



WASTEWATER

DESIGN AND CONSTRUCTION MANUAL

Vertical Municipal Infrastructure Standards



REVISION TRACKING

EXISTING VERSION	VERSION NUMBER
March 2019	N: V1 - Original Final Submission
December 2020	V2
May 2022	V3
January 2023	V4
March 2024	V5
March 2025	V6

2024 REVISION SUMMARY

SECTION	MODIFICATION & COMMENTARY
2.4 Table 1	Type I ≤ 75 L/s Type II 76 L/s to 119 L/s Type III > 120 L/s
2.4 Table 1	Type III Stations: Split wet well/dry well design with dry pit submersible pumps. Provide a minimum of two wet well cells.
2.4 Table 1	Two equally-sized forcemains, each sized for peak flow. Provide a motorized isolation valve for each force main connected to SCADA.
2.5.3 Flow Meters	Measure influent flow to the wet well, where possible, with an open-channel flow meter located in an upstream maintenance hole. Measure discharge flow for each forcemain with an in-line flowmeter. All flowmeters shall be connected to SCADA for monitoring. Provide straight pipe runs upstream and downstream of the flowmeters in accordance with the recommendations of the flowmeter manufacturers.
2.5.4 Wet Well Sizing and Operating Depths	The minimum vertical separation between float elevations shall be no less than 100 mm;
2.5.4 Wet Well Sizing and Operating Depths	The wet well high-high level alarm elevation shall be a minimum of 300 mm below the invert of the inlet sewer; and,
2.5.7 Wet Well Ventilation Ducts	Revised Title: Wet Well Ventilation Ducts
2.5.7 Wet Well Ventilation Ducts	Provide stainless steel 316L or FRP ventilation ducts in the wet well with exterior access to permit connection of a portable ventilation fan for personnel access. For larger stations, ventilation fans shall be permanent and tied into SCADA for remote and manual operation. All mounting hardware shall be Type 316L stainless steel.

2024 REVISION SUMMARY

SECTION	MODIFICATION & COMMENTARY
2.5.9 Wet Well Cleaning	The wet well should be designed so that it can be easily accessed for cleaning. from the outside without the need for confined space entry. Provide a permanent Type 316L stainless steel standpipe cleanout inside the wet well with an exterior camlock connection to facilitate vacuum cleaning for wet wells deeper than 6.0 m. Provide a reduced pressure zone (RPZ) separated water supply for wet well cleaning.
2.5.11 Wet Well Lighting	Wet Well Lighting Wet Well, Dry Well and Valve Chamber Lighting
2.6.2 Valves and Gates	Revised Title: Valves, and Gates and Actuators
2.6.2 Valves and Gates	Pump laterals and forcemain valves shall not be installed inside the wet well. All process valves shall be installed within the dry well or a separate valve chamber. All valves and process mechanical equipment shall be material Type 316L stainless steel. Check valves shall be equipped with backflow actuators. For stations with more than one forcemain, provide motorized actuated isolation valves controlled by SCADA on each forcemain. Remote Automatic pumping operation shall alternate between the two forcemains at a pre-set frequency.
2.7.1 General Design Considerations	All pumps should be designed to prevent the need for grinders or screening equipment
2.7.2 Submersible Wet Well Pumps	Wet well submersible pump motors shall be rated for operation within Class 1 Division 1 environments in accordance with the latest version of NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

2024 REVISION SUMMARY

SECTION	MODIFICATION & COMMENTARY
2.7.3 Dry Well Pumps	<p>Revised Title: Dry pit submersible pumps</p> <p>Dry pit submersible pump motors shall be rated for Class 1 Division 2 environments in accordance with NFPA820.</p>
2.11.1 Wet Well Ventilation	<p>Ventilation shall exceed required air exchanges per hour. meet or exceed the required air exchanges per hour as indicated in the MECP Design Guidelines for Sewage Works.</p>
Section Revised: 2.14 Instrumentation and Controls	<p>2.14 Generic Process Control Narrative</p> <p>A primary PLC will control the pumping sequences via hydrostatic probe(s) located within the wet well(s). In the event of PLC related failures or maintenance:</p> <ol style="list-style-type: none"> 1. The level in the wet well(s) will rise tripping the back-up system float and activating the back-up pumping control system, 2. a manual selector switch will disable all PLC pumping control and activate the back-up pumping control system. These stations will be unmanned and require an auto dialer alarm system so staff can respond to any issues. <p>Refer to SCADA standards for more details.</p>

