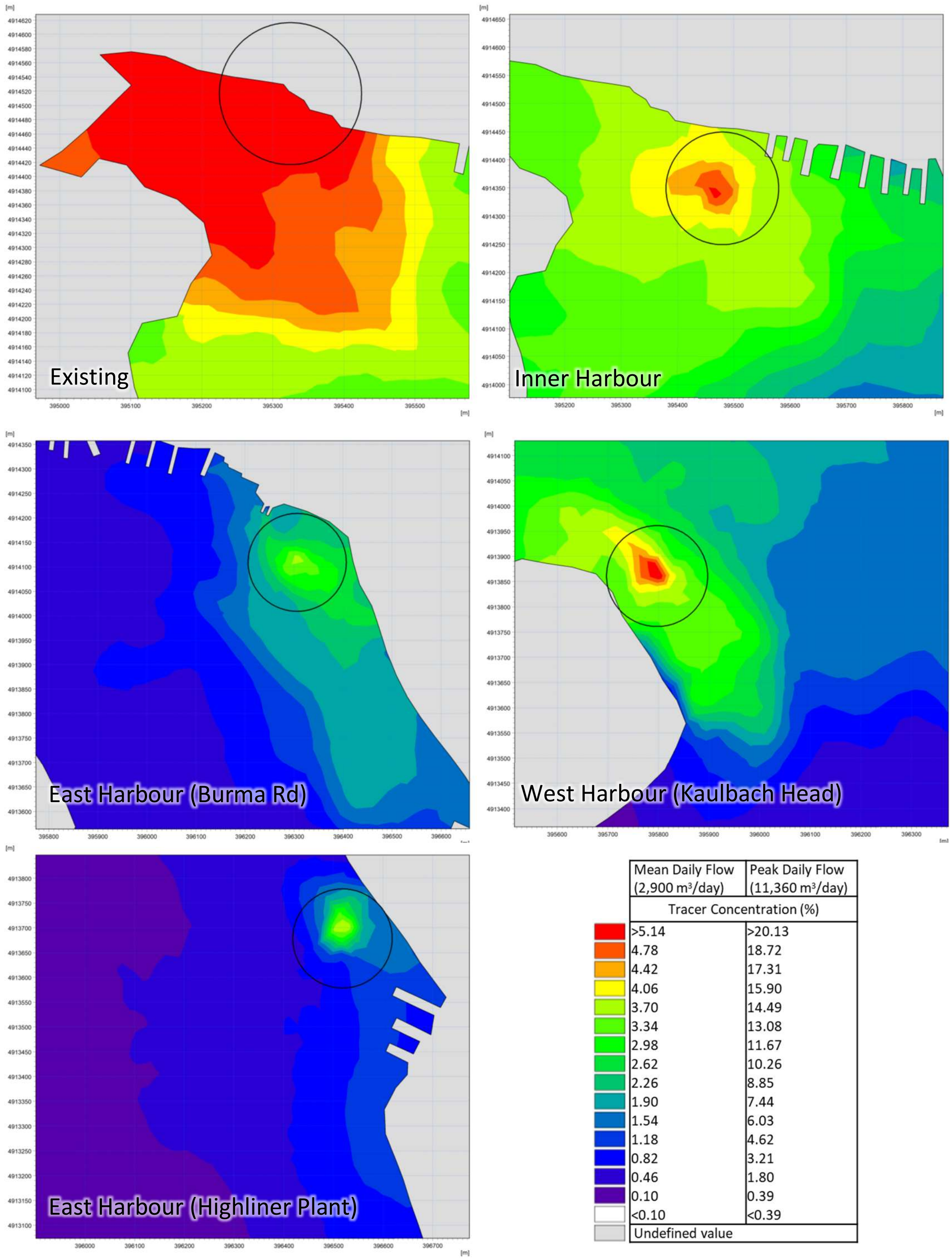
Figure 4-4: Composite image in Lunenburg Harbour of maximum concentration over modelled area (Existing conditions). Note the colour scale is greatly increased compared to other plots to show detail.

4.2 Modelled Concentrations 100 m From Each Outfall Location

After the thirty-day simulation period, the modelled effluent concentrations were estimated at a distance of 100 m from each outfall. The highest values were averaged over a 24-hr period and recorded in Table 4-1. The maximum modelled concentrations at 100 m were recorded as well. Maps depicting the two scenarios (maximum and mean concentrations) are shown in Figure 4-5 and Figure 4-6, respectively.

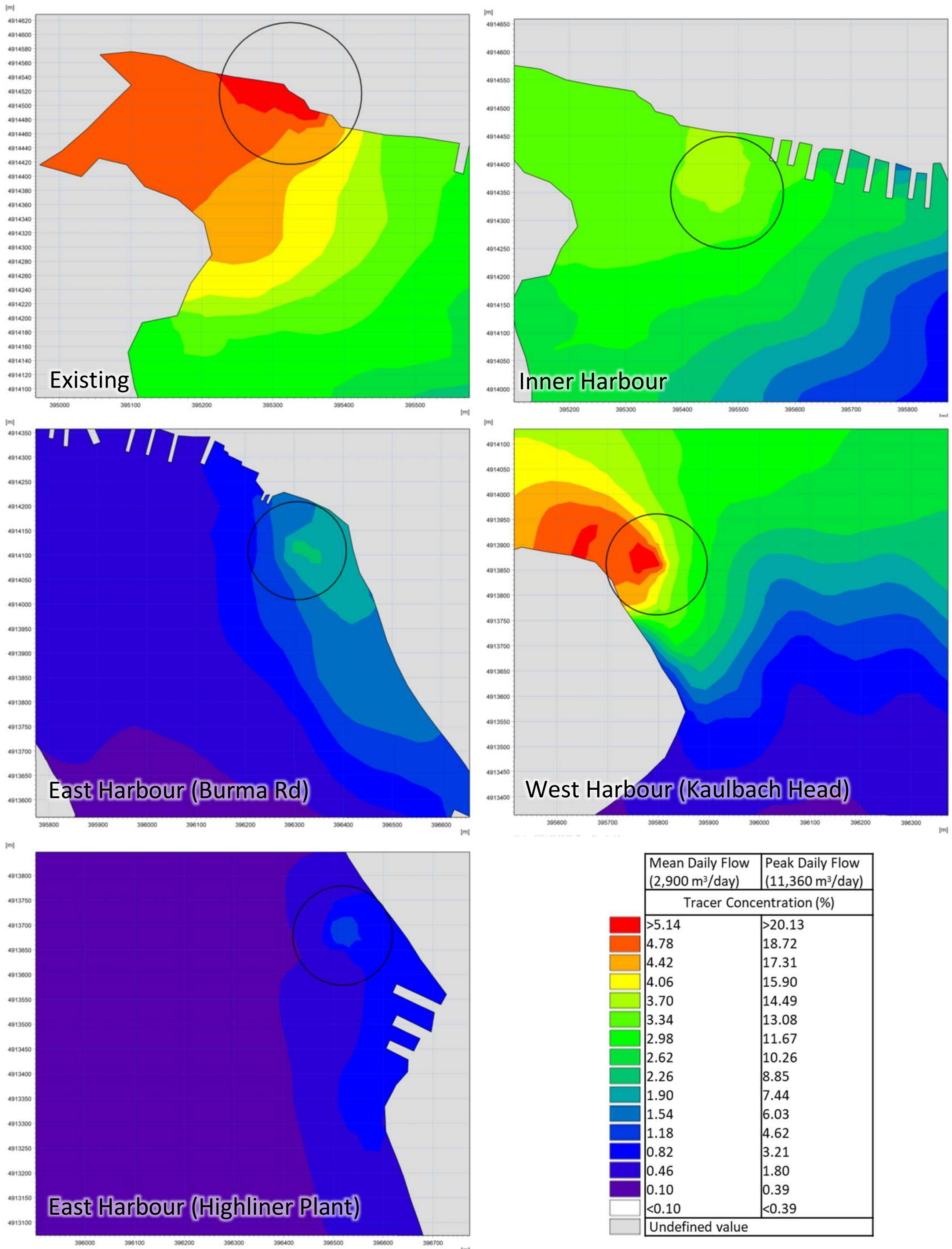
Table 4-1: Mean and maximum concentrations at a 100 m distance from each outfall, after 30 days of simulation time (Mean daily flow conditions) for mean daily flow (2,900 m^3/day)

	% Effluent Concentration After 30 Days of Simulation Time	
	Mean Concentration (Final 24 Hours of Simulation)	**Maximum Concentration**
Existing Conditions	**5.2**	**6.2**
Inner Harbour	**3.7**	**4.4**
East Harbour (Burma Road)	**2.1**	**2.9**
West Harbour (Kaulbach Head)	**2.1**	**2.9**
East Harbour (High Liner Plant)	**1.0**	**1.9**



	Mean Daily Flow (2,900 m³/day)	Peak Daily Flow (11,360 m³/day)
	Tracer Concentration (%)	
	>5.14	>20.13
	4.78	18.72
	4.42	17.31
	4.06	15.90
	3.70	14.49
	3.34	13.08
	2.98	11.67
	2.62	10.26
	2.26	8.85
	1.90	7.44
	1.54	6.03
	1.18	4.62
	0.82	3.21
	0.46	1.80
	0.10	0.39
	<0.10	<0.39
	Undefined value	

Figure 4-5: Maximum concentration values at end of 30 day simulation, averaged over 24 hours. Circles denoting 100 m radius around outfall location.



Mean Daily Flow (2,900 m³/day)	Peak Daily Flow (11,360 m³/day)
Tracer Concentration (%)	
>5.14	>20.13
4.78	18.72
4.42	17.31
4.06	15.90
3.70	14.49
3.34	13.08
2.98	11.67
2.62	10.26
2.26	8.85
1.90	7.44
1.54	6.03
1.18	4.62
0.82	3.21
0.46	1.80
0.10	0.39
<0.10	<0.39
Undefined value	

Figure 4-6: Mean concentration values at end of 30 day simulation, averaged over 24 hours. Circles denoting 100 m radius around outfall location.

5 Conclusion

Of the modelled options, the option that showed the greatest improvement in dispersion over existing conditions was the **East Harbour (Highliner Plant)** location.

The **East Harbour (Burma Rd.)** and **West Harbour (Kaulbach Head)** locations also show improvements in the model over existing conditions, with East Harbour (Burma Rd.) showing the better modelled dispersion of the two.

The **Inner Harbour** location showed only a marginal improvement in the dispersion model over existing conditions.

The model results are presented in terms of effluent concentration (%) and can be used for the following purposes:

- Comparison of outfall locations (as described above)
- Evaluation of concentrations of key water quality parameters, based on design end-of-pipe concentrations to be determined.

Yours very truly,

CBCL Limited

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APPENDIX B

Outfall Options Technical Memo

CBCL Memo

Date	2021-05-11
Memo to	Ian Tillard, P.Eng.
Project name	Town of Lunenburg Wastewater Treatment Plant & Outfall Predesign
Subject	Outfall Options (Revision B)
From	Allan MacAulay, P.Eng.
Copies to	Dennis MacPherson, P.Eng.; John Lohnes; Paul Bracken; Bea Renton; file

Introduction

The purpose of the Technical Memo is to inform and discuss the various options for the relocation of the existing sanitary outfall from its current location underneath the Inshore Fishermen's Wharf on Lunenburg Front Harbour. The objective is to find an economical route to transport the effluent from the WWTP to a safe and acceptable location.

Options Identified

An initial meeting was held at the CBCL office followed up by another meeting on March 11, 2021 with the Lunenburg Harbour Master attending. The purpose of the second meeting was to identify some outfall location options and discuss constraints. Following this meeting, six options for consideration were identified and assessed. These options are discussed below. A key plan showing the locations of the discussed options is shown on **Figure 1** for reference. Sites are not numbered in any particular order.

Figure 1: Locations summary.

Option 1- Lunenburg Back Harbour

The closest tidal water to the Lunenburg WWTP is Lunenburg Back Harbour. However, there are several key considerations for potentially discharging treated effluent to these waters. Back Harbour receives infrequent flows from two emergency overflows. The first is for the Back Harbour Pump Station (untreated and only when pump capacity is exceeded) and the second is for the Effluent Pump Station (fully treated, and again only when the capacity of the pumps is exceeded).

Depth

Atlantic Canada Wastewater Guidelines recommends a 1 m minimum submergence of an outfall pipe. The height of an outfall pipe and any diffuser nozzles off the seabed might be approximately 1 m high. Therefore, the end of any outfall pipe should be in at least 2m depth of water (at low tides). There is only a relatively small area within Back Harbour that is sufficiently deep to meet this guideline (see Figure 2). This area is much closer to the north side of the harbour than the south side (TOL side). The 2 m depth of water quoted is simply a starting point to determine limitations on where treated effluent might be dispersed. Hydrodynamic modeling may show that a greater depth is required.

Figure 2: Option 1- Red shaded areas represent areas with depths of water sufficient to terminate an outfall at as per Atlantic Canada recommendations.

Effluent Dispersion

Back Harbour is a relatively long distance (7 km) away from the Atlantic Ocean in comparison to other potential outfall locations. This sheltered harbour would be expected to have significantly less wind, current, and tidal effects thus reducing mixing and dilution capabilities.

Environmental Considerations

While the Back Harbour may presently receive effluent inputs from emergency overflows, the relocation of the WWTP outfall to this location will result in a substantial increase of effluent to this waterbody. Effects from increasing the effluent volume to this location may include changes to physical, biological and chemical characteristics of the receiving environment, such as increases to overall nitrogen, phosphorus, suspended solids, and bacteria. Further assessment of this waterbody would be required to understand the existing conditions, dispersion and flushing ability of the effluent, and potential effects of additional effluent discharge to this area.

