Town of Edson

Town of Edson WWTP Upgrade Functional Design Brief

Prepared by:

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Project Number:

60330572

Date:

November, 2014

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November 4, 2014

Mr. Dawit Solomon, M.Sc., P. Eng.
Director of Engineering
Town of Edson
605-50th Street
Edson AB T7E 1T7

Dear Mr. Solomon:

Project No: 60330572

Regarding: Town of Edson WWTP Upgrade Functional Design Brief

We are pleased to provide our Functional Design Brief for the Town of Edson's WWTP Upgrade and Expansion. This design brief outlines the functional design for the site work, process components, building mechanical, electrical and controls systems for the new mechanical wastewater treatment plant.

If you have any questions, please feel free to contact me directly at 240.928.8346

Sincerely,
AECOM Canada Ltd.

BChaput

Barb Chaput, P. Eng.
Water/Wastewater Engineer
Water
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Distribution List

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Revision Log

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0	B. Chaput	September 2014	Draft
1	B. Chaput	October 16, 2014	Comments incorporated from Ray Bilevicius (AECOM), Dawit Solomon (Edson)

AECOM Signatures

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1. Introduction

1.1 Background

In February 2013, AECOM was retained by the Town of Edson (Town) to undertake a pre-engineering design study for the upgrade of the Town's existing WWTP. The pre-engineering design study was intended to allow the Town to immediately consider appropriate increased utility rates and plan for developing retention of capital reserves with increased WWTP annual operating costs prior to implementing the construction of the 2014 – 2015 WWTP upgrade program as mandated by the Alberta Environment (AENV) Amending Approval No. 640-0202 dated 21 February 2012. The Amending Approval (640-02-02) requires the Edson WWTP to meet new effluent limits by September 15, 2015. The Amending Approval requires the Town to submit a pre-design report to AENV outlining the new works required to meet the new effluent discharge limits that come into effect in 2015. This design study was successfully completed and submitted to AENV.

Prior to the work above, AECOM also undertook a study to assess treatment options for the upgrade of the WWTP, the results of which are presented in the Feasibility Study Report issued in July 2012. After consideration of various treatment options, the recommended WWTP option comprised a conventional activated sludge (CAS) process based on a combined treatment unit (CTU) where the bioreactor is around the secondary clarifier, together with a headworks building providing fine screening and grit removal. A preliminary design report was submitted on this treatment option to the Town by AECOM in 2014 and identified general plant design concepts.

More recently the Town retained AECOM to proceed with detailed design and tender of the new mechanical WWTP for Edson. AECOM submitted an updated Design Criteria Technical Memoranda (AECOM 2014) on the design flows and loadings for the upgrade, which is the basis for the detailed design and this report.

The purpose of this Functional Design Brief is to expand on the design criteria and recent design basis for the civil, structural, mechanical, and electrical works.

1.2 Existing Treatment Plant

The Town of Edson is located approximately 200 km west of Edmonton, along the Yellowhead Highway. Their wastewater treatment lagoon is located approximately 2km east of the community.

According to existing documentation, the existing WWTP was designed to treat 4,863 m^3/d, approximately equivalent to a population of 10,500[1]. The existing lagoon system comprises four anaerobic cells (only 3 in normal operation) followed by two aerated cells in series. Incoming wastewater is divided between Anaerobic Cells No. 1 and No. 2 with outflow from each cell then combined and directed to Anaerobic Cell No. 3.

Flow is then conveyed to Aerated Cell No. 1 followed by Aerated Cell No. 2 (Existing Anaerobic Cell No. 4 is generally bypassed and not used.). Existing Pond No.1 is used periodically to receive and store excess wastewater flows at times when the WWTP inflow is considered too high to pass through the WWTP. The operator advises that the peak flow at which flow is diverted to the Pond No.1 is approximately 800 m^3/hr (equivalent to 19,200 m^3/d) and this usually occurs during the spring melt. Outflow from Aerobic Cell No. 2 is normally directed into (unaerated) Pond No.3 before discharging to the McLeod River. The Town has the option to sell the treated effluent from Pond No.3. Cross connections are provided to allow for redirection of flow or by-pass of lagoon cells. (Refer to Figure 1.1.) Except for the occasional use of Pond No.1 as described above,

[1] *Town of Edson Lagoon Assessment, Earth Tech, October 2007*

existing Pond No.'s 1 & 2 are not used as part of the wastewater treatment process; however, they are used for storage and drying of sludge removed periodically from the anaerobic cells. It is reported that Aerated Cell No.'s 1 & 2 have not been de-sludged since their construction in 1983. The existing process flow diagram is shown in **Appendix A**.

At present there are three positive displacement (PD) blowers, two duty and one standby, serving Aerated Cell No.1 and No.2, each of which is provided with a submerged aeration system. The blowers are able to provide a variety of airflows at different discharge pressures with airflow ranging from 200 cfm to1590 cfm. No significant operating problems have been reported with the present Town operating practice for regular repair and refurbishing of the blowers. Existing Aerated Cell No. 1 is completely mixed and receives 70% of the airflow and Aerated Cell No.2 is partially mixed and receives 30% of the airflow.

Figure 1.1: Existing Lagoon Layout

1.3 Project Overview

A new inlet pipe connection will convey raw wastewater flows from the existing flow sampling measurement box to the new headworks building constructed to the west side of existing aeration Pond No.1 and north of unused Pond No.2. Following fine screening and grit removal in the headworks building, wastewater flows will be split between each bioreactor train. Excess wet weather flows will be diverted to the existing aeration cells for equalization, and then returned to the mechanical plant for full treatment.

Each bioreactor train is constructed around a secondary clarifier. Baffling is provided in each biological reactor to provide the partitions required to separate each of the anoxic and aerobic zones of each train. Mixers are provided as required in the unaerated zones to provide completely mixed conditions and a low head pump will be provided to return nitrified mixed liquor to the anoxic zone. Waste activated sludge will be pumped to Aerated Cell No. 1 for settlement and stabilization. The supernatant will be decanted and pumped back the splitter well upstream of the bioreactors.

After settlement of solids in the secondary clarifiers, final effluent will be discharged via a new outfall pipe to the existing effluent weir/sampling box. The Town will continue to have the option to divert treated effluent into Pond No.3 in order for end-users to withdraw and beneficially reuse the effluent. From the effluent weir/sampling box, treated effluent will discharge to the McLeod River via the existing outfall pipeline.

UV disinfection will be accounted for in the hydraulics of the new mechanical plant for future installation.

2. Design Criteria

2.1 Effluent Objectives

Since October 29, 2007 the discharge of effluent from Edson WWTP has been regulated under Approval No. 640-02-00. This sets a discharge limit for 5-day carbonaceous biological oxygen demand ($cBOD_5$) of 25 mg/L. The new Alberta Environment (AENV) Amending Approval (640-02-02) requires the Edson WWTP to meet the new specified limits of $cBOD_5$ and Total Suspended Solids (TSS) of 25 mg/L, Ammonia Nitrogen 5 mg/L for summer and 10 mg/L for winter by September 15, 2015. Phosphorus and total nitrogen limits were not included in the Amending Approval but are required to be monitored and could be applied in a future permit renewal. The future (2015) discharge limits are shown below.

Table 2.1: Design Effluent Objectives

Parameters	Concentration limit (mg/L)	Sample Type
$CBOD_5$	<= 25	Monthly average of weekly samples
Total Suspended Solids (TSS)	<= 25	Monthly average of weekly samples
Ammonia Nitrogen (NH3-N)	<= 5 May to October	Monthly average of weekly samples
Ammonia Nitrogen (NH3-N)	<= 10 November to April	Monthly average of weekly samples
Total Nitrogen (TN)	No Current limit	
pH	6.5 – 8.5	Monthly average daily samples
Total Phosphorus (TP)	No Current limit	

The results of a previous River Sensitivity Study and Risk Assessment for the WWTP effluent impact on the McLeod River, undertaken as required by AENV, showed that concentrations of TN in the effluent from the Edson WWTP exceeded concentrations known to cause acute toxicity to fish during the wintertime. TP was found to exceed the AENV Surface Water Quality Guideline of 0.05 mg/L. The possibility of future TN and TP limits was suggested in the study report with a TP limit of 1 mg/L suggested. Although a TN limit was not stated, TN of 15 mg/L was subsequently identified as a reasonable possible future limit and will be considered in the design. These potential future discharge limits were endorsed by AENV at a meeting on 17th September 2013 and are shown in below.

Table 2.2: Future Effluent Objectives

Parameters	Concentration limit (mg/L)	Sample Type
Total Nitrogen (TN)	<= 15	TBD
Total Phosphorus (TP)	<= 1	TBD

2.2 Population

The Town of Edson provided a projected population of 12,000 for the design year 2032 for AECOM to use as the design basis. The population takes into account the allowance for the “floating” population i.e. those people who do not reside in Edson, but often spend some time within the Town (lunch / dinner / overnight stay / rural people who come shopping).

AECOM will continue to use the projected population of 12,000 for development into detailed design.

2.3 Wastewater Characteristics

The per capita generation rates, peaking factors and theoretical loadings used in the process design are based on wastewater characterization data presented in the “Wastewater Treatment Plant Upgrade and Expansion Options Feasibility Study Report” (AECOM 2012).

The per capita flow heading into detailed design has been revised to 460 l/c/d from 430 l/c/d, as requested by the Town. The peaking factors used for this Project will remain unchanged, however flow peaking factors for winter conditions have been calculated; these factors are normalized values based on historical data collected at the WWTP and as summarized in “Wastewater Treatment Plant Pre-Design Study” (AECOM 2011).

Table 2.3: Design Peaking Factors

Description	Peaking Factor
Peak hour factor – winter	5.17
Peak hour factor – summer	5.66
Maximum day factor – winter	2.48
Maximum day factor – summer	3.62
Maximum month factor– winter	1.37
Maximum month factor – summer	1.57
Annual average flow factor	1.00

NOTE: Peaking factors are based on the information presented in the AECOM (2011) Report

For most communities there is a peak flow period in the mid-morning between 9:00 a.m. and 10:00 a.m., which is followed by a second peak in the early afternoon and possibly another peak in the late evening. Generally, the wastewater flow drops significantly in the early hours of the morning, before increasing again at about 6:00 a.m. It is assumed that the diurnal flow pattern for Edson will be similar to a typical community in North America.

Obtaining representative raw wastewater data can be challenging and in some cases impossible. Solids tend to settle so sampling points should be midstream, samples should be thoroughly mixed, and sampling points located to best represent the influent wastewater for the plant. Unless a community has an industrial contribution, wastewater plant expansions usually base their design on typical theoretical loadings.

In the AECOM 2012 and AECOM 2014 Reports to the Town, influent data from 2006 through to 2012 were analysed. The reports conclude that the “historical influent data was inappropriate for identifying actual loadings… and instead design loadings in typical municipal wastewaters were used…” as there were concerns with the sample taken.

Prior to proceeding with design, the Town provided influent concentration data from January 2013 to July 2014. The updated data was compiled and compared against the previous data and can be referenced in the following Figure. The variance in the latest data is ‘tighter’ than historical data.

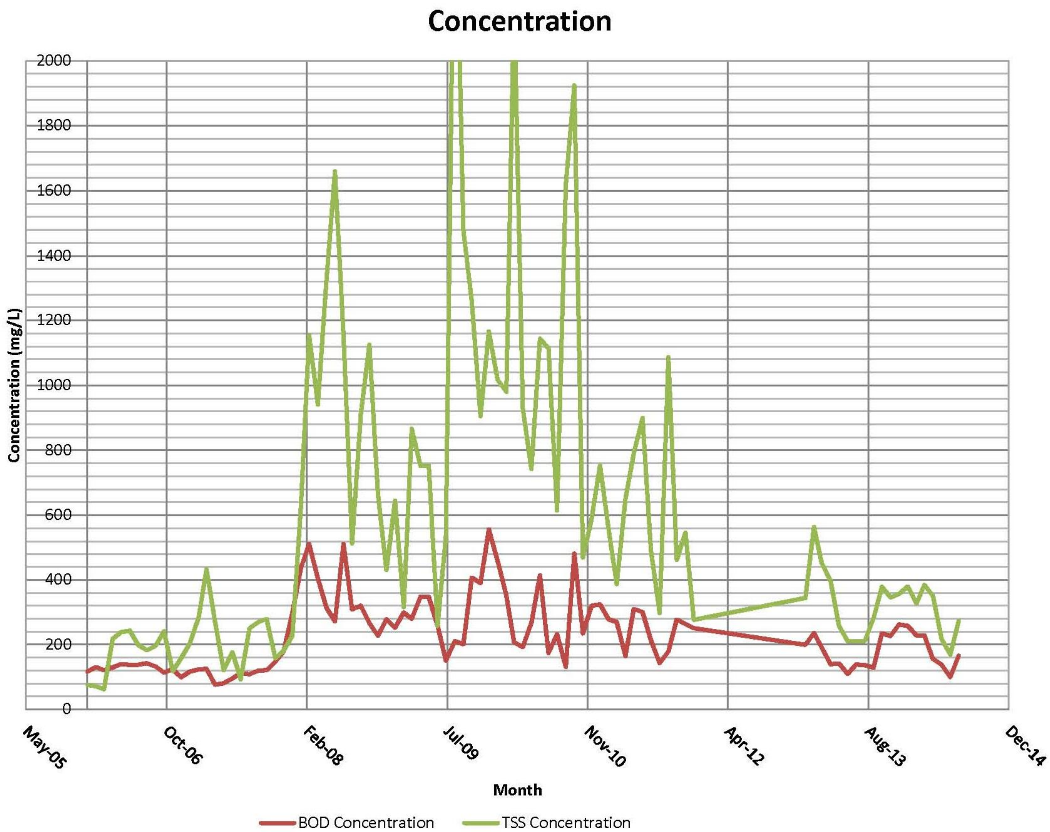


Figure 2.1: Raw Influent Data (2006-2014)

Table 2.4 shows design concentrations for BOD and TSS, based on the increase in per capita flow, compared to typical theoretical comparison. As concentrations are based on per capita flow, the values recorded in the previous reports are less than the below (increase in per capita flow). Based on the table below, the design BOD and TSS are within the assumed and expected range of a medium-strength municipal wastewater.

Table 2.4: BOD and TSS Design Concentrations

Loading Parameter	Edson Design Criteria WWTF	Metcalf & Eddy 5th Edition[1]		
BOD mg/L	207	Low - 133	Medium - 200	High -400
TSS mg/L	226	Low - 130	Medium - 195	High -389

[1] Wastewater Engineering Treatment and Resource Recovery, 5th Edition Metcalf and Eddy, Chapter 3, Table 3-18, page 221.

Typical wastewater concentrations rarely vary significantly between communities unless there is an industrial contributor. With no industries, The Town of Edson can be considered a typical community and AECOM will continue to use typical Design Criteria. The following discusses the typical loadings assumed for the upgrade.

2.3.1 Organic and Nutrient Loading

The per capita generation rates for organics and nutrients that have been used in the process design for the Edson WWTP in the 2014 PDR are summarized in Table 2-5 and will continue to be used. The values shown are based on typical municipal wastewater design loadings as the historical wastewater characterization data for Edson WWTP was considered unreliable.

Table 2.5: Per Capita Loading

Loading Criteria	Average Annual Per Capita Load
Flow (L/d)	460
Biological Oxygen Demand (g/d)	95.0
Chemical Oxygen Demand (g/d)	190
Total Suspended Solids (g/d)	104
Total Kjeldahl Nitrogen (g/d)	18.0
Total Phosphorus (g/d)	3.0

2.3.1.1 Biological Oxygen Demand (BOD_5) and Chemical Oxygen Demand (COD)

The annual average day per capita BOD_5 load to the WWTP is estimated to be approximately 95 g/capita/d. This is representative of the loading rates experienced in other communities and will be used in this design. The ratio of COD/BOD_5 is assumed to be 2.0, which is in the typical range of 2.0 to 2.2 for raw municipal wastewater.

2.3.1.2 Total Suspended Solids (TSS)

The annual average day TSS generation rate of 104 g/capita/d is considered typical for raw municipal wastewater and will be used in the process design.

2.3.1.3 Total Kjehldahl Nitrogen (TKN)

An annual average day per capita TKN generation rate of 18 g/capita/d is used in the process design and at the upper end of the range which is typical for other communities in western Canada.

2.3.1.4 Total Phosphorus (TP)

The annual average day per capita phosphorus generation rate of 3.0 g/capita/d is used in the design and is typical of municipal wastewater without significant industrial discharges.

