Winnipeg Sewage Treatment Program

NEWPCC Upgrade Project
RFP 182-2015 Supporting Documentation

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1 INTRODUCTION

The Supporting Documentation is a high level overview of the main process units at the North End Water Pollution Control Centre (NEWPCC). It is not intended to explain all elements of the existing plant or the required wastewater upgrade. The information provided herein is a mechanism by which to provide the Proponents of the RFP some knowledge of the existing facility, the major results of evaluations the City has considered to date, and the basis of those evaluations.

The Supporting Documentation includes a description of:

- The NEWPCC Existing Facility
- The Proposed NEWPCC Upgrade (as presently envisioned)
- The NEWPCC Power Supply Upgrade (Outside scope of RFP 182-2015)
- The NEWPCC Upgrade Project Planning Phase

The supporting document does not present asbuilts, possible operating scenarios, isolation scenarios or comprehensive information or details. The documentation provided does not relieve the selected Consultant from providing the necessary investigations of the existing facilities and detailed engineering work to prepare a comprehensive design for a complete and operable upgrade to the NEWPCC. The upgrade must comply with City, Regulatory and Code requirements as well as the discharge licence. Unless shown on asbuilts, the existing buildings, tunnels large piping and other structures are considered to be on piles.

2 NEWPCC EXISTING FACILITY

2.1 LIQUID PROCESS TRAIN

The liquid train consists of the surge well, raw sewage pumps, discharge chamber, preliminary treatment, primary treatment, secondary treatment, junction chamber, UV disinfection and the outfall.

2.1.1 SURGE WELL, DISCHARGE CHAMBER AND RAW SEWAGE PUMPS

The surge well, discharge chamber and raw sewage pumps are housed in the administrative building as shown in Figure 2.1.

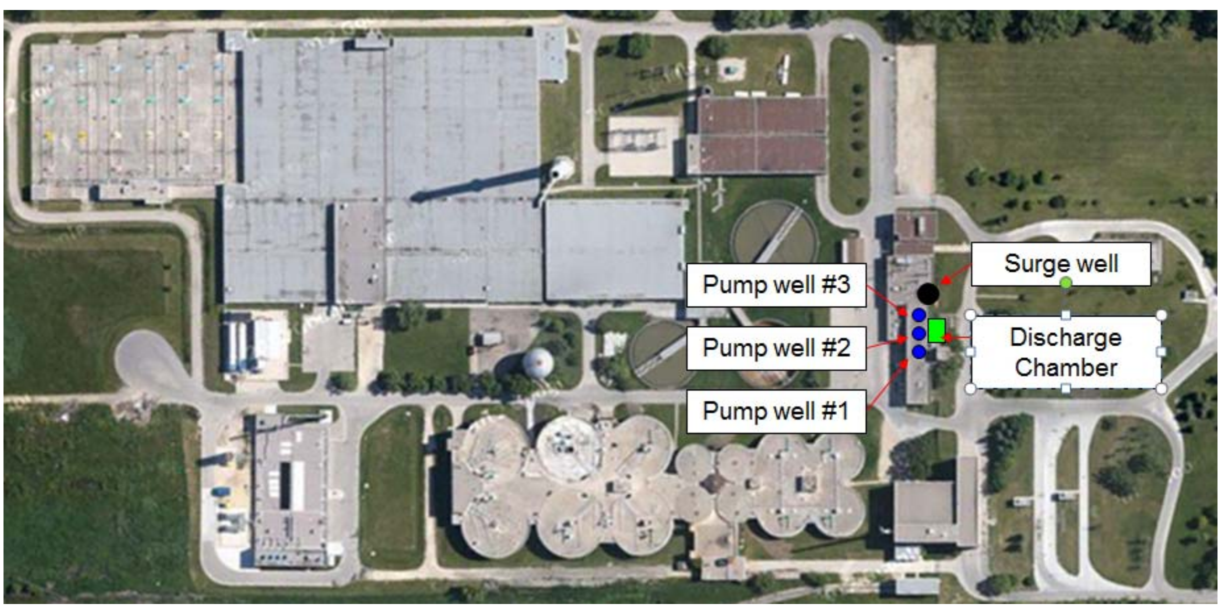

Figure 2.1 NEWPCC Surge Well, Pump Wells, and Discharge Chamber

Surge Well

The surge well receives raw sewage from the main interceptor at an invert of -6.29m. The reference elevation (0m) is established at 221.76m above mean sea level. This elevation is the normal winter ice level downstream of the Forks at the confluence of the Red and the Assiniboine Rivers in the City. The sewage from the surge well is then directed into two raw (east / west) sewage suction headers as shown in Figures 2.2 and 2.3.

Raw Sewage Pumps

There are six raw sewage pumps located in three pump wells. These wells are opened to the main floor level. Pumps #1 and #2 are located in pump well #3. Pumps #3 and #4 are located in pump well #2. Pumps #5 and #6 are located in pump well # 1. The surge well and the raw sewage pumps are connected by the east and west headers as indicated in Figure 2.3.

Sewage is lifted by the raw sewage pumps from the surge well at an elevation range of-5.5 to +3.0 metres, to 11 to 12.8m in the discharge chamber. The connection between the pump wells and suction headers can be isolated, if necessary. Each suction header has a guide rail for stop logs.

A maximum of 820 ML/day can be pumped to the grit building; however, 740MLD is the current maximum capacity to ensure the performance of grit removal process.

Raw sewage pump details are indicated in Table 2.1.

