Engineering Ltd.

Final Report for:

English River Property Management

Wastewater Treatment Facility

Design Basis Memorandum

Date: December 4, 2020
7603-002-00

English River PROPERTY MANAGEMENT

Proud of our Past... Building the Future

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December 4, 2020
File: 7603-002-00\R04

Attention: Jeff Balon, P. Eng., M.Eng.
Manager, Land Development

Dear Mr. Balon:

Re: Design Basis Memorandum Report (Final) – Wastewater Treatment Facility

We are pleased to submit three (3) copies of the above noted report. We thank you for the opportunity to be of service and to have prepared this report on your behalf. We look forward to assisting you in implementing your plans for the future. If you have any inquiries regarding our report or if clarification is required, please contact the undersigned at (306) 715-5609 or jstusick@mpe.ca.

Yours truly,

MPE ENGINEERING LTD.

M. Jason Stusick, P.Eng.
Project Manager

JS: ik

Enclosure

CORPORATE AUTHORIZATION

This report has been prepared by MPE Engineering Ltd. under authorization of English River Property Management. The material in this report represents the best judgment of MPE Engineering Ltd. given the available information. Any use that a third party makes of this report, or reliance on or decisions made based upon it is the responsibilities of the third party. MPE Engineering Ltd. accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions taken based upon this report.

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Association of Professional Engineers & Geoscientists of Saskatchewan
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Ivan Kagoro, P.Eng.
Project Engineer

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List of Acronyms	
ADF	Average daily flow
AEP	Alberta Environment and Parks
BOD_5	Biochemical oxygen demand (5 day)
CFA	Continuous flight auger
CIP	Cast in place
CWWF	Clean Water and Wastewater Fund
EPEA	Environmental Protection and Enhancement Act
HVAC	Heating, ventilation, and air conditioning
IEC	Illuminating Engineers Society
LSD	Limit state design
MCC	Motor control center
MLSS	Mixed liquor suspended solids
MMF	Maximum monthly flow
PCC	Pollution Control Centre
PHF	Peak hourly flow
RAS	Return activated sludge
RWWTF	Regional Wastewater Treatment Facility
SCADA	Supervisory control and data acquisition
SIP	Structural insulated panels
TAC	Transportation Association of Canada
TDH	Total dynamic head
TKN	Total Kjeldahl Nitrogen
TSS	Total suspended solids
VFD	Variable frequency drive
VNC	Virtual network computing
WAS	Waste activated sludge
WSER	Wastewater Systems Effluent Regulations
WWTF	Wastewater treatment facility

1.0 Introduction

1.1 Project Overview

English River Property Management (ERPM) has retained MPE Engineering Ltd. (MPE) to complete the detailed design of English River's Wastewater Treatment Facility (WWTF) that will meet the capacity and treated effluent requirements for the proposed light industrial and commercial development. The primary objectives are as follows:

- Provide treatment capacity that is sufficient for wastewater from the industrial and commercial ERPM development.
- Ensure treatment processes incorporated into the facility allow ERPM to meet the treated effluent limits as determined by the Soils Suitability Study and Downstream Uses Impact Study (DUIS).

1.2 Background

ERPM completed a feasibility study in June 2019 for the proposed WWTF. The facility will serve the treatment and disposal needs for the proposed industrial and commercial development within the Grasswood Reserve. Membrane Bioreactor (MBR) wastewater treatment is the preferred choice of technology elected by ERPM, with the intent of producing high quality treated effluent for initial disposal via irrigation. The MBR system was also chosen so that a variance to the setback limits for the facility can be applied to allow its location within the development.

1.3 Objectives

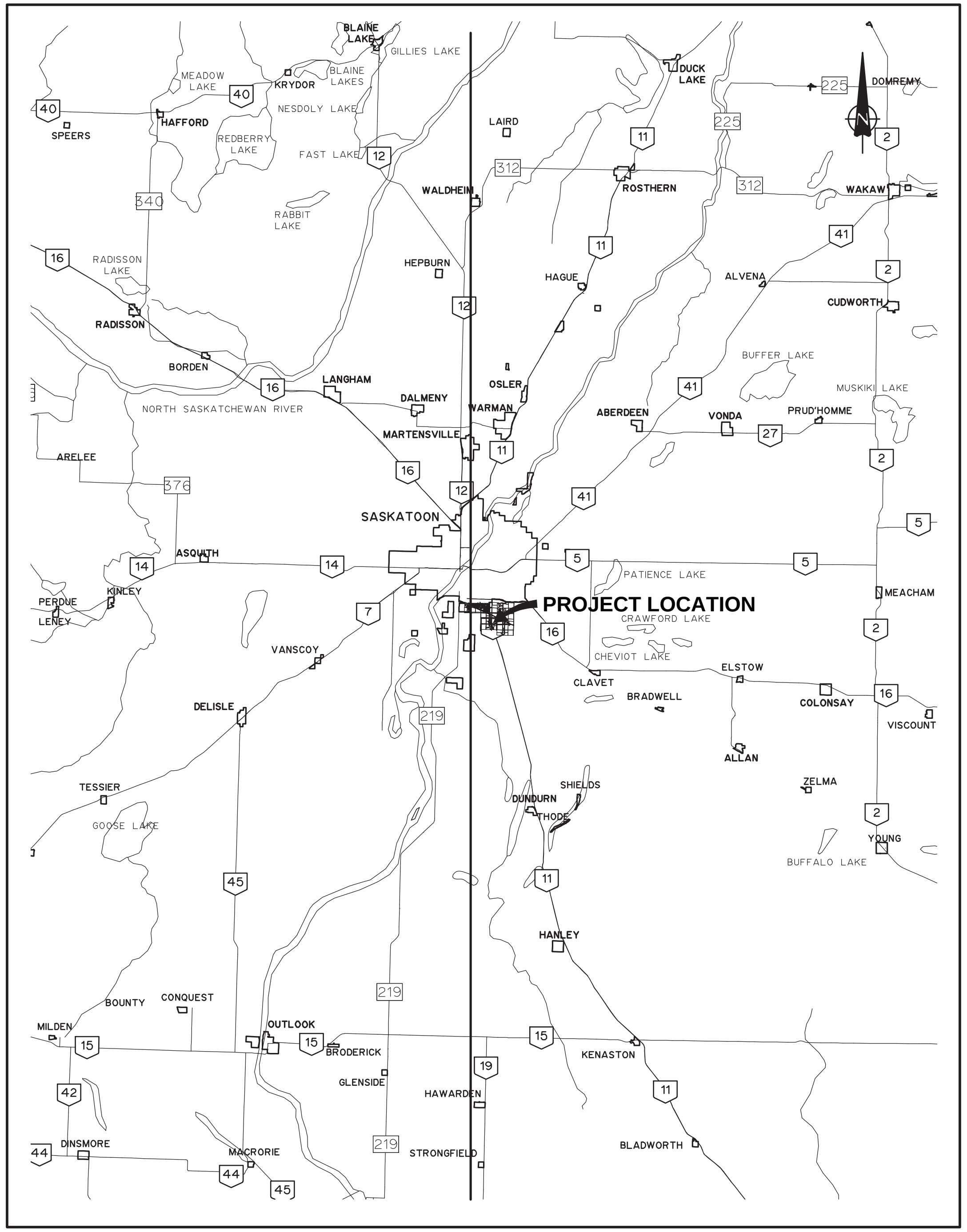
The intent of this report is to present a refined set of design criteria for the process and equipment proposed to implement the MBR WWTF. Specifically, the memorandum's objectives are as follows:

- Review of the design concepts from the previous report and update.
- Review flow data and wastewater generation rates from the previous report and update.
- Develop wastewater characteristics expected from the ERPM development.
- Review recommendations from the previous report.
- Review of Design Criteria.
- Complete mass balance calculations for the liquid and solids streams from the WWTF.
- Develop the hydraulic profile throughout the entire treatment facility.
- Review major process equipment selection and develop specifications for major process equipment.
- Review process mechanical design criteria and complete the system design.
- Review civil and site works design criteria and complete the system design.
- Review architectural and structural design criteria and complete the system design.
- Review mechanical HVAC design criteria and complete the system design.
- Review electrical design criteria and complete the system design.
- Review controls strategies and complete the system design.
- Review constructability issues and Contract approach.
- Review regulatory approval and permit requirements.

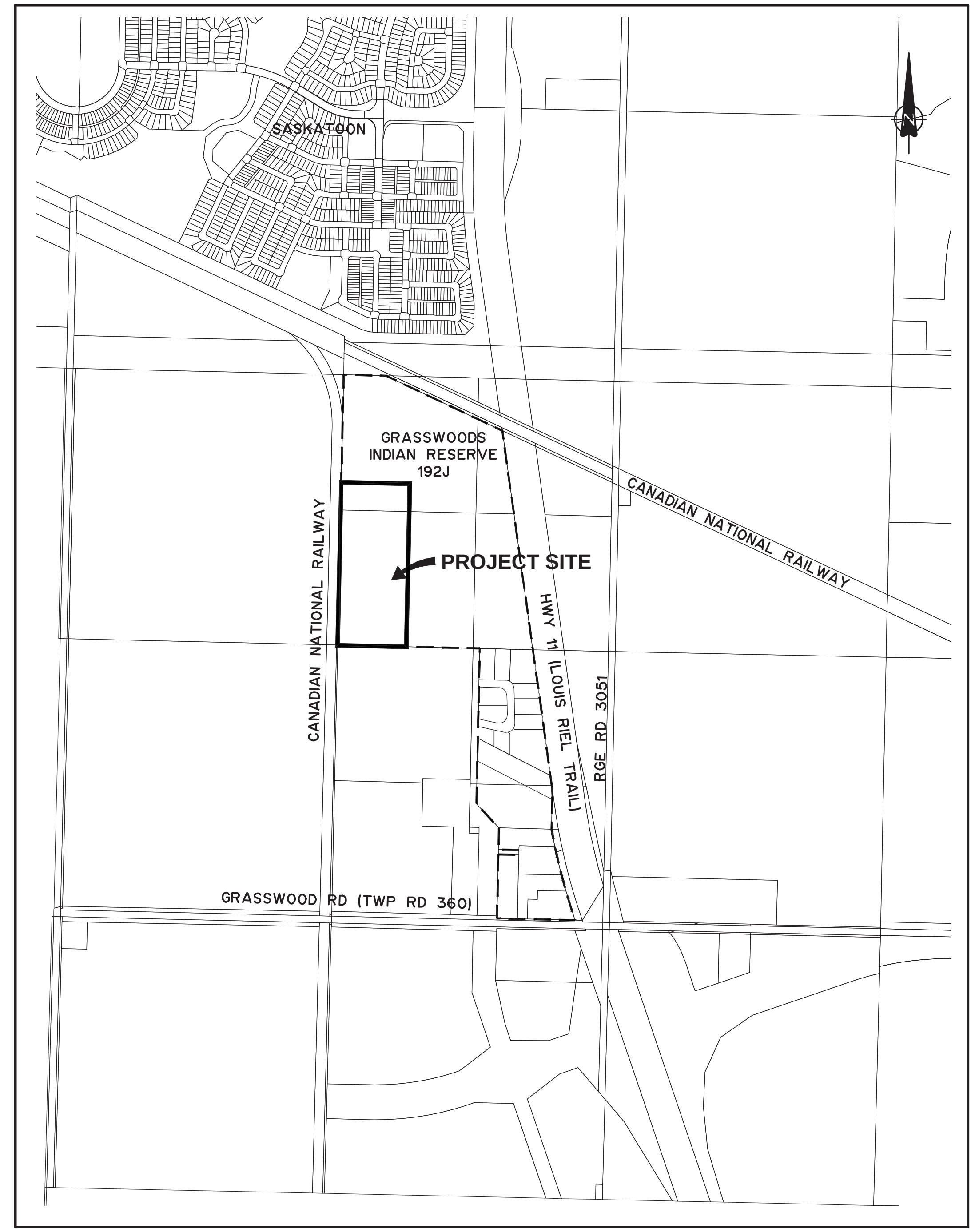
1.4 Location

ERPM's development is situated immediately south of the City of Saskatoon. The proposed MBR WWTF will be located within the setback limits identified in LSD10-02-36-05-3 EXT61.

Figure 1.1 illustrates the location of the proposed ERMP MBR facility.



LOCATION PLAN
1:1000000



SITE PLAN
1:10000

THIS DRAWING MAY HAVE BEEN MODIFIED FROM ITS ORIGINAL SIZE. ALL SCALE NOTATIONS INDICATED ARE BASED ON 11"x17" FORMAT DRAWINGS

ISSUE	YY-MM-DD	REVISION
1	20-05-29	FOR REPORT

MPE Engineering Ltd.

ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
LOCATION PLAN AND SITE PLAN

DESIGNED	I.K.	JOB	7603-001-00
DRAWN	J.P.	SCALE	AS SHOWN
DATE	DECEMBER 2019	FIGURE	1.1

2.0 Historical Data Review

2.1 Review of Available Information

2.1.1 Data Collection

ERPM has not historically collected data on sewage flows from any of the existing developments; therefore, sewage flows have been determined based on the expected development and usage, as well as corresponding typical wastewater flows.

2.1.2 Plans, Reports, & Manuals

The following data, plans, reports, and manuals were compiled and reviewed to complete this report:

- Effluent Disposal Strategy $ Downstream Use and Impact Study; MPE; November 2020
- Grasswood Development – Wastewater Treatment and Disposal Feasibility; June 2019
- Agricultural Feasibility Report for Irrigation; CanNorth; December 2019
- English River First Nation MBR Firm Proposal; SUEZ; May 31, 2020
- Issued for Approval Drawings; Urban Systems: January 2019
- Grasswood Reserve Development Project Conceptual Servicing Plan; Urban Systems: January 2019
- English River First Nation Geotechnical Investigation; Clifton Associates; July 2016
- English River First Nation Servicing Study; Clifton Associates; 2016
- English River Property Management Hydrogeological Investigation; Clifton Associates; 2016
- English River First Nation Stormwater Report; Clifton Associates; 2016
- English River First Nation S; Clifton Associates; 2016

2.2 Wastewater Flow Projections

2.2.1 Historic Water Demands

Historical wastewater inflows for the English River study area were outlined in the January 2019 Conceptual Servicing. These historical records are based on a 20-month (Feb. 2017 to Nov. 2018) record of water consumption by three existing buildings located on the south end of the study area. The following table summarizes the daily water usage from each building and the corresponding water demand per square area of the building.

Table 2.1: Historical Water Demand

Existing Building	Area	Building Current Usage	Water Demand	
			Daily Usage	Demand per Area
	m^2		m^3/d	$L/m^2/d$
100 Block	2146	Offices, Convience Store, Subway Restaurant	5.04	**2.35**
200 Block	1217	Offices	1.17	**0.96**
300 Block	3551	Offices	1.02	**0.29**

Water demand between these three buildings is dependant on the building use and the demand values per floor area. Without detailed recent historical flows and an anticipated usage of future commercial and industrial development, the values presented here will be a guide for current and future development.

2.2.2 Forecast Wastewater Flows

Previous reports completed by Clifton Associates and Urban Systems extensively reviewed projected flows for the English River First Nation development area. MPE has completed our own preliminary review of the expected wastewater flows from the study area and the findings are presented below.

Average Dry Weather Flow (ADWF)

Average dry weather flows (ADWF) were calculated based on the following assumptions. Note that the most conservative approach was taken while still ensuring ERPM's concerns, discussions, and decisions from previous reports were maintained or addressed.

1. Phase 1: This phase is comprised of existing and proposed developments.
    a. Water demand rate per square meter of floor area for Block 100 and 200 were maintained for this building's wastewater production rates to keep consistent with previous reports that outline discussions with ERPM.
    b. Block 300 is identified in previous reports to be converted into a strip mall style building and the estimated wastewater generation to be similar to that of Block 100 at 2.35 $L/m^2/d$.
    c. Two additional office buildings are proposed; previous reports reviewed potential rates with the client and used 8 $L/m^2/d$ for these buildings which is consistent with the *City of Saskatoon Design & Development Standard Manual*. This was maintained for these buildings.
    d. A quick service restaurant is proposed for this phase. A rate similar to the *City of Saskatoon Design & Development Standard Manual* guidelines of 20 $L/m^2/d$ shall be used.
2. Phase 2: This phase consists of proposed building only. No existing development is noted.
    a. A sit-down restaurant is proposed for this phase. A rate similar to *City of Saskatoon Design & Development Standard Manual* guidelines of 20 $L/m^2/d$ for wastewater generation shall be used.
    b. A 12,000m^2 arena is proposed for this phase. Previous reports used a smaller common space of 2490 m^2 to derive appropriate wastewater flows. *City of Saskatoon Design & Development Standard Manual* guidelines for "Places of Assembly" of 24 $L/m^2/d$ was maintained for this report. It is noted that design of the Arena is ongoing and more precious wastewater flows can be determined. Once these are provided, they will be updated on here.
    c. Hotel wastewater flow generation is based on Water Security Agency (WSA) and Sewage Works Design Standards (EPB 503), which is 90 L/single bed/day. Each proposed room is assumed to have two (2) beds.
3. Phase 3 and Phase 4: proposed small lot industrial.
    a. Previous reports highlighted discussion and a decision to go with a reduced equivalent residential population of 50 ppl/ha of industrial land in these phases. In addition, the equivalent per capita wastewater flow of 290 Lpcd, similar to that of City of Saskatoon, was maintained.

Table 2.2 presents the assumptions presented previously and the total anticipated ADWF.

Table 2.2: Average Day Dry Weather Flow Calculations														
Location	Status	Development	Parameter						Average Day Dry Weather Flows				MBR Design ADWF	
			Gross Area	Equivalent P'pn		Floor Area		Beds	Rate			Flow	Stage 1 - Current	Stage 2 - Future
			(ha)	ppl/ha	ppl	ft^2	m^2	#	$L/m^2/d$	L/d/bed	Lpcd	m^3/d	m^3/d	m^3/d
Phase 1	Existing (Block 100)	Office, Convenience Store, Subway Restaurant	4.02				2146		2.35			5.04	5.04	5.04
	Existing (Block 200)	Office					1217		0.96			1.17	1.17	1.17
	Existing (Block 300)	Strip Mall Commercial					3551		2.35			8.34	8.34	8.34
	Proposed	Office Space				20,000	1,858		8			14.86	14.86	14.86
	Proposed	Office Space				40,000	3,716		8			29.73	29.73	29.73
	Proposed	Quick Service Restaurant				5,000	465		20			9.29	9.29	9.29
Phase 2	Proposed	Sit-Down Restaurant	4.02			4,500	418		20			8.36		8.36
	Proposed	Arena (office floor area only)				26,802	2,490		24			59.76		59.76
	Proposed	100 Room Hotel						200		90		18.00		18.00
Phase 3	Proposed	Small Lot Industrial	2.98	50	149						290	43.21	43.21	43.21
Phase 4	Proposed	Small Lot Industrial	2.9	50	145						290	42.05	42.05	42.05
											TOTAL	239.82	153.70	239.82

To check the validity of the above wastewater flow assumptions, the ERPM commercial and industrial ADWF wastewater flow guideline of 0.2 L/s/ha was applied to the gross areas of the above phases. The resultant ADWF was 240 m^3/day, which is similar to that determined in the above table.

Infiltration and Inflow (I/I)

An Infiltration rate of 0.08 L/s/ha was adopted in the MBR feasibility study and servicing plan and shall be adopted in this design. Inflows at manholes were not considered in this analysis, as it is assumed construction of these will ensure the manholes are not located in sag locations and will not be in roadways or storm water vicinities.

Table 2.3 presents the design infiltration and inflow rates expected from this development.

Table 2.3: Infiltration and Inflow						
Location	Status	Development	I / I		MBR Design I / I	
			Rate	Flow	Current	Future
			L/s/ha	m^3/d	m^3/d	m^3/d
Phase 1	Existing (Block 100)	Office, Convenience Store, Subway Restaurant	0.08	27.79	27.79	27.79
	Existing (Block 200)	Office				
	Existing (Block 300)	Strip Mall Commercial				
	Proposed	Office Space				
	Proposed	Office Space				
	Proposed	Quick Service Restaurant				
Phase 2	Proposed	Sit-Down Restaurant	0.08	27.79	-	27.79
	Proposed	Arena (office floor area only)				
	Proposed	100 Room Hotel				
Phase 3	Proposed	Small Lot Industrial	0.08	20.60	20.60	20.60
Phase 4	Proposed	Small Lot Industrial	0.08	20.04	20.04	20.04
			TOTAL	96.22	68.43	96.22

Peaking Factors

To account for diurnal fluctuations in wastewater flow, maximum daily flows are calculated based on the peaking factor formulas provided by WSA.

Table 2.4: Peaking Factor

Standard	Formular	Min.	Max.	Q (ADWF)			Peaking Factor (Pf)	
				Phase	m^3/d	L/s	Calc'd	Use
Water Security Agency	$Pf = 6.659 * Q^{-0.168}$	-	5	Current	154	1.8	6.0	5.0
				Future	240	2.8	5.6	5.0

The peaking factors derived are higher than the maximum requirement of five (5). A factor of 5 shall be adopted to determine the peak hourly flows for determining equalisation volumes.

Forecast Wastewater Flows

MBR treatment systems are typically designed to ensure they are able to treat the maximum month flow while still being able to hydraulically accept flows as high as the max day flows. The following was used to derive average day, max month, and max day.

- Average Day Flow: average of the average dry and average wet weather flows expected. ADWF would be expected to happen for most part of the year (7 to 8) months. However, the above approach is more conservative.
- Max Month Flow: a factor of 1.5 times the average day flow shall be adopted, which is a factor that is deemed reasonable for industrial wastewater flows.
- Max Day Flow: a factor of 2.0 times the average day flow shall be adopted, which is a factor that has typically been seen in domestic wastewater flows.

Table 2.5 summaries the design criteria for influent flows for the ERPM WWTF.

Table 2.5: ERPM WWTF Influent Design Flows

Paramenter	Avg Dry Weather Flow	Infiltration / Inflow	Avg Wet Weather Flow	Avg Day Flow	Max Month Flow	Max Day Flow	Peak Dry Weather Flow (PDWF)	Peak Hour Flow
	m^3/d	m^3/d	m^3/d	m^3/d	m^3/d	m^3/d	m^3/d	m^3/d
Peaking Factor	-	-	ADWF + I/I	(ADWF + AWWF)/2	1.5 x ADF	2.0 x ADF	5.0 x ADWF	PDWF + I/I
Initial/Current	154	68	222	188	282	376	769	837
Future MBR Expansion	240	96	336	288	432	576	1199	1295

The proposed WWTF processes and pumping systems will be required to meet the wide range of influent flow conditions listed in the above table.

2.3 Wastewater Characterization

2.3.1 Raw Wastewater Characteristics

The composition of wastewater constituents from commercial operations can vary widely depending on the function and activity of the establishment. It will be difficult to define operating conditions expected for the small lot industrial development planned for phases 3 and 4.

Wastewater from commercial and institutional establishments will mostly be a product of human consumption and can be assumed to be within the domestic wastewater ranges for composition.

The mixture of wastewater coming into the proposed MBR will be expected to be of high strength. Table 2.6 provides typical documented raw wastewater ranges retrieved from Metcalf and Eddy.

Table 2.6: Typical Composition of Raw Domestic Wastewater (Metcalf & Eddy)

Constituent	Unit	Concentration		
		Low	Medium	High
Total Solids (TS)	mg/L	537	806	1612
Total Disolved Solids (TDS)	mg/L	374	560	1121
Total Suspended Solids (TSS)	mg/L	130	195	389
Biological Oxygen Demand (BOD5)	mg/L	133	200	400
Total Organic Carbon (TOC)	mg/L	109	164	328
Chemical Oxygen Demand	mg/L	339	508	1016
Total Nitrogen (TN)	mg/L	23	35	69
Organic	mg/L	10	14	29
Free Ammonia	mg/L	14	20	41
Total Phosphorus (TP)	mg/L	3.7	5.6	11
Potassium	mg/L	11	16	32
Chlorides	mg/L	39	59	118
Sulfate	mg/L	24	36	72
Oil and Grease	mg/L	51	76	153
Volatile Organic Compounds (VOCs)	µg/L	< 100	100-400	>400
Total Coliform	mg/L	10^6-10^8	10^7-10^9	10^7-10^{10}
Fecal Coliform	mg/L	10^3-10^5	10^4-10^6	10^5-10^8

The medium and high concentrations presented in the above table shall be utilized as the basis for the design of the MBR treatment system.

Other parameters that are unknown shall be assumed as follows:

- Temperature: typical design temperatures used are the lowest temperatures expected during the winter months. A temperature of 9°C shall be used.
- Alkalinity: Alkalinity is important for biological nitrification processes and shall be assumed at 200 mg/L for this project. This value is typical for domestic wastewater and will be a good starting point. Provisions for alkalinity addition shall be included in the design.
- pH: pH for industrial and commercial wastewater can vary. Assumed at 7.0.
- Volatile Suspended Solids (VSS): the ratio of VSS/TSS is critical to the biological design process and shall be assumed to be 0.75, which is typical for wastewater.

3.0 Regulatory Requirements

3.1 General

The performance requirements of the proposed WWTF will be determined by regulatory standards established by the First Nations, Indian and Northern Affairs Canada (INAC), Environment Canada and Health Canada, as well as a review of other provincial and federal guidelines and standards. Regulatory performance requirements and established end-of-pipe limits are documented in the WWTF Downstream User's Impact Study (Environmental Risk Assessment), which is currently being completed by MPE Engineering Ltd. The following section reviews, confirms, and builds upon the regulatory requirements established during the conceptual design phase.

3.2 Regulatory Review

3.2.1 Standards and Guidelines

The following standards and guidelines will be used to develop the design criteria for the ERPM WWTF as a minimum:

- The Waterworks and Sewage Works Regulations, Water Security Agency, 2015
- The Environmental Management and Protection Act, Water Security Agency, 2010
- Sewage Works Design Standard (EPB 503), Water Security Agency, 2015 [Formerly EPB 203]
- Surface Water Quality Objectives (EPB 356), Water Security Agency, 2015
- Treated Municipal Irrigation Guidelines (EPB 235), Water Security Agency, 2014
- Fisheries Act, Fish and Fish Habitat Protection and Pollution Prevention SOR/2012-139, Department of Fisheries and Oceans, 2012
- Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment (CCME), 2007
- Guidance on the Site-Specific Application of Water Quality Guidelines in Canada, Canadian Council of Ministers of the Environment (CCME), 2003
- Wastewater Systems Guidelines for Design, Operating and Monitoring, Alberta Environment and Parks (AEP), Standards and Guidelines for Municipal Waterworks, 2013
- Wastewater Systems Standards for Performance and Design; Alberta Environment and Parks (AEP), 2013
- Environmental Quality Guidelines for Alberta Surface Waters; Alberta Environment and Parks (AEP), 2014
- Water Quality Based Effluent Limits Procedures Manual, Alberta Environmental Protection, 1995
- Emergency Response Plan for Wastewater Systems in First Nations Communities, Aboriginal Affairs and Northern Development Canada (AANDC), 2014
- Protocol for Centralised Wastewater Systems in First Nations Communities, Indian and Northern Affairs Canada (INAC), 2010

3.2.2 Protocol for Centralized Wastewater Systems in First Nations Communities

Standards for the design, construction, operation, maintenance, and monitoring of centralised wastewater treatment systems located in First Nation communities are provided in the Protocol for Centralised Wastewater Systems in First Nations Communities (Protocol). The proposed WWTF for ERPM will service a commercial development and will be governed by the requirements of the Protocol, as well as any other INAC policies. INAC is involved in the project and will provide guidance regarding the compliance with applicable requirements. As part of this study and in compliance with The Protocol, project implementation will meet or exceed the most stringent of the following:

- The Protocol's Requirements.
- Federal Requirements under the Canadian Environmental Protection Act, 1999.
- Federal requirements under the Fisheries Act.
- Provincial requirements (standards, regulations, codes, or guidelines).

At a minimum, the Protocol requires that the wastewater treatment level shall be secondary treatment and systems discharging to sensitive receiving waters shall be designed and operated to provide a minimum of tertiary – level treatment. The proposed MBR treatment system selected by ERPM conforms with these requirements for ultimate discharge of effluent to the South Saskatchewan River.

ERPM will be responsible for the MBR treatment system located in the LSD 10-02-36-5-3 Ext 61 and will operate under the conditions and requirements provided in the Protocol by the province. These requirements pertain to:

- Construction.
- Management and operation.
- System classification and operator requirements.
- Sampling and monitoring.
- Monitoring and reporting.
- Record keeping.
- reporting and consumer reporting.
- Inspection.
- Effluent quality limits.
- Residuals Management Requirements.

The proposed WWTF must be presented to INAC for their review and approval and will likely be classified as a Class III facility.

3.2.3 Government of Canada Regulatory Requirements

Federal wastewater effluent quality standards were enforced on January 1, 2015, under the Department of Fisheries and Oceans, Fisheries Act, Wastewater System Effluent Regulations (WSER). These regulations are a combination of discussions by CCME since 2009 and place stringent limits on carbonaceous biological oxygen demand (CBOD), total suspended solids (TSS), and un-ionized ammonia-nitrogen (NH_3-N), which are released by both intermittent and continuous discharging wastewater treatment systems.

Treatment systems that are regulated by WSER are required to produce effluent of the following quality:

a) CBOD: $\leq$ 25 mg/L
b) TSS: < 25 mg/L
c) Total residual chlorine: < 0.02 mg/L
d) Un-ionized Ammonia – N: < 1.25 mg/L @ 15 C

In addition to the effluent quality standards, the WSER includes requirements on toxicity, effluent monitoring, record keeping, and reporting. When designing a new system or upgrading an existing system, WSER requirements must be considered by the designer, as they are necessary to conduct a Downstream Use and Impact Study (DUIS). A DUIS is needed to evaluate the quality of the receiving water body prior to the detailed design of a new system; however, a study will not be required for the initial phase of development because effluent irrigation is being used for disposal. Future buildout of the development may then see effluent disposal by continuous discharge to the South

Saskatchewan River. At that point, a DUIS will be required. MPE is currently conducting a DUIS in parallel with the design of the MBR treatment system to ensure treatment limits for the future discharge point at the River are met.

3.2.4 Saskatchewan Regulations and Design Standards & Guidelines

As stipulated in Sewage Works Design Standard (EPB 503), the WSA and Saskatchewan Ministry of Environment have established acceptable secondary and tertiary treatment and disposal design standards, and these shall be used for reference during the detailed design of the ERPM facility.

Additionally, WSA legislations (i.e. *The Environmental Management and Protection Act, 2010*; *The Waterworks and Sewage Works Regulations, 2015*; and *EPB 356 Surface Water Quality Guidelines; WSA; 2015)* will be consulted when designing a wastewater treatment system.

3.2.5 Operators & Certification

Mechanical wastewater treatment facilities must be operated by or under the supervision of a certified operator. INAC stipulates that the certification requirements will match the requirements of the applicable provincial system. Saskatchewan's level of certification is dependent on a variety of factors, including the type of treatment and controls, monitoring responsibilities, discharge method, and the sensitivity of the receiving water body. The approval requires the ERPM WWTF be operated by a person with at least a Level II wastewater treatment certification.

3.3 Treated Effluent Disposal

3.3.1 Effluent Disposal Strategy and Downstream Use and Impact Study

MPE completed an assessment to determine the preferred discharge and disposal method for the future MBR treated effluent. The study also included a Downstream Use & Impact study (DUIS) section that assessed the potential downstream impact of the recommended disposal would have on the river and determine the assimilation capacity of the River.

The Study determined that the preferred disposal method was by discharge to the South Saskatchewan river. Work for this disposal method would include, but not be limited to the following.

- Construction of effluent pumping system as part of the WWTF project.
- Construction of a 6,800 m, 250 mm HDPE forcemain.
- Installation of a precast concrete transition manhole.
- Construction of a 1,400 m, 250 mm HDPE gravity line with corresponding manholes.
- Construction of an outlet structure to the River.

With regards to the Downstream Use & Impact review, the following conclusison were drawn.

- The South Saskatchewan River is a major waterbody in Western Canada with municipal, agricultural, and aquatic habitat uses. The River experiences consistent flow throughout the year and is largely regulated by outflows through Gardiner Dam.
- There is Significant assimilation capacity is available in the River to received the treated effluent.
- The proposed WWTF MBR treated effluent is expected to be of extremely high quality and exceed all applicable guidelines and regulations.
- The mixing zone will not contain acute concentrations of any parameter. Effluent plume will facilitate the majority of the mixing within 1.5 m, plume will be undetectable prior to reaching the COS WTP intake.
- The ERPM Grasswood Development will have a negligible impact on the River quality during worst-case

flow scenarios.

The Downstream Use and Impact Study (DUIS) was also required to determine the recommended "end-of-pipe" limits for ERPM's proposed WWTF as reviewed in the following section.

3.3.2 Recommended Effluent Limits

To establish end-of-pipe design criteria for the WWTF, it is recommended that the WWTF be capable of providing a high-quality effluent within the receiving waterbody guidelines where feasibly attainable. These guidelines are set by considering the, Department of Fisheries and Oceans, Fisheries Act, WSER Regulations, 2012, and Canadian Water Quality Guidelines for the Protection of Aquatic Life; CCME; 2004. End-of-pipe limits were recommended based on assessment of the receiving environment. The assimilation capacity of the River using 10% of the minimum regulated flows under a worst-case scenario and the required concentrations can be achieved using the advanced technology proposed for ERPM WWTF. Recommended limits to be applied to the WWTF have been recommended based on the capabilities of the technology as they will be significantly more stringent than the available assimilation capacity. Table 3.1 summarizes the recommended end-of-pipe limits for the WWTF.

Table 3.1 - Recommended End-of-Pipe Limits

Parameter	Unit	Generic Instream Objectives					Regulated Maximum Effluent Limits		Available Assimilation Capacity	Recommended Limits
		WSA	AEP	CCME	Prairie Provinces Water Board	Best Industry Practices	AEP[1]	WSA/WSER		
BOD	(mg/L)	-	-	-	-	5	20	25	997	**10**
TSS	(mg/L)	-	15	-	5.6-339.8	-	20	25	1,432	**10**
Total Ammonia - N (Summer/Winter)	(mg/L)	0.283/0.764	0.238/0.643	0.283/0.764	-	-	50.29/18.65	50.29/18.65	77.6/214.4	**1.0/5.0**
Unionized Ammonia	(mg/L)	0.019	0.016	0.019	-	-	1.25	1.25	-	**1.25**
Total - P	(mg/L)	-	-	-	0.159/0.054	-	1.0	-	42.4/12.5	**1.0**
Fecal Coliform	(CFU/100 ml)	100	100	100	100	-	200	-	24,467	**100**
pH		-	6.5 - 9.0	6.5 - 9.0	-	-	-	-	6.5 - 9.0	**6.5 - 9.0**

[1]Based on the Best Practicable Technology Standards

[2]Based on the background pH, temperature resulting in 1.25

3.3.3 Future Limits & Effluent Targets

As a minimum, the proposed WWTF will be designed to achieve the provincial and federal effluent limits. In addition, the WWTF will include provisions to meet potential future standards and limits on parameters of concern such as total nitrogen (TN) in the treated effluent. An anoxic zone has been included in the design to allow for the denitrification process. Provisions for a supplementary carbon source have been included in the design to ensure the denitrification process has sufficient food source to meet the TN target. Turbidity of the treated effluent will target 0.3 NTU and be limited to less 0.5 NTU 95% of the time. Treated effluent targets not limited by regulatory agencies for the proposed WWTF treated effluent discharged to the Vermilion River have been summarized in Table 3.2.