Seasonal Load Peaking Factors and Diurnal Load Pattern

As with flows, organic and nutrient loads discharged to a municipal WWTP vary throughout the year. As flows increase during the spring and early summer, accumulated solids may be flushed through the system. Also, wastewater associated with summer tourism will have different strength and diurnal loading characteristics than wastewater generated mainly by permanent residents.

In the absence of detailed wastewater sampling, it is assumed that the diurnal load patterns will be similar to the diurnal flow pattern.

2.3.2 Wastewater Temperature

Temperature is an important factor in the design of biological nitrification systems because the growth rate of bacteria responsible for converting ammonia to nitrate is significantly lower at colder temperatures. The rate of ammonia utilization is directly proportional to the net autotrophic growth rate, which is a function of temperature. As a result, at lower temperatures a considerably higher mixed liquor inventory needs to be carried to ensure that nitrification can be maintained during the winter and early spring.

For the Edson WWTP process design, the minimum week temperature in the winter is assumed to be 10 C, a typical assumption for municipal wastewater design . The average summer month temperature is assumed to be 15 °C. The minimum week temperature is used as the basis for design of the biological nitrification system and sizing of the bioreactor tanks. As there is no actual temperature data, it is proposed that the Town being a program to record the influent temperature at the existing splitter well.

2.4 Design Criteria

For the purposes of this technical memorandum, all wastewater flow peaking factors will be expressed relative to the annual average day flow. Based on the above noted changes in flow generation, the projected flows and loads for Edson in 2032 are summarized below.

Table 2.6: Flow and Load Design Criteria

Description	Unit	Value
Design Population (For The Year 2032)		**12,000**
Flow		
Annual average day per capita flow[1]	L/c/d	460
Annual average day flow (AAF)	m^3/d	5,520
Peak hour flow – winter (PHF – Winter)	m^3/d	28,540
Peak hour flow – summer (PHF – Summer)	m^3/d	31,240
Maximum day flow – winter (MDF – Winter)	m^3/d	13,690
Maximum day flow – summer (MDF – Summer)	m^3/d	19,980
Maximum month flow – winter (MMF – Winter)	m^3/d	7,562
Maximum month flow – summer (MMF – Summer)	m^3/d	8,666
BOD		
Annual average day per capita load	kg/c/d	0.095
Annual average day load	kg/day	1,140
Annual average concentration	mg/L	207
Maximum month daily load (Winter)	kg/day	1,562
Maximum month daily load (Summer)	kg/day	1,790
COD		
Annual average day per capita load	kg/c/d	0.190
Annual average day load	kg/day	2,280
Annual average concentration	mg/L	413
Maximum month daily load (Winter)	kg/day	3,124
Maximum month daily load (Summer)	kg/day	3,580
TSS		
Annual average day per capita load	kg/c/d	0.104
Annual average day load	kg/day	1,248

Description	Unit	Value
Design Population (For The Year 2032)		**12,000**
Annual average concentration	mg/L	226
Maximum month daily load (Winter)	kg/day	1,710
Maximum month daily load (Summer)	kg/day	1,959
TKN		
Annual average day per capita load	kg/c/d	0.018
Annual average day load	kg/day	216
Annual average concentration	mg/L	39
Maximum month daily load (Winter)	kg/day	296
Maximum month daily load (Summer)	kg/day	339
TP		
Annual average day per capita load	kg/c/d	0.003
Annual average day load	kg/day	36
Annual average concentration	mg/L	7
Maximum month daily load (Winter)	kg/day	49
Maximum month daily load (Summer)	kg/day	57
TEMPERATURE		
Winter – minimum week	Deg C	10
Summer	Deg C	15

Notes:

1. *Summer refers to the period between June to October; winter refers to the period between November to May.*

3. Process Modelling and Mass Balances

3.1 Sludge Retention Time (SRT)

The sizing of activated sludge tanks is governed by the requirement to nitrify in cold weather. As the nitrifying bacteria grow more slowly at lower temperatures, a higher inventory of bacteria must be maintained to ensure that a high level of ammonia oxidation is achieved. The required SRT is inversely proportional to the difference between the nitrifier growth rate at a given temperature less the decay rate and multiplied by the aerobic mass fraction.

For the Edson WWTP, a design SRT of 15 days (winter) has been selected for the following reasons:

- There is a negligible level of commercial/industrial activity in Edson, therefore the nitrifier growth rate is unlikely to be inhibited by compounds in the raw wastewater; and
- Recent research from the Water Environment Research Foundation (WERF) has shown that the variation in nitrifier growth rates between municipalities is relatively low and in the range of 0.80 to 0.90 day^{-1}.

3.2 Biological Reactor Configuration

The bioreactor for Edson WWTP will be configured as a Westbank Process and includes a nitrified mixed liquor return stream from the last aerobic zone to the first anoxic zone. Experience at several wastewater facilities across Western Canada indicates that this configuration best satisfies the design criteria and functionality requirements. In this configuration, the bioreactor is configured with an arrangement of pre-anoxic / anaerobic / anoxic / aerobic zones to achieve carbonaceous BOD removal, ammonia oxidation and nitrogen removal. Primary effluent is step-fed across multiple zones, distributing the readily biodegradable organic material present in the incoming wastewater to where it can be used most effectively by each step of the process. Return activated sludge from the secondary clarifiers is introduced at the pre-anoxic zone, and mixed liquor is wasted from either the third aerobic zone or return sludge stream.

Based on a nominal total bioreactor volume of 5,000 m^3 and two bioreactors, the sizing of the zones in each of the bioreactors is identified in the **Table 3.1** and illustrated schematically in **Figure 3.1**.

Table 3.1: Bioreactor Zone Sizing

Cell No.	Cell Name	Cell Volume (each) (m^3)	Volume (Total) (m^3)	Volume Split
1	Pre-Anoxic	32.5	65	1.3%
2	Anaerobic	175	350	7.0%
3	Anoxic 1	190	380	7.6%
4	Anoxic 2	190	380	7.6%
5	Aerobic 1	637.5	1275	25.5%
6	Aerobic 2	637.5	1275	25.5%
7	Aerobic 3	637.5	1275	25.5%
	Volume per Bioreactor	2,500		100%
	No of Bioreactors - 2			
	Total Bioreactor Volume		5,000	

3.3 BioWin Modelling

To assist in developing design criteria, the proposed biological process for the Edson WWTP was modelled using Envirosim's BioWin simulation program (refer to **Figure 3.1**). The basis of sizing the various zones in the biological reactor is summarized in the following section.

BioWin uses a general Activated Sludge/Anaerobic Digestion (ASDM) model. The BioWin model has 50 state variables and 60 process expressions. These expressions are used to describe the biological processes occurring in activated sludge and anaerobic systems, several chemical precipitation reactions, and the gas-liquid mass transfer behaviour for six gases. The model was used to optimize sizing of the bioreactor and process air blowers.

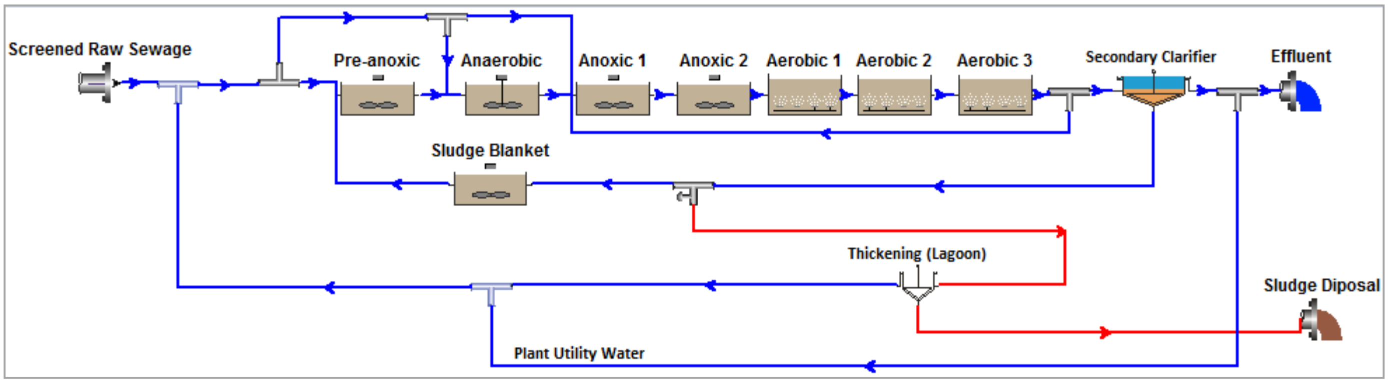


Figure 3.1: BioWin Schematic of Process Configuration

3.4 Mass Balances

Generally, the winter loading condition governs the sizing of the bioreactor/secondary clarifier complement as this condition has the highest mixed liquor inventory and solids loading to the secondary clarifiers during peak flows. The summer loading condition represents the highest sustained organic loading period and sludge production and therefore governs the sizing of the elements for the sludge treatment train, as well as the process air blowers and aeration equipment in the biological reactors.

3.5 Preliminary Treatment – Screening and Grit Removal

Preliminary treatment includes raw wastewater screening to remove coarse, inorganic material and an enhanced settlement process to remove grit. Each of these process components is summarized in the sub-sections below.

3.5.1 Influent Screening and Washer/Compactor

Two mechanical fine screens will be located in the Headworks Room, upstream of the grit removal system.

The channels proposed in the current design are sized to accommodate the two step screens coupled with a single washer/compactor unit. This type of screen provides a robust and compact solution to screening.

Screenings will be conveyed to a screenings washer and compactor. The screenings washer/compactor flushes any organics from the screening material, returning them to the process channel via a gravity drain.

Table 3.2 provides a summary of design criteria used for the mechanical fine screening system.

Table 3.2: Mechanical Fine Screen Design Criteria

Parameter	Design Criteria
Number of Units, Total/Duty	2/1
Type	Bar, Step Screen
Design Flow	
Average, m^3/d	5,520
Peak (hourly), m^3/d	31,240
Peak Capacity Each, m^3/d	31,240
Opening Size	6 mm
Max. Headloss, mm	300
Channel Width, mm	900
Channel Depth, mm	900
Maximum Face Velocity, m/s	1.0
Upstream Water Level, mm	To be confirmed
Minimum Freeboard, mm	500
Motor, kW	1 kW

The screen capacity is dependent upon the opening size, channel width, and maximum upstream and downstream water levels. The design will be based on two screens operating in a duty/standby mode. When either of the fine screens needs to be removed from service, flow can be diverted to the other fine screen channel.

The screened flow will be collected in wet well where it will be pumped to the grit chamber for grit removal.

3.5.2 Grit Removal

Grit is removed to minimize abrasive wear on downstream equipment and to prevent accumulation and deposition of heavy, non-biodegradable material in downstream tankage. Grit removal removes heavy inorganic and some organic particulates from the wastewater flow. Grit removed by the grit chambers is classified and dewatered to reduce organics content and increase solids content so that the material is less likely to cause nuisance odours and is therefore, more amenable to landfill disposal.

Table 3.3: Grit Removal System Design Criteria

Parameter	Design Criteria
Number of Units, Total/Duty	1/1
Type	Vortex
Capacity, m^3/d	31,240
Diameter, mm	3,500
Side Water Depth, mm	4,000
Inlet channel width, mm	762
Outlet channel width, mm	1,524
Vortex Grit Mechanism Drive Motor, kW	1.0
Grit Pump Type	Recess Impeller
Capacity, L/s (ea)	15
TDH, m	10
Grit Pump Drive Motor, kW	7.5
Grit Washer Type	Hydrocylone
Classifier Type	Shaftless Auger
Classifier Drive Motor, kW	TBD

A vortex grit chamber, classifier and grit dewatering screw have been included in the basis of design. When installed, screened raw wastewater will flow by gravity through the vortex grit tank which will be situated outdoors. Grit that is captured in the grit tank will be pumped to the classifier/dewatering screw located in the screenings loading room for collection.

The screenings loading room, located adjacent to the screens will be sized to accommodate the compactor to collect both the grit and the primary screenings. The equipment will be arranged such that dewatered grit will be discharged into the dewatered screenings bin.

3.6 Primary Clarifier/Fermenter

A primary clarifier/fermenter is not necessary to comply with the known future 2015 discharge limits, and therefore, not included in the design. However, as a primary clarifier may be required in the future to comply with a possible future TP 1 mg/L discharge limit, a suitable allowance in the hydraulic design as well as blind flange piping connections are included.

3.7 Bioreactor and Aeration

3.7.1 Bioreactor Design Concept

Two bioreactor trains will be constructed to provide for a total volume of 5,000 m^3. The new bioreactors will be constructed around the secondary clarifiers. An illustration showing the proposed arrangement of a bioreactor around a secondary clarifier is provided in **Figure 3.2**.

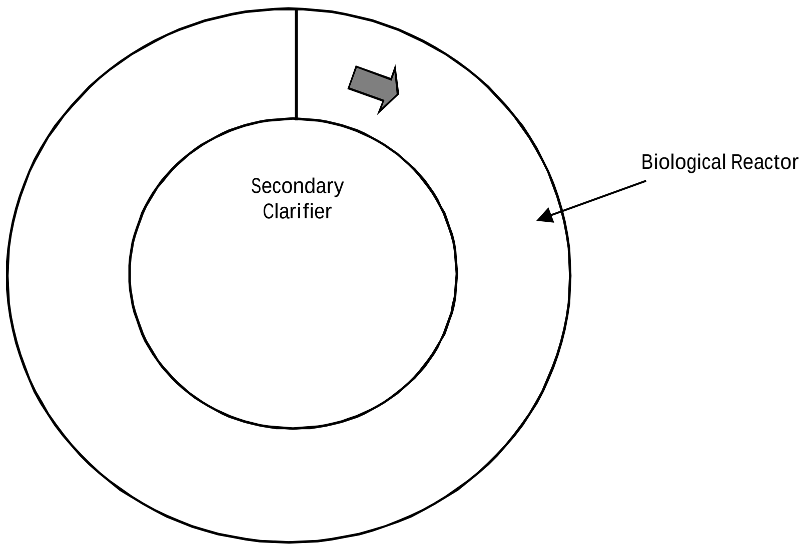


Figure 3.2: Schematic of Bioreactors with Secondary Clarifiers

Baffles will be installed in each biological reactor to partition each into pre-anoxic, anaerobic, anoxic and aerobic zones. Mixers will be installed in the unaerated zones to provide completely mixed conditions and low head pumps will be used to return nitrified mixed liquor from the third aerobic zone to the first anoxic zone.

3.7.2 Process Requirements

The overall objective of the BNR process is to remove non-settleable colloidal and dissolved organics and nutrients (nitrogen and phosphorus) from the wastewater. Manipulating the physical environment in which the active biological organisms work can control the biological reactions to achieve the desired effluent discharge requirements. Process control elements include:

- Hydraulic retention time (HRT) in each zone
- Presence or absence of dissolved oxygen (DO)
- Presence or absence of nitrate – nitrogen (NO3-N)
- Solids retention time (SRT) of active organisms
- Presence of readily biodegradable carbon

3.7.2.1 Carbonaceous BOD Removal

Biological nutrient removal requires longer HRT and SRT than does the removal of biodegradable organics (BOD). Thus, the design for the biological process is dictated by the requirements for BNR.

3.7.2.2 Biological Nitrogen Removal

The removal of organic nitrogen from the wastewater requires the manipulation of bacteria through a two-step process.

First, the hydrolysis of organic nitrogen to ammonia nitrogen and the subsequent oxidation of ammonia to nitrate are performed in the aerobic phase of the process. In addition, there is likely some hydrolysis for ammonia-nitrogen in the Pre-Anoxic, Anaerobic and Anoxic Zones. Sufficient active organisms, dissolved oxygen, alkalinity and retention time provide for the growth of the organisms that facilitate nitrification.

The conversion of dissolved nitrate to free nitrogen gas occurs in the second step of the process. Heterotrophic organisms, which require a biodegradable carbon source, use nitrate in the absence of molecular dissolved oxygen and convert it to molecular nitrogen. The bioreactor process layout provides for nitrogen formation in the second stage and recycling of nitrate-rich liquor back to the initial denitrification stage. The recycle takes advantage of the available biodegradable carbon in the primary effluent plus supplemental carbon generated in the Anaerobic Zone for improved denitrification rates.

3.7.2.3 Biological Phosphorus Removal

The arrangement of the bioreactor will be configured to support enhanced biological phosphorus removal since it is anticipated that future effluent discharge requirements will include a limit for total phosphorus.