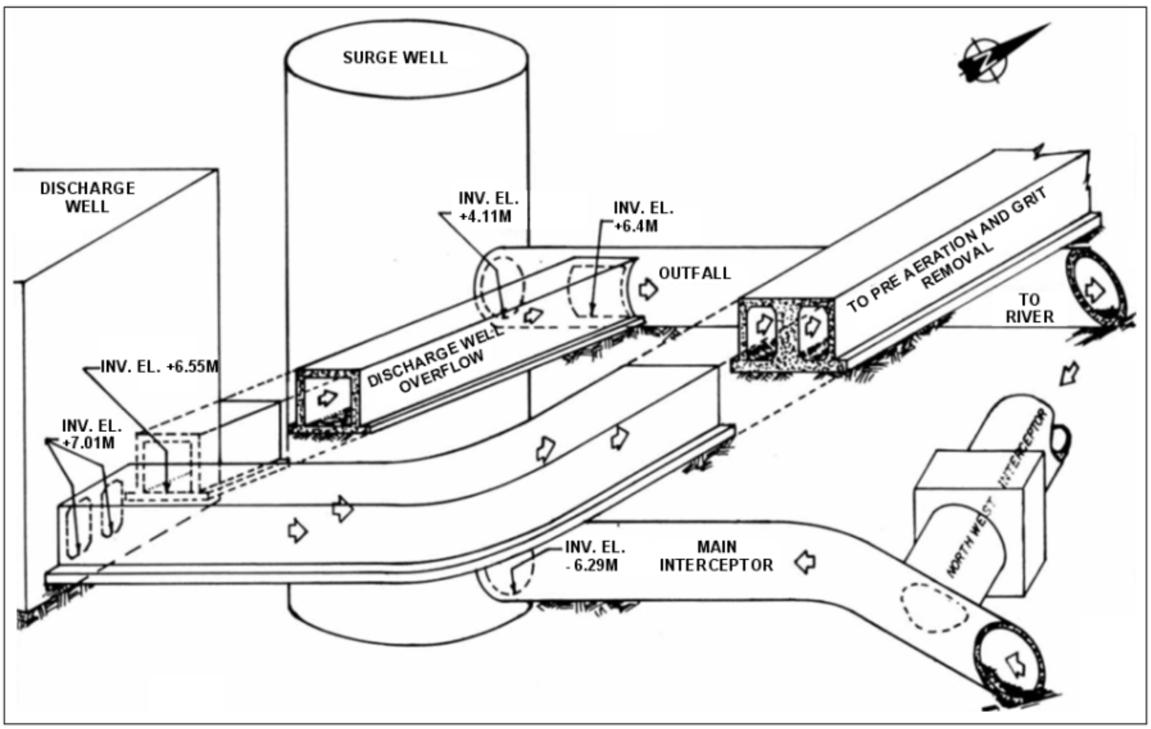

Figure 2.2 Raw Sewage Connections to and from the Administrative building

Discharge Chamber

The discharge chamber provides a free discharge for the raw sewage pumps and for the sump pumps. Raw sewage can be directed seperately or simultaneously to either the outfall or the pre-aeration and grit removal building from the discharge chamber

All flow is directed to the pre-aeration and grit removal building on normal operating conditions. When the flow exceeds the capacity of the pre-aeration and grit removal process, the sewage could be directed to the outfall through weirs (located at an elevation of -12.74m) or sluice gates at the discharge chamber. However, the sluice gates are inoperable.

Sewage flows from the discharge chamber to the pre-aeration and grit removal building through two(2) underground conduits. There is a possibility of isolating either conduit through the use of sluice gates. However, the conduits have never been isolated. The capacity of the conduits have been found to range from 675 to 700MLD during wet weather days. Flow beyond this range goes over the weirs to the outfall.

The capacity of the weirs is approximately 100 ML/d when the sewage level is 0.3m above the weirs. The weirs are shown in Figure 2.3 while the plan view of the discharge chamber is shown in Figure 2.4.

There is a venturi between the discharge chamber and the grit building however it has not been in operation for years.

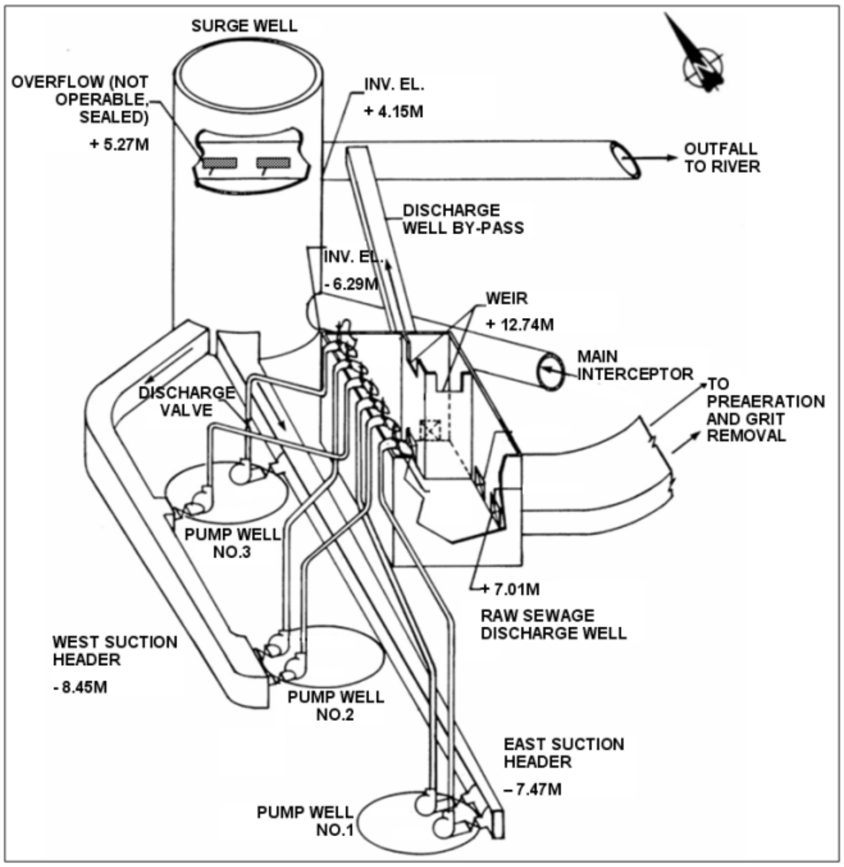

Figure 2.3 Raw Sewage Pumping Schematic

Table 2.1 Raw Sewage Pumps Capacity and Specification

Pump	Type	Capacity (MLD)	Spec
1	Constant speed	109	300 kW (400 hp)
2	Variable speed	77 – 188	522 kW (700 hp)
3	Constant speed	188	522 kW (700 hp)
4	Variable speed	77 – 188	522 kW (700 hp)

