

Town of Deep River

# Deep River Water Treatment Plant Phase 1: Trihalomethanes Reduction Study

## Conceptual Design Report

Friday, September 8, 2023

A001332

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Engineering for **people**



## Conceptual Design Report

Deep River Water Treatment Plant

Phase 1: Trihalomethanes Reduction Study

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# 1 Introduction

## 1.1 Background

The Deep River Water Treatment Plant (WTP) is located at 177 River Rd., Deep River, County of Renfrew, Ontario. It is owned by the Corporation of the Town of Deep River (Town) and operated by the Ontario Clean Water Agency (OCWA). The Deep River WTP is operated with a rated capacity of 13,638 m<sup>3</sup>/d under the Drinking Water Works Permit No. 189-201 and the Municipal Drinking Water License No. 189-101.

The WTP serves a population of approximately 4,109 people within the Town with a network of watermains and an elevated storage tank (water tower). In 2019, a booster pumping station and an approximately 9 km long watermain were constructed to connect the Deep River distribution system to the Canadian Nuclear Lab (CNL) facility, which contains an on-site reservoir.

The Town has retained CIMA+ to address the elevated concentrations of disinfection by-products (DBPs), especially trihalomethanes (THMs), in the Town's treated drinking water tower and in the CNL reservoir. This project will be completed in two (2) phases:

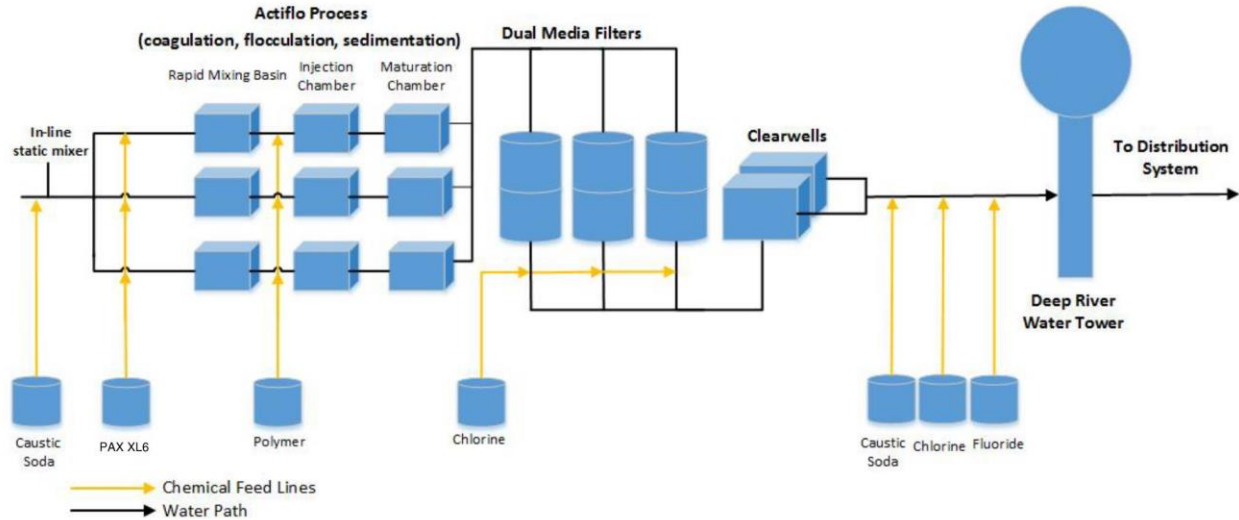
- Phase 1 includes development and evaluation of feasible THM reduction technologies, as well as a conceptual design of the preferred alternative.
- Phase 2 will follow selection of the preferred technology with completion of detailed design, tendering and construction.

Concurrently to this project, CNL has retained an engineering firm for the design of an in-tank aeration system to reduce THMs at their on-site reservoir. This project is in collaboration with the Town and under the same overall scope to reduce THMs from the municipally generated water. The two projects are complimentary with the end objective to achieve THM compliance throughout the distribution system.

## 1.2 Overview of Existing WTP and Distribution System

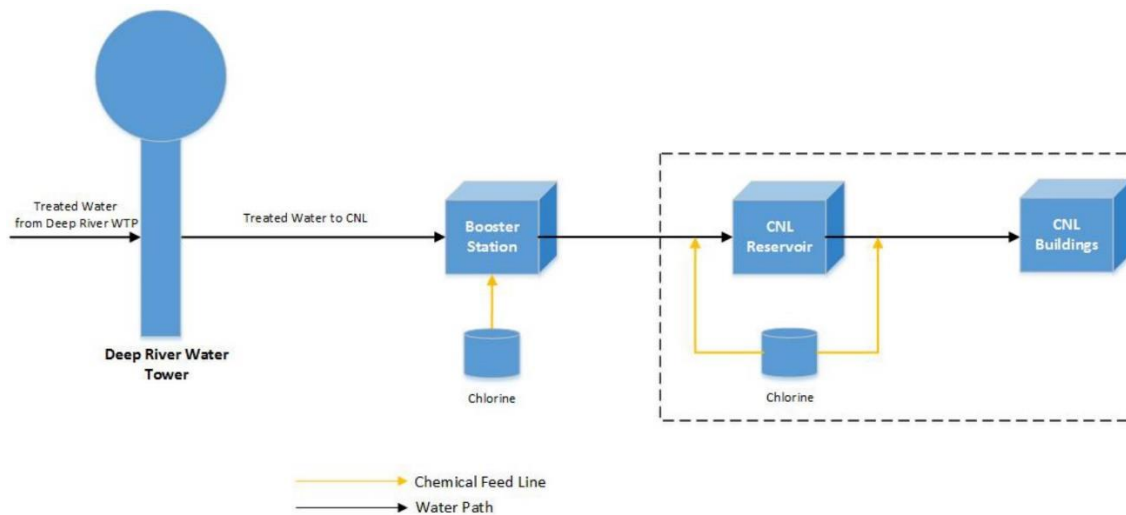
The Deep River WTP is a surface water treatment plant, constructed in 2007, with a rated capacity of 13,638 m<sup>3</sup>/day. The plant contains a low lift pumping station building, which draws raw water from the Ottawa River and pumps it to the main treatment plant building. The water passes through three (3) parallel treatment trains, consisting of Actiflo® sand ballasted clarifier units and dual media filters. Three (3) Actiflo® units, with the addition of microsand, coagulant and polymer, provide coagulation, flocculation, and sedimentation. Water then flows to three (3) dual media (anthracite and sand) filters before being disinfected in two (2) clearwells with chlorine gas (primary disinfection). Treated water is dosed with chlorine gas for secondary disinfection before being

pumped to the distribution system via high lift pumps. The pH of water may be adjusted before the Actiflo® process and as the treated water enters the distribution system. A process flow diagram for the Deep River WTP is provided in Figure 1.



**Figure 1: Deep River WTP Process Flow Diagram (OCWA, 2021)**

Based on OCWA’s annual reports, the Deep River distribution system consists of approximately 38 km of watermains, constructed mainly of cast iron and polyvinyl chloride (PVC) pipes, ranging from 40 mm to 400 mm. The distribution system includes a 1,513 m<sup>3</sup> elevated storage reservoir (water tower) and a booster station dedicated to supplying drinking water to the CNL site via an approximately 9km long watermain. Chlorine is able to be dosed at the booster station, and at the inlet and outlet of the CNL reservoir, as shown in Figure 2.



**Figure 2: CNL Water Supply Process Flow Diagram (OCWA, 2021)**

## 1.3 Summary of TM1 – THM Reduction Technologies Evaluation

In June 2023, CIMA+ prepared technical memorandum 1 (TM1) to develop and evaluate feasible THM reduction technologies for the Deep River WTP. The following summarizes the key findings and recommendations from TM1:

- On average over the past 5 years, the plant is operating at 25% of its rated capacity and below 50% of the maximum water taking quantity.
- High concentrations of total and dissolved organic carbon (TOC/DOC) and chlorine residual are noted in the treated water based on available sampling data, which are leading to DBP formation in the distribution system.
- The existing Actiflo® units are performing well to remove on 45-50% of TOC/DOC at actual flows; however, an enhanced treatment process is required to reduce TOC/DOC to 2 mg/L prior to primary disinfection.
- Ion exchange, powdered activated carbon (PAC), and granular activated carbon (GAC) pressure filters were considered for Deep River WTP for additional TOC/DOC removal. Ultimately, PAC was determined to be the only feasible option given the existing site constraints.
- Key considerations that will be addressed in future design and construction phases of the PAC upgrades include:
  - Providing access for delivery of PAC to the slurry preparation system,
  - Providing a separate, classified area for the PAC slurry preparation system to meet health and safety standards,
  - Maintaining the plant's hydraulic grade line, and
  - Replacement of the existing hydrocyclones.
- TOC/DOC removal was proven to be effective with PAC in laboratory testing. PAC and coagulant dosage to be optimized with further laboratory testing in fall 2023.
- Additional plant processes should be included in the conceptual design:
  - Automation of polymer preparation system,
  - Replacement of the assets within the Actiflo® units that are approaching the end of their useful life, including the lamella plates, and
  - Replacement of the Actiflo® control system.

## 1.4 Purpose of Conceptual Design Report

The purpose of this Conceptual Design Report is to complete Phase 1 of the project, as noted in Section 1, by developing design details for the preferred alternative (PAC) identified in TM1. Specifically, this report will summarize:

- Description of the proposed design concept;
- Process design basis including design flow, TOC/DOC concentration prior to primary disinfection, and maximum THM concentration objective;
- Basis of design to be used for each of the engineering disciplines;
- Additional Deep River WTP upgrades that are recommended to be included within Phase 2 of the project;
- Conceptual Drawings of the proposed PAC upgrades (**Appendix A**);
- Discussion of constructability and construction sequencing; and
- A conceptual cost estimate (**Appendix B**) and schedule.

## 2 Powdered Activated Carbon Conceptual Design

### 2.1 THM Reduction Design Basis

The design basis for TOC/DOC removal and THM reduction, including the proposed PAC and existing Actiflo® systems, at the Deep River WTP is presented in Table 1.

**Table 1: Deep River WTP THM Reduction Design Basis**

Parameter	Value
Rated Capacity	13,638 m <sup>3</sup> /d
Max Day Flow	15,911 m <sup>3</sup> /d
Raw Water TOC/DOC	8.05 / 8.65 mg/L <sup>(1)</sup>
Average Existing Actiflo® TOC/DOC Removal Rate	45 – 50% <sup>(2)</sup>
Max TOC/DOC concentration prior to Primary Disinfection	2 mg/L <sup>(3)</sup>
Max THM Concentration Objective	80 µg/L <sup>(3)</sup>
Notes:	
(1) Based on laboratory testing in January 2023 (Veolia, 2023)	
(2) Based on OCWA DBP Report for 6-week sampling program (Mar-Apr 2021) (OCWA, 2021)	
(3) Recommended by US EPA	

It is recommended that the Town perform additional raw water TOC/DOC sampling and PAC laboratory testing in Fall 2023 to capture peak concentrations of NOM to the plant and refine the recommended PAC dosage.

## 2.2 Process Design

### 2.2.1 PAC System Design Characteristics

The proposed PAC system consists of a Dry PAC Preparation System and a PAC Tank. Dry PAC preparation begins with a bulk bag handling system, which will be a hoist style bag carriage for hanging and supporting the 1000 kg PAC bulk bags. Hung PAC bags will empty into a contained storage hopper, while ensuring that no powder leaks out of the equipment. A volumetric screw feeder will feed PAC at a set feed rate from the storage hopper to the wetting system. An eductor nozzle will combine the PAC with raw water from the plant, producing a PAC slurry. The slurry will flow through a wetting cone before continuing to the dosing system and PAC Tank.

An example PAC preparation and dosing system is provided in **Appendix A**. The design criteria and specifications of the PAC system are summarized in Table 2.

**Table 2: Deep River WTP PAC System Design Criteria and Specifications**

System	Criteria
Bulk Bag Handling System	Safe Working Load: 2000 kg Motor Classification: CSA Class 2 Div 1 Group F
Volumetric Screw Feeder	Powder Density: 512 kg/m <sup>3</sup> Minimum Capacity: 48.9 kg/hr (PAC) Maximum Capacity: 135 kg/hr (PAC) Motor Classification: CSA Class 2 Div 1 Group F
Wetting System	Service Water Req.: 8 m <sup>3</sup> /hr Minimum Capacity: 2,445 L/hr (Slurry) Maximum Capacity: 6,750 L/hr (Slurry) PAC Slurry Conc.: 2%
PAC Dosing Tank	Contact Time Required: 10 min <sup>(1)</sup> Tank Volume: 100 m <sup>3</sup>
Actiflo® Hydrocyclones	Existing three (3) Actiflo® Hydrocyclone replacement with MAA Hydrocyclone for PAC recirculation
Notes: (1) Based on Veolia Assessment of Performance: ActifloCARB Technology (March 2023)	

### 2.2.2 Conceptual Process Control Narrative

Under normal operation (i.e. during seasonal low Natural Organic Matter (NOM) concentrations), the Deep River WTP will operate as it does currently. Raw water from the Ottawa River will be pumped from the low lift pumps directly to the Actiflo® process. During periods of seasonally high NOM concentrations, the PAC system will be brought online. This will be completed by operating three actuated motorized valves to be located adjacent to the new PAC Building. Firstly, the valve on the PAC system inlet line will be opened, allowing flow to enter the PAC system. Once that valve has been

confirmed open, the valve on the main forcemain adjacent to the PAC tank will be closed, sending all flow through the PAC system. Lastly, the valve controlling the PAC tank discharge line will be opened, allowing flow to bypass a section of the main forcemain and flow through the PAC system before continuing to the Actiflo® process.

