







Near-Term Upgrades Town of Lunenburg Wastewater Treatment Plant

Final Report



210803.01 • August 2021

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August 12, 2021

Dennis MacPherson, Town Engineer
Public Works, Town of Lunenburg
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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 predesign 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.

Yours very truly,

CBCL Limited

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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
<i>E. coli</i>	Escherichia Coli
H ₂ S	Hydrogen Sulphide
MBBR	Moving Bed Bio-reactor
NSECC	Nova Scotia Environment and Climate Change
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 pipework;
- ▶ Modification of the headworks water supply pipework;
- ▶ Replacement of headworks grating and hatches;
- ▶ Replacement of the aeration blowers;
- ▶ Replacement of the compressed air pipework;
- ▶ 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.

This report should be read in conjunction with the Town of Lunenburg WWTP Long Term Expansion Conceptual Design Report (CBCL Limited, 2021) and the Town of Lunenburg Wastewater Outfall Extension Pre-Design (CBCL Limited, 2021). This report does not include upgrade or modifications to the existing Plant PLC/HMI control system.

Chapter 2 Design Basis

2.1 Wastewater Flow Characteristics

Wastewater flows and influent characteristics were analyzed during the WWTP Evaluation and Option Identification Study (CBCL Limited, 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.

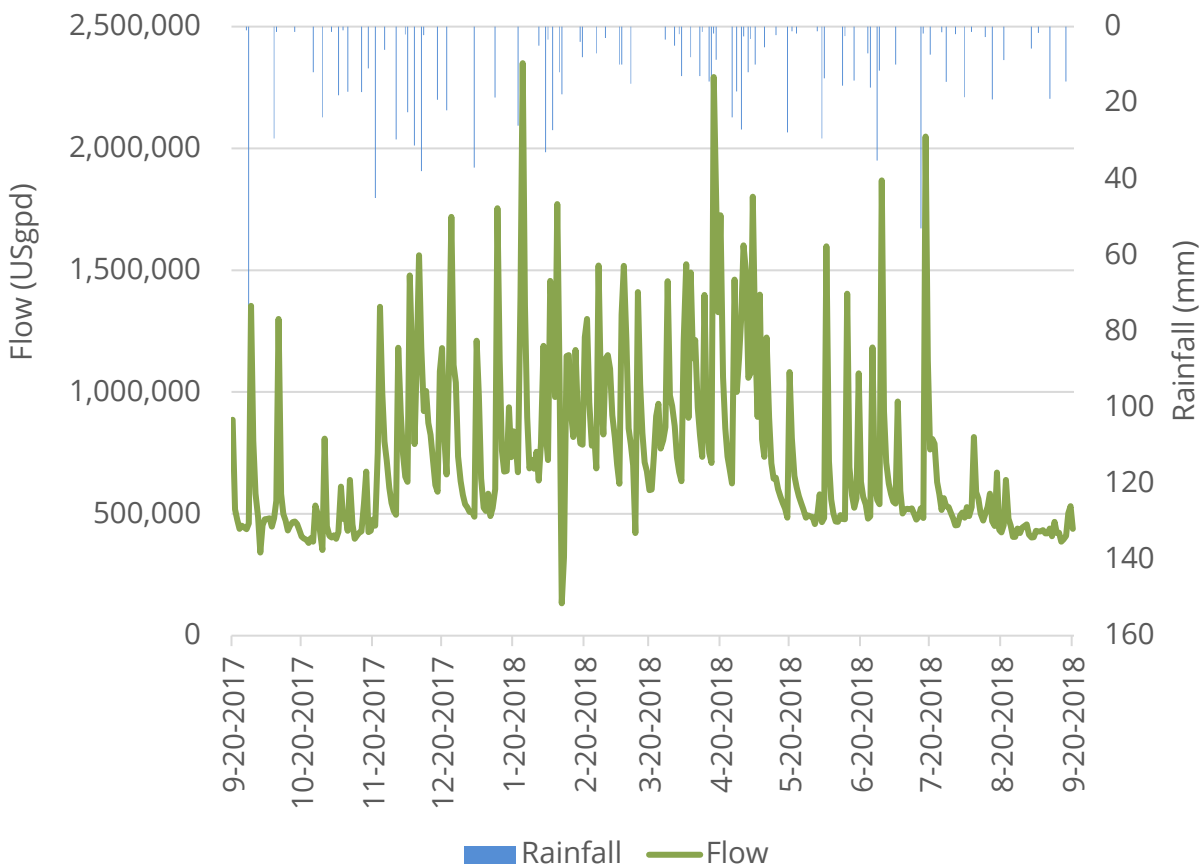


Figure 1: Wastewater Flows

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 has 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 modifications 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 and Climate Change (NSECC) 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
<i>E. coli</i> (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 pipework, 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 Pipework and Grit Water Supply Pipework

The grit pipework 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 pipework. Although the pipework was upsized at that time, the plant still frequently experiences blockages within the pipework 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, pipework 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 pipework 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 pipework 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

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



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

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.

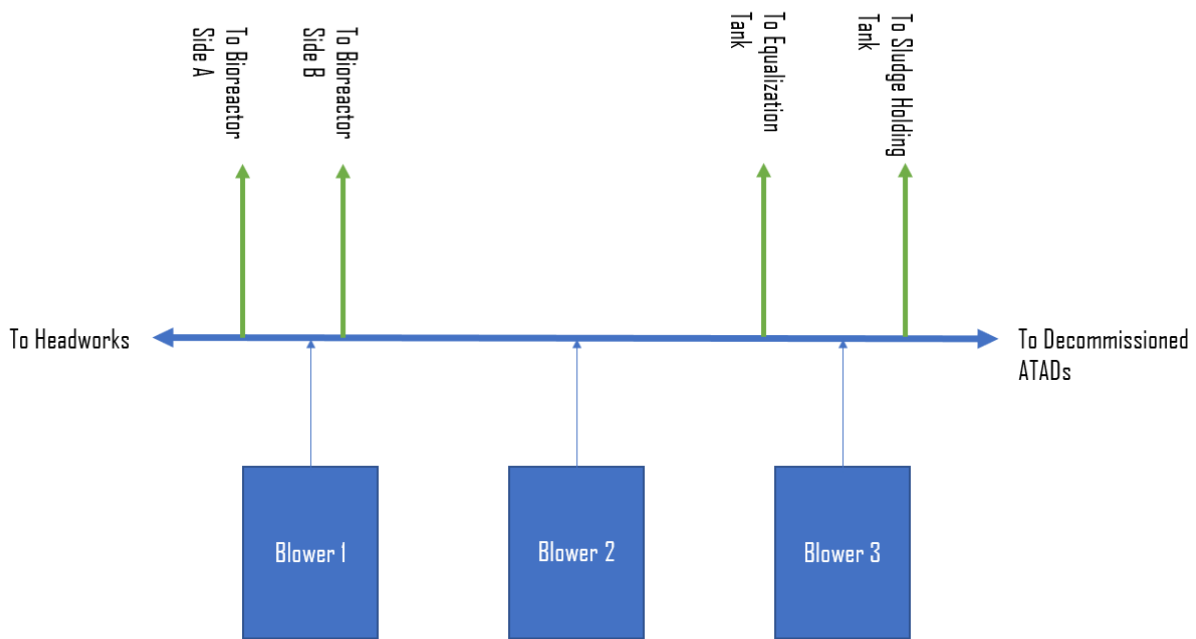


Figure 5: Existing Aeration Header Arrangement

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.



Figure 6: Existing Blower Room

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 H₂S 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.

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.



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

3.2.10.2 H₂S Capture in Process Room

There were several areas identified within the Process Room where the capture of H₂S 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 H₂S 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 Pipework

The existing compressed air pipework is original to the plant and was originally installed without a dryer. The compressed air pipework 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 pipework/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 and includes a pivot point. The existing channel width is approximately 18" in width and the proposed screening surface width is 11", with a frame on either side. 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 Pipework

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 pipework is critical to the overall efficiency of the aerated grit chamber. To reduce the risk of clogging or abrasion the pipework 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 pipework is equipped with appropriate bends but is undersized at 2½" diameter. The increased size of the grit pipework along with the improved screenings capture rate will reduce the risk of plugging and abrasion of the pipework. 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 pipework arrangement, both above and below the floor level of the headworks room but using 3" schedule 10 stainless steel pipework.

It is proposed that the existing water pipework be removed, and new pipework installed complete with heat tracing and insulation. Refer to mechanical sketch in Appendix A for the potable water pipework 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 blower intake and discharge will be insulated to match.

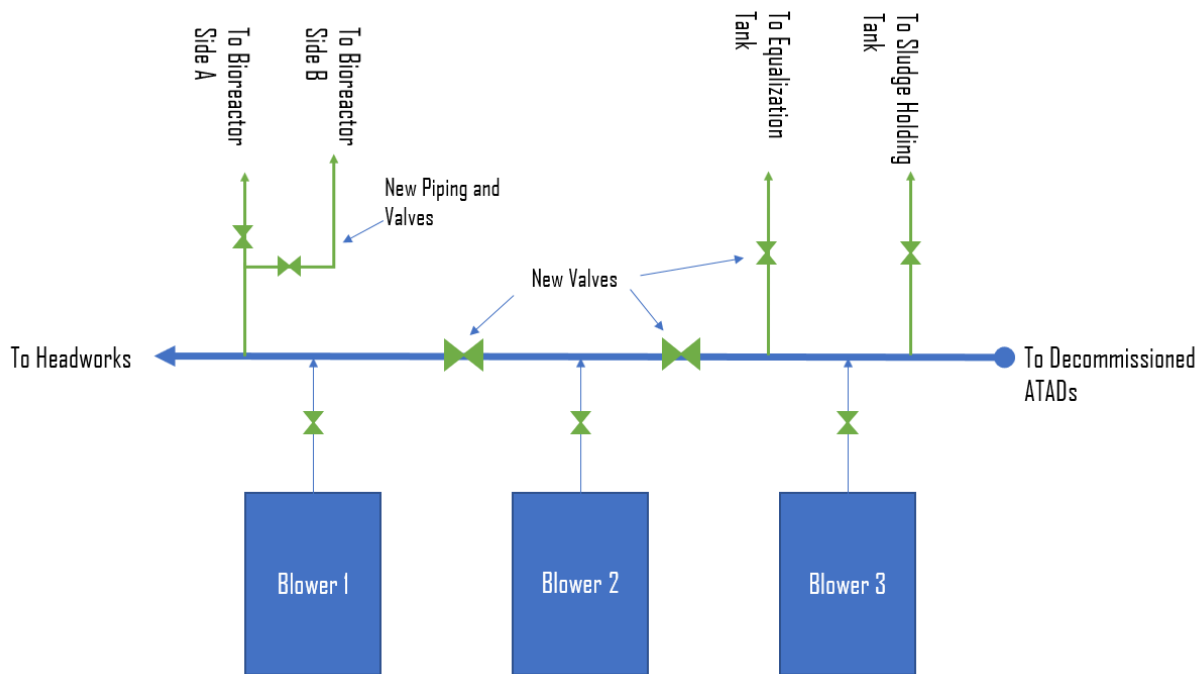


Figure 11: Proposed Aeration Header Modifications

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 3.5 ft 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 from the control panels. The new blowers will be wired from the ceiling, in line with the latest electrical code.

All aeration pipework (air intake, blower outlets, aeration headers, and laterals) will be replaced. As noted above, the blower intakes and discharges will be insulated. 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 three (3) dissolved oxygen (DO) probes: one in each bioreactor train, and 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 TSS and conductivity readings 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 has 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 supplying 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 is 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 capacity is required at the plant to consistently meet effluent limits. The current disinfection equipment is not sufficient, as the UV transmittance through the effluent is lower than required. This blocks UV light so that it cannot disinfect the effluent to the level required. 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 somewhat, but this is not certain. The UV transmittance at the plant falls below the required 60% in summertime, 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 considered 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 additional UV bank is needed during the summertime, but could be turned down or turned off to save electricity when it is not required, according to operator daily UVT results.

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 (<i>E. coli</i> / 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 pipework from the blowers. There is approximately 160 ft² of exposed surface area of hot pipework, operating as high as 155°F, or roughly 70°C. This exposed pipework 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 pipework 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 H₂S Capture in Process Room

In order to improve the H₂S capture within the process room it is recommended that re-routing of ductwork and capping of exhaust grilles be implemented. H₂S 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 Pipework

In order to remove corroded sections within the compressed air pipework network, the pipework 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 to use galvanized pipework for the new pipe runs. Refer to Appendix A for compressed air pipework 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 are 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 that 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 190m³ (6,710 ft³). A rough calculation of the amount of 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 330m³ (11,654 ft³) 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 pipework;
- ▶ 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 be 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 used 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 pipework 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 pipework could be replaced by running the new pipework 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 Pipework)	4	5	3	5	5	2	24
Aeration Upgrades	5	5	3	3	4	4	24
Compressor Pipework	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 ₂ S 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, in order of priority, should include:

- ▶ Flood Control;
- ▶ UV Upgrades;
- ▶ Polymer Dosing System;
- ▶ Headworks Modifications (Screen, Compactor, Hatches, Grit Pipework);
- ▶ Aeration Upgrades;
- ▶ Online Instrumentation;
- ▶ Standby Generator; and
- ▶ Building Mechanical Upgrades (HVAC, H2S Capture and Service Water).

Lower priority items that could be deferred include:

- ▶ DAF Weir Level Control;
- ▶ Polymer Make Down System; and
- ▶ Compressor Pipework.

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 pre-design 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 Pipework)	\$437,000	\$87,000	\$44,000	\$66,000	\$634,000
Aeration Upgrades	\$425,000	\$85,000	\$43,000	\$64,000	\$617,000
Compressor Pipework	\$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 ₂ S Capture and Service Water)	\$60,000	\$12,000	\$6,000	\$9,000	\$87,000
Flood Control	\$146,000	\$29,000	\$15,000	\$22,000	\$212,000
Total					\$3,604,000

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 significantly 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.

7.1 Highest Priority Items

It is recommended that the highest priority items including flood control, UV upgrades, and the minimum polymer dosing system pump replacement items be undertaken as soon as possible. These items are an immediate risk to the successful and compliant operation of the existing WWTP. Flood control and UV upgrades are relevant to all the future expansion options, while the polymer pumps themselves are required to operate the existing process and are in poor condition.