Table 3.2 - Treated Effluent Targets

	Monthly Arithmetic Mean	Units	Remark
TN	≤ 10	mg/L	
Alkalinity	≥ 50	mg/L as CaCo3	
Turbidity	≤ 0.3	NTU	
E. Coli	≤ 200	CFU/100mL	
Dissolved (	> 2	mg/L	
Turbidity	≤ 0.5 NTU, 95% of the Time	NTU	
		NTU	

4.0 WWTF Design Criteria

4.1 Building Layout

Two building / site layout options were explored at the being of the detailed design phase, following the MBR site tours of March 24, 2020, completion of geotechnical investigation, and revision of preliminary costing. These options included:

Option 1 – MBR Steel Tanks represents the conceptual design presented in the feasibility study of December 2019, in this option, the MBR treatment system comprising on the bioreactors and membrane trains would be packaged in prefabricated steel structures and housed in the building. The building is proposed to be a pre-engineered building sitting on a structurally supported slab. Recent geotechnical review (Section 4.3) confirms that the building would have to supported by deep foundation.

The underground structures comprising of the wet well / equalisation storage, wasted activated sludge storage, and effluent chamber would have shall foundation system at adequate depth.

Option 2 - MBR Concrete Tanks explores an alternate layout for the site and building where the bioreactor tanks and membrane tanks are constructed of concrete and incorporated into a common wall configuration with the other underground structures. The pre-engineered building would then sit on the underground structure and the foundation system would be a shallow foundation design.

The premise of this option was to present an optimised configuration that would provide reduction in footprint, provide easy construction logistics, better integration of future expansion capabilities and potentially lower costs.

4.1.1 Preferred Building Option.

Option 2 – Concrete Tank layout provided superior qualities and advantages that exceeded those for the initial Steel tank option and is therefore was carried as the preferred and more desirable layout option for the ERPM WWTF. A summary of the key advantages and qualities of Option 2 are:

- Reduced footprint and aesthetically pleasing building height;
- Cost effective foundation system suitable for the subsurface conditions encountered;
- Better odour control;
- Easier long-term future expansion capabilities; and,
- Reduced capital cost

4.2 Process

4.2.1 Flow

4.2.1.1 Wastewater Flow Projections

The design flows for the proposed were developed from review of historical water usage and estimation based on design standards. Historical flows have been outlined in section 2.2 of the report.

4.2.1.2 Flow Design Criteria

Wastewater treatment processes require careful analysis of variations of wastewater flow. Table 4.2 summarizes the design criteria for various flow conditions anticipated through the ERPM WWTF.

Table 4.1: Flow Design Criteria					
Period	**Units**	**Ave Day**	**Max Month**	**Max Day**	**Peak Hour**
Current	m^3/d	188	282	376	837
Future	m^3/d	288	432	576	1295

4.2.2 Process Design

4.2.2.1 General

Due to the stringent limits for space and odour control and discharge, MBR process was selected as the preferred technology for treatment in the conceptual design phase as documented in the previous report prepared by Urban Systems. The following is a summary of benefits that the MBR offers:

- Provides the most consistent and highest quality of effluent.
- Meets and exceeds treated effluent quality requirements.
- Lower footprint requirements as compared to other comparable technologies.
- Lower capital cost as compared to other comparable technologies.
- Produces minimal odor.
- Easily expanded to accommodate future growth.
- Relatively easy to operate.

MBR can meet and exceed required effluent quality limits such as BOD, TSS, total ammonia - N, and total – P. MBR can meet the following effluent parameters:

- T.S.S. and BOD5: < 5 mg/L.
- Total Ammonia-N: 1.0 mg/L.
- Fecal Coliform: < 1 CFU / 100 mL after disinfection.
- TP < 1.0 mg/L

While other wastewater treatment alternatives are typically a biological process only, MBR technology is a physical barrier treatment process. Treatment involves applying a vacuum suction to draw water through the membrane. Particles larger than the membrane pore size (0.1 micron) are retained on the membrane surface. Water that passes through the membrane is considered filtered water. Due to the membrane pore size, MBR systems require excellent fine screening to eliminate larger objects and debris that can foul or damage the membranes.

Subsequent to screening, wastewater flows into a pre-anoxic tank. The water is mixed in the absence of oxygen to reduce nitrogen levels. Biological activity occurs in the aeration tank where microorganisms degrade organic matter in the water and provide further removal of nutrients. The MBR can provide high levels of treatment, including significant nutrient removal. In addition, some proprietary MBR systems have been proven to remove micro-organisms (E coli, fecal coliforms, and total coliforms) to levels lower than regulation requirements. This is possible because the physical barriers are pores that are smaller in size than micro-organisms.

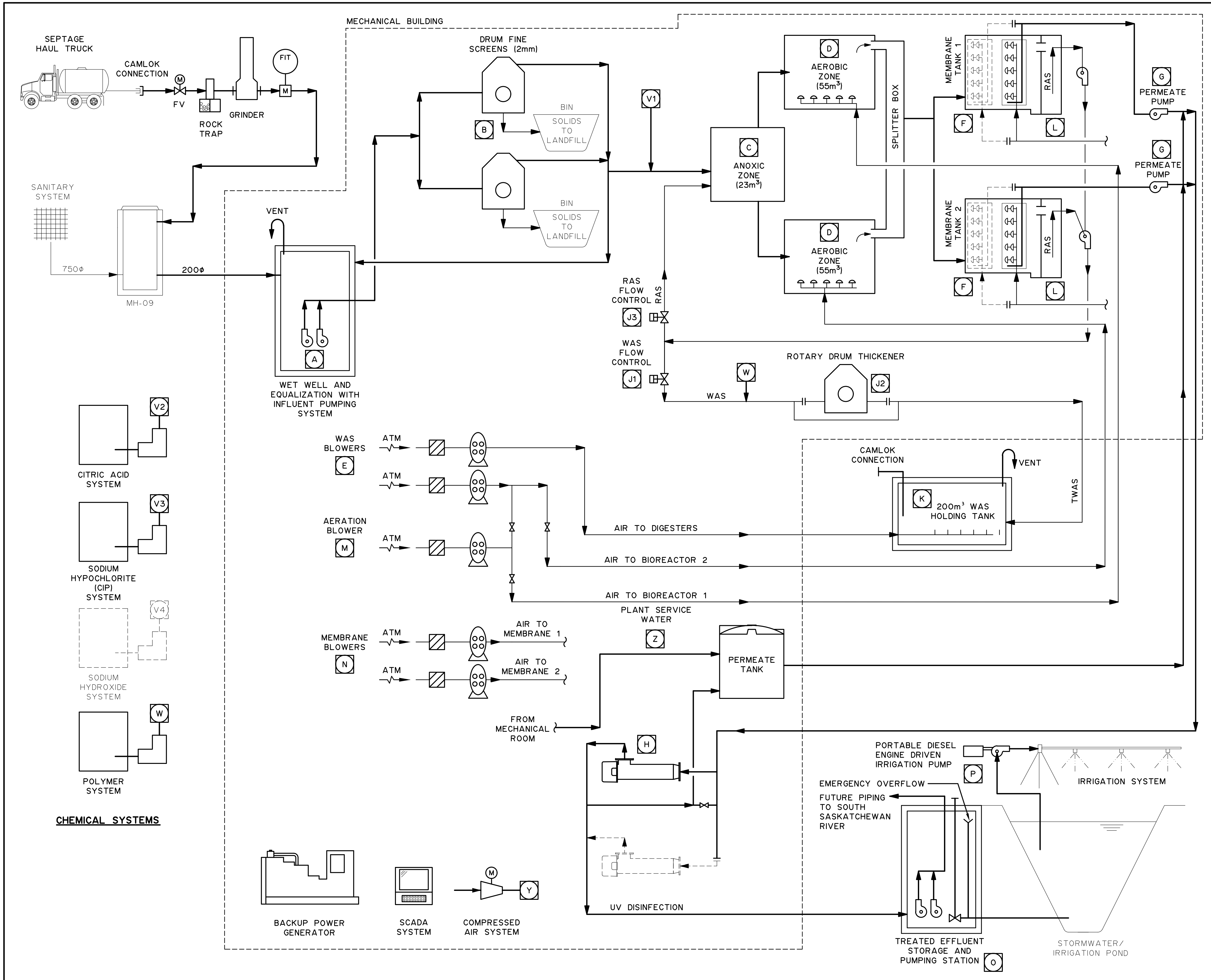
Particle build-up on the membrane surface is controlled in three ways. Compressed air is introduced at the bottom of the membrane system, which removes retained particles from the membrane surface and maintains aerobic conditions. The system is also backwashed periodically by reversing the flow of the water through the membrane with small additions of chlorine to remove particle build-up. The system can be designed to introduce air at specific time intervals or when the monitoring system indicates a maximum pressure level is reached at the membrane surface. Chemical cleaning is also required approximately two to three times per year.

4.2.2.2 Process Flow

The proposed WWTF will include the following:

- Septage Receiving Station.
- Equalization.
- Influent Pumping.
- 2mm Fine Screening.
- Bioreactors:
    - Pre-Anoxic Zone,
    - Aerobic Zone,
- Membrane Biological Reactor (MBR).
- UV Disinfection.
- Effluent Pumping Station
- Sludge Management:
    - Thickening,
    - Storage and aeration.
- Gravity connection to Storm Pond.
- Storm pond (By Other)
- Disposal piping to the South Saskatchewan lake. (Future)

Figure 4.1 illustrates the process design overview which is identical for both Option 1 and Option 2.



TAG	DESCRIPTION	DESIGN	UNITS
A	INFLUENT PUMPING	580 6.7	m³/DAY L/sec
B	FINE SCREENING (2mm)	580 6.7	m³/DAY L/sec
C	BIOREACTOR ANOXIC	23	m³
D	BIOREACTOR AEROBIC	55	m³/TRAIN
E	WAS BLOWER	65	CFM
F	MBR AVG DAY FLOW MBR MAX MONTH FLOW (N-1) PEAK HYDRAULIC	190 374 580	m³/DAY m³/DAY m³/DAY
G	PERMEATE PUMPING	580	m³/DAY
H	UV DISINFECTION TREATMENT FUTURE HYDRAULIC	374 580	m³/DAY m³/DAY
I	-		
J	(1) WAS FLOW CONTROL (2) ROTARY DRUM THICKENER (3) RAS FLOW CONTROL	7.29 7.29 2273	m³/DAY m³/DAY m³/DAY
K	SLUDGE STORAGE	100	m³
L	RAS PUMPING	2273	m³/DAY
M	AERATION BLOWER SYSTEM	187 EA	CFM
N	MEMBRANE BLOWERS (EA)	122	CFM
O	EFFLUENT PUMPING SYSTEM	7	L/sec
P	IRRIGATION PUMPING SYSTEM	7	L/sec
V1	ALUM SYSTEM	1.2	L/hr
V2	CITRIC ACID SYSTEM (CIP)	45	L/hr
V3	SODIUM HYPOCHLORITE (CIP)	116	L/hr
V4	SODIUM HYDROXIDE SYSTEM	-	L/hr
W	POLYMER FEED SYSTEM	-	L/hr
Y	COMPRESSED AIR SYSTEM	--	SCFM
Z	PLANT SERVICE WATER	--	L/sec

THIS DRAWING MAY HAVE BEEN MODIFIED FROM ITS ORIGINAL SIZE. ALL SCALE NOTATIONS INDICATED ARE BASED ON 11"x17" FORMAT DRAWINGS

ISSUE	YY-MM-DD	REVISION
1	20-10-15	FOR TENDER

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ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
PROCESS PIPING
PROCESS FLOW DIAGRAM
OVERVIEW

DESIGNED	I.K.	JOB	7603-002-00
DRAWN	L.J.S.	SCALE	NTS
DATE	OCTOBER 2020	FIGURE	4.1

4.2.2.3 Process Design Modeling

Process modeling was performed to determine the size of the treatment processes, including coarse and fine screening, bioreactor anoxic and aerobic zone volumes, membrane filtration surface area requirement, UV disinfection requirements, waste activated sludge thickening, aerobic digestion tank volumes, and sludge dewatering equipment sizing.

Several scenarios were reviewed regarding wastewater treatment system hydraulic and solids loading. Process models that were developed and reviewed are listed in Table 4.2.

Table 4.2: Process Models

Scenario	Flow		Influent Parameters									Operating Parameters	Effluent Parameters							
			BOD	TSS	TKN	VSS	NH_3-N	COD	TP	Alkalinity	Temp	MLSS	BOD	TSS	TP	F/T Coliform	NH_3-N	NO_3	Turbidity*	E. Coli
	m^3/d	L/s	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	C	mg/L	mg/L	mg/L	mg/L	MPN/100 mL	mg/L	mg/L	NTU	MPN/100 mL
Stage 1 (Phase 1, 3 & 4 Industrial Development)																				
ADF	188	2.2	350	350	55	280	32	714	11	250	9	8000	≤ 5	≤ 5	≤ 1	≤ 200	≤ 1	≤ 10	≤ 0.3	≤ 1
MMF	282	3.3	250	250	34	200	20	508	5.6	250	9	8000	≤ 5	≤ 5	≤ 1	≤ 200	≤ 1	≤ 10	≤ 0.3	≤ 1
MDF	376	4.3	200	200	34	160	20	408	5.6	250	9	8000	≤ 5	≤ 5	≤ 1	≤ 200	≤ 1	≤ 10	≤ 0.3	≤ 1
PHF	837	9.7																		
Stage 2 (Phase 2 Industrial Development)																				
ADF	288	3.3	350	350	55	280	32	714	11	250	9	10000	≤ 5	≤ 5	≤ 1	≤ 200	≤ 1	≤ 10	≤ 0.3	≤ 1
MMF	432	5.0	250	250	34	200	20	508	5.6	250	9	10000	≤ 5	≤ 5	≤ 1	≤ 200	≤ 1	≤ 10	≤ 0.3	≤ 1
MDF	576	6.7	200	200	34	160	20	408	5.6	250	9	10000	≤ 5	≤ 5	≤ 1	≤ 200	≤ 1	≤ 10	≤ 0.3	≤ 1
PHF	1295	15.0																		

*Average Monthly Limit

4.2.2.4 Process Design Summary

Mass balance calculations were completed to determine process equipment sizing and include recycle streams such as return activated sludge, sludge thickening filtrate, and sludge dewatering concentrate. The design criteria for the proposed treatment processes for the WWTF are summarized in Table 4.3.

Table 4.3 - Process Design Summary										
Design Parameter	Unit	Stage 1 - Current Design				Stage 2 - Future Design				Design Criteria
		Ave. Day Flow	Max Month Flow	Max Day Flow	Peak Hourly Flow	Ave. Day Flow	Max Month Flow	Max Day Flow	Peak Hourly Flow	Design
		(ADF)	(MMF)	(MDF)	(PHF)	(ADF)	(MMF)	(MDF)	(PHF)	
Flow										
Flow	m3/day	188	282	376	837	288	432	576	1295	
	L/sec	2.2	3.3	4.4	10	3.3	5.0	6.7	15	
Influent Parameters										
BOD	mg/L	350	250	200		350	250	200		
TSS	mg/L	350	250	200		350	250	200		
TKN	mg/L	44	34	34		44	34	34		
Alkalinity	mg/L	250.0	250.0	250.0		250.0	250.0	250.0		
TP	mg/L	11.0	11.0	11.0		11.0	5.6	5.6		
T (minimum)	C	9.0	9.0	9.0		9.0	9.0	9.0		
Effluent Parameters										
BOD	mg/L	5.0	5.0	5.0		5.0	5.0	5.0		5.0
TSS	mg/L	5.0	5.0	5.0		5.0	5.0	5.0		5.0
NH4-N	mg/L	1.0	1.0	1.0		1.0	1.0	1.0		1.0
DO	mg/L	2.0	2.0	2.0		2.0	2.0	2.0		2.0
TN	mg/L	10.0	10.0	10.0		10.0	10.0	10.0		10.0
TP	mg/L	1.0	1.0	1.0		1.0	1.0	1.0		1.0
Equalization / Wetwell										
Equalization Tank (Usable Volume)	m3	100	100	100	100	100	100	100	100	100
Equalization Available in Bioreactor	m3									
Total Equalization Volume	m3	100	100	100	100	100	100	100	100	100
Design Flow	m3/day	188	282	376	837	288	432	576	1295	1295
	L/sec	2.2	3.3	4.4	10	3.3	5.0	6.7	15	15
HRT (No Flow Out)	hr	12.8	8.5	6.4	2.9	8.3	5.6	4.2	1.9	1.9
HRT (MBR @ ADF Stg1)	hr		25.5	12.8	3.7	24.0	9.8	6.2	2.2	2.2
HRT(MBR @ MMF Stg1)	hr			25.5	4.3	400.0	16.0	8.2	2.4	2.4
HRT (MBR @ ADF Stg2)	hr			27.3	4.4		16.7	8.3	2.4	2.4
HRT (MBR @ MMF Stg2)	hr				5.9			16.7	2.8	2.8
Influent Pumping										
Design Flow	m3/day	188	282	376	837	288	432	576	1295	576
	L/sec	2.2	3.3	4.4	10	3.3	5.0	6.7	15	7
Fine Screening										
Number	No.	2	2	2	2	2	2	2	2	2
Size	mm	2	2	2	2	2	2	2	2	2
Design Flow	m3/day	188	282	376	837	288	432	576	1295	576
	L/sec	2.2	3.3	4.4	10	3.3	5.0	6.7	15	7
Bioreactor										
Aerobic SRT	day	10	10	10		10	10	10		10.1
Aeration Tanks		2	2	2		2	2	2		2.0
Volume of Aeration Basin	m3	84	90	96		103	111	118		110.5
Aeration Tank volume (ea)	m3	42	45	48		52	55	59		55
Hydraulic Detention Time	hr	10.8	7.7	6.2		8.6	6.1	4.9		6.1
MLSS	mg/L	8000	8000	8000		10000	10000	10000		10000.0
MLVSS	mg/L	5562	5562	5564		6952	6951	6955		6950.9
F/M		0.140	0.140	0.140		0.140	0.141	0.140		0.1
BOD Loading	kg/m3	0.781	0.781	0.779		0.976	0.977	0.974		1.0
Observed yield	kg TSS/kg BOD	1.020	1.020	1.023		1.019	1.019	1.023		1.0
	kg VSS/kg BOD	0.703	0.703	0.705		0.703	0.703	0.705		0.7
Oxygen Required	kg/h	3.7	4.0	4.7		5.6	6.2	7.3		6.2
Airflow Rate per tank	m3/min	1.3	1.4	1.7		2.0	2.2	2.6		2.2
	ACFM	46	51	60		71	78	92		78.2
	Nm3/hr	79	87	102		120	133	156		132.9
Airflow Rate Total	m3/min	2.6	2.9	3.4	0.0	4.0	4	5.2		4.4
	ACFM	92.5	102.0	119.7	0.0	141.8	156	183.4		156.4
	Nm3/hr	157.2	173.3	203.4	0.0	241.0	266	311.6		265.8
Bioreactor Blower Power Total	HP									0.0
Bioreactor Blower Power per Tank	HP									0.0
Anoxic Tank Volume	m3	9.8	21.2	28.2		15.0	27.2	36.3		27.2
Anoxic Mixer Power	kW	0.10	0.21	0.28		0.15	0.27	0.36		0.3
Anoxic Mixer Power	HP	0.13	0.28	0.38		0.20	0.36	0.49		0.4
RAS Ratio		4	4	4		4	5	4		5.0
RAS Flow Rate	m3/day	752	1128	1504		1152	2160	2304		2160.0
Alkalinity Addition Requirements	**mg/L**	**-15**	**-22**	**-34**		**-15**	**-21**	**-34**		**-21.3**
Effluent BOD	mg/L	4.2	4.2	4.2		4.2	4.2	4.2		4.2
TSSe	mg/L	5.0	5.0	5.0		5.0	5.0	5.0		5.0
Effluent NH4-N	mg/L	1.0	1.0	1.0		1.0	1.0	1.0		1.0
Sludge Production	kg/d	67	72	77		102	110	117		109.7
@ 1% solids	m3/day	6.7	7.1	8		10.2	10.9	12		10.9
Optional Sludge Storage										
3 Day Storage	m3	20.0	21.4	22.9		30.7	32.8	35.1		21
5 Day Storage	m3	33.4	35.7	38.2		51.1	54.7	58.5		36
7 Day Storage	m3	46.7	50.0	53.5		71.5	76.6	81.9		50
14 Day Storage	m3/day	93.4	100.1	106.9		143.1	153.1	163.8	0.0	100
21 Day Storage	m3/day	140.1	150.1	160.4		214.6	229.7	245.8	0.0	150
Chemical Phosphorus Removal										
Phosphorus Loading Rate	kg/day	2.1	3.1	4.1		3.2	2.4	3.2		3.2
Alum Soln Feed Rate	L/hr	2.4	3.6	4.8		3.7	2.8	3.8		3.7
Alum 30 day storage requirement	L	1720.6	2607.7	3477.0		2663.2	2033.7	2711.6		2663.2
Effluent Chamber										
Equalization Tank (Usable Volume)	m3	50	50	50		50	50	50		50
Equalization Available in Bioreactor	m3									
Total Equalization Volume	m3	50	50	50		50	50	50		50
Design Flow	m3/day	188	282	376		288	432	576		0
	L/sec	2.2	3.3	4.4		3.3	5.0	6.7		0
HRT (No Flow Out)	hr	6.4	4.3	3.2		4.2	2.8	2.1		0.0
HRT (Pump @ ADF Stg1)	hr		12.8	6.4		12.0	4.9	3.1		0.0
HRT(Pump @ MMF Stg1)	hr			12.8		200.0	8.0	4.1		0.0
HRT (Pump @ ADF Stg2)	hr			13.6			8.3	4.2		0.0
HRT (Pump @ MMF Stg2)	hr							8.3		0.0
Effluent Pumping										
Design Flow	m3/day	188	282	376	837	288	432	576.0	1295	576
	L/sec	2.2	3.3	4.4	10	3.3	5.0	6.7	15	7
Waste Activated Sludge Thickening										
Sludge Feed Rate	m3/day	6.7	7.1			10.2	10.9			10.2
weekly	m3/week	46.7	50.0			71.5	76.6			71.5
Miminum RDT Sludge Feed Rate	m3/day	136.2	136.2			136.2	136.2			136.2
	m3/hr	5.7	5.7			5.7	5.7			5.7
Process Time	hrs / week	8.2	8.8			12.6	13.5			12.6
	hrs / day	1.2	1.3			1.8	1.9			1.8
% Solids	%TS	1.0	1.2			1.0	1.2			1.0
Dry Solids Load	kg/day	1366.1	1639.3			1366.1	1639.3			1366.1
	kg/hr	56.9	68.3			56.9	68.3			56.9
Polymer Feed Requirement	kg/tonne_solids	5.0	5.0			5.0	5.0			5.0
Polymer Feed Rate by Weight	kg/hr	0.28	0.34			0.28	0.34			0.3
Polymer Soln	%	30.0	30.0			30.0	30.0			30.0
Polymer feed rate	L/hr	0.912	1.095			0.912	0.164			0.9
Filtrate Flow to Wet Well	m3/day	104.3	97.9			104.3	97.9			104.3
	m3/hr	4.34	4.08			4.34	4.08			4.3
Dry Solids	kg/day	68.3	82.0			68.3	82.0			68.3
	kg/hr	2.85	3.42			2.85	3.42			2.8
Recovery Rate	%	95	95			95	95			95.0
Filtrate TSS	mg/L	655	837			655	837			655.0
Cake Volume	m3/day	32.06	38.5			32.1	38.5			32.1
	m3/hr	1.3	1.6			1.3	1.6			1.3
Daily Cake Volume Production	m3	1.6	2.0			2.4	3.1			2.4
Weekly Cake Volume Production	m3	11.0	14.1			16.8	21.6			16.8
Monthly Cake Volume Production	m3	47.1	60.6			72.2	92.7			72.2
Annual Cake Volume Production	m3	573.3	737.0			878.0	1127.8			878.0
Dry Solids	kg/day	1297.8	1557.4			1297.8	1557.4			1297.8
	kg/hr	54.1	64.9			54.1	64.9			54.1
Daily Dry Solids Production	kg	63.6	81.7			97.4	125.1			97.4
Weekly Cake Volume Production	kg	445.1	572.2			681.6	875.5			681.6
Monthly Cake Volume Production	kg	1907.6	2452.3			2921.2	3752.3			2921.2
Annual Cake Volume Production	kg	23208.7	29835.7			35541.1	45653.5			35541.1
%Solids	%TS	4.0	4.0			4.0	4.0			4.0
Sludge Storge (Digestion)										
Aerobic Digestor air flow rate at field conditions	m3/min	1.57	1.7	1.8		2.4	2.6	2.8		2.4
	ACFM	55	59.4	63.4		84.9	90.9	97.2		84.9
	Nm3/hr	94	100.9	107.8		144.2	154.4	165.1		144.2
Aerobic Digestor Blower Power	HP									0.0
Aerobic Digestor Design Hydraulic Retention Time	day	30.0	30.0	30.0		30.0	30.0	30.0		30.0
Aerobic Digestor Volume based on HRT	m3	50	53	57		76	81	87		76.0
VSS loading rate for first stage tank (HRT)	kg/m3d	1.3	1.3	1.3		1.3	1.3	1.3		1.3
Design SRT for pathogen kill (winter conditions)	day	60.0	60	60.0		60.0	60.0	60.0		60.0
Minimum Temperature	C	9.0	9	9.0		9.0	9.0	9.0		9.0
Aerobic Digestor Volume based on VSS Reduction	m3	34	36	39		52	55	60		52.0
VSS loading rate for first stage tank (VSS reduction)	kg/m3d	1.97	1.97	1.97		1.97	2.01	1.97		2.0

4.2.2.5 Process Hydraulic Design Criteria

Processes within the wastewater treatment system are designed to different criteria for hydraulic capacity. Table 4.4 presents the hydraulic design criteria for the main treatment process within the wastewater treatment system. Also presented are the redundancy conditions designed to for each major process.

Table 4.4: Process Hydraulic Design Criteria (Stage 2)

Process	Redundancy condiiton	Hydraulic			Treatment			Units
		Condition	Design		Condition	Design		
Equalization	Bypass	Peak Hourly for 3 hrs	1,295	[15]	Peak Hourly for 3 hrs	1,295	[15]	m^3/d [L/sec]
			162			162		m^3
Influent Pumping	(N+1)	Peak Hour	576	[7]	Peak Hour	576	[7]	m^3/d [L/sec]
Fine Screening	(N+1)	Max Day	576	[7]	Max Day	576	[7]	m^3/d [L/sec]
Bioreactor	MDF	Max Day	576	[7]	Max Month	432	[5]	m^3/d [L/sec]
Membrane Filtration	MDF	Max Day	576	[7]	Max Month	432	[5]	m^3/d [L/sec]
UV Disinfection	(N+1)	Max Day	576	[7]	Max Day	576	[7]	m^3/d [L/sec]
Effluent Storage	240 Days of Winter Storage	Average Day for **Stage 1**	188	[3]	Average Day for **Stage 1**	188	[3]	m^3/d [L/sec]
			45,099			45,099		m^3
Irrigation Pumping	Summer Pumping	Max Day	576	[7]	Max Day	576	[7]	m^3/d [L/sec]
WAS Thickening	Bypass	Average Day	288	[4]	Average Day	288	[4]	m^3/d [L/sec]
Thickening Polymer Feed	Shelf Spare Pump	Average Day	288	[4]	Average Day	288	[4]	m^3/d [L/sec]
Sludge Storage	Sized for Sludge Storage	Average Day (30 day HRT)	288	[4]	Average Day (30 day HRT)	288	[4]	m^3/d [L/sec]
			76			76		m^3

4.2.2.6 Hydraulic Analysis

4.2.2.6.1 Hydraulic Modelling

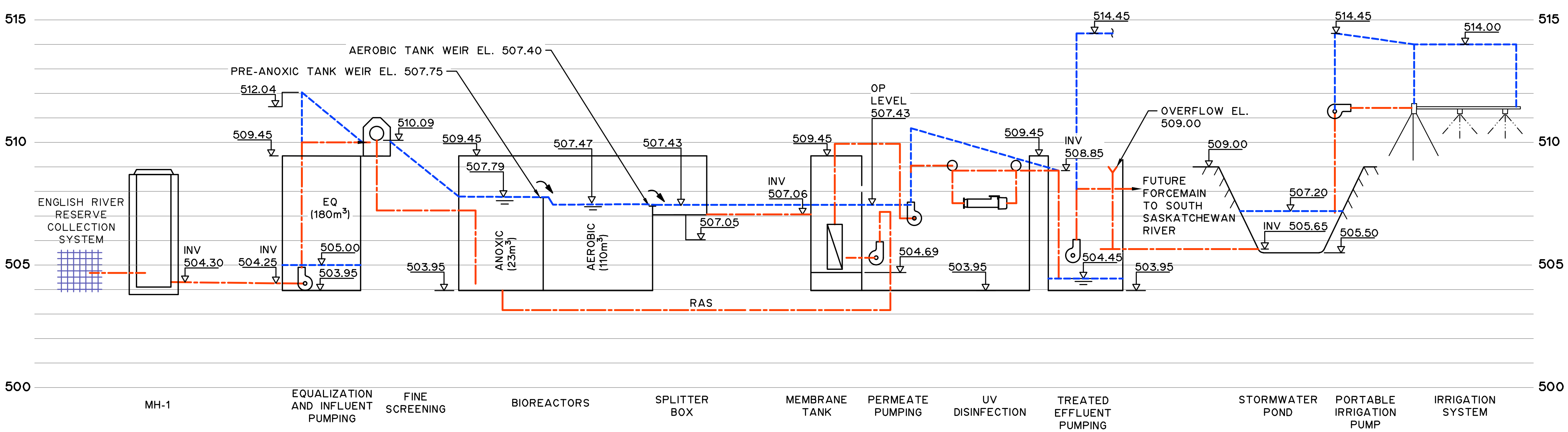
The ERPM WWTF is composed of pumping systems, multiple open process channels, tanks, screens, weirs, and connecting piping. Since significant portions of the process are driven by gravity, it is critical that a proper hydraulic analysis be completed to ensure the treatment system can achieve the ultimate system design flow. The ultimate design flow of the facility is 576 m^3/day (7 L/sec) of treated effluent. The entire process should be designed to allow this flow through the facility.

4.2.2.6.2 Computer Model

Due to the critical nature of the hydraulics in the ERPM WWTF, a spreadsheet model integrated with a Visual Basic Macro was utilized. The model reviewed the flow path through the entire wastewater treatment system including the equalisation, influent pumping, fine screening, bioreactors, Membrane Filtration, UV disinfection system, effluent pumping, and outlet structures. The system was modelled at the max day flow of 576 m^3/day (7 L/sec).

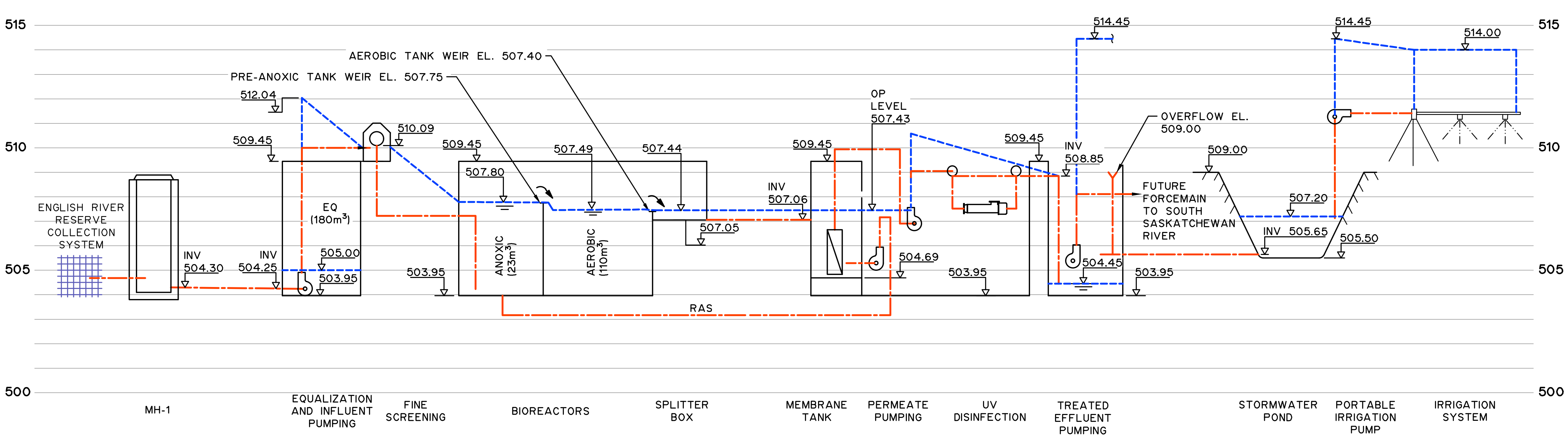
4.2.2.6.3 Hydraulic Profile

Once completed, the models were used to analyze the hydraulic profile through the wastewater treatment system, the hydraulic profile is illustrated on Figures 4.2.1 and Figure 4.2.2.