Raw water will enter the PAC tank and be dosed with the PAC slurry produced by the Dry PAC Preparation System. From the PAC tank, water will flow by gravity to an adjacent Intermediate Pump Well, where two low lift pumps will operate to pump water through the forcemain to the Actiflo® process. PAC will be pumped with the water and flow through the Actiflo® process before being removed by hydro-cyclone.

At the end of high NOM concentration seasons, the plant will be returned to normal operation. This will be completed by first closing the PAC system inlet valve and temporarily shutting off the low lift pumps at the Pump House. Water already in the PAC tank will be drained using the Intermediate Pump Well. The PAC system will then shutdown and the valve on the PAC tank discharge line will be closed. The valve on the main forcemain will be reopened and the low lift pumps at the Pump House will start, allowing the plant to return to normal operation.

### **2.2.3 Hydraulic Profile Modifications**

The new PAC tank will be built adjacent to and connect into the existing forcemain connecting the Pump House to the Actiflo® process. Water discharged from the PAC tank will be pumped back into the forcemain and to the Actiflo® process, and will therefore have no impact on plant hydraulics. The total dynamic head required to pump from the low lift pumps to the PAC tank will be less than the total dynamic head required to pump directly to Actiflo®. Therefore, the existing pumps will be sufficient for the new PAC system. Furthermore, the new fixings on the forcemain, including three (3) control valves, three (3) check valves, and two (2) intersections, are anticipated to have a negligible impact on the head loss through the forcemain. A markup of the existing hydraulic profile showing the PAC tank is provided in **Appendix A**.

## **2.3 Civil Design**

A new PAC tank and building are recommended to be located on the existing Deep River WTP site, east of the existing plant access driveway gate as shown on the conceptual site plan (**Appendix A**), which provides easy access for delivery of PAC to the slurry preparation system. A survey and geotechnical investigation are recommended to confirm the suitability and inform foundation designs of the selected site.

The new PAC system will be divided between a new PAC Process Building, the PAC Tank, and the Intermediate Pumping Station. The existing fencing will be extended to square the northeast corner of the plant, and the plant entrance gate will be relocated closer to the roadway. This will create space within the fence line for the new structures to be placed adjacent to the east side of the driveway on the interior of the gate.

To provide space for the new structures and the new fence, some tree removal will be required in the proposed construction area. The site will also need to be graded to bring the ground level surrounding the building to approximately the same elevation as the driveway. Some excavation will be required to install the new valves and connections to the existing forcemain, as well as for the new structures, which will be partially below grade.

## 2.4 Structural / Architectural Design

Table 3 provides a summary of the conceptual structural and architectural design criteria and specifications for the new PAC Tank and Building, which will be refined in detailed design. Refer to **Appendix A** for a conceptual PAC Tank and Building plan and section.

**Table 3: Structural / Architectural Design Criteria and Specifications**

Parameter	Criteria
PAC Tank	Size: 7.00 m by 7.50 m by 2.40 m (Height) Material: Concrete
PAC Building	Size: 7.00 m by 6.00 m by 6.00 m (Height) Material: Metal siding to match existing WTP building Main Floor: PAC Dosing Room, Electrical Room Doors: Electrical Room Exterior Door (Single-Man), PAC Dosing Room Exterior Door (Single-Man), PAC Dosing Room Exterior Roll-up Door (3.0 m by 3.0 m) Roof: Sloped with metal shingles

## 2.5 Electrical Design

Table 4 provides a summary of the electrical design criteria and specifications for the new PAC Tank and Building.

**Table 4: Electrical Design Criteria and Specifications**

Parameter	Criteria
System Power Requirements	575 V, 60 Hz, 3 Phase (Transformers providing step down to 115 V and 24 V)
PAC Control Panel	Allen-Bradley CompactLogix PLC with Ethernet Allen-Bradley PanelView 6" colour touchscreen operator interface To be installed in a non-hazardous zone (Electrical Room)
Equipment Requirements	Bulk Bag Handling System Motors: 600 V AC VFD for the volumetric feed screw
PAC Building Electrical Room	Size: 3.50 m by 2.40 m Separate entrance from exterior of building to be a declassified space (Entrance exterior to building).
PAC Building PAC Dosing Room	Classified space (Class 2, Div 1)

### 3 Conceptual Design of Additional Upgrades

In addition to proposed PAC upgrades, the following plant processes should be considered in the upcoming capital project. Several of the upgrades can be included as provisional items in the construction contract, to be added pending available funding and construction costs.

#### 3.1 Automated Polymer Preparation System

As noted in TM1, OCWA operators are currently required to mix polymer batches for the Actiflo® process manually (as shown by the equipment in Figure 3), which can lead to variations in treatment efficiency. An automated polymer preparation and dosing system is required to optimize the Actiflo® system due to the dependence on a robust ballasted floc to operate at high rise rates for this process.



**Figure 3: Existing Deep River WTP Actiflo® Polymer Manual Mixing Equipment**

Several suppliers offer turn-key automatic polymer make-up and dosing units that prepare batches from powdered or liquid polymers. Dry polymer is typically fed from a hopper, wetted, then agitated in a mixing tank to prepare a homogenous activated polymer solution with consistent and repeatable results. It is assumed that the plant's existing polymer dosing pumps will be maintained for conveying activated polymer solution from the mixing/storage tank to the Actiflo® units.

An example polymer preparation system is provided in **Appendix A**. The preferred location for the unit in the Deep River WTP is the Chemical Room. Exact installation location will be confirmed in detailed design.

Table 5 provides a summary of the proposed polymer system criteria and specifications.

**Table 5: Polymer System Criteria and Specifications**

Parameter	Criteria
Polymer Characteristics	Dry, viscosity < 1000 cPs
Dry Polymer Capacity	34.32 Kg/day (solution at 0.25%)
Aging (Maturation) Time	60 min
Power Requirements	600 VAC, 60 Hz, 3 ph
Hopper	Material: 304SS Min. Capacity: 75 L Polymer Delivery Method: 25 kg (50 lb) bags
Volumetric Screw Feeder	Body Material: SINTER (engineered polymer) Screw Material: 304SS Capacity: 88 kg/h Feed Rate: Constant, to meet design demand Motor: 0.5 HP NEMA TEFC
Wetting Unit	Water Inlet Line: Tempered, PVC SCH80 Inlet Water Rate: 5.2 m <sup>3</sup> /h Wetting Cone Material: 304SS Eductor Tee Material: PVC SCH80
Polymer Mixing Tank	Tank/Bridge Material: 304SS Lid Material: Polypropylene Installation Location: Above storage tank Tank Min. Capacity: 510 L Mixer Motor: 0.75 HP, <350 RPM Mixer Material: 304SS Mixer Impeller: 365 mm Liquid Level Monitoring: Hydrostatic type
Polymer Storage Tank	Material: LLPE Capacity: 700 L

Parameter	Criteria
	Liquid Level Monitoring: Ultrasonic type
Frame	Material: 304SS

### 3.2 Actiflo® Upgrades (Provisional)

Components in the existing Actiflo® units are approaching the end of their useful life (20 years), including the lamella setting plates and control panel (Figure 4). OCWA operators have noted that the Actiflo® control panel is also unable to be reprogrammed due to proprietary integrated software. The upcoming upgrades project presents an opportunity for asset renewal for the lamella plates and control panel, while assessing the interior of the Actiflo® units for any additional rehabilitation needs. In addition, installing air scouring in the Actiflo® units during the upgrades project could mitigate solids collection on the lamella plates during operation and reduce the required frequency of cleaning for the Actiflo® setting tanks.

It is recommended that items to upgrade the existing Actiflo® units are included as provisional in the upcoming PAC upgrades project as they are not essential for the reduction of THM formation; however, these items would improve the operation of the Actiflo® units.



Figure 4: Existing Actiflo® Control Panel

### 3.2.1 Microsand Dosing System (Provisional)

Currently, microsand is added to the Actiflo® units manually using the bags shown in Figure 5. Since the original construction of the Actiflo® units, Veolia has designed and now offers an automated microsand dosing system, which reduces physical labour of dosing microsand for operators.



**Figure 5: Microsand Bags On-Site**

The microsand dosing system is capable of loading and unloading bulk bags, dosing, wetting and transferring microsand mixed with service water to the Actiflo® units. The bulk bag unloading system consists of a structural bulk bag frame with monorail and hoist to lift the microsand bag and place them in position. A bulk bag lifting cross, suspended by a hoist and trolley system supports the microsand bulk bags during unloading. The interface between the bulk bag and hopper is a sealed, dust-tight connection. Dry microsand from the hopper is conveyed to the volumetric screw feeder by gravity, and then into the wetting cone and through the educator to the injection line.

It is recommended that a microsand dosing system be included as a provisional item in the upcoming PAC upgrades project as it is not essential for the reduction of THM formation.

An example microsand dosing system is provided in **Appendix A**. The preferred location for the unit in the Deep River WTP is the Chemical Room. Exact installation location will be confirmed in detailed design.

Table 6 provides a summary of the proposed microsand dosing system criteria and specifications.

**Table 6: Microsand Dosing System Criteria and Specifications**

Parameter	Criteria
Microsand Characteristics	Dry silica sand, 85 µm
Microsand Capacity	515.9 kg/h
Dry Material Density	1.5 kg/L
Service Water	Minimum Flowrate: 18 m <sup>3</sup> /h Minimum Pressure: 70 psig
Discharge Pressure (min)	22 psig
Power Requirements	600 VAC, 60 Hz, 3 ph
Bulk Bag Handling System	Working Load Capacity: 2,000 kg Material: Epoxy coated carbon steel Bulk Bag Dimensions: 29" x 29" x 39" H Bulk Bag Weight: Approx. 1,000 kg
Microsand Storage Hopper	Hopper Material: Painted carbon steel Outlet Slide Gate Material: 304SS Seal: Black Rubber
Volumetric Screw Feeder	Screw Material: 304SS Feed Rate: Constant, to meet design demand Motor: 0.5 HP NEMA TEFC
Wetting Unit	Water Inlet Line Material: PVC SCH80 Wetting Cone Material: 304SS Eductor Tee Material: 306L stainless steel (body), hardened stainless steel 416H (nozzle and diffuser). Injector Line Material: 304SS

### 3.3 Rehabilitation or Replacement of Stainless Steel Piping (Provisional)

During the project initiation site visit, it was noted that several sections of stainless steel piping adjacent to the Actiflo® units and filters were showing signs of corrosion (Figure 6). Excessive moisture or stagnant water in the stainless steel piping may have contributed to the exterior corrosion. The interior condition of the stainless steel piping is unknown.

It is recommended that a provisional item be included in the upcoming contract for investigation, rehabilitation, and/or replacement of stainless steel piping that is in poor condition.



**Figure 6: Corrosion of Existing Stainless Steel Piping**

## 4 Constructability

The majority of the construction of the new PAC building and tank can be completed without interruption to plant operation. The site will first be cleared of existing fencing and trees, and temporary fencing will be set up to maintain site security during construction. The site will then be graded and the new structures and fencing will be built. Preparatory works for tying the PAC system into the existing 350mm raw watermain from the low lift pump station will be completed, including construction of the valve chambers for the new control valves that will control the direction of flow in the forcemain (to Actiflo® or to the PAC tank).

The tie ins to the forcemain and the installation of the valves will take place simultaneously during one window of time that the plant is offline. The elevated water tower and CNL reservoir will both be filled prior to plant shutdown as contingency for unforeseen issues. Furthermore, the Contractor will be required to submit a detailed shutdown workplan for the approval of the Town and CIMA+ prior to this shutdown. Overnight work may be required to ensure that the shutdown does not exceed allowable timeframes.

Following completion of the valve installation and tie ins, the remaining equipment and piping for the PAC system will be installed, and the system will be tested and commissioned prior to handover to plant operations.

Similarly, the upgrades to the Actiflo® system can be completed without interruption of the plant treatment process by allowing one Actiflo® unit at a time to be taken offline for upgrades. The automatic polymer and sand dosing systems can be installed without interruption of the Actiflo® treatment process, and will be tested and commissioned prior to handover to plant operations.

## 5 Permitting and Approvals

Permits and approvals noted in Table 7 will be reviewed in detailed design for their applicability to the PAC Upgrades project. It is important to note that this project is anticipated to be exempt under the Municipal Class Environmental Assessment process, as amended in 2023, as the proposed upgrades will not increase the plant’s rated capacity, nor require land acquisition.

