CITY OF WINKLER

ENVIRONMENT ACT PROPOSAL
for the new
Winkler Wastewater Treatment Facility

Prepared by:
Engineering Department
City of Winkler

April, 2014

CITY OF WINKLER

185 MAIN STREET, WINKLER, MANITOBA R6W 1B4 / PHONE : (204) 325-9524 FAX: (204) 325-5915
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Environmental Approvals Branch
Manitoba Conservation and Water Stewardship
Suite 160, 123 Main Street
Winnipeg, MB
R3C 1A5

Re: Environmental Act Proposal – New Wastewater Treatment Facility for the City of Winkler

We hereby apply for a Class 2 Environment Act License for the construction and operation of the proposed new wastewater treatment facility (mechanical plant) for the City of Winkler.

Enclosed is the Environment Act Proposal Form and Report, prepared by the City's Engineering Department.

The new Winkler Wastewater Treatment Facility will be comprised of a new building to accommodate the new headworks and storage building, one primary clarifier, one bio-reactor, one secondary clarifier, primary sludge pump station, a RAS/WAS pumping system, chemical dosing, a final effluent pump station, ultraviolet disinfection, a workshop, offices, laboratorium, pipelines, peripheral and site works.

The existing aeration cells will be used for sludge stabilization and storage and peak wet weather flow balancing. The existing storage cells will be used for winter storage of the treated effluent for the months in which freezing conditions exists downstream of the plant and by routing the final effluent through these ponds to enhance ultraviolet disinfection.

The site of the proposed facility lies entirely within the footprint of land owned by the City on which the existing lagoon system is being situated on.

As outlined in this report, the proposed facility has been designed to treat the wastewater from Winkler and the two villages in the Rural Municipality of Stanley, ie Schanzenfeld and Reinfeld, to meet the newest provincial effluent discharge standards as per "Manitoba Water Quality Standards, Objectives and Guidelines, November 28, 2011" to be discharged to the Dead Horse Creek.

In this report, we also motivate to continue to discharge the reject water from the new water treatment plant (reverse osmosis concentrate) with the wastewater due to no noticeable effect on Dead Horse Creek.

We provide four (4) hard copies and one (1) electronic copy (CD) of this submission.

We are looking forward to your response with instructions concerning the assessment process and schedule to be followed.

We would be pleased to provide any additional information that you may require.

Sincerely,

Johan Botha, P. Eng.
Director of Engineering and Water Resources

cc: Dale Toews, CAO, RM of Stanley

JB/jt

PROVINCE OF MANITOBA
J. D. BOTHA
Member
23625
REGISTERED PROFESSIONAL ENGINEER

Environment Act Proposal Form

Manitoba
Conservation and Water Stewardship

Name of the development:
Winkler Wastewater Treatment Facility

Type of development per Classes of Development Regulation (Manitoba Regulation 164/88):
Class 2

Legal name of the proponent of the development:
City of Winkler

Location (street address, city, town, municipality, legal description) of the development:
Rural Municipality of Stanley, SE 22-3-4W, SW 23-3-4W

Name of proponent contact person for purposes of the environmental assessment:
Johan Botha, P.Eng.

Phone: 204.325.9524 Fax: 204.325.9902	Mailing address: 185 Main Street, Winkler, MB, R6W 1B4

Email address: jbotha@cityofwinkler.ca

Webpage address: www.cityofwinkler.com

Date: 4 APRIL 2014	Signature of proponent, or corporate principal of corporate proponent: Printed name:

A complete **Environment Act Proposal (EAP)** consists of the following components:

- **Cover letter**
- **Environment Act Proposal Form**
- **Reports/plans supporting the EAP** (see "Information Bulletin - Environment Act Proposal Report Guidelines" for required information and number of copies)
- **Application fee** (Cheque, payable to Minister of Finance, for the appropriate fee)

Per Environment Act Fees Regulation (Manitoba Regulation 168/96):

Class 1 Developments $500
Class 2 Developments $5,000
Class 3 Developments:
Transportation and Transmission Lines $5,000
Water Developments $50,000
Energy and Mining $100,000

Submit the complete EAP to:

Director
Environmental Approvals Branch
Manitoba Conservation and Water Stewardship
Suite 160, 123 Main Street
Winnipeg, Manitoba R3C 1A5

For more information:
Phone: (204) 945-8321
Fax: (204) 945-5229
http://www.gov.mb.ca/conservation/eal

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EXECUTIVE SUMMARY

The City of Winkler currently owns and operates an aerated lagoon system under Environment Act License #2525, which states the following conditions:

- A minimum of 2mg/l of Dissolved Oxygen (DO) is detectable at all times in the liquid of the aerated cells.
- The organic loading on the aerated wastewater treatment lagoon, in terms of the five-day Biochemical Oxygen Demand (BOD5), is not in excess of 1837 kg/day.
- No effluent from the lagoon shall be discharged between the 1st day of November of any year and the 15th day of June of the following year and where:
  - The organic content of the effluent, as indicated by the BOD5 is in excess of 30 mg/l;
  - The fecal coliform content of the effluent, as indicated by the MPN index, is in excess of 200 per 100 ml of sample;
  - The total coliform content of the effluent, as indicated by the MPN index, is in excess of 1500 per 100 ml of sample.

The lagoon system has performed very well after the last upgrade except that the storage capacity has been reached during 2008/2009 and 2009/2010 and been exceeded during 2010/2011, during which time an early release one month prior has been requested. The current BOD organic loading is also only about 50% of the allowable 1837 kg/day.

The exceedance of the storage capacity was completely due to the high infiltration/inflow the City experienced with wet weather flow conditions. Although the City is growing in population, in reality the water consumption was nearly constant for several years now and the new sub-divisions have not contributed to a higher wastewater flow.

Notwithstanding the excellent water quality of the cell drained to provide adequate storage for one additional month in 2011, the City was informed that the conditions of the existing licence has not fully been met and that a moratorium will be placed on any further sub-divisions if the City doesn't attend to an upgrade to meet the newest effluent discharge standards. By providing an upgrade to the existing treatment facility the City will be able to proceed with new sub-divisions.

The only option the City has, is to build a mechanical plant to meet the new standards. Natural systems like wetlands have been considered but no guarantee can be provided that the effluent standards will be met. The mechanical plant to be provided, allows for cost effective phasing and it was also long overdue to provide screening and grit removal to allow a much cleaner sludge to enter the aeration cells. Phosphorous removal will also to be implemented and it is regarded to be more environmentally friendly to implement biological phosphorous removal as planned.

The new mechanical plant will incorporate the existing infrastructure as follows:

- The existing aeration cells will be used for the stabilizing and storage of the primary and waste activated sludge and scum generated by the new mechanical plant and for flow balancing during peak wet weather flows.

  The sulphate (SO_4) is high in the wastewater and together with anaerobic conditions in the rising main, it is expected that the sulphate will be reduced to H_2S by Sulphate-reducing bacteria.

  The same concentration of H_2S will remain in the water fraction of the primary sludge, resulting in potential H_2S odor problems at the Aeration Cell #1. It is foreseen to mitigate the potential odour problem through the following measures:

  - Introducing the primary sludge underneath the surface of the Aeration Cell #1 as it is being currently done with the wastewater.
  - Increasing the upfront DO level in Aeration Cell #1 as necessary but with a minimum of 3mg/L.
  - Ferric (or Alum) dosing at the Primary Sludge Pump Station, before the primary sludge is discharged to Aeration Cell #1.
- The existing storage cells (cells #4, 5, 6, 7 and 9) will be used for the storage of treated effluent during the months in which freezing conditions exists downstream of the plant to mitigate icing problems on the downstream streams. All treated effluent will be routed through the storage ponds to enhance ultraviolet disinfection to be provided by a mechanical UV system.
- The existing storage cell #8 will be used in series with the aeration cells to balance the peak wet weather flow by storing it until such time when it can be pumped back to the inletworks with the water at a higher temperature and the plant receiving only a dry average flow.

The mechanical plant has been designed to meet the newest effluent discharge standards and will comprise of the following:

- New headworks building.
- Storage building (optional if budget allows).
- A new inletworks with mechanical screening, emergency overflow to aeration cells, grit removal, measuring of flows and a splitter box to split the flows between the primary clarifiers.
- One primary clarifier with dome cover.
- One bio-reactor with dome cover
- One secondary clarifier with dome cover.
- Chemical dosing to provide redundancy for the biological removal of phosphorous.
- Primary sludge pump station which will pump all scum, primary and waste activated sludge to aeration cell #1.
- Final effluent pump station for pumping treated effluent to storage cell #9.
- Blower room.
- Electrical and mechanical rooms.

- Offices, washroom and fully equipped laboratorium.
- RAS/WAS pumping system.
- Workshop.
- Interconnecting pipework.

It is proposed to implement a three stage Biological Nutrient Removal (BNR) activated sludge process with a pre-anoxic zone. The BNR treatment process will provide the appropriate flow pattern, recycle streams and process conditions to allow the biological removal of COD, Nitrogen and Phosphorous.

Should an emergency situation develop downstream of the inletworks, the pumped wastewater flow entering the plant will be diverted to aeration cell #1 with an overflow to cells #2 & 3 and if necessary to Storage Cell #8. Water will be pumped from cell #8 to the inletworks by using a mobile pump skid.

Should an emergency situation develop at the final effluent pump station, an overflow is provided to discharge the treated water (but not disinfected) to a stormwater ditch south of the plant.

Once the plant has been commissioned, Aeration Cell #1 will be desludged with the contaminated sludge removed to the landfill site (SWAMP).

The quality and quantity of the sludge currently accumulated in the aeration cells are estimates as follows:

- Aeration Cell #1 (25,000 m^2): Contaminated – 17,000 m^3; Uncontaminated – 830 m^3
- Aeration Cell #2 (11,200 m^2): Uncontaminated – 600 m^3
- Aeration Cell #3 (11,2000 m^2): Uncontaminated – 400 m^3

Due to quality in Cell #1 it is recommended to remove most of the sludge contaminated by rags and foreign material which covers about 2/3 of the cell's floor area. The rest of the cell has minimal contamination and the build of sludge is also too low (±830m^3) to be considered for removal and land application. The aim of desludging is only to clean Aeration Cell #1 of foreign material as far as possible to allow screened and degritted sludge to enter this cell for stabilizing and eventually land application.

Due to the extensive time period, foreseen not be shorter than 10 years, produced by the new mechanical plant and accumulated in the aeration cells will be considered under a separate EAP sometime in the future.

The site of the proposed facility lies entirely within the footprint of land owned by the City on which the existing lagoon system is being situated on.

Previous to the construction of the first set of cells (#'s 4, 5, 6 & 7), part of the land was used as a landfill site. Previous to the construction of the aeration cells and the new storage cells (#'s 8 & 9), this quarter section of land was used as crop land.

The existing treatment facility has been in operation for many years and it is expected that species in the area are acclimated to its location. This land was already disturbed by previous construction activities and is currently or was previously crop land. Therefore, natural land and habitat won't be disturbed by the construction of the new facility on part of this quarter section.

While the land was already disturbed during previous construction activities it is assumed that no concern exist regarding a potential to impact significant heritage resources.

The proposed facility will treat the wastewater from Winkler and the two villages in the Rural Municipality of Stanley, ie Schanzenfeld and Reinfeld. Although not required for the EAP, a draft service agreement is attached.

The wastewater will be treated to meet the newest effluent discharge standards as per Manitoba Water Quality Standards, Objective and Guidelines, November 28, 2011.

Treated effluent will continue to be discharged into Dead Horse Creek. The discharge will be continuous during the periods when no frozen conditions exist on the downstream creeks and rivers. Treated water will however be stored during such periods to have no impact on culverts and bridges on the discharge route due to the forming of ice blocks.

The storage cells capacity will not be expanded to cater for the 2040 design flows under this upgrade as the existing capacity of 1,050,000 m^3 is expected to be adequate until the year 2030. The requirement of treated water storage has to be reconsidered at that time to determine the feasibility of providing additional storage. It may also be possible that much of the treated water could be recycled at that time or that it will be allowed to be used for the artificial recharge of the Winkler Aquifer.

The construction schedule will not interfere with the functioning of the existing system and it is foreseen to have the new plant commissioned not later than the end of 2015. Two thirds funding at least will be needed for the City to proceed with this project and the timing of the funding therefore will play a major role in the timely completion of the project.

Specific public involvement has not been spearheaded by the City, which doesn't regard it as necessary. In general the public is concerned about the development in the City which could be restrained by the Province should the development not proceeding in a timely manner. Comments from concerned members of the public will be solicited as part of Manitoba Conservation's review prior to issuing a license. Alternatively, concerned citizens of the City and of the RM of Stanley may make their concerns known to their respective councilors.

It is further motivated to continue with the discharge of the reject water from the new water treatment plant to the sewer system as accordingly to a study done on the Dead Horse Creek, the background ionic strength of the creek has not changed.

City of Winkler
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1. INTRODUCTION

During a meeting held with the staff of Manitoba Conservation on November 20, 2012, the requirements of an EAP specific to this project were clarified as follows:

.1 The mechanical plant will be designed to meet the most recent provincial regulations, with biological removal of phosphorous.

.2 The engineering information needed for the EAP could be satisfied by an engineering design report.

.3 The EAP will have to include information on the sludge handling including the cleaning of the existing aeration cells and the disposal of this sludge.

.4 A service agreement between all users of the plant will be required under the Environment Act License but is not required for the EAP.

.5 It has been concluded that the sludge disposal of sludge produced by the new mechanical plant can be considered under a separate EAP sometime in the future.

.6 Hydraulic modeling and/or delineation of the effluent plume in the Dead Horse Creek is not required at this time.

.7 A public consultation program is not required.

2. DEVELOPMENT INFORMATION

.1 Name of Development: *New Winkler Wastewater Treatment Facility*

.2 Legal Name of the Proponent of the Development: *City of Winkler*

.3 Location of Development: *Rural Municipality of Stanley – SE 22-3-4W/SW 23-3-4W*

.4 Contact Person for Proponent: *Mr. Johan Botha, P. Eng., Director of Engineering and Water Resources, City of Winkler, 185 Main Street, Winkler, MB, R6W 1B4.*

.5 Contact Person for Environment Assessment: *Mr. Johan Botha, P. Eng., Director of Engineering and Water Resources, City of Winkler, 185 Main Street, Winkler, MB, R6W 1B4.*

3. DESCRIPTION OF DEVELOPMENT

.1 Certificate of Title

A copy of the Certificate of Title for the quarter sections of SE 22-3-4W and SW 23-3-4W to be found under **Appendix A** of this report. **Figure 3.1** indicates the location of this proposed new treatment facility.

Figure 3.1: Location Map of Proposed New Treatment Facility

.2 Name of Owner

The City of Winkler owns the southeast quarter of Section 22, Township 3, Range 4, WPM, onto which the new facility will be built upon. The treatment facility will be owned, operated and maintained by the City of Winkler.

.3 Mineral Rights

The mineral rights for the area under consideration are vested with the Crown.

.4 Land Use Designation

The land use designation of the proposed development area is agriculture.

.5 Description of Existing Land Use

The new treatment facility will be constructed on land that is currently use for agriculture purposes. It is however land which incorporates the last upgrades of the lagoon system and was foreseen to be used for any future expansion of the existing treatment facility.

.6 Previous Studies

Except for studies done for the last upgrades to the lagoon system, no relevant previous studies have been done for this upgrade under consideration.

4. EXISTING WASTEWATER TREATMENT FACILITY

4.1 Existing Wastewater Management

Refer to **Figure 4.1** for the existing lagoon layout.

In 1986, the City built a Wastewater Treatment Facility (WWTF) which was a wastewater stabilization pond (lagoon) system for primary treatment and storing of wastewater. The lagoon system is located at SW 23-3-4. It was expected that the design population of 10,700 was to be reached in 2005 but reached it only in 2011.

The lagoon consisted of two primary cells and two secondary cells at that time were as follows:

- Primary cells (#4; #5) = 183,000 m^3
- Secondary cells (#6; #7) = 519,000 m^3

Total = 702,000 m^3

The wastewater was stored for 196 days before being discharged into the Deadhorse Creek, which empties into the Red River. Two discharges were made between May 15 and October 31 each year. The lagoon at the time operated under Environment Act Licence No. 1069.

In 1996, the City considered expansion of the lagoon due to inadequate winter storage and the necessity to use auxiliary aeration during the weeks prior to discharge.

In June 2000, the City received an Environment Act Order from Manitoba Conservation to:

- Address the odor problems.
- Address the discharge effluent in accordance with EAL #1069 to ensure that the organic loading in the primary cells does not exceed 56 kg BOD/d/ha.
- Submit an agreement between the City and all wet industries that discharge their wastewater to the WWTF.
- Submit an Environment Act License application which includes engineered design plans and an agreement between the City and all wet industries.

Characteristics of Wastewater for Design of 2002 Upgrade

In order to establish the characteristics of the wastewater, a sampling program was initiated based on grab samples from different locations in the City. The samples were sent to the laboratory for Biological Oxygen Demand (BOD), pH and Total Suspended Solids (TSS) analysis. That test results are indicated in **Table 4.1.**

Table 4.1: Sampling Results for 2002 Upgrade

Location of Sampling	Statistical Parameter	BOD (mg/L)	TSS (mg/L)	pH
Lift Station #8	Avg.	779	240	6.1
	Std. Dev	531	138	0.56
	CoV	68%	58%	9%
Saputo Cheese	Avg.	3536	1148	6.8
	Std. Dev	2568	1253	1.55
	CoV	73%	109%	23%
Winkler Meats	Avg.	233	199	8.4
	Std. Dev	135	142	2.26
	CoV	58%	71%	27%
Monarch Industries	Avg.	19	23	7.6
	Std. Dev	13	9	0.18
	CoV	68%	39%	2%

CoV = Coefficient of Variation (Std.Dev/Avg.)

It was clear that Saputo Cheese produces strong wastewater with an average of 3,536 mg/L. Inconsistency has been found for all BOD and TSS test results as indicated by large standard deviations which can also be contributed to the sampling process of grab samples instead of composite sampling. Another sampling program indicated that the four potato washing plants (Kroekers, Winkler Potato, Southern Potato and Four Seasons) produced wastewater with an average BOD of 400 mg/L.

Saputo Cheese also generated wastewater with high TSS (averaged at 1148 mg/L) and based on 1992 to 2000 data, the four potato washing plants (as per above) produced wastewater with an average of 1500 mg/L TSS.

The combined municipal and industrial wastewater has an average pH of 6.1 which was slightly acidic.

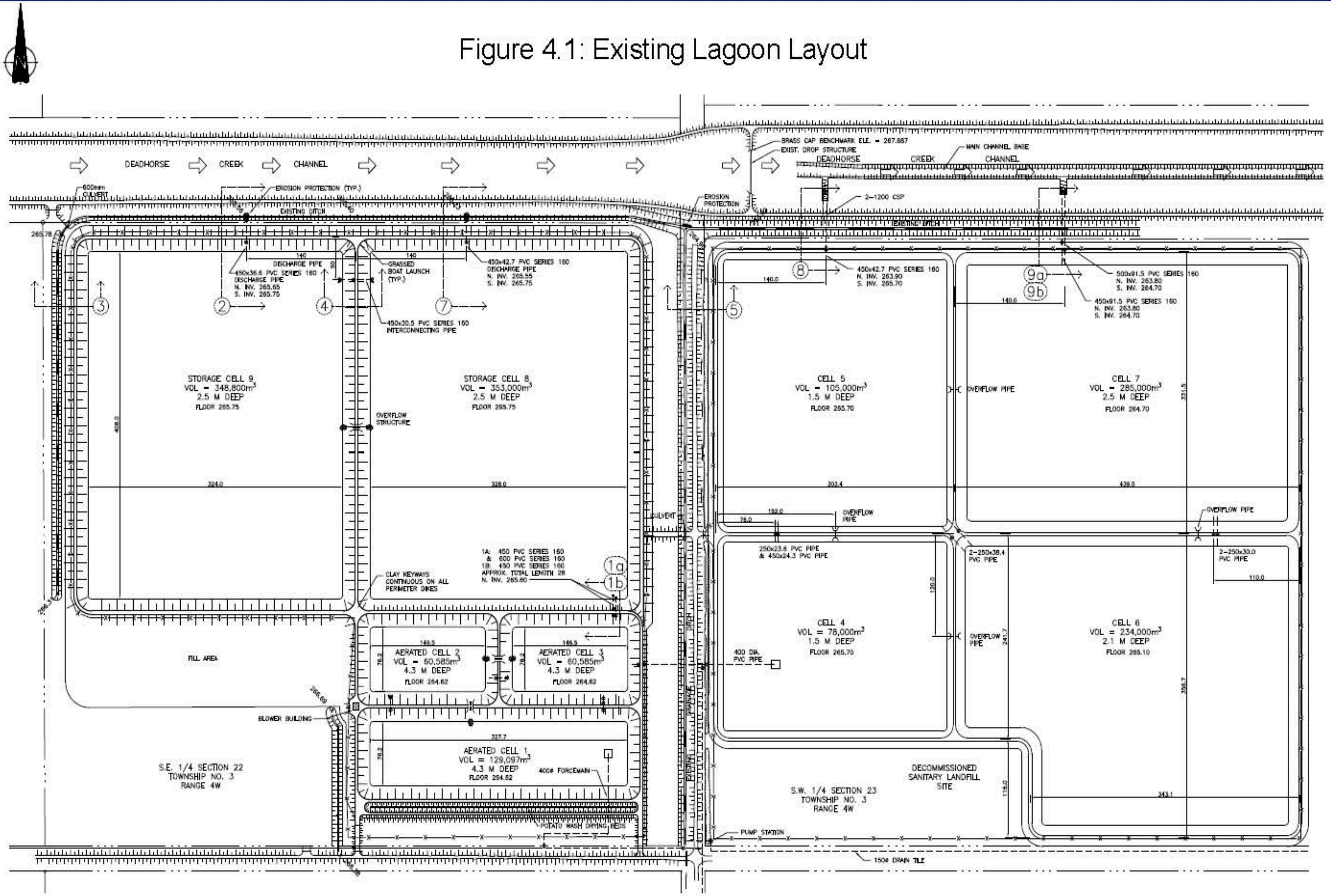
Flow Data for Design of 2002 Upgrade

Both water demand and wastewater flow profiles were investigated. The upgrade was designed based on the actual wastewater produced by the City. It was found that the wastewater generated between January 1997 and September 2000, averaged 3.1 ML/day with high peeks up to 6.6 ML/day.