SCENARIO L1: PHASE 1 ADF HYDRAULIC PROFILE

CURRENT ADF =3.3 L/sec (282 m³/day) {HEADWORKS / MEMBRANES / UV}
RAS FLOW =10.0 L/sec (866 m³/day) {BIOREACTOR / MEMBRANE INFLUENT CHANNEL}
@ADF FLOW



SCENARIO L2: PHASE 1 MMF HYDRAULIC PROFILE

CURRENT MMF =4.4 L/sec (376 m³/day) {HEADWORKS / MEMBRANES / UV}
RAS FLOW =15.7 L/sec (1355 m³/day) {BIOREACTOR / MEMBRANE INFLUENT CHANNEL}
@MMF FLOW

LEGEND

- PIPE NETWORK
- STRUCTURE
- HYDRAULIC PROFILE (LIQUID)

THIS DRAWING MAY HAVE BEEN MODIFIED FROM ITS ORIGINAL SIZE. ALL SCALE NOTATIONS INDICATED ARE BASED ON 11"x17" FORMAT DRAWINGS

ISSUE	YY-MM-DD	REVISION
1	20-10-15	FOR TENDER

Association of Professional Engineers & Geoscientists of Saskatchewan
CERTIFICATE OF AUTHORIZATION
MPE Engineering Ltd.
Number C1334
Permission to Consult held by:

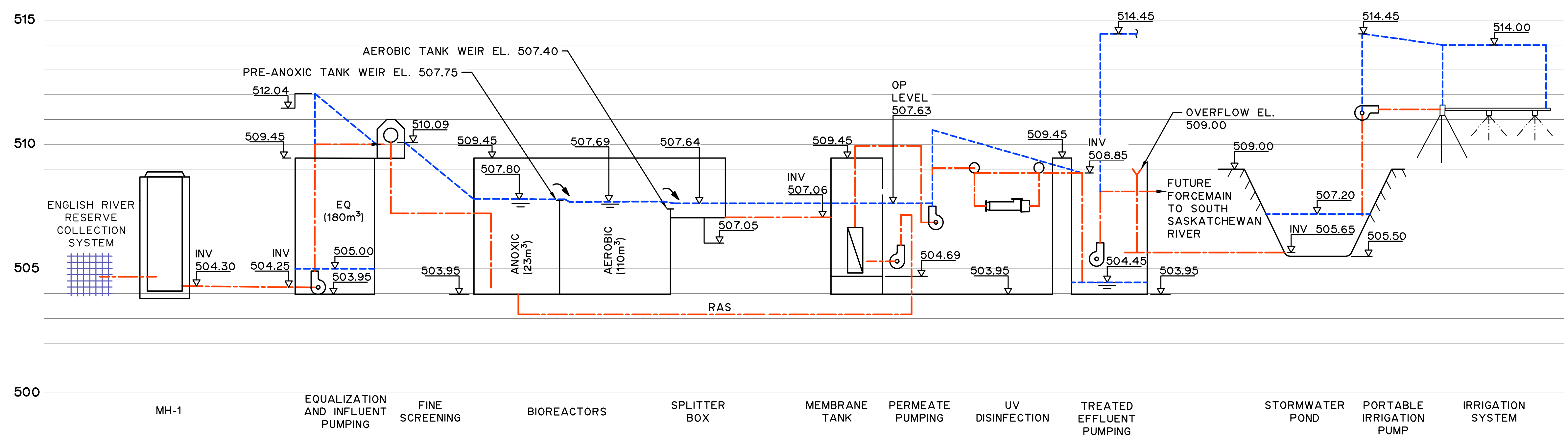
Discipline	Sk. Reg. No.	Signature
CIVIL	52886	

Engineering Ltd.

ENGLISH RIVER PROPERTY MANAGEMENT

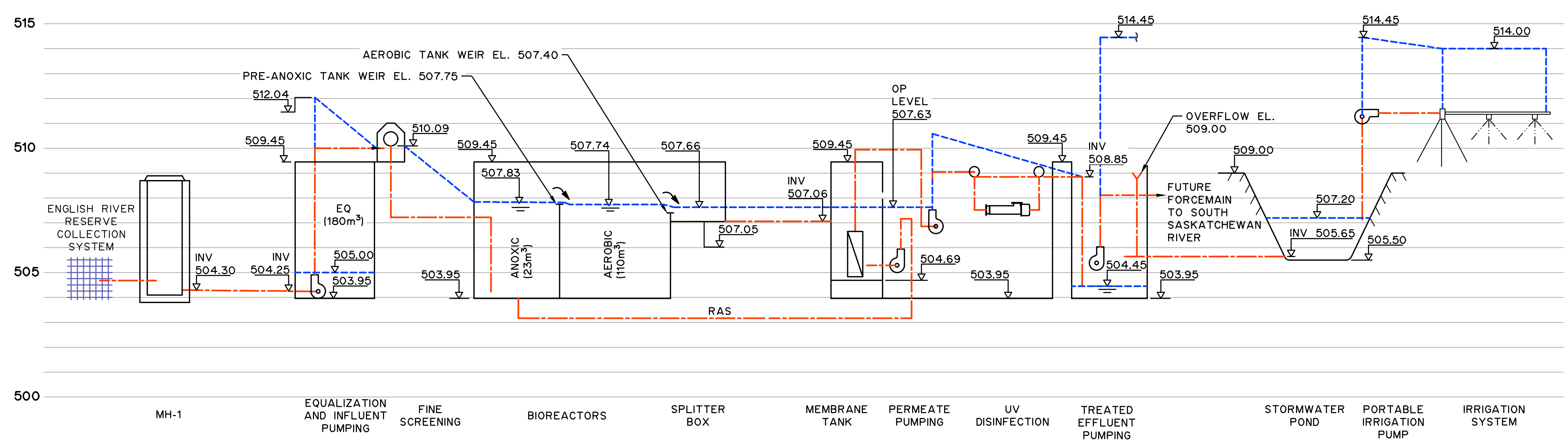
WASTEWATER TREATMENT PLANT
PROCESS PIPING
HYDRAULIC PROFILES
PHASE 1
LIQUID STREAM

DESIGNED	I.K.	JOB	7603-002-00
DRAWN	L.J.S.	SCALE	NTS
DATE	OCTOBER 2020	FIGURE 4.2.1	



SCENARIO L3: PHASE 2 ADF HYDRAULIC PROFILE

CURRENT ADF =3.3 L/sec (288 m³/day) {HEADWORKS / MEMBRANES / UV}
RAS FLOW =16.08 L/sec (1390 m³/day) {BIOREACTOR / MEMBRANE INFLUENT CHANNEL}
@ADF FLOW



SCENARIO L4: PHASE 2 MMF HYDRAULIC PROFILE

CURRENT MMF =XX L/sec (432 m³/day) {HEADWORKS / MEMBRANES / UV}
RAS FLOW =XX L/sec (2011 m³/day) {BIOREACTOR / MEMBRANE INFLUENT CHANNEL}
@MMF FLOW

LEGEND

- PIPE NETWORK
- STRUCTURE
- HYDRAULIC PROFILE (LIQUID)

THIS DRAWING MAY HAVE BEEN MODIFIED FROM ITS ORIGINAL SIZE. ALL SCALE NOTATIONS INDICATED ARE BASED ON 11"x17" FORMAT DRAWINGS

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ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
PROCESS PIPING
HYDRAULIC PROFILES
PHASE 2
LIQUID STREAM

DESIGNED	I.K.	JOB	7603-002-00
DRAWN	L.J.S.	SCALE	NTS
DATE	OCTOBER 2020	FIGURE 4.2.2	

4.2.3 Process Equipment

4.2.3.1 Design Standards & References

All process equipment design shall conform to all applicable local, provincial, and/or federal codes, standards, regulations, and references in effect at time of quote including but not limited to:

- Water Security Agency, Sewage Works Design Standard (EPB 503), 2015
- Water Security Agency, The Waterworks and Sewage Works Regulations, 2015
- Water Security Agency, The Environmental Management and Protection Act, 2010

The design will comply with the requirements of the following organizations, at a minimum:

- CSA, Canadian Standards Association
- NEC, National Electric Code
- NEMA, Standards of National Electrical Manufacturers Association
- ANSI, American National Standards Institute
- ASTM, American Society for Testing and Materials
- AISI, American Iron and Steel Institute
- AGMA, American Gear Manufacturer's Association
- AISC, American Institute of Steel Construction
- AWS, American Welding Society
- ASME, American Society of Mechanical Engineers
- AWWA – Applicable Standards
- CSA, Canadian Standards Association
- CEC, Canadian Electrical Code
- IEEE, Institute of Electrical and Electronic Engineers
- EEMAC, Electrical and Electronic Equipment Manufacturers Association of Canada

4.2.3.2 Equalization

Equalization will be incorporated into the wet well influent pumping chamber and portion of the bioreactors to overcome issues due to flow and loading variations outside the design parameters. Equalization will allow for improvements of processes downstream and facilitate in optimising the design. It is proposed to incorporate equalization prior to the process treatment systems. Influent pumps will then be utilized to transfer wastewater to the MBR facility building. Equalization has been sized to allow for one (1) hour of retention at mix month flow and for sustained peak hourly flow (PHF) for a minimum of three (3) hours with the MBR and UV system operating at maximum day flow (MDF). Equalisation volume will be sized for 100 m^3, which will be sufficient to contain incoming coming flows during peak periods or during a limited power outage. Various storage duration scenarios are presented in Table 4.5.

Table 4.5: Equalisation Design Criteria										
Design Parameter	Unit	Stage 1 - Current Design				Stage 2 - Future Design				Design Criteria
		Ave. Day Flow (ADF)	Max Month Flow (MMF)	Max Day Flow (MDF)	Peak Hourly Flow (PHF)	Ave. Day Flow (ADF)	Max Month Flow (MMF)	Max Day Flow (MDF)	Peak Hourly Flow (PHF)	Design (Stg 2 MMF)
Flow										
Flow	m3/day	188	282	376	837	288	432	576	1295	
	L/sec	2.2	3.3	4.4	10	3.3	5.0	6.7	15	
Equalization										
Equalization Tank (Usable Volume)	m3	100	100	100	100	100	100	100	100	100
Equalization Available in Bioreactor	m3									
Total Equalization Volume	m3	100	100	100	100	100	100	100	100	100
Design Flow	m3/day	188	282	376	837	288	432	576	1295	1295
	L/sec	2.2	3.3	4.4	10	3.3	5.0	6.7	15	15
HRT (No Flow Out)	hr	12.8	8.5	6.4	2.9	8.3	5.6	4.2	1.9	1.9
HRT (MBR @ ADF Stg1)	hr		25.5	12.8	3.7	24.0	9.8	6.2	2.2	2.2
HRT(MBR @ MMF Stg1)	hr			25.5	4.3	400.0	16.0	8.2	2.4	2.4
HRT (MBR @ ADF Stg2)	hr			27.3	4.4		16.7	8.3	2.4	2.4
HRT (MBR @ MMF Stg2)	hr				5.9			16.7	2.8	2.8

4.2.3.3 Septage Receiving Station

The septage receiving station (SRS) will allow ERPM to receive, control, and monitor septage disposal at the site and gather data for billing and reporting. The SRS will also allow for off-loading, which is efficient for the hauler and minimizes odor. Piping, equipment, and controls will be incorporated in the headworks room of the building will also include the fine screens.

For the feasibility study, components of the SRS include:

- Secure access and turn-around:
  - Fenced and gated access, with lock or code accessibility for pre-approved haulers.
  - A turn-around will be provided at the mechanical building.
- Billing System:
  - Provides a sign-in function that will activate the inlet system for approved haulers.
  - Billing system will collect information on volume, source and time of deposit.
  - Remote transfer of information to ERPM office could be included if desired.
- Closed pipeline inlet system:
  - Haulers would connect to the inlet with hoses and cam-lock connections.
  - Includes an automated plug valve that activates (opens) when the hauler signs in.
  - Includes a flow meter that records the volume of septage dumped and can be tied to the billing system.
  - Includes a large rock trap to remove grit material from the septage
  - Includes an inline, heavy-duty wastewater grinder that will break down trash, plastics or other solids that can be present in hauled septage. Grinder will be able to reverse several times if jammed.
  - The inlet will run through the building and into the aeration lagoon inlet structure.

4.2.3.4 Influent Pumping

Proposed influent pumping for the ERPM MBR WWTF consists of two (2) identical 10 HP semi-permanent centrifugal pumps. The pumping capacity is such that, with the largest pump out of service, the remaining pumps can handle peak flow conditions. Under normal operating conditions, only one pump will operate. The pump control will stage on a second pump as required. As required by the INAC Protocol for emergency standby or backup pumping will be provided. Design criteria for influent pumping equipment are summarized in Table 4.6.

Table 4.6: Influent Pumping Design Criteria

Design Parameter	Unit	Stage 1 - Current Design				Stage 2 - Future Design				Design Criteria
		Ave. Day Flow (ADF)	Max Month Flow (MMF)	Max Day Flow (MDF)	Peak Hourly Flow (PHF)	Ave. Day Flow (ADF)	Max Month Flow (MMF)	Max Day Flow (MDF)	Peak Hourly Flow (PHF)	Design (Stg 2 MMF)
Flow										
Flow	m3/day	188	282	376	837	288	432	576	1295	
	L/sec	2.2	3.3	4.4	10	3.3	5.0	6.7	15	
Influent Pumping										
Design Flow	m3/day	188	282	376	837	288	432	576	1295	576
	L/sec	2.2	3.3	4.4	10	3.3	5.0	6.7	15	7

4.2.3.4.1 Influent Pump Duty Point

The total dynamic head (TDH) was determined under the assumption that the total flow of a single pump can achieve the maximum day flow of 6.7 L/s. Additionally, MPE analyzed the piping of the influent pump system through the fine screen to the biological treatment system. The analysis determined that, to achieve the required total flow, each pump would require a duty point of 8.22 L/s at 8.16 m. The new pump addition will require a 2.7 HP motor. Since the pumps will be operated with a Variable Frequency Drive (VFD), the motors will be specified as premium efficient, invertor duty.

4.2.3.4.2 Net Positive Suction Head Available Analysis

The NPSHA analysis was completed. Pump flows were varied from the minimum flow requirement to the maximum flow requirement. The NPSHA at the pump inlet has been determined to be 8.73 m based on the minimum pump submergence level of 0.6 m.

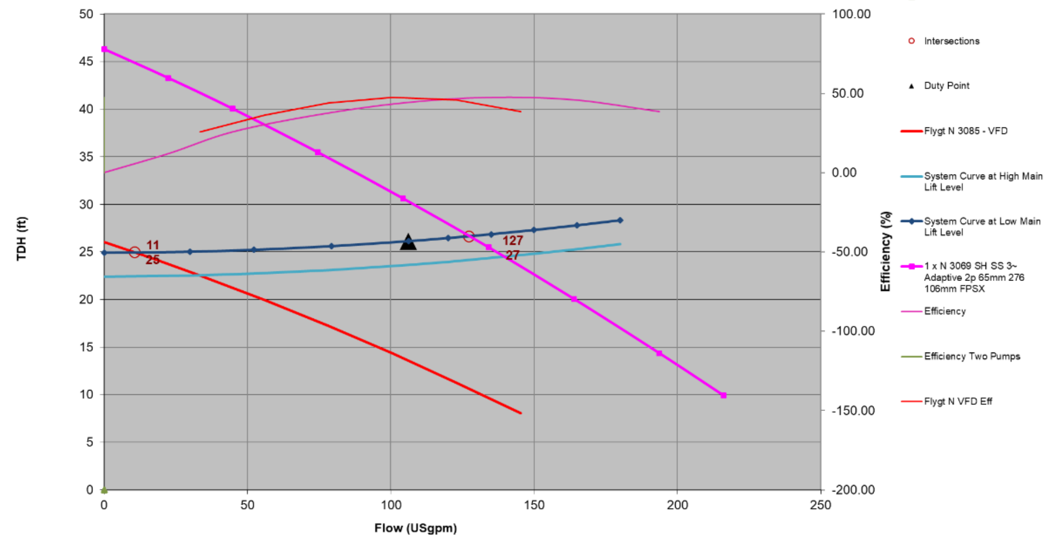
4.2.3.4.3 Pump Selection

The influent pumps are specified to be self cleaning semi open channel impeller pumps for pumping of wastewater containing solids and long fibrous material. The **N 3085_256** (116mm Impeller) premium efficient pumps by Xylem are recommended for the proposed project. These pumps are highly reliable, easy to remove and work on and are specified in many wastewater lift stations and treatment plants in Western Canada. This particular model also comes with a 125 mm impeller so future replacement of impeller to provide more flow can be accomplished.

4.2.3.4.4 System Curve Analysis

Figure 4.3 summarizes the hydraulic analysis and provides an illustration of the selected pump curve. In addition, the curve is shown at various operating speeds.

Figure 4.3
Influent Pumping System Curve



4.2.3.4.5 Pump Variable Speed Analysis

The minimum speed of the pump will be set as per manufacturer's recommendations which is typically 40Hz. At this speed, the pump will be capable of a flow rate of 0.69 L/s (11 USgpm).

4.2.3.4.6 Transient Analysis

A transient analysis was performed on the proposed piping for this project. Forces developed from the start-up and sudden shutdown of the pumps and closing of valves was reviewed. The transient analysis determined the time of wave propagation, as well as the surge pressures the system may encounter. The assumptions used for this analysis were based the maximum pressure the pumps would operate at. This condition exists when the tank is at the overflow condition. The maximum operating pressure of the piping system has been determined to be 9.97 psig. Based on the transient analysis, the maximum surge pressure that can be encountered is 45 psig. If the pumps were to be shut down instantly and the wave of propagation had no outlet (i.e. did not have tank open to atmosphere), the maximum force that can be encountered in the piping will be 2.87 kN (643 ft lb). To ensure this force does materialize, isolation valves have not been automated and will remain open during normal operation.

All pipe thrust supports for the piping on the discharge side of the pumps will be designed to withstand forces based on the weight of piping and fittings as well as a maximum surge pressure in the piping system of 276 kPa (40 psig). In other words, the supports will be designed to withstand a maximum force of 2.87 kN (643 ft lb).

4.2.3.4.7 Semi-Permanent Centrifugal Pump & Motor Specifications

Specifications for the additional influent pump are summarized in Table 4.7.

Table 4.7: Influent Pump Schedule			
Tag		P1101	P1102
Manufacturer		Flygt	Flygt
Series		N-pump Premium Efficiency	N-pump Premium Efficiency
Model		N 3085 SH 3~ Adaptive 4p	N 3085 SH 3~ Adaptive 4p
Type		Submersible Centrifugal	Submersible Centrifugal
Pressure Class		Medium Head	Medium Head
Installation Type		Semi Permanent, wet well arrangement	Semi Permanent, wet well arrangement
Impeller Diameter		116 mm	116 mm
No. of Blades		2	2
Impeller Material		Cast Iron	Cast Iron
Duty Point	Flow (L/Sec)	8.22	8.22
	TDH (m)	8.16	8.16
	NPSHR (m)	5.73	5.73
	EFF (%)	42.8	42.8
Pump Operating Speed	Min (RPM)	2600	2600
	Max (RPM)	3500	3500
BHP		2.2	2.2
Motor (HP)		2.7	2.7
Minimum Submergence		610 mm	610 mm
Discharge Flange		80 mm	80 mm
Suction Flange		-	-
Flange Rating		ANSI Class 125/150	ANSI Class 125/150
Flange Bolt Patern		ANSI Class 150 B16.5 Flange	ANSI Class 150 B16.5 Flange
Major Castings		Cast Iron, Gray 35B	Cast Iron, Gray 35B
Pump Housing		Cast Iron, Gray 35B	Cast Iron, Gray 35B
Impeller		Cast Iron, Gray 35B	Cast Iron, Gray 35B
Insert Ring		Cast Iron, Gray 35B	Cast Iron, Gray 35B
Inner Cooling Jacket		Aluminum AA1050	Aluminum AA1050
Outer Cooling Jacket		Stainless Steel 316L	Stainless Steel 316L
Lifting Handle		Stainless Steel 316L	Stainless Steel 316L
Shaft		Stainless Steel 431	Stainless Steel 431
Screws and Nuts		Stainless Steel 316	Stainless Steel 316
O-Rings		Nitrile Rubber (NBR)	Nitrile Rubber (NBR)
Heat Transfer Fluid		Glycol	Glycol
Inner Mechanical Seal		Corrosion Resisitant Cemented Carbide	Corrosion Resisitant Cemented Carbide
Outer Mechanical Seal		Silicon Carbide	Silicon Carbide
Coatings	Pump	Navy Gray Epoxy Coating	Navy Gray Epoxy Coating
	Motor	Navy Gray Epoxy Coating	Navy Gray Epoxy Coating
Accessories		Sole Plate; Performance Testing (Non-Witness)	Sole Plate; Performance Testing (Non-Witness)
Motor Information			
Tag		P1101	P1102
Motor Type		Squirrel-cage induction motor	Squirrel-cage induction motor
Starting Method		VFD	VFD
Power		2.7 HP/3 Phase/575 VAC/60 Hz	2.7 HP/3 Phase/575 VAC/60 Hz
S.F.		1.15/1.0	1.15/1.0
Number of Starts per Hr		30	30
Code Compliance		IEC 60034-1	IEC 60034-1
Monitoring		MiniCAS (thermal and leakage detection)	MiniCAS (thermal and leakage detection)
Accessories		Inverter Duty, Premium Efficient	Inverter Duty, Premium Efficient

4.2.3.5 Fine Screening

Fine screening is required to remove deleterious material 2 mm and larger from the wastewater liquid stream for membrane pre-treatment to protect the membranes from damage. For the ERPM WWTF, fine screening will be provided by SUEZ as part of their overall package and will likely be rotary drum screens that utilize a 2 mm perforated drum. One fine screen is proposed and will be fitted with a washer and compactor. Washed and compacted screenings will be conveyed to standard municipal solid waste disposal facilities. Design Criteria for fine screening will be based on e max day flow as summarized in Table 4.8.

Table 4.8: Fine Screening Design Criteria

Design Parameter	Unit	Stage 1 - Current Design			Stage 2 - Future Design			Design Criteria
		Ave. Day Flow (ADF)	Max Month Flow (MMF)	Max Day Flow (MDF)	Ave. Day Flow (ADF)	Max Month Flow (MMF)	Max Day Flow (MDF)	Design (Stg 2 MMF)
Flow								
Flow	m3/day	188	282	376	288	432	576	
	L/sec	2.2	3.3	4.4	3.3	5.0	6.7	
Liters per capita da	lpcd	40	40	54	41	62	82	
Fine Screening								
Number	No.	2	2	2	2	2	2	2
Size	mm	2	2	2	2	2	2	2
Design Flow	m3/day	188	282	376	288	432	576	576
	L/sec	2.2	3.3	4.4	3.3	5.0	6.7	7

Minimum specifications that SUEZ's fine screening equipment will be required to meet are summarized in Table 4.9.

Table 4.9: Fine Screening Specifications

Parameter	Specification
General	
Warranty	1 years minimum from time of commissioning/system startup
Commissioning and Training	1 visit, 2 days minimum (1 day minimum for operator training)
Manuals	Two (2) copies of O&M Manuals
Equipment Size and Foot Print	Supplier to identify

Influent Wastewater Characteristic	Flow	BOD5	TSS	NH3-N	TKN	TP	Temp	Alkalinity
Stage 1 Average Day	188 m3/d							
Stage 1 Max Month	282 m3/d	350 mg/l	350 mg/l					
Stage 1 Max Day	376 m3/d			41 mg/l	70 mg/l	1 mg/	9 to 20oC	200 mg/L CaCO3
Stage 2 Average Day	288 m3/d							
Stage 2 Max Month	432 m3/d	250 mg/l	250 mg/l					
Stage 2 Max Day	576 m3/d							

Parameter	Specification
Fine Screen	
Quantity	Two (2)
Redundancy Requirement	• Each screen must be sized for highest loading at peak hour flow of 576 m3/d. • Screens to operate on duty standby mode except during emergency high flow events
Model	Supplier to specify
Type	Rotary Drum Screen
Screen Type	Perforated
Construction	304L Stainless Steel
Housing	11 gauge or better
Connections	Stainless Steel stub ends c/w galvanized backup flanges
Screen Slot Openings	2mm
Max Head Loss at Peak Hour Flc	Supplier to provide head loss curves and identify
External Spray Bar	Sch 40, 304 Stainless Steel
Temperature	7 - 20 Degrees Celsius
Accessories	Supplier to provide as required for full functional system
Drive System	• Helical Gear Drive • TEFC Enclosure
Maximum Solids Loading	Supplier to Specify
Electrical Classification	Zone 1 (Class 1 Division 1)
Controls	• Controls to be performed by SUEZ PLC. • No integral control panel required. Control logic to be provided for integration into main PLC.
Spare Parts	Indicate all spare parts to be supplied
Screw Conveyor and Compactor	
Model	Supplier to specify
Capacity	Supplier to Specify
Quantity	Two (2) - one for each drum screen
Construction	304L Stainless Steel
Water Connections	Provide required piping, valving and instrumentations
Drive System	• TEFC Enclosure
Accessories	• 304L Stainless Steel outloading discharge pipe system • Continuous Screening Bagging Device c/w magazine of clear plastic • Provide additional magazines for one years use.
Controls	• Controls to be performed by SUEZ PLC. • No integral control panel required. Control logic to be provided for integration into main PLC.

4.2.3.6 Biological Process

The biological process has been designed around the Stage 2 Maximum Month Flow (MMF) condition, the BOD and TSS concentrations of 250 mg/L, and a minimum temperature of 9°C. The design will consist of two (2) bioreactors, each consisting of three zones. These include one (1) pre-anoxic zone, followed by one (1) aerobic zone, and finalised with one (1) post anoxic zone. Minimum design criteria for the biological process are summarized in Table 4.10.

Table 4.10: Process Design Summary

Design Parameter	Unit	Stage 1 - Current Design				Stage 2 - Future Design				Design Criteria
		Ave. Day Flow (ADF)	Max Month Flow (MMF)	Max Day Flow (MDF)	Peak Hourly Flow (PHF)	Ave. Day Flow (ADF)	Max Month Flow (MMF)	Max Day Flow (MDF)	Peak Hourly Flow (PHF)	Design (Stg 2 MMF)
Flow										
Flow	m3/day	188	282	376	837	288	432	576	1295	
	L/sec	2.2	3.3	4.4	10	3.3	5.0	6.7	15	
Influent Parameters										
BOD	mg/L	350	250	200		350	250	200		
TSS	mg/L	350	250	200		350	250	200		
TKN	mg/L	44	34	34		44	34	34		
Alkalinity	mg/L	250.0	250.0	250.0		250.0	250.0	250.0		
TP	mg/L	11.0	11.0	11.0		11.0	5.6	5.6		
T (minimum)	C	9.0	9.0	9.0		9.0	9.0	9.0		
Effluent Parameters										
BOD	mg/L	5.0	5.0	5.0		5.0	5.0	5.0		5.0
TSS	mg/L	5.0	5.0	5.0		5.0	5.0	5.0		5.0
NH4-N	mg/L	1.0	1.0	1.0		1.0	1.0	1.0		1.0
DO	mg/L	2.0	2.0	2.0		2.0	2.0	2.0		2.0
TN	mg/L	10.0	10.0	10.0		10.0	10.0	10.0		10.0
TP	mg/L	1.0	1.0	1.0		1.0	1.0	1.0		1.0
Bioreactor										
Aerobic SRT	day	10	10	10		10	10	10		10.1
Aeration Tanks		2	2	2		2	2	2		2.0
Volume of Aeration Basin	m3	84	90	96		103	111	118		110.5
Aeration Tank volume (ea)	m3	42	45	48		52	55	59		55
Hydraulic Detention Time	hr	10.8	7.7	6.2		8.6	6.1	4.9		6.1
MLSS	mg/L	8000	8000	8000		10000	10000	10000		10000.0
MLVSS	mg/L	5562	5562	5564		6952	6951	6955		6950.9
F/M		0.140	0.140	0.140		0.140	0.141	0.140		0.1
BOD Loading	kg/m3	0.781	0.781	0.779		0.976	0.977	0.974		1.0
Observed yield	kg TSS/kg BOI	1.020	1.020	1.023		1.019	1.019	1.023		1.0
	kg VSS/kg BO	0.703	0.703	0.705		0.703	0.703	0.705		0.7
Oxygen Required	kg/h	3.7	4.0	4.7		5.6	6.2	7.3		6.2
Airflow Rate per tank	m3/min	1.3	1.4	1.7		2.0	2.2	2.6		2.2
	ACFM	46	51	60		71	78	92		78.2
	Nm3/hr	79	87	102		120	133	156		132.9
Airflow Rate Total	m3/min	2.6	2.9	3.4	0.0	4.0	4	5.2		4.4
	ACFM	92.5	102.0	119.7	0.0	141.8	156	183.4		156.4
	Nm3/hr	157.2	173.3	203.4	0.0	241.0	266	311.6		265.8
Bioreactor Blower Power Total	HP									0.0
Bioreactor Blower Power per Ta	HP									0.0
Anoxic Tank Volume	m3	9.8	21.2	28.2		15.0	27.2	36.3		27.2
Anoxic Tank Volume (Ea.)	m3	4.9	10.6	14.1		7.5	13.6	18.1		14
Anoxic Mixer Power	kW	0.10	0.21	0.28		0.15	0.27	0.36		0.3
Anoxic Mixer Power	HP	0.13	0.28	0.38		0.20	0.36	0.49		0.4
RAS Ratio		4	4	4		4	5	4		5.0
RAS Flow Rate	m3/day	752	1128	1504		1152	2160	2304		2160.0
Alkalinity Addition Requiremer	mg/L	-15	-22	-34		-15	-21	-34		-21.3
Effluent BOD	mg/L	4.2	4.2	4.2		4.2	4.2	4.2		4.2
TSSe	mg/L	5.0	5.0	5.0		5.0	5.0	5.0		5.0
Effluent NH4-N	mg/L	1.0	1.0	1.0		1.0	1.0	1.0		1.0
Sludge Production	kg/d	67	72	77		102	110	117		109.7
@ 1% solids	m3/day	6.7	7.1	8		10.2	10.9	12		10.9
Optional Sludge Storage										
3 Day Storage	m3	20.0	21.4	22.9		30.7	32.8	35.1		21
5 Day Storage	m3	33.4	35.7	38.2		51.1	54.7	58.5		36
7 Day Storage	m3	46.7	50.0	53.5		71.5	76.6	81.9		50
14 Day Storage	m3/day	93.4	100.1	106.9		143.1	153.1	163.8	0.0	100
21 Day Storage	m3/day	140.1	150.1	160.4		214.6	229.7	245.8	0.0	150

4.2.3.7 Membrane Bioreactor

MBR process technology is a physical barrier treatment process in addition to a biological process. Treatment involves applying a vacuum suction to draw water through the membrane. Particles larger than the membrane pore size (0.1 micron) are retained on the membrane surface. Water that passes through the membrane is considered filtered water. Due to the membrane pore size, MBR's require excellent pre-screening to eliminate larger objects and debris that could foul or damage the membrane.

Subsequent to screening, water flows into a pre-anoxic tank. The water is mixed in the absence of oxygen to reduce nitrogen levels in the water. Biological activity occurs in the aeration tank where microorganisms degrade organic matter in the water, providing further removal of nutrients. The MBR can provide high levels of treatment including significant nutrient removal. In addition, some proprietary MBR systems have been proven to remove micro-organisms (E coli, fecal coliforms, and total coliforms) to levels lower than regulation requirements. This is possible because the physical barriers consisting of pores smaller in size than micro-organisms.

Particle build-up on the membrane surface is controlled in three ways. Compressed air is introduced at the bottom of the membrane system, which removes retained particles from the membrane surface and maintains aerobic conditions. The system is also backwashed periodically by reversing the flow of the water through the membrane with small additions of chlorine to remove particle build-up. The system can be designed to introduce air at specific time intervals or when the monitoring system indicates a maximum pressure level is reached at the membrane surface. Chemical cleaning is also required approximately two to three times a year.

Minimum specifications for SUEZ's proposed MBR equipment are summarized in Table 4.11.

The MBR equipment supplier for the ERPM MBR is SUEZ Water Technologies & Solutions Canada. A firm proposal provided by SUEZ outlines the details of the equipment and services to be provided.