**Table 7: Potential Permits and Approvals for Detailed Design**

Agency	Permit / Approval Description
Ontario Ministry of Environment, Conservation and Parks	<ul style="list-style-type: none"> <li>• Amendments to the Drinking Water Works Permit No. 189-201 and the Municipal Drinking Water License No. 189-101 will be completed in detailed design to add major new treatment processes (i.e. PAC dosing system and tank)</li> <li>• A Permit to Take Water (PTTW) or Environmental Activity and Sector Registry (EASR) may be required during construction activities if dewatering activities are required. An EASR may be required during construction if dewatering is anticipated to be over 50 m<sup>3</sup>/day but less than 400 m<sup>3</sup>/day. A PTTW will be required if dewatering is anticipated to be over 400 m<sup>3</sup>/day.</li> </ul>
Municipal (Town of Deep River)	<ul style="list-style-type: none"> <li>• Since this project includes a new building, it will require municipal site plan approval and building permit.</li> <li>• Tree removal will comply with applicable municipal by-laws as well as with the federal Migratory Birds Convention Act (1994), respecting the applicable April 1 – August 31 nesting period for this zone.</li> <li>• Review of the floodplain mapping generated by the Town to provide cut and fill design, as applicable for new PAC Building and Tank.</li> </ul>
Electrical Safety Authority	<ul style="list-style-type: none"> <li>• All electrical installations, repairs, replacements or alterations in Ontario need to be done in compliance with the Ontario Electrical Safety Code, and all necessary Notifications (“permits”) must be</li> </ul>

Agency	Permit / Approval Description
	<p>taken out. This creates a permanent record of the work and triggers a review process by the Electrical Safety Authority.</p>
<p>Local Utilities</p>	<ul style="list-style-type: none"> <li>• Utility clearance from local utilities, as required.</li> <li>• Coordination with local hydro utility to confirm requirements for their existing transformer enclosure, which is located adjacent to the proposed PAC Building and Tank location.</li> </ul>

## 6 Conceptual Level Opinion of Probable Cost and Project Schedule

### 6.1 Capital Cost

A conceptual cost estimate, including materials and labour, has been developed for the construction of Deep River WTP PAC and additional upgrades, as presented in **Appendix B** and summarized below. This is a Class D level cost estimate (-40% to +50%) presented in 2023 \$CAN.

**Table 8: Conceptual Level Opinion of Probable Cost**

Item	Capital Cost (2023 \$CAN, -40% to +50%)
General (Division 1), including: <ul style="list-style-type: none"> <li>• General Contractor’s Overhead &amp; Profit, Mobilization/Demobilization, Bond</li> </ul>	\$230,000
Site Works (Division 2), including: <ul style="list-style-type: none"> <li>• Excavation, Backfill, and Soil Disposal</li> <li>• New Fencing and Gate Relocation</li> <li>• Landscaping (tree planting)</li> <li>• Removal &amp; Misc.</li> </ul>	\$155,000
Structural and Architectural (Division 3-10), including: <ul style="list-style-type: none"> <li>• New PAC Equipment and Electrical Building</li> <li>• New Concrete PAC Tank and Intermediate Pump Station</li> <li>• Miscellaneous (doors, hatches, etc)</li> </ul>	\$409,000
Process Equipment (Division 11), including: <ul style="list-style-type: none"> <li>• PAC preparation and dosing equipment</li> <li>• Intermediate pumping low lift pumps</li> <li>• Isolation valves – motorized (350mm)</li> <li>• Check valves (350mm)</li> <li>• Automated Polymer Preparation System</li> <li>• Misc.</li> </ul>	\$1,163,000

Item	Capital Cost (2023 \$CAN, -40% to +50%)
Instrumentation and Controls (Division 13)	\$120,000
HVAC & Plumbing (Division 15)	\$130,000
Electrical (Division 16)	\$240,000
Sub-Total	\$2,447,000
Contingency (20%)	\$490,000
Estimating Allowance (10%)	\$250,000
Detailed Design Engineering and Contract Administration (10%)	\$250,000
<b>Total Estimated Construction Costs – Excluding Escalation &amp; HST</b>	<b>\$3,437,000</b>
Provisional Items, including: <ul style="list-style-type: none"> <li data-bbox="207 1003 1052 1121">• Actiflo® system upgrades (lamella plate replacement, air scouring installation, microsand dosing, control panel replacement, etc.) (Provisional)</li> <li data-bbox="207 1142 808 1176">• Replacement of SS piping (Provisional)</li> </ul>	\$560,000
Total Estimated Construction Costs with Provisional Items - Excluding Escalation & HST	\$3,997,000

## 6.2 Schedule

The following outlines the proposed preliminary schedule for detailed design and construction for the Deep River WTP PAC and additional upgrades project.

**Table 9: Conceptual Level Opinion of Schedule**

Project Phase	Timeline
Detailed Design (60%, 90%, 100%)	Fall 2023 – Winter 2024
Tender and Contract Award	Spring 2024
Construction	Spring 2024 – Spring 2025 (12-month construction period anticipated)

## 7 Recommendations and Next Steps

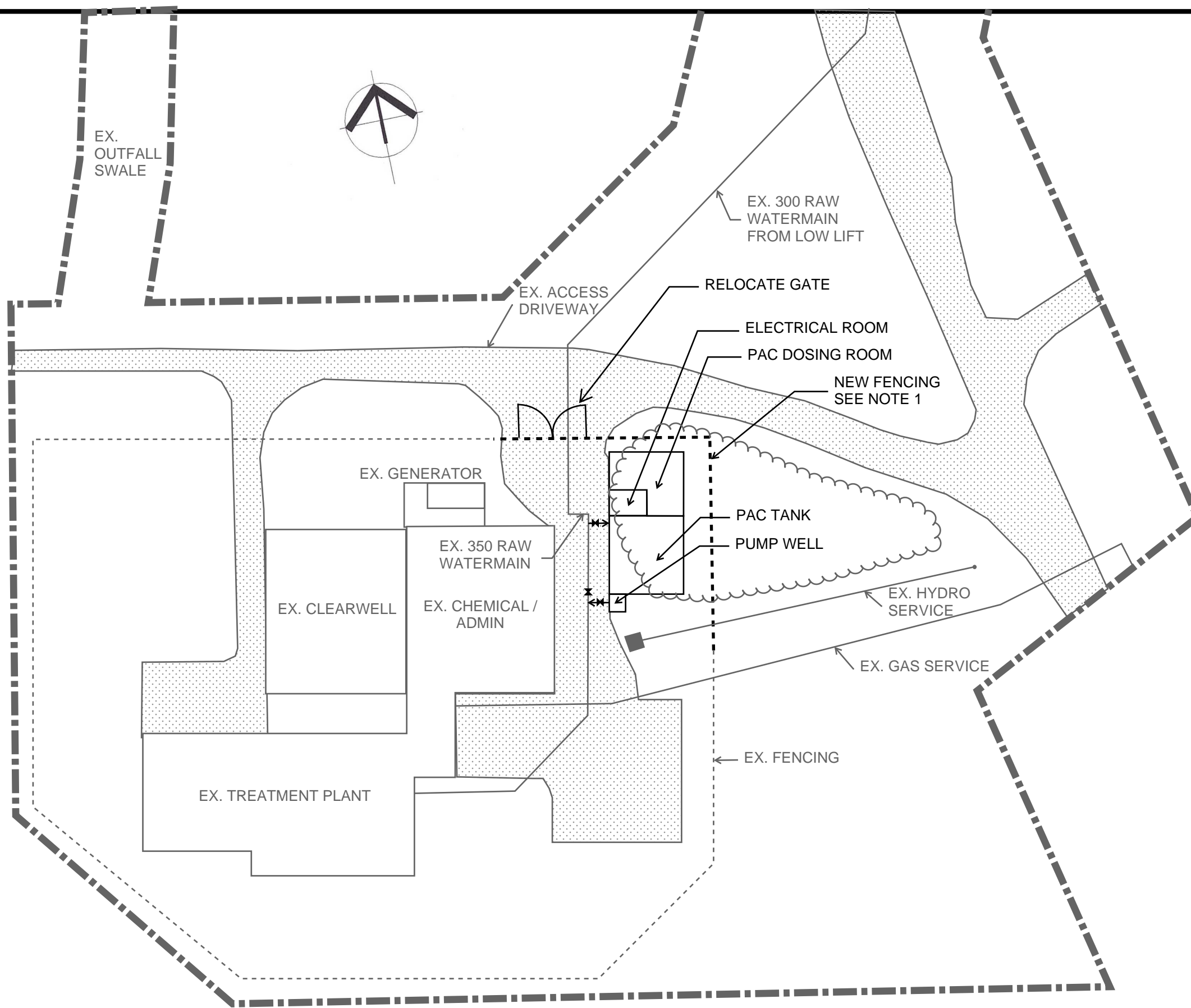
The following summarizes the findings and recommendations from the Conceptual Design Report:

- A new PAC tank and building are recommended to be located on the existing Deep River WTP site, east of the existing plant access driveway gate as shown on the conceptual site plan (Appendix A). A survey and geotechnical investigation are recommended to confirm the suitability of the selected site. The benefits of locating the new PAC infrastructure in this location include:
  - Easy access for delivery of PAC to the slurry preparation system,
  - A separate, classified area for the PAC slurry preparation system is provided to meet health and safety standards, and
  - The plant's existing hydraulic grade line is generally maintained.
- Further laboratory jar testing is recommended in Fall 2023 to optimize PAC and coagulant dosage.
- Additional upgrades are recommended for detailed design and construction (Phase 2) for the PAC upgrades project, including:
  - An automated polymer preparation system,
  - Replacement of the Actiflo® lamella plates and control panel (provisional),
  - Installation of air scouring system in Actiflo® units (provisional),
  - Installation of microsand dosing system for Actiflo® units (provisional), and
  - Rehabilitation or replacement of existing stainless steel piping (provisional).
- The majority of proposed PAC and additional upgrades can be constructed/installed while the WTP remains in operation. Short shutdowns are anticipated to tie-in the new PAC contact tank to the 350mm raw watermain from the low lift pumping station. Mitigation measures, including filling the water tower and CNL reservoir and overnight work, will be implemented to reduce impacts on service population.
- Approvals and utility/agency coordination will be completed in Phase 2 (detailed design and construction).
- A conceptual level construction cost estimate totaled \$3.4M (\$CAD 2023, -40% to +50%) and \$4.0M (\$CAD 2023, -40% to +50%) with provisional items included.

- Detailed design is anticipated to be completed by Winter 2024, with tendering and contract award in Spring 2024, and construction extending 12-months into Spring 2025.

# A

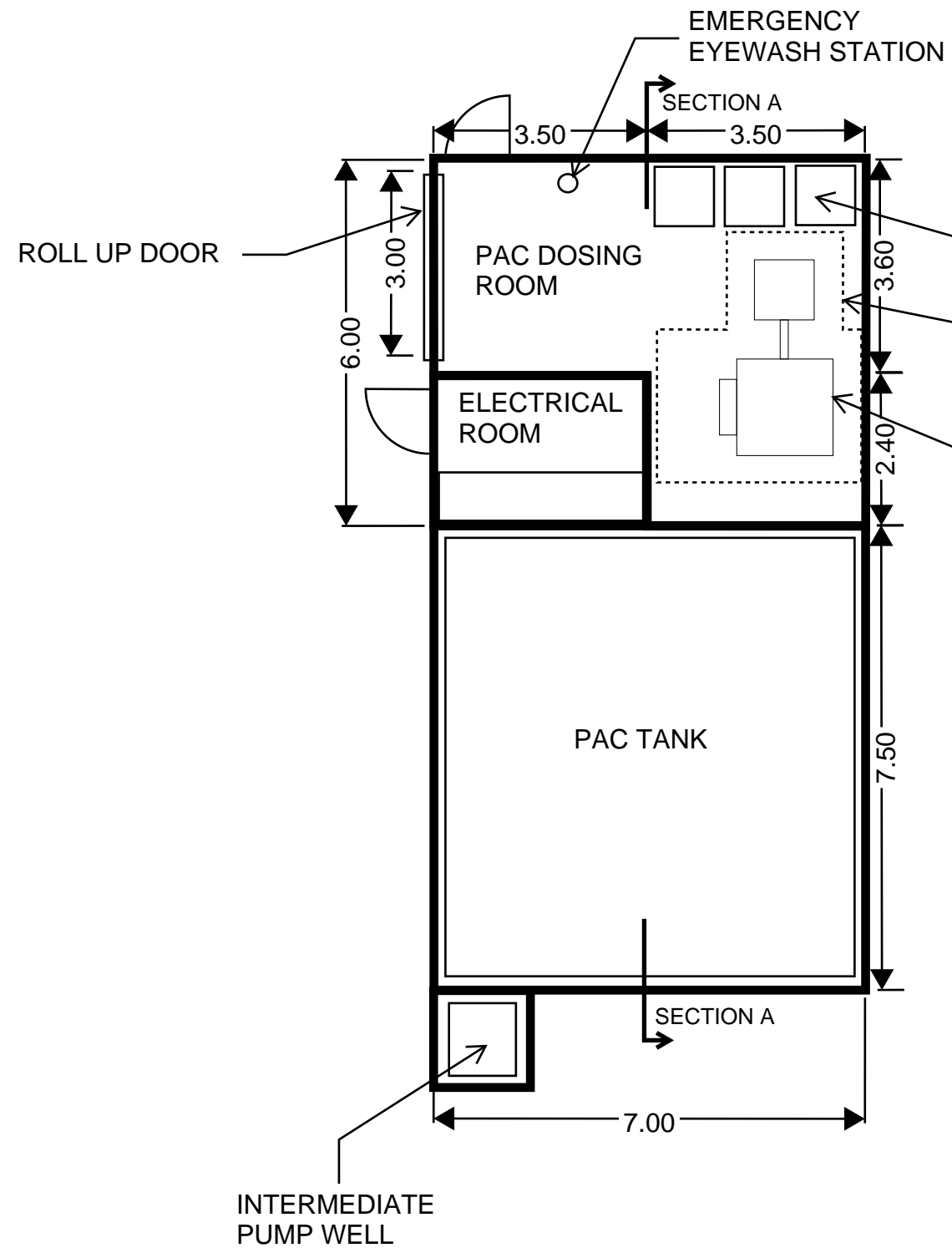
## **Appendix A: Conceptual Drawings and Vendor Layouts**



NOTE:  
 1. TREE REMOVAL  
 REQUIRED UP TO EXTENT  
 OF NEW FENCE LINE.