2024 REVISION SUMMARY

SECTION	MODIFICATION & COMMENTARY
<p>NEW SECTION: 2.14.1 Process Control Equipment</p>	<p>2.14.1 Process Control Equipment</p> <ul style="list-style-type: none"> • 1 primary PLC to control pumping sequences and control/ gather status from other applicable equipment • 1 hydrostatic level sensor (per wet well) to be utilized by the primary control system • 1 standalone back-up pumping control system (Siemens Multiranger or equivalent) • 1 hydrostatic level sensor (per wet well) to be utilized for the back-up control system • 1 float (per wet well) to activate backup system and activate back up system active alarm • 1 high high-level float (per wet well) for alarming at the surcharge/ inlet invert elevation • Pressure monitor of local potable water supply line, ability to monitor district pressure. • Other Instrumentation <ul style="list-style-type: none"> o Magnetic flow meter(s) o Pressure transmitters(s) o Air monitoring devices (H2S, CO, CH4, O2) o Atmospheric temperature sensor o Fire/ smoke detection sensors o Other applicable instrumentation

2024 REVISION SUMMARY

SECTION	MODIFICATION & COMMENTARY
4.0 Wastewater Treatment	The design of Wastewater Treatment Plant and its components shall be in accordance with the latest version of the MECP Design Guidelines for Sewage Works.
4.9 Sludge Pumps	<p>Sludge pumps, RAS pumps, and waste-activated sludge (WAS) pumps must be suitable for handling sludge and gritty material with a solids concentration of up to 5%. The pumps should be selected to efficiently cover the anticipated range of flows, not just the peak flow rate.</p> <p>Both RAS and WAS All sludge flow shall be measured through SCADA using dedicated flowmeters. The RAS discharge point or chamber shall be designed to ensure good mixing, sampling, and minimal turbulence with secondary influent flow.</p>
4.12 Automatic Sampling Stations	Automatic sampling stations are required for raw wastewater, final effluent and any other location as deemed necessary. Provide automatic sampling stations to perform discrete or composite flow proportional and time proportional sampling. The sampler enclosure shall be weatherproof, corrosion resistant, insulated, and complete with forced air heater and thermostat, locking door, and bolt down base. The refrigerated sample compartment must be lockable. The controller must be programmable with an LCD display. and connected to SCADA for monitoring.
4.14 High-Pressure Effluent Water System	Section Removed

2024 REVISION SUMMARY

SECTION	MODIFICATION & COMMENTARY
5.1 Digester	<p>Primary—All anaerobic digesters shall be equipped with at least one sidewall access bulkhead into the digester for inspection and cleaning.</p> <p>Provide mechanical mixing equipment for digester mixing. The digester system shall be equipped with recirculation pumps that force sludge through a heat exchanger to maintain the operating temperature.</p> <p>Secondary anaerobic digesters shall be equipped with Provide at least one sidewall access bulkhead into the digester for inspection and cleaning.</p> <p>The secondary digester should be equipped with a decant system for a maximum range of sludge depths. Each digester shall be equipped with an emergency overflow line to protect the structure.</p>
NEW SECTION: 5.5 Generic Equipment	All equipment shall be constructed of heavy-duty materials to prevent premature wear and corrosion.
NEW SECTION: 5.6 Classified Spaces	All classified spaces will be designed in such a manner that the design will not rely on air exchanges or shunt trip methods. All classified areas are to be fully equipped with explosion proof equipment to meet the specific classification of each area.

TABLE OF CONTENTS

1.0	Introduction	1
1.1	Scope	1
1.2	Description of the Wastewater Collection and Treatment System	1
2.0	Wastewater Pumping Stations (WWPS)	2
2.1	General Design Considerations	2
2.2	Peak Flow	2
2.3	Firm Capacity	2
2.4	Wastewater Pumping Station Layout and Design	2
2.5	Wet Well	4
2.6	Dry Well and / or Valve Chamber	5
2.7	Pump Design	6
2.8	Forcemain Design and Maintenance	7
2.9	Emergency Overflow Storage	7
2.10	Access Hatches and Ladders	8
2.11	Ventilation	8
2.12	Odour Control	8
2.13	Electrical Design	8
2.14	Generic Process Control Narrative	9
2.15	Alarming and Security System	9
3.0	Septage Receiving and Unloading	10
3.1	General Requirements	10
4.0	Wastewater Treatment	11
4.1	Plant Layout	11
4.2	Process Laboratory	11
4.3	General Structural Requirements for Wastewater Applications	11
4.4	Raw Wastewater Pumping Station	11
4.5	Preliminary Treatment	11
4.6	Primary Clarifiers	11
4.7	Aeration Systems	12
4.8	Secondary Clarifiers	12
4.9	Sludge Pumps	12
4.10	Effluent Disinfection and Dechlorination	12
4.11	Alternative Technologies	13
4.12	Automatic Sampling Stations	13
4.13	Accessibility for Manual Sampling	13
4.14	High-Pressure Effluent Water System	13