A design population of 12,840 people for the year 2020 was assumed and the municipal hydraulic loading as estimated at 5.20 ML/day.

The daily flow from Saputo was estimated to be 0.38 ML.

Figure 4.1: Existing Lagoon Layout



Organic (BOD) Loading

The municipal organic strength was estimated at 77 gram BOD per person per day, which calculated to a total municipal organic load of 988 kg/day (77g BOD per person per day x 12,840 design population). Saputo Cheese organic strength was estimated to be as high as 2,490 kg BOD per day.

TSS Loading

The municipal TSS concentration was estimated at 200 mg/L with a loading estimated at 1,040 kg/day (at 5.2 ML/day flow rate). The TSS loading from Saputo was estimated at 613 kg/day.

Summary of Design Hydraulic and Organic Loading

The following table is a summary of the Design Hydraulic and Organic loading at that time used for the 2002 upgrade.

Table 4.2: Flow and Loading for 2002 Upgrade

COMPONENT	FLOW (ML/day)	BOD (kg/day)	TSS (kg/day)
Municipal	5.2	988	1,040
Saputo Cheese	0.38	766	230
Other Industries	0.18	37	72
Hospital	0.13	46	46
Septage	-	-	-
TOTAL	**5.89**	**1,837**	**1,388**

Aerated Cells for 2002 Upgrade

It was decided to construct three aeration cells with an aeration system from Nelson Environmental Inc. as follows:

- Cell #1 = 129,097 m^3 (22 days retention)
- Cell #2 = 60,585 m^3 (10.2 days retention)
- Cell #3 = 60,585 m^3 (10.2 days retention)

Total = 250,267 m^3 (42.5 days retention)

Each cell is 4.3 m. deep (water depth) with 1 m freeboard. Two 150 hp blowers were installed with diffusers on the bottom of cells.

Storage for 2002 Upgrade

The storage capacities of the existing primary and secondary cells (total volume of 702,000 m^3) were inadequate to provide for 227 days of storage for a volume of 1,337,030 m^3 (227 days x 5,890 m^3/day). The 227 days are the days between November 1 and June 15 of the following year for which storage is needed for fish habitat protection and frozen creek conditions.

Two additional cells were constructed to provide a total storage volume as follows:

- Existing ponds = 702,000 m^3
- Cell #8 (new) = 353,000 m^3
- Cell #9 (new) = 348,800 m^3

Total = 1,403,800 m^3

Replacement of Original Aeration System

After the aerated lagoon WWTF was constructed in 2001/2002, an effluent was produced that is within the effluent discharge license. There have been ongoing maintenance issues as well as odor production which have primarily been a problem since 2004/2005.

Prior to an intensive composite sampling program conducted by the City in March and April of 2009, it was assumed that since the actual flows were well below the year 2020 design flows that the aeration system was not producing the design quantity of oxygen. The testing program showed that the organic concentrations were significantly higher than the original design concentrations. The implication of these high organic concentrations is that oxygen demand in the lagoon was at or near the original year 2020 design and may have been at this level for a number of years.

Based on extensive evaluation of the existing aerated system and discussions with Nelson Environmental it was suggested in 2008 that the replacement/upgrading to an alternate aeration system would be in the best interest of the City. Regardless of the maintenance issues, some form of upgrade was required to increase the system capacity.

It was decided to replace/upgrade the system as follows:

- Establishing the ultimate design load (UDL) of wastewater treatment system based on the volume of the existing aeration cells while maintaining partial mix aerated process.
- Size the new aeration system for this UDL.
- Install the new aeration main header for the UDL.
- Install the diffuser for the original design loading (ODL).

Since the process will immediately be operating at design levels just after the installation for the ODL, additional diffusers have to be installed as soon as budgets allow in order to prevent odors from reoccurring.

The new aeration system was commissioned on August 4, 2009 and no odors were detected up to date.

Assessment of Existing Capacities

A summary of the existing treatment and storage capacities (refer to **Figure 4.1** for the existing layout) is indicated in the following **Table 4.3.**

Table 4.3: Existing Treatment & Storage Capacities

Description	Volume (m3)	Retention* (days)	SCFM**
Treatment Capacity:			
Aerated Cell #1	129,097	23	2,340
Aerated Cell #2	60,585	11	540
Aerated Cell #3	60,585	11	168
		Total SCFM =	**3,048**
Storage Capacity:			
Storage Cell #4	78,000	14	Storage needed for period between November 1 and June 15 = 227 days
Storage Cell #5	105,000	19	
Storage Cell #6	234,000	43	
Storage Cell #7	285,000	52	
Storage Cell #8	317,700	58	
Storage Cell #9	317,700	58	
Total Storage =	**1,337,400**	**244**	

* Retention is calculated based on the average design flow of 5,500 m3/day

** SCFM - Standard Cubic Feet of Air per Minute

The treatment capacity of the Aeration Cells is based on the newly installed aeration system, which replaced the original system due to operational and maintenance problems. The Actual Oxygen Requirement (AOR) is the governing factor in the aeration design.

The following **Table 4.4** shows the Phase 1 Design AOR (ODC – Original Design Load) as well as the Ultimate Design Load Capacity AOR (UDL – Ultimate Design Load) values. To get to the UDL, only additional diffusers and an additional blower will be needed as the header piping and the anchors for the laterals are already installed.

Table 4.4: Phase 1 and Ultimate Design Loads

Parameter	Concentration (mg/l)	LOAD (kg/day)		AOR (kg02/day) *	
		ODL (@3175 m^3/d)	UDL (@5500 m^3/d)	ODL (@3175 m^3/d)	UDL (@5500 m^3/d)
BOD	394	1251	2167	1501	2600
TSS	365	1159	2008	579	1004
TKN	59	187	325	856	1483
TOTAL				**2937**	**5087**

* AOR = (1.2kg02/kgBOD) + (4.57 kg02/kgTKN) + (0.5 kg02/kgTSS)

For the ODL phase a total of 254 diffusers have been installed with 12 SCFM (Standard Cubic Feet of Air per minute) per diffuser which provide a total of 3,048 SCFM.

For the UDL phase a total of 503 diffusers will be installed which will provide a total of 6,036 SCFM.

After commissioning and up to date, the blowers are currently running at 1435 rpm which results in 1950 SCFM at 8.2 psi per blower. At this speed the blowers operating at 66% of its maximum speed.

For current design loads, 3048 SCFM will be needed. The blowers are producing 3,900 SCFM at 1,435 rpm.

At 1990 rpm (maximum blower speed) both the blowers could produce 5,336 SCFM while remaining within the 150 hp motors capacity. New motors have been installed to meet this capacity with a Variable Frequency Drive (VFD) to control the rpm to meet the AOR cost effectively.

With an airflow of 5,336 SCFM and with 254 diffusers installed, each diffuser will handle 21 SCFM, which can reduce it's effectiveness with about 2% but which is still acceptable.

2008 Organic Loads

While the replacement/upgrade of the existing aeration system was considered, it was decided to determine the organic load at that time to enable the City to determine the best strategy for the replacement/upgrade of the aeration system. Composite samples were taken at Lift Stations #5 (LS #5) and #8 (LS #8) as all wastewater generated in the City is conveyed to the WWTF via these two lift stations.

Composite samples were taken for the following water quality parameters:

- BOD (Biological Oxygen Demand)
- COD (Chemical Oxygen Demand)
- TKN (Total Kjeldahl Nitrogen)
- TSS (Total Suspended Solids)
- NH3 (Ammonia)
- Total Phosphorous

The five weekdays average flow, concentrations and daily organic loads are illustrated in the following **Table 4.5.** The values in brackets are the averages taken over seven days.

Table 4.5: Results of Composite Sampling Programme

Parameter	Concentration (mg/l)	Organic Load (kg/day)
Flow = 3171 m^3/d (3048 m^3/d)		
BOD	457 (304)	1452* (1200)
COD	1043 (973)	3307 (2965)
TKN	62 (60)	198 (182)
TSS	240 (230)	760 (703)
NH3	38 (37)	122 (114)
Total P	11 (10)	35 (31)
AOR	**3027 kg02/d**	**(2623 kg02/d)**

*Environment Act License #2525 dictates that the organic load may not exceed 1837 kg BOD per day.

The new aeration system was designed to meet the existing organic load. The Design AOR of 2937 kg02/day equals the existing organic load measured over five days and has to function adequately.

Measurements of Dissolved Oxygen levels in the aeration cells from August 5, 2009 indicate an upward trend. No odors were detected from August 10, 2009.

4.2 Functioning of the Existing System

An Environment Act License #2525 was issued to the City on January 23, 2002 for an aerated wastewater treatment lagoon located at SE22 and SW23-3-4 WPM in the RM of Stanley with discharge of treated effluent to a drainage ditch that flows into Deadhorse Creek, which empties into the Plum River, in accordance with the Proposal filed under the Environment Act on July 9, 2001.

Regarding the operation and maintenance of the aerated lagoon system, the following basic conditions have to be met:

- A minimum of 2mg/l of Dissolved Oxygen (DO) is detectable at all times in the liquid of the aerated cells.
- The organic loading on the aerated wastewater treatment lagoon, in terms of the five-day Biochemical Oxygen Demand (BOD5), is not in excess of 1837 kg/day.
- No effluent from the lagoon shall be discharged between the 1st day of November of any year and the 15th day of June of the following year and where:
    - The organic content of the effluent, as indicated by the BOD5 is in excess of 30 mg/l;
    - The fecal coliform content of the effluent, as indicated by the MPN index, is in excess of 200 per 100 ml of sample;
    - The total coliform content of the effluent, as indicated by the MPN index, is in excess of 1500 per 100 ml of sample.

The wastewater flows to the lagoon for storing between November 1 and June 15 for the past several years are provided in **Table 4.6.**

Table 4.6: Volume (m3) of Wastewater Stored 2004 - 2011

Month	2004 - 2005	2005 - 2006	2006 - 2007	2007 - 2008	2008 - 2009	2009 - 2010	2010 - 2011
October	156,319	144,151	117,789	131,759	197,630	140,594	202,796
November	**107,402**	150,775	113,075	122,902	211,684	125,294	194,615
December	**102,651**	133,842	112,912	113,442	153,354	120,864	150,508
January	111,012	118,246	108,008	110,469	140,296	110,685	131,505
February	99,466	103,069	95,963	98,462	110,732	102,385	127,960
March	128,529	131,494	136,992	114,037	149,615	159,648	172,753
April	176,630	204,519	144,700	136,523	184,950	166,550	290,981
May	217,144	189,008	199,499	154,927	237,088	374,799	305,792
Jun-15	127,912	82,285	109,027	94,441	101,667	80,340	140,037
Total	**1,227,065**	**1,257,389**	**1,137,965**	**1,076,962**	**1,487,016**	**1,381,159**	**1,716,947**

From this table it is clear that the storage capacity has been reached during 2008/2009 and 2009/2010 and been exceeded during 2010/2011. Much of the flow is from the high infiltration/inflow experienced during wet weather conditions.

Based however on a wastewater characterization study (refer to **Section 5.4**) it was found that the average COD/BOD ratio = 2.05. It was further found that all average COD concentration was 900 mg/l during an average flow between 3 and 3.5 MLD which translates to an average daily load of approximately 1,460 kg BOD, which is still lower than the stipulated BOD load.

4.3 Effluent Quality and Discharge Route

Currently, the effluent can be discharged from cell #'s 5, 7, 8 and 9. It is discharged into Dead Horse Creek to reach the Plum River.

Table 4.7 provides a summary of the results of water quality samples collected before the annual summer releases for the years 2007, 2008, 2009 and 2010.

Table 4.7: Water Quality Results Before Annual Releases

Parameter	May 30, 2007 June 6, 2007	June 9, 2008	June 2, 2009 June 15, 2009 June 22, 2009	June 14, 2010 July 6, 2010
BOD	<5 (Cell 5) <6 (Cell 7) <6 (Cell 8)		<6 (Cell 5) 20.5 (Cell 7) <6 (Cell 8) 7.8 (Cell 9)	6.6 (Cell 5) <6 (Cell 7) <6 (Cell 8) <6 (Cell 9)
TAN	13.1 (Cell 5) 3.93 (Cell 7) 10.5 (Cell 8)	1.72 (Cell 4) 1.24 (Cell 5) 9.40 (Cell 6) 4.56 (Cell 7)	20.3 (Cell 8)	0.721 (Cell 5) 0.109 (Cell 7) 17.0 (Cell 8) 13.2 (Cell 9)
TKN	12.4 (Cell 8)	7.5 (Cell 4) 7.7 (Cell 5) 12.1 (Cell 6) 12.4 (Cell 7)		2.91 (Cell 5) 1.63 (Cell 7) 19.2 (Cell 8) 16.3 (Cell 9)
pH	7.98 (Cell 5) 8.48 (Cell 7) 8.32 (Cell 8)	8.87 (Cell 4) 8.87 (Cell 5) 8.54 (Cell 6) 8.99 (Cell 7)	8.06 (Cell 8)	8.23 (Cell 5) 9.06 (Cell 7) 8.18 (Cell 8) 8.18 (Cell 9)
Total P	6.83 (Cell 8)		6.61 (Cell 8)	5.70 (Cell 5) 1.13 (Cell 7) 7.25 (Cell 8) 4.94 (Cell 9)
Fecal Coliforms (MPN/100ml)	43 (Cell 5) 237 (Cell 7) 122 (Cell 8)		5 (Cell 5) <3 (Cell 7) 18 (Cell 8) <3 (Cell 9)	261 (Cell 5) 22 (Cell 7) 7 (Cell 8) 30 (Cell 9)
Total Coliforms	10 (Cell 5) 23 (Cell 7) 11 (Cell 8)		28 (Cell 5) 5 (Cell 7) 965 (Cell 8) 12 (Cell 9)	464 (Cell 5) 53 (Cell 7) 65 (Cell 8) 42 (Cell 9)
Total N				21.1 (Cell 8) 18.8 (Cell 9)
Temperature				15ºC (Cell 8) 15ºC (Cell 9)

From this data it is clear that the Lagoon System performs extraordinary well by meeting the license requirements every year.

Table 4.8 provides also a summary of water quality parameters (full spectrum) test results of samples taken on July 15, 2013, one month of extended storage.

Table 4.8: Sample Results taken on June 15, 2013 at all Cells of Lagoon System

Water Quality Parameter	Cell 3	Cell 4	Cell 5	Cell 6	Cell 7	Cell 8	Cell 9	New Regulations
BOD	<6.0	23.4	16.6	14.4	21.7	11.3	21.0	≤25
COD	64	81	81	61	85	69	59	
P-Total	6.25	3.97	2.46	2.95	3.61	5.20	4.06	≤1
TKN	32.8	12.2	8.0	12.8	18.3	21.3	9.8	TN ≤15
TSS	30.0	84.0	72	34.0	76	64	70	≤25
Un-ionized Ammonia	0.100	<0.01	0.113	<0.01	0.155	0.158	<0.01	
Total Ammonia	2.3	<1.0	0.39	<1.0	1.1	1.8	<1.0	
pH	7.92	8.42	8.82	8.54	8.42	8.22	8.54	
Temperature (°C)	24.2	25.8	26.2	25.4	26.0	25.6	25.5	
Ammonia	6.67	5.91	4.36	3.65	3.24	3.39	Range of New Regulatoins	
pH/Temp	6.5	7.0	7.5	6.5	7.0	7.5		
Temp (°C)	9	9	9	24	24	24		

5. POPULATION SERVICED AND DESIGN LOADING

5.1 Anticipated Growth Rate

Winkler

The population numbers for Winkler according to the census numbers and the anticipated future growth are indicated in **Table 5.1**

Table 5.1: Winkler Population Growth

Census Year	Population	Annual Growth Rate
1986 Census	5,926	
1991 Census	6,597	2.17%
1996 Census	7,241	1.88%
2001 Census	7,943	1.87%
2006 Census	9,106	2.77%
2011 Census	10,670	3.22%
2020 Estimate	13,750	5.20%
2025 Estimate	15,625	2.59%
2030 Estimate	17,500	2.29%
2035 Estimate	20,000	2.71%
2040 Estimate	23,000	2.83%
2045 Estimate	26,250	2.68%
2050 Estimate	29,375	2.28%

RM of Stanley

Based on the growth numbers provided by the RM of Stanley, the population in the two villages Schanzenfeld & Reinfeld to be serviced by this regional Wastewater Treatment Facility are assumed to be 4,600 in the year 2040.

5.2 Anticipated Increase in Wastewater Flow and Load

Refer to **Appendix D** for the Process Design Report of the new mechanical plant.

5.3 Wastewater Characterization Study

The University of Manitoba's Environmental Engineering Laboratory of the Department of Civil Engineering under the guidance of Dr. Jan Oleszkiewicz was retained by the City of Winkler to perform the wastewater characterization and determine the nitrification rate in the City's wastewater. The full report is to be found under **Appendix C**.

Table 5.2 is a summary of the average concentrations of the main influent quality parameters as determined from this study; deduced from 10 days (over 24 hour periods) composite sampling during dry weather flows.

Table 5.2: Summary of Average Concentrations of Main Influent Quality Parameters

Parameter	Average Concentration and Standard Deviation (mg/L)			
		City of Winkler	Comparison: Combined Sewage City of Winnipeg	
			Winter	Spring
TCOD	Average	897	711	621
	Std. Dev.	235	72	177
	CoV*	26%	10%	29%
TN	Average	72	53.1	41
	Std. Dev.	12	2.5	13.8
	CoV	17%	5%	34%
TP	Average	21.5	7.58	6.35
	Std. Dev.	5.5	0.56	2.39
	CoV	26%	7%	38%
TSS	Average	265	365	466
	Std. Dev.	94	69	204
	CoV	36%	19%	44%
VSS	Average	194	257	224
	Std. Dev.	64	39	78
	CoV	33%	15%	35%

* CoV = Coefficient of Variation [The CoV expresses a measure of the reliability of the central tendency. The higher the CoV, the greater will be the scatter. As a rule of thumb, CoV below 10% are thought to be low, between 15 and 30% moderate, and greater than 30% high].

5.4 Basis of Design

The Winkler Wastewater Treatment Plant (WWTP) is designed for receiving and treating a combined domestic and industrial wastewater. The Basis of Design caters for a planning horizon up to 2040 (Phase I & II). The combined domestic wastewater from the City of Winkler and the Rural Municipality of Stanley (the two villages of Schanzenfeld and Reinfeld) will be treated at the proposed facility. Historically, the main source of industrial wastewater was from a cheese processing factory, Saputo, which was decommissioned during January 2014 and its impact was not considered in the design of the new facility.

The wastewater was sampled and characterized in a report by the University of Manitoba over the period of time from February 1, 2013 to March 15, 2013, (refer to the University of Manitoba report, "Nitrifier Growth Rate and Wastewater Characterization Study", J.A. Oleszkiewicz *et. al.*, 2013). For both sampling/monitoring campaigns, data was obtained with and without Saputo being online.

5.4.1 Design Flows

The design wastewater flows are summarized in **Table 5.3**. Note that the domestic wastewater flow projections for Winkler are based on a unit flow of approximately 400 litres per capita due to base infiltration and inflow experienced in the City. A lower unit flow of 250 litres per capita was used for the two villages in the RM of Stanley, as it is expected that the proposed STEP system (septic tank effluent pumping system) will exclude the residential sump pumps in that area.