Table 4.11: Membrane Bioreactor System Performance Requirements							
Parameter	**Specification**						
Influent Wastewater Characteristics							
Flows		Ave Day	Max Month	Max Day	Peak Hour	**Design**	Units
Stage 1 Flows		188	282	376	837	**282**	m3/d
Stage 2 Flows		288	432	576	1,295	**432**	m3/d
Quality		Ave Day	Max Month	Max Day	Peak Hour	**Design**	Units
BOD5		350	250	200	468	**250**	mg/L
TSS		350	250	200	632	**250**	mg/L
Temperature	Min Day	Ave Day		Max Day		**Design**	Units
	7	14		22		**9**	oC
Other Parameters	**Design**						Units
VSS / TSS	**0.761**						mg/L
NH3-N	**32**						mg/L
TKN	**55**						mg/L
TP	**11**						mg/L
Alkalinity	**250**						mg/L as CaCo3
COD / BOD	**2**						
pH	**8**						
E Coli	**High**						CFU/100mL
Fecal Coliform	**High**						CFU/100mL
Site Elevation	**511.6**						m
Treated Effluent Requirements - AEP Approval							
	Month Average						Units
BOD5	≤ 5						mg/L
TSS	≤ 5						mg/L
NH3-N	≤ 1						mg/L
TP	≤ 1						mg/L
Fecal Coliform	≤ 200						CFU/100mL
Treated Effluent Targets							
	Month Average						Units
TN	≤ 10						mg/L
Alkalinity	≤ 50						mg/L as CaCo3
Turbidity	≤ 0.3						NTU
E. Coli	≤ 200						CFU/100mL
Dissolved Oxygen	> 2						mg/L
Turbidity	≤ 0.5 NTU, 95% of the Time ≤ 1.0 NTU, 100% of the Time						
Headworks Equipment							
Wetwell Pumping	To be supplied by Others						
	Capacity:		Stage 2 Max Day Flow				
	Control		• Start/Stop Signal from the Main PLC paced on level in wetwell • VFD Controlled by Main PLC				
Fine Screening	To be supplied by **SUEZ**						
	Capacity:		Stage 2 Max Day Flow				
	Size:		2mm Drum Screen				
	Control		Start/Stop Signal from the SUEZ PLC based on Influent flow				
Biological Reactor Design							
General	• Two (2) parallel treatment trains consisting of an Pre- anoxic, Aeration and Post Anoxic Zones. • MBR Supplier to complete design for the Stage 2 development period.						
Tankage:	Steel Tank by SUEZ						
Treatment Capacity:	Pre Anoxic:	Stage 2 Max Month Flow					
	Aerobic	Stage 2 Max Month Flow					
	Post Anoxic	Stage 2 Max Month Flow					
Hydraulic Capacity	Stage 2 Max Day Flow						
Max. Mixed Liquor Concentration :	8,000 mg/L for Stage 1 Design						
	10,000 mg/L for Stage 2 Design						
Minimum Volumes	Pre - Anoxic	26 m3					
	Aerobic	55 m3					
Modelling Software	Biowin or Approved Equal						
Membrane System							
Design	**Supplier to Design and supply MBR equipment for Stage 1 conditions**						
No. of Trains:	Stage 1		One (1) with 2 Cassettes, train to be placed in its own tank				
	Stage 2		One (1) with 3 Cassettes, train to be placed in its own tank				
Capacity:	Phase 1		Max Month Flow with N-1 Condition				
	Phase 2		Max Month Flow with N-1 Condition				
Max. Mixed Liquor Concentration:	Phase 1		8,000 mg/L				
	Phase 2		10,000 mg/L				
Max Flux Rate:	20 LMH @ MMF						
Operation	Pressure						
Type	Hollow Fiber						
Backwash Rate	MBR Supplier to specific						
Nominal Pore Size:	0.04 to 0.4 microns						
Aeration System	• To be provided by the MBR supplier						
Membrane Tank Influent Valves	• Influent Flow into the membrane units to be controlled by flow control valves for each train • Flow control valves to be supplied by Others.						
Membrane Tank Drain Valves	• Membrane Tank Drain valves to be supplied by Others. • Valves to be terminated to MBR Vendor PLC						

Equipment			
All equipment to be supplied by MBR Vendor/Supplier unless otherwise noted			
Permeate Collection, Piping and Pumping System	General	One per Train	
		Provide isolation for each rack/cassette in membrane tank	
	Pump Type:	Bi-directional rotary lobe pumping equipment, self-priming pump, abrasio	
	Quantity:	One (1) duty per membrane train	
	Capacity:	Capacity to be determined by MBR Supplier	
	Control:	VFD Controlled by MBR Supplier PLC	
	Manufacturer:	Borger, Vogelsang, or approved equal	
Mixed Liquor Recirculation System	Description	Submersible Centrifugal Pump	
	Quantity	Provide one (1) individual recirculation pump for each membrane tank.	
	Capacity:	To be determined by MBR Supplier	
	Control:	VFD Controlled by MBR Supplier PLC	
	Manufacturers	Xylem's N3000 Series Pump or approved equal	
Cleaning System	Provide chemical dosing systems for all cleaning and neutralization chemicals required by the membrane system		
	One (1) duty and one (1) standby pump for each chemical.		
	Controls:	Controlled by MBR Supplier PLC	
Blowers	Type:	Positive Displacement	
	Quantity:	One (1) , one for each membrane tank	
		Two(2) , one for each aeration tank	
		One (1) to service the Sludge Storage Tanks	
	Capacity	Bioreactor Tank	Stage 2 max month air flow requirements
		Membrane Tanl	MBR Supplier to Provide
		Sludge Tank:	Stage 2 average day air flow requirements
	Controls	Aeration Tank:	• Continuous aeration when tank is online / filling • VFD paced on dissolved oxygen residual in bioreactors
		Membrane Tank:	Intermittent start stop cycle based on Supplier recommendations
		Digester Tank:	• Continuous aeration when tank is online / filling • VFD paced on dissolved oxygen residual in digesters
		Controlled by MBR PLC	
	Manufacturers:		
Aeration System	Aeration Reactors	Type:	Fine bubble diffusers
		Quantity:	Two(2) diffuser grids per aeration tank
	Digester Reactors	Type:	Course bubble diffusers
		Quantity:	one (1) diffuser grids per digester tank
	Manufacturers:	EDI or approved Equal	
Alum Feed System (Supplied by others)	General	For phosphorous removal	
	Control	• Field devices terminated to MBR Vendor PLC (3AI, 1AO, 2DI)• Controlled b	
Sodium Hypochlorite Feed System (Plant Service Water Disinfection)	General	For plant service reuse water disinfection	
		To be provided by MBR Supplier	
	Pumps	Type:	Peristaltic Pumps
		Manufacturer:	Stenner, Blue White or approved equal
	Accessories:	• Injection Quill, Strainer, sinker foot valve, and tubing	
	Control	• Field devices terminated to MBR Vendor PLC (1AI, 1AO, 1DI)	
Piping and Valves Specifications			
Chemical Piping	PVC Sch.80		
Process Piping	Stainless Steel 316 Sch 40		
Compressed air piping	Stainless Steel 304 Sch 40		
Blower Air Piping	Stainless Steel 304 Sch 10		
Plug valves	Keystone or Bray		
Butterfly valves	Keystone or Bray		
Valve Actuators	Rotork or approved equal		
Air valves	Installed at all high points		
Instrumentation Specifications			
Process	Level:	Endress Hauser, Rosemount, ABB	
	Flow:	Endress Hauser, Rosemount, ABB	
	Pressure:	Endress Hauser, Rosemount, ABB	
Analyzers	pH/Temperature:	DPD1P1 as manufactured by Hach or approved equal	
	Dissolved Oxygen:	Hach's LDOsc or DRS5; or approved equal	
	Turbidimeter:	TU 5300sc Turbidity Meters as manufactured by Hach:	
	Ammonia:	AN-ISE as as manufactured by Hach or approved equal	
	Level Switches:	Probe Type	Endress Hauser or approved equal
		Float Type	Flygt's ENM-10 or approved equal
Transmitters	SC 200 or SC 1000 by Hach		
Controls:			
PLC	Allen Bradley Compact Logix		
HMI	• AB PanelView • To be capable of remote access		
PLC and HMI application Programming	MBR Supplier to provide.		
Communication Platform	Ethernet I/P		
Trending	Supplier to ensure controls systems has trending and data logging capabilities		

4.2.3.8 UV Disinfection

Disinfection of wastewater is required to reduce organisms such as bacteria, viruses, and protozoan cysts that are commonly found in wastewater. Disinfection can be performed by several methods; however, UV disinfection is a proven technology and has been proposed for the ERPM and will be supplied by SUEZ. The UV disinfection system will consist of two “in pipe treatment” UV reactors downstream of the permeate pumps just prior to discharge from the WWTF. The configuration of the ERPM WWTF is conducive to a closed-vessel or pressurized UV reactors. UV reactors are available in multiple configurations to treat a wide range of flow rates. The closed vessel systems can disinfect filtered effluent without interrupting the hydraulic profile of the treatment process. UV disinfection can provide environmentally friendly, chemical-free treatment for chlorine resistant microorganisms (such as Cryptosporidium and Giardia). Minimum specifications for the UV disinfection equipment expected from SUEZ is summarized in Table 4.12.

Table 4.12: Disinfection Equipement Specifications	
Parameter	**Specification**
General	
Waranty	• 1 years minimum from time of commissioning/system startup • UV lamps to be warantted for 12000 hours of operation or 36 months after shipment. • The balasts shall be warranted for 5 years.
Commissioning and Training	1 visit, 3 days minimum per reactor and 1 day minimum for operator training
Manuals	Two (2) copies of O&M Manuals
Equipement Size and Foot Print	Supplier to identify
Classification	Non - Classified
Design Criteria	
Design Flow	Stage 2 Max Day Flow = 576 m3/d
Redundancy Condition	One duty; One standby; two operate in parallel in high flow condition
Total Suspended Solids	5 mg/L
Ultraviolet Transmittance @ 253.7nm	65%
Effluent Standard to be Guaranteed	200 / 100 ml fecal coliform, based on30 day geometric mean of daily samples
Temperature	7 - 20 Degrees Celsius
Minimum dosage	supplier to specify
Disinfection Equipement	
Description	Provide a UV disinfection system complete with UV lamp modules, level control, and UV monitoring system, automatic wiping system, temperature switch.
Quantity	Two (2)
Model	Supplier to specifcy
Dimensions	Supplier to Specify
Materials of Construction	316L Stainless Steel,
Intallation	Horizontal "In-Pipe Treatment"
Lamps	High intensity low pressure amalgam
Electrical and Controls	• The Vendor supplied control shall be based using various field instruments and PLC, and designed and programmed for the automated operation of the Sludge De-watering system. System design shall include for communication with main WWTP PLC and SCADA system.
Accessories	• Vendor to provide as required for full funtional system • All mechanical equipment and other components and accessories necessary for reliable operation. • UV Monitor
Spare Parts	Indicate all spare parts to be supplied
Maintenance	Provide 1 years supply of maintenance and cleaning supplies

4.2.3.9 Effluent Pumping

Proposed effluent pumping for the ERPM MBR WWTF consists of two (2) identical 2.7 HPsemi-permanent centrifugal pumps. The pumping capacity is such that, with the largest pump out of service, the remaining pumps can handle peak flow conditions. Under normal operating conditions, only one pump will operate, and the pump control will engage a second pump to run during periods of high flow when required. Design criteria for effluent pumping equipment are summarized in Table 4.13.

Table 4.13: Effluent Pumping Design Criteria										
Design Parameter	Unit	Stage 1 - Current Design				Stage 2 - Future Design				Design Criteria
		Ave. Day Flow (ADF)	Max Month Flow (MMF)	Max Day Flow (MDF)	Peak Hourly Flow (PHF)	Ave. Day Flow (ADF)	Max Month Flow (MMF)	Max Day Flow (MDF)	Peak Hourly Flow (PHF)	Design (Stg 2 MMF)
Flow										
Flow	m3/day	188	282	376	837	288	432	576	1295	
	L/sec	2.2	3.3	4.4	10	3.3	5.0	6.7	15	
Effluent Pumping										
Design Flow	m3/day	188	282	376	837	288	432	576	1295	576
	L/sec	2.2	3.3	4.4	10	3.3	5.0	6.7	15	6.7

4.2.3.9.1 Effluent Pump Duty Point

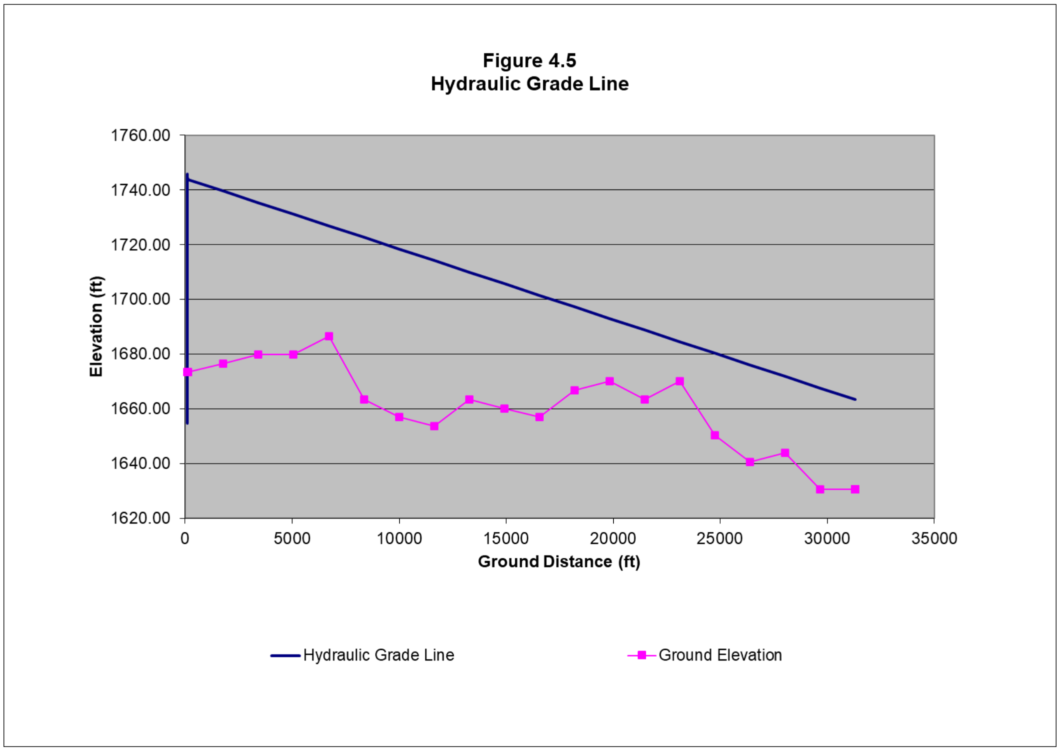
The total dynamic head (TDH) was determined under the assumption that the total flow of a single pump is able to achieve the max day flow of 6.7 L/s (106 USgpm). Additionally, the piping of the effluent pump system was analyzed based on the following assumptions:

- Future forcemain shall be 150mmm HDPE DR 17 pipe.
- Routing of the forcemain shall run south on the Reserve's main access road and east on Township Road 360 to discharge at the South Saskatchewan River. Figure 4.4 a snip showing the conceptual forcemain routing presented in the DUIS study and used for the preliminary pipe sizing. Approximate total distance of force main is 9.5 km (31,100 ft).

Figure 4.4: Conceptual Forcemain Routing and Discharge

The analysis determined that to achieve a total flow of 6.7L/s each pump would require a duty point of **6.7 L/s (238 USgpm) at 12.5 m (114 ft).** The new pumps addition will require a 2.7 HP motor. Since the pumps will be operated with a VFD, the motors will be specified as premium efficient, invertor duty.

Figure 4.5 shows the conceptual hydraulic profile of the future forcemain pipeline for the duty point; adjustments to the pump head value were made to ensure the HGL is above the pipe high points.



4.2.3.9.2 Net Positive Suction Head Available Analysis

The NPSHA analysis was completed. Pump flows were varied from the minimum flow requirement to the maximum flow requirement. The NPSHA at the pump inlet has been determined to be 5.23 m based on the minimum pump submergence level of 0.6 m.

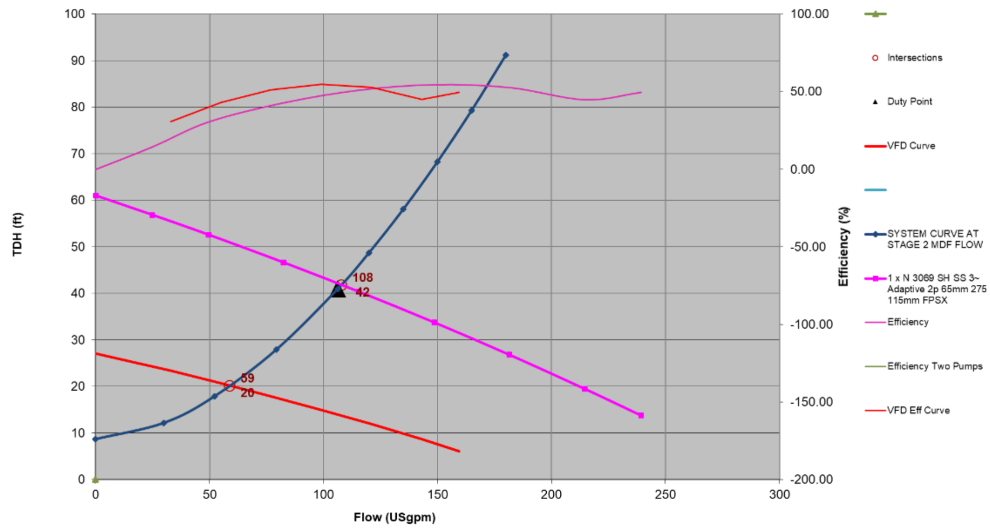
4.2.3.9.3 Pump Selection

The influent pumps are specified to be self cleaning semi open channel impeller pumps for pumping of wastewater containing solids and long fibrous material. The **N 3069** pumps by Xylem was determined to have the best fitting curve that met the design point and is recommended to be the selected pump for the proposed project. Both wet pit and dry pit applications are available for this pump. These pumps are highly reliable, easy to remove and work on, and are specified in many wastewater effluent applications and treatment plants in Western Canada.

4.2.3.9.4 System Curve Analysis

Figure 4.6 summarizes the hydraulic analysis and provides an illustration of the selected pump curve. In addition, the curve is shown at various operating speeds.

Figure 4.6
Effluent Pumping System Curve



4.2.3.9.5 Pump Variable Speed Analysis

The minimum speed of the pump will be set as per manufacturer's recommendations, which is typically 40Hz. At this speed, the pump will be capable of a flow rate of 3.7 L/s (59 USgpm).

4.2.3.9.6 Transient Analysis

A transient analysis was performed on the proposed piping for this project. Forces developed from the start-up and sudden shutdown of the pumps and closing of valves were reviewed. The transient analysis determined the time of wave propagation, as well as the surge pressures the system may encounter. The assumptions used for this analysis were based the maximum pressure the pumps will operate at. This condition exists when the tank is at the overflow condition. The maximum operating pressure of the piping system has been determined to be 9.97 psig. Based on the transient analysis, the maximum surge pressure that can be encountered is 45 psig. If the pumps were to be shut down instantly and the wave of propagation had no outlet (i.e. did not have tank open to atmosphere), the maximum force that can be encountered in the piping is 2.87 kN (643 ft lb). To ensure this force does materialize, isolation valves have not been automated and will remain open during normal operation.

All pipe thrust supports for the piping on the discharge side of the pumps will be designed to withstand forces based on the weight of piping and fittings as well as a maximum surge pressure in the piping system of 276 kPa (40 psig). In other words, the supports will be designed to withstand a maximum force of 2.87 kN (643 ft lb).

4.2.3.9.7 Semi-Permanent Centrifugal Pump & Motor Specifications

Specifications for the additional effluent pump are summarized in Table 4.14.

Table 4.14: Effluent Pump Schedule			
Tag		P8101	P8102
Manufacturer		Flygt	Flygt
Series		N-pump Premium Efficiency	N-pump Premium Efficiency
Model		N 3069 SH 3~ Adaptive 4p	N 3069 SH 3~ Adaptive 4p
Type		Submersible Centrifugal	Submersible Centrifugal
Pressure Class		Medium Head	Medium Head
Installation Type		Semi Permanent, wet well arrangement	Semi Permanent, wet well arrangement
Impeller Diameter		115 mm	115 mm
No. of Blades		2	2
Impeller Material		Cast Iron	Cast Iron
Duty Point	Flow (L/Sec)	6.79	6.7
	TDH (m)	12.8	12.8
	NPSHR (m)	5.23	5.23
	EFF (%)	54.7	54.7
Pump Operating Speed	Min (RPM)	2600	2600
	Max (RPM)	3500	3500
BHP		2.2	2.2
Motor (HP)		2.7	2.7
Minimum Submergence		610 mm	610 mm
Discharge Flange		80 mm	80 mm
Suction Flange		-	-
Flange Rating		ANSI Class 125/150	ANSI Class 125/150
Flange Bolt Patern		ANSI Class 150 B16.5 Flange	ANSI Class 150 B16.5 Flange
Major Castings		Cast Iron, Gray 35B	Cast Iron, Gray 35B
Pump Housing		Cast Iron, Gray 35B	Cast Iron, Gray 35B
Impeller		Cast Iron, Gray 35B	Cast Iron, Gray 35B
Insert Ring		Cast Iron, Gray 35B	Cast Iron, Gray 35B
Inner Cooling Jacket		Aluminum AA1050	Aluminum AA1050
Outer Cooling Jacket		Stainless Steel 316L	Stainless Steel 316L
Lifting Handle		Stainless Steel 316L	Stainless Steel 316L
Shaft		Stainless Steel 431	Stainless Steel 431
Screws and Nuts		Stainless Steel 316	Stainless Steel 316
O-Rings		Nitrile Rubber (NBR)	Nitrile Rubber (NBR)
Heat Transfer Fluid		Glycol	Glycol
Inner Mechanical Seal		Corrosion Resisitant Cemented Carbide	Corrosion Resisitant Cemented Carbide
Outer Mechanical Seal		Silicon Carbide	Silicon Carbide
Coatings	Pump	Navy Gray Epoxy Coating	Navy Gray Epoxy Coating
	Motor	Navy Gray Epoxy Coating	Navy Gray Epoxy Coating
Accessories		Sole Plate; Performance Testing (Non-Witness)	Sole Plate; Performance Testing (Non-Witness)
Motor Information			
Tag		P2101	P2102
Motor Type		Squirrel-cage induction motor	Squirrel-cage induction motor
Starting Method		VFD	VFD
Power		2.7 HP/3 Phase/575 VAC/60 Hz	2.7 HP/3 Phase/575 VAC/60 Hz
S.F.		1.15/1.0	1.15/1.0
Number of Starts per Hr		20	20
Code Compliance		IEC 60034-1	IEC 60034-1
Accessories		Inverter Duty, Premium Efficient	Inverter Duty, Premium Efficient

4.2.3.10 Effluent Storage Chamber

Treated effluent will be stored in a 100m^3 chamber prior to pumping to the future discharge point at the South Saskatchewan River. In the interim, effluent will be hydraulically connected to the proposed storm pond being implemented adjacent to the WWTF by Urban Systems. This effluent would be sufficient for irrigation purposes.

4.2.3.11 Bioreactor Blower & Aeration System

The process air supply for the proposed facility will include positive displacement blowers, piping, and fine and coarse bubble diffusers. These will become integral with the SUEZ's proposed MBR treatment system.

4.2.3.11.1 Blowers

The proposed facility will include Two (3) process positive displacement blowers that will provide process air for the bioreactors and sludge storage tank. The bioreactor will utilize two (2) 15 HP blowers for its air requirements while the WAS chamber will utilise a single 15 HP blower for its air requirements. Each bioreactor blower is sized for the maximum air requirements of a single bioreactor. The blowers will be controlled with a process control loop that will reduce blower speed when adequate dissolved oxygen is met in the bioreactors and the digester. A dissolved oxygen analyzer will provide online and continuous measurement of DO, with targets of 2 mg/L.

Table 4.15 shows the schedule for the initial blower selection by SUEZ. This blower schedule shall be updated to mimic the exact units being supplied as the design is refined.

Table 4.15: Bioreactor Blower Schedule

Tag		BL 6301	BL 6302	BL 6303
Location		Bioreactor	Bioreactor	WAS
Manufacturer		Aerzon	Aerzon	Aerzon
Series		Delta Blower Generation 5	Delta Blower Generation 5	Delta Blower Generation 5
Model		GM 7L - 80 DN	GM 7L - 80 DN	GM 7L - 80 DN
Type		Postive Displacement	Postive Displacement	Postive Displacement
Enclosure		Acoustical Enclosure (< 75 dB)	Acoustical Enclosure (< 75 dB)	Acoustical Enclosure (< 75 dB)
Discharge Diameter (mm)		80	80	80
Duty Poi	Flow (scfm)	112	112	112
	Discharge (psig)	5	5	5
Blower Speed	Min (RPM)	1200	1200	1200
	Max (RPM)	1800	1800	1800
Motor Speed	Min (RPM)	1200	1200	1200
	Max (RPM)	1800	1800	1800
Motor (HP)		15	15	15
Accessories		Vibation Mounts	Vibation Mounts	Vibation Mounts
Motor Information				
Tag		BL 6301	BL 6302	BL 6303
Motor Manufacturer		TECO - Westinghouse	TECO - Westinghouse	TECO - Westinghouse
Starting Method		VFD	VFD	VFD
Power		10 HP/3 Phase/575 VAC/60 Hz	10 HP/3 Phase/575 VAC/60 Hz	5 HP/3 Phase/575 VAC/60 Hz
S.F.		1.15/1.0	1.15/1.0	1.15/1.0
Number of Starts per Hr		3.4	3.4	3.4
Code Compliance		IEC 60034-1	IEC 60034-1	IEC 60034-1
Monitoring		Bearing & winding Temp, Vibration	Bearing & winding Temp, Vibration	Bearing & winding Temp, Vibration
Accessories		Inverter Duty, Premium Efficient	Inverter Duty, Premium Efficient	Inverter Duty, Premium Efficient

4.2.3.11.2 Diffusers

The aeration system will consist of fine bubble diffuser grid for the bioreactors and course bubble diffuser grid for the sludge holding. Table 4.16 indicates expected diffuser specifications to be incorporated in the SUEZ MBR package to be provided.

Table 4.16: Bioreactor & Digester Diffuser Schedule			
Type		Fine Bubble	Coarse Bubble
Location		Bioreactor	Sludge Holding Tank
Manufacturer		EDI	EDI
Series		FlexAir MiniPanel	PVC MaxAir
Rated Capacity (grid per tank)	Flow (scfm)	78	85
	Discharge (psig)	7.1	7.1
	Submergence (ft)	10	10
	O2 Transfer Eff (%)	35.35	mixing limited
Alfa Factor		0.52	0.7
Beta Factor		0.98	0.98
No. of Diffuser Headers		1 header per aerobic tank	1 header per Sludge tank
Diffuser Material		Polyurethane	PVC
Diffuser Frame		PVC	PVC
Diffuser Stand		304 SS	304 SS

4.2.3.12 Sludge Management

Managing the solids stream generated from municipal wastewater treatment facilities is of significant importance and, therefore, estimating sludge quantity generated is the most important design parameter in treatment and disposal of sludge. The quantity of sludge produced over a predetermined solids retention time in the bioreactors is the basis for sizing the sludge management system, including sludge thickening and storage tank. Finally, sludge quantity will determine annual transportation and disposal expenses to ultimately remove the sludge from site. Sludge management proposed for the ERPM WWTF includes thickening of waste activated sludge (WAS) and sludge storage with aeration to provide digestion. WAS will be chemically conditioned utilizing a polymer solution derived form 30-40% emulsified liquid polymer.

To estimate sludge for the ERPM WWTF, a mass balance was developed for the wastewater treatment system as it relates to solids production. At a minimum, the mass balance accounts for influent flow, influent and effluent BOD, influent and effluent TSS, percentage of BOD and TSS recycled back to headworks from sludge thickening process. Figure 4.7 illustrates the ERPM WWTF solids mass balance.

Figure 4.7: Sludge Management Mass Balance

Sludge Management Mass Balance

Design Criteria

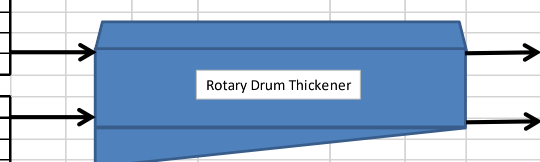
Q:	432	m3/day	*MMF Stage 2*
BOD:	250	mg/L	
TSS:	250	mg/L	

Sludge Thickening

Process Time:	13.5	hrs/week

Feed Flow Rate		
Q	136.2	m3/day
	5.68	m3/hr
%Solids	1.20	%TS
Dry Solids Load	1,639.3	kg/day
	68.3	kg/hr

Polymer Feed		
Requirement	5.0	kg/tonne
Feed Rate	0.34	kg/hr
Liquid Emulsion	30	%
Liquid Polymer Feed Rate	1.09	L/hr
Polymer Soln	0.20	%
Q	0.164	m3/hr



Filtrate (To Influent Wet Well)		
Q	97.9	m3/day
	4.08	m3/hr
Dry Solids Load	82.0	kg/day
	3.4	kg/hr
Recovery Rate	95.0	%
TSS	837.3	mg/L

Thickened Sludge (To TWAS Storage)		
Cake Volume	38.5	m3/day
	1.60	m3/hr
Dry Solids	1557.4	kg/day
	64.9	kg/hr
%Solids	4.0	%

4.2.3.12.1 Waste Activated Sludge (WAS) Thickening

Wasted Activated sludge would likely be 0.8% to 1.0% range for solids after wasting from the MBR.

Thickening will bring the solids content to 4 to 5% solids prior to Sludge Storage. This will reduce the tank volume requirements of the sludge storage while ensuring proper solids and hydraulic retention times in the sludge storage.

Rotary drum thickeners have cylindrical drums with a progressive series of screen elements that are mounted horizontally on four shaft-mounted wheels and supported in a structural housing. The smallest openings are used to screen the influent sludge, followed by coarser elements as the sludge thickens. The screening element will be woven mesh and will be used to remove free liquids from a variety of sludge, including those with appreciable amounts of microbial particles. Sludge containing 0.5% - 3% solids can be thickened to 5% - 15%, depending on the type of sludge. As sludge is pumped to the thickener, polymer solution is injected prior to sludge entering a tank. Conditioned sludge overflows into the distribution head box and is fed gently on the inside surface of the screen cylinder. The floc created is retained on the screen surface as the liquid flows rapidly through the screen opening. The liquid filtrate is collected and directed to an outlet on the bottom of the discharge pan which is then diverted back to the headworks. Solids are transported by flights along the cylinder and discharged out the open end and exiting through the discharge chute. The thickened sludge attains high levels of consistency as the rotation induces the free liquid to drain away. A shower bar along the top section applies an intermittent cleaning shower to keep screen openings clean. Thickened sludge is diverted by gravity to the sludge holding tank. Design criteria for the proposed rotary drum thickener are summarized in Table 4.17.

Table 4.17: WAS Thickening Design Criteria										
Design Parameter	Unit	Stage 1 - Current Design				Stage 2 - Future Design				Design Criteria
		Ave. Day Flow (ADF)	Max Month Flow (MMF)	Max Day Flow (MDF)	Peak Hourly Flow (PHF)	Ave. Day Flow (ADF)	Max Month Flow (MMF)	Max Day Flow (MDF)	Peak Hourly Flow (PHF)	Design (Stg 2 MMF)
Flow										
Flow	m3/day	188	282	376	837	288	432	576	1295	
	L/sec	2.2	3.3	4.4	10	3.3	5.0	6.7	15	
Liters per capita day	lpcd	40	40	54	119	41	62	82	185	
Influent Parameters										
BOD	mg/L	350	250	200		350	250	200		
TSS	mg/L	350	250	200		350	250	200		
TKN	mg/L	44	34	34		44	34	34		
Alkalinity	mg/L	250.0	250.0	250.0		250.0	250.0	250.0		
TP	mg/L	11.0	11.0	11.0		11.0	5.6	5.6		
T (minimum)	C	9.0	9.0	9.0		9.0	9.0	9.0		
Effluent Parameters										
BOD	mg/L	5.0	5.0	5.0		5.0	5.0	5.0		5.0
TSS	mg/L	5.0	5.0	5.0		5.0	5.0	5.0		5.0
NH4-N	mg/L	1.0	1.0	1.0		1.0	1.0	1.0		1.0
DO	mg/L	2.0	2.0	2.0		2.0	2.0	2.0		2.0
TN	mg/L	10.0	10.0	10.0		10.0	10.0	10.0		10.0
TP	mg/L	1.0	1.0	1.0		1.0	1.0	1.0		1.0
Waste Activated Sludge Thickening										
Sludge Feed Rate	m3/day	6.7	7.1			10.2	10.9			10.2
weekly	m3/week	46.7	50.0			71.5	76.6			71.5
Miminum RDT Sludge Feed Rate	m3/day	136.2	136.2			136.2	136.2			136.2
	m3/hr	5.7	5.7			5.7	5.7			5.7
Process Time	hrs / week	8.2	8.8			12.6	13.5			12.6
	hrs / day	1.2	1.3			1.8	1.9			1.8
% Solids	%TS	1.0	1.2			1.0	1.2			1.0
Dry Solids Load	kg/day	1366.1	1639.3			1366.1	1639.3			1366.1
	kg/hr	56.9	68.3			56.9	68.3			56.9
Polymer Feed Requirement	kg/tonne_solids	5.0	5.0			5.0	5.0			5.0
Polymer Feed Rate by Weight	kg/hr	0.28	0.34			0.28	0.34			0.3
Polymer Soln	%	30.0	30.0			30.0	30.0			30.0
Polymer feed rate	L/hr	0.912	1.095			0.912	0.164			0.9
Filtrate Flow to Wet Well	m3/day	104.3	97.9			104.3	97.9			104.3
	m3/hr	4.34	4.08			4.34	4.08			4.3
Dry Solids	kg/day	68.3	82.0			68.3	82.0			68.3
	kg/hr	2.85	3.42			2.85	3.42			2.8
Recovery Rate	%	95	95			95	95			95.0
Filtrate TSS	mg/L	655	837			655	837			655.0
Cake Volume	m3/day	32.06	38.5			32.1	38.5			32.1
	m3/hr	1.3	1.6			1.3	1.6			1.3
Daily Cake Volume Production	m3	1.6	2.0			2.4	3.1			2.4
Weekly Cake Volume Production	m3	11.0	14.1			16.8	21.6			16.8
Monthly Cake Volume Production	m3	47.1	60.6			72.2	92.7			72.2
Annual Cake Volume Production	m3	573.3	737.0			878.0	1127.8			878.0
Dry Solids	kg/day	1297.8	1557.4			1297.8	1557.4			1297.8
	kg/hr	54.1	64.9			54.1	64.9			54.1
Daily Dry Solids Production	kg	63.6	81.7			97.4	125.1			97.4
Weekly Cake Volume Production	kg	445.1	572.2			681.6	875.5			681.6
Monthly Cake Volume Production	kg	1907.6	2452.3			2921.2	3752.3			2921.2
Annual Cake Volume Production	kg	23208.7	29835.7			35541.1	45653.5			35541.1
%Solids	%TS	4.0	4.0			4.0	4.0			4.0

Specifications that would be implemented for the future rotary drum thickener equipment are summarized in Table 4.18.

Table 4.18: Sludge Thickening Specifications	
Parameter	**Specification**
General	
Description	The Sludge thickening system must be able to satisfactorily thicken waste activated sludge from the MBR reactors on a continuous basis. MBR effluent will be used for the washwater
Warranty	1 years minimum from time of commissioning/system startup
Commissioning and Training	1 visit, 5 days minimum (1 day minimum for operator training)
Manuals	Two (2) copies of O&M Manuals
Equipment Size and Foot Print	Supplier to identify
Waste Activated Sludge Characteristics	
Max. Month Flow Sludge Production	10.9 m3/day @ 1%
Ave. Day Sludge Production	10.2 m3/day @ 1%
Solids Range	3.5 - 5%
Design Criteria	
Max. Month Flow Sludge Production	10.9 m3/day @ 1%
Target Solids	4 - 5%
Minimum Solids	4%
Solids Capture	Supplier to Specify
Basis	The system shall be able to process max day sludge production assuming continuous operation 24 hr./day.
Sludge Thickening Equipment	
Quantity	One (1)
Type	Rotary Drum Thickener
Construction	304 Stainless Steel
Covers	304 Stainless Steel
Head Box and Internals	304 Stainless Steel
External Spray Bar	• 304 Stainless Steel sch 40 pipe • Stainless Steel fan spray nozzles
Temperature	7 - 20 Degrees Celsius
Accessories	• Sludge Hopper (if required) • Mixing Valve • Flocculation reactor (if required)
Drive System	• Helical Gear Drive • TEFC Enclosure • Stainless Steel Drive Chain
Maximum Solids Loading	Supplier to Specify
Electrical	575 VAC; 3PH; 60Hz
Electrical Classification	Zone 1(Class 1 Division 1)
Controls	• Controls to be performed by WWTP main PLC. • No integral control panel required. Control logic to be integrated into main PLC

4.2.3.12.2 Sludge Storage

It is proposed to construct a sludge storage tank to store and stabilize sludge produced form the ERPM WWTF. Aeration will be provided in the tank for stabilisation of the sludge. The sludge can then be recovered on a regular basis and transported to the City of Saskatoon's WWTF for further processing and disposal.

The sludge storage tank will be designed to provide at least two (4)) week storage of thickened WAS sludge (4%) for Stage 2 of the MBR treatment system. Design criteria for the sludge storage are summarized in Table 4.19.

Table 4.19: Sludge Storage Design Criteria										
Design Parameter	Unit	Stage 1 - Current Design				Stage 2 - Future Design				Design Criteria
		Ave. Day Flow (ADF)	Max Month Flow (MMF)	Max Day Flow (MDF)	Peak Hourly Flow (PHF)	Ave. Day Flow (ADF)	Max Month Flow (MMF)	Max Day Flow (MDF)	Peak Hourly Flow (PHF)	Design (Stg 2 MMF)
Flow										
Flow	m^3/day	188	282	376	837	288	432	576	1295	
	L/sec	2.2	3.3	4.4	10	3.3	5.0	6.7	15	
Influent Parameters										
BOD	mg/L	350	250	200		350	250	200		
TSS	mg/L	350	250	200		350	250	200		
TKN	mg/L	44	34	34		44	34	34		
Alkalinity	mg/L	250.0	250.0	250.0		250.0	250.0	250.0		
TP	mg/L	11.0	11.0	11.0		11.0	5.6	5.6		
T (minimum)	C	9.0	9.0	9.0		9.0	9.0	9.0		
Sludge Storge (Digestion)										
Sludge Holding Tank air flow rate at field conditions	m3/min	1.57	1.7	1.8		2.4	2.6	2.8		2.4
	ACFM	55	59.4	63.4		84.9	90.9	97.2		84.9
	Nm3/hr	94	100.9	107.8		144.2	154.4	165.1		144.2
Sludge Holding Tank Blower Power	HP									0.0
Sludge Holding Tank Design Hydraulic Retention Tin	day	30.0	30.0	30.0		30.0	30.0	30.0		30.0
Sludge Holding Tank Volume based on HRT	m3	50	53	57		76	81	87		76.0
VSS loading rate for first stage tank (HRT)	kg/m3d	1.3	1.3	1.3		1.3	1.3	1.3		1.3
Design SRT for pathogen kill (winter conditions)	day	60.0	60	60.0		60.0	60.0	60.0		60.0
Minimum Temperature	C	9.0	9	9.0		9.0	9.0	9.0		9.0
Sludge Holding Tank Volume based on VSS Reductic	m3	34	36	39		52	55	60		52.0
VSS loading rate for first stage tank (VSS reduction)	kg/m3d	1.97	1.97	1.97		1.97	2.01	1.97		2.0

The tank shall be designed for 100m^3 of sludge storage, which would also encompass the TWAS storage and aeration requirement to ensure sludge is mixed and aerated. This will prevent it from becoming septic.