7.2 Items That Depend On Expansion Timing

If the recommended SBR expansion option is completed within the next five or six years, more extensive replacement of the polymer dosing system would not be required, and the headworks modifications, aeration upgrades, online instrumentation, building mechanical upgrades and standby generator could be considered prior to expansion construction or completed at the same time. These items are highlighted based on their benefit to operations, health & safety, and/or improvement to the process. If the expansion is not going to occur within five or six years, then it is recommended that these near-term items (which could all be used in the expanded plant) are carried out prior to the expansion.

The remaining near-term items, including DAF weir level control, polymer make down system and compressor pipework are still important to maintaining a safe and operable plant if the existing process is to operate for more than another ten years, but would not be required if the SBR expansion was carried out within that timeframe.

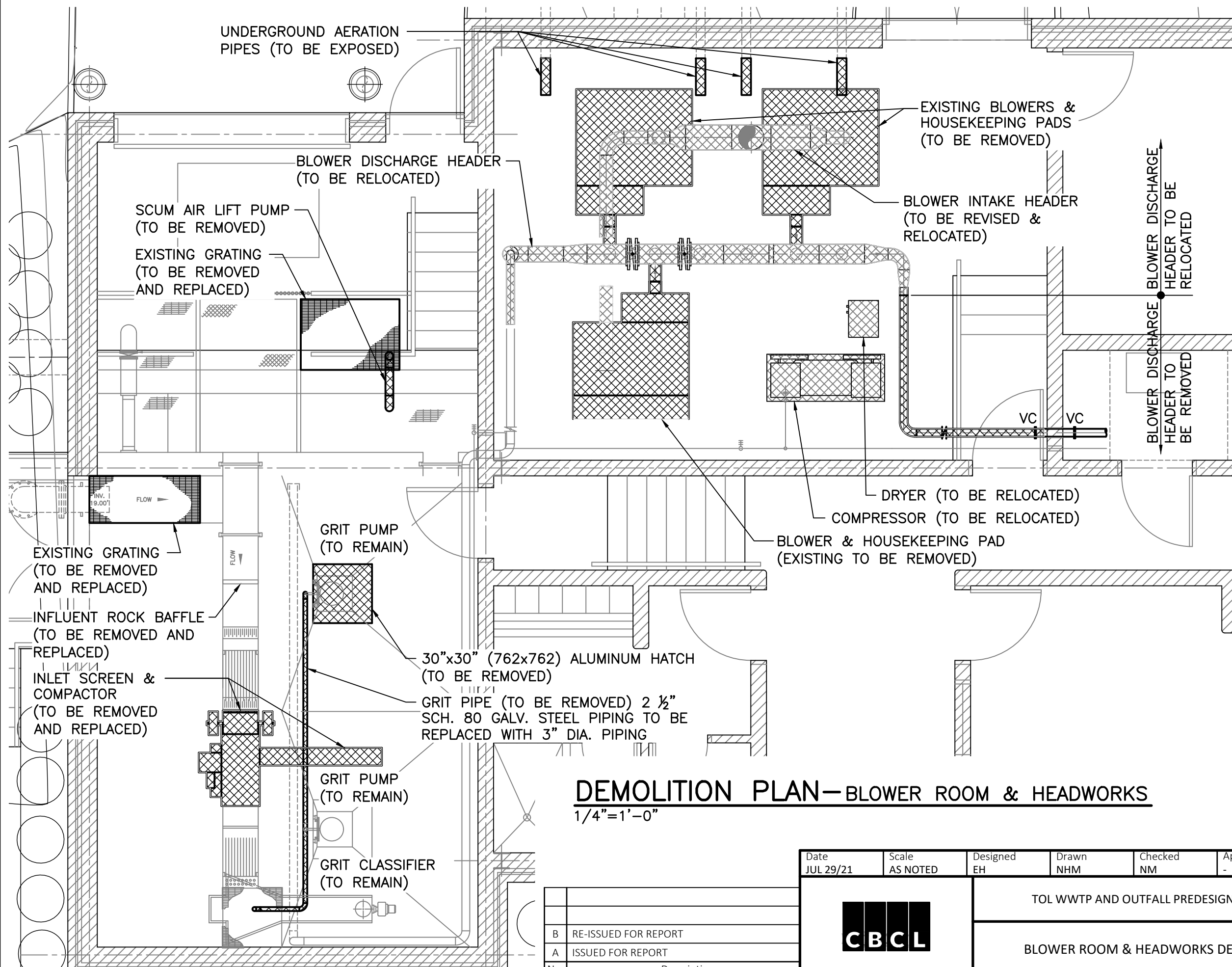
Chapter 8 References

- ACWWA. (2006). *Atlantic Canada Wastewater Guidelines Manual for Collection, Treatment and Disposal*. Environment Canada.
- CBCL Limited. (2019). *Town of Lunenburg Wastewater Treatment Plant Evaluation and Options Identification*.
- CBCL Limited. (2021). *Town of Lunenburg Wastewater Outfall Extension Pre-Design*.
- CBCL Limited. (2021). *Town of Lunenburg WWTP Long Term Expansion Conceptual Design*.

APPENDIX A

Predesign Sketches

DRAWING NAME: Y:\HALIFAX\DATA\PROJECTS\210803.01.TOL.WWTP & OUTFALL PREDESIGN AND BCA\44 CAD\06 PROCESS\210803.01-D01.DWG LAYOUT NAME: PSK01 PLOT DATE: JULY 29, 2021 2:08:42 PM CAD OPERATOR: NOELM



DEMOLITION NOTES:

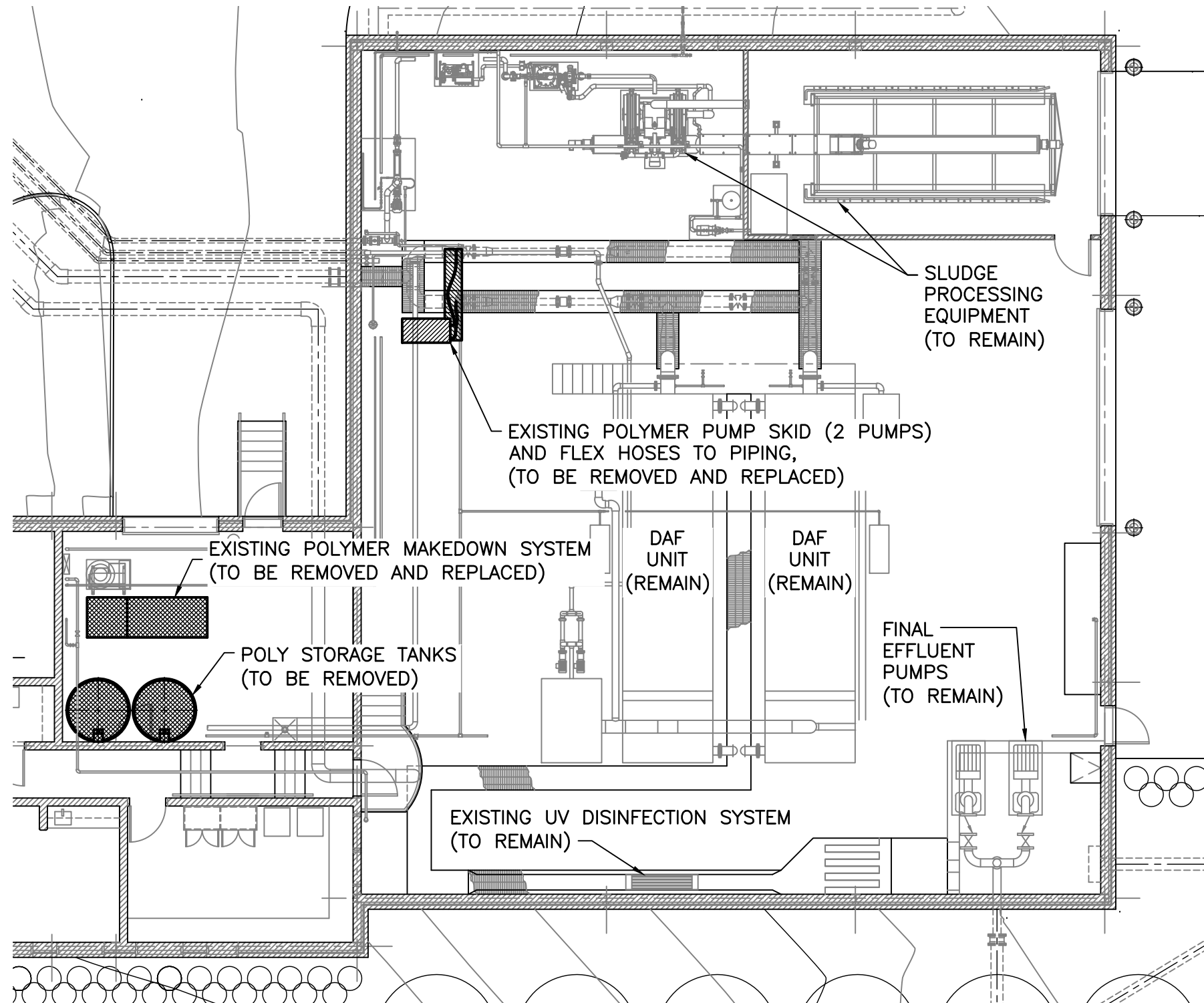
1. PRIOR TO UNDERTAKING DEMOLITION AND CONSTRUCTION, CONTRACTOR SHALL SUBMIT A PLAN/SCHEDULE OUTLINING THE PROCESS.
2. EXISTING UTILITY/SITE SERVICES (PIPING, VALVES, FITTINGS, CONDUIT, ETC.) INFORMATION IS SHOWN AS APPROXIMATE ONLY.

REMOVALS/ALTERATIONS

DEMOLITION PLAN—BLOWER ROOM & HEADWORKS
1/4"=1'-0"

Date JUL 29/21	Scale AS NOTED	Designed EH	Drawn NHM	Checked NM	Approved -	CBCL No. 210803.01	Contract -
						TOL WWTP AND OUTFALL PREDESIGN AND BCA	
						BLOWER ROOM & HEADWORKS DEMOLITION	
Drawing							PSK01
No.	Description						

DRAWING NAME: Y:\HALIFAX\DATA\PROJECTS\210803.01.TOL.WWTP & OUTFALL PREDESIGN AND BCA\44 CAD\06 PROCESS\210803.01-D01.DWG LAYOUT NAME: PSK02 PLOT DATE: JULY 29, 2021 2:08:45 PM CAD OPERATOR: NOELM



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

DEMOLITION PLAN—PROCESS & CHEMICAL ROOMS

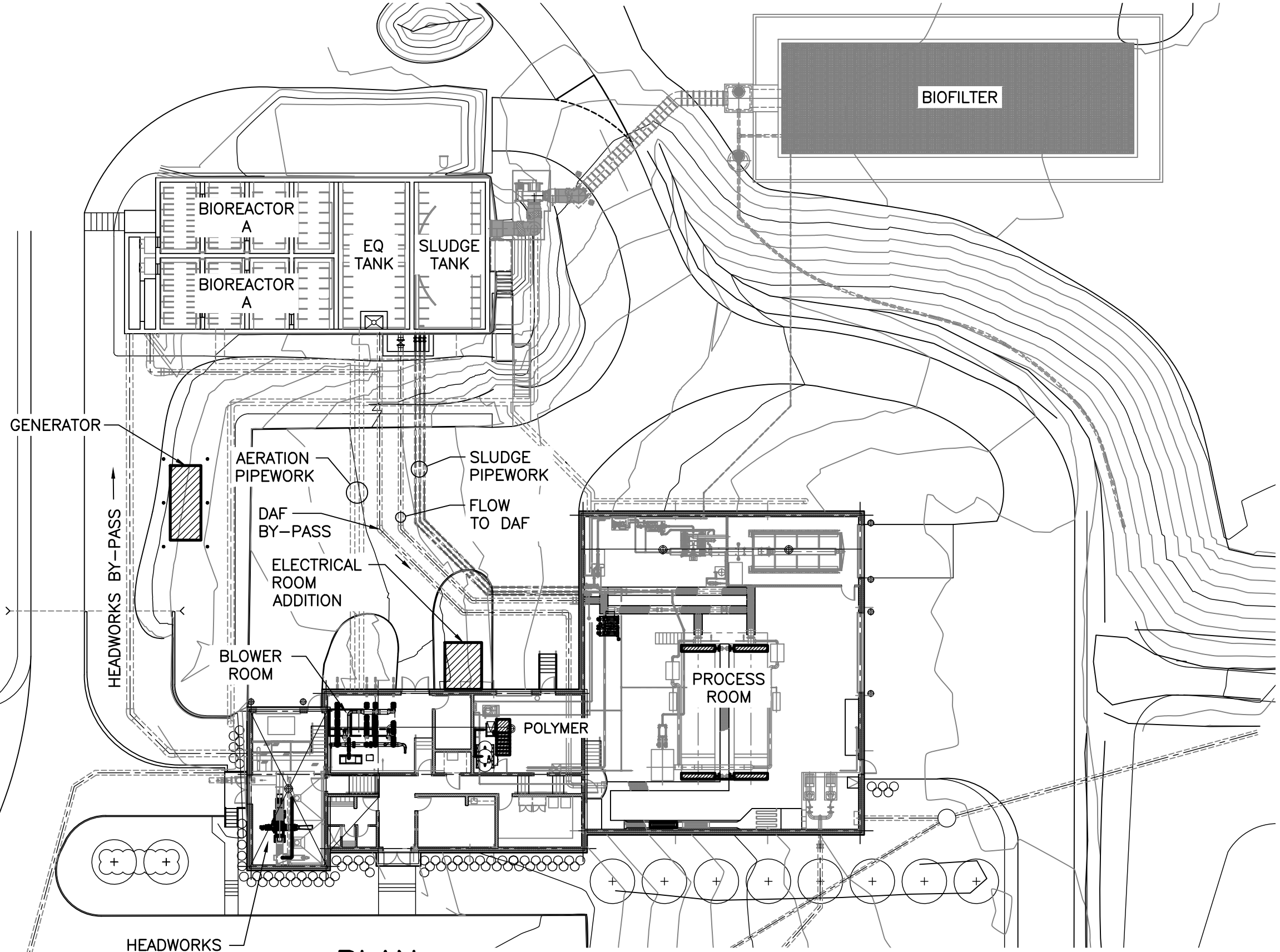
3/32"=1'-0"

	Date JUL 29/21	Scale AS NOTED	Designed EH	Drawn NHM	Checked NM	Approved -	CBCL No. 210803.01	Contract -
							Drawing	
	TOL WWTP AND OUTFALL PREDESIGN AND BCA						<h1>PSK02</h1>	
	PROCESS ROOM & CHEMICAL ROOM DEMOLITION							
No.	Description							
B	RE-ISSUED FOR REPORT							
A	ISSUED FOR REPORT							