TABLE OF CONTENTS

5.0 Biosolids Management 14

5.1 Digesters 14

5.2 Digester Bio-Gas 14

5.3 Sludge Heat Exchanger 14

5.4 Biosolids Storage and Loading Facility 14

5.5 Generic Equipment 14

5.6 Classified Spaces..... 14

1.0 INTRODUCTION

1.1 Scope

This section of the manual is intended to address design requirements related to the pumping, septage receiving, and treatment of municipal wastewater and municipal biosolids management within the City of Brantford.

Refer to the City's Linear Municipal Infrastructure Standards for sanitary collection system and forcemain design. This section should be read in conjunction with the General Preface and Common Elements sections of the Vertical Municipal Infrastructure Standards.

1.2 Description of the Wastewater Collection and Treatment System

The City of Brantford wastewater collection and treatment system is owned and operated by the Corporation of the City of Brantford. The wastewater collection and treatment system consists of a Class IV Wastewater Treatment Plant and a Class II Collection System. The City's wastewater vertical infrastructure generally consists of the following types of facilities:

- **Wastewater Pumping Stations (WWPS):** Facilities throughout the City that pump wastewater from a dedicated catchment to the gravity sewer network downstream to ultimately flow to the wastewater treatment plant.
- **Brantford Wastewater Treatment Plant (WWTP):** This facility is a Class IV conventional activated sludge treatment plant. Raw wastewater is lifted via the influent raw wastewater pumping station and flows through the plant by gravity. Preliminary treatment includes mechanically-raked bar screens and vortex grit separators. Flow is split between two parallel trains of conventional treatment and secondary clarification, after which the effluent is disinfected and dechlorinated. Final effluent is discharged to the Grand River.
- **Biosolids Management:** A biosolids storage and loading facility used to store and haul biosolids for seasonal land application.



2.0 WASTEWATER PUMPING STATIONS (WWPS)

2.1 General Design Considerations

WWPS configurations shall be designed to provide the most efficient layout of pumps, equipment, and piping with consideration for ease of access and maintenance. The design shall be aimed at minimizing or eliminating the need for confined space entry.

Facility design shall consider the following priorities:

- **Technical Feasibility:** Convey intended flows
- **Public Safety:** Limit risk to public health, the environment, and site security
- **Operator Safety:** Limit risk to operators
- **Adaptability:** Provide space for expansion, such as changes to future capacity or improvements in pumping efficiencies
- **Cost:** Maintain economics of design comparable to other systems on the market, in terms of life cycle costing (LCC) per unit of flow rate
- **Reliability of Operation:** Reduce frequency of plugging and maintenance requirements
- **Constructibility:** any proposed design changes must be able to be implemented into the existing site conditions. Where not possible, the standards can be amended to the City's approval.



2.2 Peak Flow

Peak flow is defined as the peak instantaneous inflow to the wastewater pumping station.

2.3 Firm Capacity

Firm capacity of a WWPS is defined as the pumping capacity of the facility when both the largest pump and the largest forcemain (where more than one forcemain exists) are out of service.

2.4 Wastewater Pumping Station Layout and Design

The most efficient layout of pumps and equipment for safe and cost-effective operation and maintenance of the facility shall be considered. Wet wells shall be designed and configured for safe and convenient operation with a self-cleaning configuration.

Design configuration of the pumping station is based on several factors including future flows, firm capacity, land availability, depth of wet well, flow variations, operations and maintenance considerations, construction capital costs, and life cycle costs.

Station layout shall ensure all rated and non-rated classified hazardous spaces are physically separated from each other (i.e. walls or other means).

Consider the general guidelines outlined in **Table 1** for pump station configurations based on the rated capacity. These are general guidelines only. Refer to the Standard Schematics in the Appendices of this Manual for a process schematic for each station type.