Pump	Type	Capacity (MLD)	Spec
5	Two-speed	195 / 150	448/335 kW (600/450 hp)
6	Constant speed	188	522 kW (700 hp)
Total capacity		1056	
Total firm capacity (with largest pump out of service)		860	

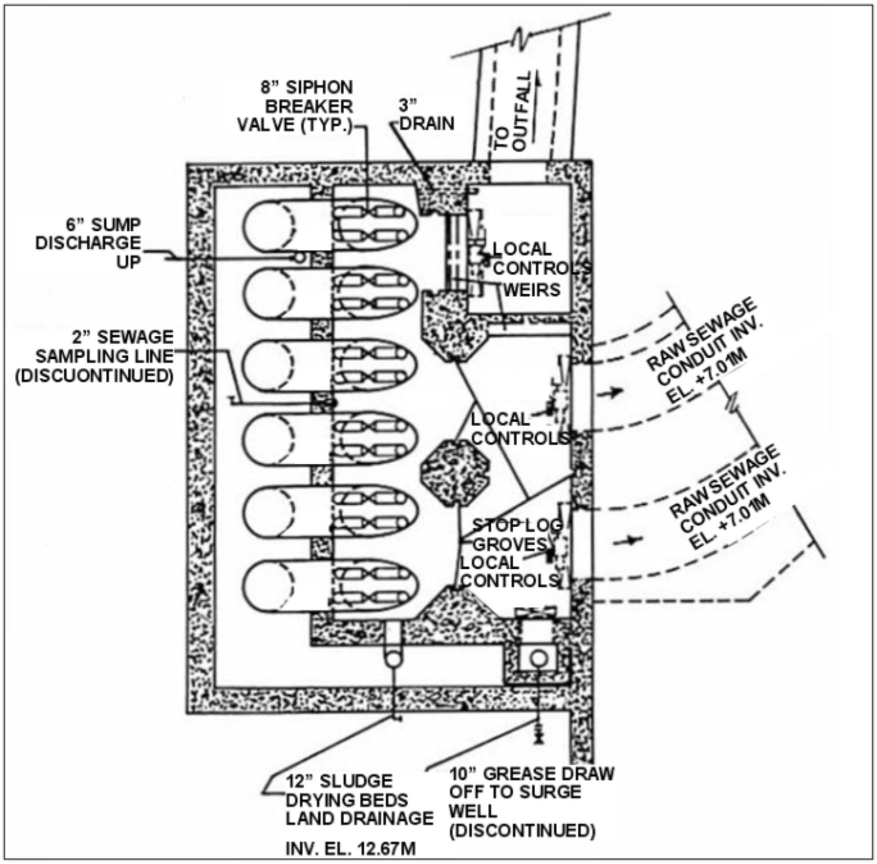

Figure 2.4 Discharge Chamber Plan View

2.1.2 HAULED LIQUID WASTE AND LEACHATE FACILITY

The Hauled Liquid Waste (HLW) facility is a receiving facility at the NEWPCC for truck hauled septage, industrial waste and leachate generated both from within the City and surrounding municipalities.

The facility consists of four lanes, each with its own receiving manhole. Liquid discharged into the manholes flows into underground monolithic concrete holding tanks located in the basement level of the buildings. Each tank has a capacity of 21000L and is designed with a 40 degree slope to assist in solid material movement. The tanks are outfitted with internally mounted hydrocarbon sensors, ultrasonic level sensors as well as high and low level floats. These three sensors are all tied into the PLC which relays information back to the distributed control system (DCS) of the plant. Liquid discharged from the facility flows through a 300mm sewer pipe into the main Interceptor that feeds the plant. The location of the facility is shown in Figure 2.5

Figure 2.5 Hauled Liquid Waste (HLW) and Leachate Facility

2.1.3 PRELIMINARY TREATMENT

Preliminary treatment at the NEWPCC consist of screening, pre-aeration and grit removal as shown in Figure 2.6