4.2.3.13 *Ancillary Systems*

4.2.3.13.1 *Plant Service Water*

The facility will be designed to limit consumption of potable water for process plant service water. All processes that require water for solution make-up, screening, and other uses will be performed with treated effluent. A side stream of treated effluent will be disinfected and distributed throughout the proposed facility for various uses. Treated effluent will be diverted to a 6.5 m^3 permeate storage tank after UV disinfection. Sodium hypochlorite will be added to treated effluent prior to the permeate tank and sufficient contact time will be provided to ensure a 4.0 log reduction in viruses. Plant service water will be distributed through the WWTF utilizing multistage inline pumps and a distribution piping network. Reuse plant service water will be used for screening washing, polymer solution preparation, RTD and centrifuge cleaning, and other in plant uses such as cleaning. Free chlorine residual in the plant service water will be monitored with an online chlorine analyzer. Potable water will be used in all occupied areas for sinks, showers, and toilets. Table 4.20 summarizes plant service requirements for the ERPM WWTF.

Table 4.20: Plant Service Water Design										
Item	Description	Type	Operation	Peak Demand			Average Demand			Pressure Required
				(l/min)	(l/sec)	(USgpm)	(l/min)	(l/sec)	(USgpm)	(psi)
1a	Drum Screen (23 jets @ 1 Usgpm ea)	Intermittent	On/Off	87	1.4	23	11	0.2	2.9	40
1B	Drum Screen Press Zone Wash (7 nozzles @ 1 Usgpm ea)	Intermittent	On/Off	26	0.4	7	3	0.1	0.9	40
5	In Plant Use	Occasional	On/Off	72	1.2	19	9	0.1	2.4	60
6	Polymer Motive Stream (RTD)	Continuous	On/Off	8	0.1	2	8	0.1	2.1	50
8	Rotary Drum Thickener (14 jet @ 1 Usgpm ea)	Continuous	On/Off	53	0.9	14	53	0.9	14.0	40
Total	**Peak Distribution Flow**			**246**	**4.0**	**65**	**84**	**1.4**	**22**	

Table 4.21 presents the effectiveness of CT disinfection when utilizing a 2.2 m^3 permeate tank, maintaining a 4 mg/L free chlorine residual within the tank, and assuming the tank is 75% full.

Table 4.21: Effectiveness of CT Disinfection				
Parameter	**Units**	**Peak Demand**	**Average Demand**	
Temperature	Celcius	0.5	0.5	0.5
pH	pH units	8.0	8.0	8.0
Peak Hourly Flow	L/sec	4.0	1.4	1.4
Proposed PSW Storage Volume				
Total Storage Capacity	m3	2.2	2.2	2.2
75% Full Volume	m3	1.7	1.7	1.7
CT Calculation				
Theoretical Detention Time	min	6.8	19.9	19.9
Baffle Factor (T10/T)		0.30	0.30	1.30
T10	min	2.0	6.0	25.9
Free Chlorine	mg/L	6.0	2.0	4.0
CT	mg/L x min	12.3	12.0	103.6
Inactivation of Viruses				
CT for Inactivation of Viruses (Table 1-B-1)		12.0	12.0	13.0
Inactivation Ratio (CT/CT99.99)		1.0	1.0	8.0
Viruses Log Inactivation: 4(CT/CT99.99)		**4.1**	**4.0**	**31.9**

4.2.4 Sludge Disposal

Sludge will be temporarily stored and aerated in an underground tank adjacent to the lift station and effluent chamber, and then the sludge will have to be pumped and truck hailed to the City's WWTF for further processing in the interim. In stage 2, sludge volume will be significantly reduced.

Table 4.22 summarizes the expected amount of sludge to be hauled offsite annually for the two (2) stages of development in the ERPM.

Table 4.22: Annual Sludge Amounts		
	Stage 1 ADF	**Stage 2 ADF**
Flow (m^3/day)	188	288
BOD (mg/L)	350	350
TSS (mg/L)	350	350
Sludge Production (m^3/day)	6.7	10.3
% Solids	4.0	4.0
Thickened Wet Sludge Volume (m^3/day)	1.57	2.41
Thickened Wet Sludge Volume (m^3/year)	573	878
Sludge Storage Volume (m^3)	100	100
If Pumpout once full, Days to next pump out	**64**	**42**

Sludge removal will be required every 2 months at the start, with frequency expected to include to about every 5 to 6 weeks.

4.2.5 WWTF Classification

The proposed WWTF for ERPM will be classified using the WSA classification system. Classification is based on population serviced, type of processes incorporated into the treatment systems, automation, and level of lab analysis required or undertaken at the facility. A review of the points for the proposed ERPM WWTF was completed based on the *Saskatchewan Water and Wastewater Works Operator Certification Standards; Water Security agency; 2016*. Tables 4.23 (a) and 4.23 (b) summarize the points for the proposed ERPM WWTF. It is anticipated that the WWTF will be classified as a Class II Facility.

Table 4.23 (a): Facility Classification Point System					
Facility	**Unit**	**I**	**II**	**III**	**IV**
WWT	Range of Points	0-30	31-55	56-75	> 76

Table 4.23 (b): Wastewater Treatment/Collection Classification		
Item	**Points**	**ERPM**
Variation in Raw Waste		
Variation in Raw Waste	0 - 6	2
Impact of septage or truck-hauled waste	0 - 4	0
Preliminary Treatment		
Plant pumping of main flow/Lift Stations/Modified	3	3
Screening, comminution	3	3
Grit Removal	3	0
Equalization	1	1
Primary Treatment		
Primary Clarifiers	5	0
Imhoff tanks or similar	5	0
Secondary Treatment		
Fixed film reactor, e.g., RBC with secondary clarifiers	10	0
Activated sludge w.sec clarifiers (inc ext aeration & oxidation ditch)	15	0
Stabilization ponds/lagoons/storage cells, no aeration	5	0
Stabilization ponds with aeration/Aerated lagoons	8	0
Tertiary Treatment		
Polishing ponds for advanced waste treatment	2	0
Chemical/physical advbanced waste treatment w/o secondary	15	0
Chemical/physical advbanced waste treatment after secondary	10	0
Biological or chemical/biological advanced waste treatment	12	0
Nitrification by designed extended aeration only	2	0
Ion exchange for advanced waste treatment	10	0
RO, EDR and other membrane filtration techniques	15	15
Advanced waste treatment chemical recovery, carbon regeneration	4	0
Media filtration	5	0
Additional Treatment Process		
Chemical addition (2 points for a maximum of 6 points)	0 - 6	2
Dissolved air flotation (for other than sludge thickening)	8	0
Intermittent sand filter	2	0
Recirculating intermittent sand filter	3	0
Microscreens	5	0
Generation of oxygen	5	0
Solids Handling		
Solids stabiliation	5	0
Gravity thickening	2	0
Mechanical dewatering	8	0
Anaerobic digestion of solids	10	0
Utilizing digester gas for heat or cogeneration	5	0
Aerobic digestion of solids	6	0
Evaporative sludge drying	2	0
Solids reduction (incl. incineration, wet oxidation)	12	0
On-site landfill for solids	2	0
Solids composting	10	0
Land application of biosolids by contractor	2	0
Land application of biosolids under direction of facility operator in direct responsible charge	10	0

Disinfection (Min. 0 to Max. 10)		
Chlorination or UV radiation	5	5
Ozonation	10	0
Effluent Disposal (Min. 0 to Max. 10)		
Direct recycle and reuse	6	0
Continuous discharge into water body	6	6
Controlled or intermittent discharge into a receiving body of water	4	0
Controlled or intermittent discharge - Overland/Wetlands	2	0
Effluent Irrigation	4	4
Evaporation	2	0
Subsurface	4	0
Facility Characteristics		
Instrumentation	0 - 6	4
Laboratory Control		
Bacteriological/biological	0 - 5	3
Chemical/physical	0 - 10	5
Total		**53**
Class		**II**

4.2.6 Peak Flows Peak Loadings and Emergency Shutdown

Influent storage will be provided within the wet well pumping chamber to provide equalization or dampening of peak flows and loadings as well as a buffer during emergency shutdown procedures. In addition to storage capacity, the chamber will be fitted with a suction piping and camlock by Vacuum Trucks, if required.

The effluent chamber will also have capacity to provide 3.7 days of storage based on MMF. An overflow in the effluent chamber will be connected to the proposed storm pond hence ensuring that the facility will never flood.

4.2.6.1 Peak Flows / Overcapacity and Peak Loadings Mitigation Measures

The proposed WWTF for ERPM will be provided with an equalization or peak flow storage in the wet well chamber sized for the Stage 2 Worst case scenario. During overcapacity or peak flows (as estimated), the chamber will provide 5.7 and 3.7 hours of storage for stage 1 and stage 2, respectively. Peak flows typically do not exceed 1 to 2 hours; therefore, the storage design is conservative.

Level in the chamber will be monitored and if it reaches a predetermined high point, Vacuum Trucks can be ordered to come pump out the wet well chamber. Raw sewage would be trucked to one of the City of Saskatoon Waste Hauler Disposal Stations in an emergency situation.

Peak Loadings will be mitigated in two ways:

1. Adjusting process flow accordingly and utilizing available emergency storage.
2. Increasing air flow to the bioreactors to provide enhanced treatment.

4.2.6.2 Emergency Shut Down Procedure

In the event of an emergency shut down, Stage 1 and Stage 2 developments will allow for up to 25.5 and 16.7 hours of storage, respectively, during Max Day flows. Level in the chamber will be monitored and, if it reaches a predetermined high point, Vacuum Trucks can be ordered to come pump out the chamber. Raw sewage would be trucked to one of the City of Saskatoon Waste Hauler Disposal Stations.

Additionally, the effluent chamber will provide 100 m^3 of additional storage or approximately 13 and 8 hours of additional storage during stage 1 and stage 2 MDFs, respectively. An overflow in the effluent wet well will be connected to the proposed storm pond hence ensuring that the facility will never flood.

Emergency backup power will be provided at the site to provide backup power in case of utility power outage.

4.2.7 Odour Control

ERPM's WWTF will have the entire MBR Biological treatment process will be enclosed in a building. Aerated sludge storage will be totally enclosed in a concrete tank. Aeration is the basis for the biological treatment and typically presents minimal odour issues. In addition, the sludge storage tank will be equipped with diffusers to provide aeration such that the sludge is stabilised. Odour issues from the facility are not anticipated with the current design, however, if odour mitigation is required in the future, provisions will be in place to install carbon filters within the ventilation system.

Details regarding the proposed heating, ventilation, and air conditions for ensuring proper ventilation are discussed in Section 4.6.

4.2.8 Emergency Response Plan (ERP)

The protocol requires that a detailed Emergency Response Plan (ERP) be prepared for the wastewater treatment facility. This ERP would encompass the discussions provided in 4.2.1 to 4.2.7 in more detail and be incorporate in the over all ERP for the reserve.

4.2.9 Long Term Expansion

The Capacity of the MBR Facility is based on current available flows and mostly on estimates based on recommended regulations and typical flows and loadings for similar proposed developments. Conservativeness has been included in the design and the layout as well as building configuration of the facility will allow for future expansion to the south for addition of a third process train.

4.2.10 Storm Pond and Irrigation System

As indicated in Section3.3.2, the initial disposal method for the high-quality treated effluent will be by irrigation. Effluent will be stored in the storm pond being implemented by ERPM and Urban Systems and a portable irrigation pump which directs this water to irrigation system. The storm pond and irrigation pump an system are not part of this scope of work however coordination between MPE and US for the implementation of the pond and connection piping to the WWTF would be required.

4.2.11 Future Forcemain

Disposal by irrigation as identified in 4.2.10 (above) is a temporary measure. Final disposal will be to the South Saskatchewan river located approximately 9.5 km from the facility. Discharge will be by a 150mm diameter HDPE pipe.

4.3 WWTF Site Location and Review

4.3.1 General

The proposed ERPM WWTF, storm pond, and irrigation area will be located in LSD10-02-36-05-3 EXT61. Exact location of the WWTF building is dependant on the following:

- Condition of the subsurface conditions based on previous and the most recent detailed geotechnical investigations completed by MPE.

- Setback limits as required by WSA regulations to buffer the effect of any potential odours and provide a margin of public safety.

4.3.2 Geotechnical Investigation

A geotechnical evaluation of the WWTF site was completed by MPE as part of the design and was compiled in a separate report. the evaluation determined the proposed site is generally suitable for the proposed WWTF; however, the following will need to be considered:

- The clay fill stockpile occupying the area will either need to be moved prior to construction or a new site be selected.
- Water soluble sulphate present in the soil will dictate the use of an S1 exposure class for concrete in contact with soil.
- Low strength clay extending to a considerable depth will increase the overall foundation costs.
- Buried topsoil and silt soils within frost depth make surfacing the site costly. A gravel surfacing structure is recommended.
- A layer of silt, potentially hydraulically connected to the adjacent pond, will likely increase the care of water for any below grade excavations.

4.3.2.1 Recommendations

4.3.2.1.1 Wastewater Treatment Plant Foundation Design

Shallow foundations are recommended as the preferred foundation for the building, given the foundation is placed within the footprint of the existing site stockpile.

4.3.2.1.2 Shallow Foundations

Shallow foundations will require careful planning to be successful and should adhere to the following general recommendations.

- Shallow foundations must be placed on natural, firm high plastic clay only, at an approximate elevation of 503.95.0 ± 0.5 m in the area of the building expansion.
- Any fill, deleterious matter, or soft natural soil that does not meet the design bearing capacity must be completely removed at the time of excavation and replaced with lean mix concrete (or the bearing surface may be lowered to more suitable natural soil).
- The final excavation of the bearing surface should be completed using a smooth trimming bucket and all loose material should be removed from the surface prior to the inspection. Surface should not be allowed to freeze, become desiccated, or saturated at any point during construction.
- MPE should be retained to inspect the exposed bearing surface at the time of excavation. Upon positive inspection, a 50 mm thick concrete mud slab should be placed immediately.
- The net static bearing capacity of the native soil at an elevation of 503.95 ± 0.5 m may be taken as 510 kPa (ultimate). Assuming a slab dimension of approximately 10 m by 20 m.

4.3.2.1.3 Deep Foundation

Design and construction of bored CFA concrete piles should adhere to the following general recommendations:

- The minimum pile length is 9.0 m; however, pile uplift due to frost should be considered when calculating minimum pile lengths. The minimum pile diameter is 0.4 m.

- Friction should be neglected for any portion of the shaft placed within existing or planned fill materials.
- Piles should be spaced no closer than 2.5 times the base diameter, measured center to center. Where piles are spaced closer than this, overlapping stresses must be considered.
- Full time pressure monitoring and reporting of concrete injection pressure and auger torque is required.
- A minimum of two full scale pile PDA load tests are to be supplied by the piling contractor.

4.3.2.1.4 Foundation Concrete

The use of Type HS (or equivalent) Portland cement at a maximum water/cementing material (W/CM) ratio of 0.45 and a minimum 56-day compressive strength of 35 MPa is recommended for foundation concrete and all concrete exposed to groundwater. If available, a proven fly ash may be used as a supplemental cementing material. Higher strengths or lower W/CM ratios may be required due to structural considerations or for exposure to de-icing chemicals.

4.3.2.1.5 Structural Slab Recommendations

Structurally supported slabs are recommended for the generator pad and may be used for the WWTF structure. The following are recommendations for preparation of the structural slab:

- Subgrade prep and leveling graded to prevent ponding.
- Installation of a 150 mm thick void form on the subgrade for temporary support of the floor slab. Installation of the void form should be according to the manufacturer's specifications. Care should be taken to select a void form with adequate temporary strength to support the fresh concrete and slab while curing.
- A continuous sheet of 6 mil thick (minimum) polyethylene vapor barrier should be placed between the void form and the bottom of the slab.
- Penetrations through the structurally supported slabs should be separated from the slab to allow for independent movement of utilities as the ground moves below the floor system.

4.3.3 WWTF Setback Limits

EPB 503 identifies setback requirements of mechanical wastewater treatment plants "to prevent the occurrences of objectionable odours" in neighbouring residential communities during normal operation. Minimum setback limits from an operating mechanical treatment plant are as follows:

- 30 m of the facility property line.
- 30 m of the designated right-of-way of a rural road or railway.
- 100 m of the designated right-of-way of a primary or secondary highway.
- 150 m setback variance from portions of land where a building exists, can or may be constructed. (See Appendix B)
- Proposed 50 m setback variance for locating totally enclosed WWTF within a commercial and light industrial subdivision.

Figure 4.8.1 and 4.8.2 illustrates the proposed WWTF location along with the WSA required setbacks.

NOTES:

1. FOR INFORMATION REGARDING GENERAL NOTES, UTILITIES, SYMBOLS AND ABBREVIATIONS REFER TO THE LEGEND AND ABBREVIATIONS DRAWINGS.
2. CONTRACTOR TO EXPOSE EXISTING UTILITY LINES BY HYDROVAC EXCAVATION AND CONFIRM ELEVATIONS.

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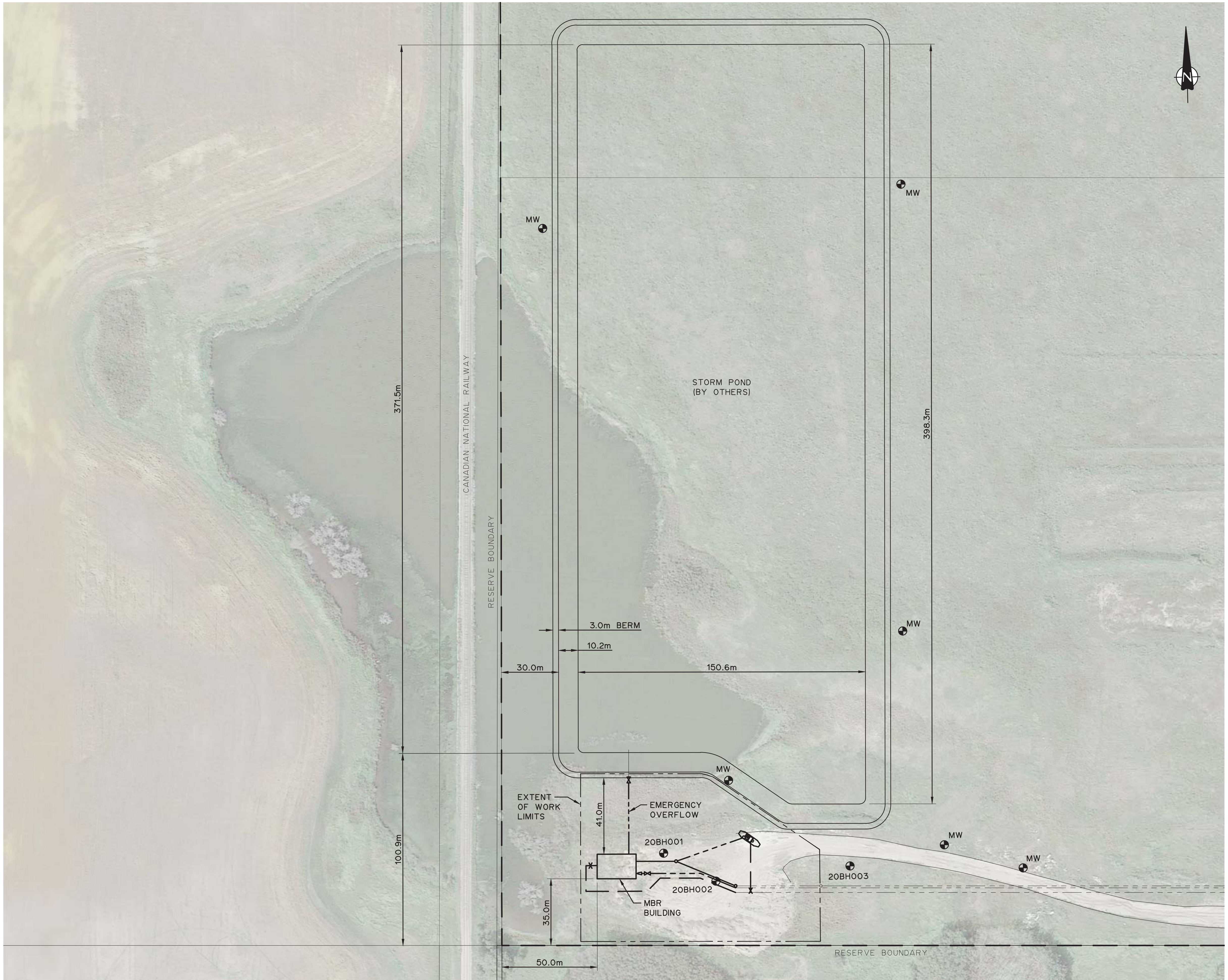
ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
CIVIL
SITE SETBACK PLAN

DESIGNED	I.K.	JOB	7603-002-00
DRAWN	T.D.D.	SCALE	1:10000
DATE	OCTOBER 2020	FIGURE	4.8.1



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2. CONTRACTOR TO EXPOSE EXISTING UTILITY LINES BY HYDROVAC EXCAVATION AND CONFIRM ELEVATIONS.
3. STRIP SITE AS NECESSARY TO PREVENT CONTAMINATION OF MATERIALS.
4. PROTECT ALL EXISTING SITE FEATURES UNLESS OTHERWISE NOTED.

20BHXXX	BOREHOLE NUMBER
MW	MONITORING WELL

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ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
CIVIL
OVERALL SITE PLAN

DESIGNED	I.K.	JOB	7603-002-00
DRAWN	T.D.D.	SCALE	1:2000
DATE	OCTOBER 2020	FIGURE	4.8.2

4.4 Civil & Site Work

4.4.1 General

The proposed ERPM WWTF, treated effluent pond, and irrigation area will be located in LSD10-02-36-05-3 EXT61. Civil and site work required for the project is as follows:

- Siting of the new WWTF based on INAC and WSA required setbacks.
- Connection of proposed subdivision development sanitary collection system to the proposed WWTF.
- Site grading, fencing, and drainage.
- Connection of proposed subdivision development deep and shallow utilities to the proposed WWTF.
- Construction of influent, sludge holding, and treated effluent pumping structure.
- Construction of the WWTF foundation.
- Site access improvements.

Figures 4.9.1 illustrate the WWTF site plan and utilities for the proposed WWTF.

4.4.2 Site Work Grading, Parking, & Fencing

4.4.2.1 Grading, Parking, and Fencing

Drainage form the facility will be positive with a minimum of 2% away from the main building and generator pad. All drainage for the site will be diverted around the facility and to the proposed treated effluent storage pond. Access to the facility will be from the proposed development. Access will likely be either a gravel or paved surface. A designated parking lot will be located directly north of the new facility and will also be granular surfaced. The lot will be sufficiently sized to accommodate supply trucks and sludge disposal trucks as well as provide parking for several passenger vehicles for operations staff. To provide adequate site security, the WWTF will be an enclosed facility. Barbed wire fencing will be placed around the perimeter of the treated effluent storage pond.

4.4.2.2 Material Borrow Source

It is anticipated there will be no borrow required for the WWTF. Borrow will be required for the Treated Effluent Storage Pond, which can be sourced from the Saskatoon area. Material onsite is unsuitable for berm or liner material.

4.4.3 Utilities

4.4.3.1 Potable Water Service

A proposed 50 mm service will be required from the proposed development. Potable water will only be used for sinks, toilets, and showers (including emergency). Potable water will be required for system startup.

4.4.3.2 Sanitary Service

Sanitary service will divert to the influent pump well. All sanitary drains will be diverted to the influent pump well.

4.4.3.3 Electrical Service

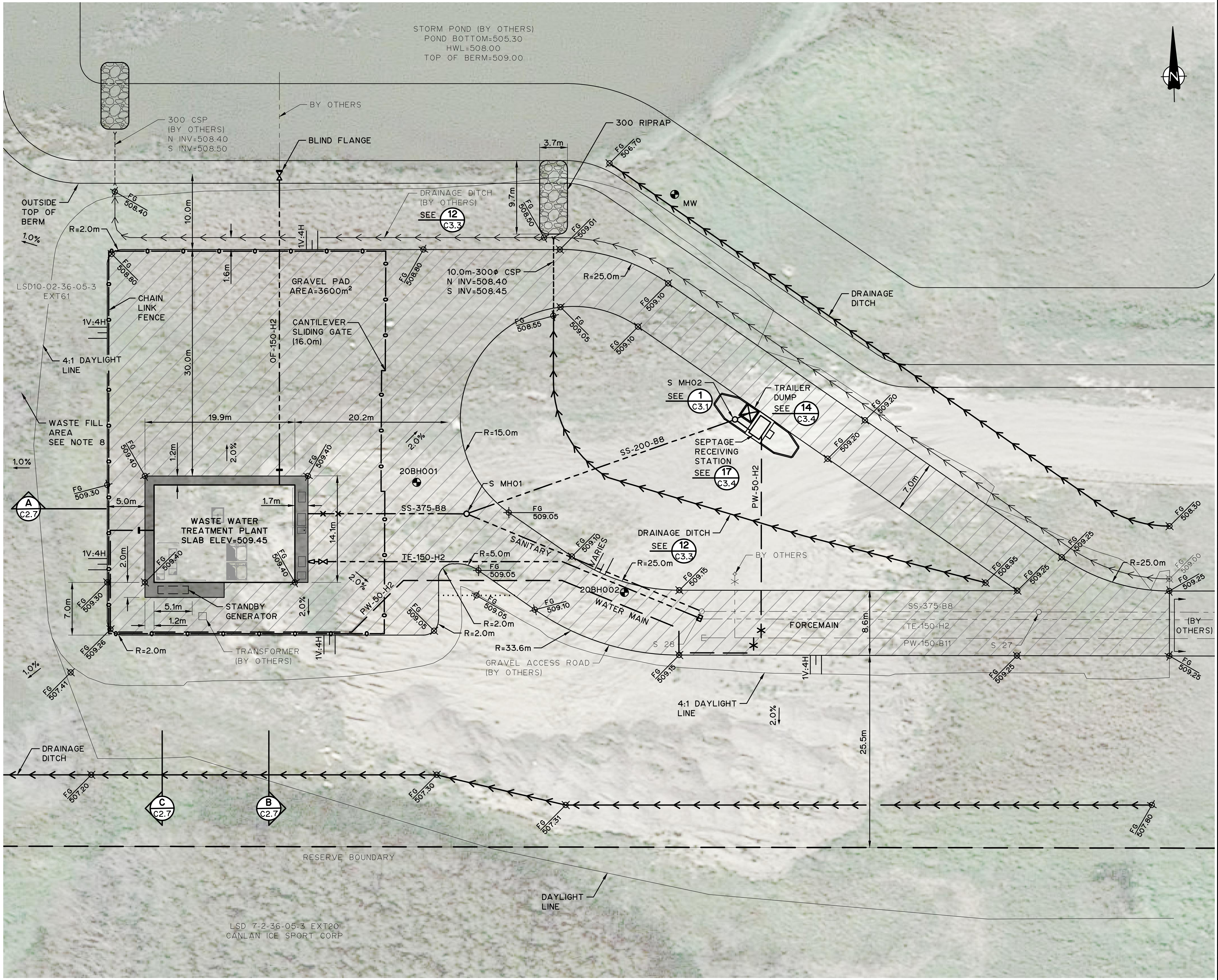
It is anticipated that facility will require a 250 A, 600 VAC, three phase service. It is proposed to meter at the service transformer. The electricity provider at this location is SaskPower.

4.4.3.4 Natural gas

Natural gas will be required for the proposed facility; however, the amount to be provided has yet to be determined.

4.4.3.5 Data

Communications to the proposed facility will be provided by SaskTel. A service with greater bandwidth should be utilized for remote operation and maintenance.



NOTES:

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2. CONTRACTOR TO EXPOSE EXISTING UTILITY LINES BY HYDROVAC EXCAVATION AND CONFIRM ELEVATIONS.
3. STRIP SITE AS NECESSARY TO PREVENT CONTAMINATION OF MATERIALS.
4. PROTECT ALL EXISTING SITE FEATURES UNLESS OTHERWISE NOTED.
5. ALL DISTURBED AREAS TO BE RESTORED WITH 150mm TOPSOIL & SEED UNLESS OTHERWISE NOTED.
6. ALL GRADES SHOWN ARE TO FINISHED GRADE.
7. UNSUITABLE MATERIAL TO BE REMOVED AND DISPOSED OF BY CONTRACTOR.
8. CONTRACTOR TO BLEND WASTE FILL AREA AND ENSURE POSITIVE DRAINAGE.

20BHXXX	BOREHOLE NUMBER
MW	MONITORING WELL

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ENV	22727	

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ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
CIVIL
SITE GRADING PLAN

DESIGNED	I.K.	JOB	7603-002-00
DRAWN	T.D.D.	SCALE	1:500
DATE	OCTOBER 2020	FIGURE	4.9.1

4.4.4 Treated Effluent Storage & Irrigation

It is proposed to store Treated Effluent in the Phase 5 Storm Water Pond. The pond should be designed to be repurposed as a storm pond once Phase 5 is developed. At this point in the development, it is anticipated that treated effluent will be disposed by way of direct and continuous discharge to the South Saskatchewan River. This is dependent upon completing all the necessary studies and receiving appropriate permits and approvals to do so. Phases I, 3, and 4 development will see treated effluent disposed by way of effluent irrigation.

.

4.5 Architectural

4.5.1 General

The proposed WWTF will be a single storey steel building with a building area of approximately **497 m^2 for Option 1 and 200 m^2 for Option 2**. The building will consist of the following areas for both options:

- Treatment Area.
- Lab/Control Room.
- Mechanical Room.
- Washroom.
- Electrical Room.
- Headworks Room.

In addition, the proposed Option 2 consists of a basement floor with the following areas:

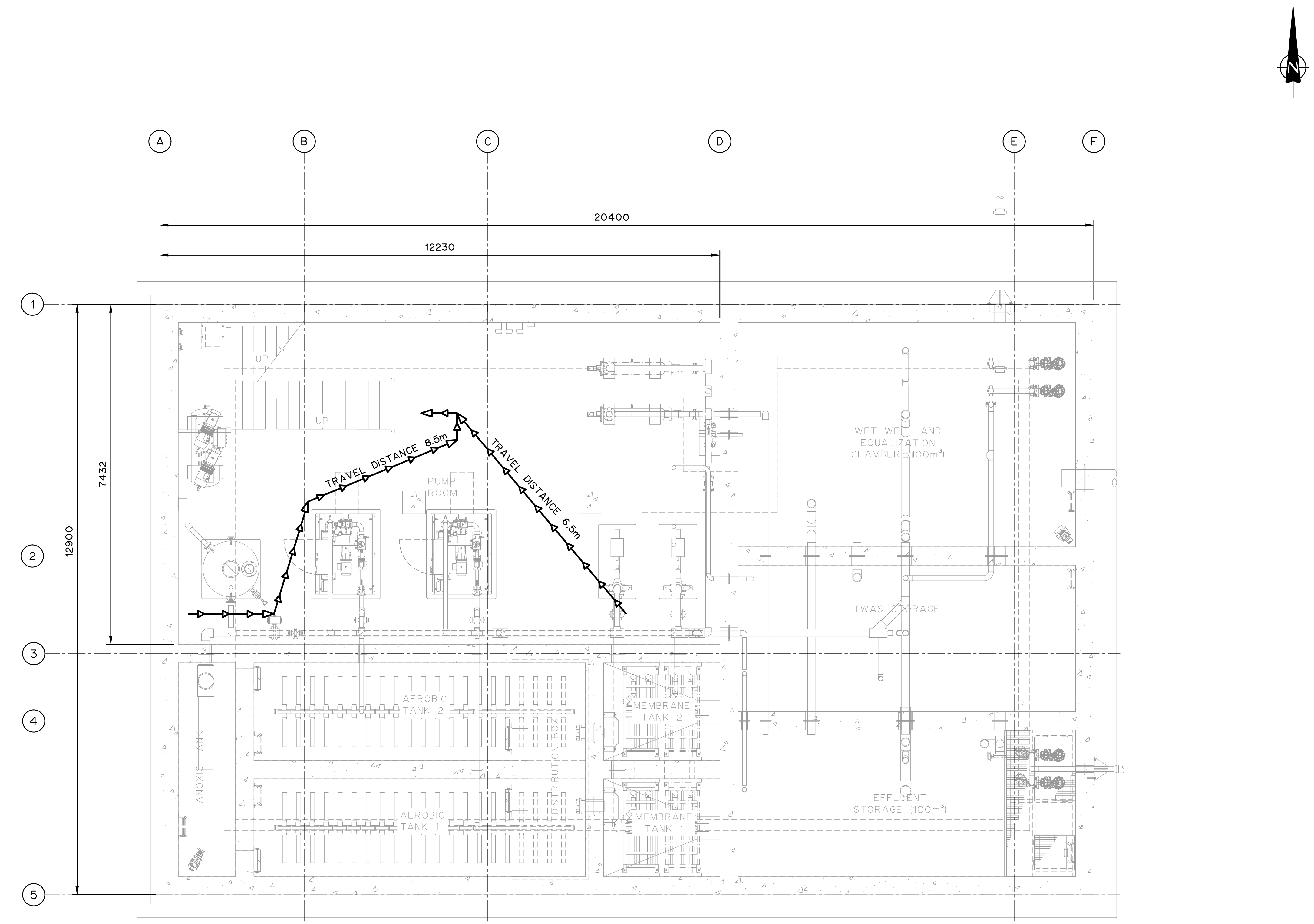
- Pump Room
- Two Anoxic Chambers
- Two Aeration Chambers
- WAS Storage
- Effluent Storage
- Three MBRs.
- Wet Well and Equalization Chamber

Figures 4.10.1 and 4.10.2 and show the building architectural layouts for the lower and upper levels.

4.5.2 Building Code Review

The proposed Wastewater Treatment Facility is in the English River First Nation south of the Saskatoon, Saskatchewan and is governed by the National Building Code 2015 (NBC). The building is considered as Post-disaster building. Preliminary Building Code review summarized in Figures 4.10.1, and 4.10.2 are in accordance to the NBC, fire protection, occupant safety and accessibility Division B Part 3 of the Code and as follows:

- Building services rooms, storage rooms and Janitor's room shall have a fire-separation with a fire-resistance rating of not less than 1 hour.
- Travel distance from floor area to at least one exit should not be more than 30m.



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.