Table 1 Wastewater Pumping Station General Design Classification

Station Type	Rated Capacity	Specific Layout and Requirements for Station Type	No. of Pumps	No. of Force mains	Wet Well Ventilation for Personnel Entry
I	≤ 75 L/s	A single cell, wet well submersible pumping station Bypass maintenance hole complete with an inlet isolation gate, located upstream within the site Electrical and control panel housed in a dedicated unclassified superstructure (prefabricated building may be considered) Below grade valve chamber housing valves and a discharge flowmeter	Two (one duty, one standby)	One sized for peak flow.	Portable ventilation system
II	76 L/s to 119 L/s	Wet well submersible pumping station with dual cells Provide a minimum of two wet well cells. Inlet isolation gates to divert flows into each cell Inlet bypass chamber large enough to house the correct size portable bypass pumps for complete station rehabilitation, maintenance purposes, and/or complete station failure Wet well interconnection gate to isolate each cell for service Electrical and control panel housed in a dedicated unclassified superstructure (prefabricated building may be considered) Below grade valve chamber housing valves and a flowmeter for each forcemain	Up to three (at least one standby)	Two equally-sized forcemains, each sized for peak flow. Provide a motorized isolation valve for each forcemain.	Ventilation duct with a permanent explosion-proof and corrosion-resistant ventilation fan
III	≥ 120 L/s	Split wet well/dry well design with dry pit submersible pumps Inlet isolation gates to divert flows into each cell Inlet bypass chamber large enough to house the correct size portable bypass pumps for complete station rehabilitation, maintenance purposes, and/or complete station failure Wet well interconnection gate to isolate each cell for service Electrical and control panels housed in a dedicated superstructure that is unclassified Ventilated below-grade dry well housing valves and a flowmeter for each forcemain	To be determined by the Proponent based on anticipated range of flows	Two equally-sized forcemains, each sized for peak flow. Provide a motorized isolation valve for each forcemain connected to SCADA.	Ventilation duct with a permanent explosion-proof and corrosion-resistant ventilation fan

Notes:

- All wet wells shall be equipped with a gooseneck ventilation duct.
- All station types shall be equipped with at least one standby pump.
- All station types shall provide stand-by power to meet the full load capacity of the facility. Must conform to **Common Elements Section 11.0**.
- All station types shall be equipped with an inlet open-channel flowmeter installed in an upstream maintenance hole within the site.
- The flowmeter shall be powered by the station and connection to SCADA for monitoring.
- Each forcemain shall be equipped with an inspection port and a forcemain bypass connection.
- The Proponent must consult with the City and the MECP regarding emergency overflow storage.
- The use of gravity outlet sewers in lieu of a forcemain may be considered where available adjacent to the station.

2.5 Wet Well

2.5.1 Inlet Hydraulics

All inlet sewers should enter the wet well perpendicular to the structure. Inlet sewers shall be designed to minimize the free-falling of liquid to the maximum wet well operating level. Design the wet well to prevent excessive turbulence and air entrainment into the stored liquid to minimize the release of odorous and corrosive compounds.

2.5.2 Benching

Provide benching to limit solids build-up in the wet-well and to achieve a self-cleaning system on manual pump down. Benching and pump clearances in the wet well shall be designed in accordance with ANSI/HI 9.8. Ensure that benching design can accommodate the full working depth of the level transmitter and backup floats to operate properly. Concrete used for benching shall be of the same type and specifications as the concrete used for walls and slabs.



2.5.3 Flow Meters

Measure discharge flow for each forcemain with an in-line flowmeter. All flowmeters shall be connected to SCADA for monitoring. Provide straight pipe runs upstream and downstream of the flowmeters in accordance with the recommendations of the flowmeter manufacturers.

2.5.4 Wet Well Sizing and Operating Depths

The depth and volume of the wet well shall be sufficient to ensure adequate control bands for each pump as well as not exceeding the maximum number of starts per hour for the selected pump motor. The following should be considered in determining the operating depth:

- The wet well low-level alarm elevation shall provide a sufficient net positive suction head (NPSH) margin in accordance with ANSI/HI 9.6.1;
- The wet well high-high level alarm elevation shall be a minimum of 300 mm below the invert of the inlet sewer; and,
- The obvert of the inlet pipe shall be located below the wet well platform where possible.

2.5.5 Process Mechanical

All piping and hardware inside the wet well and valve chamber shall be Type 316L stainless steel. The design should always ensure that the material of all equipment in submerged and humid environments is selected to minimize corrosion.

2.5.6 Service Platform

Provide stainless steel 316L or FRP platforms to facilitate service access to equipment in the wet well with non-slip gratings.

2.5.7 Wet Well Ventilation

Provide stainless steel 316L or FRP ventilation ducts in the wet well with exterior access to permit connection of a portable ventilation fan for personnel access. All mounting hardware shall be Type 316L stainless steel.