Removal of dissolved phosphorus from the wastewater requires the manipulation of the bacteria through a three-step reaction. The first step which occurs in the Pre-Anoxic Zone requires the removal of nitrates and oxygen from the primary effluent and return activated sludge (RAS). The combination of active organisms in the RAS and rapidly biodegradable carbon in the raw sewage results in rapid depletion of both free and nitrate-bound oxygen in the Pre-Anoxic Zone. The conditioned bacteria then participate in various biochemical mechanisms that do not use free oxygen for growth or cell maintenance.

The second step which occurs in the Anaerobic Zone exposes the bacteria to readily biodegradable carbon in the absence of free or nitrate-bound oxygen. When the pre-conditioned facultative bacteria are exposed to this environment, they obtain the energy required to survive by converting one form of intracellular phosphate compound to another. Excess soluble phosphorus generated by this reaction is released from the cell. The organisms use the energy by absorbing simple soluble carbon. Sufficient energy is not available for complete conversion of the soluble carbon to cell material; the simple organics are merely stored within the cell for later use. Organisms with the ability to exchange phosphorus for simple organics therefore have an advantage in this zone because of their access to the readily biodegradable food supply.

The third step which occurs in the Anoxic and Aerobic Zones requires the exposure of the bacteria from the anaerobic zone to an environment with nitrate-bound and/or free molecular oxygen. Once the bacteria are returned to this more favourable environment, they remove phosphorus from the surrounding solution to rebuild the intracellular polyphosphate molecule. In addition, there is a synthesis of additional biomass.

The maintenance of these favourable conditions provides for continued storage of phosphorus at which point the phosphorus-laden cells are removed from the main process stream through the wasting process while they are still in an aerobic state.

If biological uptake of phosphorus capacity is inadequate to meet future effluent discharge requirements, supplemental chemical removal of phosphorus will be required.

3.7.3 Design Criteria

The design criteria for the bioreactors are presented in **Table 3.4**.

Table 3.4: Bioreactor Design Criteria

Parameter	Design Criteria
Bioreactor Trains	
Number of Units	2
Side Water Depth, m	5
Minimum Freeboard, mm	600
Operating Volume per Train, m^3	2,500
Total Volume, m^3	5,000
Nominal HRT at ADF, hours	18.6
Nominal HRT at Max Month Flow – Winter, hours	13.6
Nominal HRT at Max Month Flow – Summer, hours	11.8
Design MLSS, mg/L	3,800

3.7.4 Bioreactor Mixing

Each bioreactor is equipped with at least two mixers. At a minimum, one mixer is provided in the Anaerobic Zone and one in the second Anoxic Zone. Experience has shown that a mixer in the first Anoxic Zone is not usually needed, as the energy from the mixed liquor return stream is able to completely mix the contents of the cell.

The mixers are sized to provide 2 to 4 W/m^3 of mixing energy.

3.7.5 Bioreactor Internal Recycle

Each bioreactor is equipped with one internal recycle pump to circulate nitrified mixed liquor from the Aerobic Zone 3 to the first Anoxic Zone. Each mixed liquor pump is rated to provide 4 to 6 times the average day flow. The recycle rate will typically be constant, but the pumps are equipped with variable speed drives to allow the rate to be manually adjusted to respond to long term process changes (seasonal, one tank out of service for an extended time, future nitrogen removal requirements, etc.).

Design parameters for the nitrified mixed liquor pumps are presented in Table 3.5.

Table 3.5: Bioreactor Nitrified Mixed Liquor Pumps

Design Parameter	Number of Units, per Bioreactor
Number of Units, Total/Duty	2/2
Number of Units, per Bioreactor	1
Type of Unit	Horizontal, Low-Head, Propeller
Capacity, each, m^3/d	16,560 (6 x ADF)
Discharge Head, each, m	1
Power, each, kW	3.7
Type of Drive	Variable Speed

3.7.6 Mixed Liquor Wasting

The SRT is controlled by wasting mixed liquor from the bioreactors. Selective wasting is accomplished by installing an overflow device into a wastage chamber and pumping directly to the repurposed aeration cells to treatment. The potential for foam generation with this method is lowered by preferentially wasting from the top layer of the mixed liquor where foam forming organisms tend to accumulate.

The WAS withdrawal rate is based on the desired SRT in the bioreactor. Under normal operating conditions, wasting will continuously occur from the wastage chamber. The wastage chamber collects mixed liquor directly from the last aerobic zone in each bioreactor.

Alternatively, in the event that wasting of RAS is needed, a portion of the sludge is diverted from the common RAS line header to the suction line of the WAS pumps via a wasting line equipped with a flow control valve. Discharging RAS into the suction line of the WAS pumps ensures that the suction and discharge characteristics from either wasting source are similar; facilitating the use of the same pump for wasting from either source.

The WAS rate is operator adjustable to set an SRT appropriate for the operating conditions. Typically SRT values would be in the range of 7 days in warm weather and 15 days in cold weather. The SRT is changed by either altering the speed of the VFD equipped pumps, or operating the pumps at a fixed speed for longer and shorter intervals during the day. The shortest SRT would be achieved by running the pump at full speed 24 hours a day.

Design parameters for the WAS pumps are presented in Table 3.6.

Table 3.6: WAS Pumps Design Parameters

Design Parameter	Number of Units, per Bioreactor
Number of Units, Total/Duty	2/2
Number of Units, per Bioreactor	1
Type of Unit	Centrifugal Screw Impeller
Capacity, each, L/s	1.5 to 4.0
Discharge Head, each, m	8
Power, each, kW	2.2
Type of Drive	Variable Speed

3.7.7 Aeration System

A fine bubble aeration system consisting of membrane diffusers will be provided in the three aerobic zones of each bioreactor. The number of diffusers in each zone will be dictated by the oxygen requirements, which will vary for each of the three aerobic zones. The oxygen required by the biological process can be calculated from the oxygen demand in the zones. The oxygen uptake rates (OUR) for the Edson WWTP were determined using the BioWin model and the Peak OUR (4-hour average) was predicted to be approximately 1.25 times the average OUR for the maximum month loading condition.

The OUR results are summarized in **Table 3.7**.

Table 3.7: Oxygen Uptake Rates

Aerobic Tank	Oxygen Uptake Rate (OUR), mg O_2/L h					
	Winter (10°C)			Summer (15 °C)		
	Average Day	Max Month	Peak	Average Day	Max Month	Peak
Aerobic Zone 1	24	33	41	24	38	48
Aerobic Zone 2	21	29	36	20	32	40
Aerobic Zone 3	18	24	30	17	25	31

3.7.7.1 Aeration Blower Requirements

As described above, the OURs were established based upon dynamic simulations of the BioWin model. Based on these OURs, process air and blower power requirements could then be calculated. The results of this analysis are presented in **Table 3.8**.

Table 3.8: Process Air and Blower Power Requirements

Parameter	Winter			Summer		
	Average	Max Month	Peak	Average	Max Month	Peak
Air Flow Requirements, nm^3/min	24.1	31.9	47.7	23.7	35.5	54.4
Design Discharge Pressure, kPa	60	60	60	60	60	60
Estimated Power Requirements, kW	37.5	60	90	37.5	60	90

Based on the power requirements noted above, two 45 kW blowers are required satisfy the demand to both bioreactor trains. A third blower will serve as backup. This approach will allow for supply of a wide range of air flow requirements and accommodate growth in the wastewater flow rates.

3.7.7.2 Existing Blowers

At present there are three Gardner Denver (Model 7CDL17) positive displacement blowers, two duty and one standby, serving Aerated Cell No.1 and No.2, each of which is provided with a submerged aeration system. The blowers are located in a building close to Aerated Cell No.1 and able to provide a variety of airflows at different discharge pressures. Details of the existing blowers as shown in the manufacturer's data sheet are provided in **Table 3.9**.

Table 3.9: Existing Blower Information – by Manufacturer

Blower Model		5 PSIG (34.5 kPa)		9 PSIG (62 kPa)		Remark
	Speed RPM	CFM (m^3/min)	BHP (kW)	CFM (m^3/min)	BHP (kW)	
7CDL17	3,600	2,125 (60)	64.0 (48)	**2,060 (58)**	**98.0 (73)**	Existing Motor: 3,600 RPM
	4,000	2,391 (68)	75.3 (56.2)	2331 (66)	109.3 (81.5)	

The capacity of one existing blower at the Edson WWTP is enough to facilitate the expected peak aeration demand of the proposed activated sludge upgrade. Following approach a single duty blower paired with the appropriate motor and variable speed drive will satisfy the various demands of both bioreactors with a second blower as a dedicated standby.

3.8 Secondary Clarification

Mixed liquor from each bioreactor flows to the secondary clarifiers, where the treated wastewater is separated from the biological solids. The clarified effluent is discharged from the surface of the tanks, while the settled biological solids are removed from the bottom, returned to the bioreactors as return activated sludge (RAS).

Mixed liquor will enter each secondary clarifier through an energy dissipation inlet consisting of a small diffuser chamber in the top centre area of the tank. From this chamber, mixed liquor will discharge into the flocculator centre well through controlled diffuser ports. A circular baffle will be installed to create a centre zone in which incoming mixed liquor will be allowed to flocculate in a low energy mixing regime. Flocculation is a process in which small biological solids collide and aggregate with other small particles to form larger particles, or flocs. The flocs are held together by polymeric bridging between particles and due to their larger size, they settle more readily than the individual smaller particles. The key to successful flocculation of mixed liquor is the maintenance of a low energy mixing regime in the flocculating centre well which provides enough energy to promote transport and attachment of particles but is not enough to disrupt the flocs by fluid shear forces.

Flocs passing under the flocculation centre well will enter the sedimentation zone of the clarifier where they will encounter controlled upward flow velocities (overflow rates) designed to prevent the flocs from being transported to the clarifier surface. Clarified supernatant that overflows a continuous V-notch weir into a peripheral launder will discharge into a gravity pipe leading to the subsequent treatment processes (direct discharge at present, UV disinfection in future).

The bottoms of the clarifier tanks are sloped downward at a gradient of between 1:6 and 1:12 from the perimeter wall to the centre. Settled biological flocs will be scraped to a central sludge pit by a spiral blade sludge scraper mechanism. The settled activated sludge will be withdrawn from the secondary clarifier by individual RAS pumps which recycle it to the Pre-Anoxic Zone of each bioreactor.

3.8.1 Secondary Clarifier Process Requirements

Two secondary clarifiers will be constructed and each will be equipped with a dedicated RAS line. Dry-pit RAS pumps equipped with flow meters and flow control valves will be provided for the required return flow to each bioreactor.

Design parameters for the secondary clarifiers are presented in **Table 3.10**.

Table 3.10: Secondary Clarifier Design Criteria

Parameter	Design Criteria
Number of Units, Total/Duty	2/2
Type	Circular, Centre Feed
Diameter of Each Clarifier, m	17.5
Total Clarifier Surface Area, m^2	481
Flow	
Average Day Flow, m^3/d	5,520
Summer Maximum Day Flow, m^3/d	19,980
Winter Maximum Day Flow, m^3/d	13,690
Surface Overflow Rate	
Average Day Flow, $m^3/m^2/d$	11.5
Summer Maximum Day Flow, $m^3/m^2/d$	41.5
Winter Maximum Day Flow, $m^3/m^2/d$	28.5
Solids Loading Rate	
Average Day, $kg/m^2/h$	1.9
Summer Maximum Day, $kg/m^2/h$	6.3
Winter Maximum Day, $kg/m^2/h$	7.1

As a means of determining whether or not the proposed clarifier arrangement can adequately thicken the incoming mixed liquor, a state point analysis was done. Based on Figure 3.3, the design MLSS was found to be 3,800mg/L.

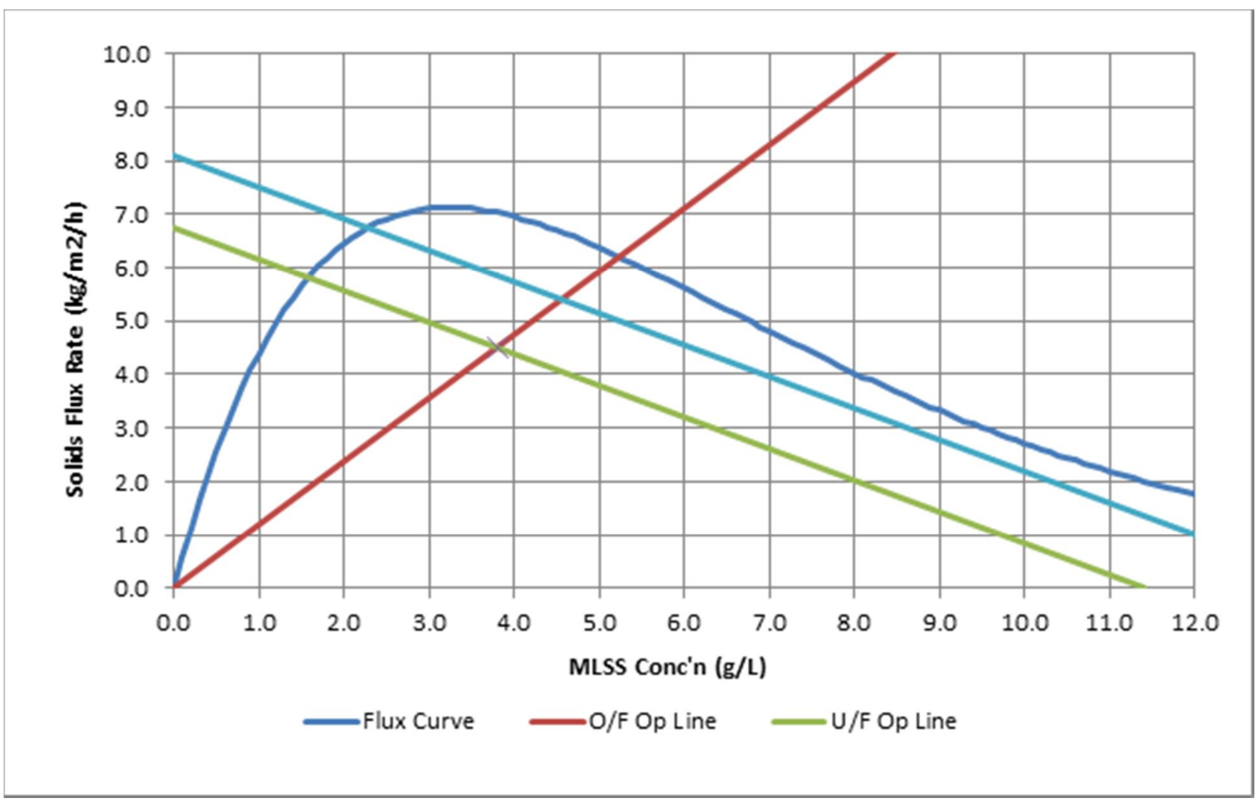


Figure 3.3: Secondary Clarifier Solids Flux Analysis

3.8.2 Return Activated Sludge Pumping Requirements

Each secondary clarifier will be provided with one dedicated RAS pump to withdraw settled sludge from the bottom of the clarifier and a shared standby pump. The RAS pumps will convey RAS to the Pre-Anoxic Zone of each bioreactor at a typical rate of 0.6 to 1.2 times the average day flow (0.6Q to 1.2Q). Generally, the RAS pumps run at constant speed, but can be manually adjusted in response to significant long term changes in peak flows or sludge settleability.

Design parameters for the RAS pumps are presented in **Table 3.11**.

Table 3.11: RAS Pumps Design Criteria

Parameter	Design Criteria
Number of Clarifiers	2
Average Annual Flow Total, m^3/d Per Clarifier, m^3/d	 5,520 2,760
RAS rate, per Clarifier 0.6 x AAF, m^3/d 1.2 x AAF, m^3/d	 1,700 3,300
Number of RAS Pumps (Total/duty)	3/2
Type of Units	Submersible
Capacity, each, L/s	27 to 57
Discharge Head, each, m	4
Power, each, kW	5.9
Drive Type	Variable Speed

3.9 Alum Trimming

Alum trimming is not necessary to comply with the known future 2015 discharge limits and is not included in the design. Alum trimming may be required in the future to comply with a possible future TP 1 mg/L discharge limit. Trimming would be provided as a back-up to the future biological phosphorus removal system and would only be used for trimming as necessary to meet the discharge limit.

4. Hydraulic Design

4.1 Design Basis

The existing WWTP receives raw wastewater via a gravity sewer. The existing treatment stream through the Anaerobic Lagoons, Aerated Lagoons, Storage Pond and treated effluent flow to the McLeod River is by gravity.