Areas prohibited for harvesting of bivalve molluscan shellfish, such as mussels, oysters, and clams, are identified through the Canadian Shellfish Sanitation Program. The inner part of Back Harbour is currently subject to a prohibition of harvesting of bivalve molluscs. The areas where these prohibitions are in place is shown by the red areas on **Figure 3** below[1]. While there is a prohibition in the inner part of Back Harbour, outer areas are currently not subject to harvesting prohibitions. Disposing of effluent in Back Harbour, although treated and disinfected, could potentially cause restrictions to be placed on harvesting bivalve molluscs in the outer areas where no restrictions currently exist. Further assessment of effluent dispersion would be required to understand if discharge to the Back Harbour area may interact with areas of bivalve mollusc areas approved for harvesting.

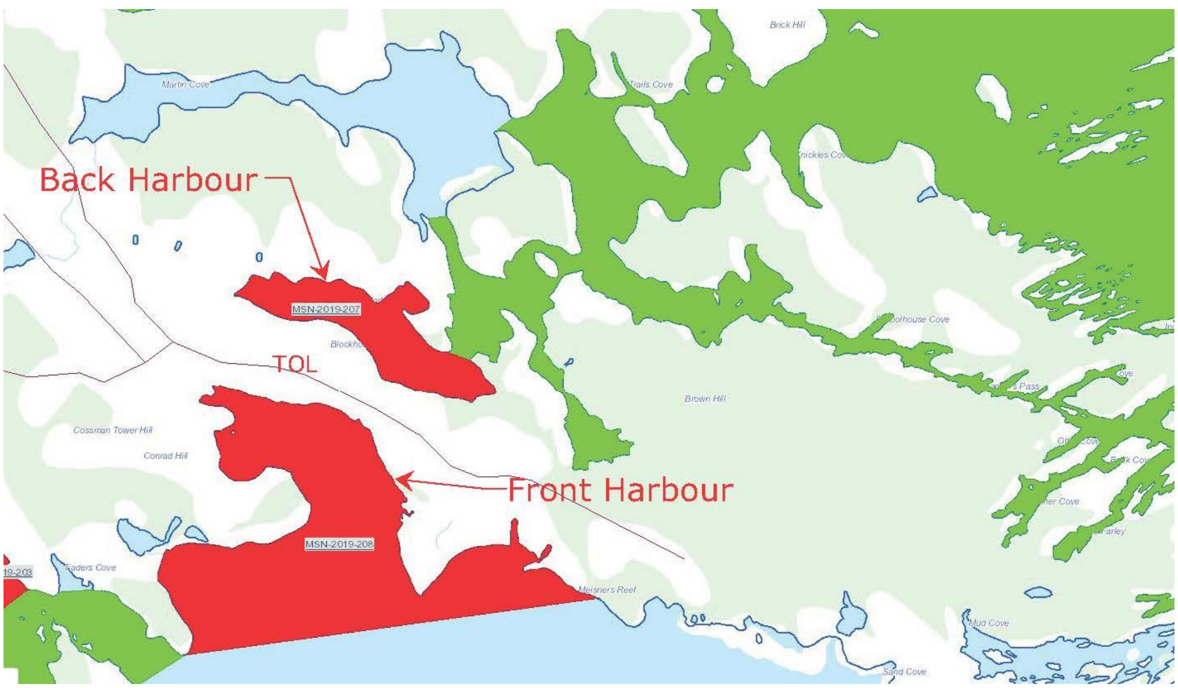


Figure 3- Bivalve Mollusc Harvesting Prohibition Zones from DFO website. Red indicates "Closed" and green indicates "Approved" (DFO. 2021[1]).

[1] DFO. 2021.SHELLI. Available:)https://gisp.dfo-mpo.gc.ca/Html5Viewer/Index.html?viewer=CSSP_Public_En_Site&locale=en

Approvals, permits, and authorizations will need to be in place prior to construction, such as under the *Environment Act*, *Canadian Navigable Waters Act*, *Fisheries Act,* and *Impact Assessment Act*.

Public Perception

As mentioned previously, the only sanitary waste Back Harbour currently receives from the TOL collection systems is from infrequent overflows caused when pump capacity is exceeded. Users and residents living along the shores of Back Harbour may react negatively to the relocation of a sanitary sewage outfall from Front Harbour to their front yards.

Option 2- Inner Front Harbour (Relocation near Existing Outfall)

This option was investigated in a report compiled for the Lunenburg Harbour Authority in Lunenburg (2014). It involved extending the current outfall from its existing location or relocating the outfall pipe from under the wharf to adjacent a vessel slipway and extending it along the harbour bottom, across the navigation channel, turning to run parallel to the navigation channel, and finally discharging at a point somewhere adjacent the navigation channel and mooring field. The report considered three different locations at varying distances along the channel **(see Figure 4)**.

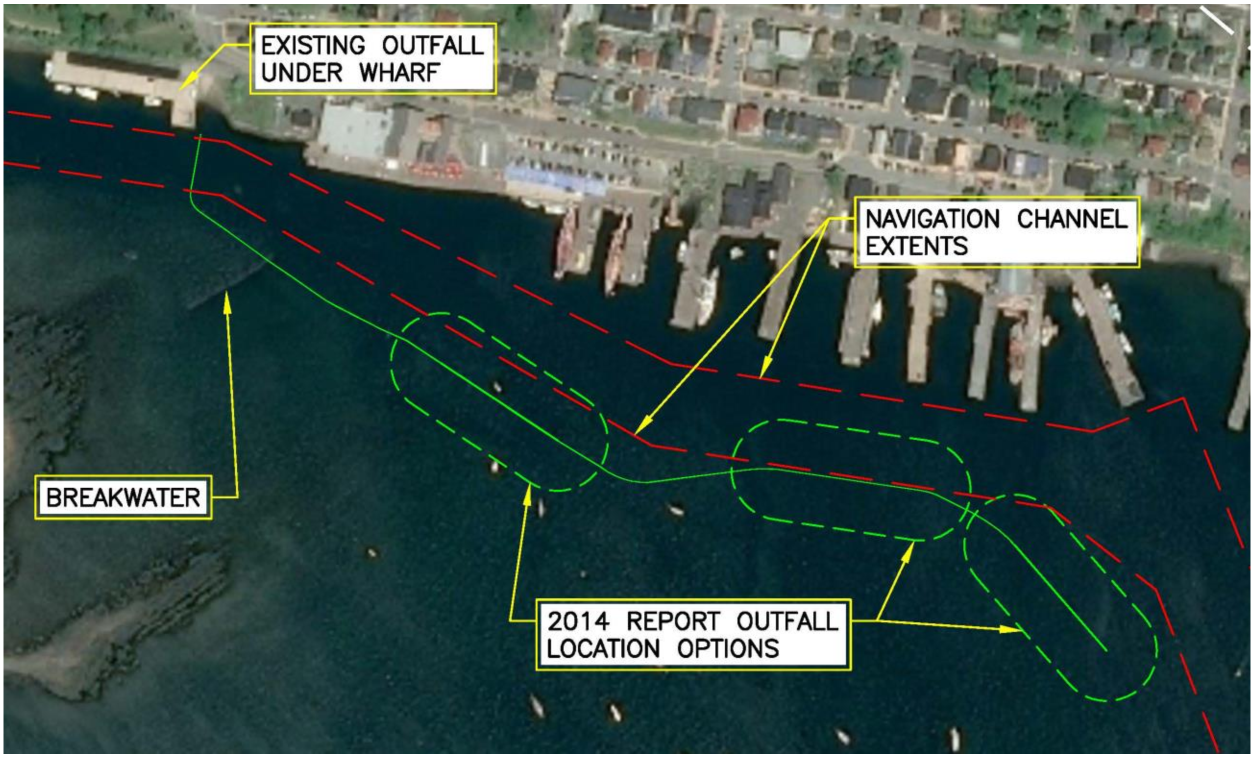


Figure 4: **Option 2**- 2014 Report options for extensions into Front Harbour near the existing outfall.

Harbour Marine Traffic

Often in storms, vessels will moor in the navigation channel off the main town wharves so as to prevent the vessels from being battered against the wharves in wind and waves. The small vessel mooring field currently operates at capacity in summer months and transient vessels visiting the harbour will often moor at the edge of the navigation channel trying to be as close to the town as possible. Having an outfall in this area presents a significant risk of being hooked by vessel anchors.

In order to reduce the risk of anchor entanglements, it would make sense to try and minimize the amount of new outfall pipe installed at this location. Perhaps the shortest option from the 2014 report or a location slightly closer to the floating breakwater may be preferable.

Effluent Dispersion

The initial conceptual dispersion model showed that there is marginal dispersion available at this location, which is not significantly better than the existing location, though it does reduce the risk of public contact with the wastewater. Please refer to the Coastal Dispersion Modelling of WWTP Outfall Locations Technical Note for details.

Navigation Channel

The typical method of construction for this option would involve laying any new pipes directly on the harbour bottom and across the navigation channel to reach the desired outfall end location. Two considerations should be taken into account with this configuration.

The first consideration would be reduction in channel depth where the extended outfall pipe would cross. A new outfall pipe with concrete collar weights attached may be in the order of 1m high off the harbour bottom. From reviewing harbour charts, the depth in this area of the navigation channel is approximately 6 m deep at Lower Low Water Large Tide (LLWLT). A depth reduction of 1 m (to 5 m overall depth over the pipe) would represent a significant decrease in navigable depth of the channel. This reduction would add restrictions to the size of vessels that could be brought to the Lunenburg Foundry & Engineering Plant No. 1, for example.

Worth noting is the amount of water that is drawn by tall ships familiar to the harbour: Bluenose II at approx. 5.0 m, Picton Castle at approx. 4.4 m, and French frigate L'Hermoine (2015 visitor) at approx. 5.8 m. Reductions in channel depth by a new outfall pipe could restrict these vessels from being in this area of the harbour. The channel is currently narrow and larger vessels are somewhat limited in their ability to manoeuvre. Reducing the overall depth of channel would make this more difficult.

The second consideration would be any future dredging activities that may take place to remove sediment build up. Flanged connections were suggested to be installed in the 2014 report on the outfall pipe on either side of the channel. This would allow the piece crossing the channel to be unbolted and removed to allow for dredging activities. This solution may not be practical as when the section of pipe is reinstalled after dredging, bolted connections may not line up as nicely as they would have during original construction. This work would have to be carried out by specialized divers who may find it difficult to re-bolt the connection. There also may be environmental concerns as when the section would be removed; sewage would outfall significantly closer to shore than intended by the design for as long as it takes to complete the dredging activities.

A way to avoid these issues may be installation by horizontal directional drilling (HDD) under the channel. This is a construction method that is further discussed in the Alternative Technologies Discussion further along in this Memo.

Infrastructure

This option may offer the solution with the least amount of infrastructure upgrades required to install a new outfall. This option requires the least amount of new piping and only some minor upgrades to the existing treated effluent pumps at the WWTP may need to be undertaken.

Environmental Considerations

This option is located within the existing receiving environment and is located closest to the existing outfall location (Figure 4). Similar to the Back Harbour, the Lunenburg Front Harbour is also subject to bivalve mollusc harvesting prohibitions (Figure 3); the existing outfall and proposed Option 2 occurs within this prohibited area.

Option 2 is located close to the existing harbour front, where historical and current commercial and industrial activities have occurred. There is a potential to encounter contaminated materials during construction. For example, the property adjacent to the vessel slipway where a relocated outfall would enter the harbour is currently owned by Public Services and Procurement Canada (PSPC). It is understood that this was also the location of a former fuel storage depot. On a site visit (March 11, 2021) it was noted that there were soil environmental remediation activities underway on this property-presumably for hydrocarbon contamination. These remedial activities may limit the amount of work or infrastructure that could be installed underground as part of an outfall relocation to this location.

As mentioned in the previous paragraph, the property where a relocated outfall would enter the harbour is currently owned by Public Services and Procurement Canada (PSPC). Agreements may be required with landowners, where TOL does not own the lands or waterlots in order to extend an outfall into the harbour at this location.

Approvals, permits and authorizations will need to be in place prior to construction, such as under the *Environment Act, Canadian Navigable Waters Act, Fisheries Act,* and *Impact Assessment Act.*

Option 3- East Side of Front Harbour (Burma Road)

This location is on the east side of Front Harbour at the boundary between the TOL and the Municipality of the District of Lunenburg (MODL). Access to the harbour is via a "Local Common" (Burma Road) from Blue Rocks Rd. The MODL is owner of a water lot which extends out into Front Harbour.

New Infrastructure

Treated effluent would have to be pumped from the WWTP to this location through a new forcemain. The Bay to Bay Trail right-of-way may be a potential route a new forcemain could follow. Starting at the WWTP and after following the trail right-of-way for approximately 2 km, the forcemain route would connect to Blue Rocks Rd and then onto Burma Road where it would outfall into Front Harbour. The total length of new forcemain required would be approximately 2.5 km.

The majority of the route would be along the Bay to Bay Trail portion which is owned by TOL but after leaving the town limits would be on portions own by the provincial Department of Lands and Forestry and road rights-of-way within MODL. Agreements may be required where TOL does not own the lands or water lots.

Upgrades of the existing treated effluent pumps at the WWTP would likely need to be undertaken in this option as the overall length of forcemain is approximately 3x longer than the current treated effluent forcemain and the topography over which the new forcemain would travel is slightly higher (approx. 10 m higher at the highest point).

Effluent Dispersion

From reviewing harbour bathymetry, there appears to be sufficient depth relatively close to shore to allow for new outfall installations. Given its central location within Front Harbour and exposure to wind and wave action from the Atlantic Ocean to the southwest, there appears to be good potential for hydrodynamic mixing and dispersion actions, which modelling will confirm. The initial conceptual dispersion model showed that there is good dispersion available at this location, which is significantly better than the existing location, reduces the risk of public contact with the wastewater, and reduces effluent concentrations in the Inner Harbour area. Please refer to the Coastal Dispersion Modelling of WWTP Outfall Locations Technical Note for details.

Existing Sanitary Sewerage Infrastructure

The location is currently home to sanitary sewage pumping infrastructure. There is a pump station which collects untreated sanitary sewage from the eastern-most parts of TOL and pumps sewage towards the WWTP. There is an overflow from this pump station that discharges sewage at the shoreline if the pump station exceeds its pumping capacity. TOL also stated that there are several "straight pipes" which discharge sanitary waste from the homes outside TOL limits along the harbour in this area.