NOTES:

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



PLAN— LUNENBURG WWTreatment SITE
1"=10'-0"



No.	Description
B	RE-ISSUED FOR REPORT
A	ISSUED FOR REPORT

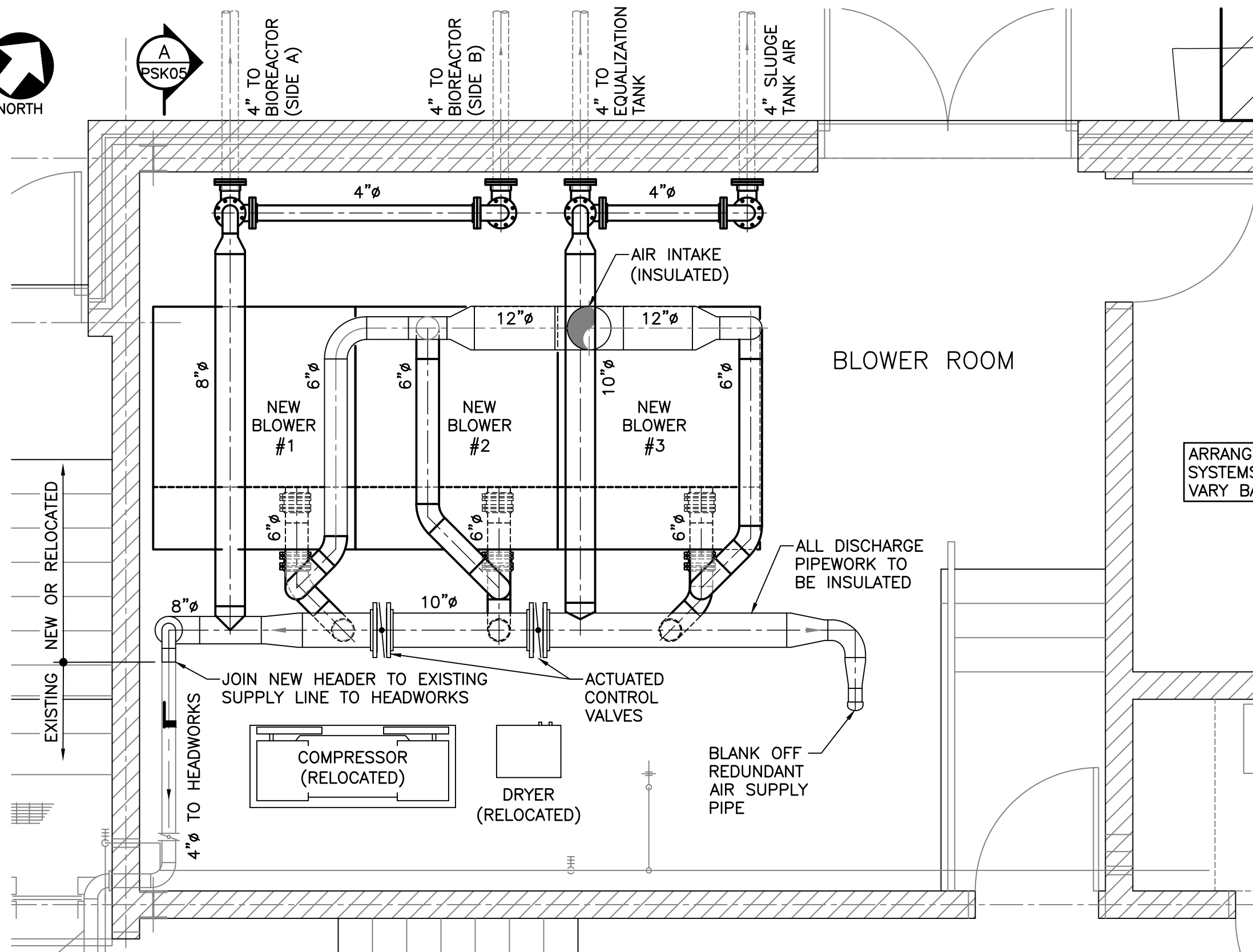
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						TOL WWTP AND OUTFALL PREDESIGN AND BCA	
						Drawing PSK03	
SITE PLAN							

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LEGEND:


-  NEW PIPE
-  EXISTING PIPE



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
B	RE-ISSUED FOR REPORT
A	ISSUED FOR REPORT

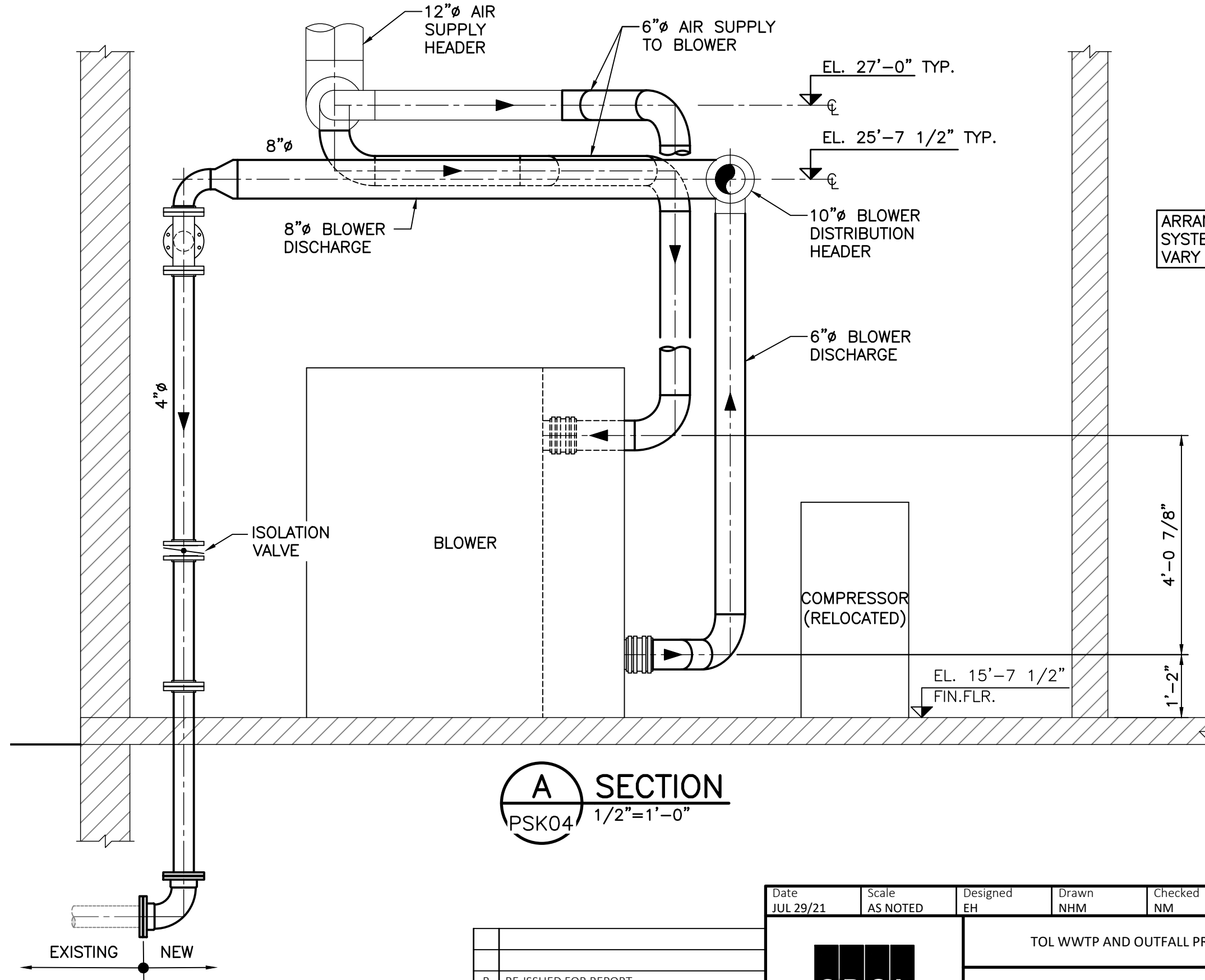
Date JUL 29/21	Scale AS NOTED	Designed EH	Drawn NHM	Checked NM	Approved -	CBCL No. 210803.01	Contract -
						TOL WWTP AND OUTFALL PREDESIGN AND BCA	
						BLOWER ROOM PLAN	

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LEGEND:

- NEW PIPE
- EXISTING PIPE



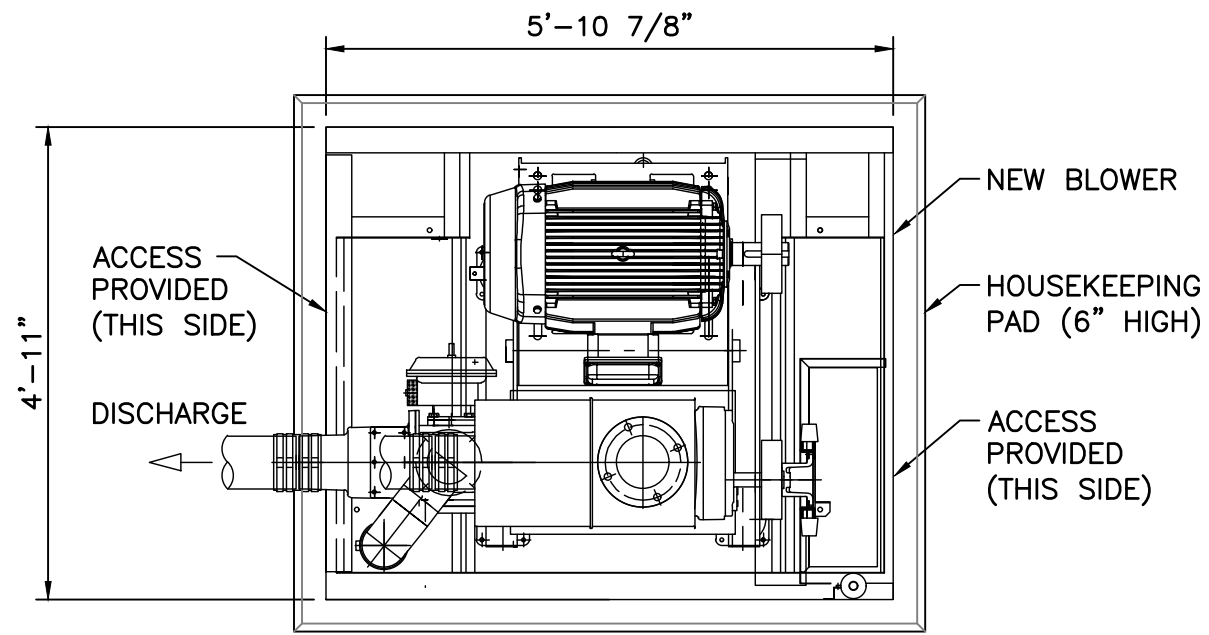
A SECTION
PSK04 1/2"=1'-0"

No.	Description
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A	ISSUED FOR REPORT

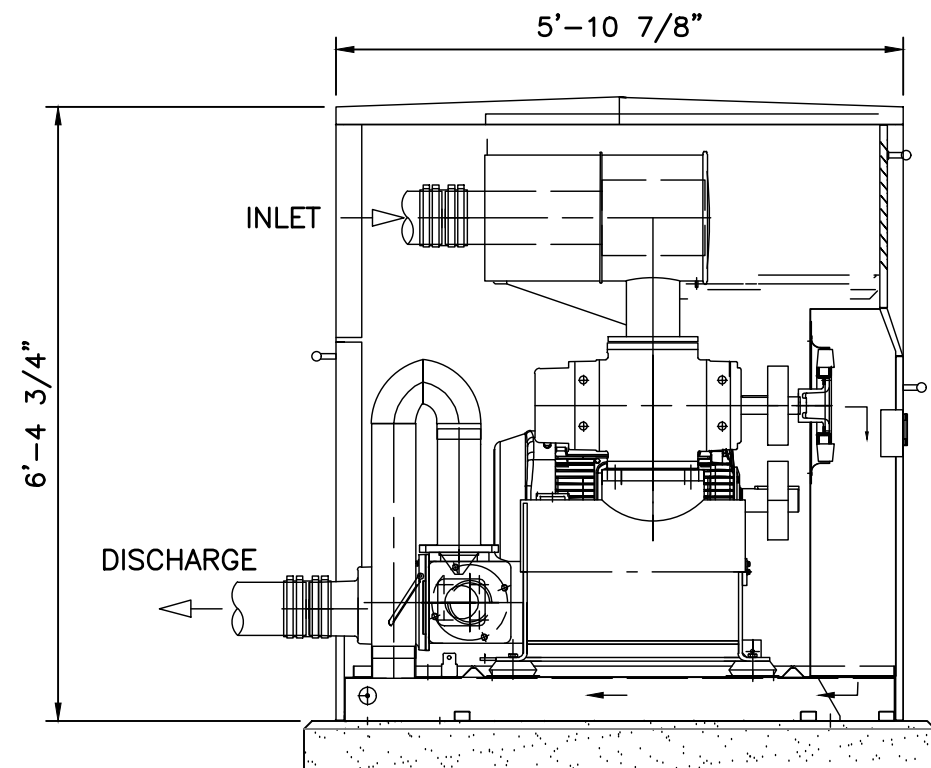
Date JUL 29/21	Scale AS NOTED	Designed EH	Drawn NHM	Checked NM	Approved -	CBCL No. 210803.01	Contract -
TOL WWTP AND OUTFALL PREDESIGN AND BCA						Drawing	
						PSK05	
BLOWER ROOM SECTION							

DRAWING NAME: Y:\HALIFAX\DATA\PROJECTS\210803.01.TOL.WWTP & OUTFALL PREDESIGN AND BCA\44 CAD\06 PROCESS\210803.01-P02.DWG LAYOUT NAME: PSK06 PLOT DATE: JULY 29, 2021 2:09:15 PM CAD OPERATOR: NOELM

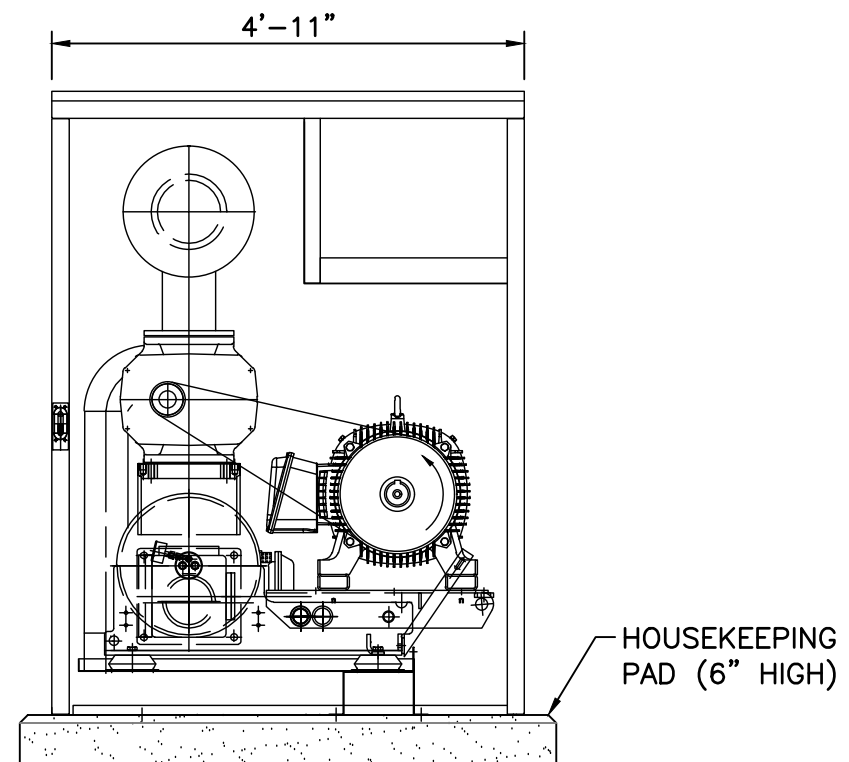
ARRANGEMENTS PROVIDED ARE FOR TYPICAL SYSTEMS. FINAL EQUIPMENT SELECTION MAY VARY BASED ON DETAILED DESIGN.