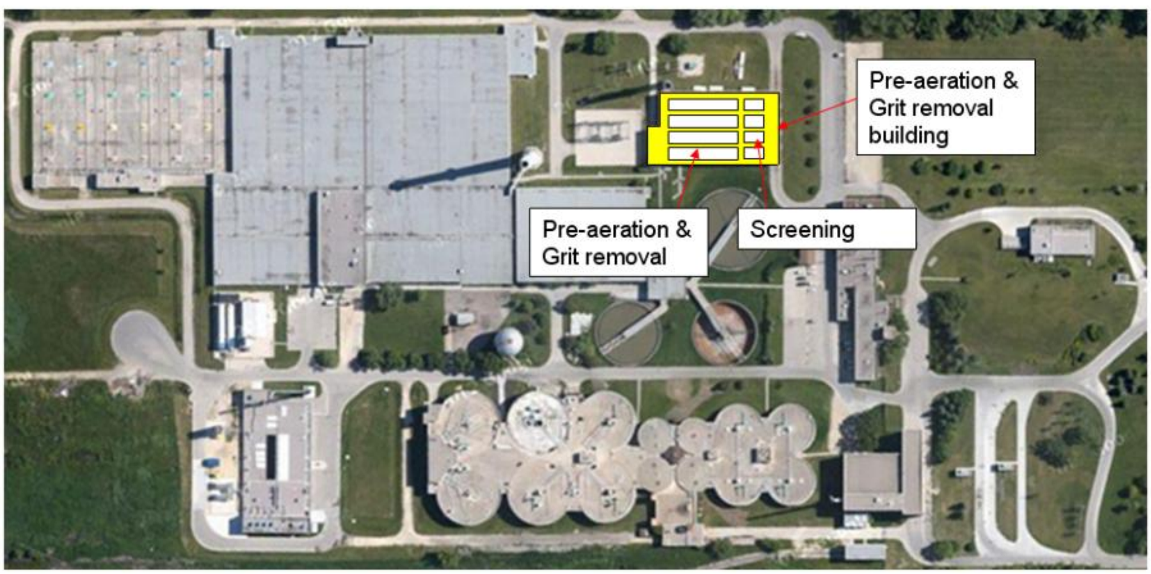

Figure 2.6 Location of the Preliminary Treatment

The sewage from the discharge chamber flows by gravity, through two underground conduits, into the Pre-aeration and Grit removal building. The sewage passes through bar screens before it flows into the grit tank where it is pre-aerated and the grit is removed. A plan and cross sectional views of the processes in the Pre-aeration and Grit removal building are shown in Figures 2.7 and 2.8 respectively.

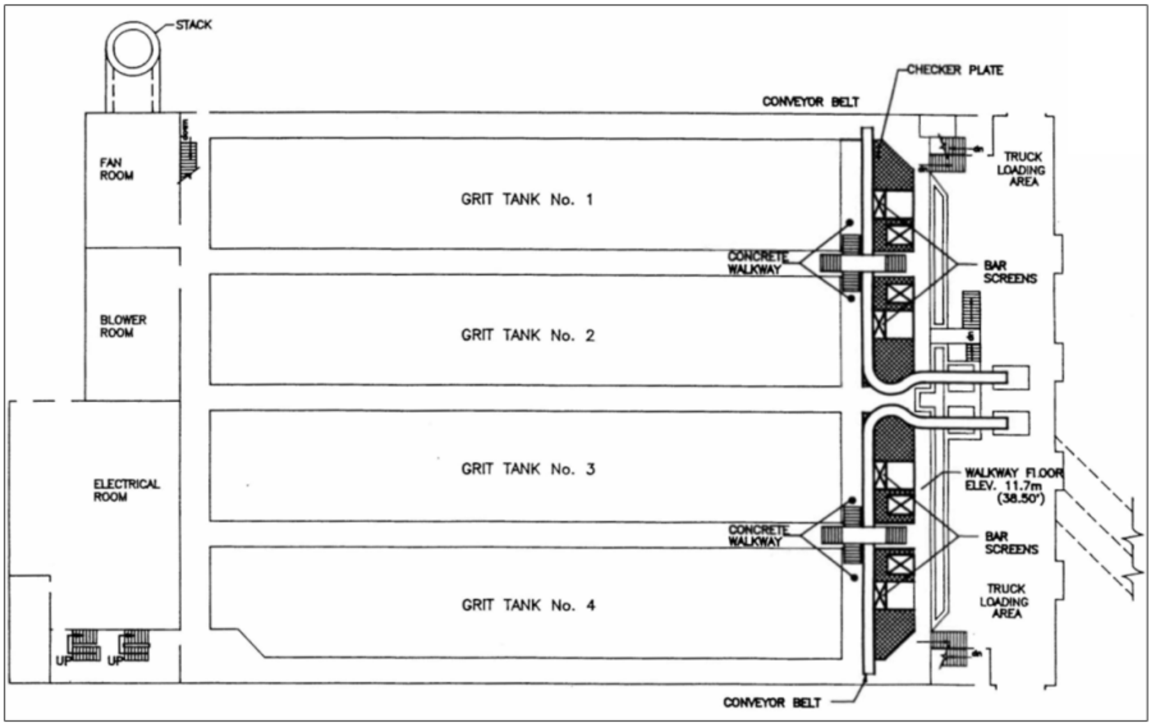

Figure 2.7 Bar Screens and Grit Tanks

Bar Screens

Four mechanically cleaned bar screens are used to remove large objects from the raw sewage. Each screen is located at the front end (east) of each grit tank. A rake in each screen automatically clears debris from the bar screens and dumps it onto a conveyor belt. The conveyor belts transport the debris into two hoppers before it is trucked to the landfill.

Grit tanks

The sewage is gently agitated with air at a rate of 10-17 m^3/hr/m in the first 21.5m of the grit tank to remove heavier inorganic materials. Clam-shell buckets are used to remove the grit which is trucked to the landfill for disposal. Pre-aeration occurs in the next 24.5m of the grit tanks at a rate of 33 m^3/hr/m. This vigorous agitation strips off odorous gases and replenishes dissolved oxygen reducing odours within the plant and improving scum separation in the primary clarifiers.