Table 5.3: Design Population and Wastewater Flows

Design Population for 2040 (Phase I & II)		
Contributor	**# of People**	**Flow (m^3/d)**
Winkler	23,000	9,200
RM of Stanley	4,600	1,150
Daily Dry Weather Flow (DDWF)		10,350 m^3/day
Peak Dry Weather Flow (PDWF)		18,000 m^3/day

The design wastewater flows are as follows:

- Average dry weather flow = 5,175 m^3 per day (Phase 1),
  = 10,350 m^3 per day (Phase 2),
- Peak dry weather flow = 9,000 m^3 per day (Phase 1),
  = 18,000 m^3 per day (Phase 2).

Peak daily wet weather flow; flows in excess of 9,000 m^3 per day in Phase 1 (and flows in excess of 18,000 m^3 per day in Phase 2) will be diverted away after screening and degritting from the downstream wastewater treatment processes and discharged to the existing aeration cells, which will also act as a balancing facility. The inletworks, screens and grit removal system are designed to handle a peak wet weather flow of 54 000 m^3 per day for Phase I to IV.

5.5 Design Wastewater Loads

Based on the wastewater characterization done by and reported in the University of Manitoba (UoM) report, the proposed design concentrations and loads in terms of the main wastewater constituents are indicated in **Table 5.4**:

Table 5.4: Design Wastewater Organic Loads (2040) (Phase I & II)

Parameter	Concentrations (mg/l)	Per Capita contribution (g/p/d)	Total Load (kg/d)	
			Phase I	Phase II
TSS	260	98	1346	2691
VSS	190	71	984	1967
BOD_5	440	165	2277	4554
COD	900	338	4658	9315
Soluble COD	540	203	2795	5589
ffCOD*	310	116	1605	3209
TKN	77	29	399	797
Ammonia as N	43	16	223	445
Total P	21	7.9	109	217
Ortho-Phosphate as P	18	6.8	93	186

* Flocculated, filtered COD

Other design parameters (obtained from diurnal wastewater flow and quality monitoring results):

pH = 7.1 (ranging from 6.5 to 7.5)

Temperature = 9.0 °C minimum winter temperature

= 24.0 °C maximum summer temperature (assumed)

The wastewater characteristics were also defined based on the results of the supplemental sampling done by the University of Manitoba. The key wastewater characteristics assumed for the purposes of the process engineering design were as follows, with typical values (WERF Manual, Mecer, *et. al.*, 2003) in brackets:

- **COD fractions:**
  - Soluble unbiodegradable COD (f_{US}) = 0.03 (0.05)
  - Soluble readily biodegradable COD (f_{BS}) = 0.31 (0.16)
  - Unbiodegradable, particulate COD (f_{UP}) = 0.09 (0.13)
  - Slowly biodegradable, particulate COD (f_{BP}) = 0.62 (0.66)
- **Nitrogen fractions:**
  - NH_3 fraction of TKN= 0.56 (0.66)
- **Phosphorous fractions:**
  - Orthophosphate fraction of TP= 0.86 (0.5)
- COD/BOD ratio= 2.05 (1.9 to 2.2)

The f_{BS} fraction of COD is higher than typically expected from a predominantly domestic/residential wastewater. This could be attributed to the impact of the Saputo factory. An f_{BS} sensitivity analysis was conducted to assess the significance of this observation.

5.6 Diurnal Flow and Load Patterns

The diurnal wastewater flow and load patterns for Lift Station 8 were recorded on 4, 6 and 8 March 2013. For the purposes of the process engineering design, the averages for these data sets were calculated and then analyzed. The following approach was adopted:

- The recorded raw wastewater flow rates were normalised around an average flow rate,
- The recorded wastewater COD, TKN and TP loads were also normalised around an average load for each specific wastewater constituent,
- The daily load pattern was then simulated by applying the daily raw wastewater flow rate,
- The simulated daily flow and load patterns were then used to simulate hourly concentrations for each specific wastewater constituent. These values were used as the basis of design for the dynamic simulation of the treatment process.

The following comments apply to the observed flow and load patterns:

- Two distinct peak flow/load events were observed; a significant peak around midday and a smaller peak late in the evening;
- The peak flow (PDWF) was attenuated in the wastewater collection and pumping system. The design peak flow factor (18.0/10.35 = 1.74) was reached on one of the monitored days (8 March 2013);
- The load peak factors, specifically for COD and TKN exceeded the flow peak factor. This is significant and presents the most challenging period to the treatment process;
- The performance of the proposed treatment plant was confirmed by conducting dynamic process simulations.

5.7 Inorganic Wastewater Quality

The following average inorganic wastewater quality parameters were obtained from the University of Manitoba report (values were adjusted according to the relative contributions from LS5 and LS8):

pH	=	7.25
TDS	=	2876 mg/L
Alkalinity	=	448 mg/l as CaCO3
Calcium	=	173 mg/L
Magnesium	=	58 mg/L
Hardness	=	668 mg/L as CaCO3

The diurnal raw wastewater flow and load patterns for each wastewater constituent are reflected below:

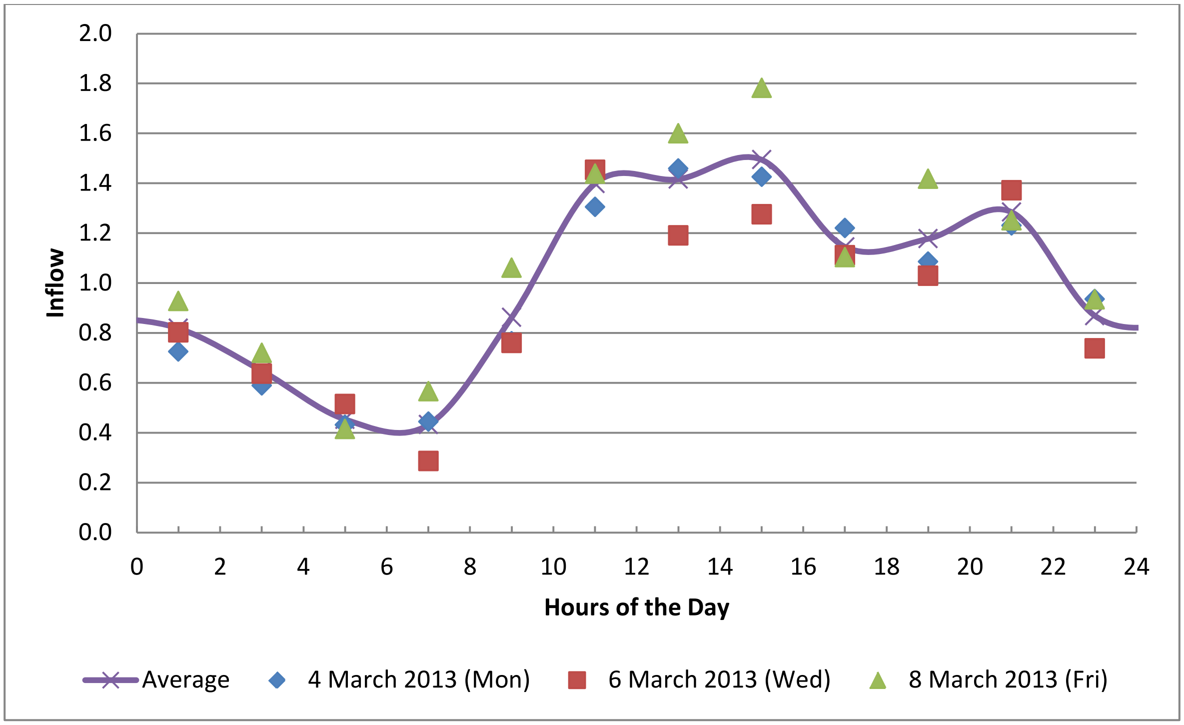


Figure 5.1: Normalised Wastewater Flow Diurnal Cycle

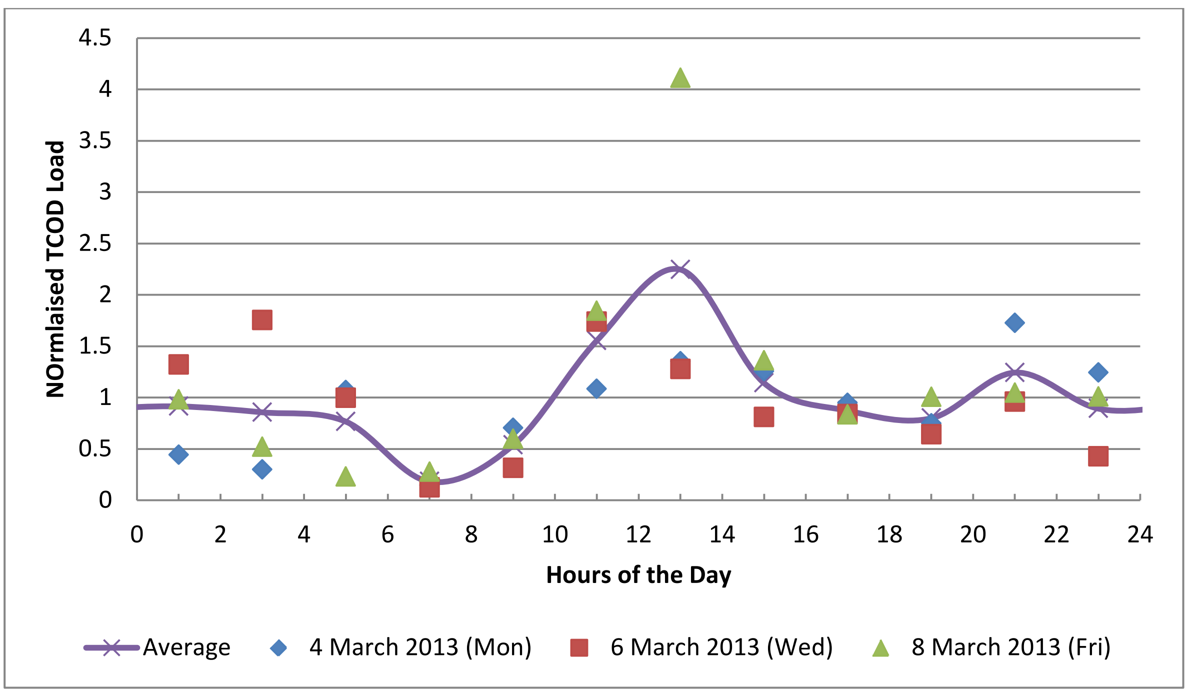


Figure 5.2: Normalised Wastewater TCOD Load Diurnal Cycle

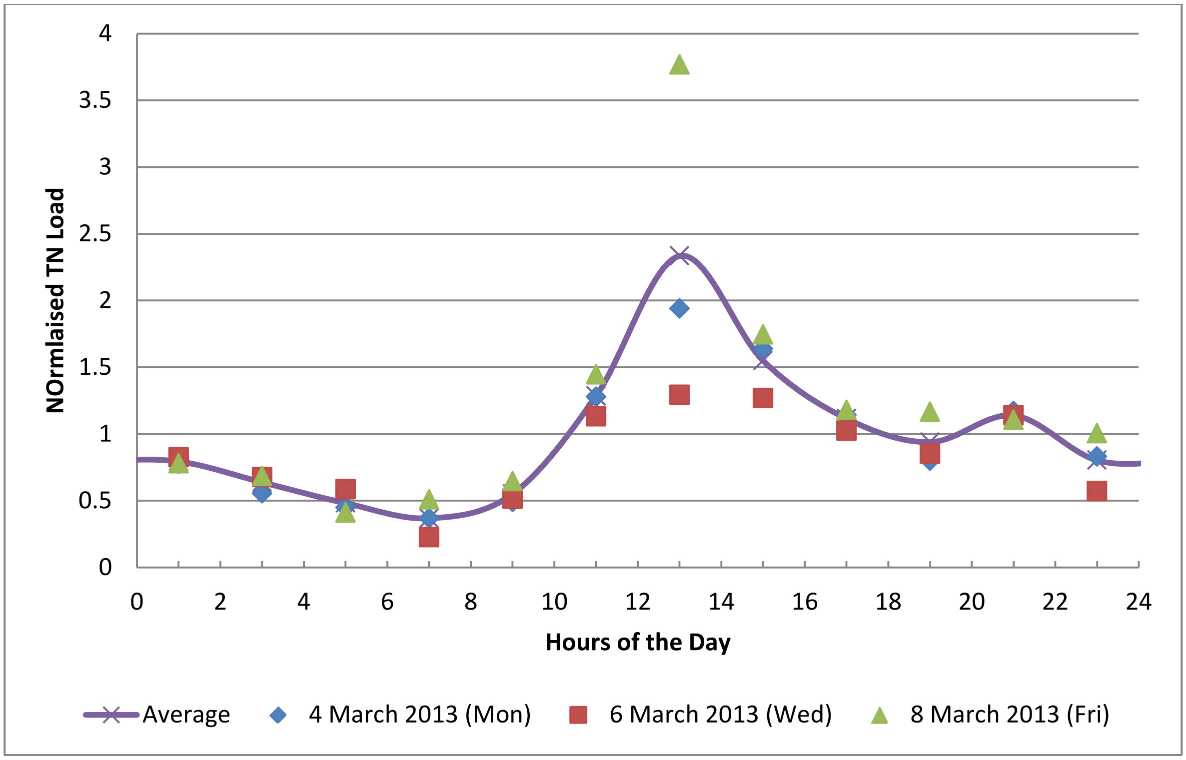


Figure 5.3: Normalised Wastewater TKN Load Diurnal Cycle

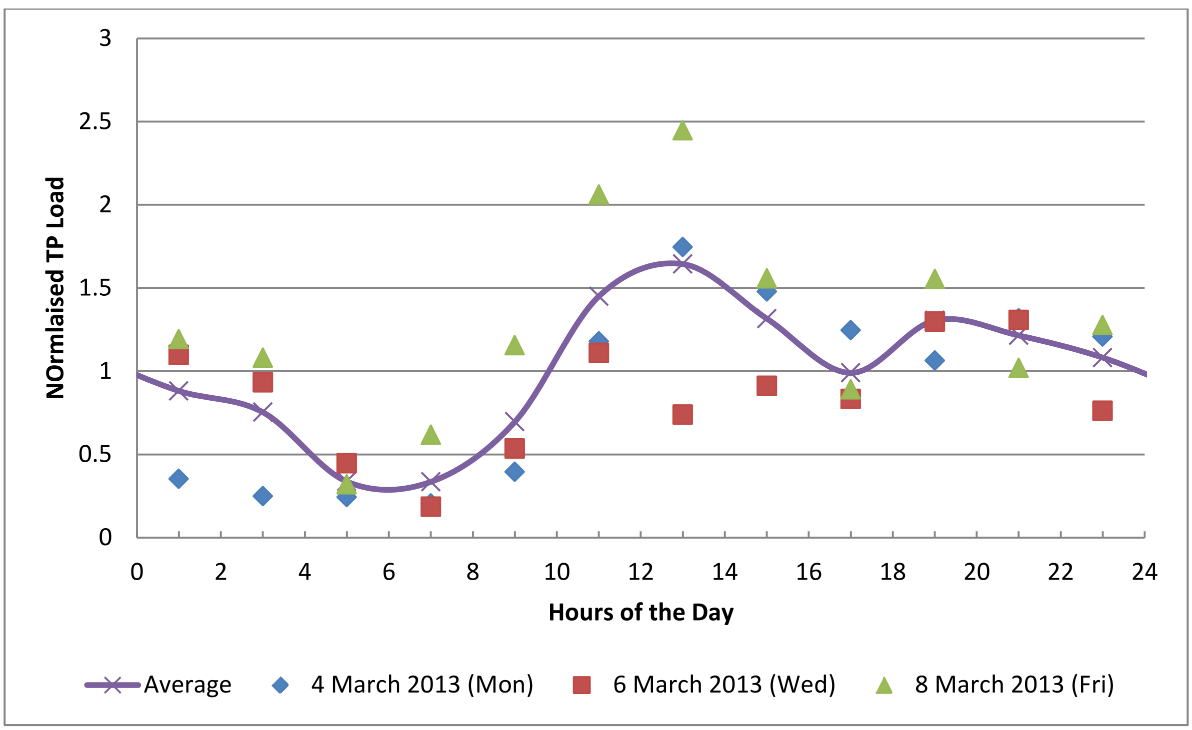


Figure 5.4: Normalised Wastewater TP Diurnal Load Cycle

5.8 Effluent Discharge Standards

Based on the provincial effluent discharge standards (Manitoba Water Quality Standards, Objectives and Guidelines, Nov 28, 2011), the following discharge standards would apply to treated effluent discharged to the local Dead Horse Creek:

$CBOD_5$	≤	25 mg/L
BOD_5	≤	25 mg/L
TSS	≤	25 mg/L
TN	≤	15 mg/L
TP	≤	1 mg/L
TDS	≤	3000 mg/L
E coli	≤	200# /100 mL
Fecal coliforms	≤	200# /100 mL
Total Ammonia	≤	6.67 mg/L (at 9 °C and pH of 6.5)
	≤	5.91 mg/L (at 9 °C and pH of 7.0)
	≤	4.36 mg/L (at 9 °C and pH of 7.5)
	≤	3.65 mg/L (at 24 °C and pH of 6.5)
	≤	3.24 mg/L (at 24 °C and pH of 7.0)
	≤	3.39 mg/L (at 24 °C and pH of 7.5)

Metals (for hardness of more than 400 mg/L as $CaCO_3$):

Cd	≤	7.74	μg/L
Cr III	≤	231	μg/L
Cu	≤	29.3	μg/L
Pb	≤	10.9	μg/L
Ni	≤	168	μg/L
Zn	≤	379	μg/L

6. PROPOSED DEVELOPMENT

6.1 Site Conditions

M. Block & Associates Ltd (MBA) was retained by the City to conduct a geotechnical investigation at the proposed development site.

A total of five test holes were bored implementing a truck-mounted B-40 and CME drill rigs, using 5' long x 5" and supplied by Maple Leaf Drilling Ltd. of Winnipeg, Manitoba. Representative "undisturbed" and "disturbed" soil samples were retrieved from the test holes and brought back to MBA's CSA certified materials testing laboratory in Winnipeg for unconfined compression and moisture content testing, respectively, and verification of the field soil classifications. Alternatively, during the field investigation, the fine grained soils' respective 'disturbed' undrained shear strengths were measured implementing a hand-held calibrated Pocket Geotester. Upon the completion of this investigation, the test holes' elevations and the groundwater elevations in them, if any, were measured and referenced to The City of Winkler's geodetic site survey, as illustrated on pages 18 – 25 of this report. In addition, the test holes were completely backfilled with bentonite and soil cuttings.

Refer to **Appendix B** for the complete Geotechnical Report.

6.2 Summary of Proposed Development

Refer to **Appendix D** for the complete Process Design Report. **Figures PF01 and PF02** indicate schematically the process flow for the preliminary and primary treatment and the secondary and tertiary treatment respectively.

It is proposed to implement a three stage Biological Nutrient Removal (BNR) activated sludge process with a pre-anoxic zone. The BNR treatment process will provide the appropriate flow pattern, recycle streams and process conditions to allow the biological removal of COD, Nitrogen and Phosphorous.

6.2.1 Screening

Influent wastewater will be screened to remove the solids and debris of a non-biodegradable and non-organic form, such as plastics, wood, metals from the influent wastewater stream. Screening of wastewater is essential to protect the downstream unit treatment processes and associated mechanical equipment against damage and blockage. The proposed screening will incorporate the following features:

- Mechanical screening using one (1) front screen field raked device with an effective gap size of 6.0 mm,
- An emergency bypass channel to which sewage would automatically flow in the event of the mechanical screen being unavailable. The bypass channel will be equipped with an inclined bar screen to allow manual removal of accumulated screenings. The manual emergency screen will be replaced by a mechanical screen in the future.
- The screened material is discharged directly into a screenings conveyor/compacting device and then into a grit/screenings bin for landfilling.