PLAN



ELEVATION

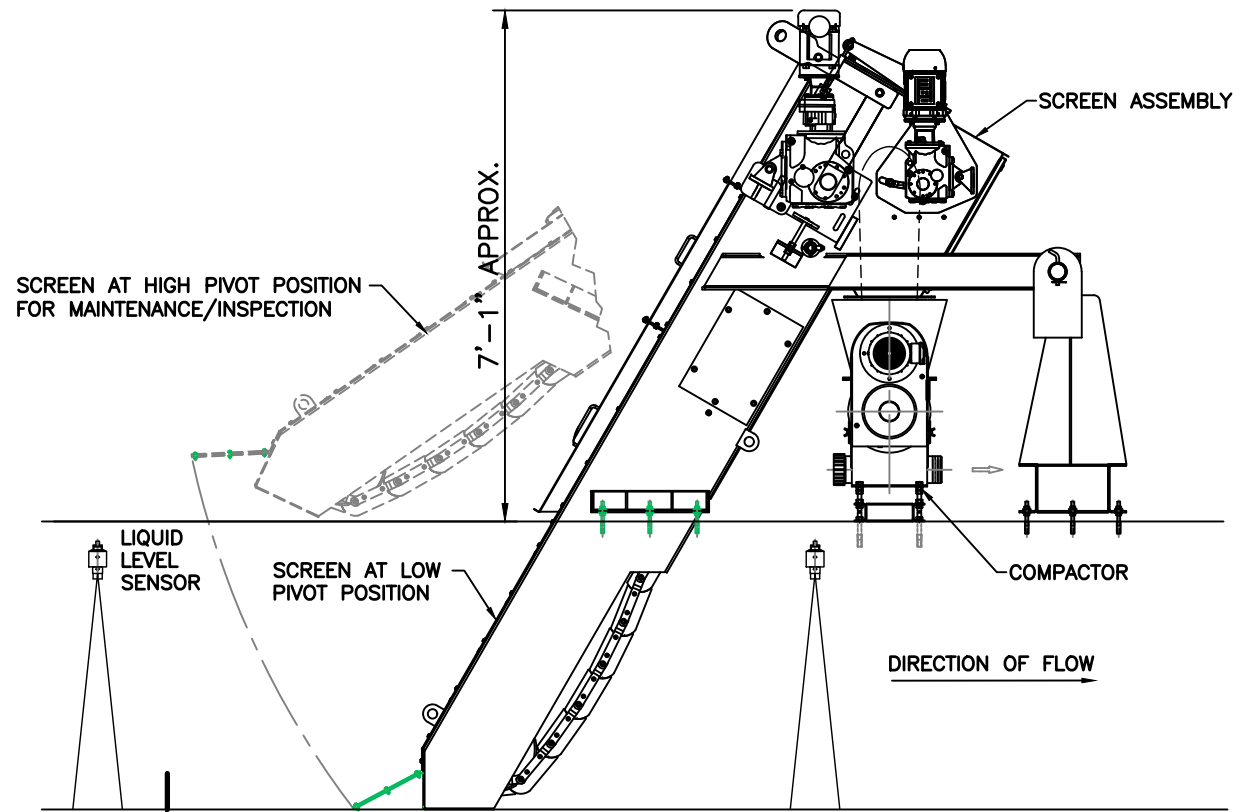
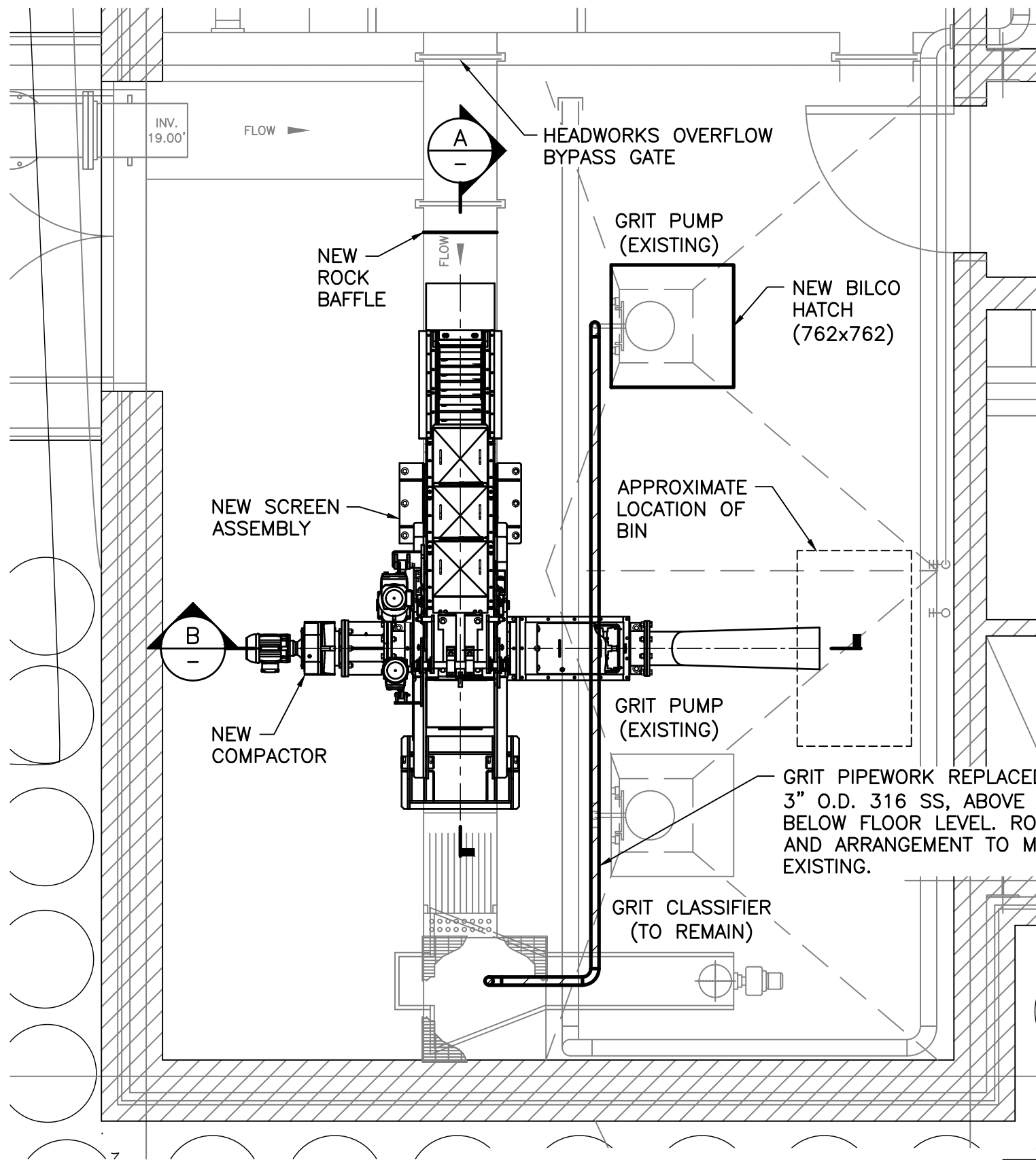


ELEVATION

BLOWER
1/2"=1'-0"

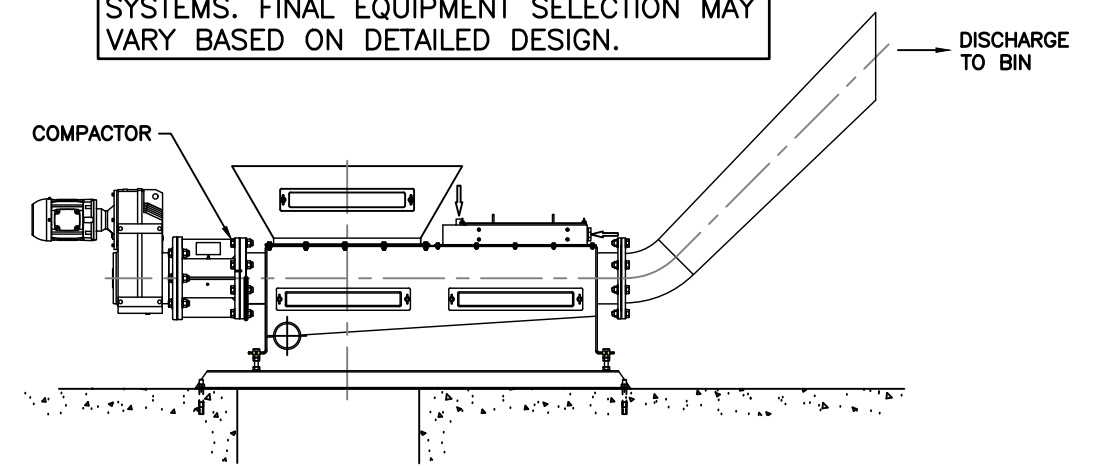
No.	Description
B	RE-ISSUED FOR REPORT
A	ISSUED FOR REPORT

Date JUL 29/21	Scale AS NOTED	Designed EH	Drawn NHM	Checked NM	Approved -	CBCL No. 210803.01	Contract -
CBCL		TOL WWTP AND OUTFALL PREDESIGN AND BCA				Drawing PSK06	
		BLOWER PLAN & SECTIONS					



A SECTION — SCREEN ASSEMBLY
3/8" = 1'-0"


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



B SECTION — COMPACTOR
3/8" = 1'-0"

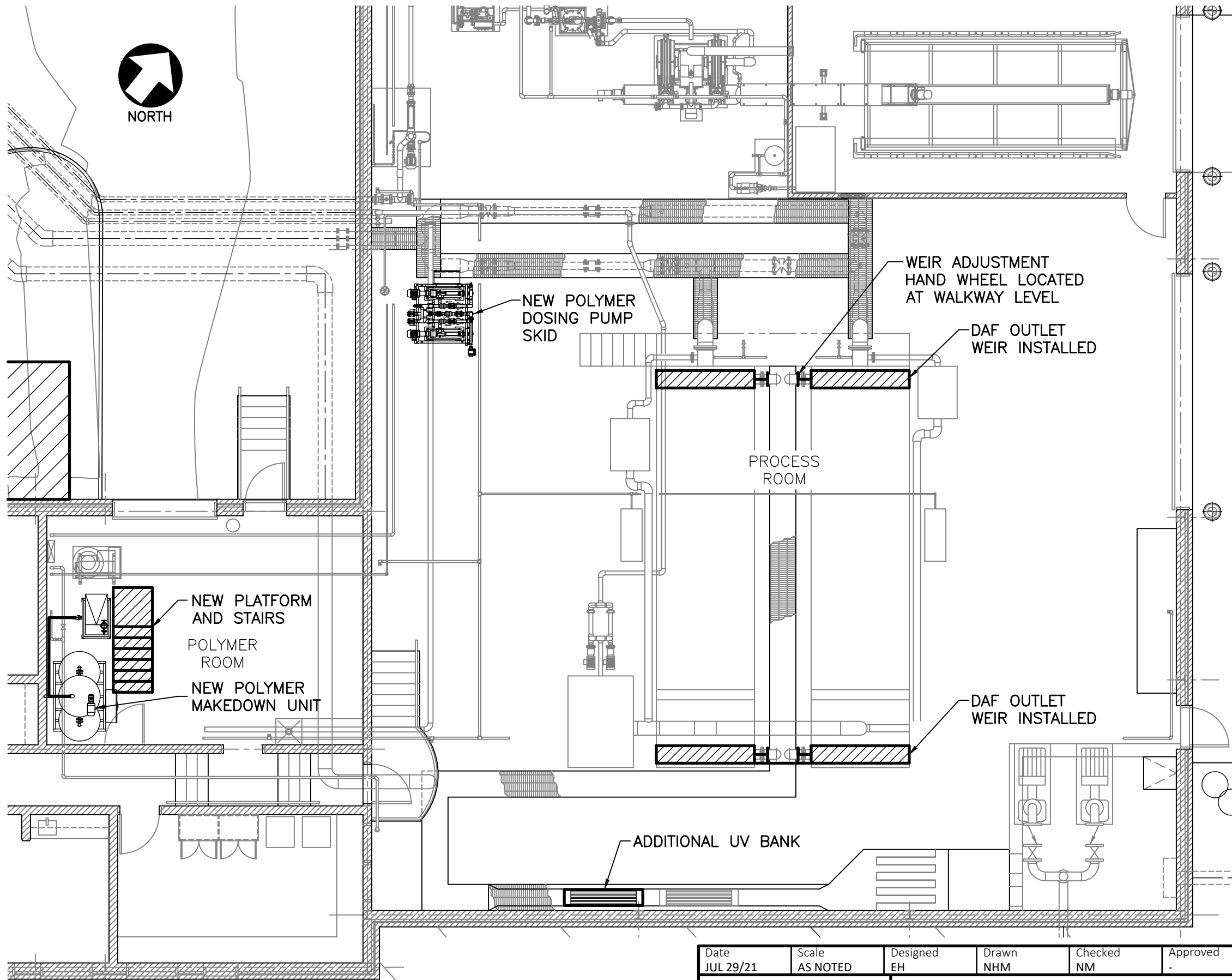
PARTIAL PLAN — HEADWORKS
3/8" = 1'-0"