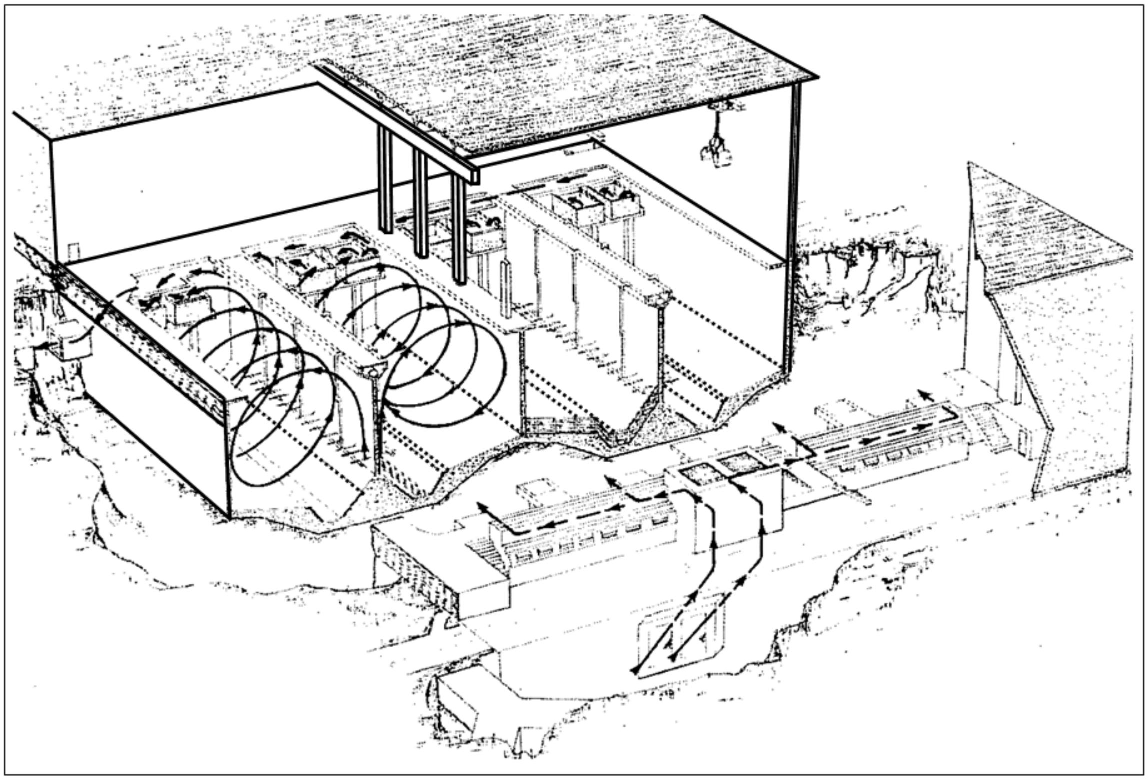

Figure 2.8 Sewage Flow through Pre-aeration and Grit building

2.1.4 PRIMARY TREATMENT

The Primary treatment at the NEWPCC consists of the following:

- The primary clarifier tanks
- The sludge removal system
- The scum removal system

There are five primary clarifier tanks; three circular uncovered tanks and two covered rectangular tanks. The sludge removal system involves the use of sludge pumps, operating in sequence to remove settled sludge from the primary clarifiers into the digesters. Generally, the scum removal system skims the scum off the surface of the primary clarifiers and pumps it to the digesters. However the scum from the rectangular clarifiers goes into a scum hopper before it is transferred into the digesters. The odour from the two rectangular clarifiers is vented through a 76 m tall stack located at the North of the rectangular primary clarifiers. Location of the primary clarifiers and stack are shown in Figure 2.9.

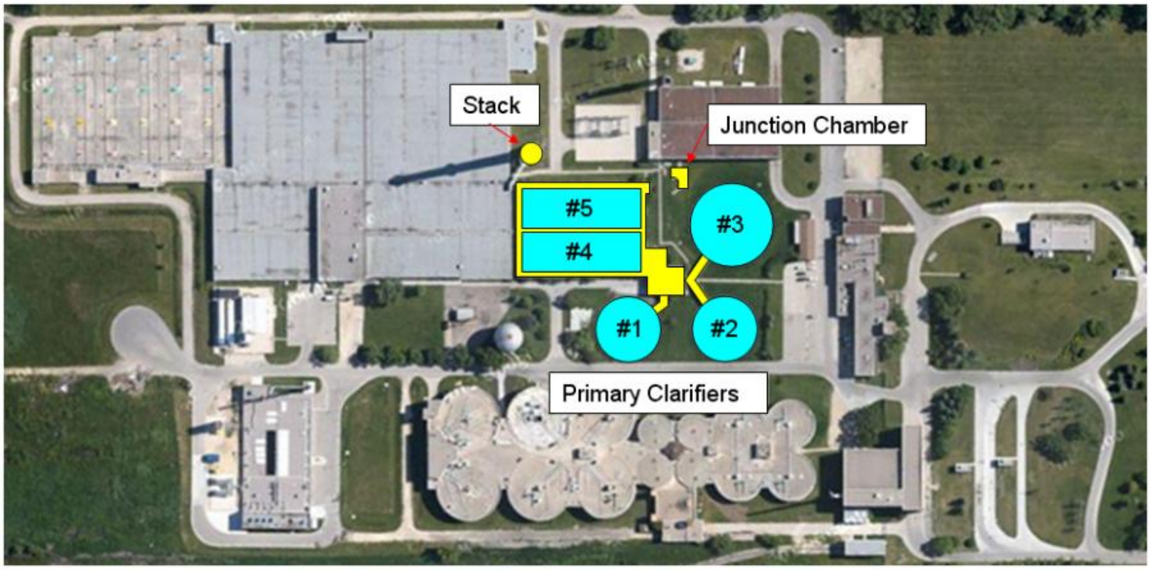

Figure 2.9 NEWPCC Primary Treatment

Sewage from the pre-aeration and grit building flows through the junction chamber and splits into two conduits. Both conduits carry sewage to the circular tanks while the rectangular primary clarifiers receive sewage from one of the conduits (Figure 2.10).

The influent to the circular clarifiers is controlled by the sluice gates located in the control chamber room. Flow into the rectangular clarifiers is controlled by sluice gates located at the front of each tank. The primary clarifier influent channels are aerated using the pre-aeration and grit removal blowers. This controls the scum and keeps the solids in suspension.

Effluent from primary clarifiers #1 and #2 flows into the outer ring of the control chamber while the effluent from primary clarifiers #3, #4 and #5 flows directly into one of the primary effluent conduits. These primary effluent conduits lead to the high purity oxygen (HPO) reactor tanks. Flow of effluent from the primary clarifiers is shown in Figure 2.11.