DATE:	
DRAWN BY:	
APPROVED BY:	
SCALE:	REVISION:
STD No.:	

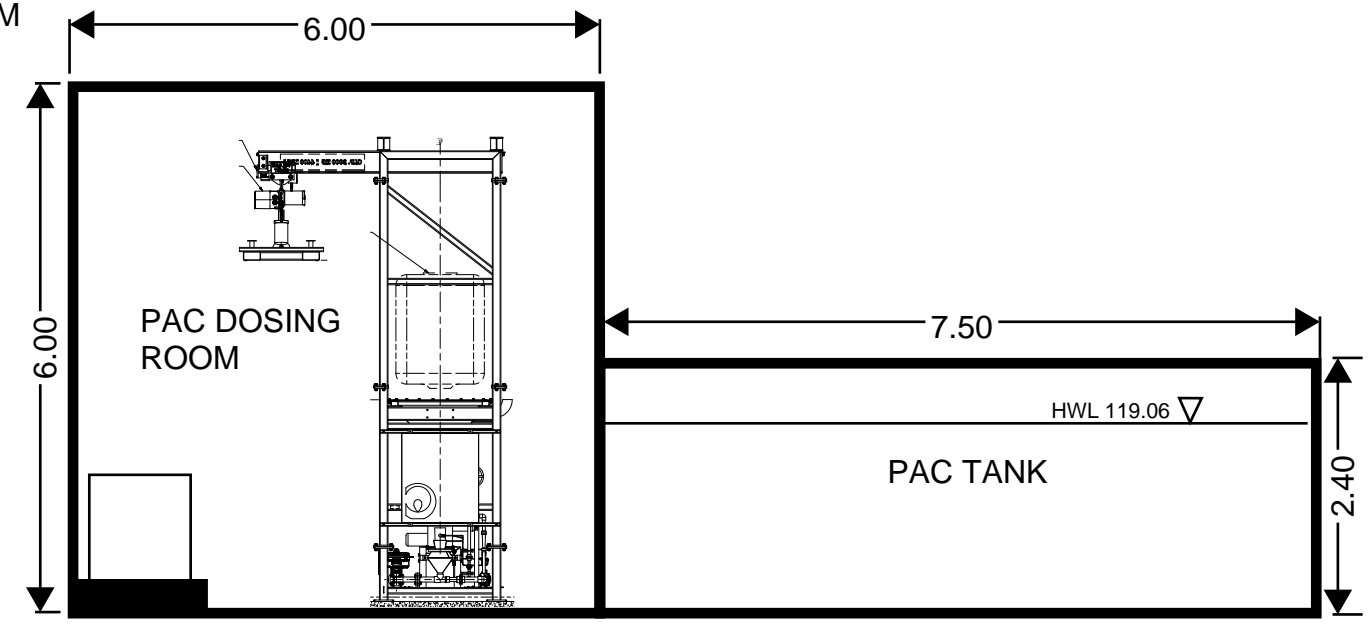


PALLET LOCATION  
1000 x 1000 PALLETS

MINIMUM CLEARANCE  
REQUIREMENTS

DRY PAC SLURRY  
PREPARATION AND  
DOSING SYSTEM

PLAN VIEW



SECTION A

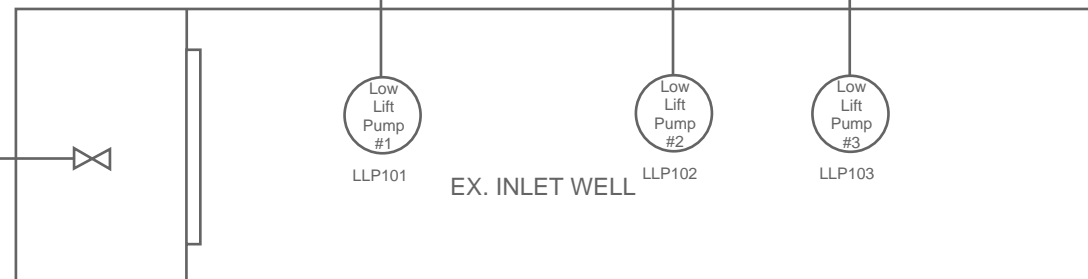


DATE:	
DRAWN BY:	
APPROVED BY:	
SCALE:	REVISION:
STD No.:	

OTTAWA RIVER

EX. INTAKE  
SCREEN

EX. 750 INTAKE



PS  
PG

PS  
PG

PS  
PG

EX. 350 RAW  
WATERMAIN

NEW 350 RAW  
WATERMAIN

PAC Tank

Int.  
Pump  
#1

Int.  
Pump  
#2

WATER TREATMENT PLANT



DATE:

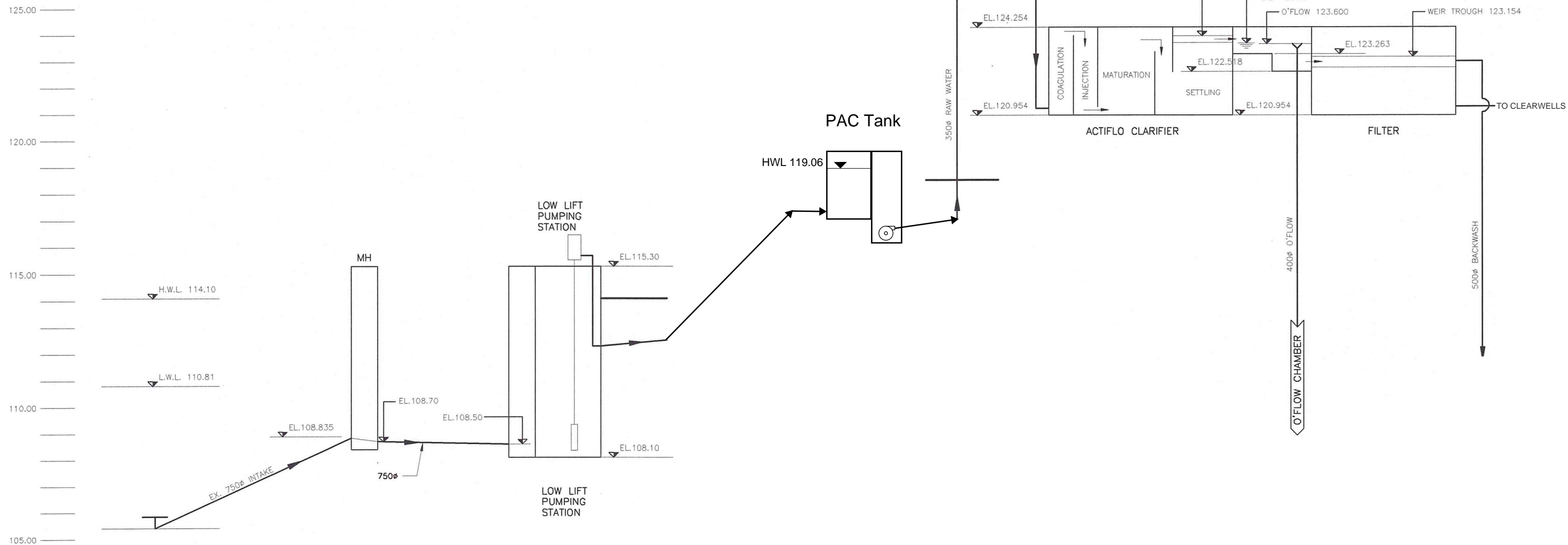
DRAWN BY:

APPROVED BY:

SCALE:

REVISION:

STD No.:



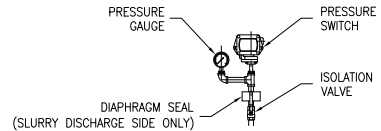
DATE:	
DRAWN BY:	
APPROVED BY:	
SCALE:	REVISION:
STD No.:	

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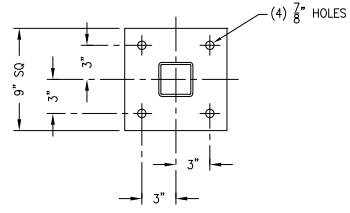
**CHEMCO SYSTEMS, L.P.**  
 1500 INDUSTRIAL DRIVE MONONGAHELA, PA

SHT. DESCRIPTION: **GENERAL ARRANGEMENT**  
 DWG. DESCRIPTION: **PAC BULK BAG UNLOADER**

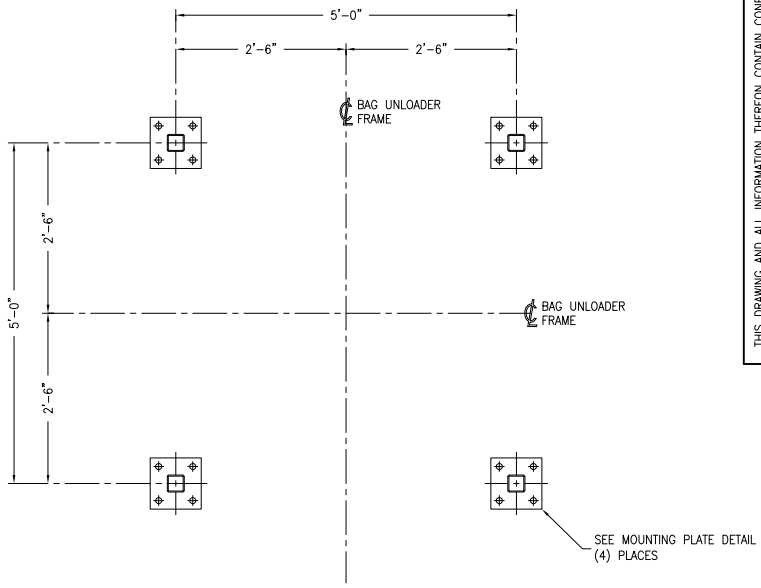
PRELIMINARY  
 DATE: REV. BY: REMARKS:  
 SCALE: 3/4" = 1'-0"  
 DATE: MARCH 19, 2020  
 CHECKED BY: D  
 APPROVED BY:



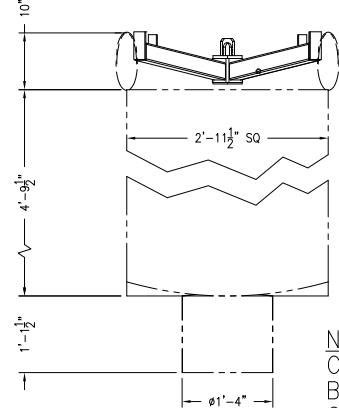
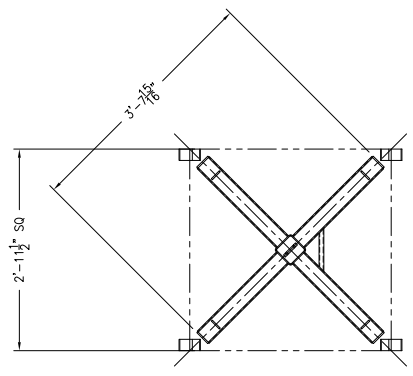
**DETAIL "1"**  
 PRESSURE GAUGE/SWITCH MOUNTING DETAIL  
 TYP. (3) PLACES