6.2.2 Grit Removal

Screened wastewater is treated to remove inorganic particles such as grit and detritus. The grit removal process is designed to effectively remove relatively heavy inorganic grit particles, but not the lighter organic material which needs to carry forward to the biological treatment process. The proposed grit removal would incorporate the following features:

- A multiple-tray vortex type grit removal device which is effective for this type and scale of wastewater treatment plant. The vortex tank is hydraulically designed to introduce a circular motion of the wastewater which allows the grit particles of a selected size to settle onto a boundary layer on each tray and into a centre underflow collection chamber, providing separation from the flow stream,

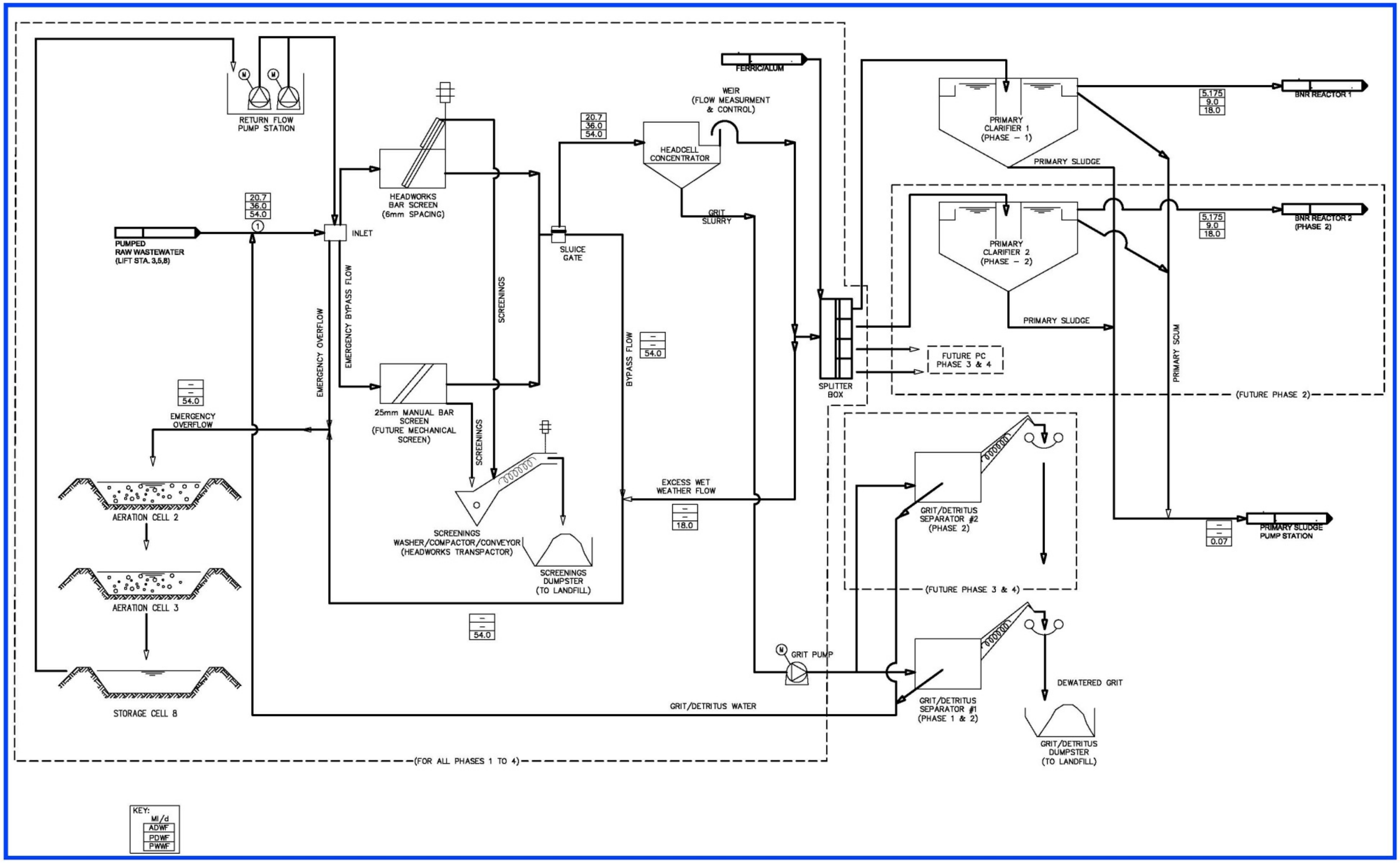


Figure PF01: Preliminary and Primary Treatment Flow Diagram

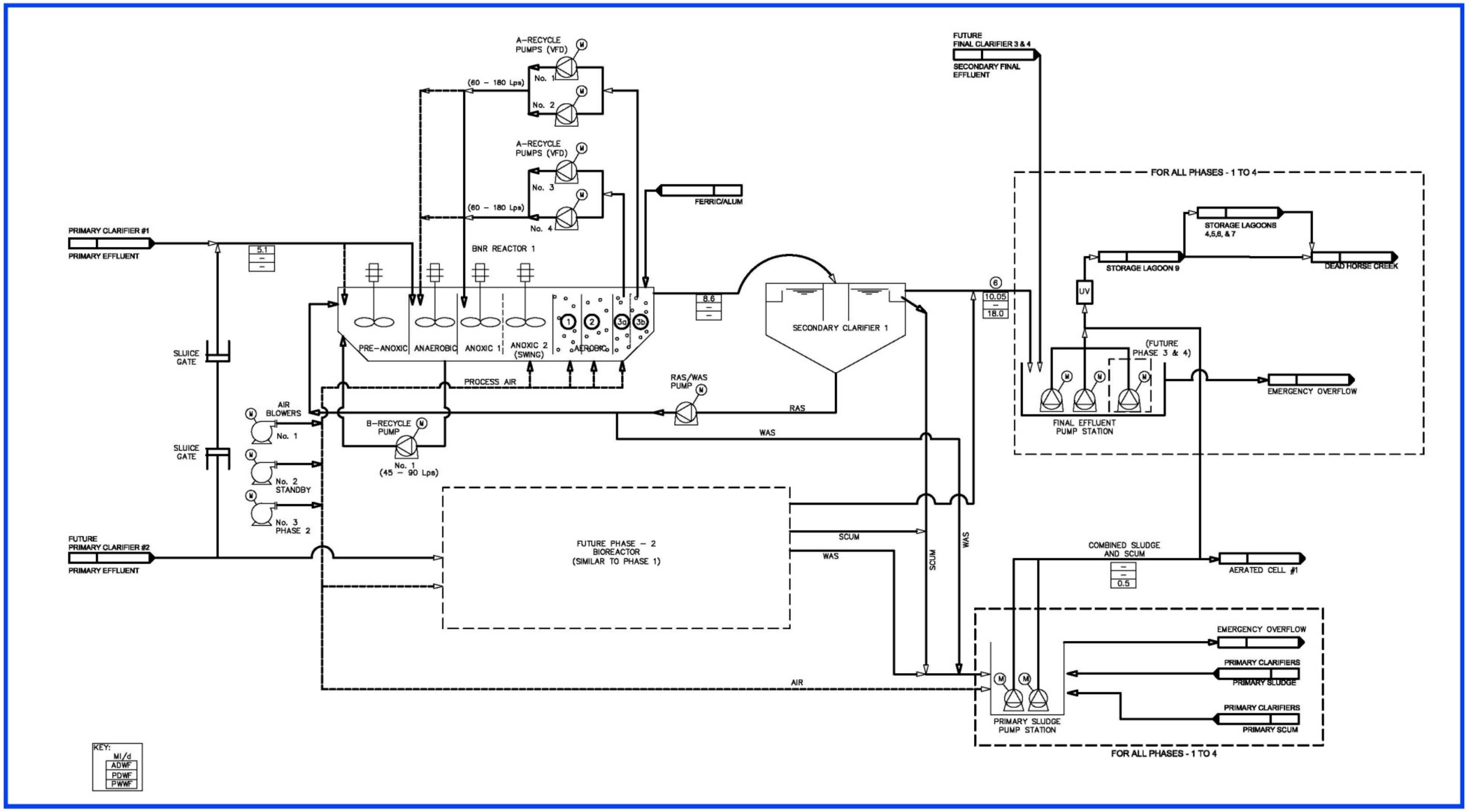


Figure PF02: Secondary and Tertiary Treatment Flow Diagram

- Grit tanks have conical bottoms in which the accumulated grit and detritus material collects,
- The grit material is periodically withdrawn from the bottom of the degritter tank and pumped to a grit separator device,
- The grit separator produces a relatively dry grit and detritus material, which is discharged to a grit dumpster for landfilling,

The grit separator liquid overflow is returned to the mainstream wastewater treatment process, upstream of the influent screens.

6.3 Primary Sedimentation Tank

The City of Winkler wastewater has relatively concentrated inorganic and particulate matter and it is appropriate to pre-settle the wastewater upstream of the biological wastewater treatment process. The proposed primary sedimentation tank is circular in geometry and provide the appropriate quiescent flow condition to allow the separation and settling of some suspended solids, estimated to remove 50% of the influent TSS for average flow and load conditions. **Figure 6.1** shows the proposed dimensional configuration of the primary sedimentation tank.

The proposed primary sedimentation tank have the following features:

- The wastewater will be split eventually between four parallel primary sedimentation tanks, when the final phase (Phase IV) will be implemented,
- The circular primary sedimentation tank has an energy dissipation centre well into which the influent wastewater is introduced. The centre well is designed and configured to dissipate hydraulic energy and to introduce a gentle downward flow pattern of the wastewater,
- The primary sedimentation tank has an appropriate retention to allow sufficient time for the effective settling of a fraction of the influent TSS,
- The primary sedimentation tank is equipped with a mechanical sludge scraper bridge to progressively move the settled solids across the sloping clarifier floor towards the central sludge hopper,
- Primary sludge is withdrawn from the central sludge hopper to the primary sludge pump station, from where it is sent to the existing aerated lagoons,
- The primary sedimentation tank is also equipped with rotating scum/floatables removal devices. The scum/floatable removal device is attached to the sludge scraper bridge. Scum is scraped from the sedimentation tanks' surface and discharged via a scum box to the primary sludge pump station.

Ferric chloride or alum dosing to the primary sedimentation tank feed (splitter box) is provided. This will allow some flexibility to enhance PST performance, lower the organic load on the BNR process and to enhance/augment the biological phosphorus removal process.

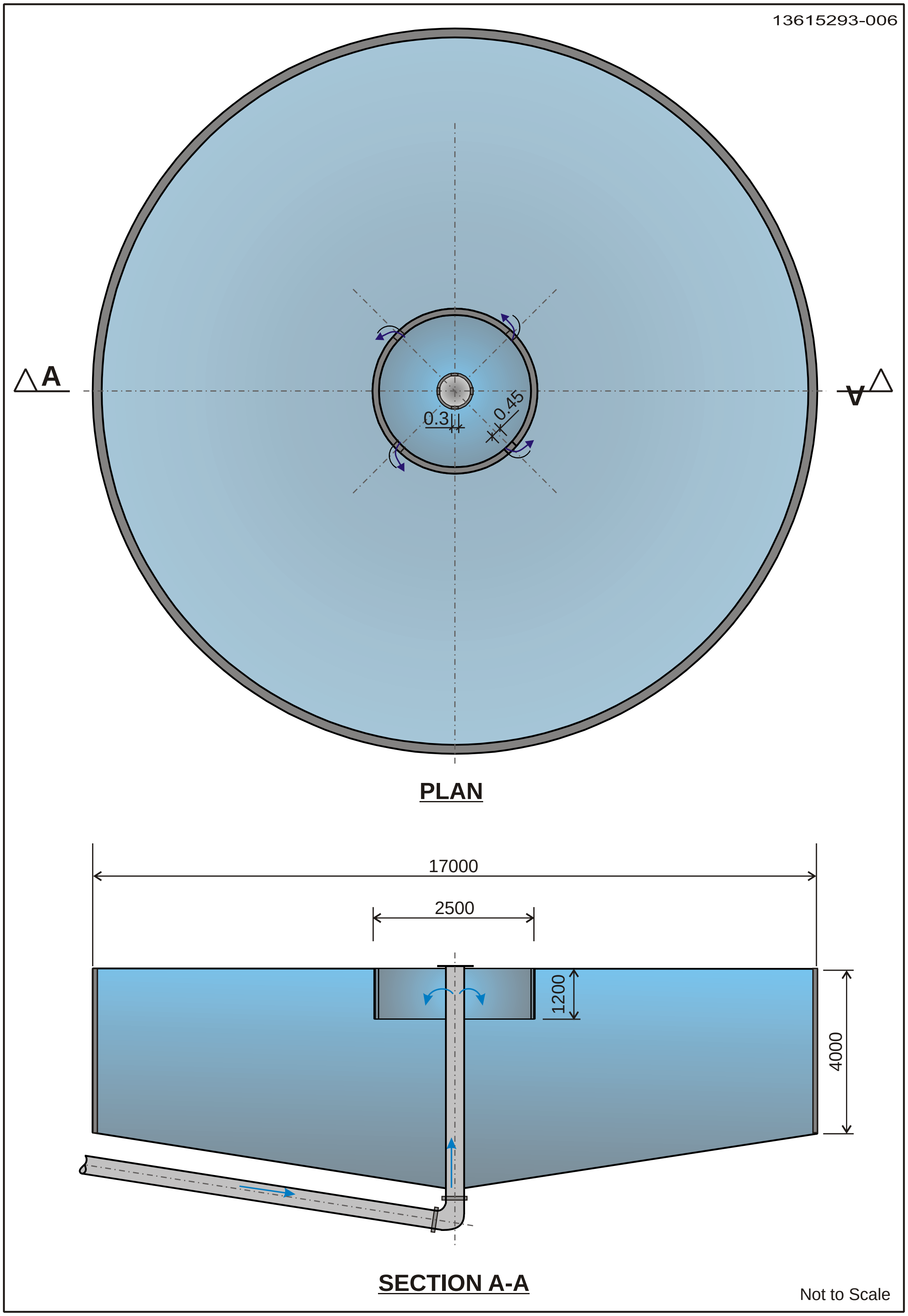


Figure 6.1: Sketch showing dimensional configuration of a primary sedimentation tank

6.4 BNR Activated Sludge Process

It is proposed to treat the primary effluent in a four stage BNR activated sludge process with a pre-anoxic zone. The BNR treatment process provides the appropriate flow pattern, recycle streams and process conditions to allow the biological removal of COD, Nitrogen and Phosphorus. The BNR process incorporates the following features:

- Primary effluent (a small fraction of 5-10%) and return activated sludge (RAS) are introduced into the pre-anoxic compartment. The pre-anoxic compartment is operated without aeration, but gentle mixing. The residual nitrate contained in the RAS is removed by de-nitrification (Nitrate No_3 → Nitrite No_2 → Nitrogen Gas N_2) using a fraction of the primary effluent to accelerate the process. A recycle stream from the downstream anaerobic compartment is also introduced to the pre-anoxic compartment. This stream contains fermentation products which also accelerates the de-nitrification process and preconditions the return activated sludge before entering the anaerobic compartment.
- Primary effluent and overflow from the pre-anoxic compartment are introduced into the first anaerobic process compartment. This process compartment is operated under anaerobic conditions, since there are no free and very little bound oxygen compounds available. Anaerobic conditions and the availability of readily biodegradable soluble COD compounds stimulate growth of a phosphate releasing/accumulating bacterial population.
- The anaerobic compartment overflows into a downstream anoxic compartment. The anoxic compartment is split into two cells and also receives a recycle of nitrate rich mixed liquor from the downstream aerobic process compartments. Process conditions are conducive to the removal of nitrate via a process of converting the nitrate to nitrogen gas in the presence of biodegradable COD compounds.
- The anoxic compartment overflow enters the first aerobic compartment. The aerobic compartment is split into three separate cells. Aerated conditions with a target dissolved oxygen concentration of 1 to 2 mg/L are maintained in the aerobic compartment cells. Such process conditions allow the bacterial population to oxidise the residual COD organic compounds as well as the ammonia nitrogen.
- Phosphate, released in the anaerobic compartment is progressively taken up by the specialized bio-P culture in the aerobic compartment cells.
- The aerobic compartments are supplied with process air from a set of process blowers.
- The BNR process reactor configuration is done in a manner to promote plug flow conditions and to prevent any local trapping and accumulation of floatables on the process surface.

The BNR activated sludge process configuration is reflected on **Figure 6.2**.

The selected BNR process configuration also incorporates operational flexibility to respond to changes in operating conditions, changes in the influent wastewater flow and load and changes in the wastewater discharge standards in future. The operational flexibility includes the following:

- Variable nitrate rich recycle flow rates (A-recycle), ranging from 0 to 300% of the average influent wastewater flow rate;
- Variable recycle (B-recycle) from the anaerobic compartment back to the pre-anoxic compartment, ranging from 0 to 150% of the average influent wastewater flow rate;

- The second anoxic compartment can be operated as a swing zone with allowance to aerate this zone. This will provide additional nitrification capacity under extreme winter operating conditions;
- The configuration for the nitrate rich recycle flow can be changed to increase the effective size of the anoxic compartment, by recycling back to the anaerobic compartment. This may be an operating mode in the event of activating the aerobic swing zone;
- The last aerobic compartment is split into two cells. The first cell can be operated at low DO to minimize oxygen recycle to the anoxic compartment and to provide for additional denitrification.
- Ferric chloride or alum dosing is recommended as a useful operational backup to assist in the biological phosphate removal process as necessary. Allowance is made to dose ferric chloride or alum to the Primary Sedimentation Tank to further enhance the solids removal in the Primary Sedimentation Tank. A further dosing point is catered for upstream of the Secondary Clarifier to polish the treated plant effluent in terms of TSS and phosphate concentration.

The BNR design thus has the versatility to employ alternative process configurations to suit different feed water quality and ambient conditions as follows:

- Conventional 3-stage BNR configuration with pre-anoxic zone (normal conditions);
- Enhanced primary sedimentation with ferric or alum addition and 3-stage BNR (high feed phosphate, winter conditions);
- Aerobic swing zone with nitrate rich recycle to the anaerobic compartment and ferric dosing or alum on the Secondary Clarifier (high feed nitrate, winter conditions);

These process configurations are represented in the **Figure 6.3**, **Figure 6.4** and **Figure 6.5**.

6.4.1 Nitrogen Removal

The BNR activated sludge process is configured to remove nitrogen species, specifically ammonia. The discharge standards applicable to the City of Winkler treatment plant contains limitations with respect to ammonia and total nitrogen. By selecting the appropriate operating mode, the total nitrogen in the plant effluent can be limited.

6.4.2 Phosphorus Removal

The three stage BNR activated sludge process is specifically configured to achieve enhanced biological phosphate removal. Some of the treatment process configurations require the addition of ferric chloride or alum to achieve the total phosphorous discharge standards of ≤1 milligram per litre.