The hydraulic profile is based on passing a maximum flow of 20 MLD (maximum day - summer) through secondary treatment. Flows in excess of this (up to 4.3 MLD during the expected peak 24.3 MLD events, or 130 L/s during short-term peak instantaneous 31.2 MLD events) will be diverted to Aerated Cell No 1 from a point between the headworks and bioreactor. This equalized flow will ultimately be returned to the main stream for full treatment after the peak inflow has subsided. The returned flow will be a mixed stream of supernatant and screened excess wet weather flow. It is presumed that the flow will be collected and returned via a gravity line fed back into the main treatment flow.

Each major hydraulic element is described below in sequence, from downstream to upstream.

4.2 Outfall (existing segment)

The 400 mm diameter 2500 m long outfall is to be reused and is bounded by two existing constraints: the high level at its discharge (ice level McLeod River March 7 1980 EL 855.940) and the concrete structure at its inlet (Effluent sampling box, invert at 893.299, TOC at 896.100).

The maximum capacity of this system is somewhere between the original peak flow of 22.7 MLD (430 LCD and peaking factor 4.4) -- at which there is a generous 2.3 m freeboard -- and the revised peak flow of 24.3 MLD (460 LCD and peaking factor 4.4) -- at which the effluent box is overtopped by almost 3 m. This is attributed to the constricting 400 mm diameter outfall pipe. Although the friction head rises by only 13%, the 5 m increase from 37.9 m to 42.9 m is almost double the chamber's 2.8 m depth.

With post-screening flow equalization, and outfall therefore limited to a maximum instantaneous flow of 20 MLD from the secondary plant, at a total headloss of 29.9 m will be well within the physical limits of the system.

4.3 Outfall (new segment)

The new mechanical plant must be connected to the existing outfall, which is about 260 m away. This pipe will be sized larger than required, in order to minimize the friction loss and maximize the allowance available for UV disinfection in future. A 600 mm diameter pipe loses about 200 mm of head. With the secondary clarifier set as shown, about 650 mm is available for disinfection.

It is proposed that this pipe will also include a structure to allow the Town to manually divert some or all of the treated effluent to Pond No 3. This system should incorporate both automatic and manual controls. The automatic system would reduce flow to the outfall if the system becomes overloaded in an emergency and needs to be relieved. The manual system would allow the owner to divert any amount of effluent at their discretion to Pond 3 for eventual sale to industrial users (in keeping with current practice).

4.4 Disinfection

Disinfection will not be installed until sometime in the future. The pipe connecting the secondary clarifier and the existing outfall has been sized to induce as little friction loss as possible; 600mm diameter has been chosen. Given the water level in the secondary clarifier, this leaves about 650 mm available, which should be sufficient for an appropriately sized and configured UV disinfection system (150 - 200 mm) and if required a filtration system (400 - 500 mm).

4.5 Secondary Clarifiers

The secondary clarifier forms the central 17.5 m diameter basin of the combined bioreactor-clarifier unit. It is equipped with a peripheral v-notch weir to dampen level fluctuations due to flow variations. Each secondary clarifier receives flow only from its own bioreactor; the mixed liquor is not combined and then split. The tank water level remains relatively constant over the entire range of flows (there is a 17 mm variation in water level between average and maximum flow, increasing to 22 mm with one out of service).

The included hydraulic profile assumes full peak flow through the clarifiers. While the outflow is approximately equal to the plant influent flow, the inflow is 60 to 120 percent higher, as it includes the RAS stream, which is equivalent to an internal recycle in the clarifier-bioreactor system. The v-notch weirs and the inlet and outlet pipes are able to accommodate this flow within the profile shown.

4.6 Bioreactors

The bioreactor surrounds the central circular clarifier. It is divided into seven sequential zones, each with a specific environment tailored to allow the biological nutrient removal to function properly. Internal recycles and return flows mean that the instantaneous flows across each baffle and in and out of each zone could be up to 7 or 8 times the average daily flow. The baffles will be configured to account for this high local flow and to hydraulically separate the zones to prevent interzone mixing, as well as to provide a gradient to allow foam to flow unhindered to the final zone for ultimate removal. Typically, the cumulative headloss across a bioreactor is 150 to 300 mm. In this case, a 200 mm difference between the inlet and outlet levels has been shown.

4.7 Splitter Box

The screened raw sewage leaves the headworks as a single stream, and will be divided equally to the two (three future) bioreactors by a chamber with three weirs of equal length and elevation. One of the weir discharge chambers will be isolated permanently until the third bioreactor is built. Each chamber feeds its bioreactor via a 500 mm diameter pipe, each with a headloss estimated to be 50 mm. The loss across each 2.5 m weir is 90 mm, plus a worst case minimum freefall of 75 mm.

4.8 Primary Clarifier/Fermenter

The primary clarifier-fermenter will not be installed until such time that a total phosphorus discharge limit is imposed and biological phosphorus removal is required. It will be configured for a longer solids retention time, to provide a degree of fermentation. The fermented supernatant is necessary to promote biological nutrient removal.

An allowance of about 800 mm has been included for in the hydraulic profile for up to two future primary clarifier-fermenters.

4.9 Screened Sewage Diversion

The secondary process (bioreactor and clarifier) is sized to treat a maximum flow of 20 MLD with all units in service. Flows in excess of 20 MLD will be diverted (after screening and grit removal) to Aerated Cell No 1 for temporary storage. This cell is also to be used to store waste activated sludge.

When the peak flow has passed, the diverted fraction (along with the normal WAS supernatant, which is returned daily or on some other regular schedule) will be conveyed back to the bioreactor inlet splitter box, at a rate low enough to ensure the maximum process and hydraulic capacities are not exceeded.

The 1980 drawings for the existing lagoons show that the proposed new headworks outlet water level (896.18 peak, 895.83 avg) will be higher than the aerobic cell water level (895.20). Assuming the reference datum has not changed, a passive gravity diversion is proposed.

4.10 Headworks

Unlike the downstream elements, the headworks consists of physical processes (screening and grit removal) that are influenced mainly by hydraulic factors only and can thus be more easily sized to span low average and high peak flows. In this case, the headworks will be sized to handle the full expected peak hour flow of 31.2 MLD, and any excess above 20 MLD being diverted to equalization after it has been screened and degritted (see above).

A vortex grit removal system is proposed. Headlosses of 300 mm at peak and 100 mm at average have been allowed for in the hydraulic profile.

Barscreens have very low headloss when they are clean. However, in the course of operation, they gradually accumulate material which impedes flow, increasing head. The maximum head can be controlled: when the differential across the screen reaches a pre-set limit (150 mm or 300 mm is typical), the automatic cleaning mechanism starts, solids are removed, and the screen is restored to its original low-head clean condition. The hydraulic profile has allowed for a maximum differential of 350 mm.

4.11 Influent Line

The headworks is some 230 m from the present inlet structure, and must be connected by a new pipe. As this must convey the full 31.2 MLD, it will be sized accordingly. However, care must be taken to ensure adequate velocities (not just during the occasional peaks) to prevent solids settlement. Furthermore, adequate freeboard must be maintained in the existing flow measurement sampling box (TOC 898.80). Based on currently assumed conditions, a 600 mm pipe appears necessary.

4.12 Summary

The entire plant, between the inlet flow measurement-sampling box and the effluent sampling box requires 4.2 m of head at maximum flow to secondary treatment (31.2 and 20.0 MLD) and about 2.5 m at average annual flow (5.52 MLD).

5. Civil Design

5.1 Plant Elevation

This section provides a brief description of the existing conditions, design issues, and functional plan of non-process components of the works, which include utilities piping, land drainage, plant roadways, fencing, parking and grading.

There are no reports of the Edson WWTP lying in a flood plain. New process tankage will be designed to suit the local ground elevations.

5.2 Access Roads and Internal Roads

Access to the new process units is intended to be the same as the access to the existing blower building, via the embankments around the existing Ponds. These will be refurbished to support larger and more frequent vehicle traffic.

The road will extend around the proposed plant site. A parking area will be included at the south east side of the proposed plant site.

5.3 Site Grading, Drainage

The site will be graded to provide positive drainage away from all process tankage and the headworks building. Appropriate storm drainage will be designed to intercept and manage surface drainage as required. The proposed headworks floor will be raised above the natural ground elevation. Excavation and grading will be such that the surface storm water from rooftop drainage will flow around the buildings and gravel roads to perimeter ditches, join the existing ditches and ultimately flow away from the site. Culverts are proposed at the proposed plant site to allow flow under the new gravel access road and parking lot.

5.4 Fire Protection Flow Storage

As required by the NFPA 1142 – Standard on Water Supplies for Suburban and Rural Fire Fighting, an adequate and reliable municipal type water supply is required to control and extinguish anticipated fires in the municipality.

The required fire protection storage can be provided on-site. An underground storage tank could be used as a potential fire flow storage structure. The storage site should be maintained and accessible on a year-round basis.

5.5 Underground Duct Banks

Electrical feeds to all new areas will be run in underground duct banks. Where appropriate and required by code these duct banks will be encased in concrete. In the event that it becomes more economical to provide electrical feeds overhead, this option will be carried.

5.6 Miscellaneous Items

Signs will be placed to orient staff and visitors, indicate building names or functions, and direct traffic.

6. Structural Design

6.1 General

This section describes the structural requirements for the major components of the WWTP. The proposed plant is divided into three major areas; the Headworks Building, the Bioreactors, and the Pumping/splitter wells

The structural design criteria, codes, and standards that will be used for detailed design of the structures are presented.

A Geotechnical Investigation has not been completed, however will be prior to detailed design. Once the report is received, the details of the concrete construction can be confirmed.

6.2 Codes and Standards

The following is a general list of codes that will be used in the design of the structures:

- Alberta Building Code 2006;
- National Building Code of Canada 2005
- ACI 350M-06 "Code Requirements for Environmental Engineering Concrete Structures";
- ACI 350.3-01 "Seismic Design for Liquid-Containing Concrete Structures"; and
- National Fire Code of Canada
- The Workplace Safety and Health Act
- CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete
- CSA A23.3, Design of Concrete Structures
- CSA S16-01, Limit States Design of Steel Structures
- CSA S304.1, Design of Masonry Structures
- Water retaining structures will be designed to: ACI 350 Code Requirements for Environmental Engineering Concrete Structures and Commentary
- Water retaining structures will be tested to: ACI 350.1 Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures and Commentary

The structural design will be based on the NBC 2005. The design of the above-grade structures will be based on the Canadian Standards Association codes such as A23.1, "Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete"; A23.3, "Design of Concrete Structures"; S16.1, "Limit States Design of Steel Structures"; and S304.1, "Masonry Design for Buildings".

The water retaining structures will be designed to the American Concrete International Standard ACI 350, "Code Requirements for Environmental Engineering Concrete Structures and Commentary."

6.3 Below Grade Structures

The expansion and upgrade of the WWTP will include a number of below or partially below grade facilities including:

- A new headworks building containing fine screens;
- Two new bioreactors and secondary clarifiers (each bioreactor and secondary clarifier paired in a CTU structure).
- Decant chambers
- Yard conveyance piping

All of these below grade structure must be designed with consideration of the geotechnical conditions at the site. The preliminary assessment of soil indicates a high water table, therefore structures should be designed to counteract the buoyant forces or be provided with pressure relief valves to prevent flotation when tanks are dewatered for maintenance. Shoring and/or dewatering will likely be required for any underground structures. The potential for excavation base heave due to artesian conditions should be assessed for each of the major excavation areas following completion of a detailed test drilling program and geotechnical investigation at the location of each below grade structure.

6.4 Foundations

The Headworks Building, the Bioreactors, and the pumping/decant chambers will be constructed as per the recommendations in the geotechnical investigation report.

6.5 Building Structures

Materials for the new building construction for the proposed works should be durable and provide for low maintenance. Energy efficient building envelopes should be selected to reduce building operational costs.

The Headworks Building will be designed as a pre-fabricated building, similar to the blower building currently on site.

Interior guardrails and handrails will be designed as galvanized steel. Landings will be designed as reinforced concrete toppings on galvanized steel decking supported by galvanized steel.

Exterior staircases, guardrails and handrails will be designed as galvanized steel. The stair treads and landings will be designed as galvanized serrated steel grating to minimize snow build-up and snow clearing in the winter months. The exterior stairs will be supported by reinforced concrete beams and belled piles to minimize potential differential movements between the staircase and main building.

The raw wastewater inlet channels of the headworks building will be constructed of cast-in-place reinforced concrete and designed to ACI 350, “Code Requirements for Environmental Engineering Concrete Structures and Commentary.” The concrete in these areas will be subjected to H2S gases, and will receive a special surface treatment such as a high quality applied coating or an additive. Grating and solid channel covers will be designed as either stainless steel that is passivated or fibreglass reinforced plastics (FRP) in order to mitigate corrosion. Stainless steel safety davits will be provided in all confined space areas. The safety davits will be designed in accordance with the Workplace Safety and Health Act. Additional specific Town safety protocols for confined spaces should also be reviewed to confirm that the design is compliant.

The Headworks Building will also be provided with a large double leaf stainless steel floor hatch for ease of equipment removal. A mono rail will be provided above this floor hatch for hoisting of equipment.

6.6 Design Criteria

The new structures will be designed as post-disaster structures. Typical design loading criteria is as follows:

- Ground Snow Load: Ssnow = 1.3 kPa, Srain = 0.1 kPa and Is = 1.25;
- Seismic Load: Sa (0.2) = 0.302, Sa (0.5) = 0.234, Sa (1.0) = 0.147, Sa (2) = 0.084;
- Peak Ground Acceleration, PGA = 0.151;
- Earthquake Important Factor, I.e. = 1.5;
- Wind Load:
    1. q_{50} =0.59 kPa for all structural members and cladding;
    2. q_{10} =0.40 kPa for others;
    3. Iw =1.25;
- Floor Live Loads:
    a. Lobbies, corridors and aisles = 4.8 kPa;
    b. Workshop = 3.6 kPa;
    c. Mechanical, Pump & Generator rooms = Equipment weight or 4.8 kPa, whichever governs;
    d. Catwalks = 3.6 kPa.

Durability of concrete can be achieved by using high quality concrete with a minimum compressive strength of 35 MPa at 28 days and an exposure class of F1. In order to minimize concrete shrinkage cracks caused by thermal shocks, 20% flyash will be specified in concrete mix design for the purpose of slowing down rate of hydration during concrete initial curing.

All water retaining structures will be designed in accordance with ACI 350M, complete with amount of reinforcing no less than the minimum shrinkage and temperature reinforcement as required by ACI 350M. Control and/or construction joints will also be utilized at critical locations to minimize concrete cracks caused by temperature differential related volume changes. These joints will be incorporated with PVC water-stop and sealant to prevent leakage.

For economy and practical reasons, standard uncoated deformed reinforcing steel bars will be used for all concrete structures. A minimum of 50 mm concrete cover will be specified to protect the re-bars from corrosion.

6.7 Material Specification

Material Specifications for the new facility can be summarized as follows:

- Structural steel: to CAN/CSA-G40.21M, grade 350W
- Anchor bolts embedded in concrete: to ASTM A307
- Bolts: to ASTM A325
- Welding: to CSA W59, fabricator certified to CSA W47.1, Div. 1 or 2.1;
- Fabricate steel members to in accordance to CSA S16.1 and S136;
- Shop Primer: to CAN/CGSB 1-GP-40 or CISC/CPMA 2-75;

- Galvanizing: to CAN/CSA-G164, minimum 600 gm/sq.m. ;
- Cement: General Use Hydraulic Cement, Type GU with 20% Flyash;
- Concrete: 35 MPa minimum compressive strength at 28 days with 5 to 8% air content;
- Reinforcing Steel: deformed steel bars to CSA G30.18M, grade 400; and
- Concrete Block Unit: to CSA CAN3-A165 classification H/15/A/M with type S mortar;

6.8 Geotechnical Investigation

A geotechnical investigation is proposed on the site west of the existing aeration cells and along the proposed forcemain route. As much of the existing underground piping will be used, where feasible. The purpose if the investigation will be to confirm a location for the construction of the new structures, some of which are partially below grade.

The following items are proposed to be included in the investigation.

6.8.1 Intrusive Investigation

Prior to the commencement of the drilling program, utilities will be located by AB-1-Call and private locators to assist in identifying safe testhole locations. A total of 7 testholes will be drilled for the intrusive geotechnical investigation in open, readily accessible areas. Drilling will be conducted using a track or truck mounted drill rig equipped with solid and hollow stem augers. Soil samples will be visually identified in the field according to the Modified Unified Classification System for Soils.

6.8.2 Geotechnical Analysis and Geotechnical Report

The geotechnical report will provide a summary of the activities performed as well as the results of the laboratory tests. Recommendations will be made for the following:

- Settlement and soil loading criteria
- Slope stability
- Shoring requirements
- Seismic-design information
- Foundations
- General recommendations for excavation

7. Architectural Design

7.1 Introduction

This section describes the architectural requirements for the major components of the new waste water treatment plant.