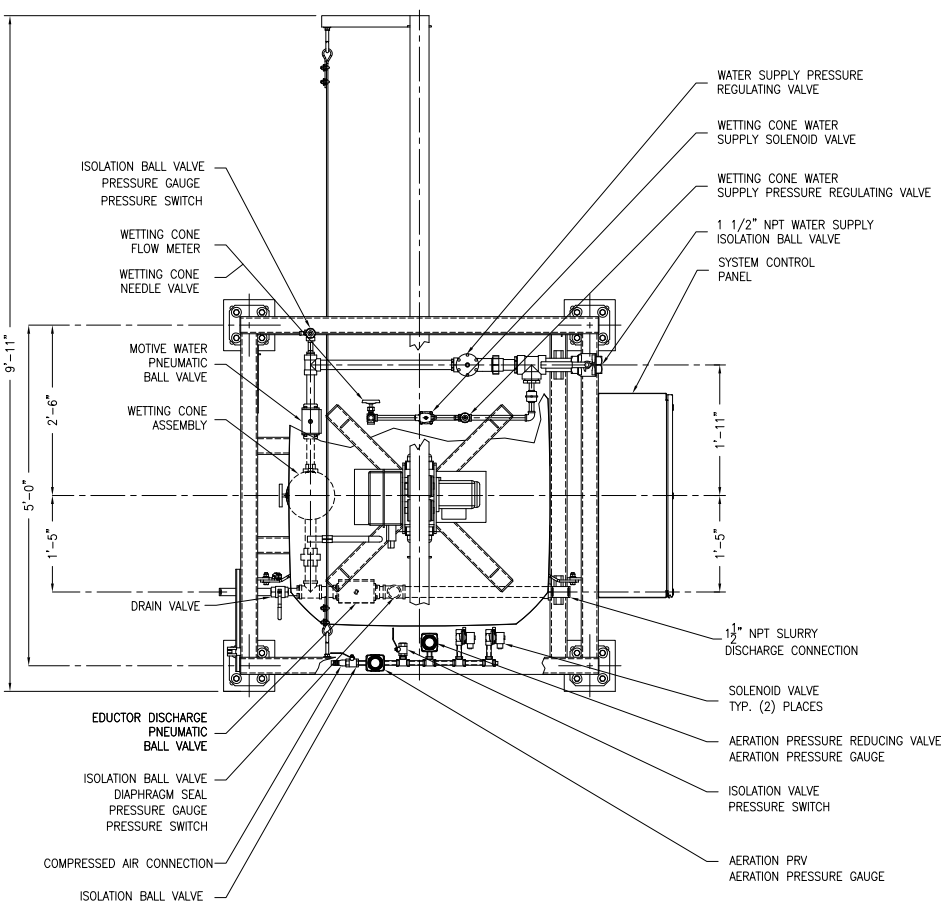
**MOUNTING PLATE DETAIL**  
 TYPICAL (4) PLACES  
 SCALE: 1 1/2" = 1'-0"



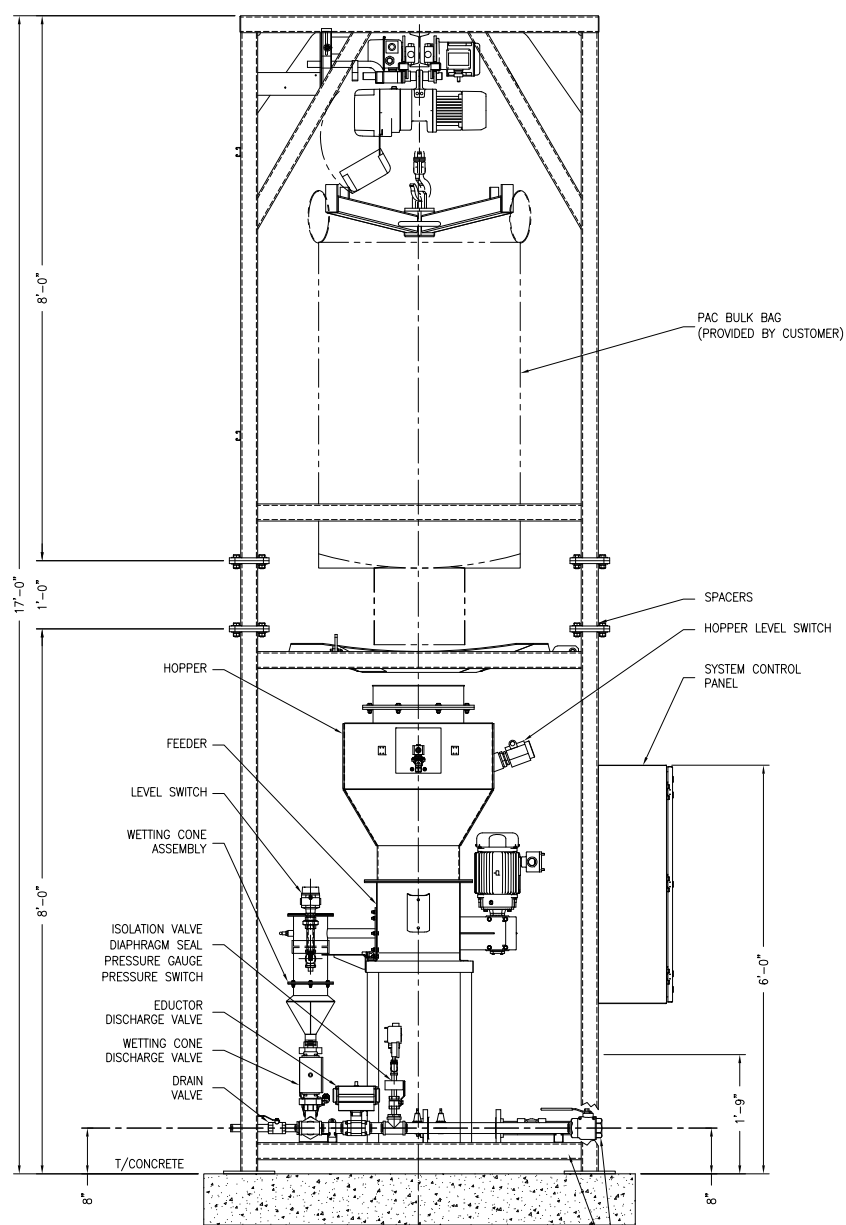
**MOUNTING DETAIL**



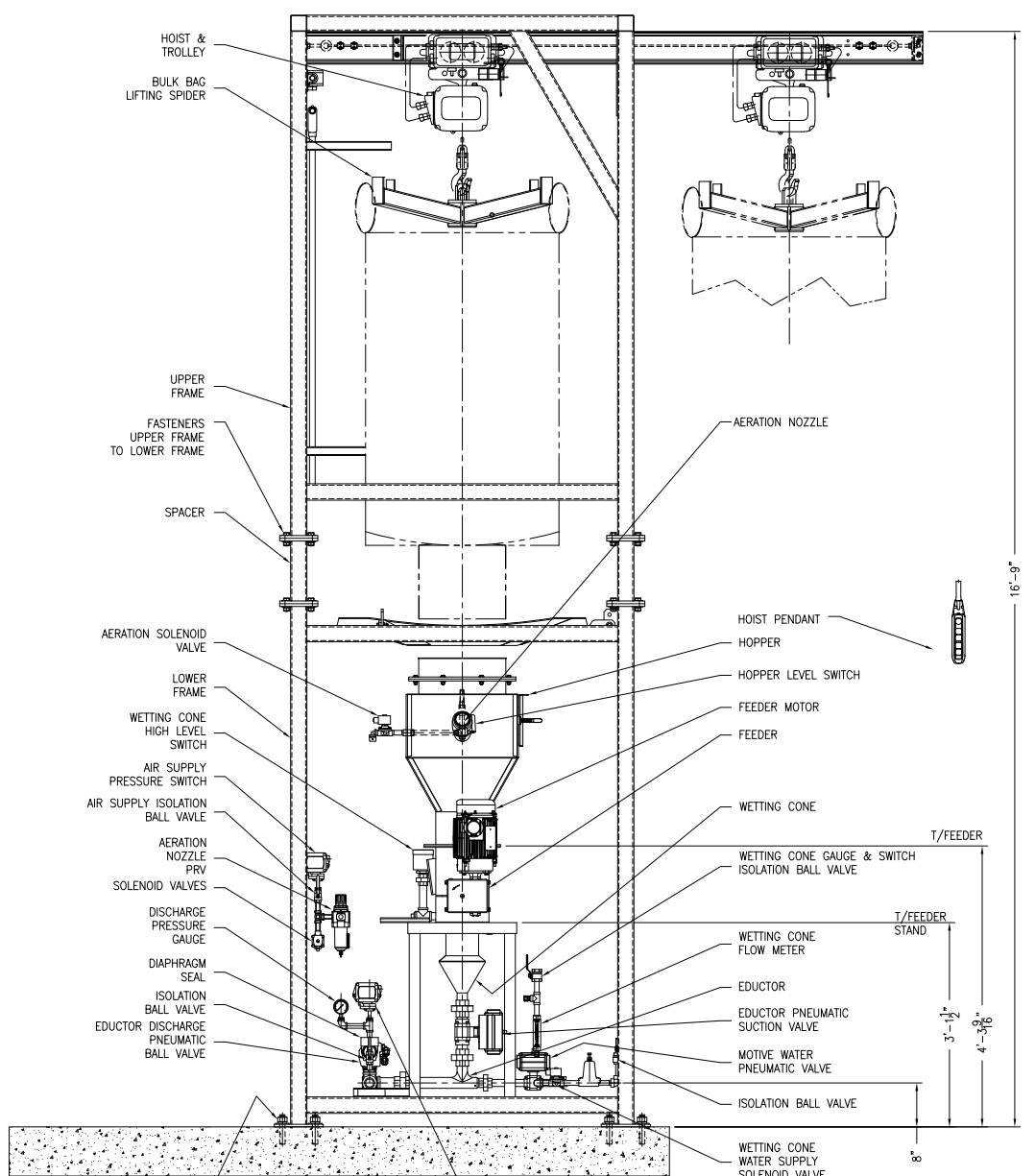
NOTE:  
 CUSTOMER TO VERIFY  
 BAG DIMENSIONS MATCH  
 CARBON SUPPLIERS.