There are four sludge pumps operating at variable speed drive that pump sludge in turn from each primary clarifier. There are two pumps dedicated to the circular and rectangular clarifiers. Sludge is pumped from a central hopper for the circular clarifiers while sludge is pumped from individual hoppers in the rectangular clarifiers. Sludge is usually pumped at the rate of 81 m^3/hr with a minimum density of 3.0 %. The sludge removal system is shown in Figure 2.12

The scum from the circular clarifiers is collected under the covered walkways. The scum is removed by manually rotating the scum troughs and then pumped directly to the digesters through the sludge line. Scum from the rectangular clarifiers is skimmed to the influent end of the tank by the bridge mechanisms. The scum is automatically skimmed off into a scum holding tank located between the two clarifiers. The scum is then ground in a grinder pump, recirculated and pumped to the digesters through the sludge line.

Details of the primary treatment are indicated in Tables 2.2 to 2.3.

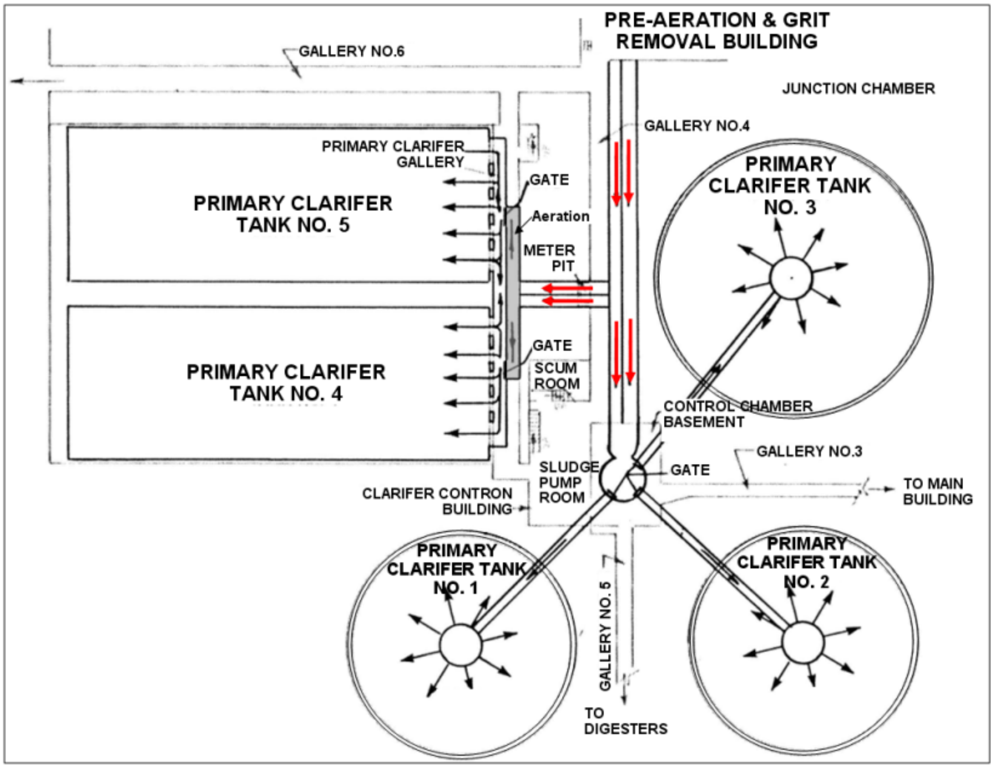

Figure 2.10 Primary Clarifier Influent Flow

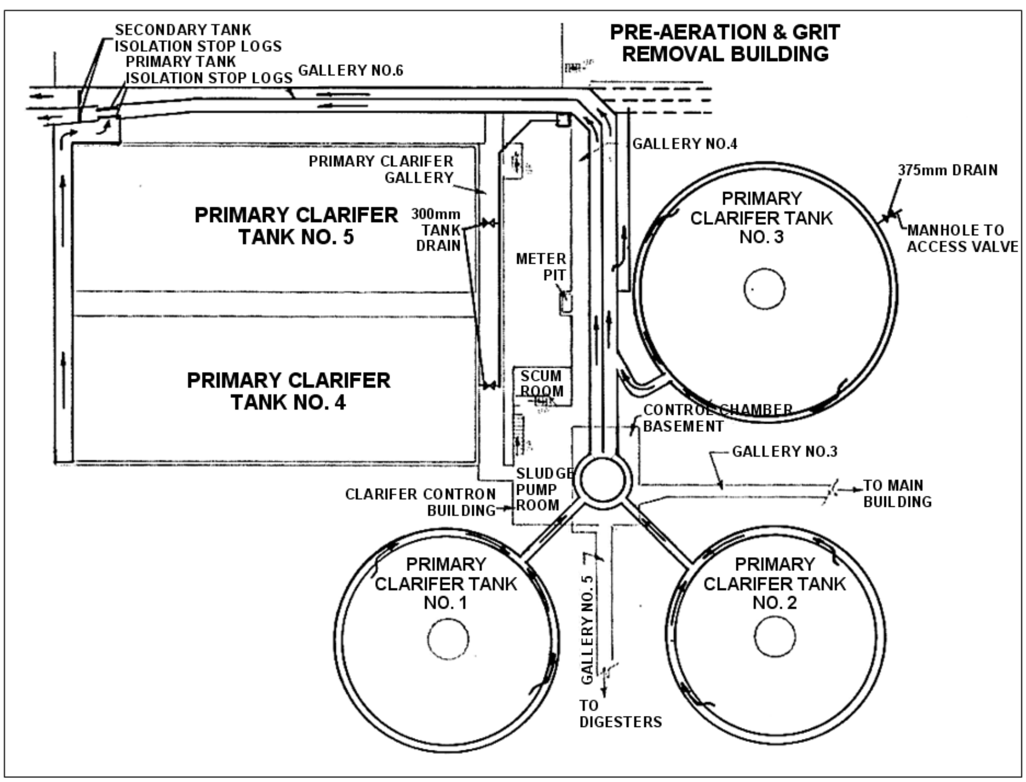

Figure 2.11 Primary Clarifier Effluent Flow

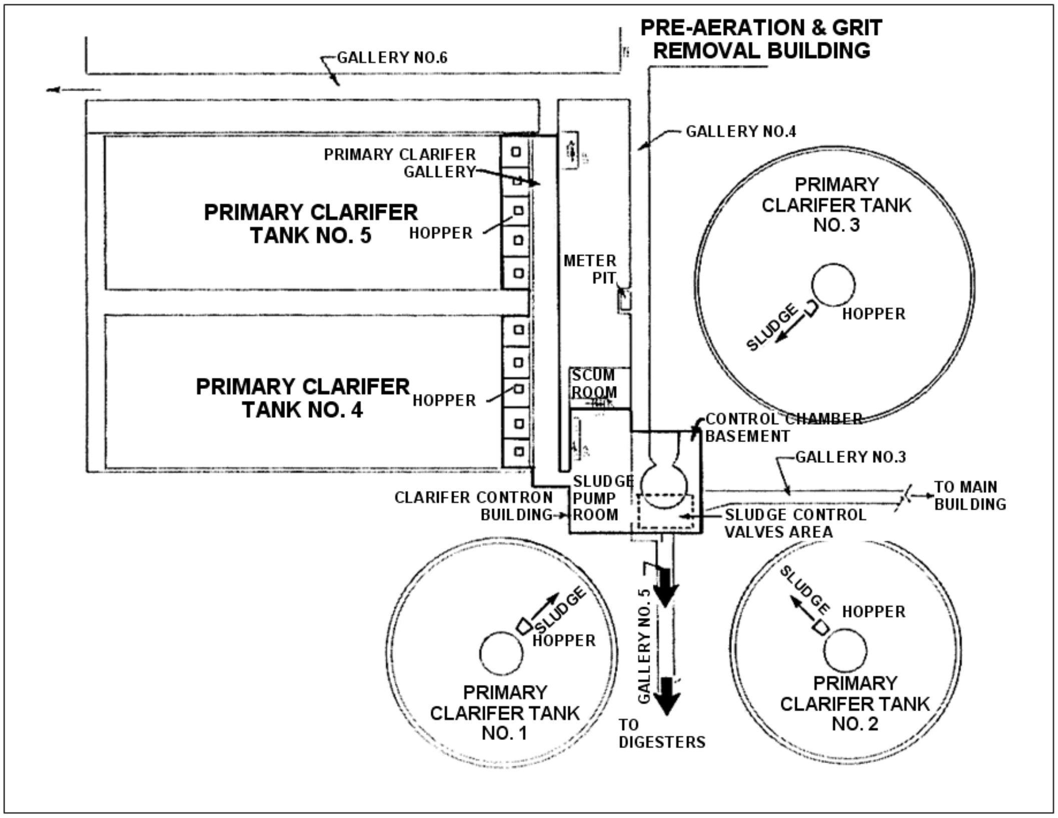

Figure 2.12 Sludge Removal System

Table 2.2 Primary Clarifier Tanks Details

Tank #	1	2	3	4	5
Year of installation	1937	1937	1953 - 1956	1980	1980
Type	Circular	Circular	Circular	Rectangular	Rectangular
Depth(+-)	3.6 m	3.6	3.6	3.6	3.6
Dimension	Ø 35 m	Ø 35 m	Ø 44 m	66.5 x 23 m	66.5 x 23 m
Surface Area	960 m^2	960 m^2	1,520 m^2	1,530 m^2	1,530 m^2
Volume	3,900 m^3	3,900 m^3	5,500 m^3	5,500 m^3	5,500 m^3
Weir Length	110 m	110 m	138 m	145 m	145 m
% Flow	14%	14%	22%	25%	25%
Note	After rehabilitation work in 2010, the capacity seems to have decreased.				