LEGEND:

1 HOUR FIRE SEPARATION

TRAVEL DISTANCE

CODE REVIEW (NATIONAL BUILDING CODE - 2015

OCCUPANCY GROUP F3: LOW HAZARD INDUSTRIAL
BUILDING AREA: 225m²
BUILDING HEIGHT: 1 STOREY
CONSTRUCTION: NON-COMBUSTIBLE/COMBUSTIBLE
SPRINKLER: NO
FACING: 1 STREET
CONFORMING TO GROUP F3: 3.2.2.85

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STRUCTURAL	34196	

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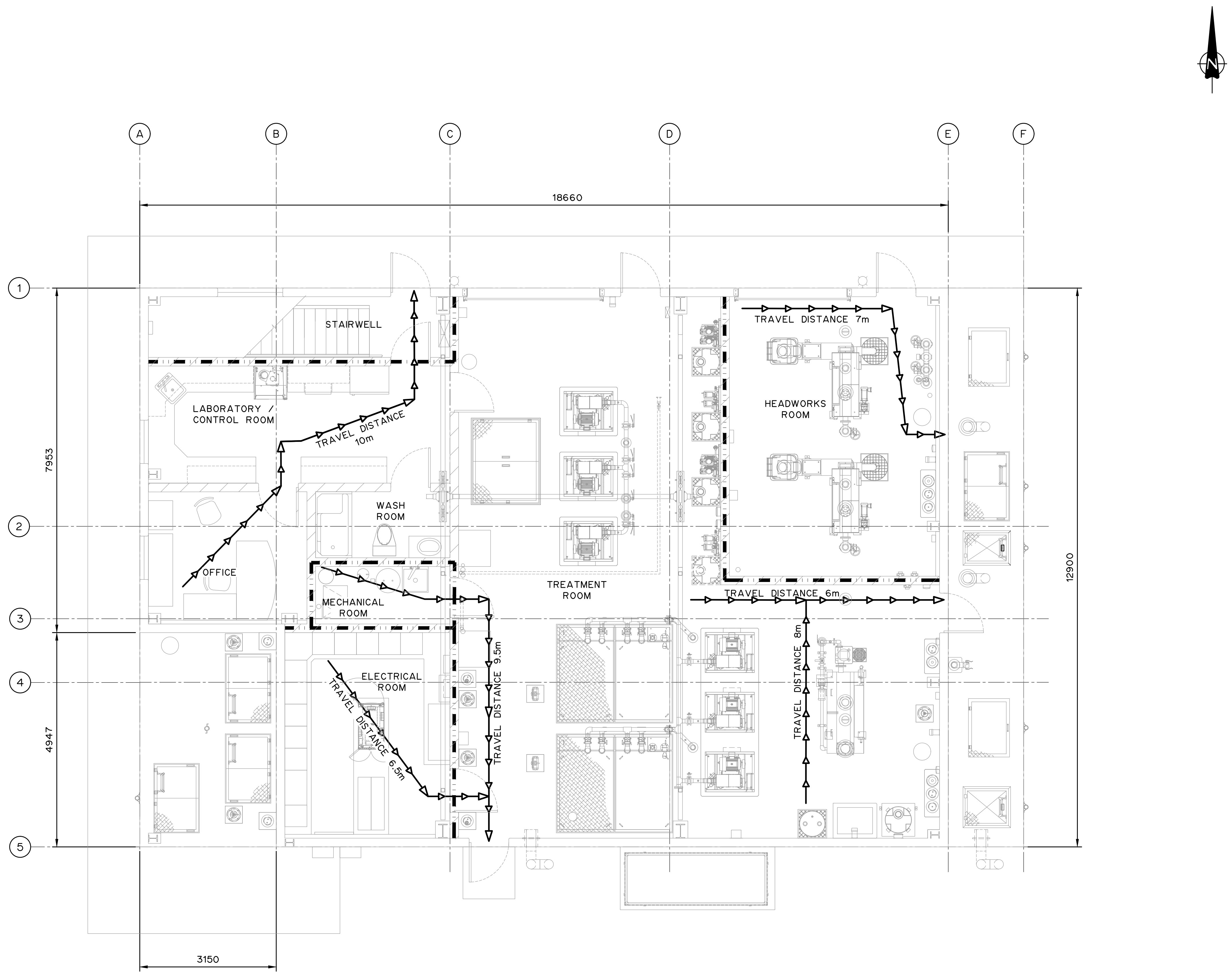
ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
ARCHITECTURAL
LOWER FLOOR
BUILDING CODE REVIEW

DESIGNED	W.W.L.S.	JOB	7603-002-00
DRAWN	D.F.F.	SCALE	1:100
DATE	OCTOBER 2020	FIGURE	4.10.1



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.

LEGEND:

1 HOUR FIRE SEPARATION

TRAVEL DISTANCE

CODE REVIEW (NATIONAL BUILDING CODE - 2015

OCCUPANCY GROUP F3: LOW HAZARD INDUSTRIAL

BUILDING AREA: 225m²

BUILDING HEIGHT: 1 STOREY

CONSTRUCTION: NON-COMBUSTIBLE/COMBUSTIBLE

SPRINKLER: NO

FACING: 1 STREET

CONFORMING TO GROUP F3: 3.2.2.85

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ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
ARCHITECTURAL
MAIN FLOOR
BUILDING CODE REVIEW

DESIGNED	W.W.L.S.	JOB	7603-002-00
DRAWN	D.F.F.	SCALE	1:100
DATE	OCTOBER 2020	FIGURE	4.10.2

4.5.3 Building Construction

The proposed WWTF will be a pre-engineered rigid frame steel building with purlins and insulated metal panels. Interior walls will be constructed using concrete blocks. Building envelope will be designed in accordance to the National Energy Code for Buildings 2015 (NECB). Based on the Degree-Days provided in Division B, Appendix C Climate and Seismic Information for Building Design in Canada, Table C-2 of the NBC for Saskatoon, Saskatchewan, the following maximum overall thermal transmittance values (U-values) are required (or the building meets NECB's Trade-off Path requirements):

- Degree-Days below 18°C for Saskatoon, Saskatchewan: 5700 (Zone 7A).
- Maximum Overall U-values for Above-ground Building Assemblies:
  - Walls = 0.210 W/(m^2-K),
  - Roofs = 0.162 W/(m^2-K).
- Maximum Overall U-value of Fenestration (windows, louvers, etc.) = 2.2 W/(m^2-K).
- Maximum Overall U-value of Doors = 2.2 W/(m^2-K).
- Maximum Overall U-value for Building Assemblies in Contact with the Ground:
  - Floors = 0.757 W/(m^2-K) for 1.2 m horizontally from perimeter for 0.6m below finished grade.
  - Walls = 0.284 W/(m^2-K) for 2.4m from ground level.

To determine the minimum RSI-value (R-value in Metric) required in an assembly, take the inverse of the maximum U-values from the list above.

4.5.4 Building Finishes

The proposed building finishes are based on MPE's experience and aim to balance durability, aesthetic, and cost.

4.5.4.1 Exterior Building Finishes

MPE proposes the following finishes for the exterior of the building:

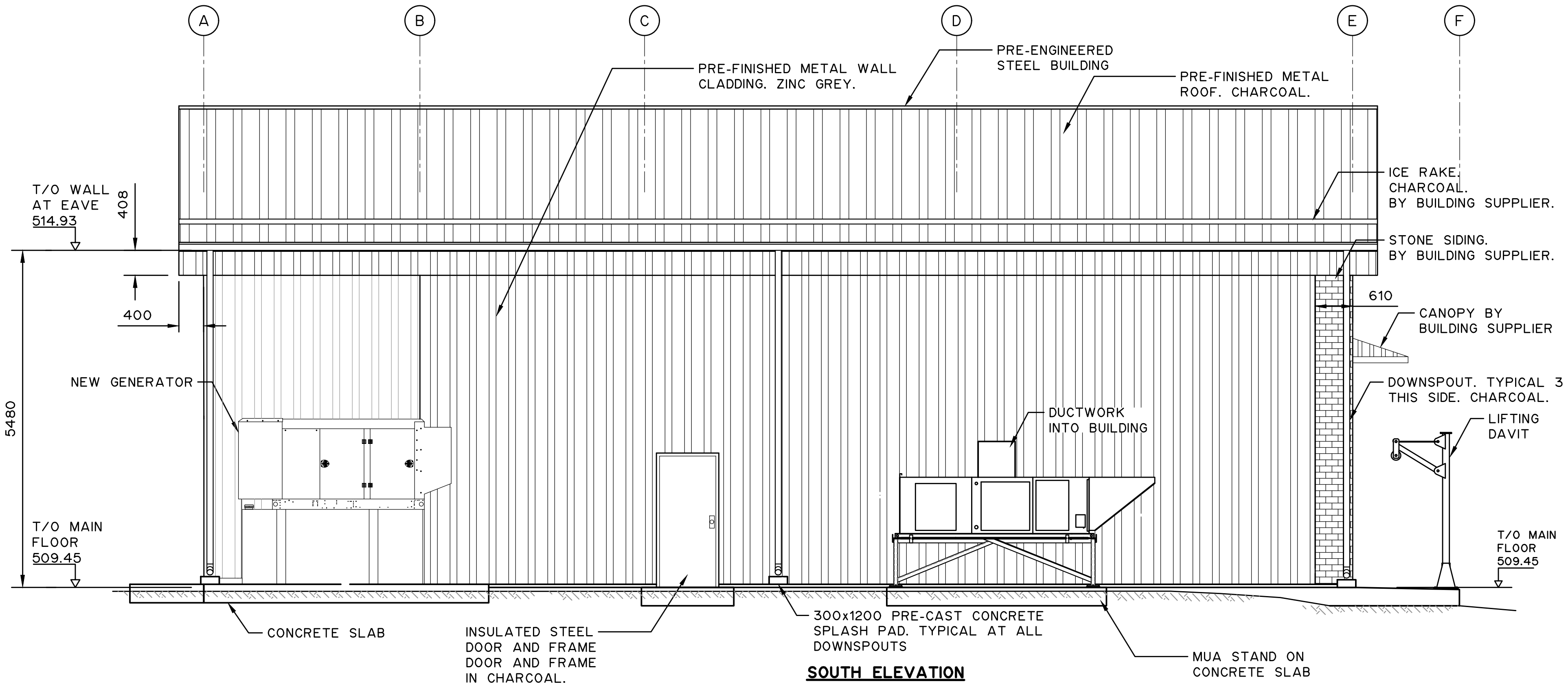
- Walls: 24 gauges prefinished metal cladding.
- Roof: 22 gauges prefinished metal cladding.
- Doors: painted and insulated metal doors.
- Fascia, soffit: prefinished metal.
- Colour: Owner to select colour from standard list from manufacturer.

4.5.4.2 *Interior Building Finishes*

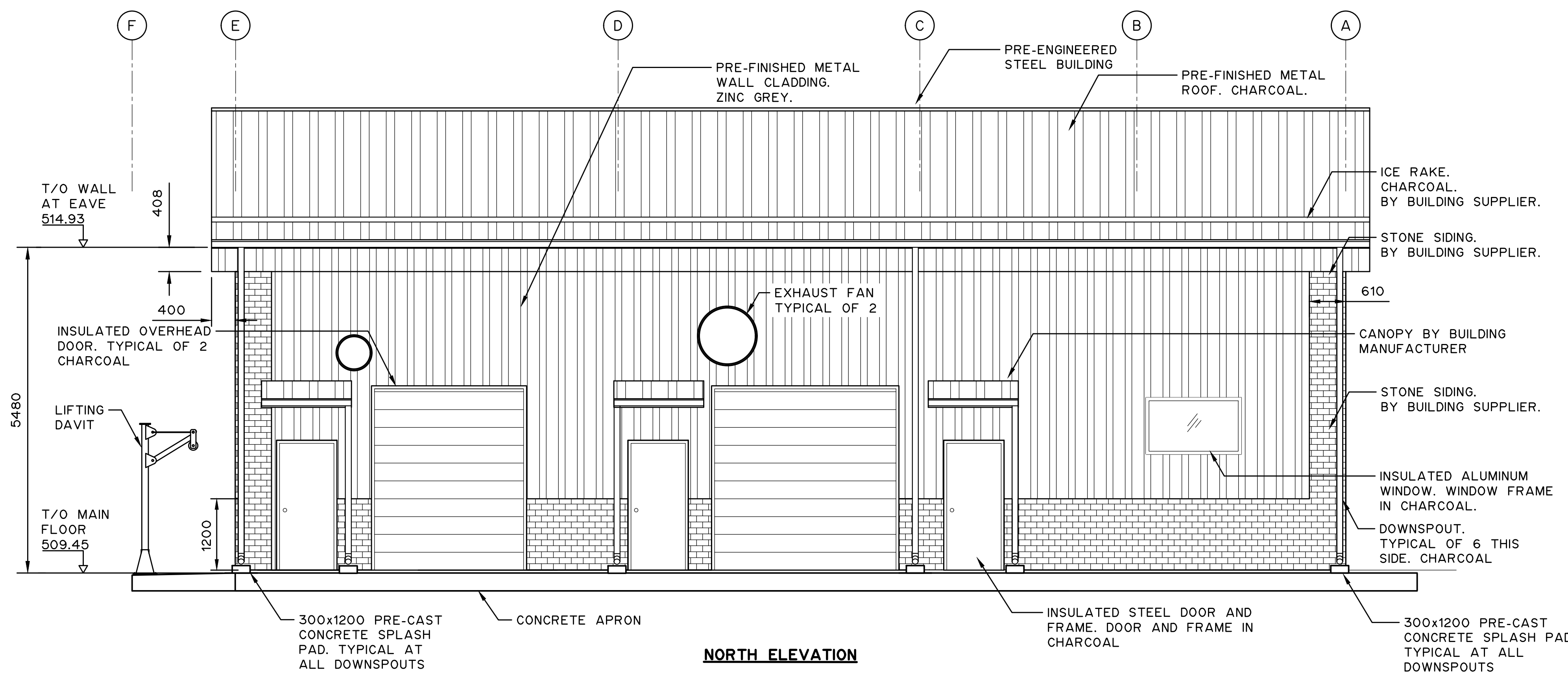
MPE proposes the following interior building finishes:

Room	Floor	Base	Walls	Ceiling
Treatment Area	Epoxy	Epoxy	Prefinished Metal Cladding	N/A
Lab/Control Room	Epoxy	Rubber Base	Drywall	Ceiling Tiles
Mechanical Room	Epoxy	Epoxy	Prefinished Metal Cladding Painted Block Walls	Prefinished Metal Cladding
Washroom	Epoxy	Rubber Base	Painted Block Walls	Ceiling Tiles
Electrical Room	Epoxy	Epoxy	Prefinished Metal Cladding Painted Block Walls	Prefinished Metal Cladding
Headworks Room	Epoxy	Epoxy	Prefinished Metal Cladding Painted Block Walls	Prefinished Metal Cladding
Pump Room	Epoxy	N/A	Painted	N/A
Anoxic Chambers, Aeration Chambers, WAS Storage, Wet Well and equalization Chamber and Effluent Storage	Cementitious Waterproofing (mix-in or shake-on)	N/A	Cementitious Waterproofing (mix-in or paint-on)	N/A
MBRs	Epoxy	N/A	Epoxy	N/A

Figures 4.11.1 and 4.11.2 show the projected elevations of the WWTF.



SOUTH ELEVATION



NORTH ELEVATION

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. BUILDING EXTERIOR COLOUR FINISH AS FOLLOWS:
   EXTERIOR WALL CLADDING: ZINC GREY
   ROOF, ICE RAKE, FASCIA, EAVESTROUGH, DOWNSPOUT, DOOR (MANDOOR AND OVERHEAD DOORS) AND WINDOWS: CHARCOAL
   ALL OTHER FINISH COLOURS NOT SPECIFIED. TO BE SELECTED BY OWNER FROM STANDARD RANGE.
3. REFER TO OTHER DISCIPLINE'S DRAWINGS FOR EXACT LOCATIONS OF MECHANICAL, ELECTRICAL AND PROCESS EQUIPMENT.
4. REFER TO CIVIL DRAWING FOR SITE GRADING DETAILS.

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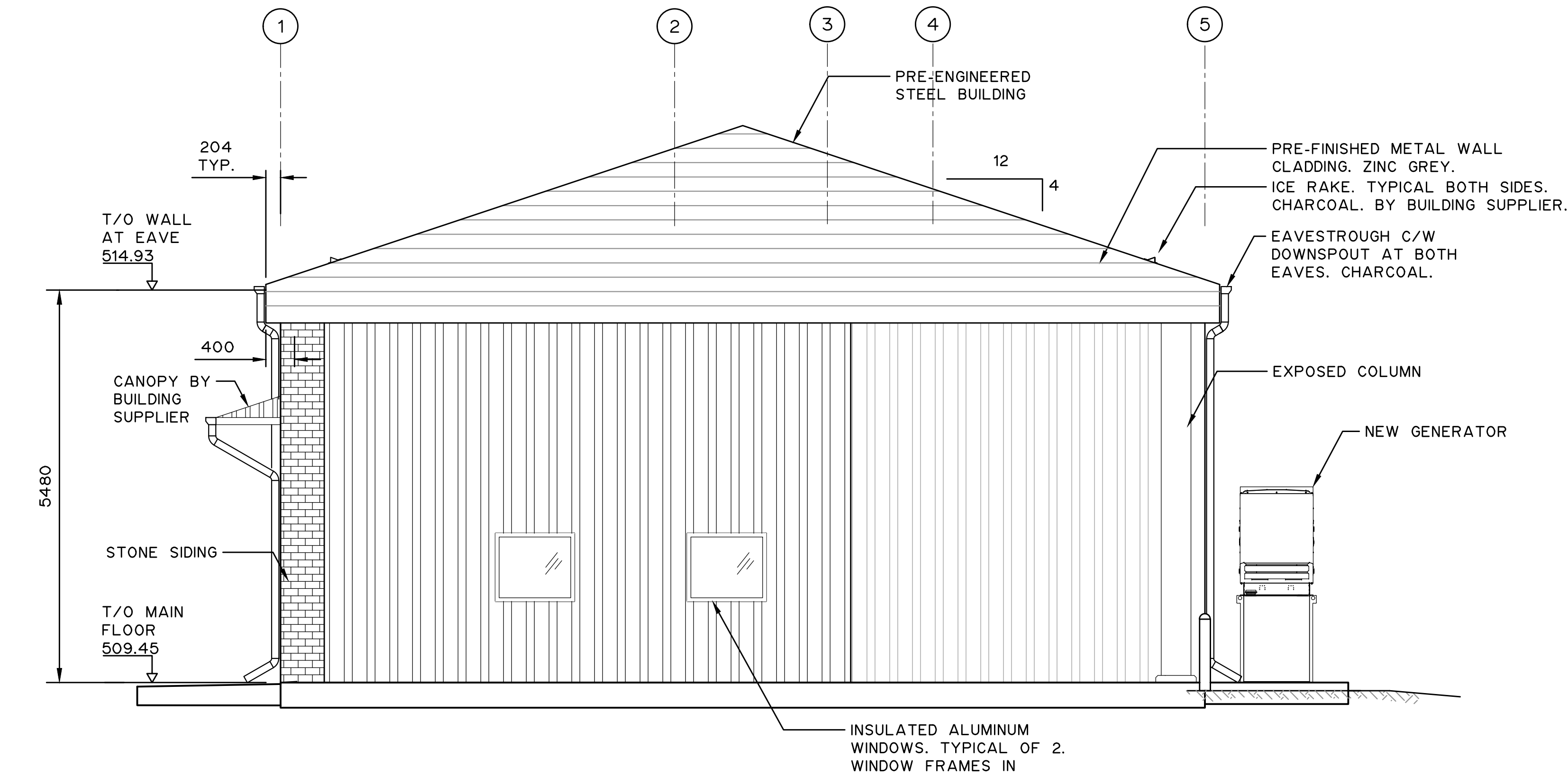
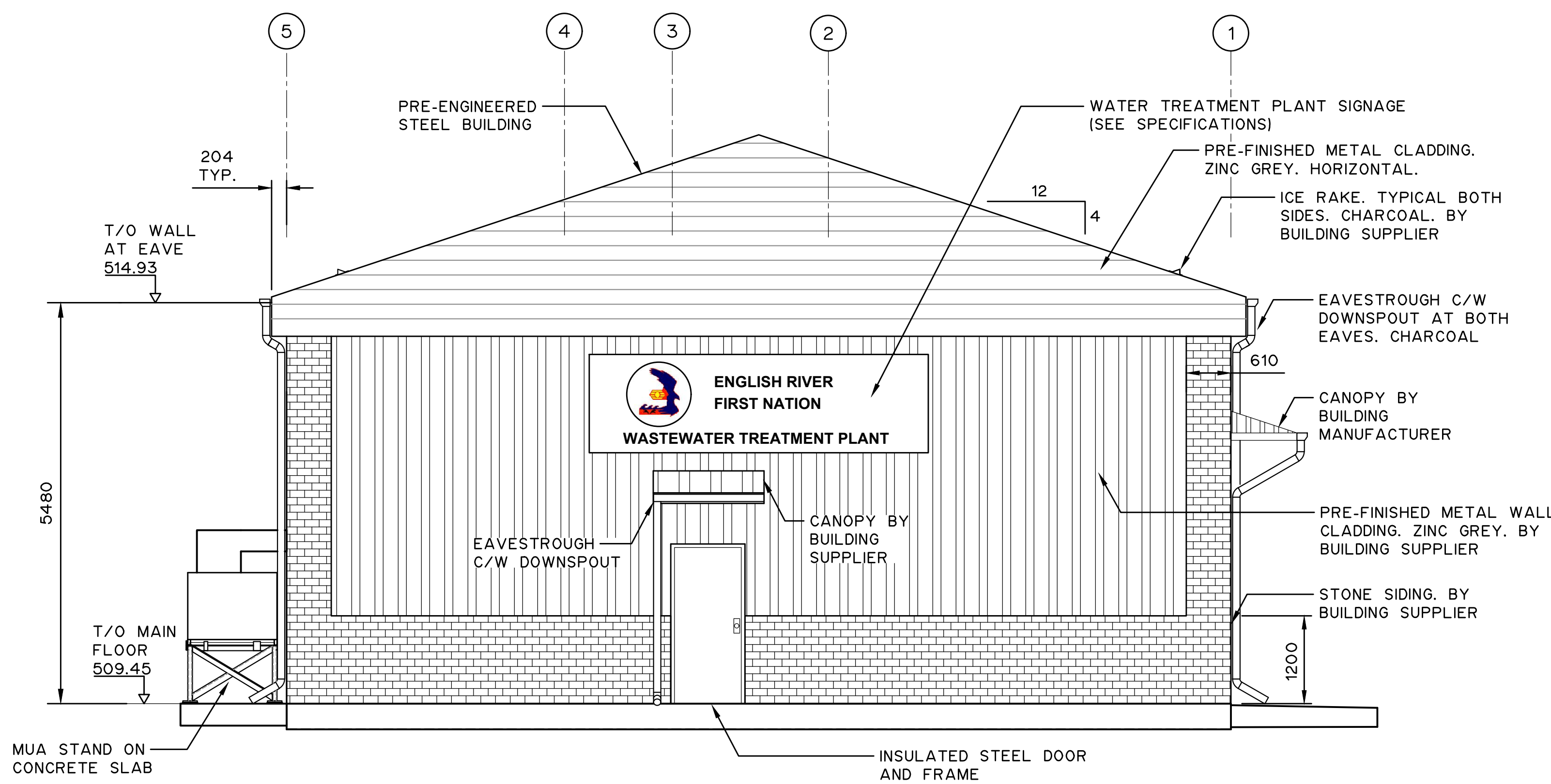
ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
ARCHITECTURAL
ELEVATIONS

DESIGNED	W.W.L.S.	JOB	7603-002-00
DRAWN	D.F.F.	SCALE	1:100
DATE	OCTOBER 2020	FIGURE	4.11.1



WEST ELEVATION



EAST ELEVATION

NOTES:

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2. BUILDING EXTERIOR COLOUR FINISH AS FOLLOWS: EXTERIOR WALL CLADDING: ZINC GREY ROOF, ICE RAKE, FASCIA, EAVESTROUGH, DOWNSPOUT, DOOR (MANDOOR AND OVERHEAD DOORS) AND WINDOWS: CHARCOAL ALL OTHER FINISH COLOURS NOT SPECIFIED. TO BE SELECTED BY OWNER FROM STANDARD RANGE.
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ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
ARCHITECTURAL
ELEVATIONS

DESIGNED	W.W.L.S.	JOB	7603-002-00
DRAWN	D.F.F.	SCALE	1:100
DATE	OCTOBER 2020	FIGURE	4.11.2

4.6 Structural

4.6.1 General

The design of the structure will follow the requirements indicated in Part 4 of the National Building Code 2015 (NBC). Since the building's primary use is treatment of wastewater, it is considered as a building that is essential in the event of a disaster. Thus, the building is categorized as a Post-disaster building in accordance to the NBC. The structural design of the building will follow Post-disaster building outlined in Part 4 of the NBC.

4.6.2 Design Loads

The Wastewater Treatment Facility will be designed to meet or exceed the following loading requirements as outlined in Part 4 of the NBC – Post-disaster Building.

4.6.2.1 Dead Loads

Dead loads are gravitational loads including the self-weight of the structure, finishes, and permanent mechanical and electrical components inside the building and will vary depending on the material and equipment.

4.6.2.2 Live Loads

Live loads are use and occupancy loads based on the assigned usage of the spaces within the building. Minimum live loads to be used in design are provided in Table 4.4.1 of the NBC. Various space usages with corresponding minimum design live loads are listed in Table 4.24 below. Please note that the loads provided below are minimum loads as required by the NBC. It is possible that these loads will be increased if the actual usage of the space require a more stringent live load to be used in the structural design.

4.24: Minimum Design Live Loads

Space	Minimum Design Live Load
Mechanical Room, Treatment Room, Electrical Room, Headworks Room, & Pump Room	3.6 kPa
Laboratory/Control Room	4.8 kPa
Washroom	2.4 kPa

4.6.2.3 Environmental Loads

Environmental loads include snow and wind loads. For this project, the environmental loads provided in Division B, Appendix C Climate and Seismic Information for Building Design in Canada, Table C-2 of the NBC for Saskatoon, Saskatchewan will be used.

4.6.2.3.1 Snow Load

The following parameters will be used to determine the design snow load for the building. The design snow load will be determined in accordance to the NBC:

- Ground snow load in a 1-to-50-year probability, S_s = 1.7 kPa
- Associated rain load, S_r = 0.1 kPa
- Importance Factor, I_s = 1.25 for Ultimate Limit State Design

4.6.2.3.2 Lateral Wind Load

The following parameters will be used to determine the design wind load for the building. The design wind load will be determined in accordance to the NBC:

- Hourly Wind Pressure for a 1-to-50-year event = 0.43 kPa

- Importance Factor, I_w = 1.25 for Ultimate Limit State Design

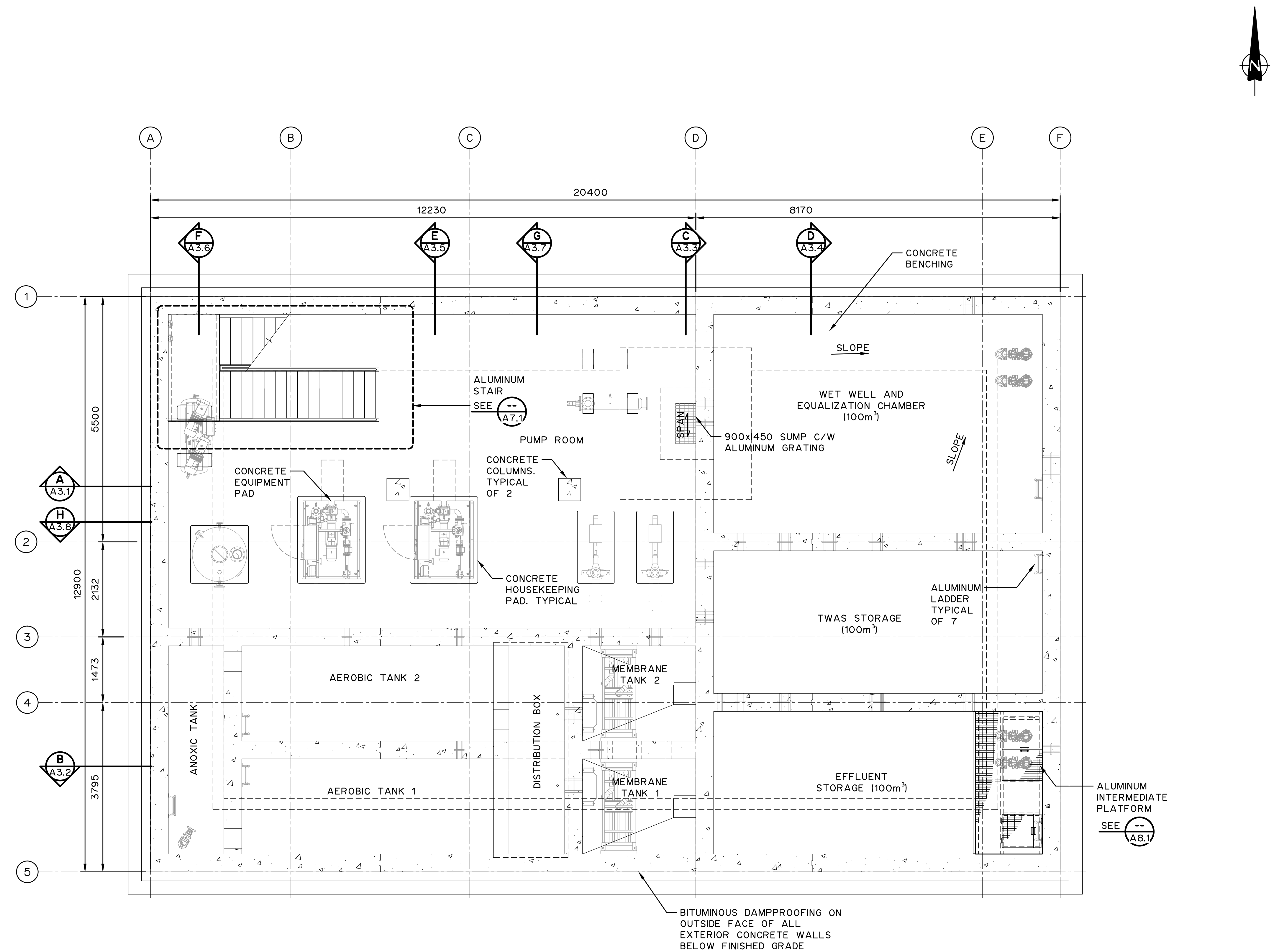
4.6.3 Foundation

Please refer to section 4.3 for a description of the preferred foundation systems dependent layout Option preference.

Figure 4.12.1 and 4.12.2 show the conceptual foundation / lower level and main floor plans for the proposed WWTF.

4.6.4 Superstructure

Please refer to section 4.5 for a description of the proposed structure.



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. SEE STRUCTURAL DRAWINGS FOR SIZE AND REINFORCEMENT OF CONCRETE COMPONENTS.
3. SEE DRAWING A4.1 FOR ROOM FINISH SCHEDULE.
4. ALL ALUMINUM LADDERS TO MEET P.I.P.
5. SEE OTHER DISCIPLINES FOR LOCATIONS AND SIZES OF PENETRATIONS.
6. SLOPE FLOOR TO DRAINS.
7. BOTTOM OF EXCAVATION IS TO BE REVIEWED BY GEOTECHNICAL ENGINEER PRIOR TO MUD SLAB. MUD SLAB MUST BE PLACED IMMEDIATELY FOLLOWING GEOTECHNICAL ENGINEER'S APPROVAL.

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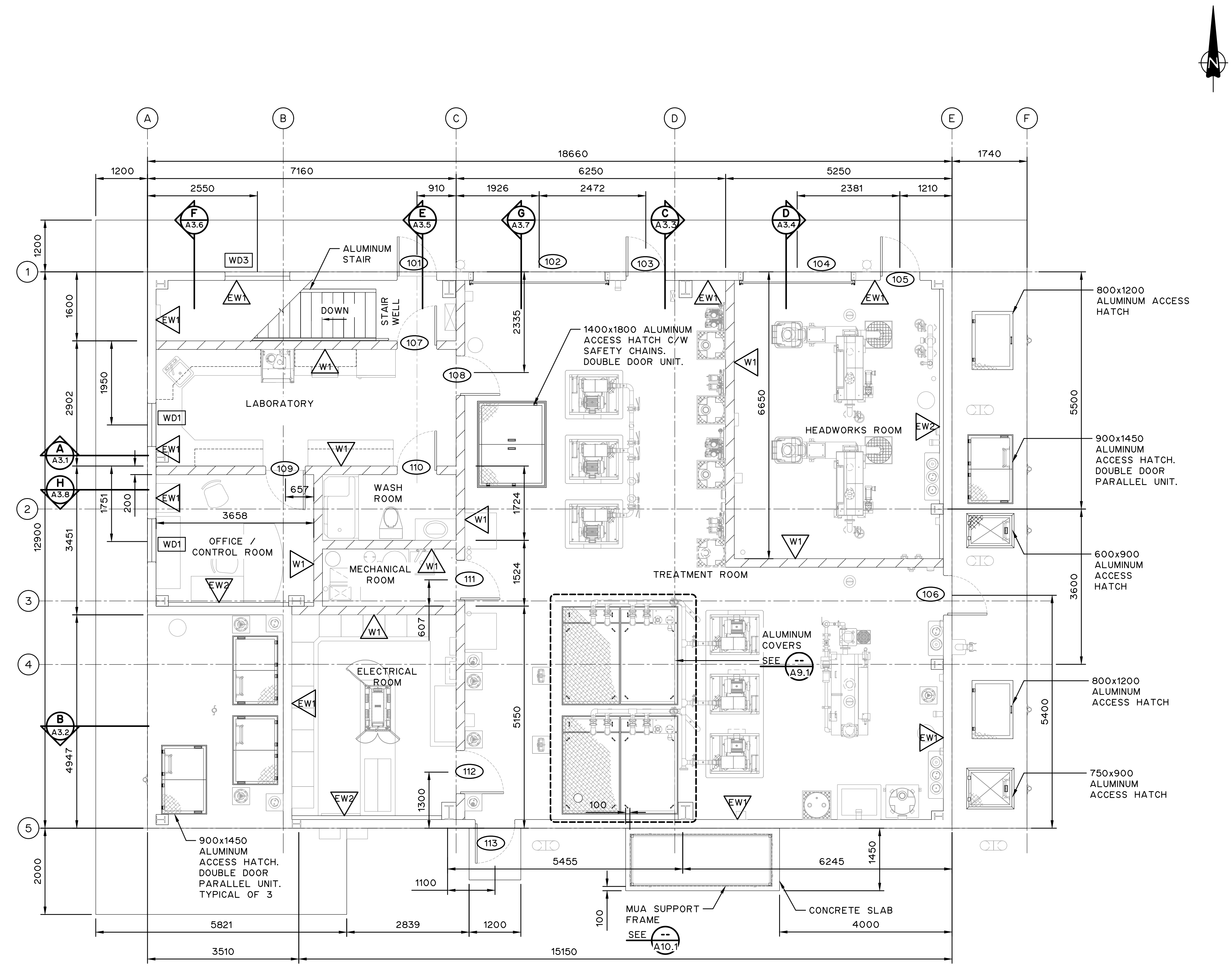
ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
ARCHITECTURAL
LOWER FLOOR PLAN

DESIGNED	W.W.L.S.	JOB	7603-002-00
DRAWN	D.F.F.	SCALE	1:100
DATE	OCTOBER 2020	FIGURE	4.12.1



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. SEE STRUCTURAL DRAWINGS FOR LOCATION AND SIZE OF CONCRETE EQUIPMENT PADS.
3. SEE DRAWING A4.1 FOR DOOR, AND WINDOW SCHEDULES.
4. SEE DRAWING A4.1 FOR ROOM FINISH SCHEDULE.
5. SEE STRUCTURAL DRAWINGS FOR DETAILS FOR ALL CONCRETE HOUSEKEEPING PADS AND CONCRETE EQUIPMENT PADS.
6. COORDINATE WITH OTHER DISCIPLINES FOR LOCATION AND SIZE OF WALL AND FLOOR PENETRATIONS.