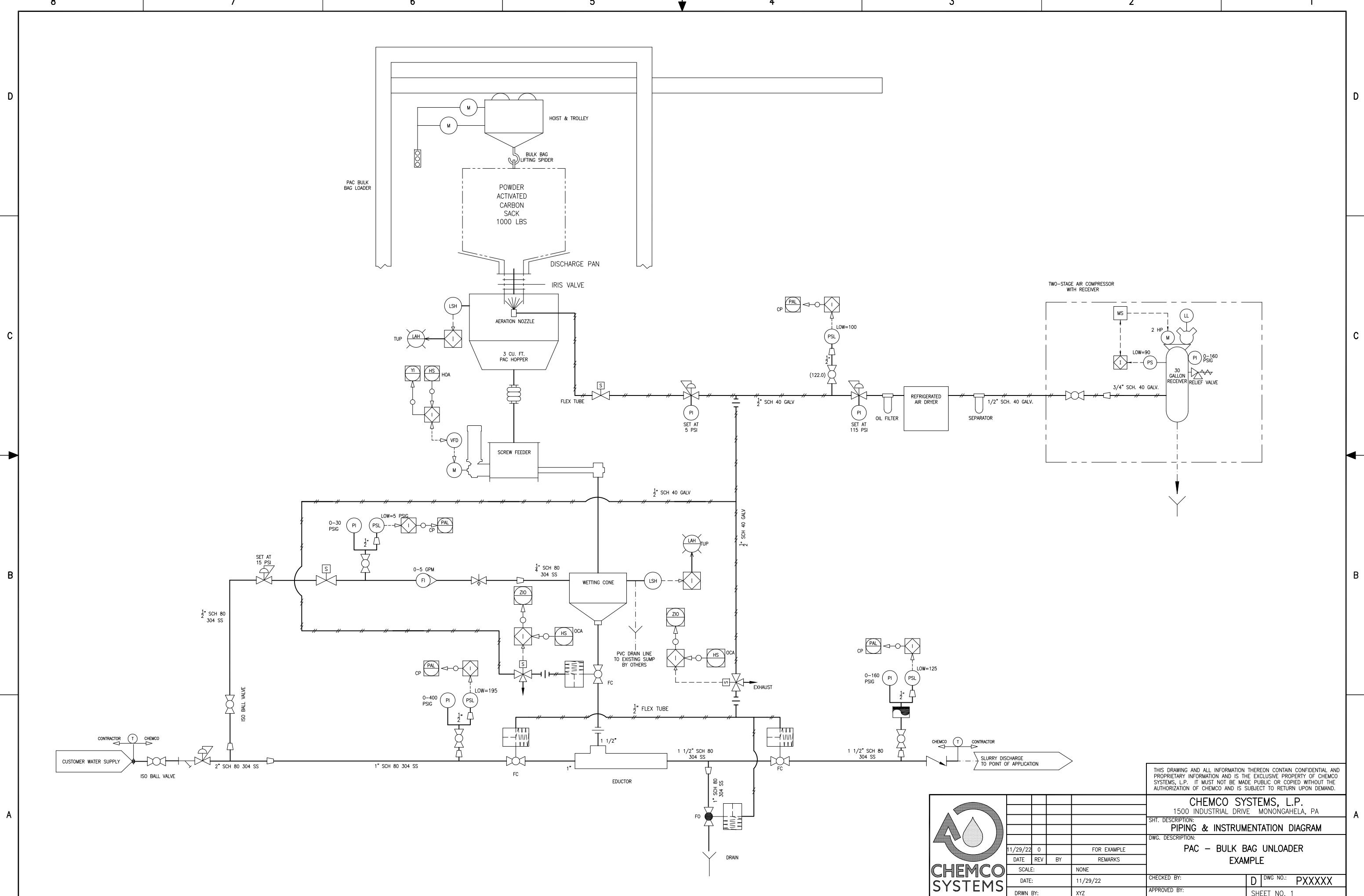
**PLAN VIEW**



**END VIEW**

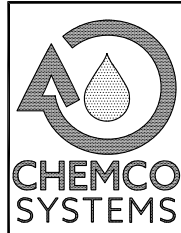


**ELEVATION VIEW**

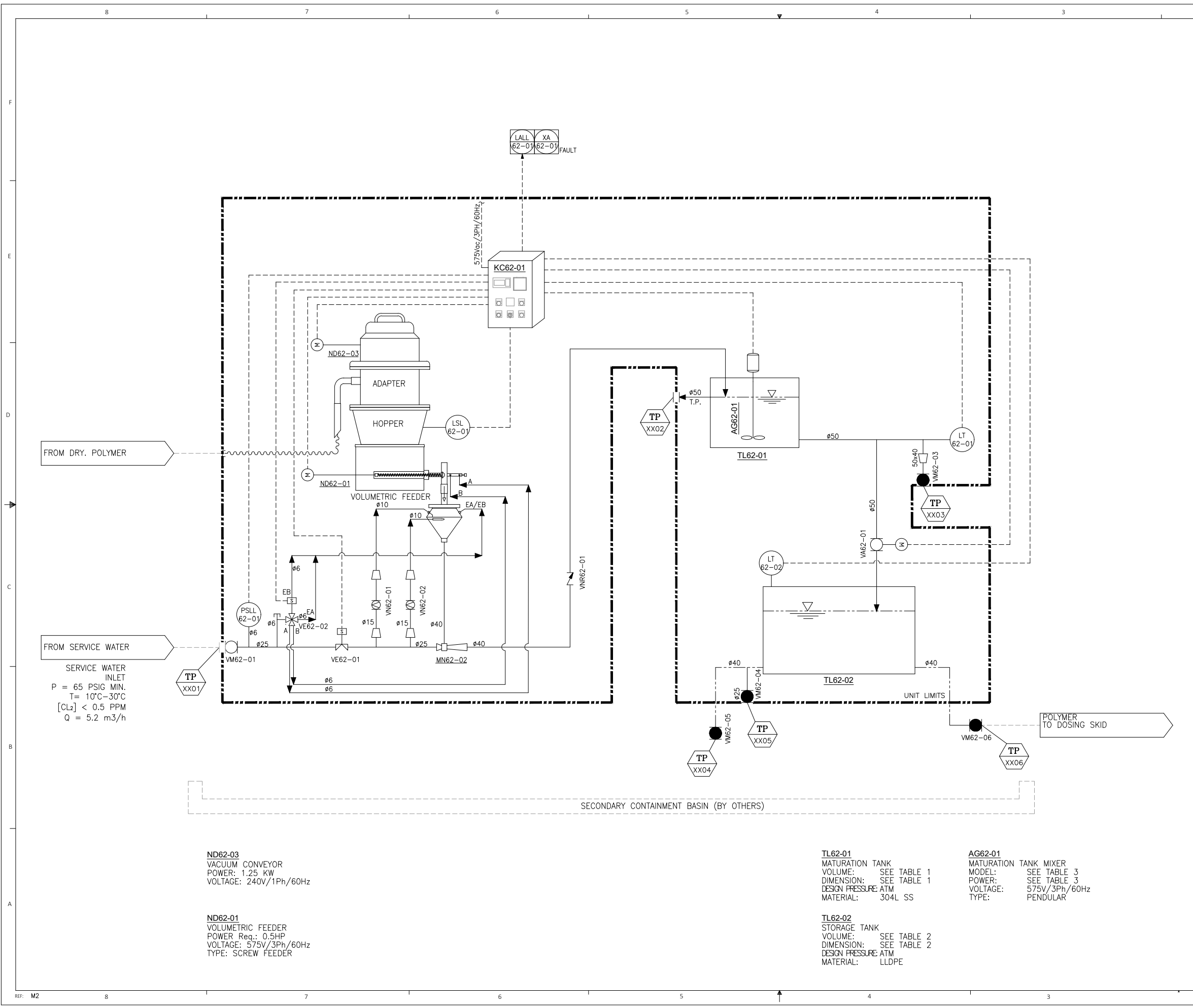


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<b>CHEMCO SYSTEMS, L.P.</b>	
1500 INDUSTRIAL DRIVE MONONGAHELA, PA	
SHT. DESCRIPTION:	
<b>PIPING &amp; INSTRUMENTATION DIAGRAM</b>	
DWG. DESCRIPTION:	
<b>PAC - BULK BAG UNLOADER EXAMPLE</b>	
CHECKED BY:	D DWG NO.: PXXXXX
APPROVED BY:	SHEET NO. 1



DATE	REV	BY	REMARKS
11/29/22	0		FOR EXAMPLE
SCALE:	NONE		
DATE:	11/29/22		
DRWN BY:	XYZ		



FROM DRY. POLYMER

FROM SERVICE WATER

SERVICE WATER INLET  
 P = 65 PSIG MIN.  
 T = 10°C-30°C  
 [Cl<sub>2</sub>] < 0.5 PPM  
 Q = 5.2 m<sup>3</sup>/h

**ND62-03**  
 VACUUM CONVEYOR  
 POWER: 1.25 KW  
 VOLTAGE: 240V/1Ph/60Hz

**ND62-01**  
 VOLUMETRIC FEEDER  
 POWER Req.: 0.5HP  
 VOLTAGE: 575V/3Ph/60Hz  
 TYPE: SCREW FEEDER

**TL62-01**  
 MATURATION TANK  
 VOLUME: SEE TABLE 1  
 DIMENSION: SEE TABLE 1  
 DESIGN PRESSURE: ATM  
 MATERIAL: 304L SS

**TL62-02**  
 STORAGE TANK  
 VOLUME: SEE TABLE 2  
 DIMENSION: SEE TABLE 2  
 DESIGN PRESSURE: ATM  
 MATERIAL: LLDPE

**AG62-01**  
 MATURATION TANK MIXER  
 MODEL: SEE TABLE 3  
 POWER: SEE TABLE 3  
 VOLTAGE: 575V/3Ph/60Hz  
 TYPE: PENDULAR

TIE POINTS TABLE		
	DESCRIPTION	MATL.
TPXX01	SERVICE WATER INLET	FLANGE #25 (1")- #150 R.F. PVC SCH.80
TPXX02	MATURATION TANK OVERFLOW	FNPT #50 (2")-PVC SCH.80
TPXX03	MATURATION TANK DRAIN	SOCKET #40 (1 1/2")-PVC SCH.80
TPXX04	STORAGE TANK OUTLET	SOCKET #40 (1 1/2")-PVC SCH.80
TPXX05	STORAGE TANK DRAIN	SOCKET #25 (1")-PVC SCH.80
TPXX06	STORAGE TANK OUTLET	SOCKET #40 (1 1/2")-PVC SCH.80

TABLE 1 MATURATION TANK VOLUME & DIMENSIONS		
HP MODEL	VOLUME	DIMENSIONS
HP500C	500L	800mm x 800mm x 1160mm
HP1000C	1000L	1000mm x 1000mm x 1160mm

TABLE 2 STORAGE TANK VOLUME & DIMENSIONS		
HP MODEL	VOLUME	DIMENSIONS
HP500C	725L	1524mm x 1219mm x 483mm
HP1000C	1128L	2032mm x 1219mm x 533mm

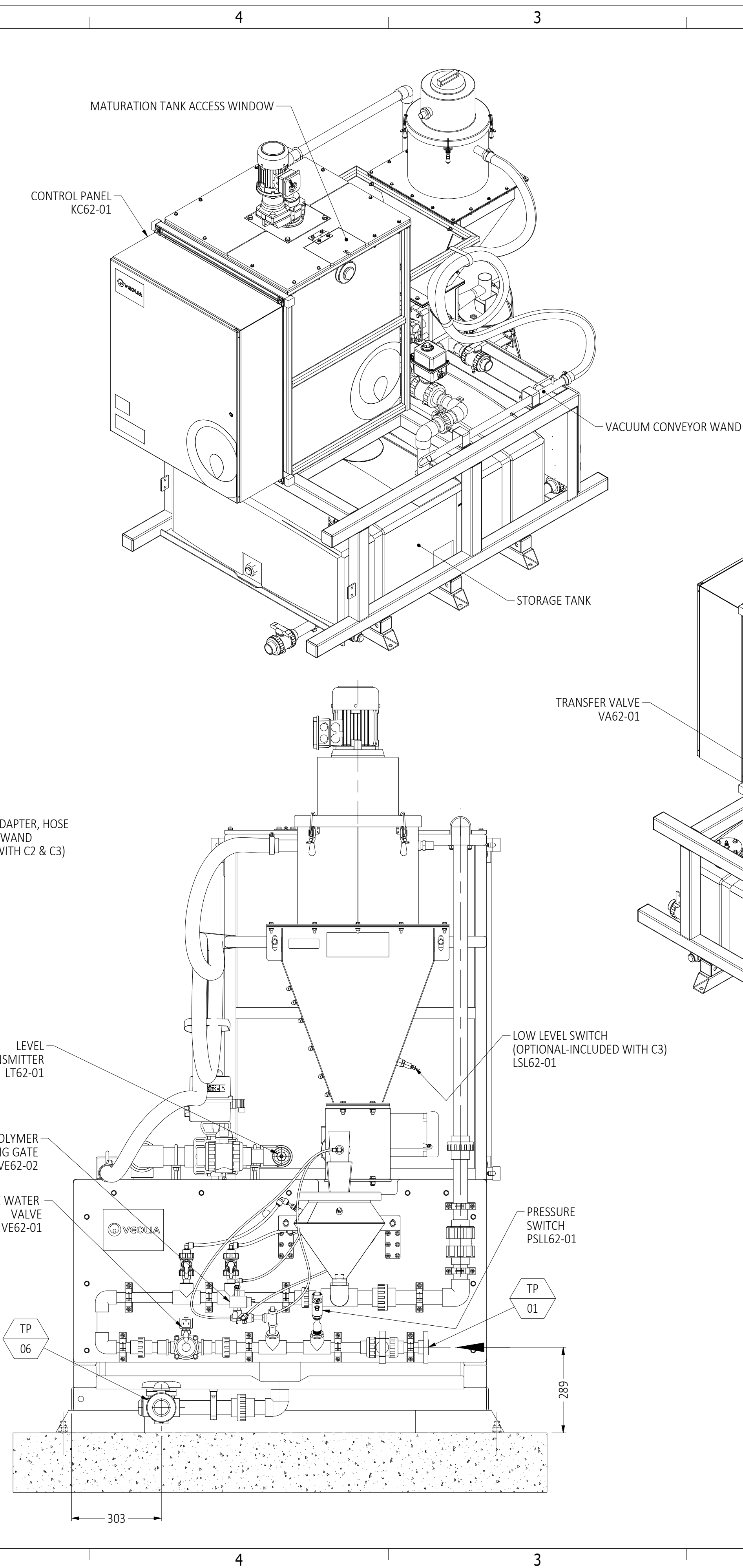
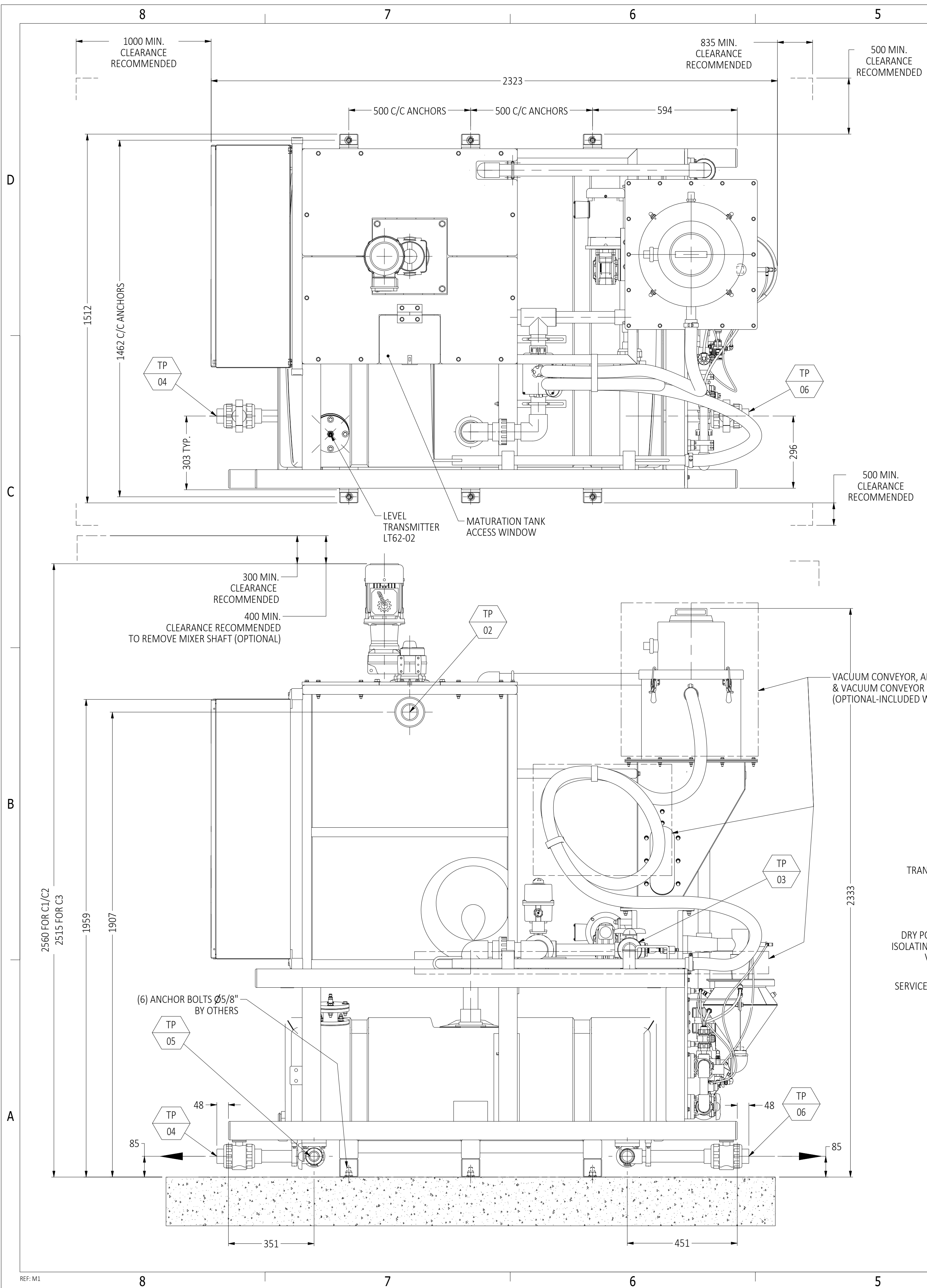
TABLE 3 MATURATION TANK MIXER	
HP MODEL	MIXER MODEL
HP500C	EVG01-0.33 HP
HP1000C	EVG01-0.5 HP