No.	Description
B	RE-ISSUED FOR REPORT
A	ISSUED FOR REPORT

Date JUL 29/21	Scale AS NOTED	Designed EH	Drawn NHM	Checked NM	Approved -	CBCL No. 210803.01	Contract -
						Drawing	
						TOL WWTP AND OUTFALL PREDESIGN AND BCA	
HEADWORKS PLAN & SECTIONS							

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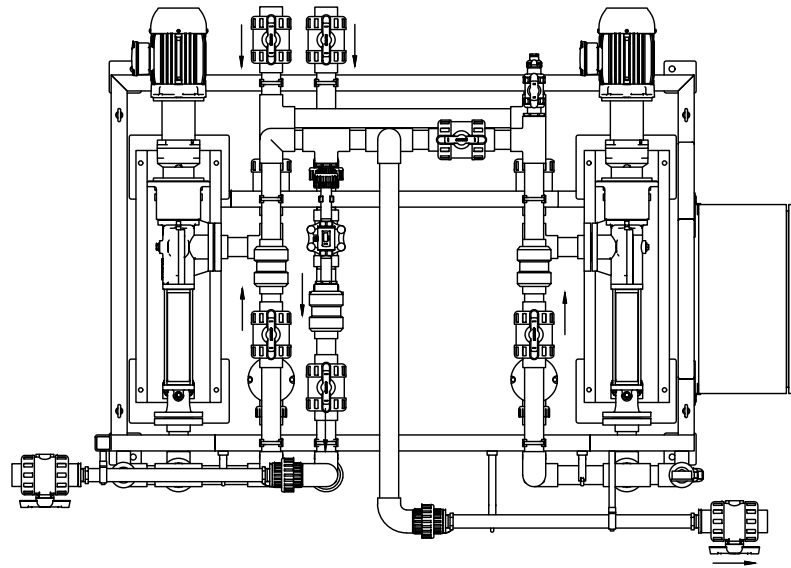


PLAN— PROCESS ROOM
1/8"=1'-0"

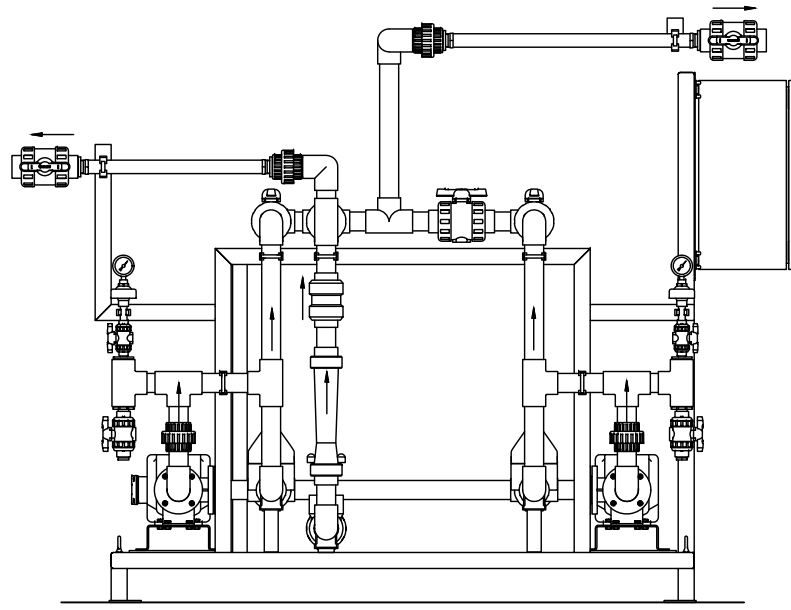
No.	Description
B	RE-ISSUED FOR REPORT
A	ISSUED FOR REPORT

Date JUL 29/21	Scale AS NOTED	Designed EH	Drawn NHM	Checked NM	Approved -	CBCL No. 210803.01	Contract -
CBCL						TOL WWTP AND OUTFALL PREDESIGN AND BCA	
						PROCESS ROOM & POLYMER ROOM PLAN	

DRAWING NAME: Y:\HALIFAX\DATA\PROJECTS\210803.01.TOL.WWTP & OUTFALL PREDESIGN AND BCA\44 CAD\06 PROCESS\210803.01-P04.DWG LAYOUT NAME: PSK09.PLOT DATE: JULY 29, 2021 2:09:48 PM CAD OPERATOR: NCELM

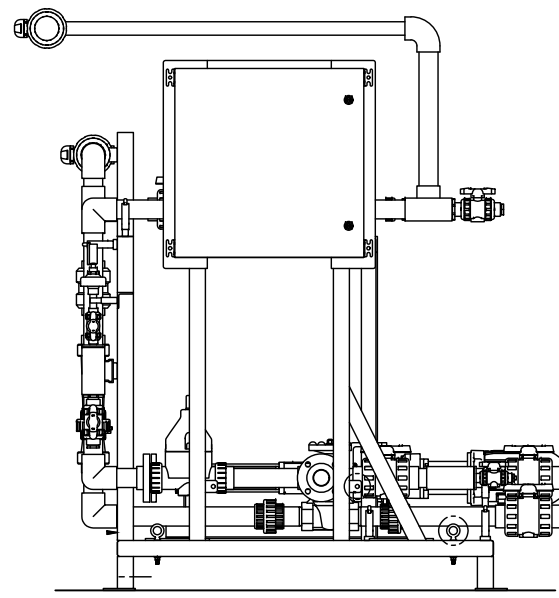


PLAN

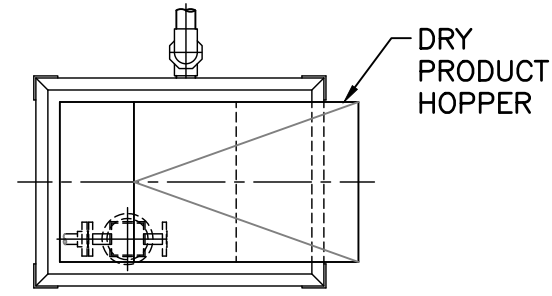


ELEVATION

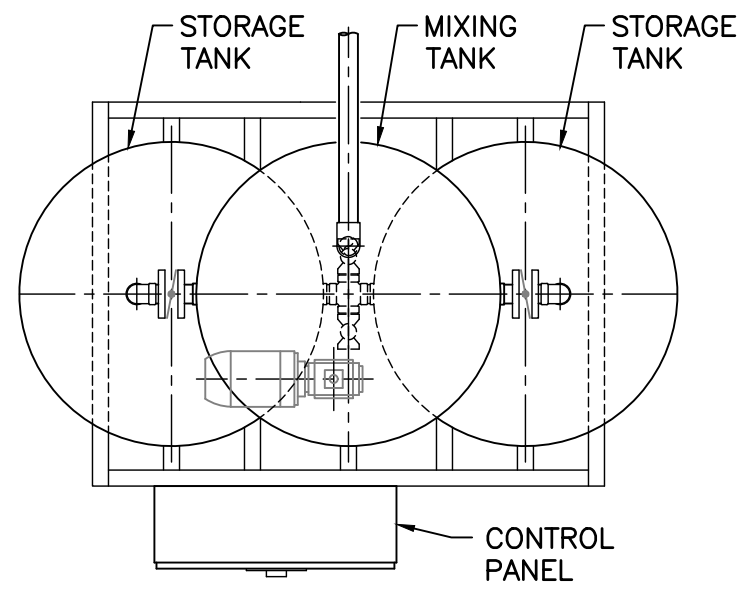
POLYMER DOSING SYSTEM
1/2"=1'-0"



ELEVATION



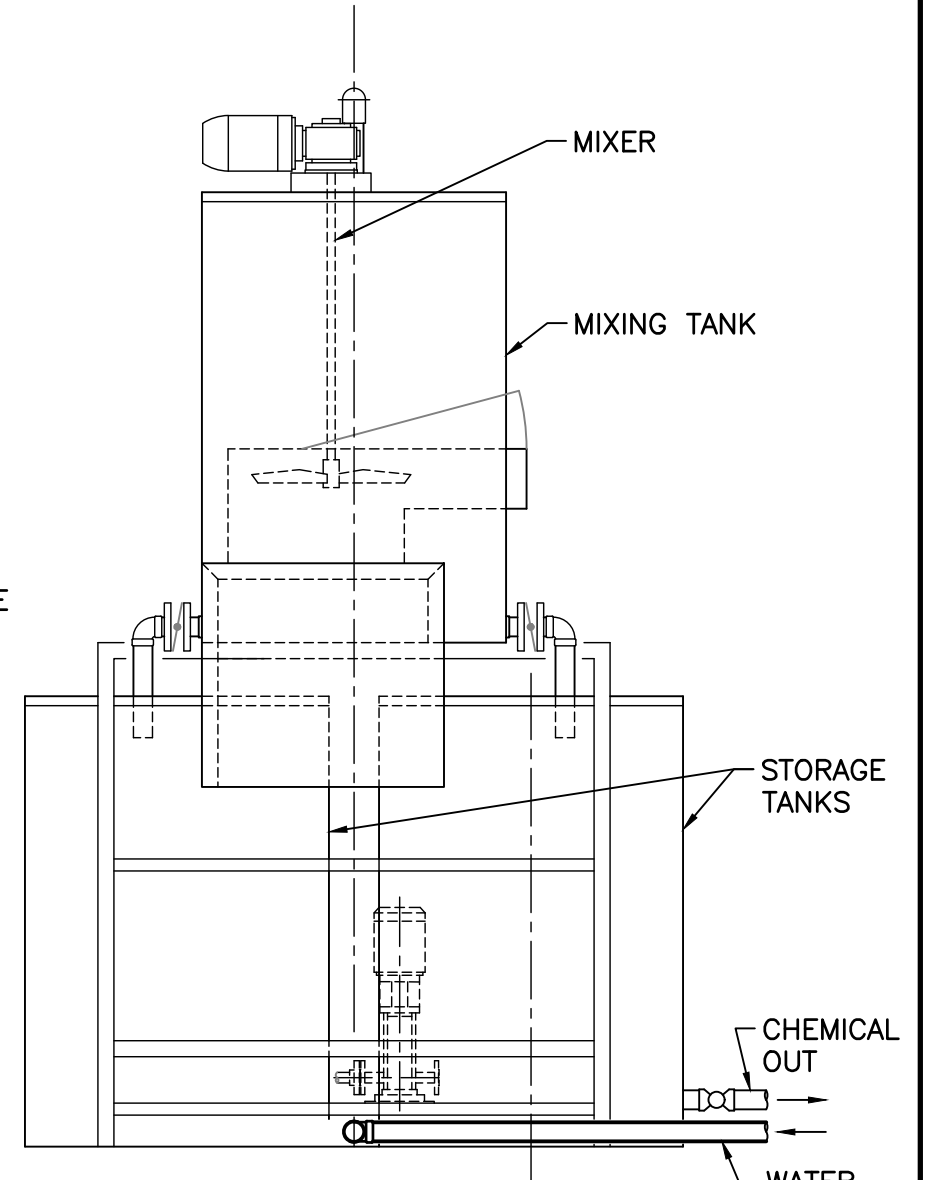
PLAN



PLAN


POLYMER MAKE DOWN ASSEMBLY
1/2"=1'-0"

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

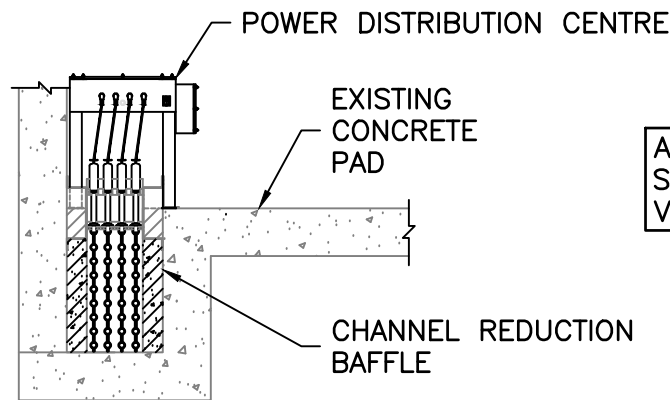
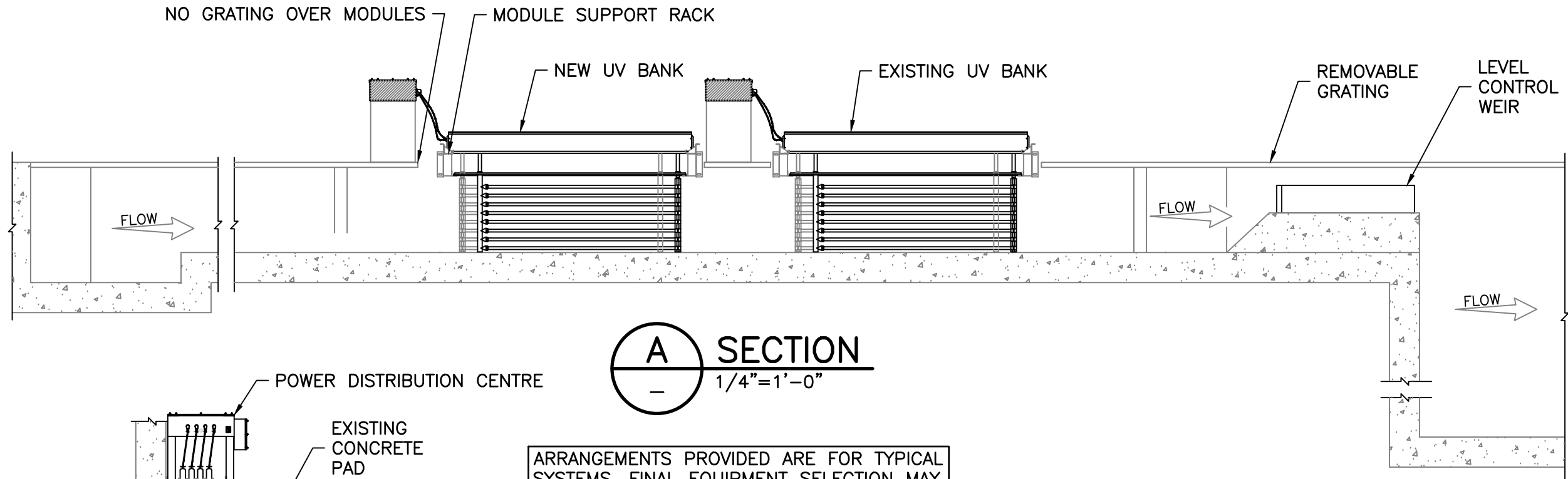
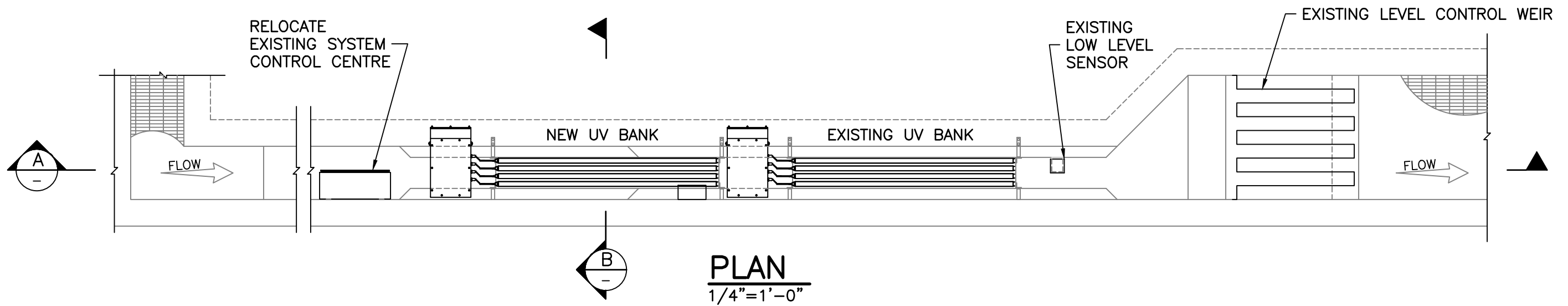