The architectural design criteria, codes, and standards that will be used for detailed design are presented with significant features highlighted.

7.2 Codes and Standards

The following is a general list of codes that will be used in the design of the structures:

- National Building Code of Canada (NBC 2005)
- National Fire Code of Canada
- The Workplace Safety and Health Act

The majority of the building area will not be occupied as are tankage and service spaces.

The Headworks Building, the Bioreactors, and the Pumping/decant chambers will provide access for Fire Department vehicles all around the building. Sprinkler or Standpipe fire protection systems are not required. The site will be cleared of trees around the building and parking lot, and granular surfaces are also provided around the perimeter of the building for emergency vehicle access.

Emergency exit signage in accordance with the NBC 2005.

No public access will be allowed due to the building's intended usage. Based on the limited occupancy and non-public access, it is assumed that Barrier Free Design is not required in any of the areas.

A single washroom and shower area will be provided and will be further reviewed with the Town in Detailed Design in order to maximize the usable space in the Headworks Building.

7.3 Interior Finishes

The interior surfaces of the Building walls will be cast-in-place concrete floors depending on the location.

The interior cast-in-place floors of the buildings will be epoxy coated. For ease of cleaning, the floor epoxy coating will also be extended up the face of the cast-in-place concrete curbs complete with a radius infill at the floor to curb intersection.

The staff support area ceiling will be constructed utilizing acoustic ceiling tiles and prefinished metal grid support systems. The acoustic ceiling materials and grid systems design will be adjusted to suit the room conditions such as the potential for high humidity in the Washroom.

Door hardware will of commercial grade and will match the current Town's current keying requirements. Doors and door frames will utilize Z275 galvanized sheet metal in accordance with ASTM A653 in both dry/wet areas and all exterior areas. All doors and frames will be painted. Clear or Georgian Wired glazing will be provided in the door assemblies for aesthetic purposes.

Locations of interior windows will be further reviewed with the Town in the Detailed Design stage.

7.4 Exterior Finishes

The exterior materials and finishes vary depending upon each area of the plant.

It is proposed that the Headworks building be clad with both veneer and pre-finished metal cladding system consisting of low profile panels oriented vertically.

The roof of the building will consist of a sloped pre-finished metal standing seam roof. Rigid insulation complete with an exterior gypsum board protection layer will be provided and will be supported by the galvanized steel deck or concrete roof substrate.

Below grade walls and grade beams of the building will be constructed with an exterior waterproofing material over the cast-in-place concrete components. Below the cast-in-place concrete floors a vapour barrier will be used and will lap to the above grade building envelope.

The exterior windows will be thermally broken pre-finished aluminum frames with hermetically sealed triple pane glazing units.

7.5 Building Envelope

The building envelope will be designed to ensure a durable and long lasting assembly. In areas of the building with a standing seam roof and veneer or pre-finished metal cladding, the roof and wall systems will utilize an air barrier system to mitigate air leakage and improve the building thermal efficiency in accordance with the NBC 2005.

8. Mechanical and HVAC

8.1 Introduction

This section describes the scope of the building mechanical systems.

- energy efficient heating, ventilation and air conditioning (HVAC) system,
- plumbing systems; and,
- fire protection.

The basis of this design is to incorporate systems and components which conserve energy and water, and maximize indoor environmental quality in normally occupied spaces, as prescribed in the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) standards.

Ventilation systems will be designed and controlled in a manner consistent with the requirements of NFPA 820 – Standard for Fire Protection in Wastewater Treatment and Collection Systems, 2012 Edition; and NFPA 496 – Standard for Purged and Pressurized Enclosures for Electrical Equipment, 2013 Edition.

8.2 HVAC Design Conditions

The HVAC design will be based on:

- The heating and cooling requirements for this facility calculated using Carrier Hourly Analysis Program (HAP) software, based on local weather data for Edson, Alberta.
- The Alberta Building Code as applicable for the local climate.

8.3 Codes and Standards

The building mechanical systems will be designed in accordance with the current edition of the following codes, standards and references:

- National Building Code (NBC).
- National Fire Code (NFC).
- National Plumbing Code (NPC).
- Canadian Standards Associations Standard CAN/CSA-B149.1, Natural Gas and Propane Installation Code
- National Fire Protection Association (NFPA) 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities
- National Fire Protection Association (NFPA) 496 – Standard for Purged and Pressurized Enclosures for Electrical Equipment
- American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) Standard 62.1 Ventilation for Acceptable Indoor Air Quality
- ASHRAE Standards, Handbooks and Periodicals
- American Society of Plumbing Engineers (ASPE) Data Books
- American Society of Mechanical Engineers (ASME) and Sheet Metal and Air-Conditioning Contractors Association (SMACNA) Standards and Guidelines

- Any provincial specific amendments to the above codes

8.4 Equipment Designations

All final locations of the equipment will be reviewed in detailed design and it will be important to provide proper accessibility for maintenance and operation of the mechanical equipment.

8.5 Headworks HVAC System Descriptions

The Headworks Area will use electric heating to provide all building and ventilation heating requirements. This will include air handling units, make-up air units, space unit heaters, baseboard heaters, and cabinet unit heaters, as required.

Space heating will be provided with hot water unit heaters.

There will be no mechanical cooling, so interior summer temperatures will depend on ambient outside air temperatures and the estimated maximum heat gain from solar, electrical equipment loads and lighting. In the interest of energy savings, since this area is not normally occupied for any significant length of time, the space temperature in the winter will be maintained lower than normal comfort levels, at 15°C at winter design conditions, but well above freezing.

Ductwork is to be constructed in accordance with SMACNA duct manuals, ASHRAE handbooks and will meet the requirements of NFPA 90A.

All HVAC piping within process areas will be stainless steel.

8.5.1 Electrical Room

The Electrical Room will be supplied from the make-up air unit with supplemental cooling from a 7 kW split-type air conditioning unit, with low ambient temperature operation capability. This will provide cooling with local control as required for the Electrical room. The air system will be balanced to provide positive pressure in the electrical room relative to adjacent spaces. A filtered outside air supply fan will also be used to provide “free cooling” during times when outside air temperatures are suitable.

8.5.2 Solids Collection Bay

This process area contains the grit and screening trailer and grit classifier. The area is ventilated at 6 ACH by make-up air unit and exhaust fan. Exhaust inlets will be located as close as possible to the foul air sources.

8.5.3 Staffing and Support Areas

The staff areas include a Plant Manager’s Office as well as the Washroom.

A workshop will not be mechanically cooled, but will use a thermostatically controlled exhaust fan to induce ambient outside air in summer conditions. Winter space temperatures will be maintained with electric unit heaters.

Entrances will be heated by electric unit heaters.

8.6 HVAC Control System

Some alarms will be connected to the overall plant control system, such as building low temperature, major equipment alarms, containment pressure loss and combustible and toxic gas levels.

Some basic controls, such as unit heaters and entrance heaters, will be left as stand-alone operations depending on whether the space is considered critical or not.

8.7 Domestic Water and Plumbing

The plumbing design and execution will comply with all the requirements of the National and Alberta Plumbing Codes, as well as any requirements of the Authority Having Jurisdiction.

8.7.1 Headworks

The plumbing systems will be designed to reduce water consumption. The toilets will be tank-type, dual flush with showers and sinks specified as low flow fixtures. Barrier-free fixtures are not required.

Hand-wash sinks and mop sinks will be provided in the process areas. A janitor mop sink will be provided in a Workshop area.

Automatic trap seal primers will be used to maintain the traps.

Re-circulation lines and pumps will be used so that hot water will be readily available at all fixtures.

An emergency eyewash and shower station will be provided in the Screenings Room and laboratory. It will be complete with a thermostatically controlled mixing valve to maintain a discharge water temperature between 20 and 25ºC. The American National Standards Institute (ANSI) Standard Z358.1-2004 “Emergency Eyewash and Shower Equipment” defines flushing fluid to be potable water, preserved water, preserved buffered saline solution or other medically acceptable solutions. Since a continuous supply of potable water is not available, provision will have to be made to store an appropriate quantity of potable water on site. This also means the emergency shower / eyewashes will require a separate hot and cold water distribution system, heater and pumps to isolate it from the untreated well water system. It is probable that a storage capacity in excess of 2,400 L will be required as emergency showers are required to deliver a flow of 75.7 L/min for a minimum 15 min duration.

Floor drains will be provided at all emergency showers, washrooms, mechanical rooms and process areas.

Depending on the chemicals used in the laboratory the drainage may need to be fabricated of acid-resistant materials.

The process areas will have hose bibs and reels for wash-down of the floor areas.

8.8 Fire Protection

Fire extinguishers will be provided throughout the new facilities in accordance with NFPA 10.

9. Electrical

9.1 Introduction

The existing electricity power supply system is located at the Blower Building. This comprises an external pad mounted transformer and Motor Control Centre (MCC) located within an electrical room adjacent to the room containing 3 No. blowers. The facility was installed in 1980 and is in operation at present.

9.2 Proposed System

The new electrical loads for the plant will be fed from a new MCC installed in the electrical room at the ground floor. A new outside transformer will be provided and it will feed the new MCC. It will be necessary to arrange with Fortis to provide a new 400Amp, 600VAC 3 phase service that is owned by Fortis.

9.3 Applicable Codes and Standards

The electrical design and system features will be selected based on the latest editions of all applicable Federal, Provincial and local Municipal codes; and the functional and environmental requirements of the facility through effective lighting, power and control systems design.

9.4 Electrical Loads

New electrical switches, gear, and MCC will be required to support the additional electrical loads and equipment for the new WWTP upgrade. New equipment added will use only high-energy efficient motors suitable for the specific process applications.

The MCCs and room spaces will be designed with enough capacity to accommodate the current and future electrical loads. The MCC will have a main circuit breaker sized for all new and future loads, power monitor and TVSS (transient voltage surge suppressor) protection devices.

Process and HVAC loads with motors and fractional horsepower (hp) motors up to ½ hp will be powered by 120/208 VAC, 60 Hz, 1 phase power. Motors between ½ hp and ¾ hp will be powered by 120/208 VAC, 60 Hz, 3 phase power. Motors equal to or larger than 1 hp will be powered by 600 VAC, 60 Hz, 3-phase from the main MCC.

Each motor starter will have either Local-Off-Remote or On-Off control, and local control with remote capability for system control through the PLC (SCADA) system.

The MCC will be used for all process loads and major HVAC equipment. The MCC will be EEMAC Class 2, Type C with copper bussing, vertically stacked with a control terminal section located in each starter. Variable Frequency Drives (VFDs) will be installed for the TF pump motors. Variable Frequency Drives (VFDs) will comply with IEEE 519 for harmonic distortion requirements. All variable speed drives will be equipped with minimum 3% line reactors, and 5% load reactors. The MCC supplied will be an intelligent MCC with the built-in Profibus DP network and all VFDs, contactors and power monitor will communicate to the PLC through the Profibus DP network.

The motor feeders will be RW90XLPE copper run in conduit or armoured RW90 XLPE if run in cable trays.

Branch circuit panels will be provided with 20% spare 15 Amp, 120 VAC breakers in each panelboard (minimum 5 spares per panel). All breakers will be suitable for bolt-on types. Lock-out devices will be provided for authorized access for switching life safety and critical loads.

All branch circuit wiring will be copper cross-link (RW90XLPE). Minimum wire size for lighting and HVAC power will be #12 AWG. Power outlets will be wired separate from lighting circuits.

9.5 Grounding

The design includes grounding systems for all new facilities to: ensure stable system voltage reference, ensure limitation of over-voltages, switching surges, ground faults and other conditions. This will enable proper operation of circuit protective devices by providing a low impedance path for the fault current. The grounding system will ensure personnel and equipment safety, as well as proper equipment operation.

Grounding systems for the MCC, control panels, distribution panelboards, dry transformers, and instrumentation bus will be connected to the main grounding bus for the Plant.

9.6 Facility Lighting

The following summarizes the lighting design and lighting systems to be implemented for the proposed upgrades:

- Lighting systems will be designed as energy efficient, quality artificial lighting systems determined by analysis of alternate designs incorporating an appropriate effective recurring lighting maintenance program. Energy consumption will meet or exceed ASHRAE 90.1-2001;
- Lighting design will be in accordance with the IESNA lighting handbook;
- The design includes luminaries in all electrical/control rooms, corridors, and process areas. Luminaires will include linear fluorescent and HID systems for process and exterior areas;
- All linear fluorescent and HID luminaires will have high power factor ballasts—electronic type;
- All luminaires will be suitable for the environment where they are located;
- Lighting control systems for exterior fixtures will include a contactor from an “On Off Auto” switch and photocell control;
- Emergency battery packs and remote heads will be provided for immediate illumination in areas of emergency egress, electrical rooms and process mechanical equipment rooms and areas to illuminate evacuation routes during emergency conditions or power outages until the standby power is activated. All units will be sized for half hour emergency operation; and,
- Exit signs will be LED type with “EXIT” written in 150 mm high red lettering on white background and with removable directional arrows. Exit lights will be connected to AC power with all breakers feeding these devices in the locked on position.

The general use spaces and individual areas, which are generally separated from adjacent occupancies by walls, are individually illuminated to the recommended IES lighting levels. The design levels for lighting in LUX (maintained average) will be:

- Control Room / Laboratory Space 550Lx
- Corridors 200 Lx
- Equipment / Maintenance Room 250-300 Lx
- Mechanical and Electrical rooms 250 Lx
- Process Areas 300 Lx

9.7 Wiring Methods and Equipment

All feeders will consist of copper conductors pulled in conduits, with separate grounding conductors for interior distribution equipment and Teck90 armoured cable for process and exterior feeders. To ensure the quality of power distribution, and to compensate for voltage transients that can occur on site, a transient voltage surge protector will be installed at the MCC distribution. All Teck90 cables will either be installed in the cable trays or in the underground duct banks.

All interior HVAC power feeders, lighting and line voltage control conductors will be run in conduit raceways or cable trays. Rigid steel conduit will be used where susceptible to damage, or in wet or hazardous locations. Different voltages will each be racked at different elevations.

All wiring will be RW90XLPE copper. The minimum size of wire for lighting and HVAC loads will be No. 12 AWG and No.14 AWG for control. Conductors for lighting and miscellaneous power wiring will be colour coded. The minimum conduit size will be 19 mm.

All wiring and equipment installed or operated within any of the Class 1, Zone 2 locations (defined in Sections 18 and 20 of the Canadian Electrical Code) will comply with applicable provisions of Section 18 of the Canadian Electrical Code. Ventilation and electrical systems will be designed in accordance with NFPA 820 provisions.

All underground wiring will be installed in PVC conduits with termination fittings approved for the location. In process areas and areas exposed to mechanical damage conduits will be rigid galvanized steel.

9.8 Standby Power

The electrical loads within the new facilities will have to be powered in the event of Fortis power failure. A new standby generator c/w Automatic Transfer Switch (ATS) will be provided. The genset will be selected to allow operation of the critical treatment, distribution and ventilation equipment in the plant during a main power outage. The genset will be diesel powered and located outside on a gravel pad and with a weather enclosure. The size of the generator will be determined during detailed design and the ATS will be rated for 600Amps at 600VAC.

10. Instrumentation and Control Systems

10.1 General

This section contains the instrumentation and control design information for the WWTP upgrade. It also outlines some of the general concepts for design of the Supervisory Control and Data Acquisition (SCADA) system—utilizing technology that is reliable, field proven and integrates with the existing plant wide system.

10.2 Process Control Philosophy

The process will be controlled by Programmable Logic Controllers (PLC). The PLCs and SCADA computers will be powered from an UPS to maintain data integrity. The main Local Control Panel (LCP) will be installed in the new electrical room and will house the main PLC and the automatic dialler. Some process equipment, such as headworks fine screens, may come with their own local control panels with the associated PLCs. Those local control panels will be installed in the electrical room.

Two new SCADA computers will be provided and installed in the control room. One more computer will be provided and will be used as an engineering station to be used for PLC programming and Profibus DP network and equipment monitoring.

Most of the primary instruments (e.g. flow meters, pressure transmitters and DO transmitters) and pneumatic modulating valves will be connected to the PLCs by Profibus network. The ultrasonic level transmitters, pneumatic on/off valves and solenoid valves will be individually wired and terminated in the PLCs and its corresponding input/outputs modules (I/O).