TABLE 4 TIE POINT CROSS REFERENCE	
P&ID TIE POINT	GA TIE POINT
TPXX01	TP01
TPXX02	TP02
TPXX03	TP03
TPXX04	TP04
TPXX05	TP05
TPXX06	TP06

REV.	DESCRIPTION	DATE	REVISE	VÉRIFIÉ	APPROUVÉ

	DESSINATEUR/DRAWING DESIGNER H.H. DATE: 2018-07-27	CLIENT
	VÉRIFICATEUR/CHECKER DATE: 2018-07-27	INGENIEUR/ENGINEER DATE: 2018-07-27
TITRE / TITLE POLYMER PREPARATION SYSTEM HYDRAPOL HP 500/1000 C3 575 PROCESS & INSTRUMENTATION DIAGRAM		
ECHELLE / SCALE N.T.S.	PROJET / PROJECT PI-6204-HYDP	INTERNE / INTERNAL GEN
FEUILLET / SHEET 1 / 1		REV./REV 0

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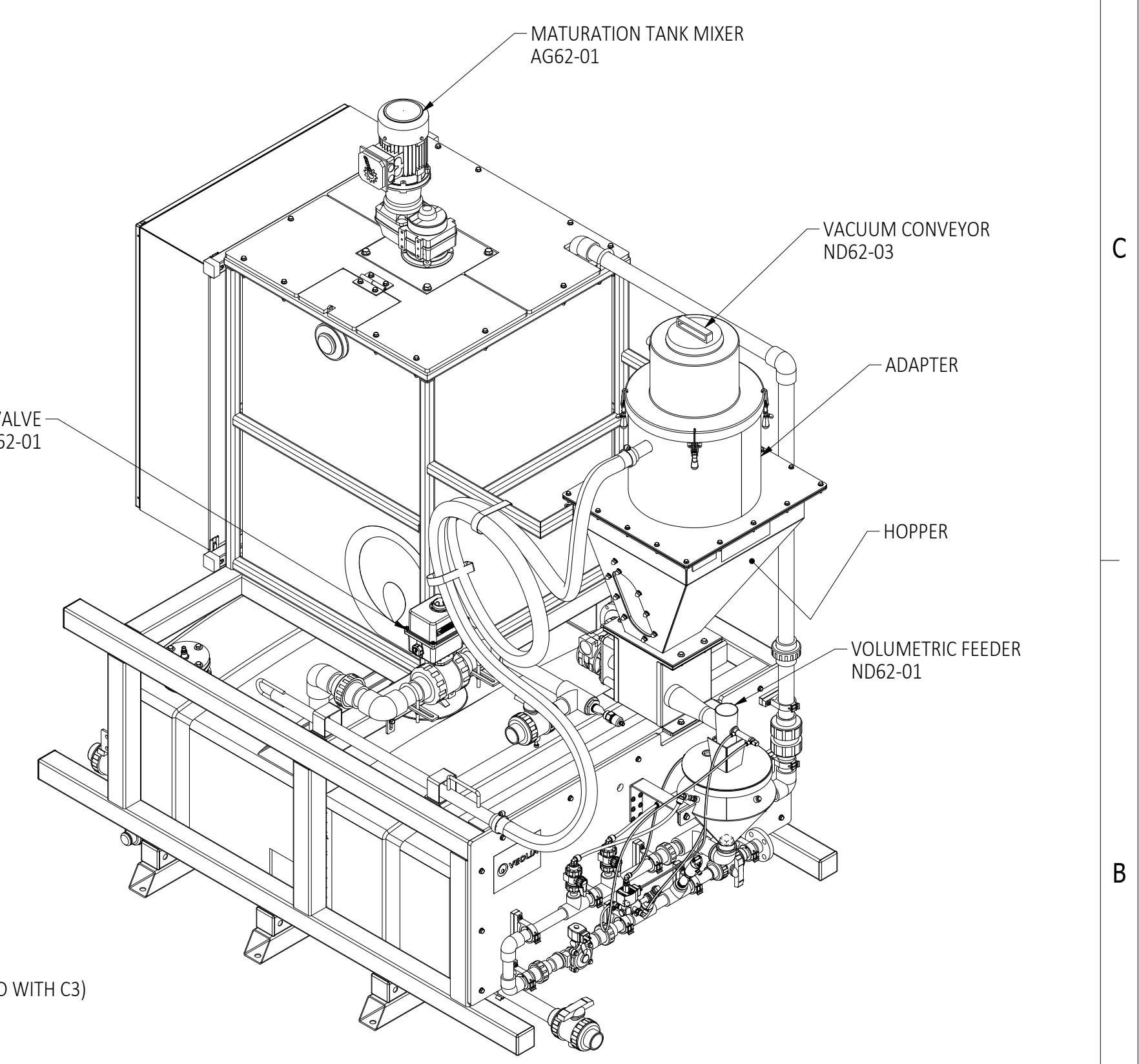
("TIE-IN") TABLE

TIE-POINT #	DESCRIPTION	DIMENSION / TYPE
TP-01	SERVICE WATER INLET	Ø1" - #150 FLANGE- R.F.   PVC
TP-02	MATURATION TANK OVERFLOW	Ø2" FNPT   PVC
TP-03	MATURATION TANK DRAIN	Ø1-1/2" SOCKET   PVC
TP-04	STORAGE TANK OUTLET	Ø1-1/2" SOCKET   PVC
TP-05	STORAGE TANK DRAIN	Ø1" - SOCKET   PVC
TP-06	STORAGE TANK OUTLET	Ø1-1/2" SOCKET   PVC

WEIGHT

MODEL	EMPTY	FULL
C1	725 KG (1598 Lbs)	2237 KG (4931 Lbs)
C2/C3	759 KG (1673 Lbs)	2272 KG (5008 Lbs)

NOTES:  
 1. EQUIPMENT IS PRE-ASSEMBLED AND PRE-WIRED & IS SHIPPED AS ONE PACKAGE EXCEPT VALVES AT THE POINTS TP-04 & TP-06 ARE SHIPPED LOOSE & MUST BE INSTALLED BY OTHERS.

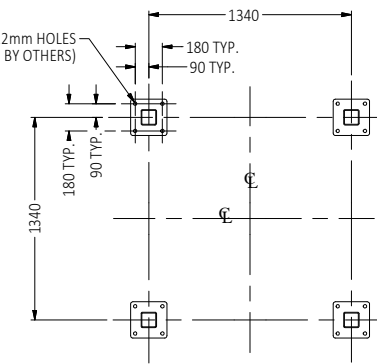
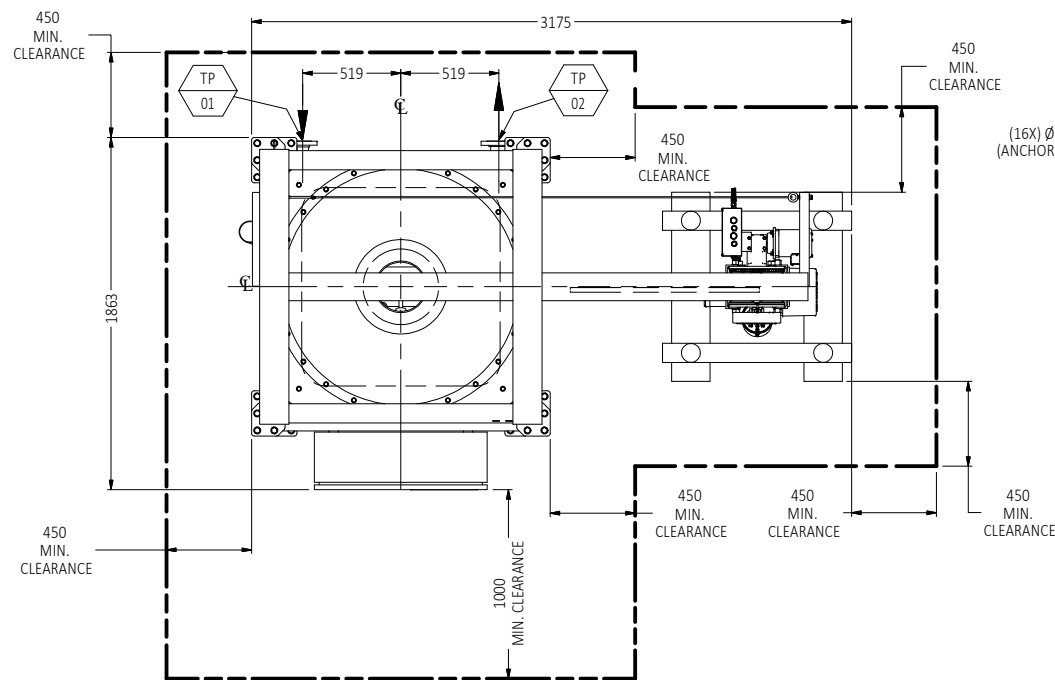


1 FOR INFORMATION		2019-02-21	H.H.	S.M.	G.P.
REV.	DESCRIPTION	DATE	REVISE	VÉRIFIÉ	APPROUVÉ
REV.	DESCRIPTION	DATE	REVISE	VÉRIFIÉ	APPROUVÉ
DESSINA TEUR / DESIGNER		DATE	CLIENT		
M.M.		2019-02-20			
VÉRIFIÉ A TEUR / CHECKER		DATE			
S.M.		2019-02-20			
INGÉNIEUR / ENGINEER		DATE			
G.P.		2019-02-20			
TITRE / TITLE		POLYMER PREPARATION SYSTEM			
		HYDRAPOL 500 C1/C2/C3 EN			
		GENERAL ARRANGEMENT			
ÉCHELLE / SCALE:	PROJET / PROJECT	DESSIN No / DRAWING No	INTERNE / INTERNAL	FEUILLET / SHEET	REV/REV
1:10	- GA 6200 HYDP			1 / 1	1

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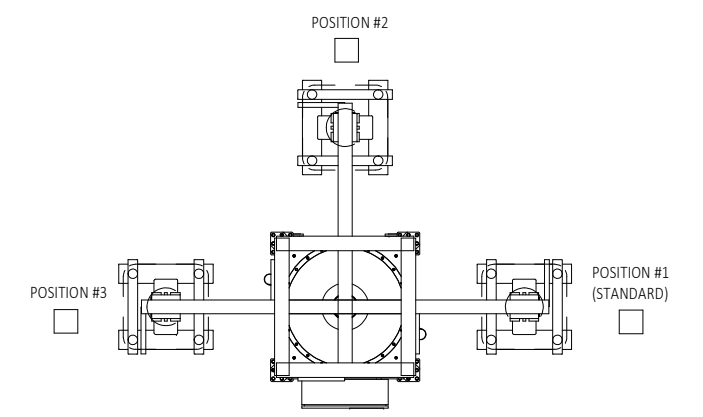


("TIE-IN") TABLE		
TIE-POINT #	DESCRIPTION	DIMENSION / TYPE
TP-01	SERVICE WATER INLET	Ø2" - #150 FLANGE - R.F.   PVC SCH.80
TP-02	DOSAGE POINT OUTLET	Ø3" - #150 FLANGE - R.F.   SS304 SCH.40