ELEVATION

No.	Description
B	RE-ISSUED FOR REPORT
A	ISSUED FOR REPORT

Date JUL 29/21	Scale AS NOTED	Designed EH	Drawn NHM	Checked NM	Approved -	CBCL No. 210803.01	Contract -
						TOL WWTP AND OUTFALL PREDESIGN AND BCA	
						POLYMER DOSING SYSTEM & POLYMER MAKE DOWN ASSEMBLY	

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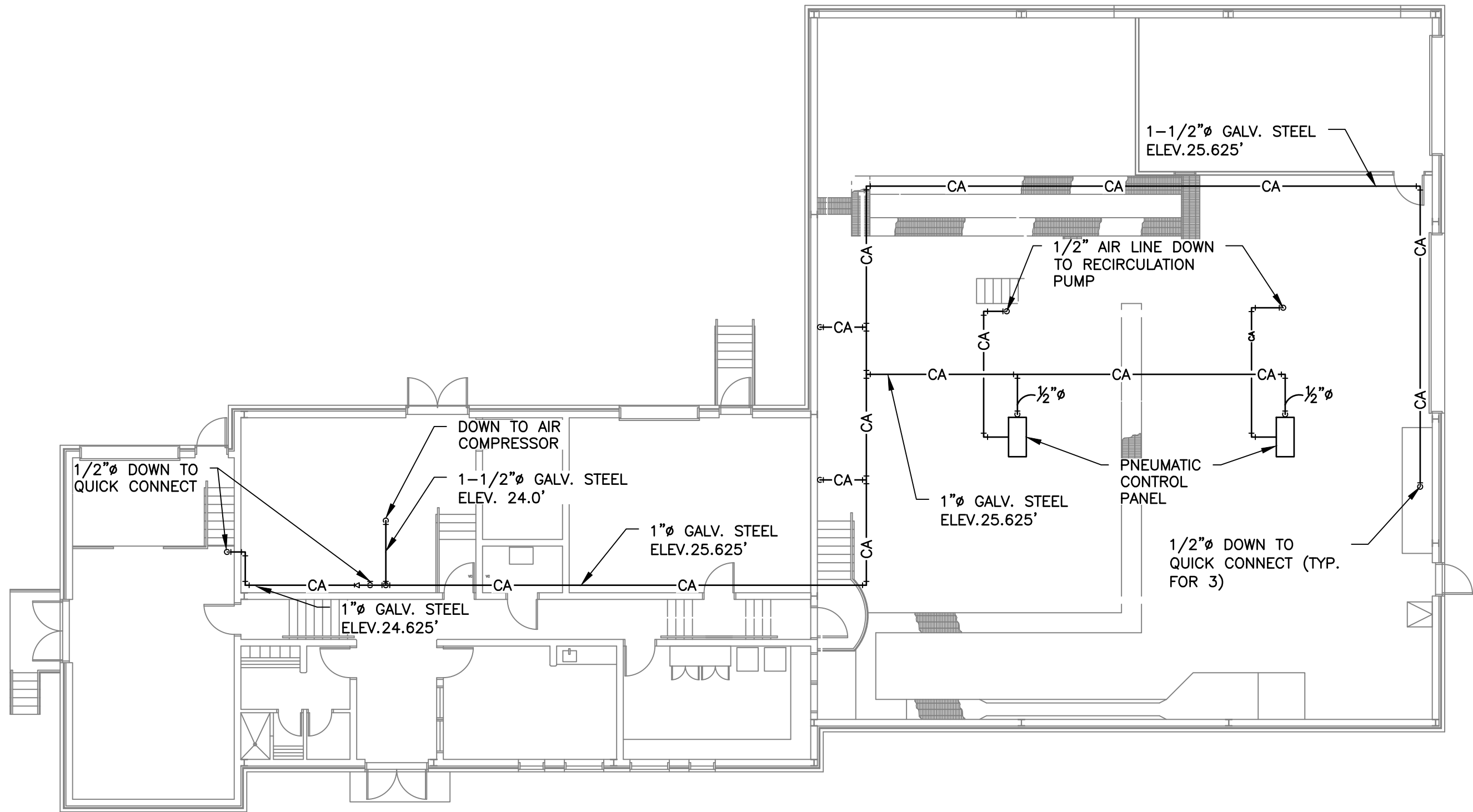


ARRANGEMENTS PROVIDED ARE FOR TYPICAL SYSTEMS. FINAL EQUIPMENT SELECTION MAY VARY BASED ON DETAILED DESIGN.

No.	Description
B	RE-ISSUED FOR REPORT
A	ISSUED FOR REPORT

Date JUL 29/21	Scale AS NOTED	Designed EH	Drawn NHM	Checked NM	Approved -	CBCL No. 210803.01	Contract -
CBCL		TOL WWTP AND OUTFALL PREDESIGN AND BCA				Drawing	
		IN CHANNEL UV UNIT				PSK10	

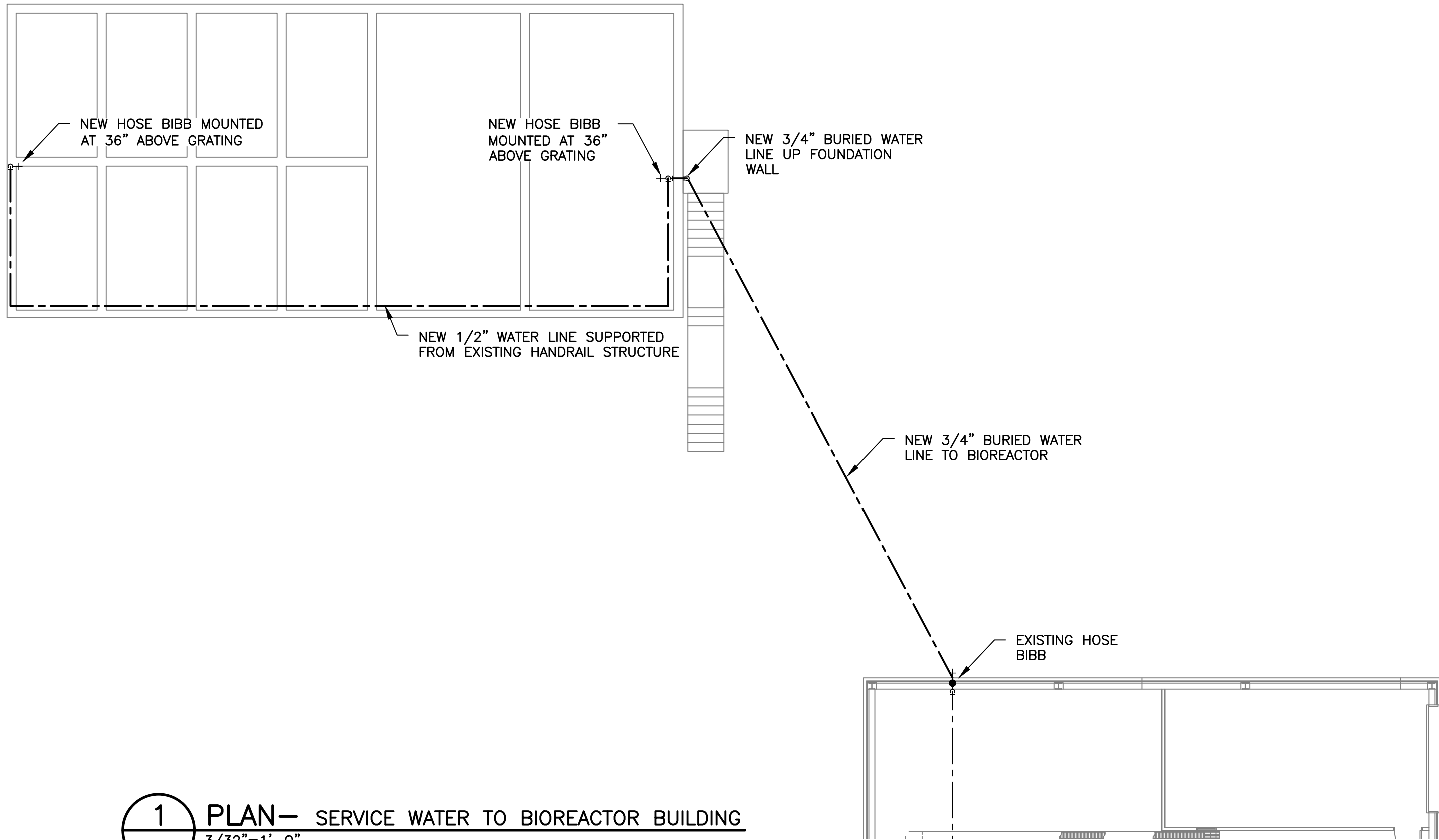
DRAWING NAME: Y:\HALIFAX\DATA\PROJECTS\210803.01.TOL.WWTP & OUTFALL PREDESIGN AND BCA\44 CAD\04 MECH\MSK1.DWG LAYOUT NAME: MSK-1 PLOT DATE: August 5, 2021 11:47:37 AM CAD OPERATOR: RCLARKE



1
PLAN— COMPRESSED AIR LAYOUT
 3/32"=1'-0"

Date	Scale	Designed	Drawn	Checked	Approved	CBCL No.	Contract
2021-05-10	3/32"=1'-0"	CJR	RDC	-	-	2120803.01	-
						TOL WWTP AND OUTFALL PREDESIGN AND BCA PROPOSED COMPRESSED AIR LAYOUT	
A ISSUED FOR REPORT						Drawing MSK-01	
No.	Description						

DRAWING NAME: Y:\HALIFAX\DATA\PROJECTS\210803.01.TOL.WWTP & OUTFALL PREDESIGN AND BCA\44 CAD\04 MECH\MSK2.DWG LAYOUT NAME: MSK-02 PLOT DATE: August 5, 2021 11:48:00 AM CAD OPERATOR: RCLARKE

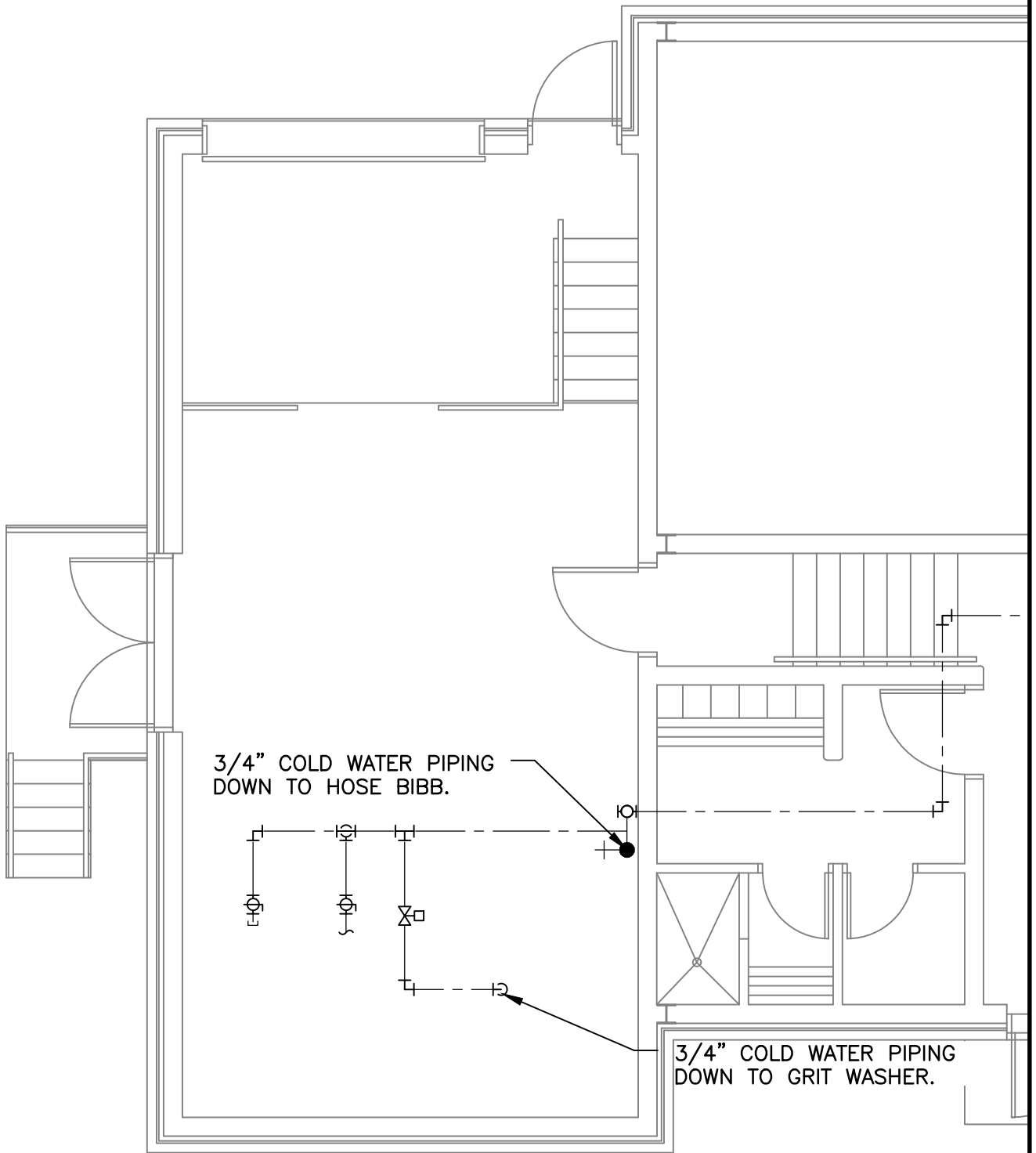


1 PLAN — SERVICE WATER TO BIOREACTOR BUILDING
 3/32" = 1'-0"

No.	Description
A	ISSUED FOR REPORT

Date 2021-05-10	Scale 3/32"=1'-0"	Designed CJR	Drawn RDC	Checked -	Approved -	CBCL No. 2120803.01	Contract -
CBCL		TOL WWTP AND OUTFALL PREDESIGN AND BCA				Drawing MSK-02	
		SERVICE WATER TO BIOREACTOR BUILDING					