The new plant control system will be based on the Schneider Quantum PLC series. The PLC CPU operating system will be Unity and the latest version of the Unity Software will be provided to the Owner at the end of the project. The number of the Quantum PLCs will be determined during the design. The process equipment supplied controlled by their own PLC equipment will be based on Schneider M340 series of the PLCs. The communication between the PLCs will be based on Modbus TCP Ethernet protocol. If the process equipment is supplied with Operator Interface Panels (OIP) they will be Schneider Magelis 12.1'" colour touchscreen panels with a built in Ethernet Port.

The new SCADA software for the plant will be Wonderware inTouch (the latest version). We will design a server/client based system with two SCADA computers located in the control room. They will run in the hot standby arrangement which will ensure that the SCADA system runs in a case of one computer failure.

10.3 Process Control Modes

The following control modes will be employed:

- All individual process equipment and packaged process units will have Automatic and Manual control modes, selectable by the operator; and
- All process equipment or packaged process units, such as aeration blowers, will be controlled by a "maintained control mode". Contact 'close' will cause the equipment to operate and contact 'open' will cause the respective equipment to stop.

Pumps, blowers and exhaust fans will be run from Variable Frequency Drives and FVNR starters installed in the MCC. Each VFD or starter will be supplied with a hard-wired Remote Operator Station (ROS). A Local-Off-Remote switch with Run and fault indication lights will be installed at each ROS with an E-Stop push button if applicable.

In the 'Local' position, manual control of the equipment will be activated. These control devices will be grouped as a remote control panel/station for individual equipment.

In the 'Remote' position, the PLC will control the operation and sequencing of the process equipment.

Each electrical motor will be supplied with the following functions as part of its control system (communication to the plant control system through Ethernet):

- Run permissive to indicate to the control system that it can run in ‘Auto’ mode;
- Run status;
- Process interlocks;
- Alarms and Faults;
- Electrical Motor Current;
- Motor speed (for VFD driven motors);
- Local-Off-Remote in ‘Remote’;
- If emergency shut-down (ESD) is provided on the packaged unit, then provisions will be made for additional ESD remotely mounted on the process floor. Status of the ESD will be monitored by the PLC; and
- The pumps, blowers and exhaust fans will automatically restart after power failure and power restoration if that is part of an automatic restart-after-power-failure routine.

10.4 Process Alarms

All process alarms will be wired in fail-safe mode. 'Open contact' will indicate an alarm condition; 'Closed contact' will indicate a normal condition.

All alarms will be shown and logged on the existing plant SCADA system.

10.5 Process Interlocks

All process interlocks will be wired into the PLC. The PLC will determine the correct process control action based on the status of the interlock.

10.6 Safety Interlocks

Two types of safety interlocks have been identified:

Equipment safety - protects process equipment against unusual process conditions. A typical equipment safety interlock would be 'level low low' to prevent a pump from running dry. All equipment safety interlocks will be wired into the PLC. The PLC will then determine the correct equipment shut down action or will prevent the equipment start.

Personnel safety - protects personnel against injury. A typical personnel safety interlock is 'Emergency Shutdown Device' (ESD). The personnel safety interlock will be hard wired to a properly selected point or points in the control system to immediately shut down the process in case of emergency. The ESD will bypass the PLC based control system and will either completely de-energize the process equipment or will cause the equipment to come to a full stop regardless of any process condition. Emergency stop push buttons or pull strings will be strategically located in process areas and by exit doors from process buildings.

10.7 Facilities Control Panels

The main control function of the facility is based on a PLC-based supervisory control system with local control panels (LCP) to facilitate the complete control and monitoring of the facility in accordance with the process requirements.

All PLC components and I/O modules will be sized to provide sufficient capacity to handle the logic and data requirements plus an additional 50% spare CPU and memory.

Each PLC control panel will be equipped with an Ethernet switch with fibre and Cat5 connection ports.

Expansion modules I/O signal voltage/parameters will be based on the following:

- Digital inputs and outputs: 120 VAC, quantity to be determined at final design. All digital output modules are to be based on isolated contact type for each individual point. Digital input modules will be isolated and non-isolated types to meet the I/O circuit requirements.
- Analog inputs and outputs: 4-20 mA, 24 Vdc; quantity to be determined at final design. All analog modules will be based on 4-20 mA dc isolated type.

The following Quantum PLC hardware will be used:

- Power Supply: 140 CPS 114 20
- CPU: 140 CPU 323 12U
- Digital Inputs: 140 DAI 540 00
- Digital Outputs: 140 DRA 840 00
- Analog Inputs: 140 ACI 030 00
- Ethernet Communication Module: NOE 771 01
- Profibus DP Master: PTQ PDP MV1

The control panel will provide minimum 20% spare I/O of each type, 10% spare slot capacity and 25% spare power supply capacity including all necessary cables, communication cards, and accessories for a full functional system. The local control panels will include incoming power transient surge suppression and an UPS. The installation will connect the surge suppressor dry contacts and UPS unit to a PLC input and configure as an alarm on the control system as soon as a major surge occurs and / or the UPS battery has a low condition.

Connection to the new Profibus network will be through Prosoft Technologies Profibus DP scanner. The scanners will be connected to the Profibus DP/PA couplers.

Profibus PA network architecture will consist of Profbus PA segments connected to the Profibus DP/ PA couplers and Profibus PA segment protectors. Each individual Profibus PA instrument will be connected to a dedicated segment protector port (spurs). The segment protectors will be installed in the dedicated junction boxes and will have the following features:

- Short circuit protected spurs
- Non-incendive spurs
- Built-in selectable segment terminator
- LED indication lights

The PLC software applications installed will control and monitor all the aspects of the process. It will store, display and control operating parameters and generate alarms and reports to local operating interface (OI) when parameters and equipment are out of normal functional range. Alarms will be treated locally by generating the alarm condition and stopping/halting the equipment that generated the condition or the “cause” associated with the equipment. All alarms will be enunciated through the plant SCADA system computers and logged in the plant electronic log residing on the SCADA server’s hard drives. Each alarm will have three states:

- Active and Not-acknowledged
- Active and Acknowledged
- Non-active and Not-acknowledged

An alarm will be acknowledged from the SCADA Wonderware inTouch application.

The PLC system will be provided with a “watch-dog” module to monitor power failure and utility black-outs, to revert to functioning condition once the power is re-established though the plant (or emergency generator started). The supervision module hardware/software will discriminate between normal operation (on utility power) and on stand-by power.

10.8 Operator Interface

The SCADA software will assist the plant operators in control, monitoring and supervision of plant processes, allowing the operator to control process equipment in auto mode from the control system. The SCADA software will allow the monitoring, storing, displaying and archiving of operating data and alarms, and to generate reports on existing data and to perform various process control functions from a remote location.

10.9 Field Instruments

Field bus technology offers many advantages (devices provide considerably more information than just the ‘traditional’ measured variables) and provides an economical system that will support future expansions. However, the technology where instruments are hardwired to the associated PLCs will also be considered. The final decision will be made once the number of instruments is determined during detailed design.

Examples of technology c/w connection method to the control system that would be utilized are as follows:

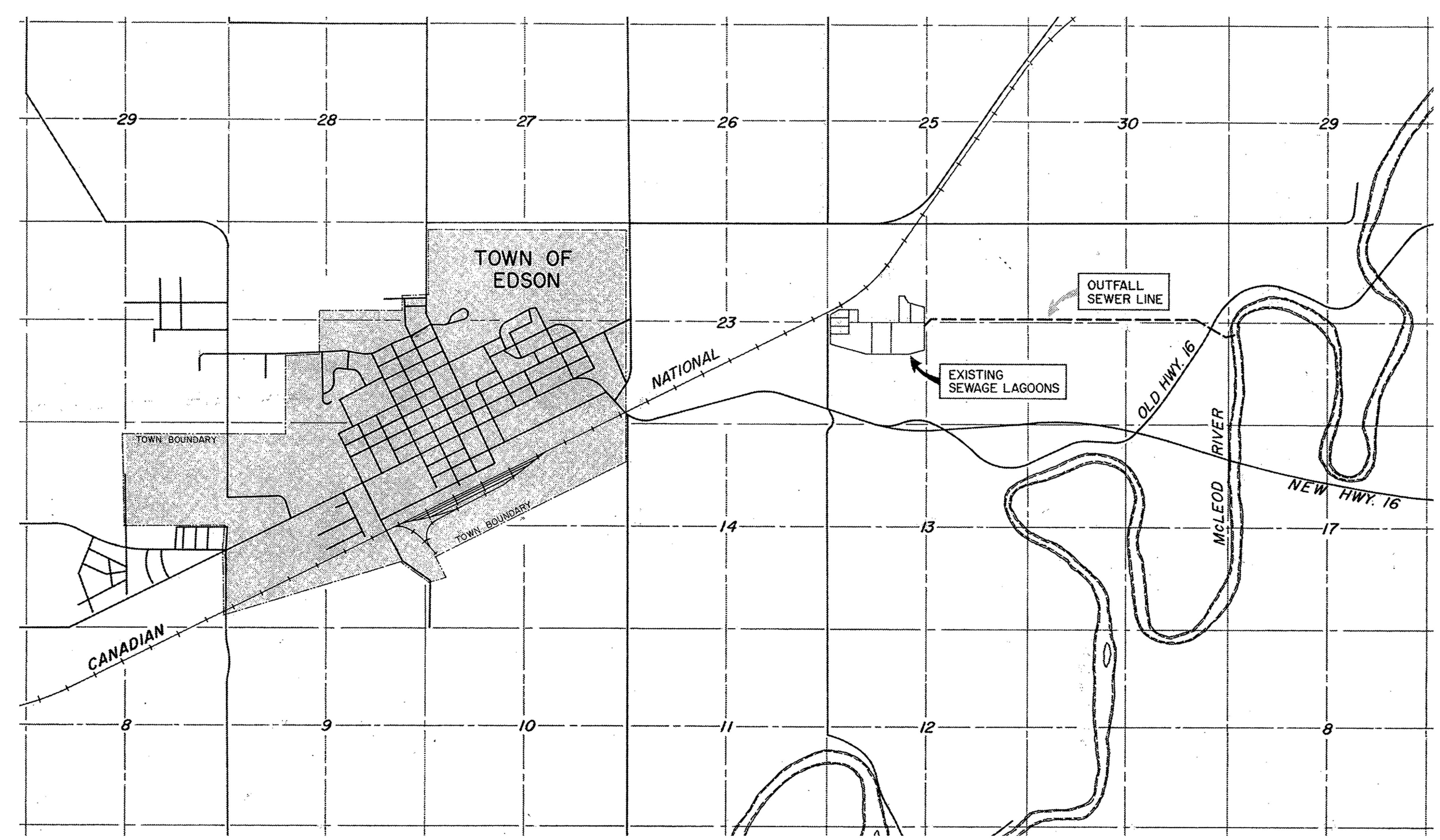
- Effluent analyzer (ChemScan)
- Magmeters for piped liquid flow applications (Siemens) – Profibus DP
- Ultrasonic level transmitters (Siemens Milltronics) – 4-20mA hardwired
- Hardwired floats for low level and overflow protection (Flygt) - hardwired
- Thermal mass flowmeters for air flow (FCI, E+H) – 4-20mA hardwired
- DO sensors for dissolved oxygen measurement (E+H, Hach) – Profibus DP
- Pneumatic Modulating Valve Positioners (Fisher) – Profibus PA
- Motorized Actuators (Rotork) – Profibus DP
- Pressure Transmitters (Siemens) – 4-20mA hardwired
- On/Off Valves – hardwired

Appendix A

Drawings

DRAWING INDEX

G-0000	GENERAL	COVER SHEET & DRAWING INDEX
G-1001	GENERAL	OVERALL SITE PLAN
D-0001	PROCESS MECHANICAL	LEGEND & ABBREVIATIONS
D-0002	PROCESS MECHANICAL	HYDRAULIC PROFILE
D-0003	PROCESS MECHANICAL	EXISTING PROCESS FLOW DIAGRAM
D-0004	PROCESS MECHANICAL	PROCESS FLOW DIAGRAM
E-0001	ELECTRICAL	SINGLE LINE DIAGRAM

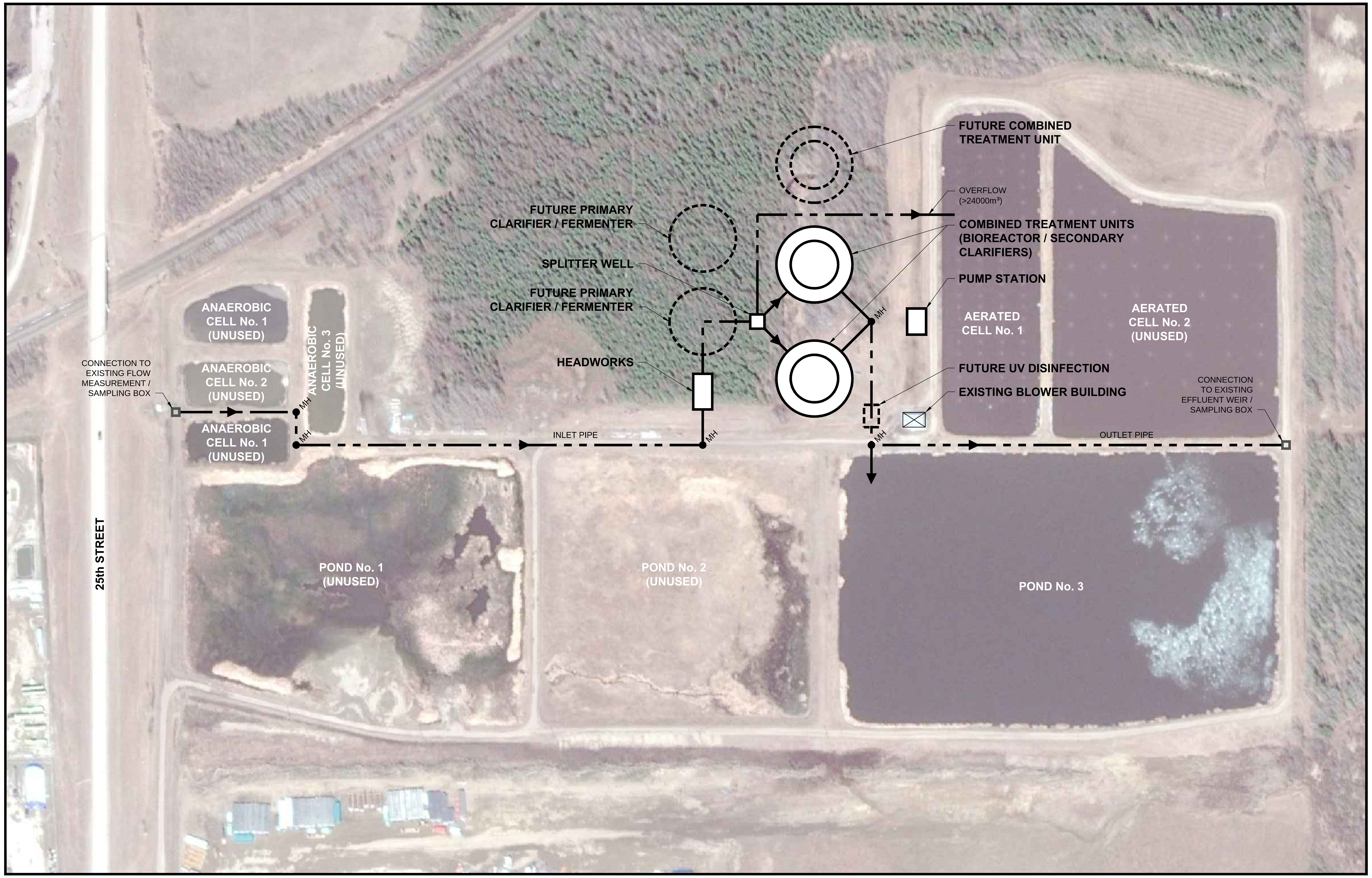


PRELIMINARY
NOT FOR CONSTRUCTION
Date: 25.09.2014

60330572

TOWN OF EDSON
Wastewater Treatment Upgrade Project

FUNCTIONAL DESIGN BRIEF, 25.09.2014



OVERALL SITE PLAN

Scale 1:1000

AECOM

PROJECT

WASTEWATER TREATMENT UPGRADE PROJECT

CLIENT

TOWN OF EDSON
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CONSULTANT

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REGISTRATION

PRELIMINARY
NOT FOR CONSTRUCTION
Date: 25.09.2014

ISSUE/REVISION

I/R	DATE	DESCRIPTION
A	25.09.2014	FUNCTIONAL DESIGN BRIEF

KEY PLAN

PROJECT NUMBER

60330572

SHEET TITLE

GENERAL
OVERALL SITE PLAN
-

SHEET NUMBER

G-1001

VALVE SYMBOLS

TYPE	ABBREVIATION
BALL VALVE (N.O.)	BV
BALL VALVE (N.C.)	BV
CHECK VALVE	CV
BUTTERFLY VALVE	BFV
PLUG VALVE (N.O.)	PV
PLUG VALVE (N.C.)	PV
GATE VALVE (N.O.)	GV
GATE VALVE (N.C.)	GV
BALL CHECK VALVE	BCV
KNIFE GATE VALVE	KV
NEEDLE VALVE	NV
GLOBE VALVE	GLV
BACKFLOW PREVENTER	BFP
BALANCING DAMPER	BD
DOUBLE LEAF CHECK VALVE	CV
DUCKBILL CHECK VALVE	DCV
PINCH VALVE	PNV
TELESCOPIC VALVE	TSV
DIAPHRAGM VALVE	DV
MUD VALVE	MDV
FLOAT VALVE	FV