SECTION A-A

ÉCHELLE: 1:20



SELECT MONORAIL POSITION

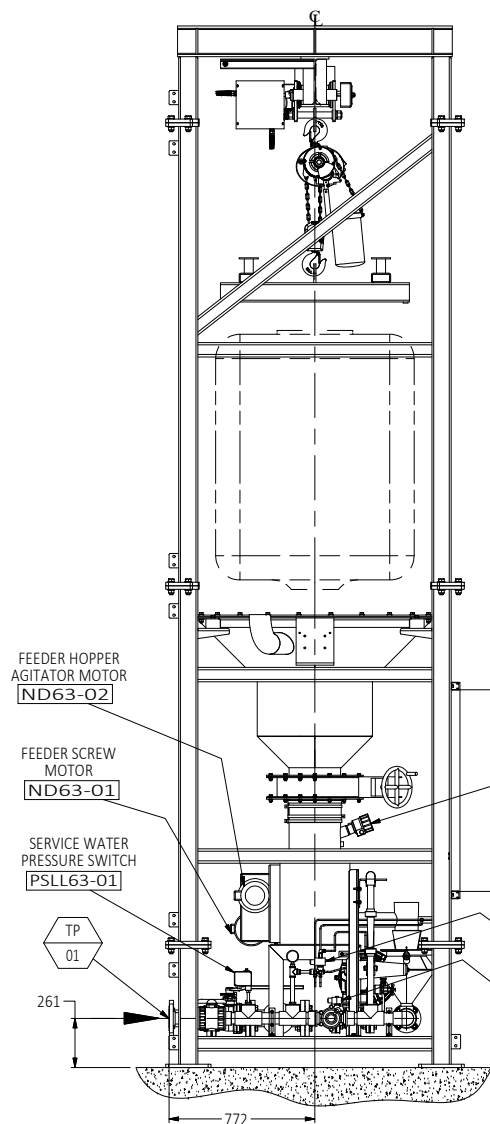
- WEIGHT: 1713 KG (3776 Lbs). EMPTY  
 - APPROX. WEIGHT: 3198 KG (7050 Lbs). FULL

NOTES:

1. HYDRASAND UNIT IS PREASSEMBLED IN SHOP BUT FOR FREIGHT PURPOSE SOME OF ITS COMPONENTS MUST BE INSTALLED ON SITE BY CONTRACTOR (SEPARATE BIGBAG, STRUCTURE SECTIONS, .....). REFER TO FIELD INSTALLATION DRAWINGS FOR DETAILS.

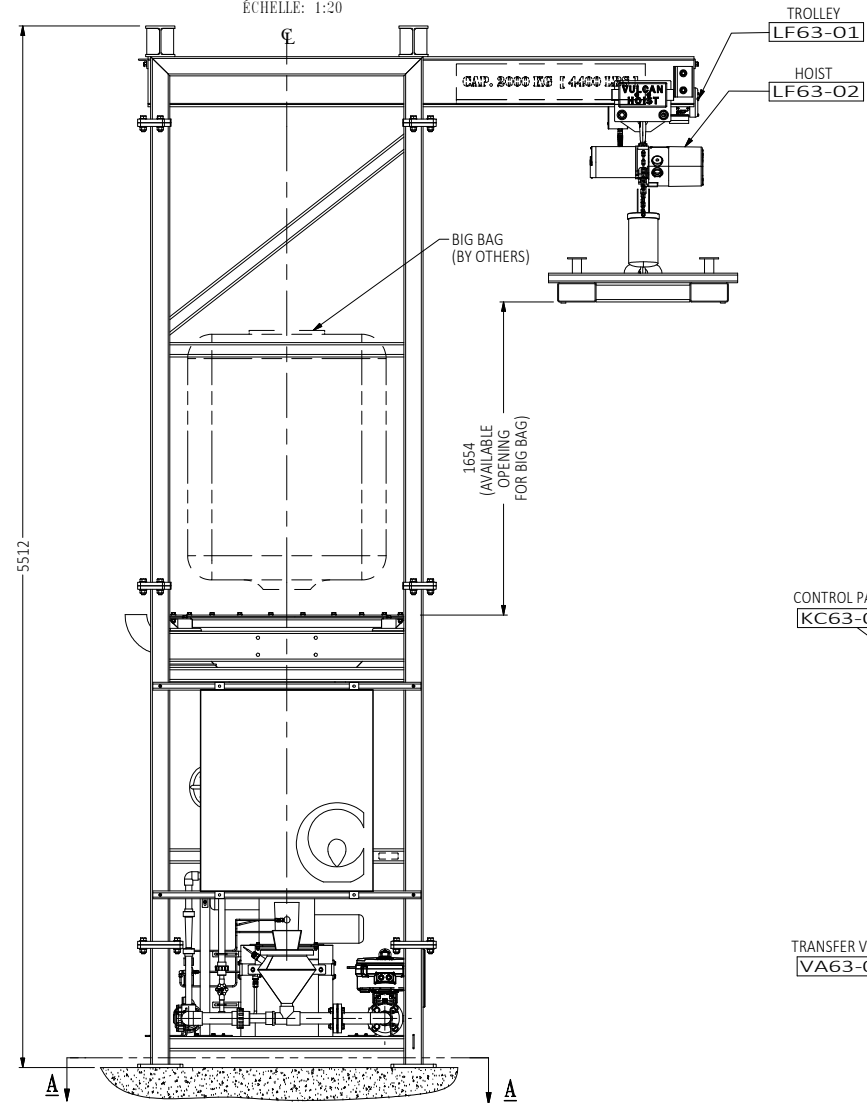
TOP VIEW

ÉCHELLE: 1:20



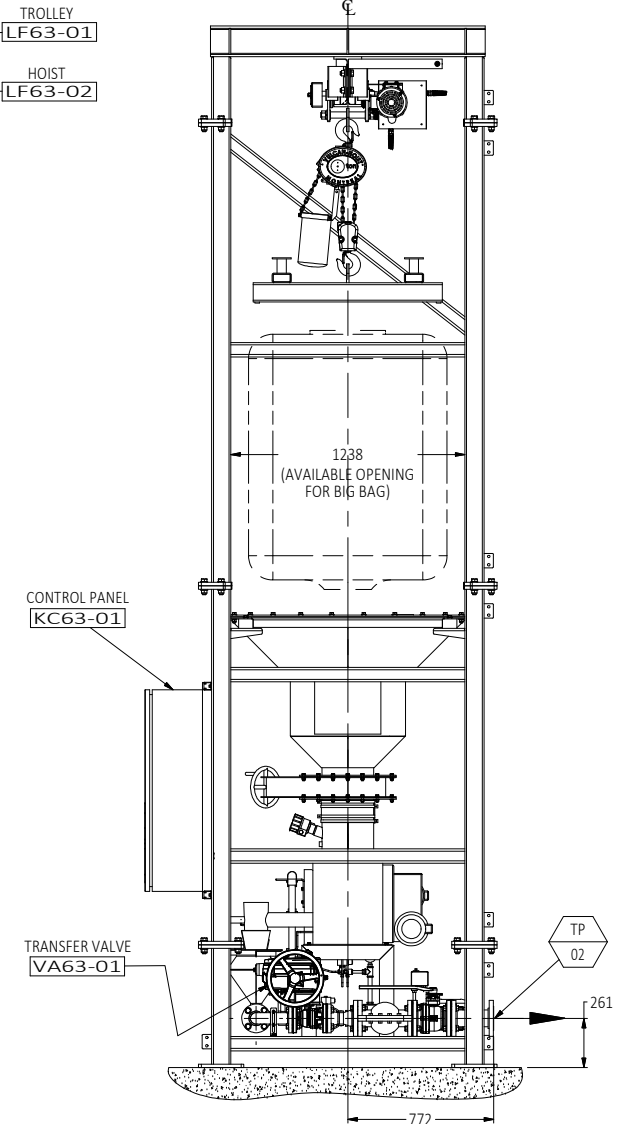
LEFT SIDE VIEW

ÉCHELLE: 1:20



FRONT VIEW

ÉCHELLE: 1:20



RIGHT SIDE VIEW

ÉCHELLE: 1:20

REV.	DESCRIPTION	DATE	REVISE	VERIFIÉ	APPROUVÉ
1	FOR INFORMATION	2020-11-13	H.H.	S.M.	G.P.
DESIGNATEUR/DESIGNER	DATE	CLIENT	DATE	REVISE	VERIFIÉ
N.L.	2018-12-18		DATE	CHECKED	APPROVED
VÉRIFICATEUR/CHECKER	DATE		DATE		
S.M.	2018-12-18		DATE		
INGÉNIEUR/ENGINEER	DATE		DATE		
S.M.	2018-12-18		DATE		
TITRE / TITLE					
MICROSAND - HYDRASAND DOSING SYSTEM					
BIG BAG STRUCTURE (HOIST & TROLLEY)					
GENERAL ARRANGEMENT					
PROJET / PROJECT		DESSIN No / DRAWING No		INTERNE / INTERNAL	
- GA_6300_HYDS		PCH		FEUILLET / SHEET	
				1 / 1	
				REV/REV	
				1	



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# B

## Appendix B: Conceptual Level Cost Estimate

**Deep River WTP Upgrade - THM**  
**Conceptual Design Class D Cost Estimate (-40% to +50%)**  
A001332

Drafted by AL  
Reviewed by BY & IP

230908

Component Description	Quantity	Unit	Unit Cost	Material Cost	Installation		Total Cost
					% of Matl	Cost	
<b>Site Works (Division 2)</b>							<b>\$ 155,000</b>
Excavation/Backfill/Disposal	800	m3	\$ 75	\$ 60,000	incl.	\$ -	\$ 60,000
New Fencing and Gate Relocation	50	m	\$ 500	\$ 25,000	incl.	\$ -	\$ 25,000
Landscaping (tree planting)	1	L.S.	\$ 30,000	\$ 30,000	incl.	\$ -	\$ 30,000
Removal & Miscellaneous	1	L.S.	\$ 40,000	\$ 40,000	incl.	\$ -	\$ 40,000
<b>Structural and Architectural (Division 3 - 10)</b>							<b>\$ 409,000</b>
New PAC Equipment and Electrical Building	42	m2	\$ 3,000	\$ 126,000	50%	\$ 63,000	\$ 189,000
New Concrete PAC Tank and Intermediate Pump Station	60	m3	\$ 2,000	\$ 120,000	incl.	\$ -	\$ 120,000
Miscellaneous (doors, hatches, etc)	1	L.S.	\$ 100,000	\$ 100,000	incl.	\$ -	\$ 100,000
<b>Process Equipment (Division 11)</b>							<b>\$ 1,163,000</b>
PAC preparation and dosing equipment	1	L.S.	\$ 490,000	\$ 490,000	50%	\$ 245,000	\$ 735,000
Intermediate pumping low lift pumps	2	ea	\$ 60,000	\$ 120,000	50%	\$ 60,000	\$ 180,000
Isolation valves - motorized (350mm)	3	ea	\$ 15,000	\$ 45,000	50%	\$ 23,000	\$ 68,000
Check valves (350mm)	3	ea	\$ 10,000	\$ 30,000	50%	\$ 15,000	\$ 45,000
Automated Polymer Preparation System	1	L.S.	\$ 50,000	\$ 50,000	50%	\$ 25,000	\$ 75,000
Miscellaneous	1	L.S.	\$ 60,000	\$ 60,000	incl.	\$ -	\$ 60,000
<b>Instrumentation and Controls (Division 13)</b>		L.S.	10%	\$ 1,163,000	incl.	\$ -	\$ 120,000
<b>HVAC &amp; Plumbing (Division 15)</b>		L.S.	30%	\$ 409,000	incl.	\$ -	\$ 130,000
<b>Electrical (Division 16)</b>		L.S.	20%	\$ 1,163,000	incl.	\$ -	\$ 240,000
<b>Sub-Total</b>							<b>\$ 2,217,000</b>
<b>Sub-Total Costs (A)</b>							<b>\$ 2,217,000</b>
Division 1 - General Contractor's Overhead & Profit, Mob., bond		% of A	10.0%				\$ 230,000
<b>Sub-Total Costs (B)</b>							<b>\$ 2,447,000</b>
Contingency		% of B	20.0%				\$ 490,000
Estimating Allowance		% of B	10.0%				\$ 250,000
Detailed Design Engineering and Contract Administration		% of B	10.0%				\$ 250,000
<b>Total Estimated Construction Costs (C) - Excluding Escalation &amp; HST</b>							<b>\$ 3,437,000</b>
<b>Provisional Items</b>							
<b>Component Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Material Cost</b>	<b>Installation</b>		<b>Total Cost</b>
					<b>% of Matl</b>	<b>Cost</b>	
Actiflo® system upgrades (lamella plate replacement, air scouring installation, microsand dosing, control panel replacement, etc.) (Provisional)	1	L.S.	\$ 300,000	\$ 300,000	50%	\$ 150,000	\$ 450,000
Replacement of SS piping (Provisional)	1	L.S.	\$ 75,000	\$ 75,000	50%	\$ 37,500	\$ 112,500
							<b>\$ 560,000</b>
<b>Total Estimated Construction Costs (C) with Provisional Items - Excluding Escalation &amp; HST</b>							<b>\$ 3,997,000</b>



Engineering  
for **people**