DRAWING NAME: Y:\HALIFAX\DATA\PROJECTS\210803.01.TOL.WWTP & OUTFALL PREDESIGN AND BCA\44 CAD\04 MECH\MSK3.DWG LAYOUT NAME: MSK3 PLOT DATE: August 5, 2021 11:48:53 AM CAD OPERATOR: RCLARKE



A ISSUED FOR REPORT							
No.	Description	No.	Description	No.	Description	No.	Description
2021-05-10	Scale 3/16" = 1'-0"	Designed CJR	Drawn RDC	Checked -	Approved -	CBCL No. 210803.01	Contract -



TOWN OF LUNENBURG
WASTE WATER TREATMENT PLANT
SERVICE WATER PIPING
HEADWORKS

Drawing

MSK-03

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: August 5, 2021 11:49:41 AM CAD OPERATOR: RICLARE

REMOVE EXISTING 250x300 DUCT SEGMENT AND REPLACE WITH NEW 350x350. TIE INTO EXISTING DUCTWORK AND EXTEND TO 450mm AFF AS INDICATED. BALANCE AIRFLOW TO 360 L/S.

BLANK OFF EXISTING EXHAUST GRILLE

REMOVE EXISTING EXHAUST GRILLE AND 250x300 DUCTWORK BACK TO TRANSITION. TIE INTO EXISTING 450x300 AND ROUTE NEW 300x300 DUCTWORK AS INDICATED.

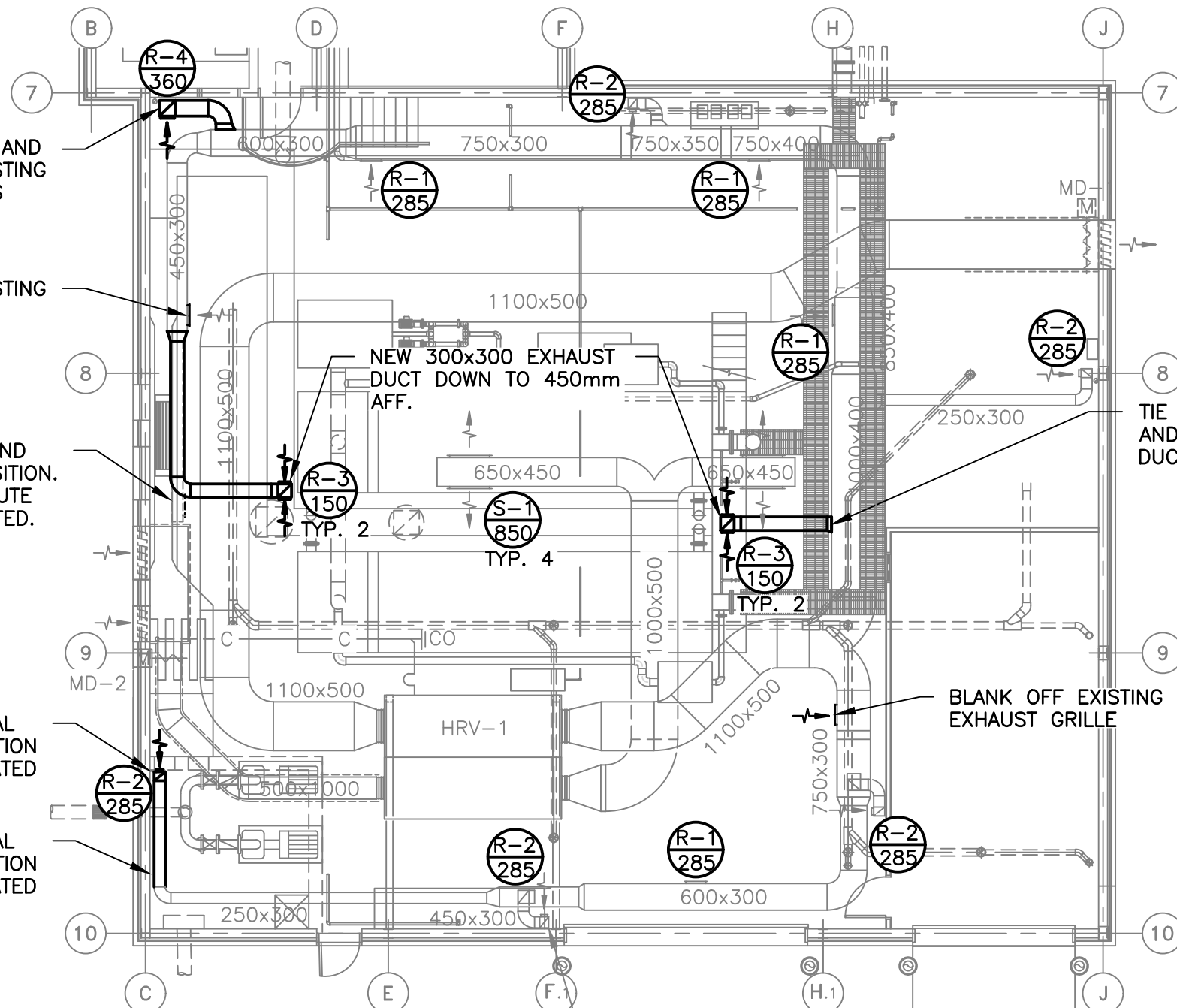
REMOVE EXISTING VERTICAL DUCTWORK IN THIS LOCATION AND RELOCATE AS INDICATED

REMOVE EXISTING VERTICAL DUCTWORK IN THIS LOCATION AND RELOCATE AS INDICATED

TIE INTO EXISTING DUCTWORK AND ROUTE NEW 300x300 DUCTWORK AS INDICATED.

BLANK OFF EXISTING EXHAUST GRILLE

10x12 DN TO RETURN GRILLE @ 1500mm AFF

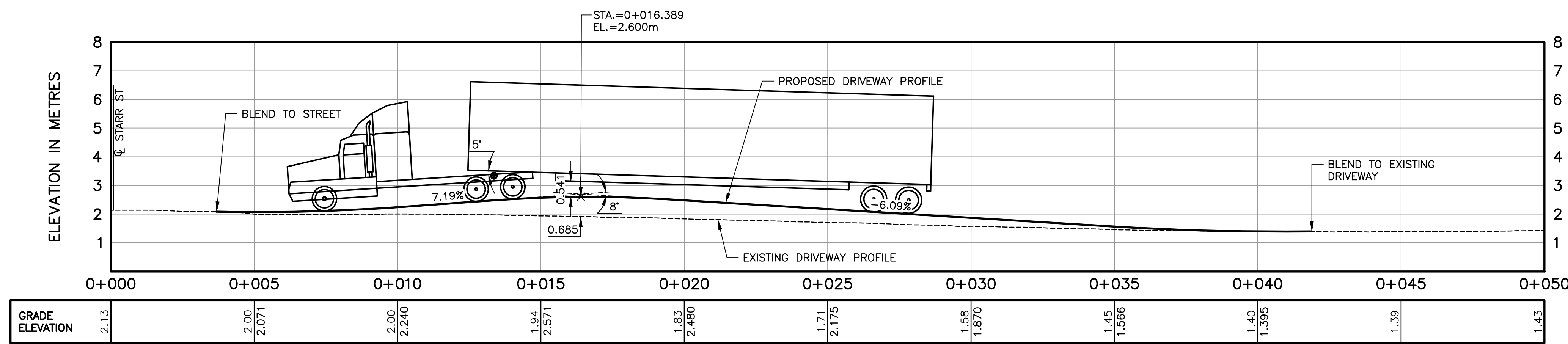


1 PLAN— MODIFICATIONS TO HRV EXHAUST DUCTWORK
3/32"=1'-0"

Date	Scale	Designed	Drawn	Checked	Approved	CBCL No.	Contract
2021-05-10	3/32"=1'-0"	CJR	RDC	-	-	2120803.01	-

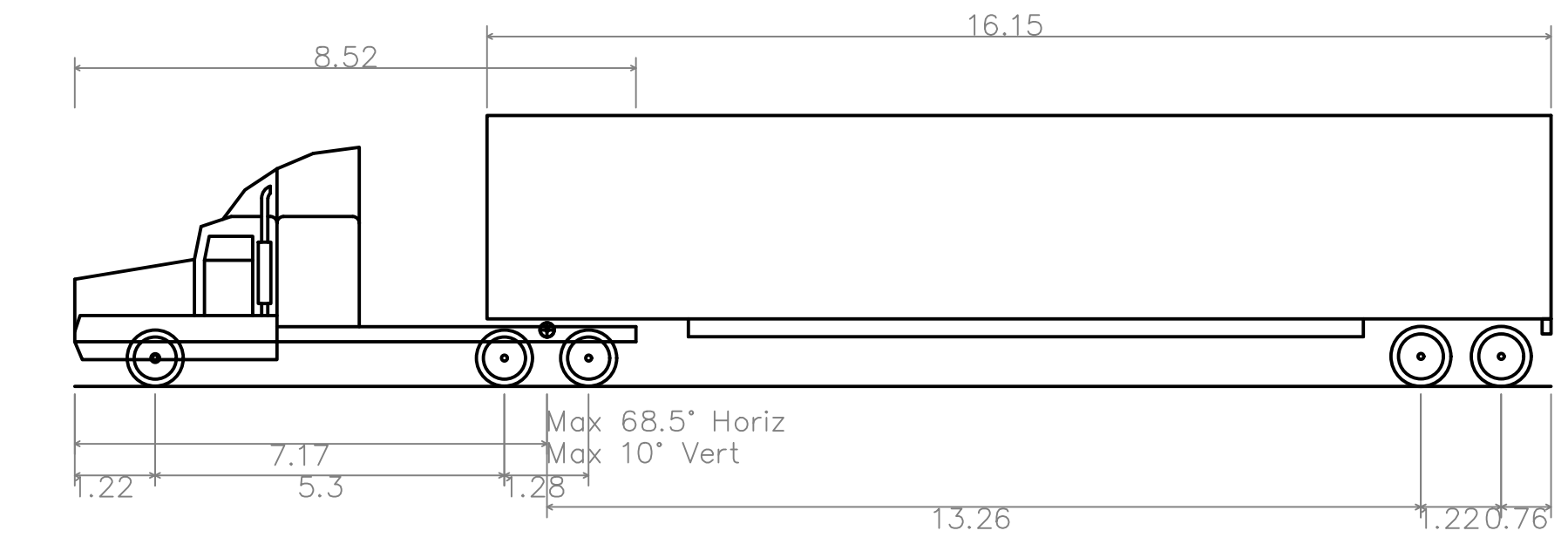
No.	Description
A	ISSUED FOR REPORT

	TOL WWTP AND OUTFALL PREDESIGN AND BCA	MSK-04
	MODIFICATIONS TO HRV EXHAUST DUCTWORK	



STATION	0+000	0+005	0+010	0+015	0+020	0+025	0+030	0+035	0+040	0+045	0+050
GRADE ELEVATION	2.13	2.00 2.071	2.00 2.240	1.94 2.571	1.83 2.480	1.71 2.175	1.58 1.870	1.45 1.566	1.40 1.385	1.39	1.43