Harbour Marine Traffic

This location is relatively far from current harbour activities (mooring field and main navigation channels) and even though adjacent to the Lunenburg Foundry and Engineering Plant No. 2 property, the location appears to be away from areas where ships would pull up to the Plant (the marine railway slips).

Harbour Authority staff stated that the existing mooring field in the western part of the harbour is currently operating at capacity and that locations along the eastern portions of the harbour may serve as future mooring fields. Considerations can be given to ensure that any new outfall placed far enough away from proposed moorings, at sufficient depth, and clearly marked to avoid entanglements.

Environmental Considerations

This option is located within the existing receiving environment (Front Harbour), east of the existing outfall and east of the active waterfront area (commercial and industrial). Option 3 is also located in the area already subject to bivalve mollusc harvesting prohibitions (Figure 3).

Approvals, permits and authorizations will need to be in place prior to construction, such as *Environment Act, Canadian Navigable Waters Act*, and *Fisheries Act*.

Option 4- East Side of Front Harbour (Shore Rd near High Liner Foods Facility)

A secondary outfall point option along the east side of Front Harbour to that of Burma Rd may be a location just to the north of the seafood plant. A new treated effluent forcemain route would follow a similar route to that of Option 3 except that from the Blue Rocks Road, it would travel 500 m along the Shore Rd right-of-way (including a currently unmaintained section of the right-of-way) before accessing Front Harbour through a "Common". Agreements may be required where TOL does not owns the lands or waterlots.

High Liner Seafood Plant

While a new forcemain route wouldn't pass thorough nor a new outfall be on High Liner Foods property or water lots, there may be a need to consult with this major harbour stakeholder. The proposed outfall location shown is close to the plant. There may be a negative response because of the perception of making a situation better for one fishing facility (the existing wharf in TOL) and making things seemingly worse for another (High Liner Foods).

New Infrastructure

The route is slightly longer than in Option 3 at approximately 3 km total. Upgrades of the existing treated effluent pumps at the WWTP would likely need to be undertaken in this option as well.

Harbour Marine Traffic

The location is away from current harbour activities (mooring field and main navigation channels). However, it is near a dredged area providing marine access to the High Liner Foods Facility.

Effluent Dispersion

There appears to be sufficient depth relatively close to shore to allow for any new outfall installations. The initial conceptual dispersion model showed that there is very good dispersion available at this location, which is significantly better than the existing location, reduces the risk of public contact with the wastewater, and reduces effluent concentrations in the Inner Harbour area. Please refer to the Coastal Dispersion Modelling of WWTP Outfall Locations Technical Note for details.

Environmental Considerations

This option is located within the existing receiving environment (Front Harbour), east of the active waterfront area (commercial and industrial), north of the High Liner Foods Facility, and further from the urban centre. Option 4 is also located with the area already subject to bivalve mollusc harvesting prohibitions (Figure 3).

Approvals, permits and authorizations will need to be in place prior to construction, such as *Environment Act, Canadian Navigable Waters Act,* and *Fisheries Act*.

Option 5- Lunenburg Bay (Battery Point Beach)

This option involves piping treated effluent in a new forcemain to the waters of Lunenburg Bay just offshore of a beach behind the Highliner Seafood Plant.

New Infrastructure

The Bay to Bay Trail right-of-way may be a potential route a new forcemain could follow. The new forcemain would follow the trail right-of-way for approximately 3 km before coming onto the Battery Point Rd. It would proceed along Battery Point Rd to the High Liner Foods Facility before turning south east and passing through private property before entering Lunenburg Bay at Battery Point Beach. The portion of private property in question is owned by High Liner Foods and the TOL would likely have to procure an easement for a new forcemain route through this property (as with any other property they do not own).

The total length of new forcemain would be approximately 3.7 km which represents the longest of all options. With the additional length of the new forcemain as well as passing over higher topography, upgrades of the existing treated effluent pumps at the WWTP would likely need to be undertaken in this option.

Environmental Considerations

The Option 5 is also located with the area subject to bivalve mollusc harvesting prohibitions (Figure 3)- near the eastern edge of the zone. The relocation of the outfall may result in the expansion of the mapped prohibited area of bivalve harvesting. There is also an extensive, approximately 18.1 ha, salt marsh wetland adjacent the potential route near Battery Point Beach. Working in the vicinity of this feature may bring extensive or even prohibitive risks for construction.

Approvals, permits and authorizations will need to be in place prior to construction, such as *Environment Act*, *Canadian Navigable Waters Act*, *Fisheries Act*, Impact Assessment Act, and the Crown Lands Act. If the proposed alignment for the new forcemain is suspected to intersect with identified wetlands, additional environmental surveys, approvals, and offsetting would be required for alteration of the salt marsh. If the proposed alignment were to result in the alteration of more than 2 ha of the wetland, this option may also result in the need for a Class 1 environmental assessment pursuant to the *Environment Act*. As well, the additional armour stone required for the installation of this option may result in additional in water impacts, and potentially the need for offsetting, pursuant to the Fisheries Act.

Public Perception

This area currently receives no direct sanitary sewage flows from the TOL. Users and residents living in this area may react negatively to the relocation of a sanitary sewage outfall from Front Harbour.

Having an outfall at this beach may limit some recreational uses of the area.

Site Exposure

The beach fronts along Lunenburg Bay in less sheltered waters than that of the harbour. Any outfall installed in this location would likely require significant amounts of large armour stone in order to protect it from the effects of storms.

Option 6- West Side of Front Harbour (Kaulbach Head/Golf course area)

This option would have the outfall installed closer to the mouth of Front Harbour in an attempt to optimize hydrodynamic mixing and separation distance from the majority of vessel traffic and mooring, as well as the main tourist attractions on the Lunenburg waterfront. The outfall would be on the southern fringe of the mooring field. There appear to be a few scattered moorings in this area just off the shore.

New Infrastructure

The presumed route of a new forcemain would connect to the existing treated effluent forcemain at the Starr St/Lincoln St intersection, then travel along Falkland St and Tannery Rd, then follow the shoreline of the Bluenose Golf Club before coming to a new outfall location just off shore of the eastern side of the course.

This route does present several complications in that the majority of the route is along paved town streets with underground municipal infrastructure. Design and construction could be complicated as a new forcemain would have to thread through all other underground infrastructure and reinstatement of paved streets would need to be undertaken. A significant portion also passes through the Bluenose Golf Club (private property).

Reinstatement of areas affected by construction on the golf course property may also prove to be equally challenging as the work would likely have to be completed to golf course standards. The TOL would likely have to procure an easement for a new forcemain route through this property (as with any other property they do not own).

The overall route is approximately 1.75 km long between Starr St and the outfall location at the golf course. As was noted in the Burma Road option, upgrades of the existing treated effluent pumps at the WWTP would likely need to be undertaken in this option.

Site Exposure

The initial conceptual dispersion model showed that there is good dispersion available at this location, which is significantly better than the existing location, reduces the risk of public contact with the wastewater, and reduces effluent concentrations in the Inner Harbour area, though not as much as Option 3 (Burma Rd.) or Option 4 (High Liner). Tidal patterns at the Option 6 site tend to allow effluent concentrations to be pulled back into the inner harbour instead of tending to be flushed out that is evident in Option 3 and 4. Please refer to the Coastal Dispersion Modelling of WWTP Outfall Locations Technical Note for details.

Environmental Considerations

Option 6 involves relocation to the opposite side of Lunenburg Harbour. This option is still located with the area subject to bivalve mollusc harvesting prohibitions (Figure 3).

Approvals, permits and authorizations will need to be in place prior to construction, such as *Environment Act*, *Canadian Navigable Waters Act*, and *Fisheries Act*.

Alternative Technologies Discussion

Sewage Holding Tank with Existing Outfall Configuration

The question was raised whether treated effluent could be held in a surge tank and not be released into the harbour until the tide was on its way out. Lunenburg Front Harbour experiences a semi-diurnal tidal pattern (two high tides and two low tides per day) meaning there is approximately 6 hours between high tides and low tides. The effluent would only be released on a falling tide. As such, any tank would have to be large enough to accommodate storage of effluent flows for 6 hours at a time. Existing peak flows at the WWTP are approximately 3 million US gallons per day. It would be reasonable to assume that this flow rate could potentially be sustained for 6 hours in a given day. At this flow rate for 6 hours, a volume of 750,000 US gallons would accumulate (2840 m^3). Assuming an internal height of 2.5 m and 0.6 m thick reinforced concrete walls, the footprint required would be 1136 m^2. Figure 5 below shows the outline of such a structure.

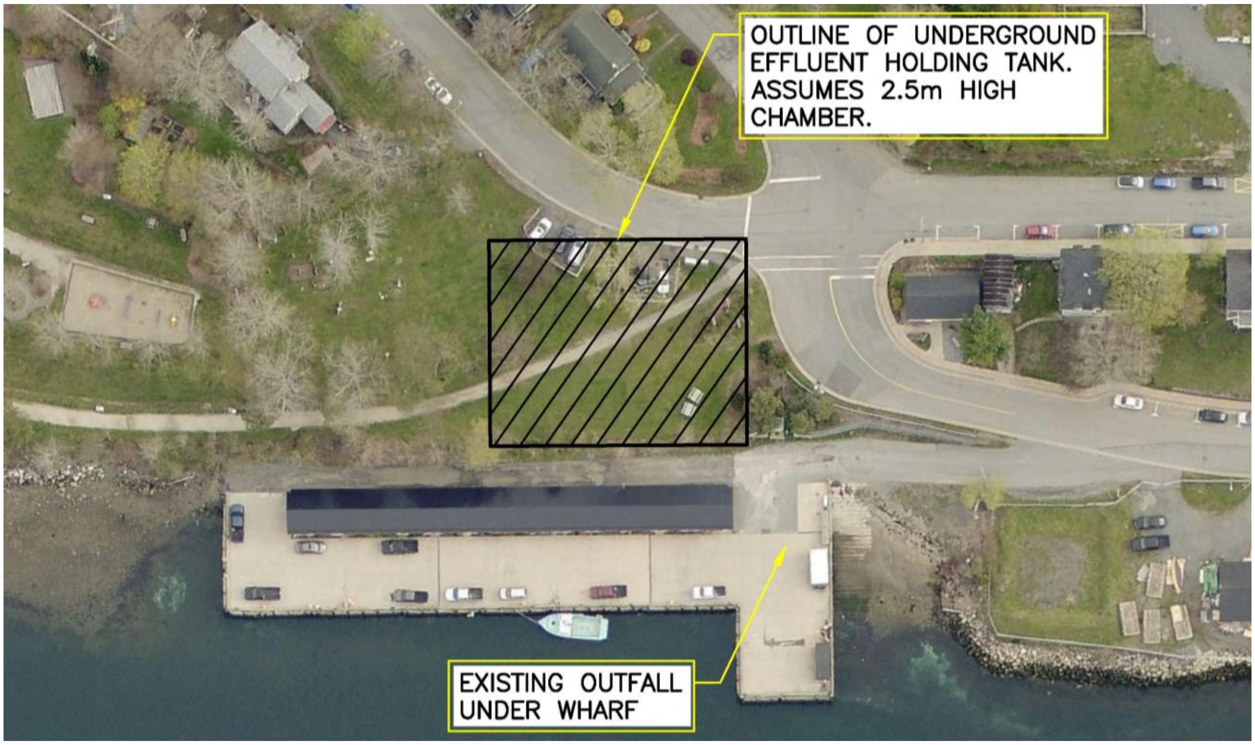


Figure 5- Required sewage holding tank footprint

Given the size of the structure required versus the amount of space available near the existing outfall, this solution is likely not practical.

Tunneling Technology

TOL highlighted that they had been approached by an individual who has equipment and experience with underground tunneling who was keen to undertake any work the Town may need. It is understood that this equipment can create tunnels in the 6 ft diameter range and greater. It is not expected that this technology would be suitable for the construction of a new outfall as the expected diameters would be in the range of only 1 ft to 2 ft (0.3 m to 0.6 m).

Horizontal Directional Drilling (HDD)

The installation of outfall pipe by this method would mean that the outfall pipe would be drilled beneath the harbour bottom until a suitable discharge point is reached. This would mean minimal amounts of pipe installed directly on the harbour bottom thus reducing potential risks to harbour users. This method would allow an outfall to be discharged at any point in the harbour. Installing a new outfall pipe in this manner may require specialized HDD contractors as the typical method of installed pipe by HDD methods involves drilling a pipe between two dry pits situated on land.

A significant amount of planning would be required to determine the viability of such an application including extensive geotechnical investigations with a marine borehole program to determine the geology underlying the harbour.

However, if hydrodynamic mixing models show that required mixing can be achieved relatively close to shore somewhere along the harbour, this installation method may not be economical or necessary.

There may be some financial risk associated with this method. If, during installation, unknown geologic conditions are encountered which prevent complete installation of the pipe to the desired location, the installed pipe may have to be abandoned and another installation attempt made. TOL may be obligated to reimburse contractors for the attempted installation. If TOL wished to transfer that risk to contractors for example, transferring that risk may bring a higher up-front financial burden to TOL in the form of higher priced tenders received from contractors.

Conclusions and Recommendations

From the previously discussed considerations in this memo, we can summarize and make recommendations. Recommendations on each new outfall location option and alternative technology are listed below.

Location Options

Option 1 Lunenburg Back Harbour- This option is **not recommended**. The shallow depths present in Back Harbour and distance from the ocean are not conducive to effluent dispersion. There is a significant risk of garnering negative public reactions and the option runs the risk of imposing shellfish harvesting restrictions in the outer reaches of Back Harbour.

Option 2 Inner Front Harbour- This option is **not recommended**. This option poses the risk of being damaged by harbour activities or limiting harbour activities. Effluent dispersion does not appear to be significantly better than the current outfall configuration (refer to the Coastal Dispersion Modelling of WWTP Outfall Locations Technical Note for details). There is also risk of encountering contaminated materials during construction.