2.5.8 Wet Well Equipment and Personnel Entry Layout

The wet well shall be designed with confined space entry and third-party rescue entry in mind. Provide a paved surface that permits vehicles and trucks to be entirely off the main road. This paved surface must meet the requirements outlined in the Common Elements section of this Manual and be able to sustain the weight of a fully-loaded vacuum truck without damage. Provide an entry sketch for each hatch that shows ventilation, operator hazards, appropriate tie-off points, davits, hatch opening sequences, attendant safety, and non-entry rescue procedure to safeguard the personnel conducting maintenance and simplify retrieval.

2.5.9 Wet Well Cleaning

The wet well should be designed so that it can be easily accessed for cleaning without the need for confined space entry. Provide a reduced pressure zone (RPZ) separated water supply for wet well cleaning.

2.5.10 Dual-Purpose Bypass

Provide a dual-purpose forcemain bypass and wet well bypass connection to allow for the following:

- Pumping from the wet well through the discharge header to a tanker truck (bypassing the forcemain); and,
- Portable pumping from the inlet bypass maintenance hole to the forcemain (bypassing the wet well and pumps).

2.5.11 Wet Well, Dry Well and Valve Chamber Lighting

The wet well shall have adequate lighting for all wet well applications (equipment to match the classification area).

2.6 Dry Well and / or Valve Chamber

2.6.1 Piping Design

Provide minimum 50 mm taps and ball valves before and after each pump and after each check valve. In addition, provide hand access clean-out ports on the suction side of each pump. Provide anchorage and lateral supports for the vertical discharge pipe.

2.6.2 Valves, Gates and Actuators

Pump laterals and forcemain valves shall not be installed inside the wet well. All process valves shall be installed within the dry well or a separate valve chamber. All valves and process mechanical equipment shall be material Type 316L stainless steel. For stations with more than one forcemain, provide motorized actuated isolation valves on each forcemain.

2.6.3 Sump Pumps

In dry well stations, install a duplex submersible sump pump system designed to pump drainage to the wet well. Pumps must be of the solids handling type and intended for wastewater service. In valve chambers, provide a sump with gravity drainage to the wet well complete with check valve. Size the sump so that a pump could be lowered into the sump and pump out the valve chamber if required.

2.6.4 Design for Dry Well Flooding

Pumping functionality must be maintained under flooded condition.

2.6.5 Surge Protection

When considering the design of a surge relief system:

- Evaluate the impact of hydraulic transients under normal and worst-case operation conditions.
- Protect the forcemain system from uncontrolled transient pressures.
- Do not rely solely on combination air valves to protect the system from high transient pressures.



2.7 Pump Design

2.7.1 General Design Considerations

Pump selection shall be optimized to satisfy the peak design flow rate, the acceptable range of forcemain velocity, the wet well volume to facilitate pump cycling, and the life cycle costs.

Selection of pump type and size shall take into consideration the full range of anticipated flows (including low flows) within the planning horizon. Evaluate the fill time during low flow periods (particularly the first few years of a new development area) and consider the potential for odour generation due to long residence times in the wet well and/or forcemain.

After reviewing various demand scenarios, design pump operation to fall within the pump's preferred operating range (POR) under most flow scenarios.

Pumps should be designed to achieve maximum efficiency under normal operating conditions. Where more than one duty pump exists, avoid sizing the pumping system to achieve maximum efficiency under peak flow conditions if they rarely occur.

All pumps should be designed to prevent the need for grinders or screening equipment.

2.7.2 Submersible Wet Well Pumps

- Wet well submersible pump motors shall be rated for operation within Class 1 Division 1 environments in accordance with the latest version of NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
- Pumps wet and wearing parts must be made from highly durable materials, such as High Chromium Iron or 420 Stainless Steel.
- Pumps shall be removable from the surface along guide rails. Provide a lifting system as described in the Common Elements section of the Manual.
- Pumps shall be of the solids-handling type and intended for wastewater service.

2.7.3 Dry Pit Submersible Pumps

- Dry pit submersible pump motors shall be rated for Class 1 Division 2 environments in accordance with NFPA 820.
- Pumps wet and wearing parts must be made from highly durable materials, such as High Chromium Iron or 420 Stainless Steel.
- Motors shall be designed to be cooled with a glycol jacket or equivalent. The use of process fluid for motor cooling is not acceptable.
- Pumps and sump pumps shall be of the solids-handling type and intended for wastewater service.
- Provide access ports to manually clean and unclog each pump without removing the pump.
- Evaluate the potential for vibrations and harmonic excitations.

2.8 Forcemain Design and Maintenance

Design the forcemain in accordance with the City's Linear Municipal Infrastructure Standards. Provide access points into each forcemain for bypass, swabbing, inspection, and investigations through insertion of analytical devices or closed-circuit television (CCTV) cameras. Provide at least one spare tap on each forcemain for pressure monitoring devices. The use of gravity outlet sewers in lieu of a forcemain may be considered where available adjacent to the station.