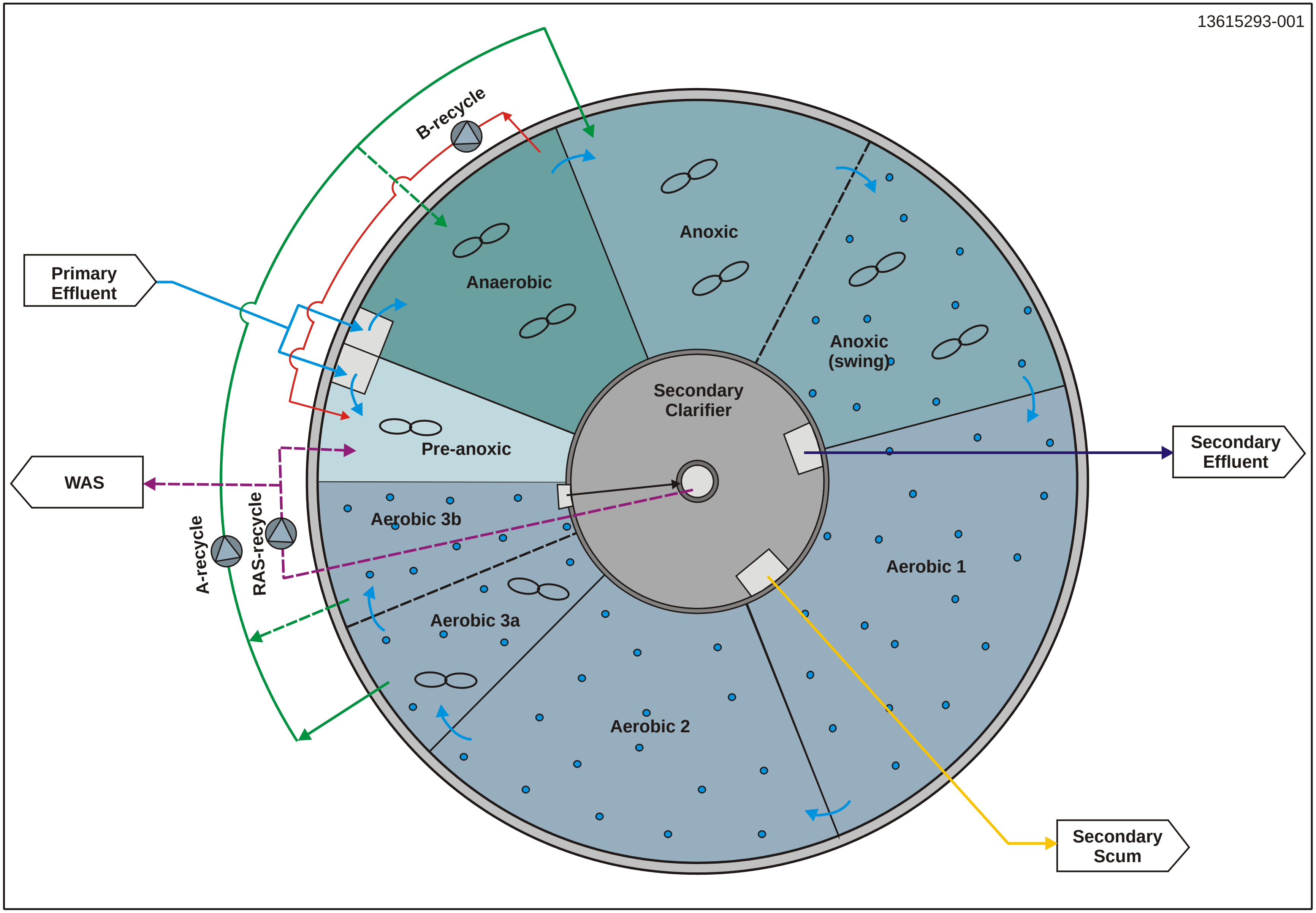


Figure 6.2: Typical 4-stage BNR process configuration

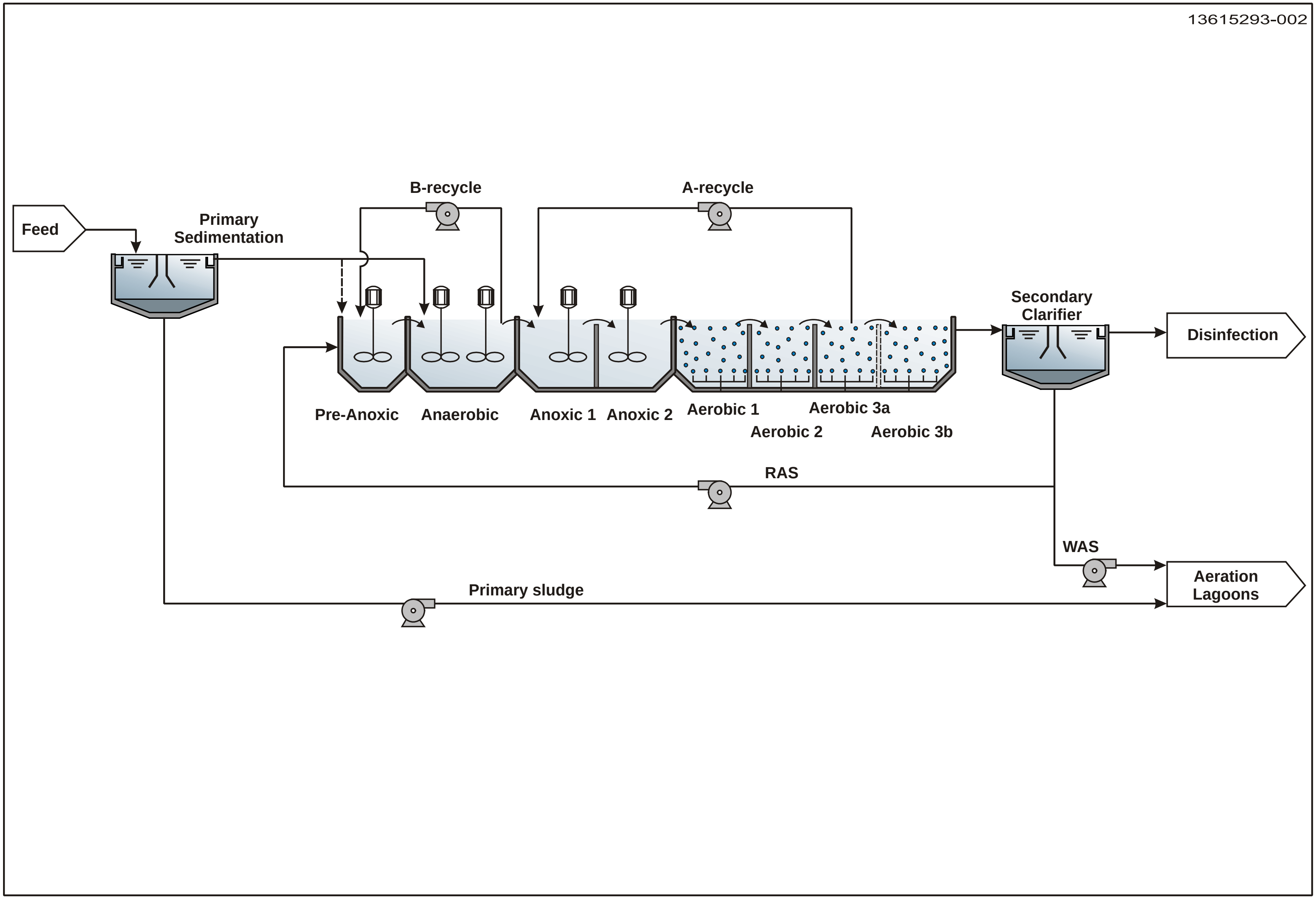


Figure 6.3: Conventional 3-stage BNR configuration with pre-anoxic zone

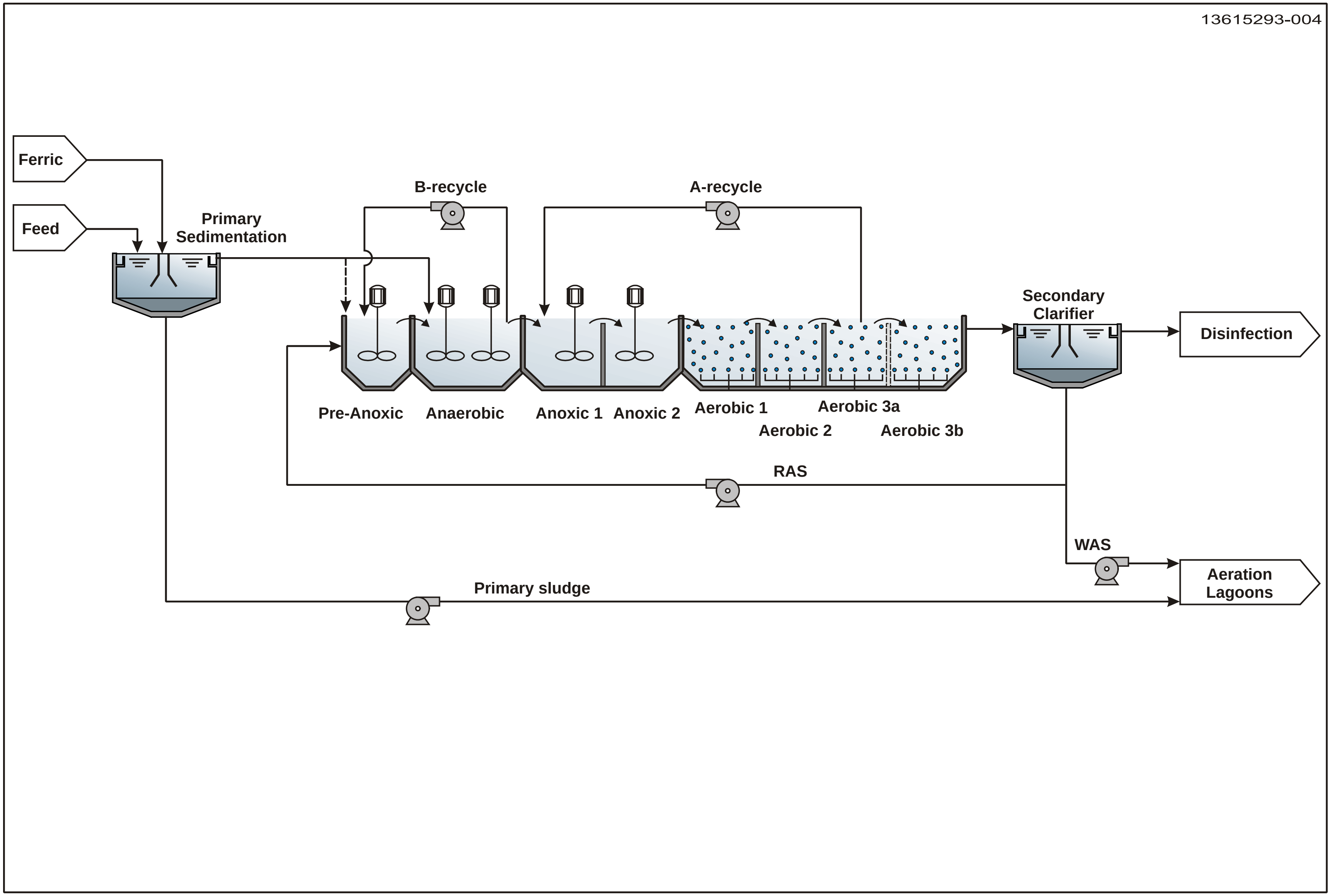


Figure 6.4: Enhanced primary sedimentation with ferric addition and 3-stage BNR

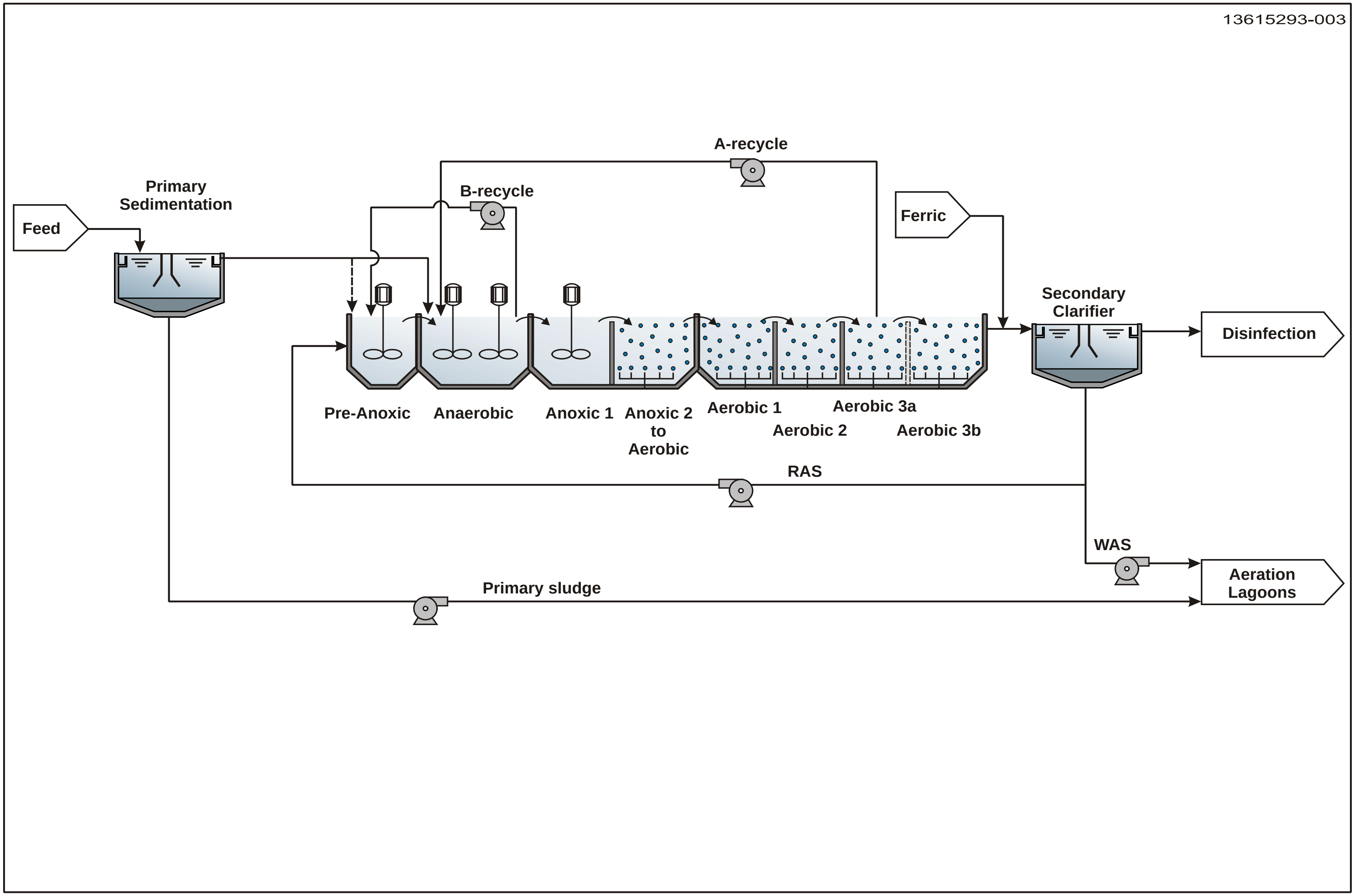


Figure 6.5: Aerobic swing zone with nitrate rich recycle to the anaerobic compartment and ferric dosing on the Secondary Clarifier

6.5 Secondary Clarifier

The biological process liquor, called mixed liquor, contains suspended solids and volatile suspended solids in the range of 2000 to 4000 mg/L. The active biological solids must be separated from the clear treated effluent before disinfection and storage in the downstream lagoons. The proposed secondary clarifier is circular in geometry and serve a process purpose to separate the mixed liquor solids from the clear product water.

Figure 6.6 shows the proposed dimensional configuration of the secondary clarifier.

The secondary clarifier have the following features:

- The proposed secondary clarifier is circular in geometry and have central flocculating wells into which the mixed liquor from the upstream BNR activated sludge process is introduced.
- The central flocculating well provides a flow pattern and process conditions to allow the re-flocculation of small and colloidal biological solids into larger biological flocs,
- The flocculated mixed liquor then enters the clarifier structure, which has sufficient contact time to allow the gravity separation of the biological solids,
- The secondary clarifier is equipped with central driven rotating sludge scraping bridges which progressively move the settled solids along the sloping clarifier floor to a central sludge hopper.
- The settled biological solids is continuously withdrawn from the sludge hopper and recycled to the upstream BNR treatment process, via a set of return activated sludge (RAS) pumps,
- The clarified treated effluent flows across the peripheral overflow launder to the downstream disinfection process,
- The secondary clarifier also has a surface scum scraping device attached to the rotating sludge bridge. Any accumulated scum and foam are scraped from the surface of the secondary clarifier towards a scum box. The scum box liquor is discharged to the Primary Sludge Pump Station from where the secondary scum is pumped to the aerated lagoons.

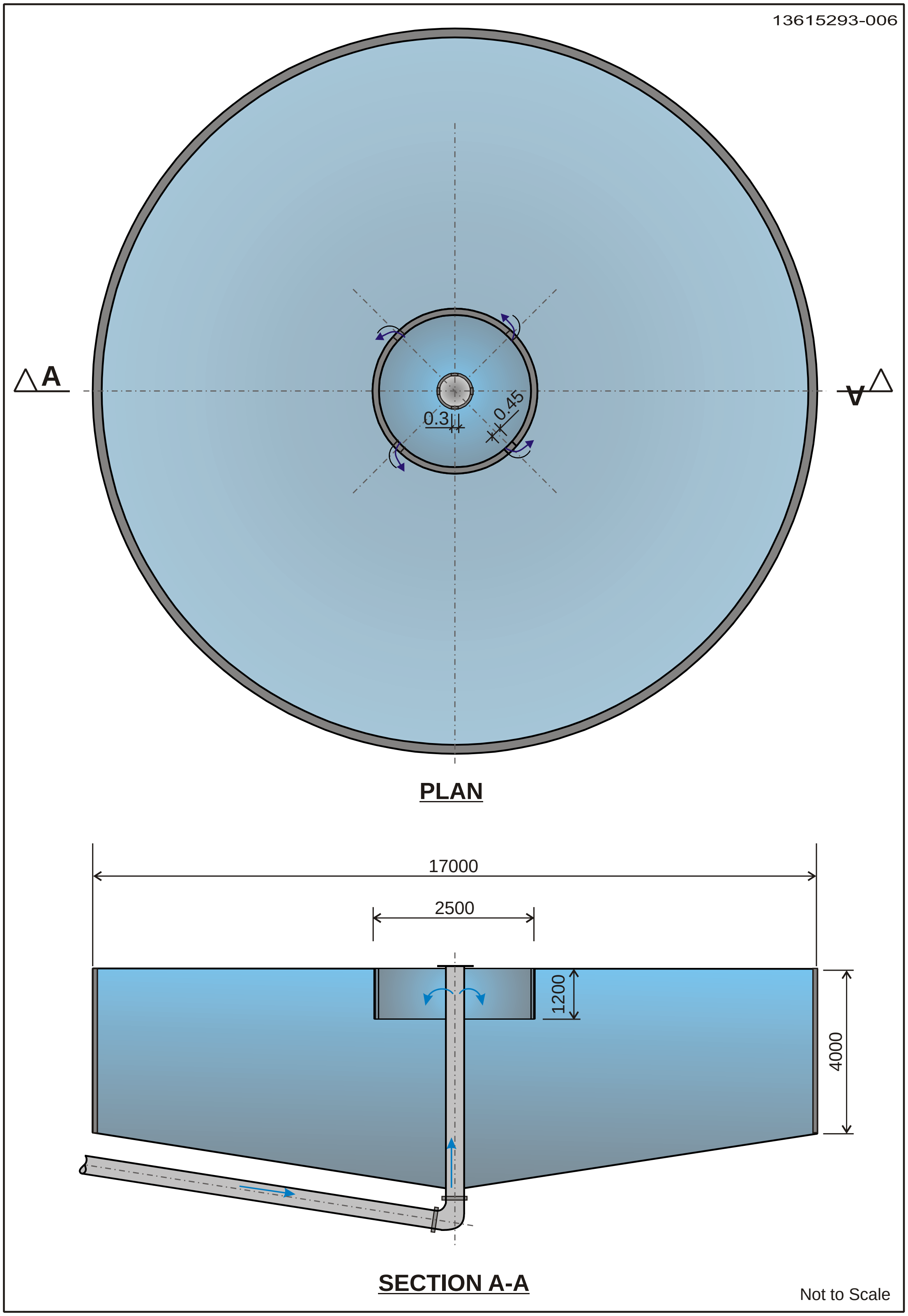


Figure 6.6: Sketch showing dimensional configuration of a primary sedimentation tank

6.6 Disinfection

It is a regulatory requirement to properly disinfect the treated wastewater to reduce the risk of any pathogenic microorganisms being discharged to the public streams and rivers. City of Winkler has taken a decision to employ ultra violet (UV) radiation as a form of disinfection. This technology is typically applied to treated wastewaters which have a high transmissibility to allow the UV rays to penetrate the full body of the treated wastewater stream and to achieve disinfection (where transmissibility > 70%).

It is foreseen, that sunlight will enhance the ultraviolet disinfection while all treated water will be routed through the storage ponds with the maximum detention time possible.

Allowance is made to install an UV system for Phase 1 with redundancy.

6.7 Sludge and Scum Handling and Disposal

The proposed wastewater treatment process generates a number of sludge and scum waste streams including:

- Primary sludge withdrawn from the Primary Sedimentation Tank underflow,
- Primary scum withdrawn from the Primary Sedimentation Tank surface,
- Waste activated sludge withdrawn from the Secondary Clarifier underflow,
- Secondary scum withdrawn from the Secondary Clarifier surface.

It is proposed to direct the sludge and scum residual streams via the Primary Sludge Pump Station to the existing aerated lagoon #1 which have sufficient retention time and aeration capacity to progressively stabilize sludge solids.

The primary sludge and the waste activated sludge will be intermittently withdrawn and pumped to the aerated lagoon where it will be stabilized buy also stored until such time arrived for desludging, which is foreseen not to be less than 10 years. During a meeting with Manitoba Conservation on November 20, 2012, it was concluded that the sludge disposal of sludge produced by the new mechanical plant can be considered under a separate EAP at that time.

The dry solids loading rate to the Aerated Lagoons for different operating scenarios are provided in **Table 6.1**:

Table 6.1: Dry Solid Load to Aerated Lagoons for Different Operating Scenarios (Phase I & II):

BNR process operating scenarios	Operating temperature (°C)	Solids retention time (days)	Solids Load (kg/day)	Solids per Feed Flow Rate (kg/ML)
1. Winter operating conditions				
Three stage BNR with pre-anoxic zone	9	20	3451	333
Enhanced primary sedimentation (ferric addition) with three stage BNR process	9	25	3582	346
Aerobic swing zone with nitrate rich recycle to the anaerobic compartment	9	20	3302	319
2. Summer operating conditions				
Three stage BNR with pre-anoxic zone	24	10	3649	353
3. Spring/fall operating condition				
Three stage BNR with pre-anoxic zone	16	15	3508	339
4. Yearly Average			**3562**	**344**

To determine the annual average stabilized sludge production, additional steady-state and dynamic runs of the Biowin model were conducted. These runs were based on the three stage BNR process with pre-anoxic zone, but expanded to include the return flow from the Aerated Lagoons. The steady-state model was run to determine the steady state sludge accumulation rate and to verify what the oxygen requirements would be to ensure that the sludge is adequately stabilized. To confirm this, the dynamic model was run for a duration of 365 days, taking into account temperature variation throughout the year.

The output of Aerated Lagoon model (for the steady state model condition, which includes an allowance for ferric phosphate precipitation) is provided in **Table 6.2**:

Table 6.2: Aerated Lagoon Modelling Output (Phase I & II)

Parameter	Stabilised Sludge at 8% TS	Stabilised Sludge at 12% TS
Stabilized sludge production (tonne TS per year)	804	804
Stabilized sludge flow rate (m^3/year)	10 074	6 716
Stabilized sludge production per feed flow rate (m^3/ML)	2.67	1.78
Stabilized sludge VSS as % of TSS	56%	56%
Return flow rate back to the WWTW from the Aerated Lagoons (m^3/day)	262	271

The Aerated Lagoon storage capacity and oxygen requirements (for the steady state model condition) are presented in **Table 6.3**:

Table 6.3: Aerated Lagoons Storage Capacities (Phase I & II)

Component	Active volume (m^3)	Hydraulic residence time (days)	Stabilised sludge storage capacity (years)	Residual DO target (mg/L)
1. Aerated Lagoon No 1	116 187	403	18.3*	0.3
2. Aerated Lagoon No 2	54 000	187	8.5*	1.0

* It is however foreseen to desludge once every 10 years.