Option 3 East Side Front Harbour (Burma Road)- This option is **recommended**. Effluent **dispersion is significantly better** than the current outfall configuration (refer to the Coastal Dispersion Modelling of WWTP Outfall Locations Technical Note for details). Access to this site is through Municipally owned Rights-of-way and government owned properties including a waterlot (with the exception of one property listed as a "Common" whose title should be confirmed).

Option 4 East Side Front Harbour (Shore Road)- This option is **recommended**. Effluent **dispersion is significantly better** than the current outfall configuration (refer to the Coastal Dispersion Modelling of WWTP Outfall Locations Technical Note for details). Access to this site is through Municipally owned Rights-of-way and government owned properties (with the exception of one property listed as a "Common" whose title should be confirmed).

Option 5 Lunenburg Bay (Battery Point Beach)- This option is **not recommended**. This location is the furthest option from the WWTP. It is also in the vicinity of an extensive salt marsh which may bring extensive or even prohibitive risks for construction. Public perception could be negative as this area currently receives no direct sanitary sewage flows from the TOL and may limit some recreational uses of the area. Easements from private property owners would need to be negotiated.

Option 6 Lunenburg Front Harbour (Kaulbach Head)- This option is **not recommended** despite having effluent dispersion significantly better than the existing outfall location. It is slightly less effective than the effluent dispersion of Option 3 due to tidal patterns. Piping effluent to this location would prove challenging having to be routed along existing paved streets and around existing buried infrastructure which would prove costly in construction. Easements from private property owners would need to be negotiated.

Kepner-Tregoe Decision Analysis

After a draft version of this memo was prepared, Options 1 through 6 were analyzed and ranked using the Kepner-Tregoe method. This process considers various “Musts” and “Wants” relating to the overall project objective. The “Musts” considered for this project were:

- No interference to marine traffic
- Meets minimum water depth requirements for effluent dispersion
- Does not expand bi-valve mollusc harvesting prohibition zones
- Addresses perceived issues of odor/residue along Public/Commercial Waterfront

If a particular Option did not meet a “Must”, it was not considered further in the decision process. Based on this, Options 3, 4, 5, and 6 were carried forward for ranking and scoring based on project “Wants”. Examples of “wants” included such things as:

- Odor/residue minimization
- Best effluent dispersion
- Environmental impact minimization
- Cost minimization
- Minimization of construction/maintenance safety hazards
- And several others

The ”Wants” were weighted and scored. Weighted scores were totaled to determine the overall score for each option. The final ranking of the options was:

1. Option 4 1099 Points
2. Option 3 1089 Points
3. Option 5 754 Points
4. Option 6 701 Points

This decision-making process helped to confirm the recommendations made (i.e. Option 3 and 4 should proceed to the pre-design stage).

Alternative Technologies

Sewage Holding Tank- This is **not recommended**. Given the size of the structure required versus the amount of space available near the existing outfall, this solution is likely not practical. This configuration does not address issues relating to effluent dispersion within in inner harbour either.

Tunneling- This is **not recommended** given the size of the outfall pipe required versus the significantly larger sized tunnels this type of technology constructs.

Horizontal Directional Drilling- This technology is most often employed when traditional methods of installing pipes via open excavations proves more difficult or costly. The locations we have recommended as discharge points for the treated effluent currently show no restrictive conditions which might warrant use of this technology. As such, **it does not appear that this technology is required for this project.**

If you wish to discuss any aspect of this memo, or if you require any additional information, please do not hesitate to contact us at any time.

Yours very truly,

CBCL Limited

Prepared by:
Allan MacAulay, P.Eng.
Civil Engineer

Reviewed by:
Sarah Ensslin, P.Eng.
Process Engineer

APPENDIX C

Plan and Profile Drawings

Project No. 210803.01

TOWN OF LUNENBURG

WASTEWATER TREATMENT PLANT AND OUTFALL PRE-DESIGN

Client Contract No. TOL2021001

ISSUED WITH
DRAFT REPORT
JULY 2, 2021

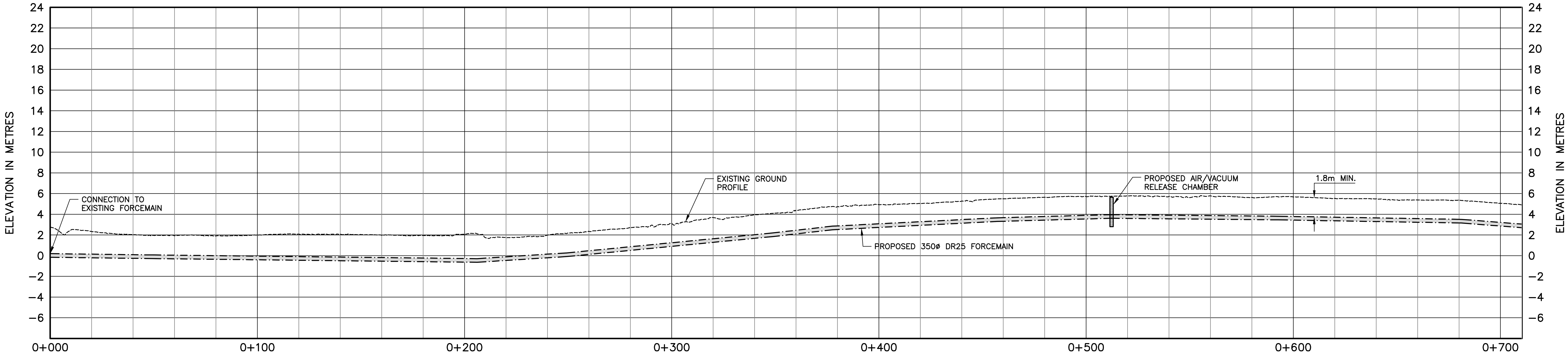
LEGEND:

- PROPOSED FORCEMAIN
- PROPOSED GRAVITY SEWER
- PROPERTY LINE (APPROX.)
- PROPOSED MANHOLE
- PROPOSED VALVE

NOTES:

1. GROUND SURFACE ELEVATIONS DERIVED FROM LIDAR PUBLISHED BY NS PROVINCIAL GOVERNMENT.
2. ELEVATIONS ARE REFERENCED TO CGVD_2013.
3. BATHYMETRIC DATA OBTAINED FROM CANADIAN HYDROGRAPHIC SERVICE NONNA DATA PORTAL. DATA CONVERTED TO CGVD_2013.
4. CGVD_2013 / CHART DATUM SEPARATION AT LUNENBURG −1.8m

CHART	CGVD_2013
4m	2m
2m	0m
0m	−2m
−2m	−4m
−4m	−6m



PROFILE– PROPOSED OUTFALL
HORZ. 1:1000 VERT 1:200

PLAN– PROPOSED OUTFALL
1:1000

No.	Description	Date	By
A	ISSUED WITH DRAFT REPORT	JUL 2/21	SE

Revision or Issue

TOWN OF LUNENBURG

WASTEWATER TREATMENT PLANT & OUTFALL PRE-DESIGN

CIVIL

PROPOSED OUTFALL ROUTE (OPTION 3 AND 4)

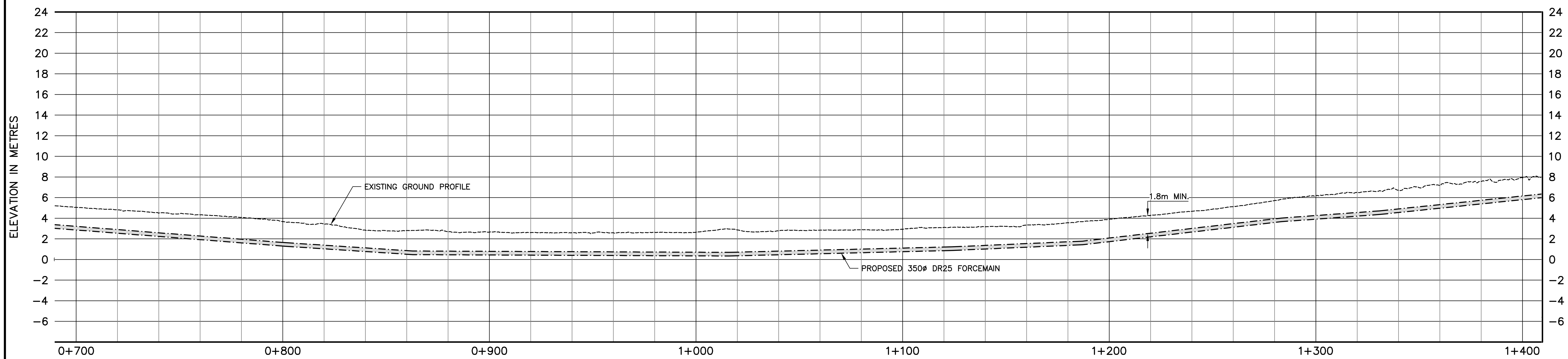
STA 0+000 TO 0+700

CBCL

CBCL No 210803.01	Contract No -
Date MAY 2021	Scale AS NOTED
Designed AMA	Drawn AMA
Checked KM	Approved SE
Sheet No 2 of 7	
Drawing No C01	

DRAWING NAME: Y:\HALIFAX\DATA\PROJECTS\210803.01 TOL WWTP & OUTFALL PREDESIGN AND BCA\44 CAD\01 CIVIL\02 WORKING FILES\02 DESIGN FILES\OUTFALL ROUTING\OUTFALL OPTION 3 AND 4.DWG LAYOUT NAME: C01 PLOT DATE: July 2, 2021 10:16:47 AM CAD OPERATOR: AMACAULAY

CBCL-610x914 TITLE SHEET (ARCH D)



PROFILE– PROPOSED OUTFALL
HORZ. 1:1000 VERT 1:200

PLAN– PROPOSED OUTFALL
1:1000

LEGEND:

- PROPOSED FORCEMAIN
- PROPOSED GRAVITY SEWER
- PROPERTY LINE (APPROX.)
- PROPOSED MANHOLE
- PROPOSED VALVE

NOTES:

1. GROUND SURFACE ELEVATIONS DERIVED FROM LIDAR PUBLISHED BY NS PROVINCIAL GOVERNMENT.
2. ELEVATIONS ARE REFERENCED TO CGVD_2013.
3. BATHYMETRIC DATA OBTAINED FROM CANADIAN HYDROGRAPHIC SERVICE NONNA DATA PORTAL. DATA CONVERTED TO CGVD_2013.
4. CGVD_2013 / CHART DATUM SEPARATION AT LUNENBURG −1.8m

CHART	CGVD_2013
4m	2m
2m	0m
0m	−2m
−2m	−4m
−4m	−6m

No.	Description	Date	By
A	ISSUED WITH DRAFT REPORT	JUL 2/21	SE

Revision or Issue

TOWN OF LUNENBURG

WASTEWATER TREATMENT PLANT & OUTFALL PRE-DESIGN

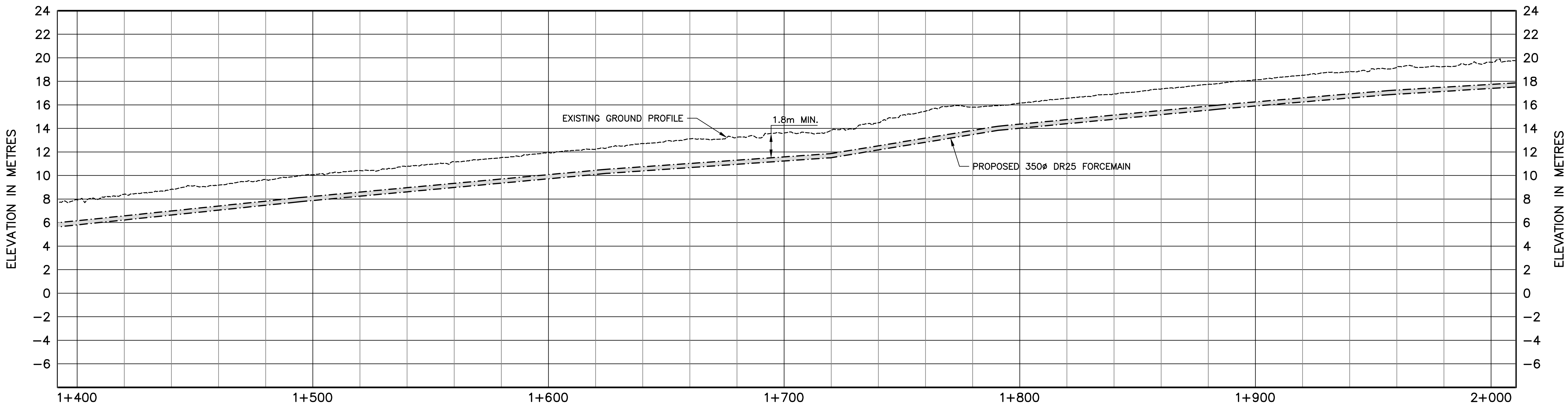
CIVIL

PROPOSED OUTFALL ROUTE (OPTION 3 AND 4)

STA 0+700 TO 1+400

CBCL

CBCL No 210803.01	Contract No -
Date MAY 2021	Scale AS NOTED
Designed AMA	Drawn AMA
Checked KM	Approved SE
Sheet No 3 of 7	
Drawing No C02	



PROFILE– PROPOSED OUTFALL
HORZ. 1:1000 VERT 1:200

PLAN– PROPOSED OUTFALL
1:1000

LEGEND:

- PROPOSED FORCEMAIN
- PROPOSED GRAVITY SEWER
- PROPERTY LINE (APPROX.)
- PROPOSED MANHOLE
- PROPOSED VALVE

NOTES:

1. GROUND SURFACE ELEVATIONS DERIVED FROM LIDAR PUBLISHED BY NS PROVINCIAL GOVERNMENT.
2. ELEVATIONS ARE REFERENCED TO CGVD_2013.
3. BATHYMETRIC DATA OBTAINED FROM CANADIAN HYDROGRAPHIC SERVICE NONNA DATA PORTAL. DATA CONVERTED TO CGVD_2013.
4. CGVD_2013 / CHART DATUM SEPARATION AT LUNENBURG −1.8m