Table 2.3 Primary Clarifier Bridge, Scum and Sludge Pump Details

	Item	Description
Primary clarifier No		
#1	Bridge manufacturer	Dorr-Oliver Eimco
	Year of installation	2010
	Motor	Need to be verified
	Gear	Need to be verified
#2	Bridge manufacturer	Dorr-Oliver Eimco
	Year of installation	2010
	Motor	Need to be verified
	Gear	Need to be verified
#3	Bridge manufacturer	Dorr-Oliver Eimco
	Year of installation	2010
	Motor	Need to be verified
#4 and #5	Bridge manufacturer	Dorr-Oliver Canada Ltd.
	Year of installation	1980
	Drive Motor	Etatech Industries Inc., 0.82 KW (1.1 hp), 1740/870 rpm, 1.2/1.9 amps, 575 volts
	Brake	FMC Stearns, torque 10 ft.lb., 575 volts
	Scraper Motor	Etatech Industries Inc., 2.24 KW (3 hp), 1740 rpm, 3.3 amps, 575 volts
	Brake	FMC Stearns, torque 10 ft.lb., 575 volts
Sludge Pump	Item	Description
PP-1 & PP-4	Location	Primary Clarifier Gallery 4B
	Year of installation	1980
	Pumps	Wemco Torque Flow, size 4, Model C, 22.7 L/sec (360 gpm) at 18.3 m (60 ft), 1120 rpm
	Motor	Hawker Siddeley Electric Motors Inc., 50 hp, 1775 RPM, 575 volt, 45 amp, 60 Hz
	Drive	Canadian Drives Limited, 44 kW (1 HP), torque 143 lb. ft., 1620 RPM
PP-2 & PP-3	Location	Sludge Pump Room, Clarifier Basement
	Year of installation	1980
	Pumps	Wemco Torque Flow, size 4, Model C, 22.7 L/sec (360 gpm) at 18.3 m (60 ft), 1120 rpm
	Motor (PP-2)	Hawker Siddeley Electric Motors Inc., 50 hp, 1775 RPM, 575 volt, 45 amp, 60 Hz
	Motor (PP-3)	Hawker Siddeley Electric Motors Inc., 50 hp, 1775 RPM, 575 volt, 45 amp, 60 Hz
	Drive	Canadian Drives Limited, 44 kW (1 HP), torque 143 lb. ft., 1620 RPM
Scum Pump	Item	Description
1PP-21	Location	Clarifier Basement - Scum Room
	Year of installation	1965
	Pumps	Wemco Torque Flow, size 4 x 3, Model C, 15.8 L/sec, (250 US gpm) at 24.4 m (80 ft), 1455 rpm
	Motor	Etatech Industries Inc., Type N-VOW4, 22.4 kW (30 hp), 575 volts, 31 amps, 1755 rpm