Aeration requirements to stabilize sludge based on the steady state model runs are presented in in **Table 6.4**:

Table 6.4: Aerated Lagoons Aeration Requirements (Phase I & II)

Component	Residual DO target (mg/L)	Oxygen transfer rate (kg O_2/hr)	Indicative air flow requirements (m^3/h at 20° C and 1 atm)
1. Aerated Lagoon No 1	0.3	100	1410
2. Aerated Lagoon No 2	1.0	1.4	10.3

6.8 Chemical Dosing

The City of Winkler treatment plant has a relatively strict phosphate discharge standard. It is proposed to provide a backup chemical phosphate removal facility to augment the biological phosphate removal process. The proposed chemical phosphate removal facility would include the following:

- Storage of a metal salt, typically ferric chloride (aluminium sulphate can also be used),
- Make up, if necessary of the ferric chloride and aluminium sulphate to a solution which can be dosed to the mainstream process,
- Ferric dosing pumps to allow the mainstream application of a controlled amount of metal salt solution. The dosing would typically take place at a mixing box upstream of the Primary Sedimentation Tanks or in the final aerated compartment of the BNR Reactor, and at the Secondary Clarifiers feed to allow sufficient time for precipitation of residual phosphate.
- Allowance has therefore been made for multi – point ferric dosing points.

7. PROCESS CONTROL PHILOSOPHY

This section of the report contains a high level description of the process control approach for each of the significant unit treatment processes. The Plant operation and control would be fully automated and the plant monitoring and control would be conducted from a centralized SCADA system.

7.1 Screening

All wastewater is being pumped via Lift Stations 5 and 8 (and in future from LS #3 directly) and discharges into the head of the inlet works and mechanical screens.

The mechanical screen will always be in operation at any time. The screenings will be discharged into a screenings conveyor/compactor for wasting/compaction, before being discharged into a screenings bin for landfilling. The wash water supply valve will open when the screen raking mechanism is activated. The excess wash water will flow back into the channel upstream of the mechanical screens.

The screening system includes a bypass channel with a manual screen, should the mechanical screen be out of operation. A manual control sluice gate upstream of the mechanical screen can be used to isolate the screen for maintenance. The screenings are removed/raked manually and placed on a drain slab with excess water draining from the screenings and returned to the main channel. The drained screenings are placed together with the dewatered screenings in the waste bin.

The mechanical screen are controlled by differential level sensors upstream and downstream of the screen and have a timer controlling the frequency and duration of screening. The mechanical rake are controlled by a PLC with an automatic stop on overload. There will be a manual override with an "inching" facility in both the forward and reverse directions. Refer to **Figure 7.1** for the Mahr Bar Screen and Transpactor intended to be installed.

7.2 Grit Removal

All of the wastewater passing through the screenings unit is discharged to one degritter. This degritter unit can be isolated by operating the sluice gate upstream to bypass the flow around the degritter to the primary clarifier splitter box or to divert the flow to the Aeration Cells.

Sand and grit settle to the bottom of the hopper where it is pumped out by a dedicated grit pump to a grit classifier unit where it will be dewatered and discharged into the grit/detritus bin for landfilling.

Degritted wastewater from the grit classifier unit will be discharged to the upstream end of the degritter or upstream of the primary clarifier splitter box. Refer to **Figure 7.2** to **Figure 7.3** for the Eutek HeadCell Concentrator, GritCup grit washing unit and the SpiraSnail grit dewatering conveyor intended to be installed.

7.3 Flow Balancing

The aeration cells and Storage Cell #8 will be used for flow balancing. High peak flows expected dumping spring, more than 9 MLD will be deviated to the tail end of Aeration Cell #1 and pass through Aeration Cell #2 and 3 with an overflow to Storage Cell #8 where it will be stored until higher temperatures will be reached to return it to plant's headworks. All flows will undergo screening and grit removal. The high peak flows will be diverted away from the Primary Clarifier after screening and degritting. It is also possible that all flows under emergency conditions can be diverted to the aeration cells upstream from the screens or upstream from the degritter. For using Cell #8 for flow balancing it is necessary to disconnect it from Cell #9 and to provide a link between Cell #9 and the rest of the storage cells to connect the existing control weir on the east end of Aeration Cell #3 to the connection between Storage Cells #8 & 9. Refer to **Figure 7.4** for the proposed configuration of the pipework to accomplish this.

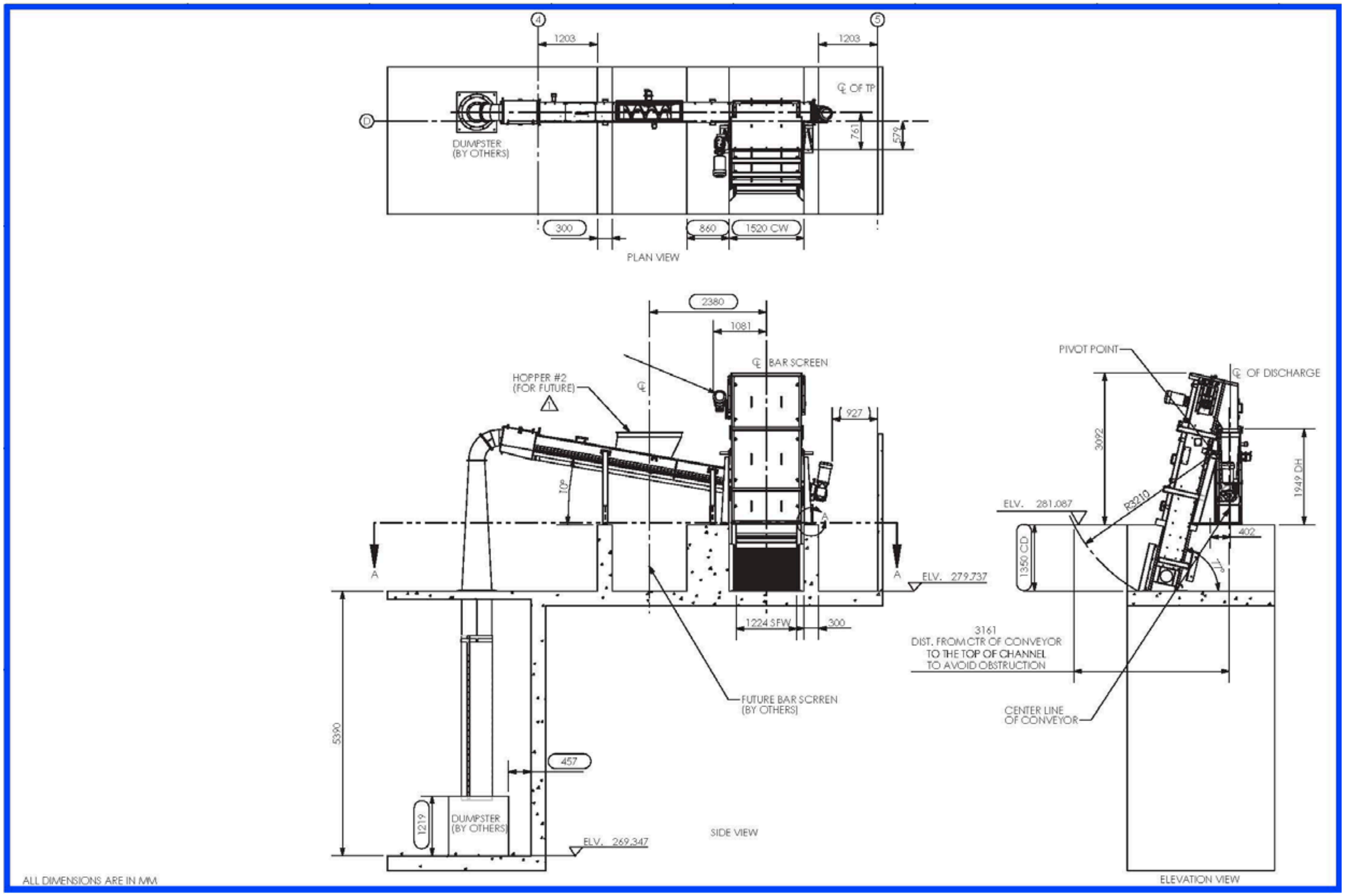


Figure 7.1: Screen and Transpactor

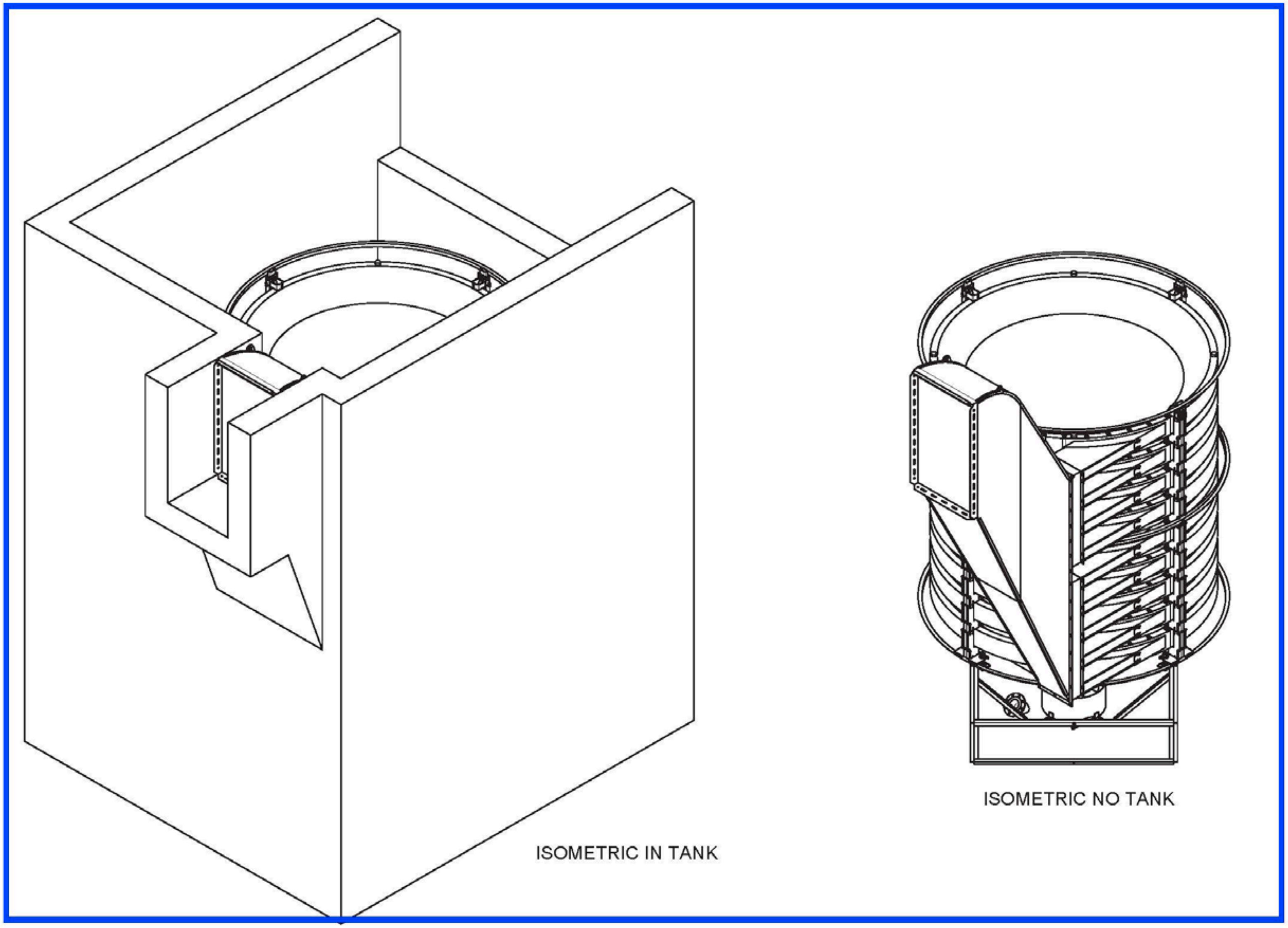


Figure 7.2: Solids Concentrator (Degritter)

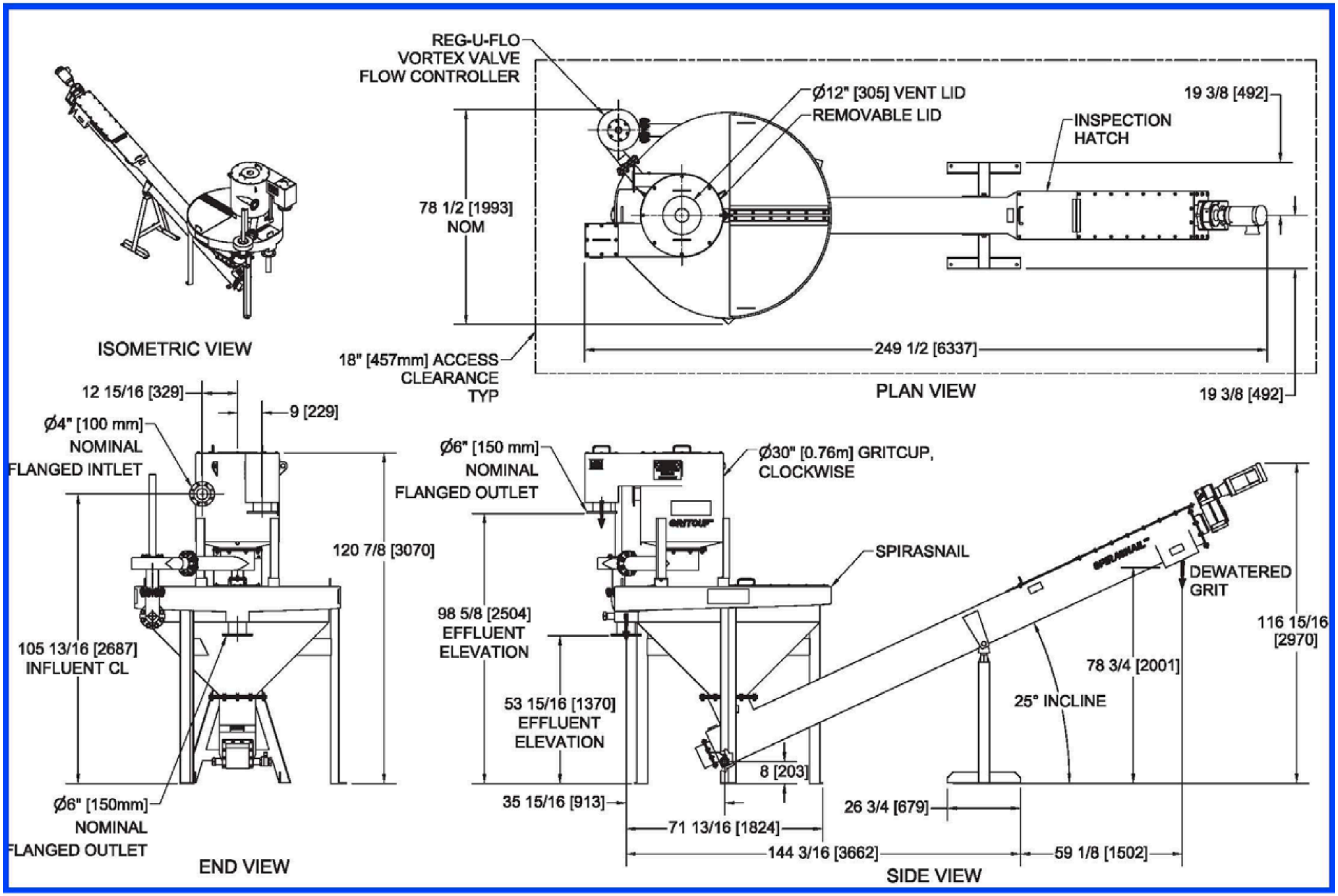


Figure 7.3: Grit Classification System

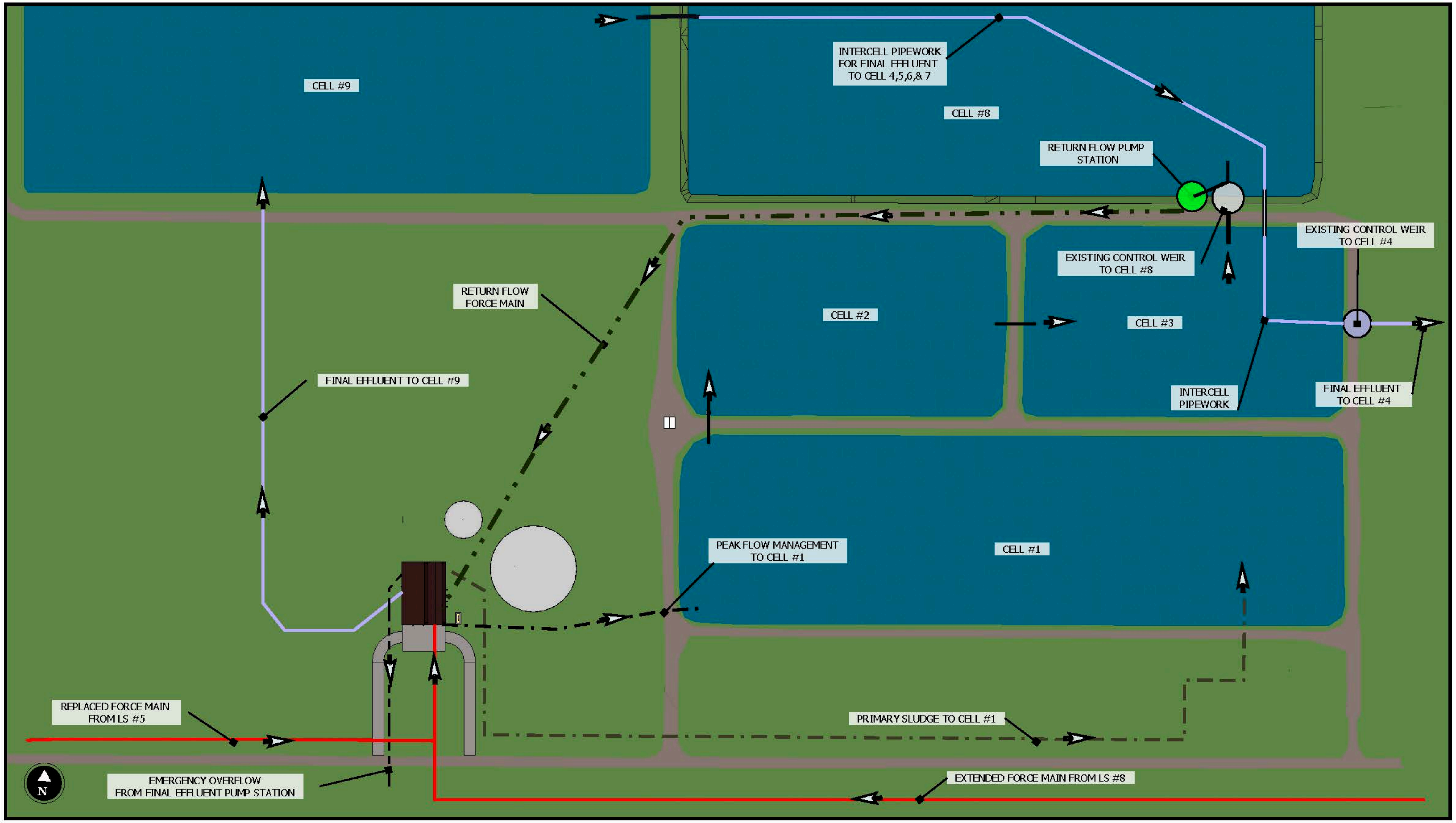


FIGURE 7.4: TREATED EFFLUENT STORAGE AND WET WEATHER PEAK FLOW MANAGEMENT

7.4 Primary Sedimentation

The process purpose of the primary sedimentation tank is to separate the solid and liquid fractions in the wastewater to reduce the load on the biological reactor. This unit removes settleable suspended solids and scum from the wastewater.

The primary sedimentation tanks splitter box provides equal flow of the screened and degritted wastewater to each of the sedimentation tanks to be built in the future. Any primary sedimentation tank can be isolated by closing the sluice gate at the splitter box in order to do maintenance on a tank.

The influent to the sedimentation tank enters a centre stilling chamber where the energy of the flow is dissipated and settlement of suspended solids is encouraged. Settled solids are directed to the central sludge hopper by the mechanical rake system, which is protected by torque overload devices. Desludging is performed by means of an actuated valve that controls the sludge flow from the central hopper into the Primary Sludge Sump based on a timer. From the Primary Sludge Sump the combined sludge is pumped with submersible pumps to Aeration Cell #1.