CHART	GGVD_2013
4m	2m
2m	0m
0m	−2m
−2m	−4m
−4m	−6m

No.	Description	Date	By
A	ISSUED WITH DRAFT REPORT	JUL 2/21	SE

Revision or Issue

TOWN OF LUNENBURG

WASTEWATER TREATMENT PLANT & OUTFALL PRE-DESIGN

CIVIL

PROPOSED OUTFALL ROUTE (OPTION 3 AND 4)

STA 1+400 TO 2+000

CBCL

CBCL No 210803.01	Contract No -
Date MAY 2021	Scale AS NOTED
Designed AMA	Drawn AMA
Checked KM	Approved SE
Sheet No 4 of 7	
Drawing No C03	

DRAWING NAME: Y:\HALIFAX\DATA\PROJECTS\210803.01 TOL WWTP & OUTFALL PREDESIGN AND BCA\44 CAD\01 CIVIL\02 WORKING FILES\02 DESIGN FILES\OUTFALL ROUTING\OUTFALL OPTION 3 AND 4.DWG LAYOUT NAME: C03 PLOT DATE: July 2, 2021 10:25:45 AM CAD OPERATOR: AMACAULAY

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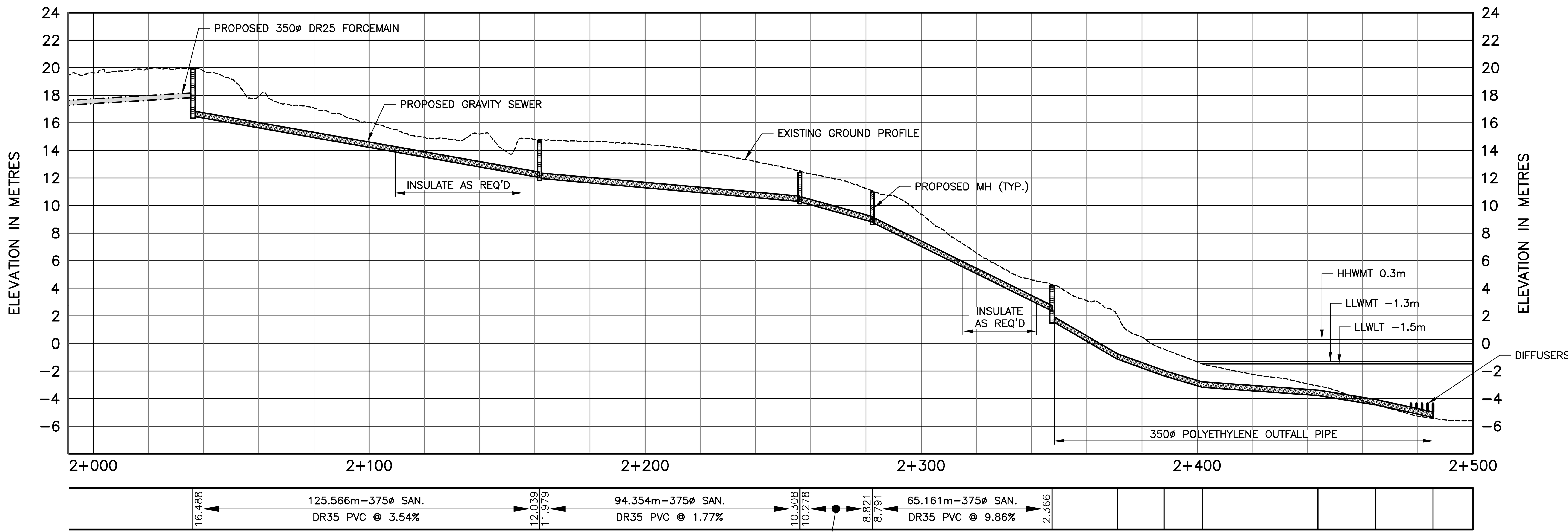


PROFILE– PROPOSED OUTFALL

HORZ. 1:1000 VERT 1:200

PLAN– PROPOSED OUTFALL

1:1000

LEGEND:

- PROPOSED FORCEMAIN
- PROPOSED GRAVITY SEWER
- PROPERTY LINE (APPROX.)
- PROPOSED MANHOLE
- PROPOSED VALVE

NOTES:

1. GROUND SURFACE ELEVATIONS DERIVED FROM LIDAR PUBLISHED BY NS PROVINCIAL GOVERNMENT.
2. ELEVATIONS ARE REFERENCED TO CGVD_2013.
3. BATHYMETRIC DATA OBTAINED FROM CANADIAN HYDROGRAPHIC SERVICE NONNA DATA PORTAL. DATA CONVERTED TO CGVD_2013.
4. CGVD_2013 / CHART DATUM SEPARATION AT LUNENBURG −1.8m

CHART	CGVD_2013
4m	2m
2m	0m
0m	−2m
−2m	−4m
−4m	−6m

No.	Description	Date	By
A	ISSUED WITH DRAFT REPORT	JUL 2/21	SE

Revision or Issue

TOWN OF LUNENBURG

WASTEWATER TREATMENT PLANT & OUTFALL PRE-DESIGN

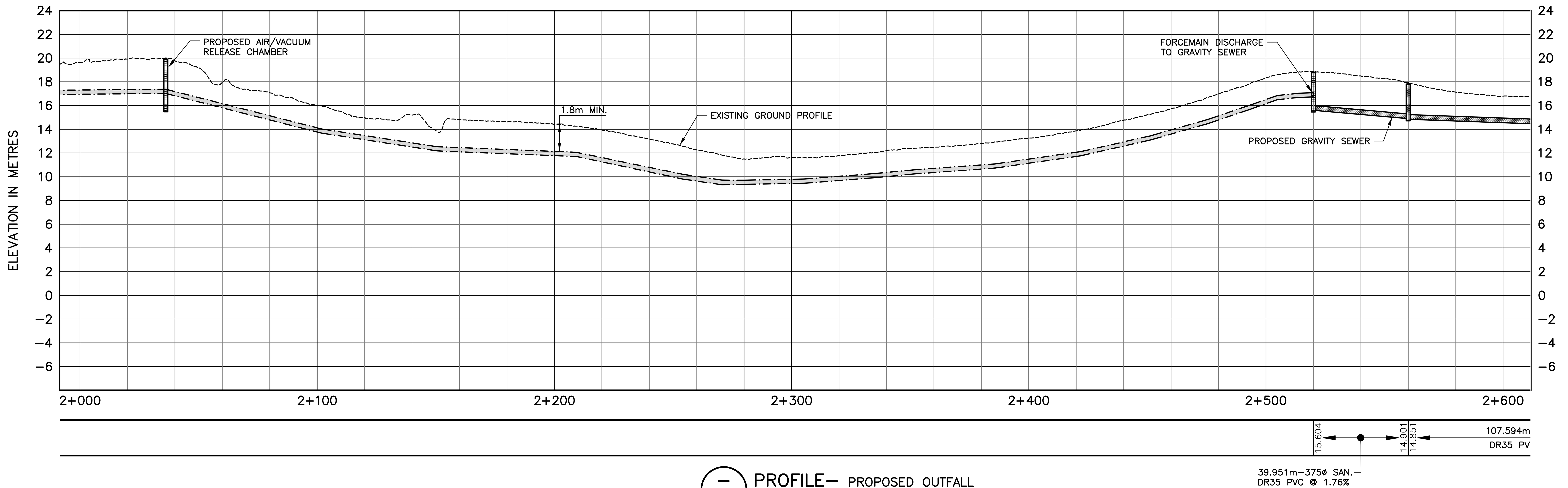
CIVIL

PROPOSED OUTFALL ROUTE (OPTION 3)

STA 2+000 TO 2+500

CBCL

CBCL No 210803.01	Contract No -
Date MAY 2021	Scale AS NOTED
Designed AMA	Drawn AMA
Checked KM	Approved SE
Sheet No 5 of 7	
Drawing No C04	



PROFILE— PROPOSED OUTFALL
HORZ. 1:1000 VERT 1:200

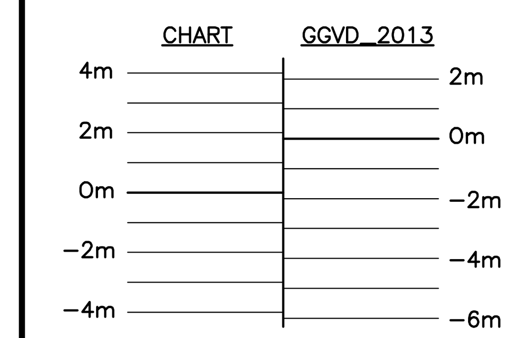
PLAN— PROPOSED OUTFALL
1:1000

LEGEND:

- PROPOSED FORCEMAIN
- PROPOSED GRAVITY SEWER
- PROPERTY LINE (APPROX.)
- PROPOSED MANHOLE
- PROPOSED VALVE

NOTES:

1. GROUND SURFACE ELEVATIONS DERIVED FROM LIDAR PUBLISHED BY NS PROVINCIAL GOVERNMENT.
2. ELEVATIONS ARE REFERENCED TO CGVD_2013.
3. BATHYMETRIC DATA OBTAINED FROM CANADIAN HYDROGRAPHIC SERVICE NONNA DATA PORTAL. DATA CONVERTED TO CGVD_2013.
4. CGVD_2013 / CHART DATUM SEPARATION AT LUNENBURG −1.8m



No.	Description	Date	By
A	ISSUED WITH DRAFT REPORT	JUL 2/21	SE

Revision or Issue

TOWN OF LUNENBURG

WASTEWATER TREATMENT PLANT & OUTFALL PRE-DESIGN

CIVIL

PROPOSED OUTFALL ROUTE (OPTION 4)

STA 2+000 TO 2+600

CBCL

CBCL No 210803.01	Contract No -
Date MAY 2021	Scale AS NOTED
Designed AMA	Drawn AMA
Checked KM	Approved SE
Sheet No 6 of 7	
Drawing No C05	

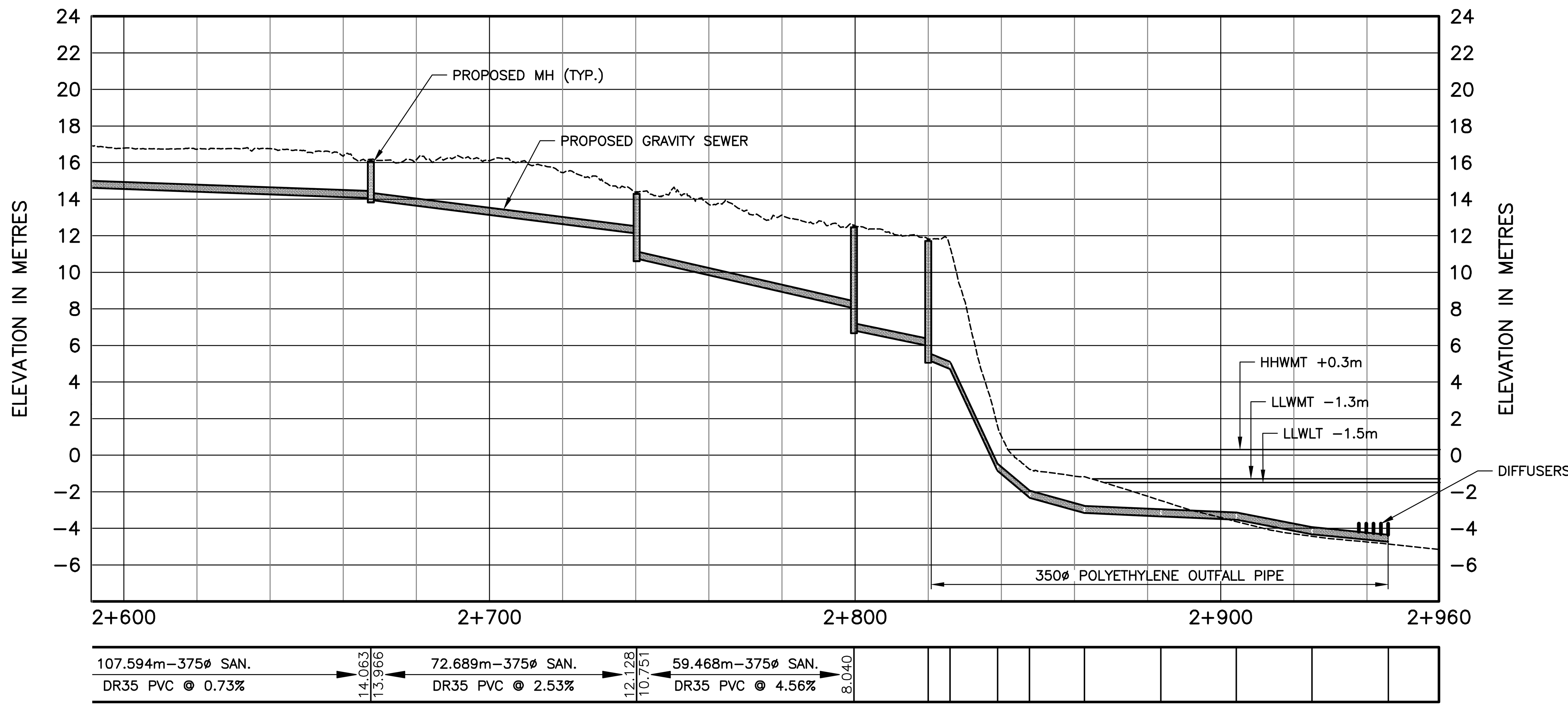
LEGEND:

PROPOSED FORCEMAIN
PROPOSED GRAVITY SEWER
PROPERTY LINE (APPROX.)
PROPOSED MANHOLE
PROPOSED VALVE

NOTES:

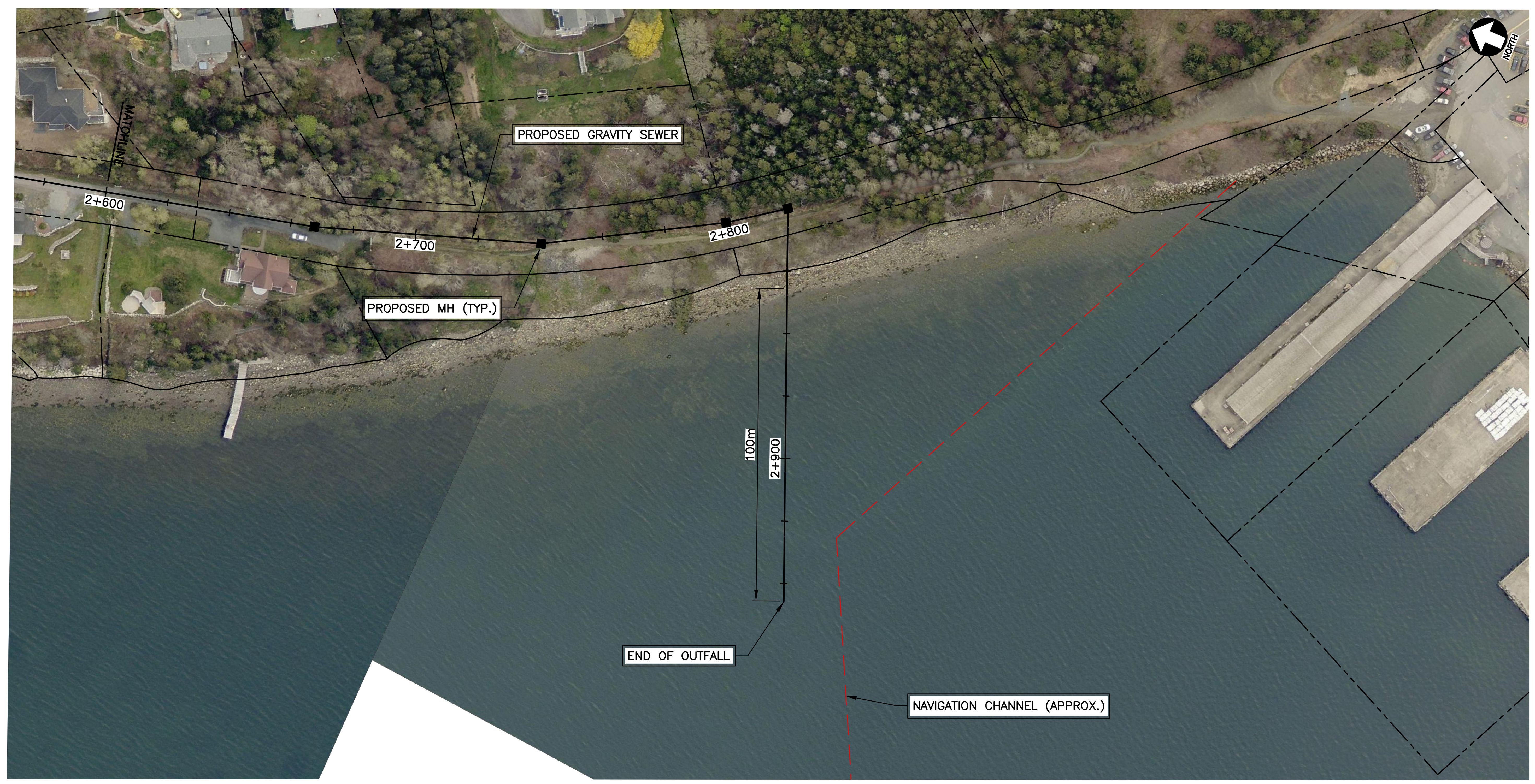
1. GROUND SURFACE ELEVATIONS DERIVED FROM LIDAR PUBLISHED BY NS PROVINCIAL GOVERNMENT.
2. ELEVATIONS ARE REFERENCED TO CGVD_2013.
3. BATHYMETRIC DATA OBTAINED FROM CANADIAN HYDROGRAPHIC SERVICE NONNA DATA PORTAL. DATA CONVERTED TO CGVD_2013.
4. CGVD_2013 / CHART DATUM SEPARATION AT LUNENBURG −1.8m

CHART	CGVD_2013
4m	2m
2m	0m
0m	−2m
−2m	−4m
−4m	−6m



PROFILE– PROPOSED OUTFALL

HORZ. 1:1000 VERT 1:200



PLAN– PROPOSED OUTFALL

1:1000

No.	Description	Date	By
A	ISSUED WITH REPORT	JUL 2/21	SE

Revision or Issue

TOWN OF LUNENBURG

WASTEWATER TREATMENT PLANT & OUTFALL PRE-DESIGN

CIVIL

PROPOSED OUTFALL ROUTE (OPTION 4)

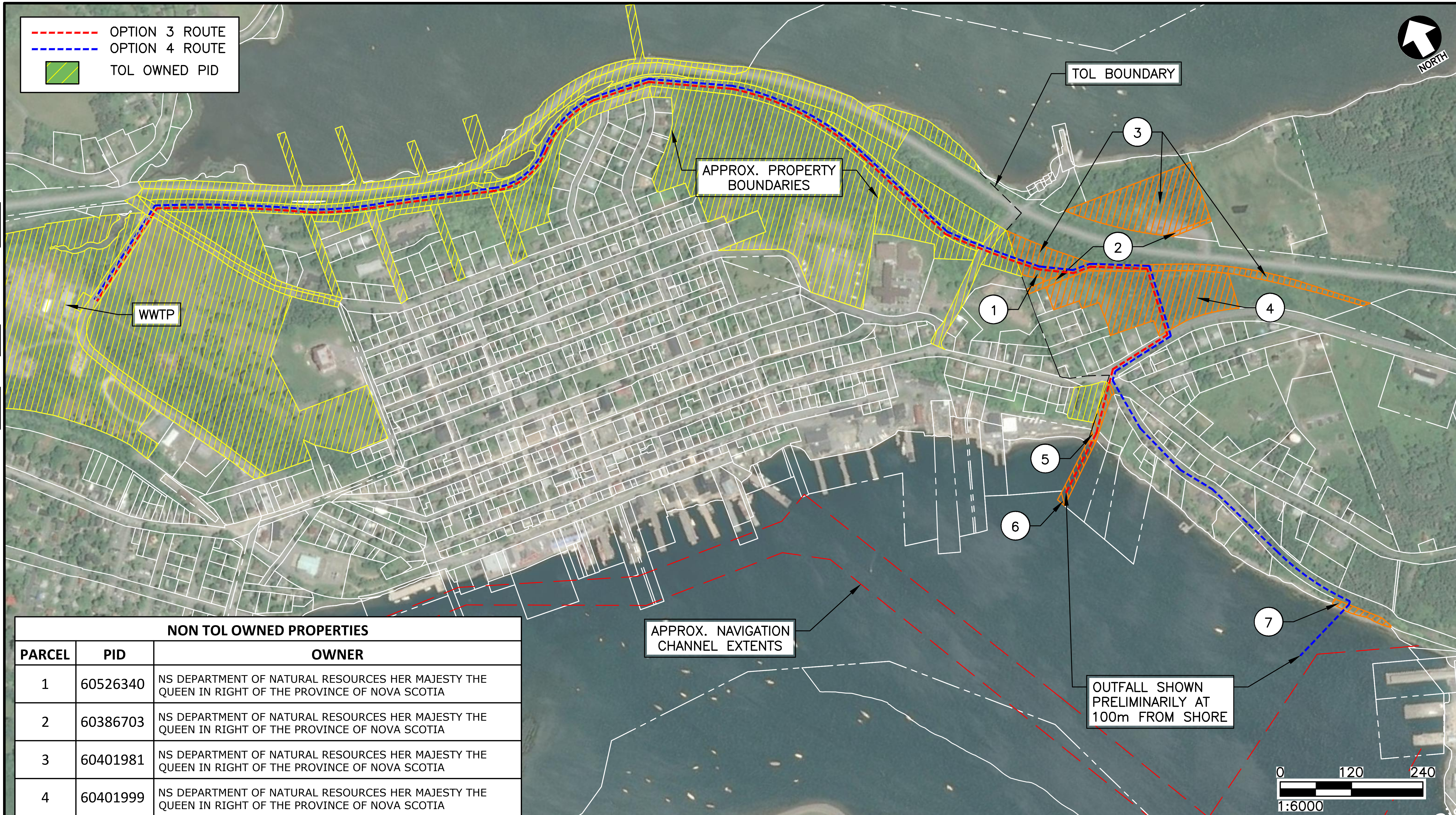
STA 2+600 TO 2+960

CBCL

CBCL No 210803.01	Contract No -
Date MAY 2021	Scale AS NOTED
Designed AMA	Drawn AMA
Checked KM	Approved SE
Sheet No 7 of 7	
Drawing No C06	

APPENDIX D

Option 3 and 4 Routing Sketch with Property Boundaries



NON TOL OWNED PROPERTIES

PARCEL	PID	OWNER
1	60526340	NS DEPARTMENT OF NATURAL RESOURCES HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF NOVA SCOTIA
2	60386703	NS DEPARTMENT OF NATURAL RESOURCES HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF NOVA SCOTIA
3	60401981	NS DEPARTMENT OF NATURAL RESOURCES HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF NOVA SCOTIA
4	60401999	NS DEPARTMENT OF NATURAL RESOURCES HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF NOVA SCOTIA
5	60386695	LOCAL COMMON
6	60386612	MUNICIPALITY OF THE DISTRICT OF LUNENBURG
7	60401809	TRUSTEES OF THE COMMON LAND

No.	Description

Date	Scale	Designed	Drawn	Checked	Approved	CBCL No.	Contract
APR 2021	1:6000m	AMA	AMA	SE	SE	210803.01	-

CBCL

TOL WWTP AND OUTFALL PRE-DESIGN

OUTFALL OPTION 3 AND 4 ROUTING

Sketch

SK1

DRAWING NAME: Y:\HALIFAX\DATA\PROJECTS\210803.01 TOL WWTP & OUTFALL PREDESIGN AND BCA\44 CAD\01 CIVIL\02 WORKING FILES\02 DESIGN FILES\OPTION 3 AND 4.DWG LAYOUT NAME: LAYOUT1 PLOT DATE: May 17, 2021 8:57:37 PM CAD OPERATOR: AMACAULAY

APPENDIX E

Regulatory Review Table

Legislation / Guidelines	Regulator	Permit / Approval	Context / Requirements	Relevance / Recommendations and Application Details	Regulator Contact Information
Federal					
Impact Assessment Act* (IAA)** ***Physical Activities Regulations	Impact Assessment Agency of Canada (IAAC)	Federal IA	Designated projects require a federal impact assessment (IA) and the proponent of a designated project is required to submit a project description to the IAAC for screening on whether an IA is required. For the proposed Project to be classified as a designated project, it must be described under the *Physical Activities Regulations* (Project List) or designated in an order made by the Minister under subsection 9(1).	An IA is not anticipated to be required as the current Project is not a designated project under the Physical Activities Regulations.	IAAC Atlantic Office 200-1801 Hollis Street Halifax, NS B3J 3N4 Tel.: 902-426-0564 Fax: 902-426-6550
IAA (Section 82)	Federal authority	Environmental Effects Determination (EED)	Under Section 82 of the IAA, a project must not be carried out on federal lands unless a federal authority has determined that it is unlikely to result in significant adverse environmental effects. Pursuant to Section 82 of the IAA, a project is defined as: *(a) a physical activity that is carried out on federal lands or outside Canada in relation to a physical work and that is not a designated project or a physical activity designated by regulations made under paragraph 112(1)(a.2); and* *(b) a physical activity that is designated under section 87 or that is part of a class of physical activities that is designated under that section.* Pursuant to Section 82 of the IAA: *…an authority must not carry out a project on federal lands, exercise any power or perform any duty or function…that could permit a project to be carried out, in whole or in part, on federal lands or provide financial assistance to any person for the purpose of enabling that project to be carried out, in whole or in part, on federal lands, unless*	A determination of the significance of potential environmental effects of the Project will be required if the outfall is constructed within federal lands. Outfall option 4 would fall within the seabed that is administered by a federal authority, however, there is uncertainty over which federal authority has ownership over the seabed in question. The determination must include an evaluation of effects to the physical environment, biological environment, Indigenous peoples, and socio-economic environment. The federal authority must post a notice to the Canadian Impact Assessment Registry (CIAR). The notice is to advise the public that the authority is making a determination under section 82. The notice must be posted at least 30 days prior to making the decision. There is no formal requirement for a proponent to submit anything to a federal authority, but the relevant authority may request such from a proponent. It is recommended that the proponent consult with both DFO and Transport Canada to confirm the request well in advance.	Fisheries Protection Program DFO P.O. Box 1006 Dartmouth, Nova Scotia B2Y 4A2 Tel: 902-426-3909 Fax: 902-426-7174 -OR- Transport Canada – Atlantic Regional Headquarters 95 Foundry Street Moncton, N.B. E1C 5H7 Tel.: 1-866-995-9737

Legislation / Guidelines	Regulator	Permit / Approval	Context / Requirements	Relevance / Recommendations and Application Details	Regulator Contact Information
			(a) the authority determines that the carrying out of the project is not likely to cause significant adverse environmental effects; or *(b) the authority determines that the carrying out of the project is likely to cause significant adverse environmental effects and the Governor in Council decides, under subsection 90(3), that those effects are justified in the circumstances.*	Information on the existing environmental conditions is typically collected in order to evaluate the potential environmental effects. The following provides an example of supporting information that may be required: • Atlantic Canada Conservation Data Centre (AC CDC) Rare Taxa Report • Consultation with DFO regarding fish and fish habitat • Consultation with the Office of Aboriginal Affairs • ARIA if determined to be relevant to the project • Any other previous environmental studies or reports with respect to the project area.	
Canadian Environmental Protection Act, 1999 **(CEPA)**	Environment and Climate Change Canada (ECCC)	N/A currently If dredging is proposed, Disposal at Sea Permit	CEPA is the legislative framework in Canada that aims to prevent pollution and protect the environment and human health. The key aspects of CEPA include prevention and management of risks posed by toxic and other harmful substances. CEPA includes provisions pertaining to environmental and human health, impacts of products of biotechnology, vehicle and equipment emissions, fuels, gasoline, hazardous wastes, toxic substances, environmental emergencies, and other sources of pollution. Link to list of regulations to assess applicability to the Project: https://pollution-waste.canada.ca/environmental-protection-registry/regulations	Regulations under CEPA were checked for applicability to the project. At the time this review was conducted, dredging was not incorporated into the design of this project. If at any time dredged material or other materials are to be disposed of at sea, a Disposal at Sea permit would be required.	
Fisheries Act	Fisheries and Oceans Canada (DFO)	*Fisheries Act* Authorization	The *Fisheries Act* prohibits the carrying out any Project or activity, other than fishing, that results in the death of fish or the harmful alteration, disruption or destruction of fish habitat (HADD) unless authorized by DFO. The Act also prohibits the obstruction of free fish passage or any activity	The current Project may result in impacts to fish and fish habitat that cannot be avoided during construction. Consultation with DFO is recommended to confirm if a Request for Review is necessary. A fish and fish habitat assessment	Fisheries Protection Program DFO P.O. Box 1006 Dartmouth, Nova Scotia B2Y 4A2 Tel: 902-426-3909