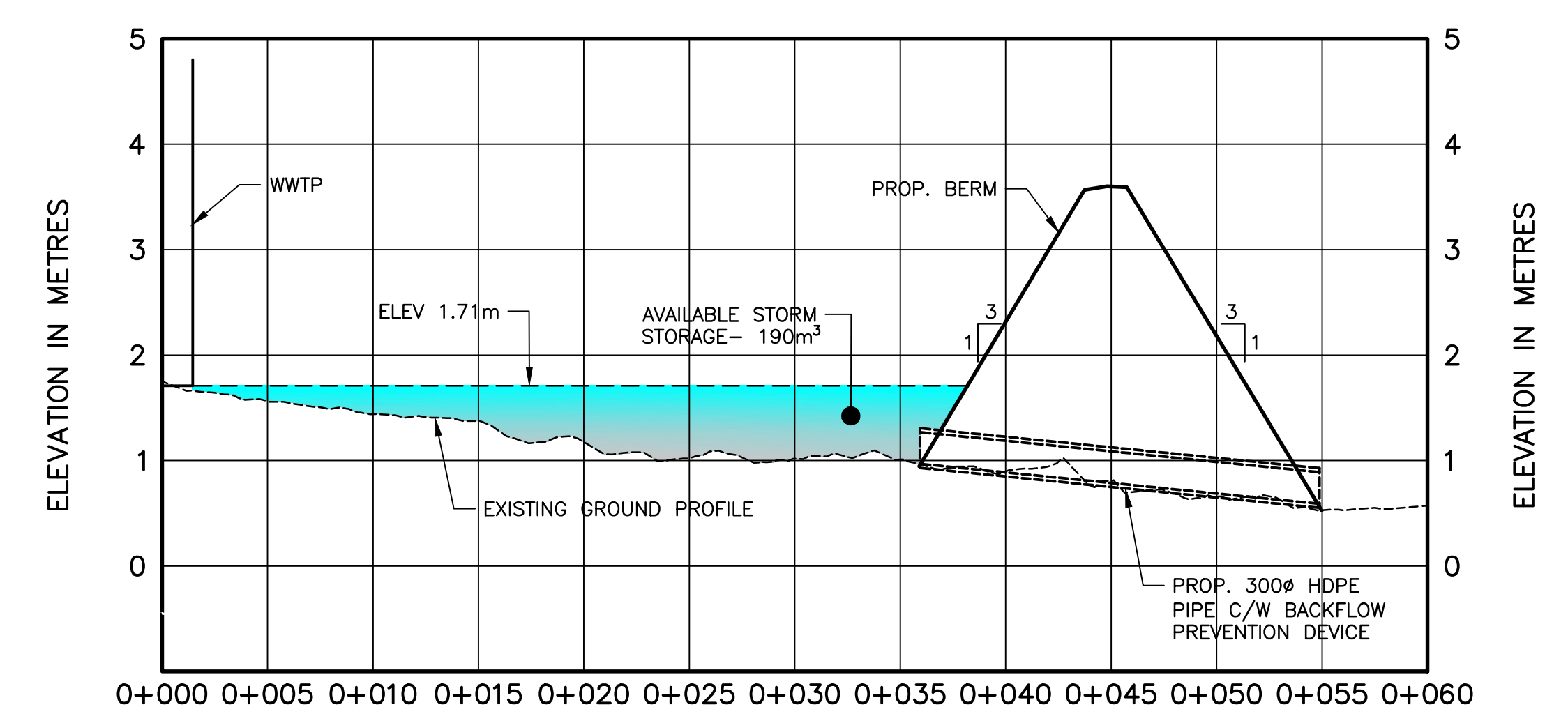
PROFILE - DRIVEWAY
 HORZ. 1:250 VERT. 1:250



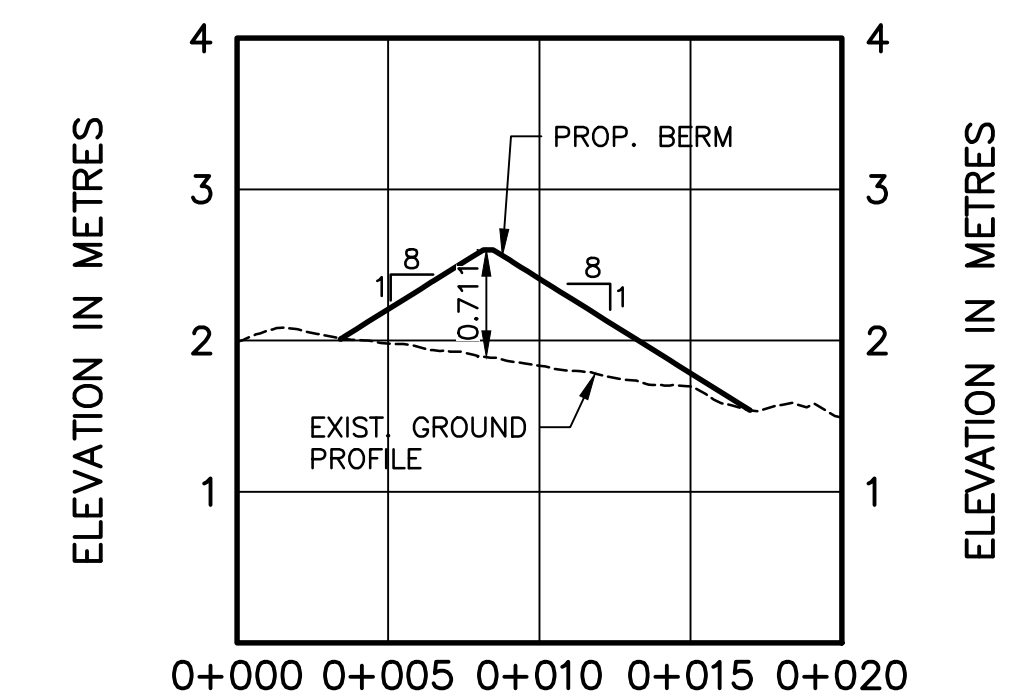
WB-20 - Interstate Semi-Trailer	
Overall Length	22.410m
Overall Width	2.590m
Overall Body Height	4.110m
Min Body Ground Clearance	0.407m
Max Track Width	2.590m
Lock-to-lock time	6.00s
Max Steering Angle (Virtual)	28.40°



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 LUNEBURG

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


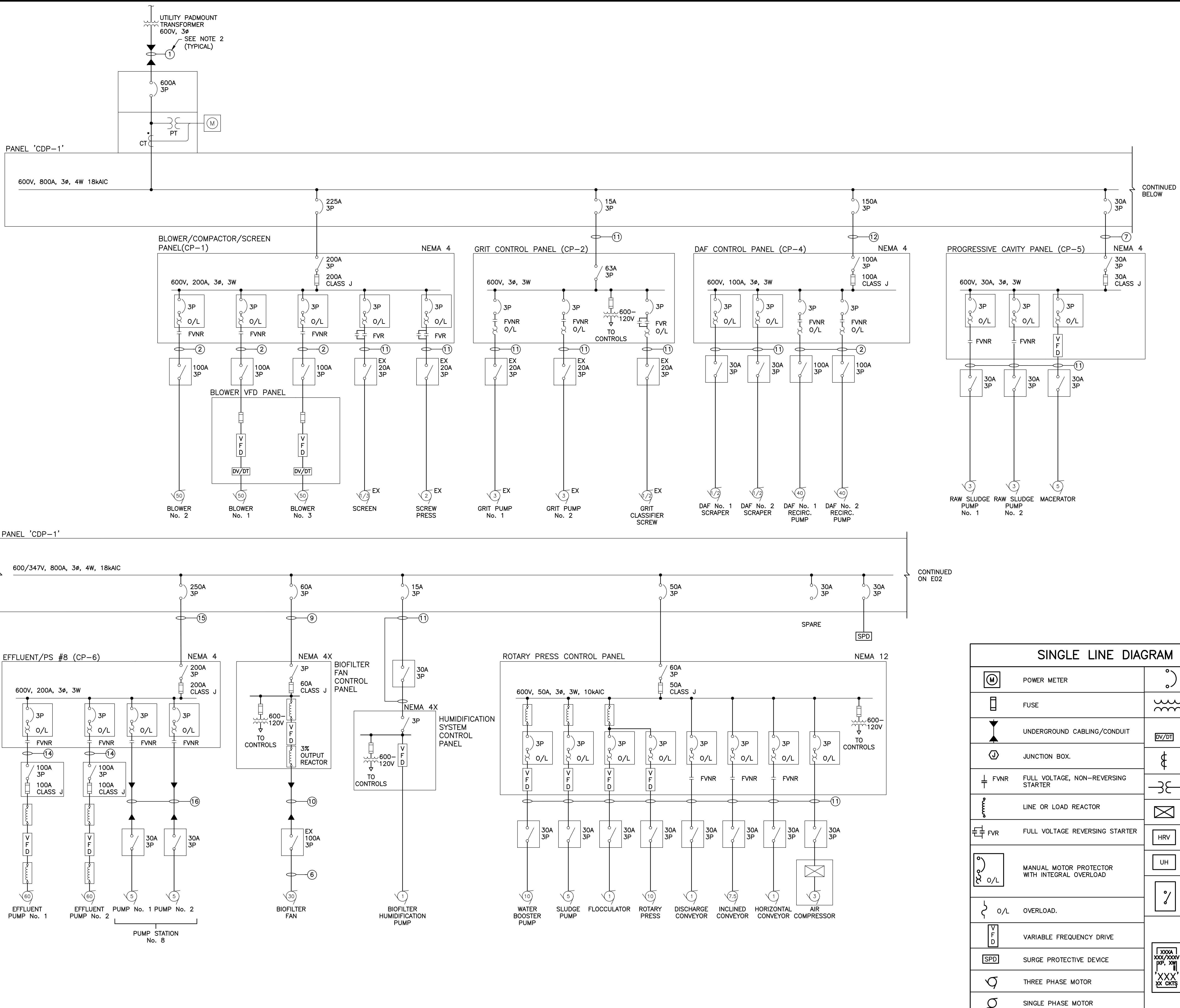
Project Name:	TOL WWTP Upgrades	
Project #:	210803.01	

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

<i>Runoff Coefficients:</i>		<i>Precipitation Amounts:</i>					
<i>Surface Type</i>	<i>Runoff Coefficient (C)</i>	<i>1 in 100 year 24hr rainfall (mm):</i>				<i>190</i>	
Impermeable Surfaces	1.00	<u><i>Storm Water Drainage Area Flow</i></u>					
Semi-Permeable Surfaces	0.40						
Permeable Surfaces	0.20						
Storm Water Drainage Collection		Total Stormwater Drainage Area (m²)	Impermeable Surface (Paved/Flooded) Drainage Area (m²)	Semi-Permeable Surface (Bare/Gravel) Drainage Area (m²)	Permeable Surface (Lawns/Grassy) Drainage Area (m²)	Weighted Runoff Coefficient	Total Annual Storm Water Volume Captured by Drainage Area (m³)
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:

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

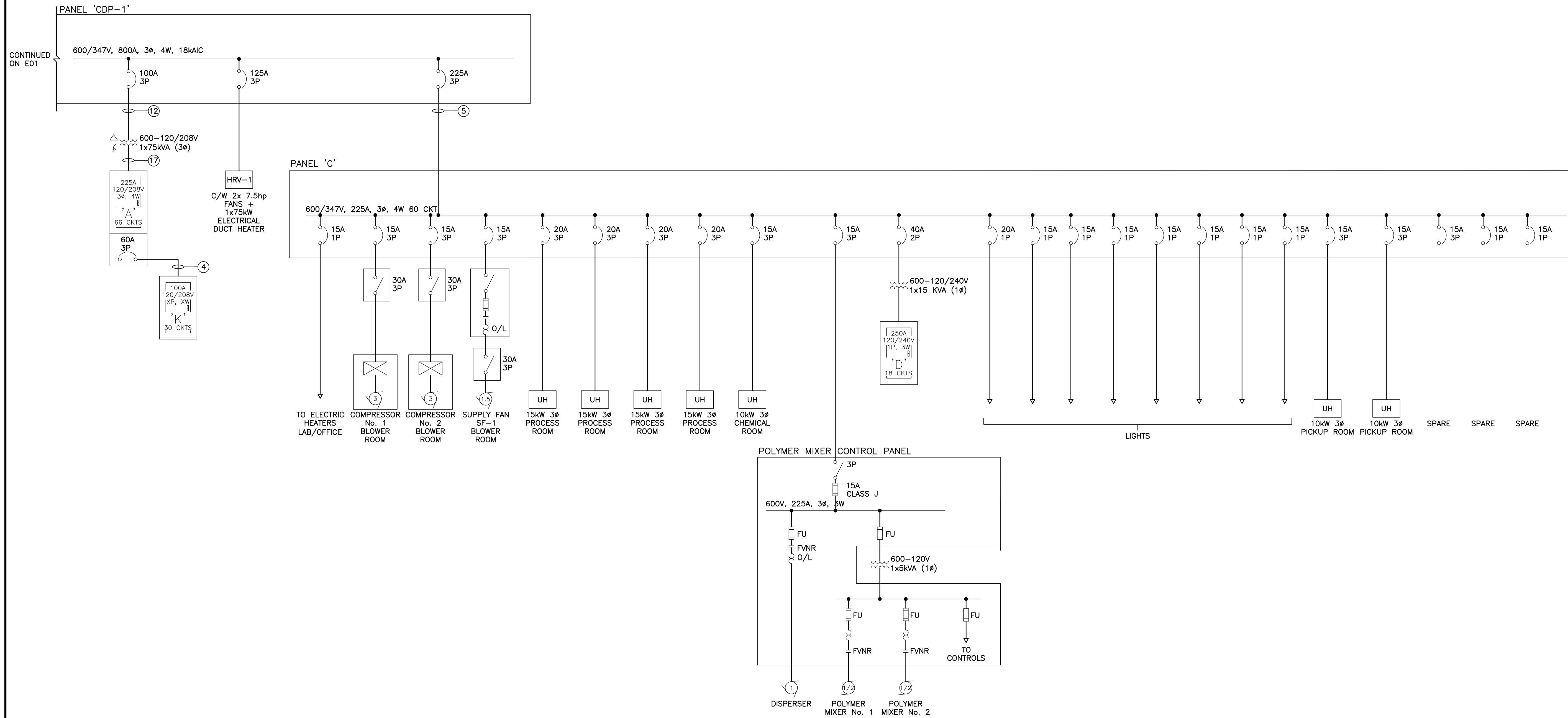
PRELIMINARY
NOT FOR CONSTRUCTION

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

SINGLE LINE DIAGRAM LEGEND			
	POWER METER		CIRCUIT BREAKER
	FUSE		TRANSFORMER
	UNDERGROUND CABLING/CONDUIT		DV/DT FILTER
	JUNCTION BOX		CURRENT TRANSFORMER
	FULL VOLTAGE, NON-REVERSING STARTER		POTENTIAL TRANSFORMER
	LINE OR LOAD REACTOR		CONTROL PANEL
	FULL VOLTAGE REVERSING STARTER		HEAT RECOVERY VENTILATOR
	MANUAL MOTOR PROTECTOR WITH INTEGRAL OVERLOAD		ELECTRIC UNIT HEATER
	OVERLOAD		DISCONNECT SWITCH
	VARIABLE FREQUENCY DRIVE		PANELBOARD
	SURGE PROTECTIVE DEVICE		
	THREE PHASE MOTOR		
	SINGLE PHASE MOTOR		

TOWN OF LUNENBURG
LUNENBURG WASTEWATER TREATMENT PLANT
ELECTRICAL
EXISTING SINGLE LINE DIAGRAM SHEET 1 OF 2

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



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 3/4" 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

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.

PRELIMINARY
NOT FOR CONSTRUCTION

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

TOWN OF LUNENBURG
LUNENBURG WASTEWATER TREATMENT PLANT

ELECTRICAL

EXISTING SINGLE LINE
DIAGRAM SHEET 2 OF 2

CBCL No. 210803.01 Date MAY 2021 Designed LTH Checked XX Sheet No. 2 Drawing No. E02	Contract No. - Scale AS NOTED Drawn TCS Approved XX of 2
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Solutions today | Tomorrow **IN** mind

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