TYPE	ABBREVIATION
PRESSURE REGULATOR EXTERNAL PRESSURE TAP	PRV
PRESSURE REGULATOR SELF CONTAINED	PRV
BACK PRESSURE REGULATOR EXTERNAL PRESSURE TAP	BPV
BACK PRESSURE REGULATOR SELF CONTAINED	BPV
THERMAL SHUT OFF VALVE	TOV
PRESSURE RELIEF VALVE	PRV
VACUUM RELIEF VALVE	PRV
PRESSURE & VACUUM RELIEF VALVE	PRV
PRESSURE RELIEF VALVE (RUPTURE DISC)	RD
VACUUM RELIEF VALVE (RUPTURE DISC)	RD
THREE-WAY VALVE	3W
FOUR-WAY VALVE	4W
ANGLE VALVE	AV

ACTUATORS

- DIAPHRAGM, PRESSURE
- DIAPHRAGM, SPRING
- DIGITAL
- MOTORIZED
- PISTON
- SOLENOID

PROCESS LINE TYPES

- MAJOR PROCESS LINE
- MINOR PROCESS LINE
- NEW STRUCTURE
- ENCLOSURE OR BOUNDARY
- VENDOR PACKAGE SUPPLY BOUNDARY
- EXISTING PIPING & EQUIPMENT
- EXISTING STRUCTURE
- INSULATED PIPE (WITH HEAT TRACING)
- FUTURE PROCESS LINE
- EXISTING ITEMS TO BE REMOVED

GATE SYMBOLS

TYPE	ABBREVIATION
FLAP GATE	FLG
LEVEL CONTROL GATE	LCG
SLIDE GATE	SG
SLUICE GATE	SLG
STOP LOG	SL
WEIR GATE	WG

STANDARD ABBREVIATIONS

EQUIPMENT ABBREVIATIONS

AC	AIR COMPRESSOR
AD	AIR DRYER
AER	SURFACE AERATOR
AF	AIR FILTER
AFC	AFTERCOOLER
AR	AIR RECEIVER
AST	AIR STRIPPER
AWH	AIR WASH
B	BOILER
BA	BIN ACTIVATOR
BPS	BELT FILTER PRESS
BIF	BIOFILTER
BL	BLOWER
BR	BRUSH
BRM	BARMINUTOR
CBA	COMPOST BAY
CBD	COARSE BUBBLE DIFFUSER
CDR	PRIMARY CLARIFIER DRIVE
CFG	CENTRIFUGE
CFL	CUT THROAT FLUME
CGS	CHLORINE GAS SCRUBBER
CH	CHILLER
CHF	CHEMICAL FEEDER
CHL	CHLORINATOR
CMM	COMMINUTOR
CMP	COMPACTOR
COL	COLLECTOR
CON	CONVEYOR
COV	COVER
CP	COMPRESSOR
CPW	CIPOLETTI WEIR
CRN	CRANE OR HOIST
CY	CYCLONE
CYL	CYLINDER
DAF	DISSOLVED AIR FLOTATION THICKENER EQUIPMENT
DDR	DAF DRIVE
DIF	DIFFUSER
DR	DRIVE
DST	ROTARY DISTRIBUTOR
DWS	DEWATERING SCREW
EF	EXHAUST FAN
EV	EVAPORATOR
EXT	EXPANSION TANK
FAR	FLAME ARRESTER
FBD	FINE BUBBLE DIFFUSER
FCH	FLAME CHECK
FCV	FLOW CONTROL VALVE (MODULATING)
FDR	FERMENTER DRIVE
FIS	FILTER SEPARATOR
FLC	FLOCCULATOR
FLG	FLAP GATE
FLT	FILTER
FOS	FOAM SEPARATOR
FV	FLOW CONTROL VALVE (OPEN/CLOSE)
GBT	GRAVITY BELT THICKENER
GCL	GRIT CLASSIFIER
GDR	GRINDER
HPG	HAND PULL GATE
HSS	HAULED SEPTAGE SCREEN
HV	HAND VALVE
INC	INCINERATOR
INJ	CHEMICAL INJECTOR
LAG	LAGOON
LCG	LEVEL CONTROL GATE
LCP	LOCAL CONTROL PANEL
LG	LEVEL SIGHT GLASS OR CALIBRATION COLUMN
LCV	LEVEL CONTROL VALVE (MODULATING)
LGR	LINEAR GRILLE
LV	LEVEL CONTROL VALVE (OPEN/CLOSE)
MB	MEMBRANE
MCP	MASTER CONTROL PANEL
MLW	MIXED LIQUOR WASTING CHAMBER
MWA	MICROWAVE ANALYZER
MXR	MIXER
ODU	OZONE DESTRUCT UNIT
P	PUMP
PBF	PALMER BOWLES FLUME
PBP	PERFORATED BAFFLE PLATE
PCN	PARTICLE COUNTER
PDC	POWER DISTRIBUTION CENTRE
PFL	PARSHALL FLUME
PLT	PELLETIZER
PSE	PLATE SETTLER
PSU	POWER SUPPLY UNIT
PT	PRESSURE TANK
PTO	POWER TAKE OFF/REDUCER
RBC	ROTATING BIOLOGICAL CONTACTOR
RCO	RESIDUAL COLLECTOR
RDT	ROTARY DRUM THICKENER
RM	ROTAMETER
SCB	SCRUBBER
SCM	SCUM COLLECTION MECHANISM
SCR	SCREENING EQUIPMENT
SCW	SCUM WEIR (ROTATING)
SDR	SECONDARY CLARIFIER DRIVE
SEP	SEPARATOR
SG	SLIDE GATE
SL	STOP LOG
SLC	SLUDGE COLLECTOR
SLG	SLUICE GATE
SM	STATIC MIXER
SMP	SAMPLER
SOL	SOLENOID ACTUATOR
SSK	SLUDGE SKIMMER
SRC	SURGE CHAMBER
T	TANK
TB	TURBIDITY METER
TCP	TEMPERATURE CONTROL PANEL
UV	ULTRA VIOLET LAMP BANK
V	VALVE
VAP	VAPORIZER
VDR	VORTEX DRIVE
VFD	VARIABLE FREQUENCY DRIVE
VNT	VENT EQUIPMENT
VSD	VARIABLE SPEED DRIVE
W	WEIR
WG	WEIR GATE

COMMODITY ABBREVIATIONS

AHP	AIR (HIGH PRESSURE)
AIR	AIR
ASH	ASH
AWH	AIR WASH
BCA	BURNER COMBUSTION AIR
BG	BIOGAS
BIS	BIOSOLIDS
BW	BACKWASH WATER (FILTERED)
BWR	BACKWASH RETURN
BWW	BACKWASH WASTE WATER
CA	COMPRESSED AIR (SERVICE)
CDW	WATER (CONDENSATE)
CEN	CENTRATE
CFE	CHLORINATED FINAL EFFLUENT
CLD	CLARIFIER BLOWDOWN
CPA	COMPOST PROCESS AIR
DCL	DECANT
DEWS	WET DEWATERED SLUDGE
DFE	DECHLORINATED FINAL EFFLUENT
DGC	CIRCULATED SLUDGE GAS
DGF	SLUDGE GAS FUEL
DGH	SLUDGE GAS (HIGH PRESSURE)
DRA	DRAIN
DS	DIGESTED SLUDGE
DSB	DAF SUBNATANT
DSE	DISINFECTED SECONDARY EFFLUENT
FCH	FLAME CHECK
FE	FINAL EFFLUENT
FLI	FILTER INFLUENT
FLW	FLOCCULATION BASIN EFFLUENT
FOA	FOUL AIR
FSL	FERMENTED SLUDGE
FSU	FERMENTER SUPERNATANT
FTW	FILTER TO WASTE
FLT	FILTRATE
FY	FERMENTER SCUM
GAC	ACTIVATED CARBON (GRANULAR)
GACL	ACTIVATED CARBON (SOLUTION)
GACS	RECARBONATION SLUDGE
GR	GRIT
GRS	GREASE
GTS	GRAVITY THICKENED SLUDGE
HF	HYDRAULIC FLUID
HS	HAULED SEPTAGE
HSC	HAULED SEPTAGE SCREENINGS
HTS	HEAT TREATED SLUDGE
IA	INSTRUMENT AIR
INF	INFLUENT
ML	MIXED LIQUOR
MS	MIXED SLUDGE
NG	NATURAL GAS
NML	NITRIFIED MIXED LIQUOR
OF	OVERFLOW
PAC	ACTIVATED CARBON (SLURRY)
PDG	PURIFIED DIGESTER GAS
PE	PRIMARY EFFLUENT
PI	PRIMARY INFLUENT
PA	PROCESS AIR
PRO	PROPANE GAS
PS	PRIMARY SLUDGE
PY	PRIMARY SCUM
RA	RETURN AIR
RAS	RETURN ACTIVATED SLUDGE
REC	RECYCLE
RES	RESIDUAL
RSL	RECIRCULATED SLUDGE
RSS	RECIRCULATED SCRUBBER SOLUTION
RSSC	RAW SEWAGE SCREENING
SAM	SAMPLE
SAN	SANITARY SEWER
SBD	SCRUBBER BLOWDOWN
SCN	SCREENINGS
SCS	SCRUBBING SOLUTION
SD	SMOKE DAMPER
SE	SECONDARY CLARIFIER EFFLUENT
SLH	SETTLED HEATED SLUDGE
SPY	SCREENED PRIMARY SCUM
SRHS	RAW HAULED SEPTAGE
SRS	SCREENED RAW SEWAGE
SRSW	RAW SEWAGE
STE	STEAM
STW	STORM SEWER
SUB	SUBNATANT
SUP	SUPERNATANT
SVC	SCAVENGER VACUUM
SW	SEAL WATER
SY	SECONDARY CLARIFIER SCUM
TBS	THICKENER BOTTOM SLUDGE
TDS	THICKENED DIGESTED SLUDGE
TOF	THICKENER OVERFLOW
TPS	THICKENED PRIMARY SLUDGE
TR	THICKENER RECYCLE
TSL	THICKENER UNDERFLOW
TWAS	THICKENED WASTE ACTIVATED SLUDGE
UTA	UTILITY AIR
VAC	VACUUM
W1	POTABLE WATER
W2	POTABLE WATER (AFTER BACKFLOW PREVENTER)
W3	NON-POTABLE WATER (PROCESS EFFLUENT)
WAS	WASTE ACTIVATED SLUDGE
WNS	WASTE NITRIFIED SLUDGE
WW	WELL WATER

CHEMICAL ABBREVIATIONS

AAG	ANHYDROUS AMMONIA, GAS
AAL	ANHYDROUS AMMONIA, LIQUID
AAS	AMMONIUM HYDROXIDE SOLUTION
AAV	AMMONIA GAS (VACUUM)
ACE	ACETIC ACID
ACS	ACTIVATED SILICA
ACTL	ACETYLENE
ALS	ALUM SOLUTION
ALU	ALUM
ASH	ASH
BRS	BRINE SOLUTION
BRW	BRINE WASTE
CAO	LIME (QUICK LIME)
CAOH	LIME (HYDRATED)
CDG	CARBON DIOXIDE
CDL	CARBON DIOXIDE LIQUID
CI	SODIUM HEXAMETA PHOSPHATE
CLD	CHLORINE DIOXIDE
CLG	CHLORINE GAS (PRESSURE)
CLL	CHLORINE LIQUID
CLS	CHLORINE SOLUTION
CLV	CHLORINE GAS (VACUUM)
CS	CAUSTIC SODA
CSS	DILUTE CAUSTIC SODA
CUS	COPPER SULFATE
FC	FERRIC CHLORIDE
FCPL	FERRIC CHLORIDE PICKLE LIQUOR
FEC	FERROUS CHLORIDE
FES	FERROUS SULPHATE
FS	FERRIC SULFATE
FSL	FERMENTER SLUDGE
GOX	GASEOUS OXYGEN
HCL	HYDROCHLORIC ACID
HEL	HELIUM
HFS	FLUOSILIC ACID
HG	HYDROGEN GAS
HL	HYDROGEN LIQUID
HP	HYDROGEN PEROXIDE
LM	LIME (DRY)
LMS	LIME SLUDGE
LOX	LIQUID OXYGEN
LS	LIME SLAKER
MET	METHANOL
N2	NITROGEN
NAOH	SODIUM HYDROXIDE
NASF	SODIUM SILICOFLUORIDE
NOX	NITROUS OXIDE
OIA	OZONE IN AIR
OIO	OZONE IN OXYGEN
OW	OZONATED WATER
PHA	PHOSPHORIC ACID
PACL	POLYALUMINUM CHLORIDE
PLY	POLYMER
PP	POTASSIUM PERMANGANATE
PPP	PHOSPHATE
PYPH	POLYPHOSPHATE
SA	SULPHURIC ACID
SAS	SODA ASH SOLUTION
SBC	SODIUM BICARBONATE
SBS	SODIUM BISULFITE
SC	SODA ASH
SDG	SULFUR DIOXIDE GAS (PRESSURE)
SDL	SULFUR DIOXIDE LIQUID
SDS	SULFUR DIOXIDE SOLUTION
SDV	SULFUR DIOXIDE GAS (VACUUM)
SH	SODIUM HYPOCHLORITE
SHS	SODIUM HYPOCHLORITE SOLUTION
SLT	SODIUM CHLORIDE
SS	SODIUM SILICATE
VAC	VACUUM

EQUIPMENT SYMBOLS

MOTORIZED EQUIPMENT

TYPE	ABBREVIATION
AERATOR (SURFACE)	AER
AIR DRYER BLOWER EXHAUST FAN	AD BL EF
CENTRIFUGE	CFG
CHILLER	CH
COMPRESSOR	CP
CONVEYOR (BELT)	CON
CONVEYOR (SCREW)	CON
GRINDER	GDR
GRIT CLASSIFIER	GCL
MIXER (PROPELLER)	MXR
SCREEN (BAR)	SCR
SCREENINGS WASHER / COMPACTOR	CMP
SLUDGE SKIMMER DAF DRIVE	SSK DDR

NON-MOTORIZED EQUIPMENT

TYPE	ABBREVIATION
CYCLONE	CY
CUT THROAT FLUME PALMER BOWLES FLUME PARSHALL FLUME	CFL PBF PFL
HEAT EXCHANGER	HEX
SAMPLER (AUTOMATIC)	SMP
SAMPLER (MANUAL)	SMP
MIXER (STATIC)	SM
MOTOR	-

PUMPS

TYPE	ABBREVIATION
CENTRIFUGAL PUMP	P
DIAPHRAGM PUMP	P
GEAR PUMP	P
METERING PUMP	P
PLUNGER PUMP	P
PROGRESSING CAVITY PUMP	P
ROTARY LOBE PUMP	P
SUBMERSIBLE PUMP	P
SUBMERSIBLE PROPELLER PUMP	P
VERTICAL PUMP	P

PIPE LINE DEVICES

- AIR GAP
- AIR INTAKE
- BLIND FLANGE OR FLANGE CONNECTION
- CALIBRATION CHAMBER
- CAP OR PLUG
- CONNECTION TO VENDOR SUPPLY PACKAGE
- DIFFUSER OR SPRAY NOZZLE
- DRAIN
- EXPANSION JOINT
- EMERGENCY EYEWASH & SHOWER STATION
- FILTER
- FLEXIBLE CONNECTION
- HOSE REEL
- PRESSURE SENSOR (IN-LINE)
- PULSATION DAMPENER
- REDUCER
- SEPARATOR, AIR
- SIGHT GLASS
- SILENCER
- SPECTACLE BLIND
- STRAINER
- STRAINER, BASKET
- TRAP
- UNION
- UTILITY CONNECTION (XX)
- UTILITY STATION
- VENT, AIR
- VENTURI
- QUICK CONNECTOR