Legislation / Guidelines	Regulator	Permit / Approval	Context / Requirements	Relevance / Recommendations and Application Details	Regulator Contact Information
			that damages or obstructs a fishway, or that stops, prevents, or hinders fish from passing through a fishway. In cases where impacts to fish and fish habitat cannot be avoided, the project does not fall within waterbodies where a review isn't required, or the scope of the project is not entirely covered under the listed standards and code of practice, proponents are asked to submit a Request for Review form to their Fish and Fish Habitat Protection Program regional office. The Request for Review would allow DFO to determine if an Authorization is required.	should be conducted and included with the submission of the Request for Review form. Request for Review Guidance and Form: https://www.dfo-mpo.gc.ca/pnw-ppe/reviews-revues/request-review-demande-d-examen-004-eng.html After reviewing the form, DFO may require an application for Authorization under the Fisheries Act along with an associated Offsetting Plan if the Project is anticipated to result in HADD following the implementation of mitigation measures. The processing time for a Request for Review is not specified by DFO but can take up to 60 business days or potentially longer due to COVID backlogs. The processing time for Fisheries Act Authorization is 60 days to review the application for completion and an additional 90 days to issue an Authorization.	Fax: 902-426-7174
***Canadian Navigable Waters Act* (CNWA)**	Transport Canada (TC)	Approval	The CNWA applies to Projects that interfere with navigation of any navigable water. A work is defined as "any structure, device or other thing, whether temporary or permanent, that is made by humans, including a structure, device or other thing used for the repair or maintenance of another work." A work also includes the dumping of fill or the excavation or dredging of materials from the bed of any navigable water. A Minor Work is defined as a work that is likely to slightly interfere with navigation and can be managed by standard requirements outlined in the Minor Works Order.	Outfalls are classified as a Minor Work per Section 11 the Minor Works and Waters Order (the Order): https://tc.canada.ca/en/marine/department-transport-navigable-waters-protection-act Minor works may proceed without a Notice to the Minister or Approval provided they can comply with the specific terms and conditions outlined in the Minor Works and Waters Order. As per 11(2)(d) of the Order, the location of outfall 3 is not near the navigation channel, while the location of outfall 4 could be within 30 m of the navigation channel. If conditions of the Minor Works Order cannot be met, then the Project may be subject to additional	TC Atlantic Region Navigation Protection Program 95 Foundry Street, 6th Floor P.O. Box 42 Moncton NB E1C 8K6 Tel: 506-851-3113 Email: NPPATL-PPNATL@tc.gc.ca Mélanie LeBlanc Navigation Protection Program Officer

Legislation / Guidelines	Regulator	Permit / Approval	Context / Requirements	Relevance / Recommendations and Application Details	Regulator Contact Information
				regulatory requirements under the CNWA (e.g. Approval). The guide to application requirements can be accessed via the link below under 'How do I Apply?' https://tc.canada.ca/en/programs/navigation-protection-program/guide-navigation-protection-program-s-notification-application-review-requirements#toc4	
***Species at Risk Act* (SARA)**	ECCC DFO	SARA Permit	The general prohibitions of the SARA state that no person shall: • Kill, harm, harass, capture or take an individual of a wildlife species listed under Schedule 1 as 'Extirpated', 'Endangered' or 'Threatened' [Section 32]; • Possess, collect, buy, sell or trade species listed under Schedule 1 as 'Extirpated', 'Endangered' or 'Threatened' [Section 32]; and • Damage or destroy the residence (e.g. nest, den) of one or more individuals of a wildlife species listed under Schedule 1 as 'Endangered', 'Threatened' or 'Extirpated', if a recovery strategy has recommended the reintroduction of that extirpated species [Section 33]. Subsection 58(1) of SARA states that no person shall destroy any part of the critical habitat of a listed 'Endangered' or 'Threatened' species. Some activities may be exempted from some or all of the prohibitions if they meet the conditions for the issuance of a permit or exemption under sections 73 and 83 of SARA. In cases where Project activities contravene the Act's general or critical habitat prohibitions, an application for a SARA permit must be submitted	Prior to construction and depending on location, it is recommended to determine whether SAR could be impacted by construction activities. A review of DFO's Aquatic species at Risk map for the Lunenburg area indicated that Fine Whale, Blue Whale, Spotted Wolffish, North Atlantic Right Whale, Leatherback Sea Turtle and White Shark could be present within the area, however, the likelihood of encountering these species close to the shoreline is low. Attention should be applied during construction to mitigate any interacts with SAR. If an aquatic SAR is affected, an application to DFO for a SARA permit may be required. If a SAR migratory bird is affected, then an application to ECCC for a SARA permit may be required.	ECCC - Atlantic Region Permits Officer Canadian Wildlife Service Environmental Conservation Branch 17 Waterfowl Lane PO Box 6227 Sackville, NB E4L 1G6 Tel: 506-364-5044 Fax: 506-364-5062 E-mail: Sarapermitting.atl@ec.gc.ca DFO - Maritimes Region Bedford Institute of Oceanography P.O. Box 1006 1 Challenger Drive Dartmouth, NS B2Y 4A2 Tel: 902-426-8503 Email: xmarsara@mar.dfo-mpo-gc.ca

Legislation / Guidelines	Regulator	Permit / Approval	Context / Requirements	Relevance / Recommendations and Application Details	Regulator Contact Information
			to the appropriate department, i.e., either ECCC or DFO. If activities may affect aquatic species (i.e., defined as fish or marine plant under the *Fisheries Act*), its residence, or its critical habitat, applications must be submitted to DFO. For all other species, their residences, and their critical habitat, applications must be submitted to ECCC. The exception is lands administered by Parks Canada, Parks Canada is the competent minister, regardless if it is an aquatic species or not.		
Migratory Birds Convention Act, 1994 **(MBCA)** ***Migratory Birds Regulations***	CWS ECCC	N/A	The MBCA and its regulations protect migratory birds and prohibit the disturbance or destruction of migratory bird nests and eggs in Canada, regardless of land ownership. The MBCA also prohibits the dumping of substances harmful to birds in areas and water frequented by them.	Prior to construction, it is recommended to review the MBCA and identify nesting periods that are applicable to the construction area and any mitigation measures that may be required. Work should be completed outside of the nesting periods. Pre-clearance surveys by a qualified biologist may be required to reduce the risk of harming migratory birds if any construction activities are to occur within or close to nesting periods.	ECCC – Atlantic Region Canadian Wildlife Service 17 Waterfowl Lane Sackville, NB E4L 1G8 Tel: 506-364-5068 Fax: 506-364-5062 Email: ec.scfatlpermis-cwsatlpermits.ec@canada.ca
Provincial					
Environment Act, **1994-95** ***Environmental Assessment Regulations*** **Environmental Assessment Approval**	NSECC	EA Approval	An Environmental Assessment (EA) Approval is required for Class I or Class II Undertakings listed under Schedule A of the Environmental Assessment Regulations: https://novascotia.ca/just/regulations/regs/envassmt.htm#TOC1_27 Should the Project involve a Class I or Class II Undertaking, a registration document must be submitted to the Environmental Assessment Branch of NSECC. Depending on the Undertaking, a Focus Report and Environmental Assessment Report may be required.	A provincial EA is not anticipated to be required as the Project does not currently fall under the definitions of a Class I or Class II Undertaking.	Environmental Assessment Branch NSECC PO Box 442 Halifax, NS B3J 2P8 Tel: 902-424-3600 or 902-424-2574 Fax: 902-424-6925

Legislation / Guidelines	Regulator	Permit / Approval	Context / Requirements	Relevance / Recommendations and Application Details	Regulator Contact Information
Environment Act*, 1994-95 *Activities Designation Regulations	NSECC	Approval for Sewage Works	Section 7(2) of the Activities Designation Regulations under the Environment Act states: 7(2) The construction, operation or reclamation of: (a) a sewage works, including (i) sewage collection systems and pumping stations (ii) retention or storage facilities, (iii) treatment facilities, (iv) outfalls; is designated as an activity that requires a notification unless the activity cannot be done in compliance with the *On-site Sewage Disposal Systems Regulation* and the On-site Sewage Disposal Systems Standard (the Standard). If the On-site Sewage Disposal Systems Regulation and the Nova Scotia Watercourse Alterations Standard cannot be complied with, an approval would be required.	The Town of Lunenburg is the holder of NSECC Approval No. 2012-082710-02 pertaining to the existing WWTP. Per condition 3(h) of the approval, "The Approval Holder(s) shall advise the Department in writing prior to any proposed extensions or modifications to the Activity and/or the Site. An amendment to this Approval may be required before implementing any extension or modification." NSECC indicated that a new Municipal Approval to Construct would be required for the proposed work and NSECC will link the existing approval to the new approval through a clause in the new approval. The application form can be found here: https://novascotia.ca/nse/forms/docs/Application-MunicipalApproval.pdf Supporting Documentation is outlined in Section 6 of the form. The processing time for an initial approval is 60 business days or less. The Regulator has requested contact via email to confirm instructions for the preparation of the application once further design details are confirmed.	Barry Gillis Environmental Engineer Barry.Gillis@novascotia.ca Tel: 902-527-6382

Legislation / Guidelines	Regulator	Permit / Approval	Context / Requirements	Relevance / Recommendations and Application Details	Regulator Contact Information
Environment Act*, 1994-95** ***Activities Designation Regulations	NSECC	Water Approval	Activities which result in the alteration of a watercourse, water resource, wetland, or water flow therein, are considered Designated Activities under Section 5A of the *Activities Designation Regulations*, unless they require a notification under Section 5B or are exempt under Section 5D. Watercourse means the bed and shore of every river, stream, lake, creek, pond, spring, lagoon or other natural body of water, and the water therein, within the jurisdiction of the Province, whether it contains water or not and all groundwater. Water Resource means all fresh and marine waters comprising all surface water, groundwater and coastal water.	Submission of a Water Approval application is not likely to be required as there are no watercourses or water resources along the construction corridor that will be intersected due to excavation works. If design changes occur that result in the intersection of a wetland, a water approval would be required. Both outfall options will discharge to waters that are federally administered. The treated wastewater being discharged to the outfall is anticipated to be compatible with marine waters and meet discharge criteria and is covered under the NSECC Approval for Sewage Works. Application processing time is approximately 60 business days.	Regional contact: David Clarke District Manager - Bridgewater 81 Logan Road Bridgewater, NS B4V 3T3 Phone: 902-543-4685 Fax: 902-527-5480
Environment Act Activities Designation Regulations	NSECC	Wetland Alteration Approval	Activities, i.e. alterations or use (e.g. infilling, excavating, draining or flooding of wetlands) that impact a wetland require a Wetland Alteration Approval pursuant to Section 5A(2) of the Activities Designation Regulations under the Environment Act. In Nova Scotia, salt marshes are considered Wetlands of Special Significance (WSS). The provincial government has established the following goals under the Nova Scotia Wetland Conservation Policy (NSECC, 2011): • no loss in WSS; and • no net loss in area and function for other wetlands. The Policy states that alteration to a WSS will not be approved by NSECC unless 1) the alteration is required to maintain, restore or enhance the WSS, or 2) the alteration is deemed necessary to provide public function (NSECC, 2011). Where the loss to a WSS, or net loss in area or function for	While there are no reported wetlands within the construction corridor for the outfall pipe, this doesn't mean that wetlands are not present. If construction of the outfall will intersect any wetlands greater than 100m2, a Wetland Alteration Approval is required. It is a best practice to maintain a buffer between any wetland and the construction area. The application form can be found here: https://novascotia.ca/nse/water/docs/Application-WaterApproval.pdf Application processing can take up to 60 business days* *If the expected impact to wetlands is larger than 2 hectares, the project will be referred to the Environmental Assessment Process, in which case the Wetland Approval process will not begin until the EA process is completed. When an EA is required for an alteration, applicants must obtain	Regional contact: David Clarke District Manager - Bridgewater 81 Logan Road Bridgewater, NS B4V 3T3 Phone: 902-543-4685 Fax: 902-527-5480