The overflow of the sedimentation tank passes over a peripheral weir where the flow is channeled to the BNR reactor. Scum and floating debris are removed from the surface of the primary sedimentation tank by a scum scraper which activates a scum draw-off mechanism with each revolution of the bridge. The scum is directed by gravity to the Primary Sludge Pump Station to be pumped along with the primary sludge to Aeration Cell #1. Refer to **Figure 7.5** for details on the Primary Clarifier.

7.5 BNR Activated Sludge Process

The main purpose of the BNR reactor is to reduce the carbon, nitrogen and phosphorus in the wastewater entering the bioreactor. The aerated and un-aerated compartments create conditions which allow microorganisms to utilize the biodegradable nutrients as a source of food and energy. Any phosphorus which is not removed in the process is removed by the addition of ferric chloride or alum.

For all Phases, it is planned that, each Primary Clarifier is feeding its own dedicated Bio-Reactor but it will be possible to divert all primary effluent to all the other Bio-Reactors if the one Bio-Reactor is offline. The wastewater enters the reactor at the anaerobic compartment with the option of partially feeding the pre-anoxic compartment. Under normal operation it is best practice to feed 90% of the primary effluent to the anaerobic compartment and 10% to the pre-anoxic compartment, however this split can be varied to suit different operating conditions.

At the pre-anoxic compartment, the reactor contents are mixed with the secondary clarifier underflow (return activated sludge). The RAS is rich in nitrates, and is denitrified, assisted by the biodegradable COD in the primary effluent entering this compartment.

From the pre-anoxic compartment, the water flows into the anaerobic compartment. This compartment has the option of being used as an anoxic or anaerobic cell. As an anaerobic cell it promotes the removal of phosphorus; however as an anoxic compartment it assists in denitrification and nitrogen removal. The A-recycle from aerobic cell 3a is normally introduced into the first anoxic cell. However, if the anaerobic cell is operated as an anoxic cell, the A-recycle will enter this cell. The B-recycle, which recycles some of the reactor contents from the anaerobic cell back to the pre-anoxic cell, will be the same, at a flow of 0.75 - 1.5 times the feed flow rate, regardless of the operational method of the bioreactor.

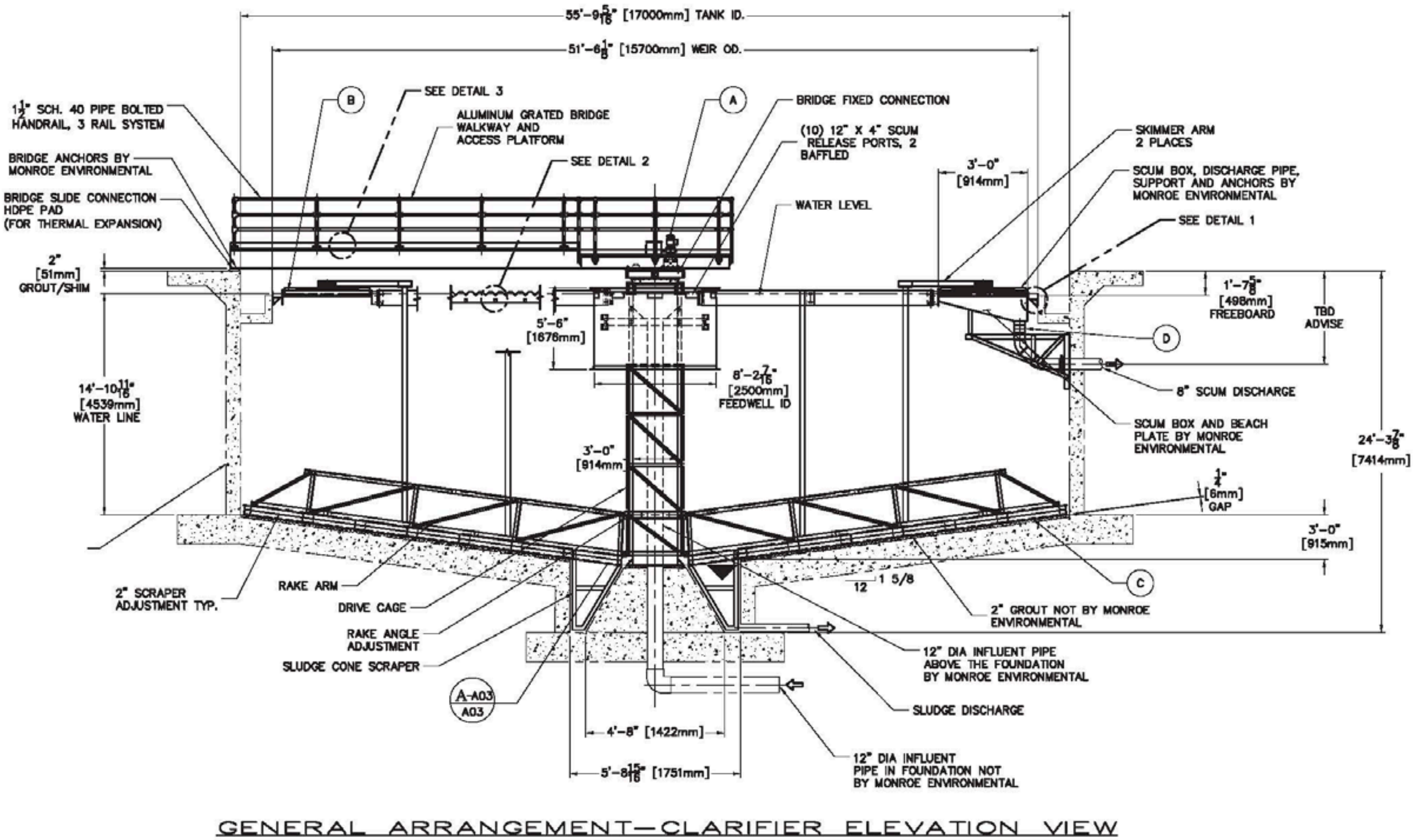


Figure 7.5: Primary Clarifier with Scraper Bridge

Downstream of the anaerobic compartment, the flow enters into the anoxic compartment, which consists of two cells. If the anaerobic compartment is operated as an anoxic cell, anoxic cell 2 can be operated as an aerobic cell (swing cell) at the same dissolved oxygen concentration of 1 to 2 mg/L as for the rest of the aerobic zones. To achieve this, air diffusers as well as submersible mixers are installed in this cell.

The following compartments are aerobic cells 1, 2, 3a and 3b. All of these cells have dissolved oxygen probes which measure the oxygen levels in the cells. The dissolved oxygen level in cells 3a and 3b are preset: cell 3a at a lower DO. All of the cells have diffused air systems and control valves, which are used to control the air feed to each individual cell. This control is automatically done by the PLC, with inputs from the SCADA. Control is also achieved, by changing the flow through the blowers by means of variable speed motors. The aerated cells diffused aeration systems are supplied from a set of air blowers.

The A-recycle is taken from aerobic cell 3a, with the option of taking it from 3b if required. This recycle is 2 to 3 times the plant feed flowrate. Reactor effluent emanates from aerobic cell 3b, and is discharged to its dedicated secondary clarifier, which are located in the centre of the donut-shaped reactor.

Ferric chloride or alum is dosed to remove soluble ortho-phosphates as a back-up facility. An on-line analyzer measures the ortho-phosphate concentration of the plant effluent. By studying the trend, the ferric chloride dosage can be calibrated. Thereafter, automatic dosing will be based on the change in flow rate. The dosage takes place in the final aerobic cell before the water enters the splitter box to the secondary clarifier. An on-line analyzer measures the ortho-phosphate concentration of the final effluent and this signal controls the ferric dosing or alum rate.

The nitrified recycle pumps (NRCY or A-recycle pumps) will be controlled by VFD's with the flows set by the plant operator. Refer to **Figure 7.6A and Figure 7.6B** for details on the Bio-Reactor. The Bioprocess Aeration Control System (BACS) is to be implemented to control the BNR process. BACS uses the airflow and DO information to calculate changes in oxygen uptake rate (OUR) in each control zone over a specified time increment (typically 15 minutes), and calculates the airflow required to achieve or maintain the desired set-point over the subsequent time period.

The BACS sends a total airflow set-point to the blower control and controls the air valves to distribute the air accurately to each aeration zone, providing precise DO control in each zone. The valve Cv curves are programmed into the BACS, facilitating fast and accurate valve control. There is no limit to the number of aeration zones that can be controlled.

This process-based control concept allows the aeration control system to respond accurately to any changes in the operating conditions and influent loading. It differentiates the BACS from a PI control loop that has a fixed gain independent of the process changes, so outside of a narrow band for which it is tuned, the PI controller will either over- or under- react to changing conditions.

The flow control of the blowers (as opposed to pressure control) has additional advantages. The system is not required to restrict the flow to maintain a constant pressure, so the most-open-valve logic of the BACS ensures that the blower is always operating at the lowest possible system pressure. It also prevents the often observed cyclical hunting of blower and valves that is caused by the blower control and valve control loops responding to the control action of the other

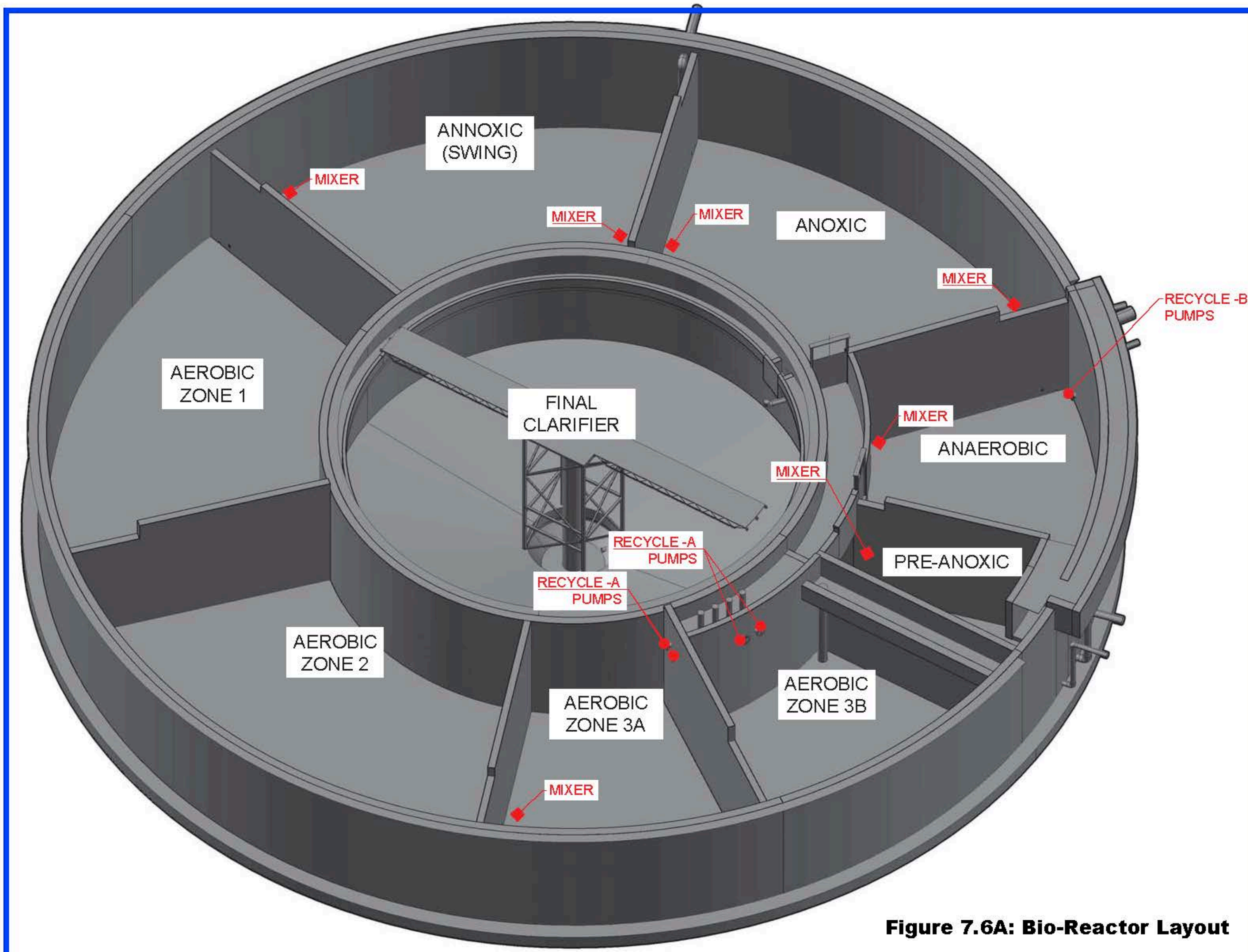


Figure 7.6A: Bio-Reactor Layout

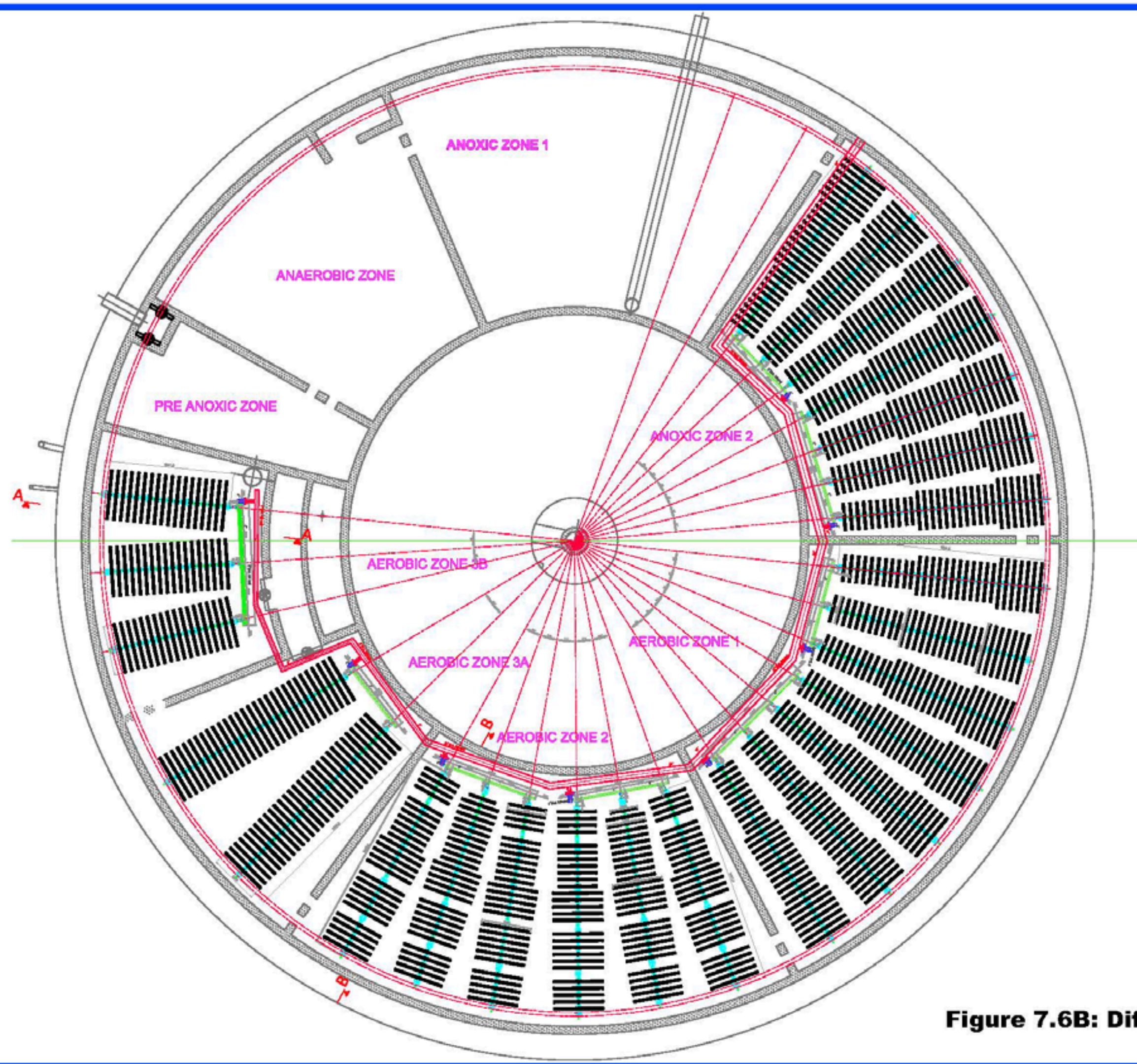


Figure 7.6B: Diffuser Layout

control loop, instead of process changes. This reduces valve and actuator actions and significantly increases the service life of the components.

The BACS can be programmed to intelligently respond to a wide range of instrumentation failures and/or alarm conditions. For example, in the case of an instrument failure or out-of-range condition, the BACS can adjust the affected control zone to a default airflow rate or valve position, alarm the operator and continue to accurately control the unaffected aeration zones.

The BACS is typically supplied as a stand-alone control panel with a PLC and a touch-screen interface for entering DO set-points and displaying process data. It can communicate with the plant SCADA through a customer-defined protocol (e.g. Modbus RTU or TCP/IP) for remote set-point control and data display. Refer to **Figure 7.6C** for a schematic of the BACS. Additional to the BACS, the City proposes to add the Bioprocess Intelligent Optimization System (BIOS). It is an integrated hardware and software system that enables real-time monitoring and control of wastewater treatment operations based on the dynamically changing biological activity occurring in the bioreactor. The BIOS, shown schematically in **Figure 7.6D**, controls the secondary treatment process to provide optimal conditions for biological (microbial) treatment.

The BIOS serves the dual purpose of minimizing the energy required for aeration, and it maximizes total nitrogen removal. Aeration energy is typically reduces by 10% to 20% and nitrogen reduction improvements of over 30% can be achieved.

The BIOS uses a customized feed-forward simulation and control algorithm to determine and adjust the dissolved oxygen set-points and nitrate recycle flow ratio (IMLR) necessary to meet treatment goals while minimizing energy consumption. It manages the supply of air to each zone of the aeration basin to achieve the precise level of nitrification required to meet the plant's specific permit requirements, and it controls the recycle flow in the tank to maximize the amount of nitrogen removed from the system.

In order to complete these real-time process optimizations, the BIOS uses data from on-line ammonium and nitrate analyzers, influent and effluent flow meters, on-line Return Activated Sludge (RAS) and nitrate recycle flow meters, on-line DO monitors, and the on-line or manual measurement of MLSS (mixed liquor suspended solids) and solids retention time (SRT).

The BIOS installation will be customized to meet the needs of the operator. It can also provide optimal control of carbon feed, SRT and waste rates. Refer to **Figure 7.6E** for a schematic summary of the Bio-Reactor Process Control System.

7.6 Secondary Clarifier

The secondary clarifier allows, solids exiting the BNR reactor to settle and thicken, and produce a clear effluent which can be disinfected. The settled and thickened sludge is returned to the BNR as RAS. However, some of it will be wasted as waste activated sludge (WAS) as necessary.

The secondary clarifier is located in the centre of the BNR reactor, with their feed coming from the last cell of each reactor. The WAS will be wasted from the RAS pipeline to the Primary Sludge Pump Sump, mixed with the scum discharged from the primary and secondary clarifiers as well as primary sludge, and discharged to Aeration Cell #1. The WAS wastage is controlled to waste a specific volume of sludge daily.

Scum baffles are used to prevent scum from exiting the clarifier together with the clear effluent. The scum is scraped from the clarifier surface into a scum trough and discharged to the Primary Sludge Pump Station.