2.9 Emergency Overflow Storage

Incorporating good design practices, appropriately sizing the wet well to contain one hour of emergency flows can serve as an effective alternative to traditional emergency overflow storage, potentially reducing the need for additional infrastructure. Emergency overflow storage must also be water-tight and compatible with the City, the Ministry of the Environment, Conservation and Parks (MECP), and local Conservation Authority requirements.

Emergency overflow storage capacity for new Municipally operated stations shall be at least one hour of retention time at peak wet weather flows. All emergency overflow storage structures shall be hydraulically connected to the collection system so that they fill by gravity without power or operator intervention, with monitoring to ensure the structure is normally empty, and alarming to indicate the fill level during an emergency. The emergency storage shall be full prior to any upstream flooding in the collection system. Automated pumps or drains shall be sized to empty the structure over 24hrs.

Alternatives to storage may be considered for existing Municipally operated stations due to space limitations on existing sites, with the understanding that future upgrades for growth should provide equivalent protection to the upstream catchment.

2.10 Access Hatches and Ladders

Provide an equipment access hatch directly above the inlet sewer into the wet well to allow for inspection and future installation of a grinder or screening if required by the City. All access hatches and ladders shall be material Type 316L stainless steel or FRP material. Provide dedicated equipment hatches for each pump and at least one personnel access hatch and ladder for wet wells and valve chambers. Refer to Common Elements for more information.

2.11 Ventilation

2.11.1 Wet Well Ventilation

All wet wells are to be equipped with a passive ventilation system to permit rising and falling liquid levels. Portable ventilation equipment is required for personnel entry into Type I stations. Permanent ventilation equipment is required for personnel entry into Type II and III pumping stations. Ventilation shall meet or exceed the required air exchanges per hour as indicated in the MECP Design Guidelines for Sewage Works.

Wet well fans shall be controlled either by the PLC or timers to cycle at specific time intervals to control odour and minimize the build-up of gases and improve corrosion control.

2.11.2 Dry Well Ventilation

Dry wells shall be physically separated from all non-classified areas. In order to provide adequate air exchange, permanent ventilation fans and duct work is required for all dry well stations.



2.12 Odour Control

Designs shall provide solutions to reduce the potential for odour generation: avoid cascading wastewater flows into the wet well or discharge maintenance hole to reduce the potential for air entrainment and odour release. Evaluate various odour treatment technologies for pumping stations located:

- Near sensitive areas or residential dwellings, and
- Where the risk of odour generation is high despite minimizing retention time.

2.13 Electrical Design

For ease of service and operation, electrical equipment must be installed in unclassified areas where possible.

Provide a local junction box that is protected from flooding to enable removal and re-installation of pumps from wet well and dry pits without pulling cables from the motor starter.

Provide two 15 A ground fault interrupt (GFI) external electrical outlets located close to the wet well and valve chamber access point.

Exterior lighting should be considered for illuminating the wet well access area if site location permits.

2.14 Generic Process Control Narrative

A primary PLC will control the pumping sequences via hydrostatic probe(s) located within the wet well(s). In the event of PLC related failures or maintenance:

1. The level in the wet well(s) will rise tripping the back-up system float and activating the back-up pumping control system,
2. a manual selector switch will disable all PLC pumping control and activate the back-up pumping control system. These stations will be unmanned and require an auto dialer alarm system so staff can respond to any issues.

Refer to SCADA standards for more details

2.14.1 Process Control Equipment

- 1 (one) primary PLC to control pumping sequences and control/ gather status from other applicable equipment
- 1 (one) hydrostatic level sensor (per wet well) to be utilized by the primary control system
- 1 (one) standalone back-up pumping control system (Siemens Multiranger or equivalent)
- 1 (one) hydrostatic level sensor (per wet well) to be utilized for the back-up control system
- 1 (one) float (per wet well) to activate backup system and activate back up system active alarm
- 1 (one) high high-level float (per wet well) for alarming at the surcharge/ inlet invert elevation
- Pressure monitor of local potable water supply line, ability to monitor district pressure.
- Other Instrumentation
 - Magnetic flow meter(s)
 - Pressure transmitter(s)
 - Air monitoring devices (H₂S, CO, CH₄, O₂)
 - Atmospheric temperature sensor
 - Fire/smoke detection sensors
 - Other applicable instrumentation

security company in the event of an illegal entry alarm via door contacts, motion detectors etc. and notify the fire department in the event of smoke/ fire alarming.