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Association of Professional Engineers & Geoscientists of Saskatchewan
CERTIFICATE OF AUTHORIZATION
MPE Engineering Ltd.
Number C1334
Permission to Consult held by:

Discipline	Sk. Reg. No.	Signature
STRUCTURAL	34196	

MPE Engineering Ltd.

ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
ARCHITECTURAL
MAIN FLOOR PLAN

DESIGNED	W.W.L.S.	JOB	7603-002-00
DRAWN	D.F.F.	SCALE	1:100
DATE	OCTOBER 2020	FIGURE	4.12.2

4.7 Heating, Ventilation, & Air Conditioning (HVAC)

4.7.1 General

The proposed wastewater treatment facility heating, ventilation, and air conditioning system will be comprised of gas fired unit heaters, an electric unit heater, a gas fired makeup air handling unit, a gas fired forced air furnace, a heat recovery ventilation system, air conditioning units, exhaust and supply fans, and associated louvres and dampers.

4.7.1.1 Design Standards & References

The design shall conform to all applicable local, provincial, and/or federal codes, standards, regulations, and references in effect at time of quote including but not limited to:

- National Building Code; 2015
- National Energy Code; 2017
- National Fire Code of Canada
- Occupational Health & Safety Act
- The Waterworks and Sewage Works Regulations; 2015
- The Environmental Management and Protection Act, 2002
- National Plumbing Code of Canada; 2015.

The design will comply with the requirements of the following organizations, at a minimum:

- CSA, Canadian Standards Association
- NEC, National Electric Code
- NEMA, Standards of National Electrical Manufacturers Association
- ANSI, American National Standards Institute
- ASTM, American Society for Testing and Materials
- AISI, American Iron and Steel Institute
- AGMA, American Gear Manufacturer's Association
- AISC, American Institute of Steel Construction
- AWS, American Welding Society
- ASME, American Society of Mechanical Engineers
- AWWA – Applicable Standards
- CSA, Canadian Standards Association
- CEC, Canadian Electrical Code
- IEEE, Institute of Electrical and Electronic Engineers
- EEMAC, Electrical and Electronic Equipment Manufacturers Association of Canada
- NFPA (National Fire Protection Association)
- ACGIH (American Conference of Governmental Industrial Hygienists)
- American National Standards Association – International Safety Equipment Association
- SMACNA (Sheet Metal and Air Conditioning Contractors' National Association)

The design will comply in particular with the following standards and manuals, at a minimum:

- ASHRAE 62.1, Ventilation for Acceptable Indoor Air Quality; 2016
- ASHRAE 55, Thermal Environmental Conditions for Human Occupancy, 2017
- ACGIH Industrial Ventilation: A Manual of Recommended Practice for Design; 2016
- ANSI/SMACNA 006, Duct Construction Standards Metal and Flexible; 2006

- ANSI/ISEA Z358.1, Emergency Eyewash and Shower Equipment; 2014
- NFPA 10, Standard for Portable Fire Extinguishers; 2013
- NFPA 90.A, Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015
- NFPA 820, Standard for Fire Protection in Wastewater Treatment & Collection Facilities; 2016

4.7.2 Climatic Data

The WWTF will be designed to climatic data provided by the National Building Code for Saskatoon, SK. Table 4.25 summarizes climatic data used for the design.

Table 4.25: Climatic Data

Location	Elevation (m)	Design Temperature (^{O}C)				Degree - Days <18^{O}C	15 Minute Rain (mm)	One Day Rain 1/50 (mm)	Annual Rain (mm)
		January		July 2.5%					
		2.5%	1.0%	Dry	Wet				
Saskatoon, SK	500	-35	-37	30	21	5,700	23	86	265

4.7.3 Ventilation & Heating Requirements

Based on the design criteria, ventilation standards, as well as provincial and federal codes, the ventilation and heating requirements of the WWTF have been calculated. Tables 4.26 summarizes the ventilation and heating requirements based on a per room basis. Applicable design codes have also been identified.

Table 4.26: HVAC Design Summary

Room	Floor Area (m^2)	Volume (m^3)	Occupied Density (No. of People)	Ventilation													Heating		Cooling	
				ASHRAE 62.1-2016 Fresh Air Requirements						NFPA 820		Design								
				Fresh Air Supply Rate Based on Area			Fresh Air Supply Rate Based on Occupancy													
				(L/s / m2)	(L/s)	Air Changes / Hour	(L/s / person)	(L/s)	Air Changes / Hour	Air Changes / Hour	Ventilation Frequency	Continuous Air Changes / Hour	Intermittent Air Changes / Hour	Supply Air Source	Exhaust Air Source	Room Pressurization	Required Heating (kW)	Heat Source	Air Conditioning	Cooling Source
Lab / Control Room	21	75	2.0	0.9	19	0.9	5.0	10	0.5	N/A	N/A	0.9	N/A	Furnace	Heat Recovery Ventilator	Positive	4	Furnace	Yes	Furnace
Office	13	45	2.0	0.9	12	1.0	5.0	10	0.8	N/A	N/A	1.0	N/A	Furnace	Heat Recovery Ventilator	Positive	4	Furnace	Yes	Furnace
Washroom	6	22	1.0	2.1	13	2.1	N/A	N/A	N/A	N/A	N/A	2.1	N/A	Furnace	Heat Recovery Ventilator	Negative	1	Furnace	Yes	Furnace
Mechanical Room	5	19	1.0	0.3	2	0.4	2.5	3	0.5	N/A	N/A	0.5	N/A	Furnace	Heat Recovery Ventilator	Neutral	1	Furnace	Yes	Furnace
Electrical Room	21	74	2.0	0.3	7	0.3	2.5	5	0.2	N/A	N/A	0.3	N/A	Furnace	Heat Recovery Ventilator	Positive	4	Furnace	Yes	Ductless Air Conditioner
Treatment Room	113	1,096	2.0	0.9	104	0.4	5.0	10	0.0	6.0	Continuous	6.0	N/A	Makeup Air Handling Unit	Exhaust Fan	Neutral	54	Gas Fired Unit Heaters	No	N/A
Headworks Room	35	147	2.0	7.5	262	6.4	5.0	10	0.2	12.0	Continuous	12.0	30.0	Makeup Air Handling Unit / Intake Louvre	Exhaust Fans	Negative	13	Electric Unit Heater	No	N/A
Pump Room / Stairway	95	470	2.0	0.9	76	0.6	5.0	10	0.1	6.0	Continuous	6.0	N/A	Makeup Air Handling Unit	Exhaust Fan	Neutral	24	Gas Fired Unit Heaters	No	N/A
Membrane Tank	11	35	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Intermittant	N/A	12	Makeup Air Handling Unit	Exhaust Fan	Negative	N/A	N/A	N/A	N/A
Aeration Tanks	36	184	0	N/A	N/A	N/A	N/A	N/A	N/A	30	Intermittant	N/A	30	Supply Fan	Vent Pipe	Neutral	N/A	N/A	N/A	N/A
Wet Well	36	186	0	N/A	N/A	N/A	N/A	N/A	N/A	30	Intermittant	N/A	30	Supply Fan	Vent Pipe	Neutral	N/A	N/A	N/A	N/A
Effluent Storage	24	121	0	N/A	N/A	N/A	N/A	N/A	N/A	30	Intermittant	N/A	30	Supply Fan	Vent Pipe	Neutral	N/A	N/A	N/A	N/A

4.7.4 Design Basis

The following will be utilized for the design of the building mechanical systems for the WWTF:

4.7.4.1 Heating

Heating in occupied areas, including the lab/control room, office, washroom, mechanical room, and electrical room will be performed by a forced air natural gas furnace. Gas fired unit heaters will heat the treatment room and pump room. An electric unit heater will heat the headworks room and an electric wall fan heater will heat the stairway.

4.7.4.2 Ventilation

A forced air natural gas furnace complete with a heat recovery ventilator will ventilate occupied areas, including the lab/control room, office, washroom, mechanical room, and electrical room. Ventilation in the process areas will be provided by a make-up air handling unit, mounted on a concrete pad outside the building. Odour removal in the process areas will be achieved by a continuous ventilation rate of six air changes per hour in the treatment room and pump room and twelve air changes per hour in the headworks room. There will be provisions for installing carbon filters for odour control in the future. The systems will maintain pressure gradients between the process and occupied areas of the building. A pressure differential of 25 Pa will be designed to prevent odour and dust from entering occupied areas. Air balancing during commissioning of the HVAC system will be completed and airflow rates will be specified. Pressurization, in descending order, is office, lab/control room, electrical room, mechanical room, treatment rooms, and washroom.

4.7.4.3 Air Conditioning

A coil will be incorporated into the forced air system to provide air conditioning for the occupied areas, including the office, lab/control room, washroom, and mechanical room. Cooling in the electrical room will be achieved through a ductless split air conditioner. The condensers will be mounted on a concrete pad outside the building. Cooling in the process areas will be achieved by continuous fresh air supply through the makeup air handling unit.

4.7.4.4 Plumbing

Domestic and hot water lines will be plumbed to service only sinks, toilets, showers, and emergency showers. To minimize potable water consumption of the facility, process water will be supplied from disinfected treated effluent.

4.7.4.5 Sanitary drains

Waste drains and vents will be gravity and sized to applicable codes. Drains will be routed to the influent manholes. Various floor drains, hub drains, and trench drains will be utilized.

4.7.4.6 Eyewash and Emergency Showers

An eyewash station will be provided in the lab/control room at the sink. An emergency shower will be located in the treatment room. Eyewashes and showers will be capable of providing tempered water at a minimum of 20 minutes of 20° C water at a flow rate of 76 L/m.

4.7.4.7 Fire Protection

The proposed WWTF will not be fitted with a sprinkler system. Fire extinguishers located in accordance with the ABC, AFC, NFPA 10, and other applicable NFPA standards will provide fire protection. Process areas as well as occupied areas will use 10 kg, cartridge operated, A:B:C dry chemical extinguishers. The electrical room will be fitted with 10 kg, pressurized CO_2 extinguishers.

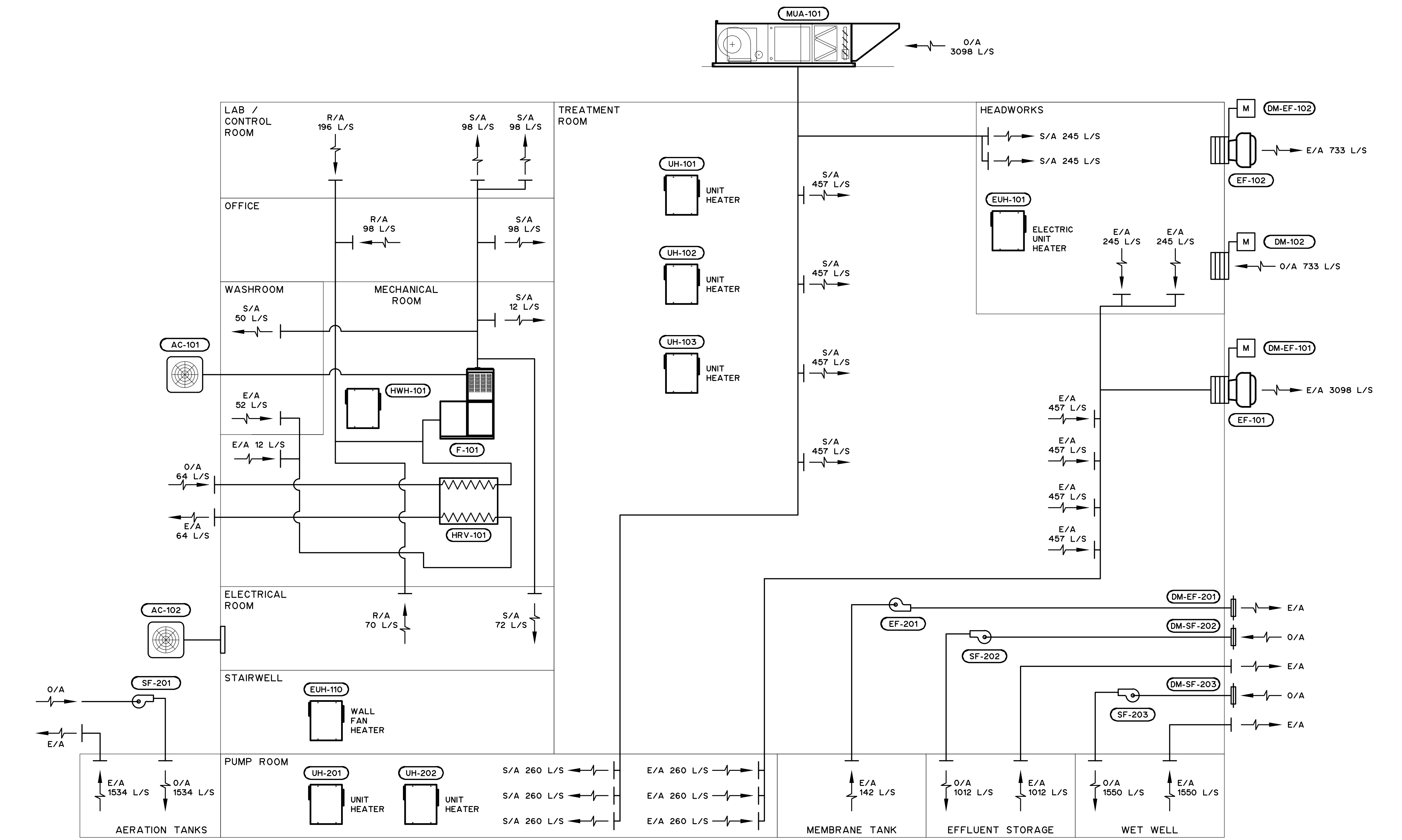
4.7.4.8 HVAC Flow Diagram

Figure 4.13.1 illustrates the flow diagram of the WWTF mechanical system and identifies key equipment design parameters.

NOTES:

ABBREVIATIONS:

S/A	SUPPY AIR
E/A	EXHAUST AIR
O/A	OUTSIDE AIR
R/A	RETURN AIR



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Discipline	Sk. Reg. No.	Signature
MECHANICAL	24112	

MPE Engineering Ltd.

ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
MECHANICAL
HEATING AND VENTILATION
FLOW DIAGRAM

DESIGN CRITERIA

MUA-101
- MAKEUP AIR HANDLING UNIT
- 5.6 kW, 3100 L/S
- 600 VAC/3 PH/60 Hz

EF-101
- EXHAUST FAN
- 1.12 kW, 3100 L/S
- 600 VAC/3 PH/60 Hz

HRV-101
- HEAT RECOVERY VENTILATOR
- 0.15 kW, 64 L/s
- 120 VAC/1 PH/60 Hz

F-101
- FORCED AIR FURNACE
- 0.22 kW, 545 L/s
- 120 VAC/1 PH/60 Hz

AC-101
- CONDENSING UNIT
- 1.98 kW
- 208 VAC/1 PH/60 Hz

AC-102
- CONDENSER
- 4.68 kW
- 208 VAC/1 PH/60 Hz
- EVAPORATOR
- 0.2kW
- 208 VAC/1 PH/60 Hz

SF-202
- SUPPLY FAN
- 1.12 kW, 1012 L/S
- 208 VAC/1 PH/60 Hz

SF-203
- SUPPLY FAN
- 1.12 kW, 1550 L/S
- 208 VAC/1 PH/60 Hz

SF-201
- SUPPLY FAN
- 1.12kW, 1534 L/S
- 208 VAC/1 PH/60 Hz

HWH-101
- HOT WATER HEATER
- 120 VAC/1 PH/60 Hz

EF-102
- EXHAUST FAN
- 0.19kW, 735 L/S
- 600 VAC/3 PH/60 Hz

EUH-101
- ELECTRIC UNIT HEATER
- 15 kW
- 600 VAC/3 PH/60 Hz

EUH-110
- WALL FAN HEATER
- 4 kW
- 208 VAC/1 PH/60 Hz

UH-101/102/103/201/202
- UNIT HEATER
- 0.2 kW
- 120 VAC/1 PH/60 Hz

EF-201
- EXHAUST FAN
- 0.11 kW, 142 L/S
- 120 VAC/1 PH/60 Hz

DESIGNED	R.R.U.	JOB	7603-002-00
DRAWN	T.D.D.	SCALE	NTS
DATE	OCTOBER 2020	FIGURE	4.13.1

4.8 Electrical

4.8.1 General

The electrical and controls design summarizes the proposed design basis for the electrical servicing, emergency power generation requirements and plant controls for the WWTF.

4.8.1.1 Design Standards & References

The design shall conform to all applicable local, provincial, and/or federal codes, standards, regulations, and references in effect at time of quote including but not limited to:

- National Building Code; 2015
- National Energy Code; 2017
- National Fire Code of Canada; 2015
- Canadian Electrical Code including SaskPower Interpretations; 2018
- Safety Code Act
- Occupational Health & Safety Act
- Water Security Agency, The Waterworks and Sewage Works Regulations, 2015
- Water Security Agency, The Environmental Management and Protection Act, 2010
- Water Security Agency, Sewage Works Design Standard (EPB 503), 2015
- City of Saskatoon Design & Development Standards Manual

The design will comply with the requirements of the following organizations, at a minimum:

- CSA, Canadian Standards Association
- NEC, National Electric Code
- NEMA, Standards of National Electrical Manufacturers Association
- ANSI, American National Standards Institute
- ASME, American Society of Mechanical Engineers
- CSA, Canadian Standards Association
- CEC, Canadian Electrical Code
- IEEE, Institute of Electrical and Electronic Engineers
- EEMAC, Electrical and Electronic Equipment Manufacturers Association of Canada
- NFPA (National Fire Protection Association)

The design will comply in particular with the following standards and manuals, at a minimum:

- NFPA 820, Standard for Fire Protection in Wastewater Treatment & Collection Facilities; 2016

4.8.2 Electrical Servicing

The electrical service will be 600 VAC, 3 Phase, 250 Amp, 60 Hz service. The service will be fed underground from a pad mount 300 kVA transformer located near the facility. It is proposed that owner metering be installed at the service transformer. A 600 VAC, 400A MCC will be used as the primary service entrance and distribution system.

4.8.3 Electrical Loads

The proposed WWTF will have a significant electrical loading. A large portion of the loading will be contributed from VFDs, which produce significant harmonic distortion. An active harmonic filter will be used to reduce harmonic distortion to the levels recommended in IEEE 519 and meet the electrical utility servicing requirements for harmonic distortion at the point of common coupling. Owner power quality metering will be included in the MCC and input into the PLC for monitoring and trending.

4.8.4 Motor Control Centers (MCC)

The design includes one MCC wrapped around the walls of the electrical room and combines all of the main servicing equipment, motor starters, and lighting panels into a single manufactured system. This allows for faster installation, neater final appearance, and a higher level of factory testing.

4.8.5 Full Voltage Starters, Soft Starters, Variable Frequency Drives, & Accessories

Motor starters and VFDs will be located inside of the MCC for all equipment. Full voltage non reversing starters and full voltage starters will be used for all motors that do not require variable speed. Soft starters will not be used.

4.8.6 Transformers, Panelboards, and Distribution Equipment

Transformers will be used to step the voltage down from 600VAC to 120/208VAC. Panelboards fed from these transformers will provide all building loads and lighting. It is anticipated that electrical room one will house one 60 circuit panelboard servicing the office area, mechanical room and treatment areas. A small panelboard powered from an uninterruptable power supply (UPS) will supply power to control panels and SCADA PC within the plant.

4.8.7 Standby Power Generators and Transfer Switches

Standby power will be provided by a 175 kW diesel powered generator, located outside the building, and complete with a 24-hour fuel tank. An automatic transfer switch will be integrated into the primary MCC to provide automatic switching between utility and standby power during outages. During a short-term power outage in which wastewater influent continues to arrive, the generator will maintain blower operation, by operating one train of the WWTF. This ensures the continued treatment of influent wastewater. Maintaining blower operation is of specific importance, as the aeration headers will remain pressured and full aeration will occur in the bioreactors and digesters. De-pressuring the aeration headers and diffusers should be avoided to prevent potential clogging.

4.8.8 Cable and Conduit

The wiring will be primarily run using TECK and tray cable within the liquid treatment area and sludge management areas. The headworks area will be a Zone 2 Category 1 hazardous location as per the CEC 22.1 Section 18 and Section 22, therefore all wiring methods and electrical equipment installed in this area will be rated for Zone 2 Category 1 use. All conduit within headworks will be rigid aluminum or rigid stainless steel with fittings and boxes meeting Zone 2 Category 1 requirements. Ventilation will be design to NFPA 820 requirements in all applicable areas of the facility.

4.8.9 Lighting

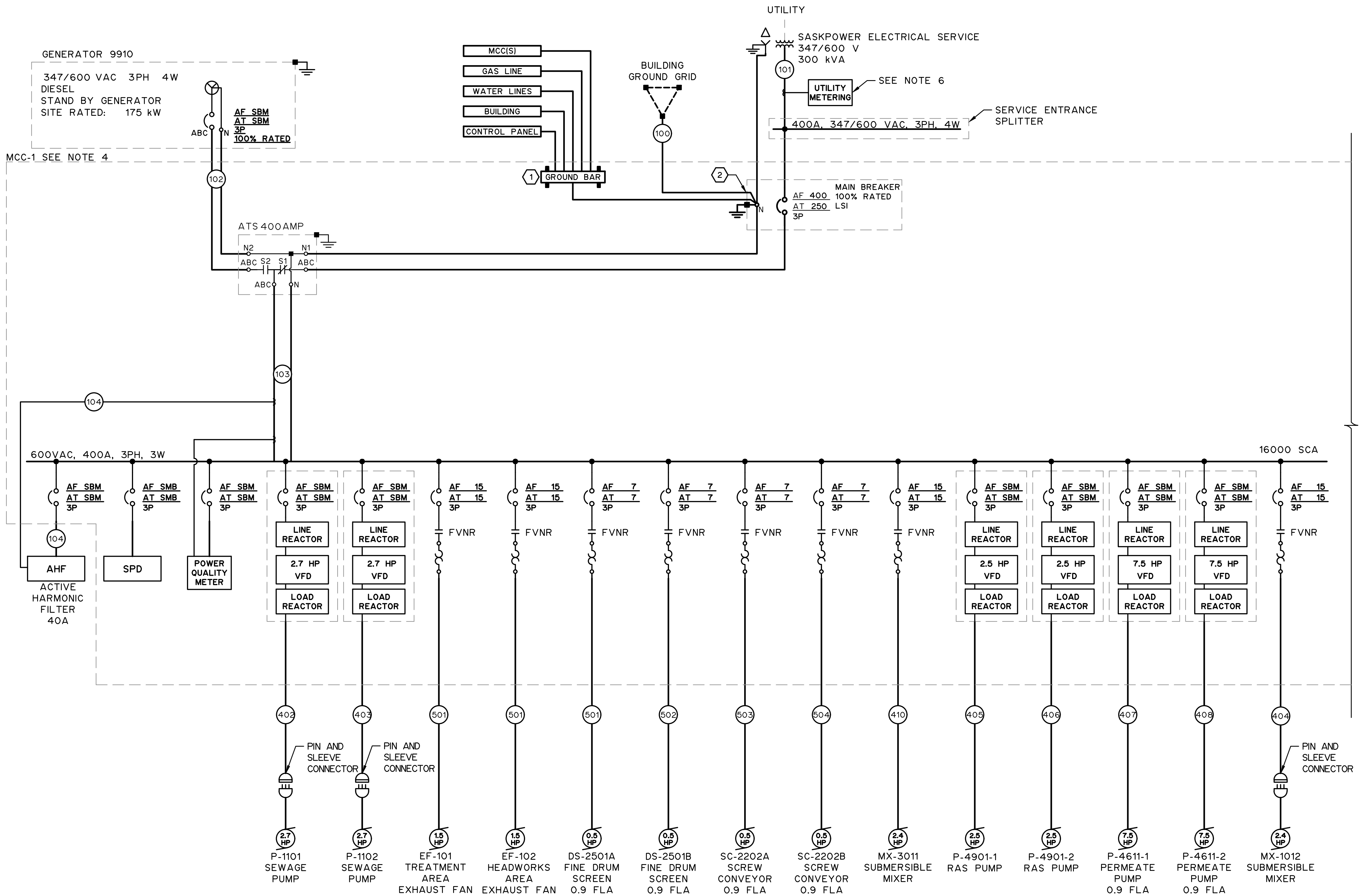
Lighting will be low maintenance, energy efficient LED fixtures throughout the facility. Internal motion detectors will be considered in office areas in which reliable and correct detection of occupancy is possible. Interior lighting levels will be to Illuminating Engineers Society (IES) Standards and the National Energy Code for Canada for Buildings. Emergency lighting will be provided throughout the plant. External security lighting will be controlled by photocell. Exterior process lighting will be controlled by personnel operated switches.

4.8.10 Fire Detection

Smoke and heat detectors will be provided in the electrical and blower rooms for onward transmission to the SCADA system. A full fire alarm system is not proposed.

4.8.11 Telephone and Internet

A new telephone landline and internet service will be installed to provide telephone and internet services. Figure 4.14.1 and 4.14.2 are single line diagrams for the proposed WWTF.



NOTES:

1. FOR INFORMATION REGARDING GENERAL NOTES, UTILITIES, ABBREVIATIONS AND SYMBOLS, REFER TO THE LEGEND DRAWINGS.
2. SBM = SIZED BY MANUFACTURER. SIZE OVER CURRENT DEVICE AND CABLING AS PER MANUFACTURERS RECOMMENDATIONS.
3. (--) SEE CONDUIT AND CABLE SCHEDULES ON E-DRAWINGS SERIES.
4. SEE MCC LINE UP FOR PROPOSED MCC LAYOUT AND DIMENSIONS.
5. EQUIPMENT SHOWN CONNECTED TO GROUND BUS IS A TYPICAL REPRESENTATION OF EQUIPMENT TO BE CONNECTED. IT IS THE CONTRACTORS RESPONSIBILITY TO PROPERLY GROUND AND BOND ALL NECESSARY EQUIPMENT AS PER RELEVANT CODES.
6. UTILITY METERING AT TRANSFORMER BY ELECTRIC COMPANY.
5. SEE MOTOR STARTER DETAILS ON E-DRAWING SERIES.

KEY NOTES:

1. GROUND BUSS BAR, HOFFMAN: DGTB216 OR EQUAL.
2. CONTINUOUS GROUND CABLE, DO NOT CUT.
3. WALL MOUNTED TRANSFORMER.

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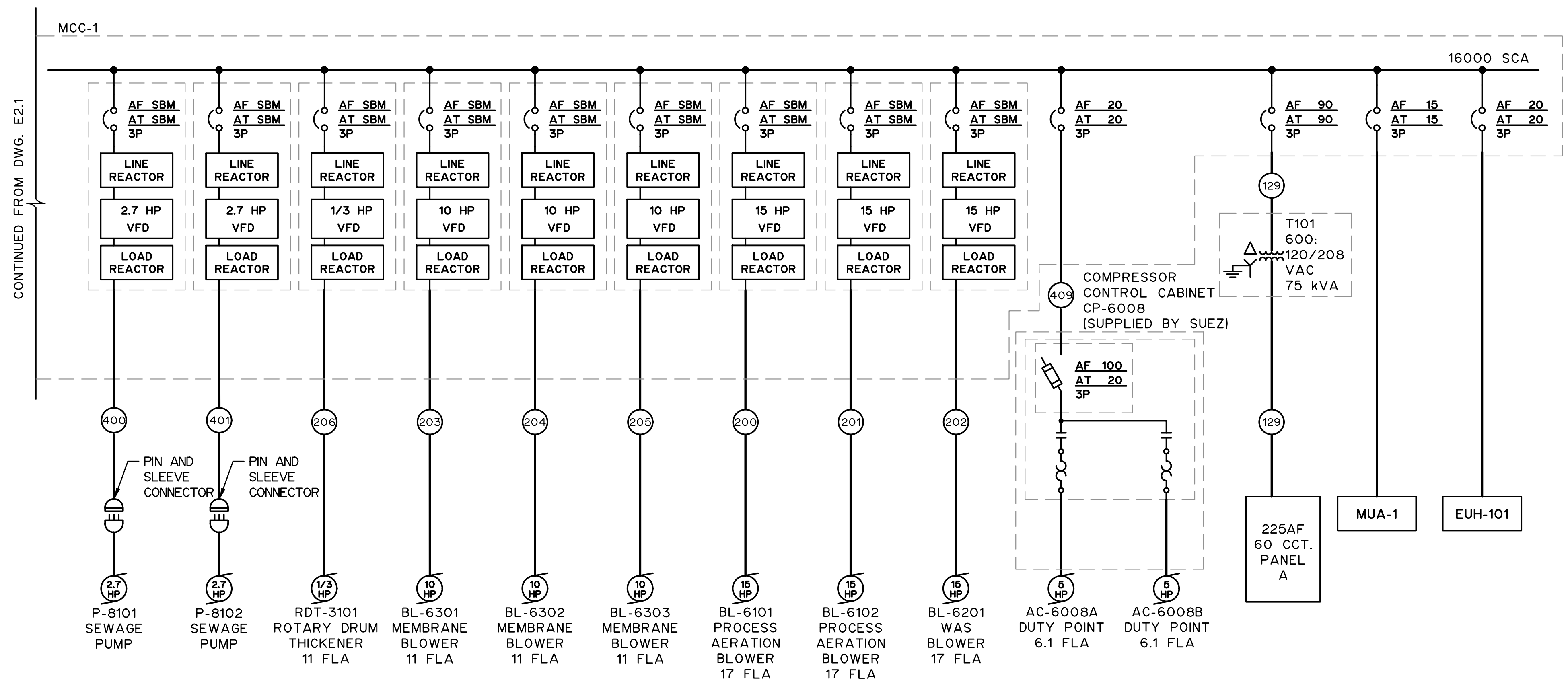
MPE Engineering Ltd.

ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
ELECTRICAL
SINGLE LINE DIAGRAM

DESIGNED	R.G.O	JOB	7603-002-00
DRAWN	T.S.	SCALE	N.T.S.
DATE	OCTOBER 2020	FIGURE	4.14.1



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4. SEE MCC LINE UP FOR PROPOSED MCC LAYOUT AND DIMENSIONS.
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ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
ELECTRICAL
SINGLE LINE DIAGRAM

DESIGNED	R.G.O	JOB	7603-002-00
DRAWN	T.S.	SCALE	N.T.S.
DATE	OCTOBER 2020	FIGURE	4.14.2

4.9 Controls & Automation

4.9.1 General

The proposed controls system for the English River WWTF will consist of two (3) Allen Bradly CompactLogix control panels and VTSCADA based software SCADA system operated on a desktop PC. Control Panels will be located in Electrical Room 1.

4.9.2 System Architecture

The WWTF will leverage AB Logix5000 platform PLCs using Ethernet I/P based communication protocol to transfer information between the various components. This Ethernet protocol will also be used to interface with SCADA and other devices. By standardizing on Ethernet I/P, the automation system will be open for integration with modern control system components such as those included with the UV Reactor system.

When implementing an Ethernet I/P network, it is recommended to install redundant Ethernet taps to provide two paths of communication to each node.

The system architecture is illustrated in Figure 4.15

4.9.3 Hardware & Software Specifications

The recommended automation hardware equipment consists of Allan Bradley PLC and communications equipment. The recommended SCADA software consists of VTSCADA. These recommendations are based upon industry standards in Western Canadian municipal facilities as well as utilization of pre-configured standards which allow our firm to rapidly develop automation systems for use in municipal facilities.

4.9.3.1 Hardware Specifications

Specifications are included for the recommended PLC processor, communications adaptors, network switches and IO modules in Table 5.1. Allan Bradley hardware is recommended due to existing infrastructure and market share in wastewater applications throughout Western Canada.

The use of managed layer 2 network switches is recommended to provide a redundant ring network path to communication nodes by use of 24 port network switches to allow for connection of all current and future equipment.

4.9.3.2 Software Specifications

The recommended SCADA software is VTSCADA. Licensing for VTSCADA depends on many factors but is primarily based upon: Number of Computers, Number of Tags and Number of Remote clients. Based on preliminary estimates, the estimated tag count for addition of the proposed WWTF PLC will be less than 5000 tags. Based on the requirements defined for this project, we recommend the upgrade of a Dual Server Redundant Complete VTSCADA license.

4.9.3.3 Computer Specifications

VTSCADA will operate on workstation operating systems. We recommend the use of Windows 10 Professional for the SCADA computers. In addition to the operating system, the following base specifications are recommended for adequate performance of the SCADA workstations:

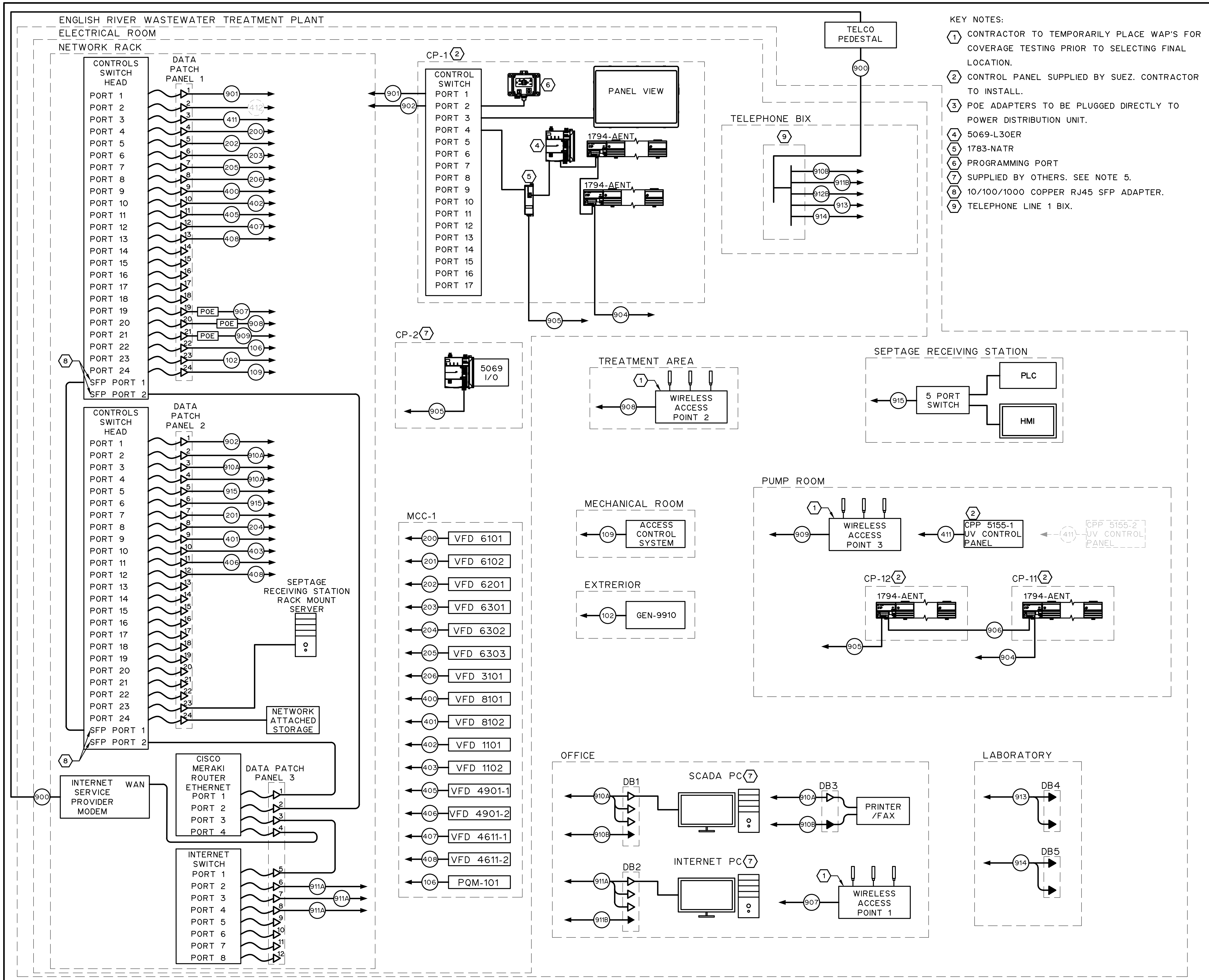
- Clock Speed 3.0 GHz or Greater
- Cores 4 or more
- RAM 16 GB or more (Primarily for remote Access)

- HDD Space 500 GB
- RAID RAID 1

Additional software which should be considered for the SCADA computers includes:

- Microsoft Office Home & Business.