ANNOTATION SYMBOLS

PIPE IDENTIFICATION

999 - NNN - MMM
NOMINAL DIAMETER
PIPE MATERIAL
COMMODITY

CHANNEL / CHUTE IDENTIFICATION

999 - NNN
COMMODITY
CHANNEL OR CHUTE SIZE WIDTH x HEIGHT (mm)

EQUIPMENT & VALVE IDENTIFICATION

MOTORIZED EQUIPMENT

EQUIPMENT ABBREVIATION
NN
99 - 999
EQUIPMENT NUMBER
PROCESS AREA

NON-MOTORIZED EQUIPMENT / VALVES

EQUIPMENT / VALVE ABBREVIATION
NN - 99 - 999
EQUIPMENT NUMBER
PROCESS AREA

PROCESS LINE IDENTIFICATION

FLOW: LEFT TO RIGHT

REFERENCE NUMBER
COMMODITY
COMMODITY
A 99-N-9999
TO / FROM
REFERENCE DRAWING
SOURCE OR DESTINATION

FLOW: BOTH DIRECTIONS

REFERENCE NUMBER
COMMODITY
COMMODITY
A 99-N-9999
TO / FROM
REFERENCE DRAWING
SOURCE OR DESTINATION

FLOW: RIGHT TO LEFT

REFERENCE NUMBER
COMMODITY
COMMODITY
99-N-9999 A
TO / FROM
SOURCE OR DESTINATION
REFERENCE DRAWING

AECOM

PROJECT
WASTEWATER TREATMENT UPGRADE PROJECT

CLIENT
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REGISTRATION

PRELIMINARY
NOT FOR CONSTRUCTION
Date: 25.09.2014

ISSUE/REVISION

I/R	DATE	DESCRIPTION
A	25.09.2014	FUNCTIONAL DESIGN BRIEF

KEY PLAN

PROJECT NUMBER
60330572

SHEET TITLE
PROCESS MECHANICAL LEGEND & ABBREVIATIONS
-

SHEET NUMBER
D-0001

ANSI D 864mm x 559mm
Approved: ____ Checked: ____ Designer: ____ Project Management Initials: ____
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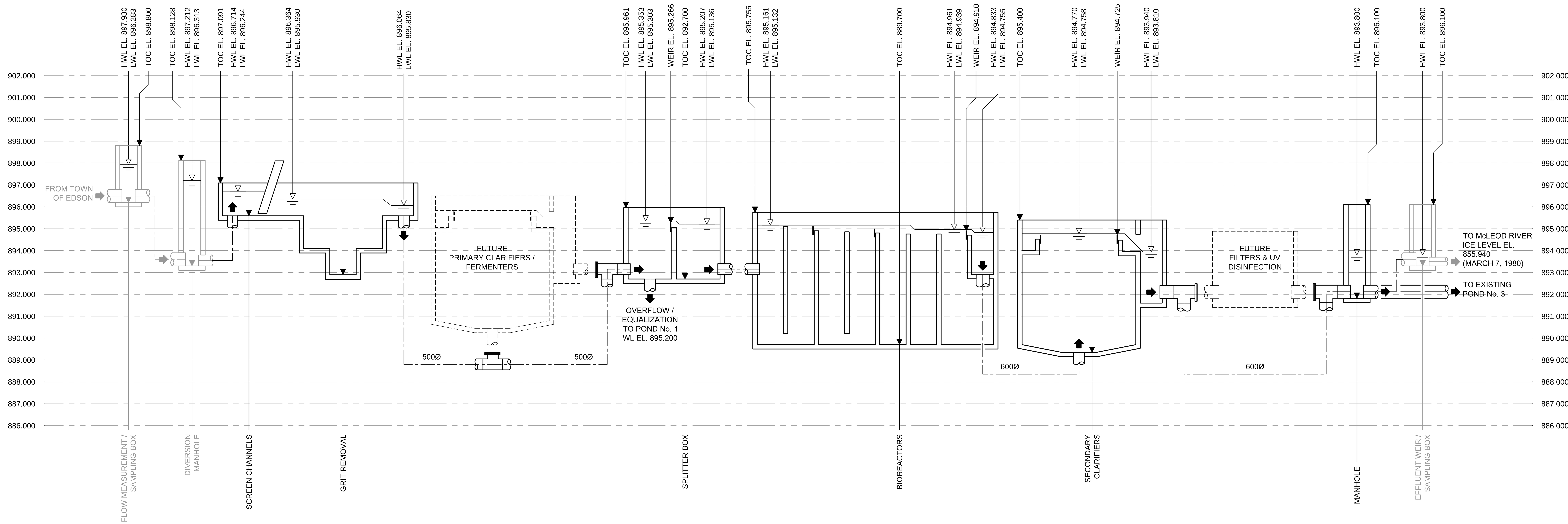

NOTE:

HWL, Q = 24.3 MLD
LWL, Q = 5.52 MLD

AECOM

PROJECT

WASTEWATER TREATMENT UPGRADE PROJECT

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KEY PLAN

PROJECT NUMBER

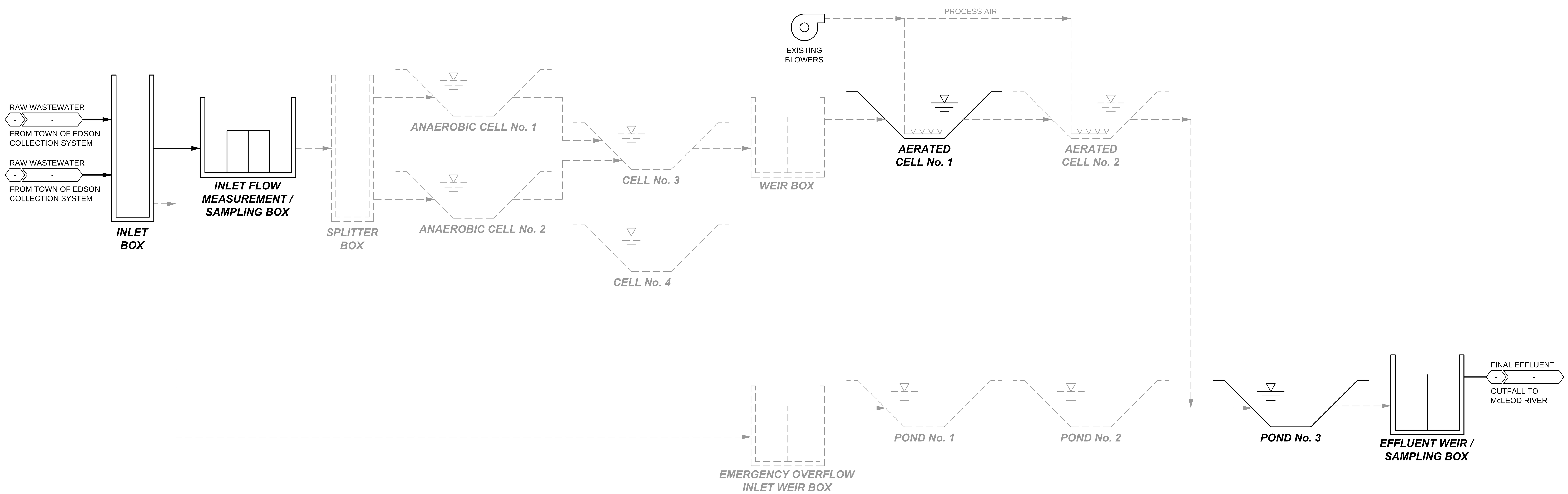
60330572

SHEET TITLE

PROCESS MECHANICAL HYDRAULIC PROFILE
-

SHEET NUMBER

D-0002



LEGEND

EXISTING TO REMAIN

EXISTING TO BE ABANDONED / DECOMMISSIONED

AECOM

PROJECT

WASTEWATER TREATMENT UPGRADE PROJECT

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KEY PLAN

PROJECT NUMBER

60330572

SHEET TITLE

PROCESS MECHANICAL
EXISTING PROCESS FLOW DIAGRAM
-

SHEET NUMBER

D-0003

ANSI D 864mm x 559mm
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Project Management Initials:

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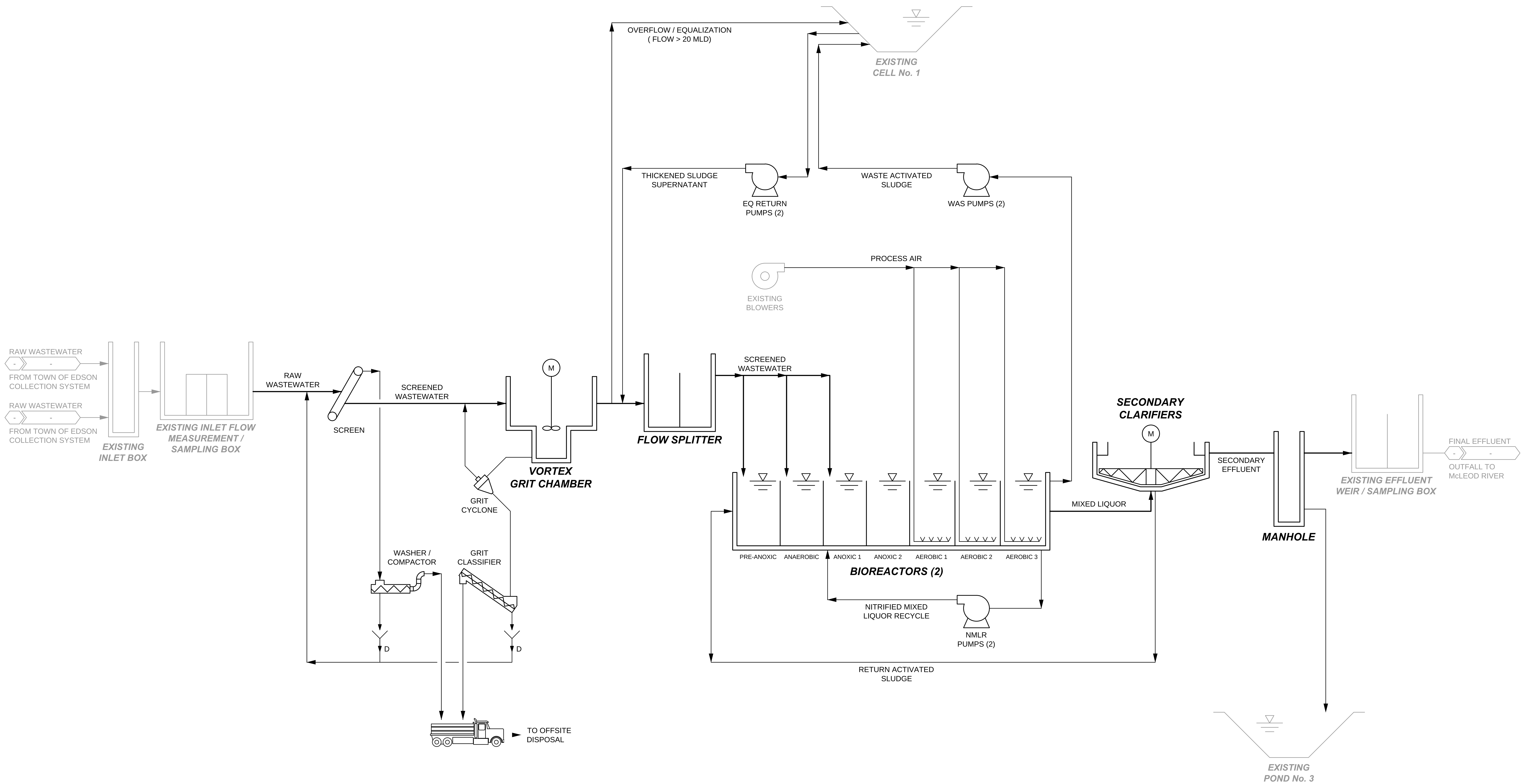

LEGEND

PROPOSED

EXISTING

AECOM

PROJECT

WASTEWATER TREATMENT UPGRADE PROJECT

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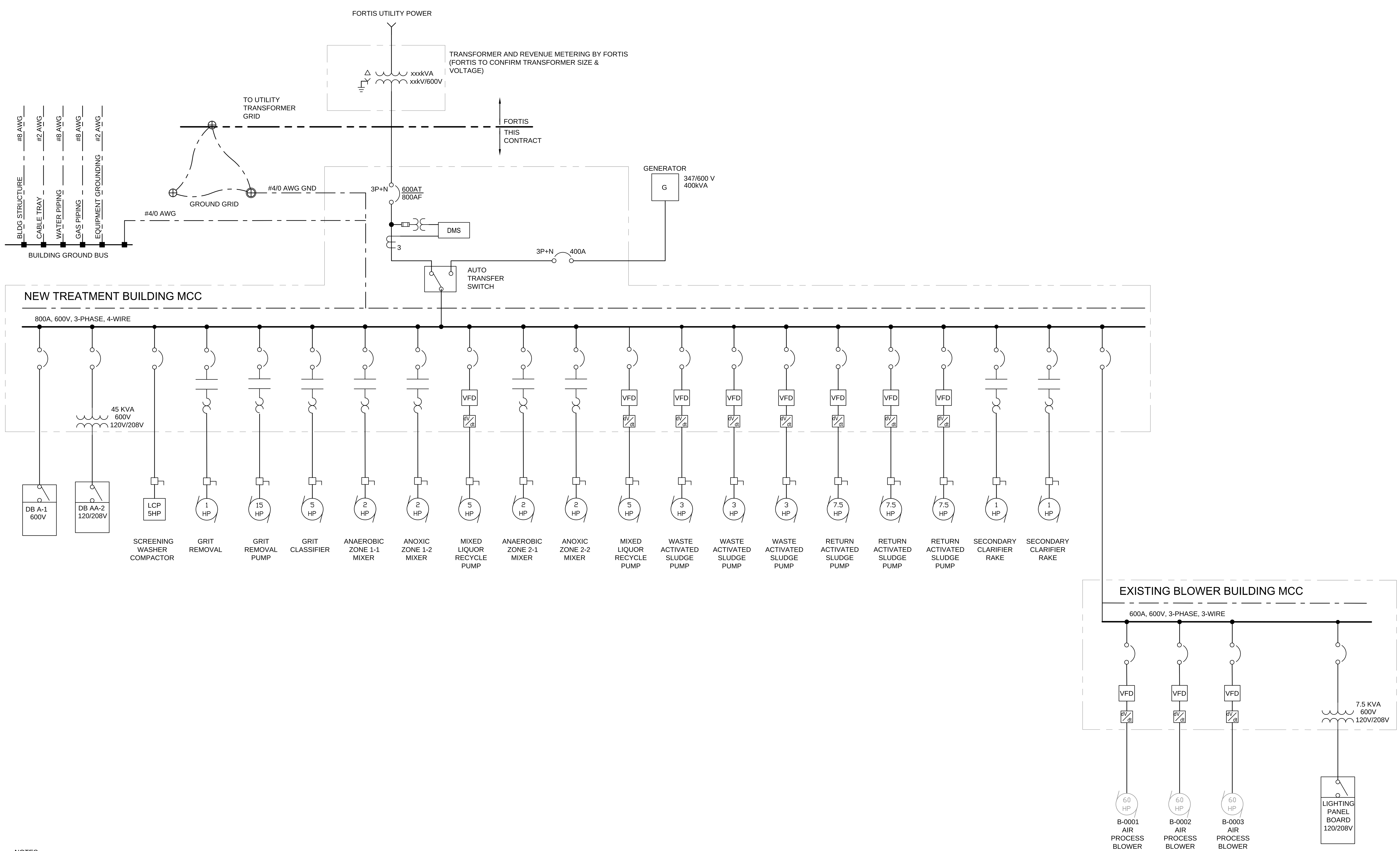
60330572

SHEET TITLE

PROCESS MECHANICAL
PROCESS FLOW DIAGRAM
-

SHEET NUMBER

D-0004



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. ELECTRICAL DRAWINGS ARE DIAGRAMMATIC AND SYMBOLS SHOWN ARE NOT TO SCALE. LOCATION SHOWN REFLECT THE DESIGN INTENT AND MUST BE COORDINATED WITH ALL OTHER TRADES.
3. AUTO TRANSFER SWITCH SIGNAL HARDWIRED TO PLC.
4. LOCAL CONTROL PANELS (LCP) TO HAVE LOCAL ISOLATION

AECOM

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KEY PLAN

PROJECT NUMBER

60330572

SHEET TITLE

ELECTRICAL SINGLE LINE DIAGRAM
-

SHEET NUMBER

E-0001

Project Management Initials: Designer: Checked: Approved: ANSI D 864mm x 559mm

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