2 sources of communication are required for each alarm system:

- 1 primary land line (bell) and;
- 1 backup GSM (cellular) device in the event of land line failure.

All designs shall conform to the City's Facility Physical Security Standards.

2.15.1 Building and Access

Install control panels, motor starters, electrical equipment within the building. All new building related appurtenances (i.e. stairs, ladders, doors, lighting, emergency lighting, etc.) must meet most current Building and Fire Codes/ Regulations.

Provide sufficient space for installation, maintenance and removal of all equipment. Provide permanent lifting systems for all major equipment. Ensure adequate separation of all classified areas.

2.15 Alarming and Security

The City currently utilizes a third party for all security and alarming requirements (Alliance Security Systems). There is 1 main alarm system per location that provides the following: Process related alarms generated from specific PLCs to provide on call staff with notifications after hours or at unmanned locations, notify a

3.0 SEPTAGE RECEIVING AND UNLOADING

3.1 General Requirements

The septage receiving station should be designed to receive hauled wastewater loads from a variety of truck sizes.

Septage receiving stations shall be laid out so that there is adequate room for septage hauling trucks to effectively maneuver and incorporate a spill containment pad. Spills will be confined to the area immediately surrounding the vehicle and hose connection and then drained to the sanitary sewer.



The following factors should be considered in the design of the septage receiving system:

- Card reader system or equivalent
- Raw wastewater grinder and/or screening complete with washer compactor
- Grit and rock separation
- Flow metering
- Heat tracing (where applicable)
- Flushing connections (effluent water or water service complete with RPZ)
- Connectivity to the SCADA system
- Odour control system (where applicable)
- Wet well with pumps and sampling access or gravity connection to the collection system (where applicable)
- Consideration for sampling and refrigeration provided in consultation with the City
- Electronic billing system.

4.0 WASTEWATER TREATMENT

The design of the Wastewater Treatment Plant and its components shall be in accordance with the latest version of the MECP Ontario Design Guidelines for Sewage Works.

4.1 Plant Layout

Maximize the site's ultimate capacity in planning the plant layout. Design of expansion works should be carried out to permit the orderly and economical construction of the facility with minimal disruption of the existing facility. Future expansion shall be considered during design of the overall layout. Where additional space is required, removal of abandoned or unused processes shall be considered.

4.2 Process Laboratory

The plant must have a centrally located on-site laboratory. The laboratory must be designed by lab design specialists. The laboratory must have an entrance on the ground floor.

4.3 General Structural Requirements for Wastewater Applications

Concrete structures handling wastewater shall have a protective coating system to suit process conditions. Open process tanks shall be equipped with adequate walkways, catwalks, and railings to facilitate operator access.

4.4 Raw Wastewater Pumping Station

The design of raw wastewater pumping stations shall comply with the design guidelines for wastewater pumping stations outlined in the Wastewater Pumping Stations section of this Manual.

4.5 Preliminary Treatment

Preliminary treatment shall be housed in a building with automated screening and grit removal systems and designed for ease of operation for the removal of grit and screening bins, clean-up of the facility, and redundancy for grit removal, screening, and washer-compactor system reliability.

Sources and characteristics of raw wastewater and septage to the plant should be considered in the design of the grit removal and screening system.

The hydraulic design of the headworks channels shall be such that solids and grit settling and buildup within channels are avoided. Adequate valving should be included to permit isolation of individual channels for bypass and maintenance.

Electrical panels shall be housed in a separate unclassified area in the Headworks building. At a minimum, the Start, Stop, and General Fault alarm signals shall be communicated to plant SCADA.

4.6 Primary Clarifiers

Primary clarifiers shall be sized to handle the largest of the surface overflow rates under either average or peak design flow.

All channels conveying wastewater from preliminary treatment to the primary clarifiers shall be designed to avoid solids deposition. Associated sludge and scum removal systems shall be designed to suit site conditions.



4.7 Aeration Systems

Aeration tanks shall be sized to meet the required hydraulic retention time. The design of the aeration tank depth shall consider maximizing the oxygen transfer rate supplied by the aeration diffusion system. The aeration tanks should be designed with an automated step-feed system. Aeration systems shall utilize high efficiency blowers with fine bubble-diffused air that is capable of achieving a minimum dissolved oxygen (DO) concentration of 2.0 mg/L at any time.

Aeration systems shall provide sufficient mixing to maintain all mixed liquor solids in suspension for treatment process purposes. The addition of other means of mixing shall be evaluated if the aeration mixing demand exceeds aeration process demand significantly.