Legislation / Guidelines	Regulator	Permit / Approval	Context / Requirements	Relevance / Recommendations and Application Details	Regulator Contact Information
			other wetlands, is unavoidable, compensation is required.	this approval before seeking any other approvals from NSECC.	
Nova Scotia *Endangered Species Act* (NS ESA)	Nova Scotia Department of Lands and Forestry (NSLF)	NS ESA SAR Permit	Species that are provincially listed as 'Extirpated', 'Endangered', 'Threatened' or of 'Special Concern', and habitat which supports these species, are formally protected under NS ESA. Under Section 13(1) of the NSESA, the following acts are prohibited: • Killing, injuring, or disturbing species at risk; • Destroying, disturbing or interfering with its residence (e.g. nest, den, hibernaculum); and • Destroying, disturbing or interfering with its core habitat.	A permit is required if Project activities will adversely impact a provincially listed species or its habitat. If mitigation measures can be put in place to avoid adverse impacts if they are identified, a SAR permit would not be required. A permit can be obtained from the NSLF Wildlife Division. NSLF has 30 days to review applications and approve a permit, pending additional information is not required.	Local NSLF office: 312 Green Street Lunenburg, NS B0J 2C0 Phone: 902-634-7555 e-mail: dnr-lunenburg-office@novascotia.ca
Crown Lands Act, 1989	NSLF	Permit for the Use of Crown Lands	Crown lands are owned by the Province and include most submerged lands (or seabeds) along the coastline of Nova Scotia, except for federally or privately owned water lots. Under Section 38(1) of the Crown Lands Act, it is an offence to dump or deposit materials on crown lands without authorization by the Minister. Under Section 40(1) of the Act, the following activities are also prohibited unless authorized by the Minister:	It is not anticipated a Crown Lands Permit will be required for outfall options 3 and 4 as both do not transect submerged provincial crown land. Outfall 3 would be contained within the Municipality of the District of Lunenburg's water lot claim, and outfall 4 would not be contained with a water lot claim (lands administered by the Coast Guard, DFO).	NSLF Land Administration Division PO Box 698 Halifax, NS B3J 2T9 Tel: 902-424-4006 Fax: 902-424-3173 Email: landweb@novascotia.ca

Legislation / Guidelines	Regulator	Permit / Approval	Context / Requirements	Relevance / Recommendations and Application Details	Regulator Contact Information
			• Cutting down or damage to timber, or other resources belonging to the Crown. • Removal of timber, or other resources, from crown lands. • Damage or removal of crown lands.		
Beaches Act, 1989 ***Beaches Regulations, 1989***	NSLF	Beaches Act Permit	The Beaches Act provides protections of beaches and associated dune systems in Nova Scotia. Pursuant to the Beaches Regulations activities that are prohibited without prior authorization or approval from the Minister include, but are not limited to, the following: • Removal of beach aggregate (section 5) • Development of a beach (section 6) • Removal, defacing or injury of any natural object, tree, shrub, plant or grass (section 7) • Removal or displacement of any rock, mineral, fossil, sand, gravel or other aggregate (section 7) • Alter, damage or destroy any watercourse (section 7) • Use of a vehicle on a beach (section 9)	The Beaches Act was reviewed to assess relevance to the project. Contact with NSLF revealed that Lunenburg Harbour is under the Federal jurisdiction and a Beaches Act permit was advised not to be required at the time of the call. NSLF recommended the proponent consult with DFO's Marine Division and the Harbour Master, Bill Towndrow (902) 634-4301 to confirm who administers the beaches. It is recommended that the Town continue to follow up with DFO's Marine Division to confirm authority.	312 Green Street Lunenburg, NS B0J 2C0 Alan Malloy Phone: 902-521-1266 e-mail: dnr-lunenburg-office@novascotia.ca
Special Places Protection Act, 1989	Nova Scotia Department of Communities, Culture and Heritage (NSCCH)	Heritage Research Permit	The Special Places Protection Act is administered by NSCCH and provides protections for palaeontology and archaeology sites. This Act applies to anyone exploring or excavating land, including land covered by water, for the purpose of seeking archaeological, historical or paleontological sites and remains. Under the Act, no person shall: • Knowingly destroy, desecrate, deface, or alter archaeological resources; or • Excavate or alter an archaeological site or remove any objects from an archaeological site without approval of a Heritage Research Permit.'	In response to CBCL's question, the Town indicated that there were no previous Archaeological Resource Impact Assessments (ARIAs) in archive that could provide information specific to the construction corridor and that information specific to undisturbed areas within the construction corridor may be limited. The Town may opt to have an ARIA conducted to investigate areas where limited information exists and to mitigate the potential of encountering an artifact or archaeological or paleontological resource during construction. The discovery of one of these could have implications to the project schedule. If the Town chooses to proceed with an ARIA, a Heritage Research Permit must be obtained first.	NSCCH Special Places Program Heritage Division 1747 Summer Street Halifax, NS B3H 3A6 Tel: 902-424-6475 Email: bennetle@gov.ns.ca

Legislation / Guidelines	Regulator	Permit / Approval	Context / Requirements	Relevance / Recommendations and Application Details	Regulator Contact Information
			If an artifact or archaeological or paleontological resource is found during construction work, construction must be halted and an Archaeologist should be contacted immediately.	It is recommended to begin planning for the ARIA during the early phases of the project to prevent any delays to the construction schedule. The permit application form can be found here: https://cch.novascotia.ca/sites/default/files/inline/documents/archaeologypermitform.pdf Application submission requirements are outlined in the Archaeological Resource Impact Assessment (Category C) Guidelines, found here: https://cch.novascotia.ca/sites/default/files/inline/documents/archaeologicalresourceimpactassessmentc.pdf The typical application processing time is 10 days though processing times may be delayed.	
Public Highways Act,* 1989 *Work Within Highway Right-of-Way Permit	Nova Scotia Department of Transportation and Active Transit (NSTAT)	Work within a Highway Right-of-Way Permit	The Public Highways Act is administered by NSTAT and governs activities including the use, construction, and maintenance of highways in the province. Any Project activities on or within a highway right-of-way, such as installing a structure within 100 m of a highway, will require a Work Within Highway Right-of-Way Permit.	A permit is required as the construction corridor of either outfall route will be within 100 m of a public highway. The permit application form can be found here: https://novascotia.ca/tran/hottopics/lpa/highwayrightofwaypermit.pdf Application submission requirements are outlined in the Information for Work within Highway Right-of-way Permit brochure, found here: https://novascotia.ca/tran/hottopics/lpa/highwayrightofwaybrochure.pdf Application processing can take up to 10 days.	*Public Highways Act,* 1989 *Work Within Highway Right-of-Way Permit*

Municipal					
Municipal Government Act, 1998	Town of Lunenburg	Development Permit	The Land Use By-law regulates the type of use permitted on any lot in the Town of Lunenburg and the location of all buildings and structures on any lots. The main tool for administration of the Land Use By-law is the requirement of a development permit for any new development or change in use, or any new structure.	Application processing can take up to 6 weeks.	Development/Planning Dawn Sutherland, Development/Planning Manager 119 Cumberland Street, Lunenburg, NS Tel: 902-634-4410, ext. 255 Fax: 902-634-4416 dsutherland@explorelunenburg.ca
Municipal Government Act, 1998 ***Sewer Discharge Bylaw #34***	Town of Lunenburg	N/A	The Municipal Government Act provides authority to municipal governments to develop municipal planning strategies and by-laws. The Sewer Discharge bylaw regulates wastewater and sewage discharge to combined and/or sanitary sewers.	The Waste wastewater treatment plant should be operated in accordance with this bylaw, particularly when it comes to sewage collection and sewer discharge.	
Municipal Government Act, 1998 ***Solid Waste Management Bylaw #38***	Town of Lunenburg	N/A	The Solid Waste By-Law outlines requirements for the disposal of solid waste in the municipality.	Any waste generated within the town of Lunenburg is subject to provisions of the Solid Waste Management Bylaw. Waste disposal must comply with the bylaw. Construction or demolition materials must be delivered by the owner or occupant to the appropriate area or site within Kaizer Meadow or an approved C&D debris disposal site. Disposal of C&D debris cannot occur by stockpiling, sorting or any other method.	
Municipal Government Act, 1998 ***Town of Lunenburg Noise Bylaw #58***	Town of Lunenburg	N/A	The Town of Lunenburg Noise By-law includes guidelines for respecting noise levels in the Town of Lunenburg. Prohibited times for various activities that produce noise emissions are outlined under the by-law.	Review Bylaw to ensure construction work occurs within the times designated by the Noise Bylaw under Schedule “A”. Construction activities, except where such equipment is used or operated on any highway, must be conducted after 7:00am or after a half hour beyond sunset.	

APPENDIX F

Opinion of Probable Capital Cost Tables

TOL WWTP & Outfall Pre-design

Opinion of Probable Cost - Option 3
July 2, 2021

ITEM NO.	DESCRIPTION	UNIT OF MEASURE	EST. QUANT.	ENGINEERS ESTIMATE UNIT PRICE	TOTAL PRICE
A	**Sewer Construction**				
1	Pressure Pipe				
	.1 350mm PVC Pipe (DR25) Off-road	m	1825	$ 500.00	$912,500.00
	.2 350mm PVC Pipe (DR25) On-road	m	210	$ 650.00	$136,500.00
2	Gravity Pipe				
	.1 375 dia. PVC (DR35) Off-road	m	185	$ 300.00	$55,500.00
	.2 375 dia. PVC (DR35) On-road	m	130	$ 500.00	$65,000.00
3	Outfall Pipe				
	.1 Mobilization	L.S.	1	$ 100,000.00	$100,000.00
	.2 375 dia. HDPE	m	135	$ 1,500.00	$202,500.00
4	Manholes				
	.1 1500 dia. Pre-cast	each	1	$ 4,000.00	$4,000.00
	.2 1200 dia. Pre-cast	each	4	$ 4,000.00	$16,000.00
5	Connections/Disconnections to Existing Forcemains				
	.1 350 dia. to 300 dia.	L.S.	1	$ 7,000.00	$7,000.00
6	Air Release Chamber	each	1	$ 25,000.00	$25,000.00
7	Forcemain Drain	each	2	$ 6,000.00	$12,000.00
8	WWTP Pump Upgrades	L.S.	1	$ 150,000.00	$150,000.00
	A. Sewer Construction Subtotal				**$1,686,000.00**
B	**Provisional Items**				
9	Rock Excavation	m^3	100	$ 100.00	$10,000.00
10	Trench Excavation Unsuitable Material	m^3	100	$ 20.00	$2,000.00
11	Replacement of Unsuitable Material	m^3	100	$ 30.00	$3,000.00
	C. Provisional Items Subtotal				**$15,000.00**
	Summary of Tender				
	A. Sewer Construction Subtotal				$1,686,000.00
	B. Provisional Items Subtotal				$15,000.00
	C. Construction Contingency (10%)				$170,100.00
	D. Design Development Contingency (25%)				$425,250.00
	E. Engineering Contingency (15%)				$255,150.00
	Estimated Price (excluding HST)				**$2,551,500.00**
	Add HST (15% of Total Tendered Price)				$382,725.00
	Total Price				$2,934,225.00

THIS OPINION OF PROBABLE COSTS IS PRESENTED ON THE BASIS OF EXPERIENCE, QUALIFICATIONS, AND BEST JUDGEMENT. IT HAS BEEN PREPARED IN ACCORDANCE WITH ACCEPTABLE PRINCIPLES AND PRACTICES. MARKET TRENDS, NON-COMPETITIVE BIDDING SITUATIONS, UNFORESEEN LABOUR AND MATERIAL ADJUSTMENTS AND THE LIKE ARE BEYOND THE CONTROL OF CBCL LIMITED. AS SUCH WE CANNOT WARRANT OR GUARANTEE THAT ACTUAL COSTS WILL NOT VARY FROM THE OPINION PROVIDED.

TOL WWTP & Outfall Pre-design

Opinion of Probable Cost - Option 4
July 2, 2021

ITEM NO.	DESCRIPTION	UNIT OF MEASURE	EST. QUANT.	ENGINEERS ESTIMATE UNIT PRICE	TOTAL PRICE
A	**Sewer Construction**				
1	Pressure Pipe				
	.1 350mm PVC Pipe (DR25) Off-road	m	1950	$ 500.00	$975,000.00
	.2 350mm PVC Pipe (DR25) On-road	m	575	$ 650.00	$373,750.00
2	Gravity Pipe				
	.1 375 dia. PVC (DR35) Off-road	m	150	$ 300.00	$45,000.00
	.2 375 dia. PVC (DR35) On-road	m	150	$ 500.00	$75,000.00
3	Outfall Pipe				
	.1 Mobilization	L.S.	1	$ 100,000.00	$100,000.00
	.2 375 dia. HDPE	m	125	$ 1,800.00	$225,000.00
4	Manholes				
	.1 1500 dia. Pre-cast	each	1	$ 4,000.00	$4,000.00
	.2 1200 dia. Pre-cast	each	6	$ 4,000.00	$24,000.00
5	Connections/Disconnections to Existing Forcemains				
	.1 350 dia. to 300 dia.	L.S.	1	$ 7,000.00	$7,000.00
6	Air Release Chamber	each	2	$ 25,000.00	$50,000.00
7	Forcemain Drain	each	3	$ 6,000.00	$18,000.00
8	WWTP Pump Upgrades	L.S.	1	$ 150,000.00	$150,000.00
	A. Sewer Construction Subtotal				**$2,046,750.00**
B	**Provisional Items**				
9	Rock Excavation	m^3	125	$ 100.00	$12,500.00
10	Trench Excavation Unsuitable Material	m^3	125	$ 20.00	$2,500.00
11	Replacement of Unsuitable Material	m^3	125	$ 30.00	$3,750.00
	C. Provisional Items Subtotal				**$18,750.00**
	Summary of Tender				
	A. Sewer Construction Subtotal				$2,046,750.00
	B. Provisional Items Subtotal				$18,750.00
	C. Construction Contingency (10%)				$206,550.00
	D. Design Development Contingency (25%)				$516,375.00
	E. Engineering Contingency (15%)				$309,825.00
	Estimated Price (excluding HST)				**$3,098,250.00**
	Add HST (15% of Total Tendered Price)				$464,737.50
	Total Price				$3,562,987.50

THIS OPINION OF PROBABLE COSTS IS PRESENTED ON THE BASIS OF EXPERIENCE, QUALIFICATIONS, AND BEST JUDGEMENT. IT HAS BEEN PREPARED IN ACCORDANCE WITH ACCEPTABLE PRINCIPLES AND PRACTICES. MARKET TRENDS, NON-COMPETITIVE BIDDING SITUATIONS, UNFORESEEN LABOUR AND MATERIAL ADJUSTMENTS AND THE LIKE ARE BEYOND THE CONTROL OF CBCL LIMITED. AS SUCH WE CANNOT WARRANT OR GUARANTEE THAT ACTUAL COSTS WILL NOT VARY FROM THE OPINION PROVIDED.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