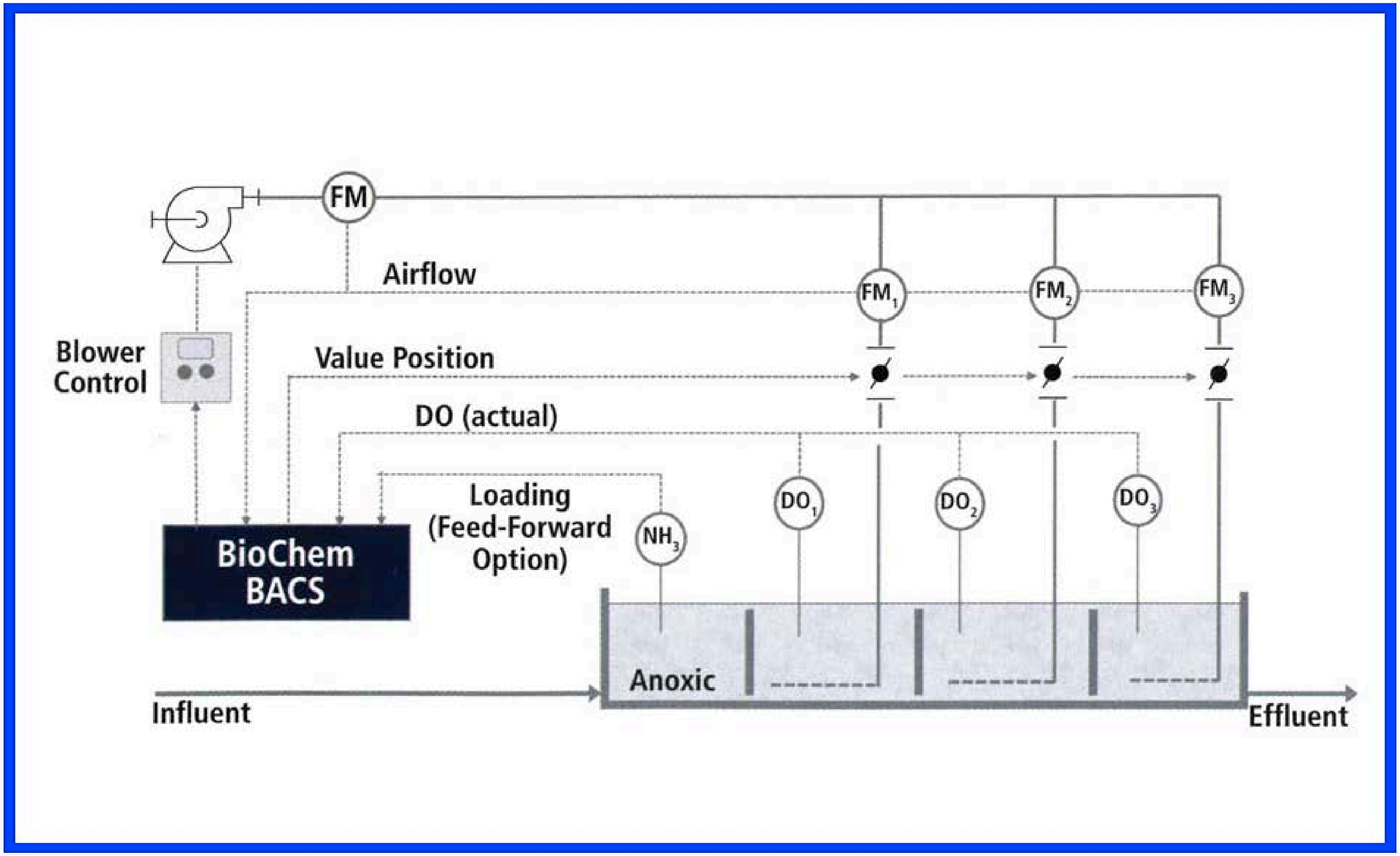


Figure 7.6C: Bioprocess Aeration Control System Schematic (BACS)

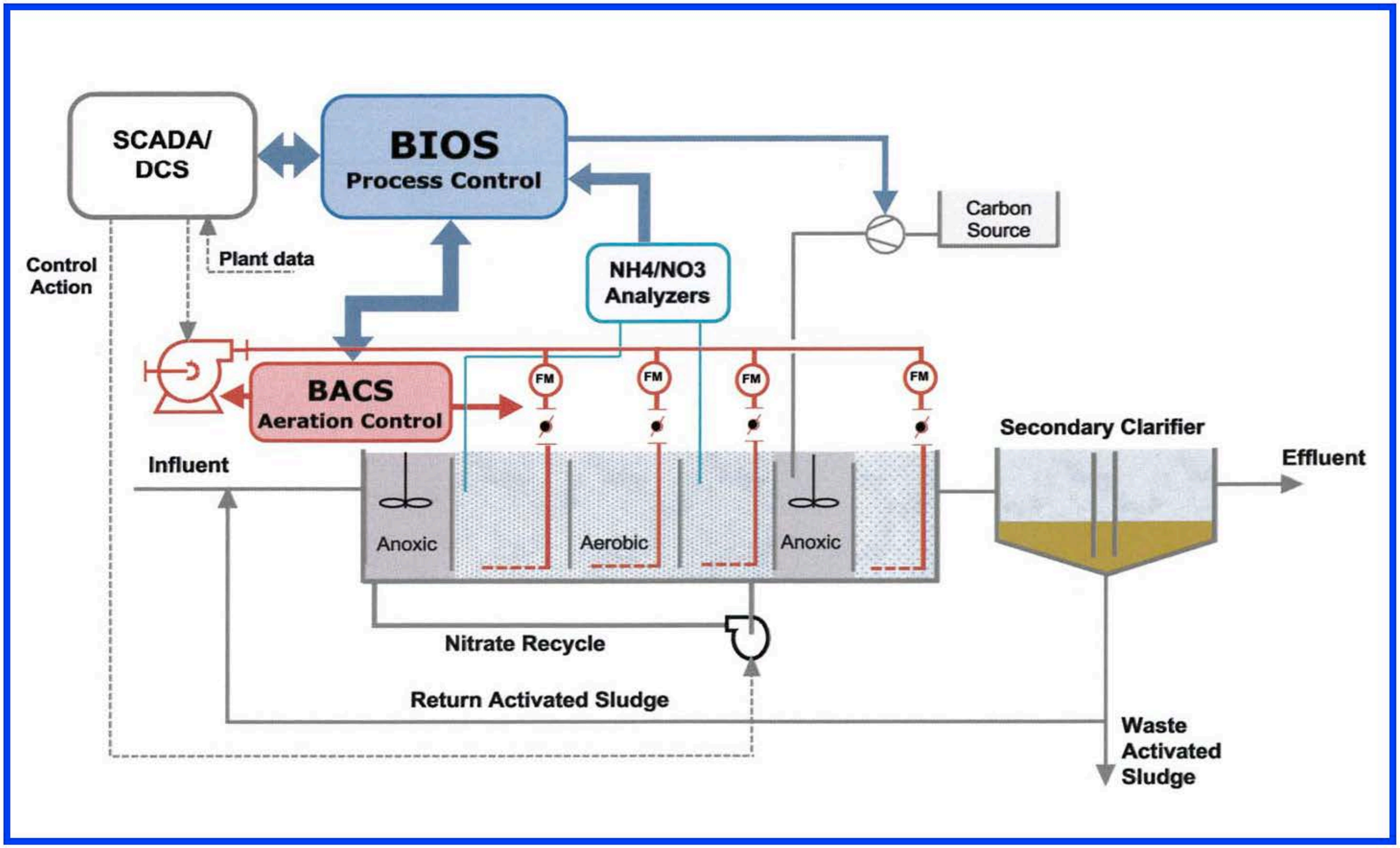


Figure 7.6D: Bioprocess Intelligent Optimization System Schematic (BIOS)

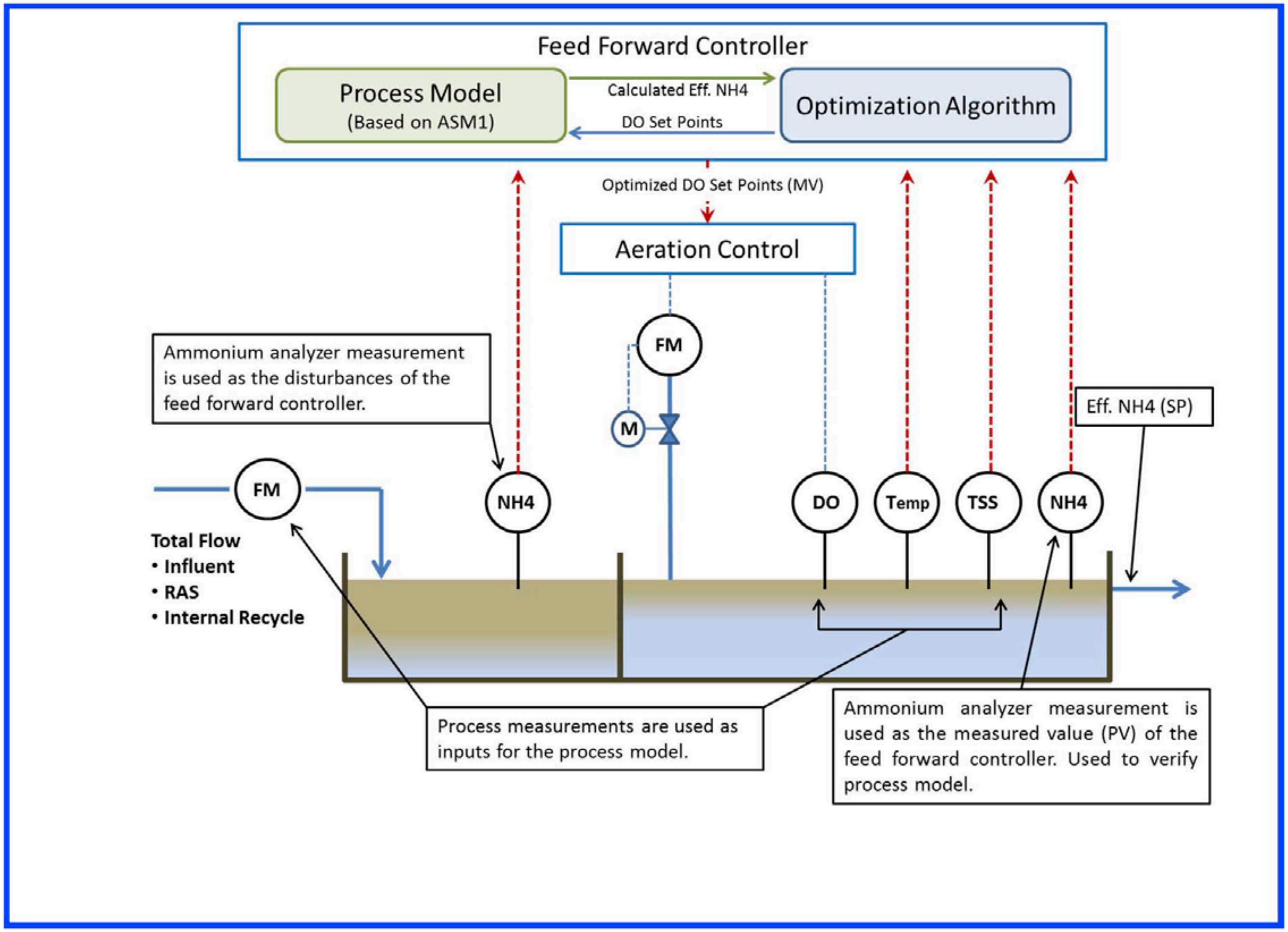


Figure 7.6E: Bio-Reactor Process Control System Control Summary

The overflow of the secondary clarifier will pass over a peripheral weir with v-notches, and will be directed to the Final Effluent Pump Station. Refer to **Figure 7.7** for details on the Secondary Clarifier.

7.7 Sludge and Scum Handling and Disposal

The Primary and Secondary Clarifiers all collect scum and discharged to the Primary Sludge Pump Station. Primary sludge from the Primary Sedimentation Tank and WAS is mixed with this scum using aeration mixing. Aeration mixing is accomplished on a continuous basis with the use of a coarse bubble blower which produces a rolling motion within the pump station. An air extraction system is also installed to remove foul air from this pump station.

7.8 Chemical Dosing

Provision is made to dose ferric or alum at both the Primary Sedimentation Tank as well as at the BNR Reactor, upstream of the Secondary Clarifier. Ferric or alum is dosed automatically based on the flow rate of the mainstream process flows. This is manually adjusted by monitoring the phosphorus concentration over time. Ferric or alum dosing may also be required when wastewater high in phosphorous is returned from Storage Cell #8.

7.9 Treatment Process Monitoring

The proposed plant flow metering and recording include the following process streams:

- Influent wastewater flow.
- Treated wastewater flow.
- RAS flow rate.
- WAS flow rate.
- Potable water use.
- Ferric chloride or alum dosing

Process monitoring of the BNR activated sludge process is proposed to include the following online equipment:

- Suspended solids (MLSS) concentration monitor at the downstream end of the BNR activated sludge reactor.
- DO concentration monitors in each of the aerated cells of the BNR reactor.

The proposed online continuous plant effluent quality monitoring could include the following:

- Conductivity, as the surrogates measurement of the TDS concentration;
- Ammonia concentration;
- Nitrate concentration;
- Phosphate concentration.

8. ENVIRONMENTAL IMPACTS

8.1 Lagoon Sludge Disposal

Due to the lack of any screening of the wastewater at the lift stations or at the lagoon system, the foreign material found in wastewater (especially with a strong industrial component) accumulated in the first aeration cell. With the cleaning of the diffusers in this cell late last year (2013) it was found that the sludge in about ¾ of this cell was severely contaminated making it unsuitable for land application. Refer to **Appendix G** for pictures showing the extent of this contamination. The build-up of sludge in the rest of the cell and both the other two cells are minimal and not being considered for removal at this stage. The aim of desludging will only be to clean the first aeration cell of foreign material as far as possible to allow screened and degritted sludge to enter this cell for stabilizing and for land application eventually.

8.2 Odour Considerations

Odour control will be implemented in the new headworks building in which the inletworks with screens, grit removal system and the primary sludge lift station will be incorporated. The inletworks will receive only pumped wastewater with an expected high concentration of H2S released when entering the Plant. The inlet works, grit removal system and the primary sludge lift station will however be isolated form the offices and the rest of the processes inside the building by a dividing wall. The Primary Sludge Pump Station will further be enclosed with air withdrawn from within this lift station. All air within this section of the building will be released to the outside through an exhaust air tower.

The Primary Clarifier and Bio-Reactor will be covered by dome structures where ventilation will be implemented.

The sulphate (SO_4) is high in the wastewater and together with anaerobic conditions in the rising main, it is expected that the sulphate will be reduced to H_2S by Sulphate-reducing bacteria.

The same concentration of H_2S will remain in the water fraction of the primary sludge, resulting in potential H_2S odor problems as the aeration cell #1. It is foreseen to mitigate the potential problem through the following measures:

- Introducing the primary sludge underneath the surface of the aeration cell #1 as it is being currently done with the wastewater.
- Increasing the upfront DO level in the Aeration Pond as necessary but with a minimum of 3mg/L.
- Ferric (or Alum) dosing at the primary sludge pump station, before the primary sludge is discharged to the aeration cell.

8.3 Land Impact

Previous to the construction of the first set of cells (#'s 4, 5, 6 & 7), part of the land was used as a landfill site. Previous to the construction of the aeration cells and the new storage cells (#'s 8 & 9), this quarter section of land was used as crop land. Therefore, natural land and habitat won't be disturbed by the construction of the new facility on part of this quarter section.

8.4 Surface Water

Treated effluent will continue to be discharged into Dead Horse Creek. The discharge will be continuous during ice-free periods while treated water will be stored during the period when the downstream streams are frozen to mitigate any negative impacts on culverts and bridges on the discharge route due to the forming of ice blocks.

The storage cells capacity will not be expanded to cater for the Phase I design flows as the existing capacity of Storage Cells #'s 9, 4, 5, 6 and 7 (1,050,000 m^3) is expected to be adequate until the year 2030. The requirement of treated water storage has to be reconsidered at that time to determine the feasibility of providing additional storage. It may also be possible that treated water could be recycled at that time or that it will be allowed to be used for the artificial recharge of the Winkler Aquifer.

8.4.1 Fuel Storage on Site

The proposed facility will have a power standby generator onsite with diesel fuel stored in a double wall fuel tank. During construction, all contractors will have to prevent leaks and spills of fuel and motor fluids. Refueling of equipment is not allowed within 100 meters of a water body, stream or wetland. As noted from the Department of Fisheries and Oceans, the deposit of deleterious substances into water frequented by fish is prohibited under the Fisheries Act.

8.5 Groundwater

The development or the discharge route is not in a groundwater pollution hazard area. There is no concern that the groundwater may be polluted from this development.

8.6 Species Impact

The existing treatment facility has been in operation for many years and it is expected that species in the area are acclimated to its location. This land was already disturbed by previous construction activities and is currently or was previously crop land. Minimal habitat damage and/or disturbance are expected.

8.7 Fisheries

Based on the latest provincial effluent discharge standards (Manitoba Water Authority Standards, Objectives and Guidelines, November 28, 2011), the following Total Ammonia discharge standards will be met by the treated effluent discharged to the Dead Horse Creek:

- ≤ 6.67 mg/L (at 9 °C and pH of 6.5)
- ≤ 5.91 mg/L (at 9 °C and pH of 7.0)
- ≤ 4.36 mg/L (at 9 °C and pH of 7.5)
- ≤ 3.65 mg/L (at 24 °C and pH of 6.5)
- ≤ 3.24 mg/L (at 24 °C and pH of 7.0)
- ≤ 3.39 mg/L (at 24 °C and pH of 7.5)

It will have no or minimum impact on fish in the critical springtime spawning season.

8.8 Forestry

There is no forestry activity in the area.

8.9 Heritage Resources

While the land was already disturbed during previous construction activities it is assumed that no concern exist regarding a potential to impact significant heritage resources.

8.10 Socio-Economic Impacts

By proceeding with this development, the City will be able to increase community development like sub-divisions. It was made clear by the Provincial Government that a moratorium will be placed on the City's future sub-divisions if not being attended to an upgrade of the lagoon system which couldn't meet the 227 days storage requirement during 2011.

8.11 Public Involvement

Specific public involvement has not been spearheaded by the City, which doesn't regard it as necessary. In general the public is concerned about the development in the City which could be restrained by the Province should the development not proceeding in a timely manner. Comments from concerned members of the public will be solicited as part of Manitoba Conservation's review prior to issuing a license. Alternatively, concerned citizens of the City and of the RM of Stanley may make their concerns known to their respective Councilors.

9. MANAGEMENT PRACTICE

The new Winkler Wastewater Treatment Facility is specifically designed to treat wastewater to meet the latest Provincial Effluent Standards. The facility will continuously discharge to the Dead Horse Creek via the Storage Cells.

10. WATER TREATMENT PLANT REJECT WATER

According to a study done on the Dead Horse Creek, conductivity did not vary significantly among the measuring sites, indicating that sewage discharge did not change the background ionic strength of the creek. (Elsevier Publishers: Science of the Total Environment Journal, Presence and hazards of nutrients and emerging organic micro pollutants from sewage lagoon discharges into Dead Horse Creek, Manitoba, Canada; page 69) The conclusion is therefore that the RO reject water from the new water treatment plant is not impacting the creek negatively and therefore recommended to continue to waste the reject water to the sewer system as being currently practised.

Refer to the following **Table 10.1** for concentrations and loads of the waste and reject water as measured between April 2011 and March 2012. As nothing has changed at the plant from this period, it can be assumed the same will apply for any periods after this. Although the City is evaluating the possibility to reduce the reject water, the loads will not differ until the water use is increased.

Table 10.1: Waste & Reject Water Quality – April 2011 to March 2012

Parameter	Maximum	Minimum	Range	Average *	Std. Dev *	CoV*
pH	7.82	7.30	0.52	7.61	0.1	1.3%
Temperature	12.9	8.4	4.5	10.0	1.07	10.7%
Total Dissolved Solids (mg/L)	7711	1461	6250	4286	2173	50.7%
Load (kg/day)	6662	1262	5400	3703	1877	
Calcium Hardness as CaCO3 (mg/L)	2492	844	1648	1388	336	24.2%
Load (kg/day)	2153	729	1424	1199	290	
Turbidity	2.01	0.18	1.83	0.64	0.45	70.3%
Ferrous Iron (mg/L)	0.14	0.01	0.13	0.03	0	96.7%
Load (kg/day)	0.12	0.01	0.11	0.03	0	
Manganese (mg/L)	1.959	0.319	1.64	0.719	0	45.3%
Load (kg/day)	1.693	0.276	1.417	0.621	0	
Magnesium Hardness as CaCO3 (mg/L)	1100	404	696	713	179	25.1%
Load (kg/day)	950	349	601	616	155	
Conductivity	15740	2980	12760	8746	4435	50.7%
Total Hardness as CaCO3 (mg/L)	3524	1248	2276	2108	488	23.1%
Load (kg/day)	3045	1078	1966	1821	421	
Total Alkalinity as CaCO3 (mg/L)	2048	864	1184	1085	310	28.6%
Load (kg/day)	1769	746	1023	937	268	
Ammonia (mg/L)	4.12	0.65	3.47	3.24	1	21.6%
Load (kg/day)	3.56	0.56	3.00	2.80	1	
Ferric Iron (mg/L)	0.7	0.02	0.68	0.08	0	137.5%
Load (kg/day)	0.60	0.02	0.59	0.07	0	
*Note: The calculation of the Average, Standard Deviation and Coefficient of Variation excludes the Maximum and Minimum Values. The average flow of Reject Water is 10 lps continuously.						

11. POTABLE WATER

A potable waterline will be provided from the Pembina Valley Water Co-Op network.

12. LABORATORIUM

A fully equipped laboratorium will be provided if funding will allow.

13. SCHEDULE

It is anticipated that the Environmental Act License process will be finalized by June 2014 with commencing of construction in late summer of 2014, weather permitting and with Federal/Provincial Funding secured.

Tenders for mechanical process equipment, dome covers for the clarifier and bio-reactor and SCADA have been received. No awards can however be made prior to the securing of funding. Tenders for structural concrete work, pipelines, pumps & mixers etc will be issued during April to June 2014 and for the building later in the project when concrete work on the inletworks is completed. All depending on funding, it is anticipated to commission the plant in spring 2015.

Once the plant has been commissioned, Aeration Cell #1 will be desludged by only removing contaminated sludge to the landfill.

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Director of Engineering and Water Resources