The air flow rate shall be monitored in SCADA. Isolation valves shall be provided on the main header and all sub-headers. The blower power draw shall be monitored in SCADA. Adequate dissolved oxygen metering devices shall be provided at the end of each pass of each tank and shall be tied to a fully automated DO control system.

LCC analysis shall be completed on aeration network design. Blower selection (count, capacity, operation range, etc.) shall be based on providing turn-down capacity to match low diurnal loadings and minimum mixing requirements during each season while still maintaining good overall efficiency. For multiple aeration tanks, the influent chamber and mixed-liquor suspended solids (MLSS) chamber shall be designed to provide uniform distribution of flow and capability of isolating each tank using weirs and gates.

4.8 Secondary Clarifiers

Secondary clarifiers shall be sized to handle the largest of the surface overflow rates under either average or peak design flow. Secondary clarifiers shall be designed for flow-paced return activated sludge (RAS) control to facilitate a continuous wasting process.

4.9 Sludge Pumps

Sludge pumps must be suitable for handling sludge and gritty material with a solids concentration of up to 5%. The pumps should be selected to efficiently cover the anticipated range of flows, not just the peak flow rate.

All sludge flow shall be measured through SCADA using dedicated flowmeters.



4.10 Effluent Disinfection and Dechlorination

Design of chlorine contact tank shall provide sufficient residence time to achieve the desired disinfection level. Online monitoring of the effluent chlorination and dechlorination processes must be considered when selecting monitoring equipment. The instruments shall be connected through SCADA for monitoring.

4.11 *Alternative Technologies*

Where a change in the treatment technology is suggested/required, a LCC analysis and efficiency comparison between the existing and proposed technology must be completed to determine if it is an applicable replacement.



4.12 *Automatic Sampling Stations*

Automatic sampling stations are required for raw wastewater, final effluent and any other location as deemed necessary. Provide automatic sampling stations to perform discrete or composite flow proportional and time proportional sampling. The sampler enclosure shall be weatherproof, corrosion resistant, insulated, and complete with forced air heater and thermostat, locking door, and bolt down base. The refrigerated sample compartment must be lockable. The controller must be programmable with an LCD display.

In the event of a power failure, program settings and stored information shall be maintained by an internal lithium battery. The installation of samplers in classified environments is to be avoided whenever possible. Sampling stations shall collect a sample from a well-mixed area with continuous flow to provide representative samples.

4.13 *Accessibility for Manual Sampling*

Design sampling locations to allow operators to safely and conveniently obtain grab samples.

Provide dedicated sampling points throughout the plant to allow for obtaining grab samples for raw wastewater, raw sludge, digested sludge, RAS, WAS, secondary effluent, and final effluent. Provide flushing ability at every location where an online instrument exists.

5.0 BIOSOLIDS MANAGEMENT

5.1 Digesters

All anaerobic digesters shall be equipped with at least one sidewall access bulkhead into the digester for inspection and cleaning.

Provide mechanical mixing equipment for digester mixing. The digester system shall be equipped with recirculation pumps that force sludge through a heat exchanger to maintain the operating temperature.

The secondary digester should be equipped with a decant system for a maximum range of sludge depths. Each digester shall be equipped with an emergency overflow line to protect the structure.

5.2 Digester Bio-Gas

Digester generated bio-gas shall be utilized for generation of hot water or heat generated electricity. A dedicated gas meter shall be provided to measure total gas flow of the generated biogas. Generated biogas shall be treated to remove impurities. All exterior piping shall be fully insulated and heat traced. Any unused generated bio-gas shall be flared to atmosphere

5.3 Sludge Heat Exchanger

Heat exchangers used for sludge heating shall be tube-in-tube type complete with a minimum of two recirculation pumps, one duty and one standby.



5.4 Biosolids Storage and Loading Facility

Digested sludge (biosolids) is transferred in liquid form to Biosolids Storage Tanks (BST). BSTs shall be adequately sized to store biosolids over the winter period of Dec. 1st to Mar. 31st while accounting for poor weather conditions. Each storage tank shall be equipped with level measurement, mechanical mixers and decant system. The tanks shall have one access hatch for entry.

The sludge loading station shall be designed for minimum interference to the operation of the plant during sludge loading operation. Access to the sludge loading station shall be designed to permit trucks to enter and leave the station directly with an appropriate tracking system to measure the volumes hauled offsite.

5.5 Generic Equipment

All equipment shall be constructed of heavy-duty materials to prevent premature wear and corrosion.

5.6 Classified Spaces

All Classified spaces will be designed in such a manner that the design will not rely on air exchanges or shunt trip methods. All classified areas are to be fully equipped with explosion proof equipment to meet the specific classification of each area.