Remote access to the SCADA application will be through thin clients. This implementation consists of the primary SCADA as a host with client computers, laptops, cellular phones, or tablets achieving remote connection through an HTML 5 compliant web-browser independently to that of the session running on the host machine. This approach requires very little computing power for client machines, with the host application meeting the specification above.



KEY NOTES:

1. CONTRACTOR TO TEMPORARILY PLACE WAP'S FOR COVERAGE TESTING PRIOR TO SELECTING FINAL LOCATION.
2. CONTROL PANEL SUPPLIED BY SUEZ. CONTRACTOR TO INSTALL.
3. POE ADAPTERS TO BE PLUGGED DIRECTLY TO POWER DISTRIBUTION UNIT.
4. 5069-L30ER
5. 1783-NATR
6. PROGRAMMING PORT
7. SUPPLIED BY OTHERS. SEE NOTE 5.
8. 10/100/1000 COPPER RJ45 SFP ADAPTER.
9. TELEPHONE LINE 1 BIX.

NOTES:

1. FOR INFORMATION REGARDING GENERAL NOTES, UTILITIES, ABBREVIATIONS AND SYMBOLS, REFER TO THE LEGEND DRAWINGS.
2. (--) SEE CONDUIT AND CABLE SCHEDULES ON E-DRAWINGS SERIES.
3. POE = POWER OVER ETHERNET
   DB = DEVICE BOX
4. ALL CABLES TO BE CAT6 UNLESS OTHERWISE NOTED.
5. CP-2 TO BE PROVIDED BY OTHERS. CONTRACTOR TO INSTALL CONTROL PANEL AND TERMINATE DEVICES ACCORDING TO PID P1.x SERIES DRAWINGS AND PANEL DRAWINGS. PANEL DRAWINGS TO BE PROVIDED AT TIME OF CONSTRUCTION.

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ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
ELECTRICAL
COMMUNICATION AND CONTROL

DESIGNED	R.G.O.	JOB	7603-002-00
DRAWN	T.S.	SCALE	N.T.S.
DATE	OCTOBER 2020	FIGURE	4.15

5.0 Financial Analysis

5.1 Capital Cost Estimate

The Cass D capital costs for the proposed MBR WWTF layout have been estimated and are summarized in Table 5.1. The capital cost estimate includes contingency, engineering and are exclusive of PST and GST.

Table 5.1: Capital Cost Estimate

Item	Description	Capital Cost
1	General Items	$390,000.00
2	Wet well, Sludge Storage and Influent Pumping System	$139,400.00
3	Drum Fine Screening Appurtenances	$19,500.00
4	Membrane Biological Reactor	$1,741,400.00
5	Sludge Thickener	$115,000.00
6	Polymer Feed System	$97,000.00
7	Laboratory Equipment	$27,800.00
8	Structural	$1,546,900.00
9	HVAC Mechanical	$161,300.00
10	Electrical	$795,100.00
11	Civil/Site Work	$373,000.00
12	Septage Receiving Station	$183,300.00
	SUB TOTAL Construction	**$5,589,700.00**
	TOTAL CONTINGENCY (5.0%)	$284,835.00
	ENGINEERING & MATERIALS TESTING (10.4%)	$613,134.28
	GRAND TOTAL	**$6,487,700.00**

The cost estimate provided is an opinion of probable cost and is a function of many factors that can change with time and hence must not be relied upon as the actual cost. Construction equipment and methods that are commonly used in the industry are assumed for estimating purposes. Refer to Appendix A for the complete details of the capital cost estimate.

6.0 Project Delivery

6.1 Contract Delivery

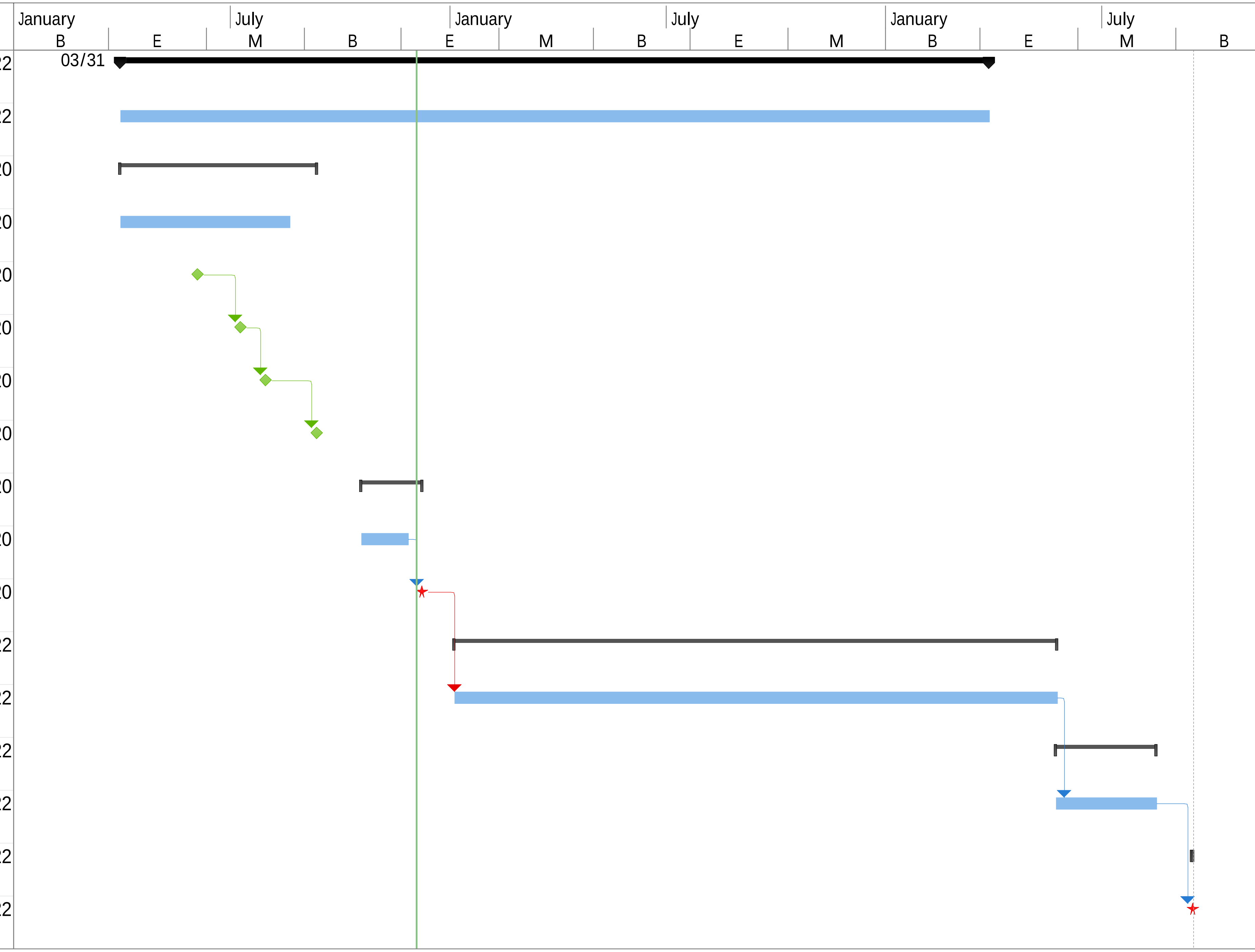
It is assumed that ERPM will follow a conventional design-bid-build delivery model to implement this project typical of projects of this magnitude. This approach provides the ERPM with a high level of control over quality, as well as the sequencing of construction work, tie-ins to existing infrastructure, and timing of shutdowns, which are important considerations for the project.

6.2 Schedule

The contract provided a project substantial and total completion dates at the mid and end of September of year 2022. This will allow the selected contractor to start construction of the project at an optimal time of the year which will allow ease of construction and reduced costs.

Figure 6.1 provides an overview of the project schedule from its inception to expected completion. as the project is moving to the construction phase, a detailed construction schedule will be requested and obtained from the selected contractor; which schedule will govern the remainder of the project's schedule.

ID	Task Name	Duration	Scheduled Start	Scheduled Finish
1	PROJECT MANAGEMENT	520 days	Tue 03/31/20	Mon 03/28/22
2	Management of Project Activities	520 days	Tue 03/31/20	Mon 03/28/22
3	DETAILED DESIGN	119 days	Tue 03/31/20	Fri 09/11/20
4	Detailed Design Phase	102 days	Tue 03/31/20	Wed 08/19/20
5	Design Meeting 1 (DBM Update)	1 day	Wed 06/03/20	Wed 06/03/20
6	Design Meeting 2 (50%)	1 day	Thu 07/09/20	Thu 07/09/20
7	Design Meeting 3 (75%)	1 day	Thu 07/30/20	Thu 07/30/20
8	Design Meeting 4 (95%)	1 day	Fri 09/11/20	Fri 09/11/20
9	TENDERING	37 days	Mon 10/19/20	Tue 12/08/20
10	Tendering	29 days	Mon 10/19/20	Thu 11/26/20
11	Notice of Award	1 day	Tue 12/08/20	Tue 12/08/20
12	CONSTRUCTION	361 days	Tue 01/05/21	Tue 05/24/22
13	Construction Services	361 days	Tue 01/05/21	Tue 05/24/22
14	COMMISSIONING	60 days	Tue 05/24/22	Mon 08/15/22
15	Commissioning	60 days	Tue 05/24/22	Mon 08/15/22
16	TOTAL PROJECT COMPLETION	1 day	Thu 09/15/22	Thu 09/15/22
17	Total Project Completion	1 day	Thu 09/15/22	Thu 09/15/22



Project: ERPM WWTP
Date: Fri 12/04/20

Task
Split
Milestone
Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
Deadline
Progress
Manual Progress

7.0 Conclusions & Recommendations

7.1 Conclusions

We have revised the design basis memorandum for the ERPM WWTF and the major conclusions are as follows:

- Report reviewed the current and future requirements for ERPM wastewater treatment requirements based on the proposed development phases identified in previous reports. These include:
    - Stage 1: Development of Phases 1, 3, and 4, which are proposed currently.
    - Stage 2: Development of Phases 2 and 5 for future.
- Previously determined wastewater projections were reviewed and revised to reflect typical commercial and industrial uses proposed for the ERPM. A detailed reviewed determined the raw wastewater influent design criteria as follows:
    - Max month flow for stage 1 and 2 development are 282 and 432 m^3/day respectively.
    - BOD concentration of 350 mg/L and 250 mg/L for average day and maximum month flows, respectively.
    - TSS concentration of 350 mg/L and 250 mg/L for average day and maximum month flows, respectively.
    - Design temperature of 1% Percentile temperature of 9.0 ^{o}C.
- The proposed WWTF will be designed to achieve the INAC, provincial and federal effluent limits.
- Two building layout options were reviewed previously and the MBR Concrete Tanks option was selected as the most preferred option carried through this DBM.
- Membrane Bioreactor (MBR) treatment technology has been maintained as the preferred treatment technology of choice by ERPM and SUEZ Technologies was selected as the preferred vendor.
    - SUEZ has been revised their proposal submission and is included in the contract documents.
- Thickened waste sludge from the MBR treatment system will be stored in an aerated and enclosed chambered, and the pumped out regularly to be disposed of at the City of Saskatoon's treatment facility for further treatment.
- Odour control and mitigation measures:
    - ERPM's WWTF processes are contained in enclosures and are aeration based which typically presents less odour issues as compared to lagoon-based technology. Odour issues from the facility are not anticipated with the current design; however, provisions would be in place to install carbon filters for odour control in the future.
    - Location of the MBR facility has been revised to the Phase 5 development area and in close proximity to the proposed treated effluent storage and future storm pond. This location allows for the facility to meet the 150m variance set back limit to proposed commercial development.
    - Proposed WWTF design ensures the building occupied areas are free from odours.
- Influent emergency storage will be provided within the wet well pumping chamber to provide equalization or dampening of peak flows and loadings as well as a buffer during emergency shutdown procedures.
    - Peak flows typically last for 1 to 2 hours however, 4.3 and 2.4 hours of storage are available for Stage 1 and Stage 2 respectively and at design treatment capacity (MMF).
    - Emergency shutdown during average day flows; the storage chamber will provide 12.8 and 8.3 hours of buffer storage for Stage 1 and Stage 2, respectively.
    - The influent wet well will be designed to allow liquid ot overflow to the sludge storage chamber

for pump out by vacuum trucks in the case of an emergency shutdown. In this event, raw sewage would be disposed of at one of the City of Saskatoon's Waste Hauler Stations.
    - The equalization chamber will also be used to facilitate mitigation of peak loading rates in conjunction with an increase of aeration from the blowers.
- The capacity of the MBR Facility is based on current available flows and mostly on estimates based on recommended regulations and typical flows and loadings for similar proposed developments. The process design is conservative and the layout as well as building configuration of the facility will allow for future expansion to the south for addition of a third train if additional inflow is brought to the WWTF.
- Treated Effluent will be disposed of by irrigation in the Stage 1 development. Once Stage 2 commences, the ERPM will have to consider alternative disposal options such as direct disposal to the South Saskatchewan River.
- The capital costs presented in this report have been refined based on SUEZ's October 2020 Proposal, and quotes from suppliers for all other equipment and materials. The total class B capital cost for the MBR Treatment Facility is $6,487,669.28 plus taxes.

7.2 Recommendations

The following recommendations have been made:

- Submit this design memorandum to the INAC for their review and comment
- Submit this design memorandum to the WSA for their review and comment in support of the approval application for the proposed effluent discharge piping and outlet at the South Saskatchewan River.
- Submit this design memorandum to the City of Saskatoon for their review and comment in support of the approval application for the proposed effluent discharge piping and outlet at the South Saskatchewan River.

8.0 References

(1) Water Supply and Pollution Control, 8th Ed. W. Viessmen, Jr., M. Hammer, E. Perez, and P. Chadik. Prentice Hall, 2009.

(2) Ministry of Justice, “Wastewater Systems Effluent Regulations”, http://laws-lois.justicr.gc.ca

(3) Metcalf & Eddy, Inc., “Wastewater Engineering Treatment and Reuse, 4th Ed.”, McGraw-Hill, New York, NY, 2003.

(4) Department of Fisheries and Oceans, Fisheries Act, Wastewater Systems Effluent Regulations SOR/2012-139, 2012.

(5) Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines, 2007.

(6) Alberta Environment, “Standard and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems”, Drinking Water Branch, Environmental Policy Branch, Environmental Assurance Division, Edmonton, Alberta, March 2013.

(7) Wastewater Systems Standards for Performance and Design; Alberta Environment and Parks; 2013.

(8) Environmental Quality Guidelines for Alberta Surface Waters; Alberta Environment and Sustainable Resource Development; 2014

Appendix A – Class B Capital Cost Estimate

ENGLISH RIVER PROJECT MANAGEMENT

MBR Treatment Facility

CLASS B COST ESTIMATE

MPE Engineering Ltd.

	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	INSTALL	COST
	MBR Treatment Facility					
General Items						
1	Mobilization / Demobilization / Bonding & Insurance / Profit @ 7.5%	1	LS	$ 390,000.00		$ 390,000.00
						$ -
		SUBTOTAL				**$ 390,000.00**
Wet well, Sludge Storage and Influent Pumping System						
1	Self-Priming Sewage Pump Package	4	ea.	$ 15,000.00	$ 4,500.00	$ 78,000.00
2	Mechanical Piping	1	LS	$ 10,000.00	$ 3,000.00	$ 13,000.00
3	Plug Valve (100 mm)	6	ea.	$ 1,200.00	$ 360.00	$ 9,400.00
4	Check Valve (100mm)	4	ea.	$ 700.00	$ 210.00	$ 3,600.00
5	Couplings	1	LS	$ 1,000.00	$ 300.00	$ 1,300.00
6	Magmeter (150 mm)	2	LS	$ 5,000.00	$ 1,500.00	$ 13,000.00
7	Multi Ranger Ultrasonic Level Transmitter	2	LS	$ 2,500.00	$ 3,500.00	$ 12,000.00
8	Level Pressure Transducers	2	LS	$ 2,500.00	$ 750.00	$ 6,500.00
9	Pressure Gauges with Isolators	2	ea.	$ 500.00	$ 150.00	$ 1,300.00
10	Level Switches	2	ea.	$ 500.00	$ 150.00	$ 1,300.00
		SUBTOTAL				**$ 139,400.00**
Drum Fine Screening Appurtenances						
1	Dual Rotary Drum Screens c/w Washer/Compactor *(Carried in MBR)*	1	LS			$ -
2	Mechanical Piping	1	LS	$ 10,000.00	$ 3,000.00	$ 13,000.00
3	Plug Valves (75 mm)	2	ea.	$ 1,000.00	$ 300.00	$ 2,600.00
4	Fluidisation Line c/w valves, strainer and flow indicator	1	LS	$ 2,000.00	$ 600.00	$ 2,600.00
5	Disposal Bin	2	ea.	$ 500.00	$ 150.00	$ 1,300.00
		SUBTOTAL				**$ 19,500.00**
Membrane Biological Reactor						
1	MBR Treatment Plant c/w • membranes and tankage • ejector and associated equipment • master control panel • 2-permeate pump skid • backpulse system • 2-membrane air scour blowers • 2-mixed liquor recirculation equipment • biological equipment: 2-blowers, diffusers, 2-mixers, 2-O2 sensors • membrane cleaning systems, 3-NaOH, 2-Citric • Fine Drum Screens • 2-Internal Recirculation Pumps	1	LS	$ 1,395,670.00	$ 209,350.50	$ 1,605,000.00
2	SUEZ Engineering	1	L.S.	$ 107,000.00		$ 107,000.00
3	100mm Influent Piping	1	L.S.	$ 4,000.00	$ 1,200.00	$ 5,200.00
4	Influent Control Valves	2	ea.	$ 4,000.00	$ 1,200.00	$ 10,400.00
5	75mm Aeration WAS Piping	1	L.S.	$ 2,000.00	$ 600.00	$ 2,600.00
6	MBR Aeration Piping	1	L.S.	$ 2,500.00	$ 750.00	$ 3,300.00
7	Process Aeration Piping	1	L.S.	$ 2,500.00	$ 750.00	$ 3,300.00
8	100mm Piping (Drain Pipe)	1	L.S.	$ 3,500.00	$ 1,050.00	$ 4,600.00
		SUBTOTAL				**$ 1,741,400.00**
Sludge Thickener						
1	Rotary Drum Thickener c/w washer / compactor	1	ea.	$ 80,000.00	$ 16,000.00	$ 96,000.00
2	Plug Valves (75 mm)	1	ea.	$ 750.00	$ 150.00	$ 1,000.00
3	75mm Piping WAS	1	ea.	$ 6,000.00	$ 1,200.00	$ 7,000.00
4	Magmeter (75 mm)	1	ea.	$ 2,000.00	$ 400.00	$ 2,000.00
5	75mm Piping FI	1	ea.	$ 3,003.00	$ 600.60	$ 4,000.00
6	75m Piping TWAS	1	ea.	$ 1,000.00	$ 200.00	$ 1,000.00
7	Influent WAS Line, Valving and Fitting	1	ea.	$ 3,000.00	$ 600.00	$ 4,000.00
		SUBTOTAL				**$ 115,000.00**
Polymer Feed System						
1	Polymer Feed System	1	ea.	$ 45,000.00	$ 9,000.00	$ 54,000.00
2	Day Tank	1	ea.	$ 1,500.00	$ 300.00	$ 2,000.00
3	Weigh Scale, c/w Transmitter	4	ea.	$ 4,500.00	$ 900.00	$ 22,000.00
4	Magmeter	1	ea.	$ 3,000.00	$ 600.00	$ 4,000.00
5	Level Switch	1	ea.	$ 500.00	$ 100.00	$ 1,000.00
6	Drum and Transfer Pump	1	ea.	$ 2,000.00	$ 400.00	$ 2,000.00
7	Piping	1	ea.	$ 10,000.00	$ 2,000.00	$ 12,000.00
		SUBTOTAL				**$ 97,000.00**

ENGLISH RIVER PROJECT MANAGEMENT

MBR Treatment Facility

CLASS B COST ESTIMATE

	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	INSTALL	COST
Laboratory Equipment						
1	Fume Hood	1	ea.	$ 3,000.00	$ 900.00	$ 3,900.00
2	Glassware Washer	1	ea.	$ 3,000.00	$ 900.00	$ 3,900.00
3	Misc. Lab Equipment	1	ea.	$ 20,000.00		$ 20,000.00
		SUBTOTAL				**$ 27,800.00**
Structural						
1	Pre - Engineered Building Supply & Install	200	m^2	$ 1,000.00	$ 300.00	$ 260,000.00
2	Concrete (Structural, Beams, Pads)	467	m^3	$ 1,000.00	$ 1,000.00	$ 934,900.00
3	Concrete (Generator Pad and Piles)	1	LS	$ 20,000.00	$ 6,000.00	$ 26,000.00
4	Interior Walls (200 concrete block walls)	170	m^2	$ 300.00	$ 90.00	$ 66,300.00
5	Misc. Steel	1	LS	$ 8,000.00	$ 2,400.00	$ 10,400.00
6	Xypex Coating	527	m^2	$ 25.00	$ 25.00	$ 26,300.00
7	Damp Proofing	338	m^2	$ 5.00	$ 10.00	$ 5,100.00
8	Epoxy Floor Painting	200	m^2	$ 40.00	$ 60.00	$ 20,000.00
9	Aluminum - Access Hatches and Ladder	5	ea.	$ 5,000.00	$ 1,500.00	$ 32,500.00
10	Aluminum - Ladder	4	ea.	$ 4,000.00	2000	$ 24,000.00
11	Aluminum - Stairs	1	ea.	$ 12,000.00	2000	$ 14,000.00
12	Aluminum - Grating		m^2	$ 1,500.00	300	$ -
13	Aluminum - Handrails	1	m	$ 300.00	100	$ 400.00
14	Aluminum - Pipe Supports	5	ea.	$ 3,000.00	100	$ 15,500.00
15	Bridge Crane	1	LS	$ 30,000.00	$ 9,000.00	$ 39,000.00
16	Epoxy Flooring	320	m^2	$ 75.00	$ 25.00	$ 32,000.00
17	Drywall (Walls and Ceiling)	110	m^2	$ 30.00	$ 20.00	$ 5,500.00
18	Paint	1	LS	$ 7,500.00		$ 7,500.00
19	Ceiling Tile	50	m^2	$ 30.00	$ 20.00	$ 2,500.00
20	Building Signage	1	LS	$ 10,000.00		$ 10,000.00
21	Millwork	1	LS	$ 15,000.00		$ 15,000.00
		SUBTOTAL				**$ 1,546,900.00**
HVAC Mechanical						
1	Domestic Plumbing	1	LS	$ 3,000.00	$ 3,000.00	$ 6,000.00
2	Fire Extinguishers	5	ea.	$ 500.00	$ 150.00	$ 3,300.00
3	Emergency Shower and Mixing Valve	1	ea.	$ 2,000.00	$ 600.00	$ 2,600.00
4	Indirect Hot Water Heater	1	ea.	$ 2,500.00	$ 750.00	$ 3,300.00
5	Condensing Boilers	2	ea.	$ 10,000.00	$ 3,000.00	$ 26,000.00
6	Expansion Tanks and Boiler Accessories	1	LS	$ 3,500.00	$ 1,050.00	$ 4,600.00
7	Heating Pumps	2	ea.	$ 2,000.00	$ 600.00	$ 5,200.00
8	Unit Heaters	5	ea.	$ 2,500.00	$ 750.00	$ 16,300.00
9	Heating Controls Mechanical Installation Component	5	ea.	$ 300.00	$ 90.00	$ 2,000.00
10	Hydronic Heating Piping	1	LS	$ 4,000.00	$ 4,000.00	$ 8,000.00
11	Forced Air Furnace	1	ea.	$ 5,000.00	$ 1,500.00	$ 6,500.00
12	Condenser and Fan Coil	1	ea.	$ 2,500.00	$ 750.00	$ 3,300.00
13	Refrigeration Piping	1	LS	$ 1,000.00	$ 1,000.00	$ 2,000.00
14	Heat Recovery Ventilator	1	ea.	$ 1,500.00	$ 450.00	$ 2,000.00
15	Insulation	1	LS	$ 4,500.00	$ 4,500.00	$ 9,000.00
16	Direct Fired Make-up Air Unit	1	ea.	$ 16,000.00	$ 4,800.00	$ 20,800.00
17	Exhaust Fan	2	ea.	$ 3,000.00	$ 900.00	$ 7,800.00
18	Motorized Dampers and Louvers	2	ea.	$ 1,650.00	$ 495.00	$ 4,300.00
19	Ductwork and Accessories	1	LS	$ 7,500.00	$ 7,500.00	$ 15,000.00
20	Washroom and Laboratory Appliances	1	LS	$ 2,500.00	$ 750.00	$ 3,300.00
21	Natural Gas Piping	1	LS	$ 5,000.00	$ 5,000.00	$ 10,000.00
		SUBTOTAL				**$ 161,300.00**

Engineering Ltd.

ENGLISH RIVER PROJECT MANAGEMENT

MBR Treatment Facility

CLASS B COST ESTIMATE

	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	INSTALL	COST
Electrical						
1	MCC-1 c/w VFDs, Starters, Panel boards etc.	1	LS	$ 130,000.00	$ 20,000.00	$ 150,000.00
2	Automatic Harmonic Filter	1	LS	$ 35,000.00	$ 6,500.00	$ 41,500.00
3	Lighting Fixtures Switches and Installation	1	LS	$ 15,000.00	$ 6,000.00	$ 21,000.00
4	Emergency Lighting	1	LS	$ 2,500.00	$ 1,000.00	$ 3,500.00
5	CP-200 Supply and Installation	1	LS	$ 40,000.00	$ 20,000.00	$ 60,000.00
6	125 kW Diesel Generator c/w Fuel Tank and Winter Enclosure	1	LS	$ 75,000.00	$ 20,000.00	$ 95,000.00
7	Computers & Networking Equipment	1	LS	$ 7,500.00		$ 7,500.00
8	Gate Operator c/w Keypad Pedestal and Wireless FOBs	1	LS	$ 10,000.00	$ 2,400.00	$ 12,400.00
9	Pin and Sleeve Connectors	6	ea.	$ 2,000.00		$ 12,000.00
10	Building Alarm Instrumentation (Smoke/Heat/Leak Detectors & RTDs)	1	LS	$ 3,000.00	$ 1,200.00	$ 4,200.00
11	Prime Cost Allowance for PLC Programming and SCADA Computer	1	LS	$ 85,000.00		$ 85,000.00
12	General Electrical Costs (Receptacles, boxes etc...)	1	LS	$ 20,000.00		$ 20,000.00
13	Cable Tray	1	LS	$ 15,000.00	$ 6,000.00	$ 21,000.00
14	General Cable Costs	1	LS	$ 85,000.00	$ 50,000.00	$ 135,000.00
15	Telephone & Internet Service Costs	1	LS	$ 10,000.00	$ 2,000.00	$ 12,000.00
16	Electric Service	1	LS	$ 15,000.00		$ 15,000.00
17	Arc Flash Study	1	LS	$ 10,000.00		$ 10,000.00
18	Commissioning	1	LS	$ 90,000.00		$ 90,000.00
		SUBTOTAL				**$ 795,100.00**
Civil/Site Work						
1	Care of Water	1	LS	$ 20,000.00		$ 20,000.00
2	Common Excavation	500	m^3	$ 4.00		$ 2,000.00
3	Compacted Fill	500	m^3	$ 4.00		$ 2,000.00
4	Wastewater Treatment Plant Excavation and Backfill	1	LS	$ 65,000.00		$ 65,000.00
5	Topsoil Placement	7,500	m^2	$ 2.00		$ 15,000.00
6	300mm CSP Culvert Complete	1	ea.	$ 5,000.00		$ 5,000.00
7	Chain link fencing	160	m	$ 110.00		$ 17,600.00
8	16m wide gate complete with 1.2m wide man gate	1	ea.	$ 15,000.00		$ 15,000.00
9	Granular Type 108, 50mm Compacted Depth	3,700	m^2	$ 6.00		$ 22,200.00
10	Granular Type 33, 250mm Compacted Depth	3,700	m^2	$ 28.00		$ 103,600.00
11	Grass Seeding	1	LS	$ 5,000.00		$ 5,000.00
12	1200mm Sanitary manhole, complete	8	v.m.	$ 3,000.00		$ 24,000.00
13	Bollards	14	ea.	$ 1,250.00		$ 17,500.00
14	50mm HDPE DR 11 Waterline	130	m	$ 75.00		$ 9,800.00
15	150 HDPE DR 11 Overflow/Forcemain	100	m	$ 125.00		$ 12,500.00
16	200 PVC SDR 35 Sanitary	95	m	$ 250.00		$ 23,800.00
17	50mm Gate Valve	2	ea.	$ 1,500.00		$ 3,000.00
18	150mm Gate Valve	2	ea.	$ 5,000.00		$ 10,000.00
		SUBTOTAL				**$ 373,000.00**
Septage Receiving Station						
1	Septage Receiving Station (Flow Point)	1	LS	$ 85,000.00	$ 17,000.00	$ 102,000.00
2	General Electrical and Controls	1	LS	$ 5,000.00		$ 5,000.00
3	Concrete Slab	3	m3	$ 1,000.00	$ 1,000.00	$ 6,000.00
4	Foundation	4	LS	$ 3,500.00		$ 14,000.00
5	1200mm Sanitary manhole, complete	4	v.m.	$ 3,000.00		$ 12,000.00
6	300mm CSP Complete	1	LS	$ 5,000.00		$ 5,000.00
7	Trailer Dump Complete	1	LS	$ 7,500.00		$ 7,500.00
8	25mm HDPE DR 11 Waterline	35	m	$ 50.00		$ 1,750.00
9	200 PVC SDR 35 Sanitary	25	m	$ 250.00		$ 6,250.00
10	25mm Gate Valve	1	ea.	$ 1,200.00		$ 1,200.00
11	Precast concrete parking curbs	6	ea.	$ 185.00		$ 1,110.00
12	Granular Type 108, 50mm Compacted Depth	650	m^2	$ 6.00		$ 3,900.00
13	Granular Type 33, 250mm Compacted Depth	650	m^2	$ 27.00		$ 17,550.00
		SUBTOTAL				**$ 183,300.00**
		SUB TOTAL Construction				**$ 5,589,700.00**
TOTAL CONTINGENCY (5.0%)						$ 284,835.00
		TOTAL Construction				**$ 5,874,535.00**
ENGINEERING & MATERIALS TESTING (10.4%)						$ 613,134.28
		GRAND TOTAL				**$ 6,487,669.28**

Appendix B - WSA 150m Variance

Dan Surkan

From: Mica Paez <Mica.Paez@wsask.ca>
Sent: May 16, 2019 4:32 PM
To: Dan Surkan
Cc: Grant Campbell; O.S. (Arasu) Thirunavukkarasu; Ryan Evans
Subject: RE: Dan Surkan's Contact Info

Hi Dan,

In regards to industrial areas, we would consider industrial areas as commercial. So for a mechanical wastewater treatment facility, the setback distance can be lowered to a minimum of 150 m so long as the facility is equipped with advanced odour control and is enclosed.

Thanks,

Mica Paez - EIT
Approvals Engineer-in-Training, Engineering & Approvals
420-2365 Albert Street
Regina, SK S4P 4K1
Ph: 306.787.9166 | Fax: 306.787.0780
wsask.ca | mica.paez@wsask.ca

From: Dan Surkan <dsurkan@urbansystems.ca>
Sent: Thursday, May 16, 2019 4:08 PM
To: Mica Paez <Mica.Paez@wsask.ca>
Cc: Grant Campbell <gcampbell@urbansystems.ca>
Subject: Dan Surkan's Contact Info

Hi Mica,

Thanks for taking my call earlier today. As a summary, we are interested in learning if setback requirements are treated differently for industrial land uses because they are not included in this table from EPB 415:

	Facultative Lagoon Buffer Zone (Metres)	Mechanical Treatment Facility Buffer Zone (Metres)
Single Isolated Residence	300	300[1]
Built-up Residential Area	550[1]	300[1]
Institutional Area	550[1]	300[1]
Commercial Area (with no built-up residential area)	300	300[1]

[1] WSA may approve a reduced buffer zone subject to certain terms and conditions

Please note that, under the *Subdivision Regulations, 2014*, Government Relations requires a 457 metre setback from land used or authorized for use as a wastewater treatment facility or wastewater lagoon; however, this set back distance does not apply to commercial, industrial or institutional development.

We are working with English River First Nation to develop an industrial subdivision south of Saskatoon which would use a membrane bioreactor (MBR) system for wastewater treatment. This type of system does not require a lagoon, is enclosed, and would also use carbon filtration to address odour concerns. I believe that WSA previously stated that the setback requirement could be reduced to 150m. Our best case scenario would be to reduce this setback even further since the plant would only be adjacent to light industrial land uses. This would allow our client to use more of their land for development.

Let me know if you'd like any further clarification. Otherwise I look forward to hearing from you soon.

Thanks,

Dan Surkan, Civil EIT

**#204 – 220 3rd Avenue South
Saskatoon, SK S7K 1M1
T: 306 955 6666 x 2317
C: 306 290 7165**
dsurkan@urbansystems.ca
urbansystems.ca