2.1.5 SECONDARY TREATMENT

Secondary treatment involves the mixing of the primary effluent, return activated sludge (RAS) and high purity oxygen (HPO) to biologically remove organic material. The mixed liquor flows into the secondary clarifiers for settling. The location and the layout of the secondary treatment are shown in Figure 2.13.

The HPO reactors consist of three independent reactor trains, each of which includes two separate tanks. Detailed information on the tanks are indicated in Table 2.4. Each tank has four compartments referred to as “stages”. Weir troughs on the effluent side of the tank system maintain a controlled water level in the reactors.

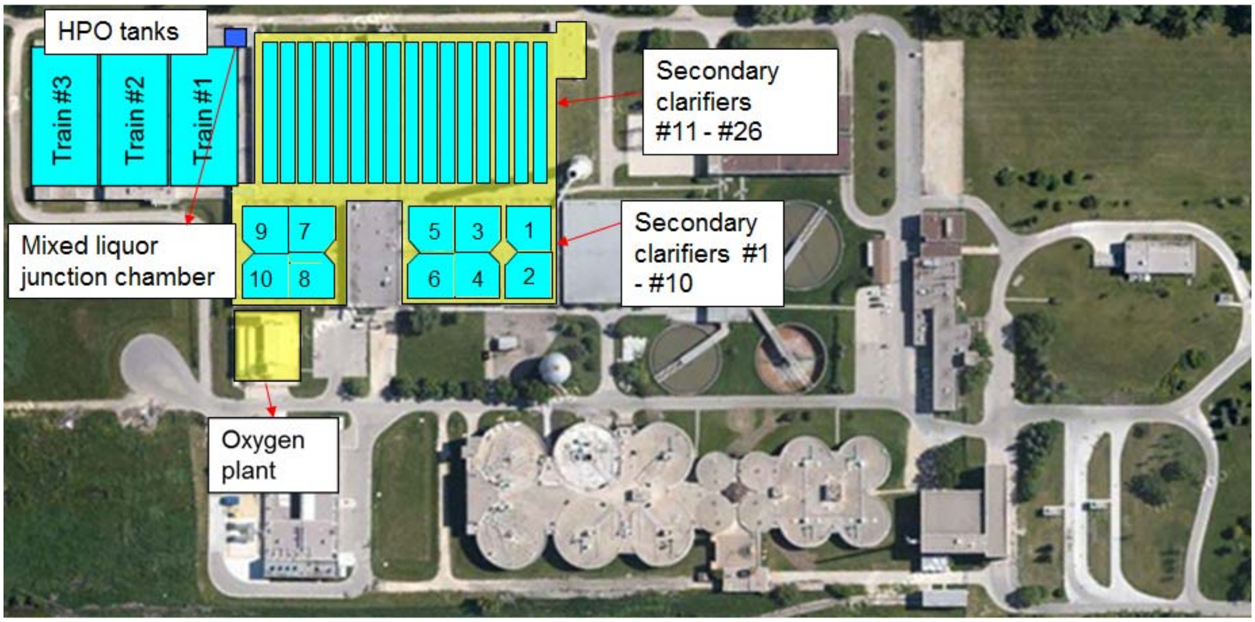

Figure 2.13 NEWPCC Secondary Treatment

The primary effluent from the primary clarifiers flows through a concrete conduit and is diverted through dedicated 1200 mm (48”) diameter pipes to each of the six HPO tanks. The RAS is pumped from the secondary clarifiers, through a piping system, to the reactor tanks. High purity oxygen necessary for microorganism growth and reproduction is supplied to the tanks from an on-site cryogenic plant. The cryogenic plant is owned and operated by an external vendor.

Mixers located on the roof of the reactor tanks; with shaft and paddles extending into the tanks mix the primary effluent, RAS and oxygen. This mixing and splashing permit continuous dispersion of the oxygen in the mixed liquor and maintain the solids in suspension.

Currently, 380 to 400MLD of primary effluent are processed in the HPO reactor and secondary clarifiers.

Mixed liquor is then diverted through the mixed liquor conduit chamber located at the northeast corner of the HPO building into the secondary clarifiers. Under normal operating conditions, diversion of mixed liquor into the secondary clarifiers involves the installation of two sets of stop logs as shown in Figure 2.14. This arrangement enables the mixed liquor from train #1 to flow into secondary clarifiers #1 to #10, and the mixed liquor from train #2 to flow to secondary clarifiers #11 to #18. The mixed liquor from train #3 flows into secondary clarifiers #19 to #26.

The appropriate stop logs must be installed to isolate the HPO reactor trains and their associated mixed liquor conduits or secondary clarifiers and their associated mixed liquor conduits. These isolations are shown in Figures 2.15 and 2.16.

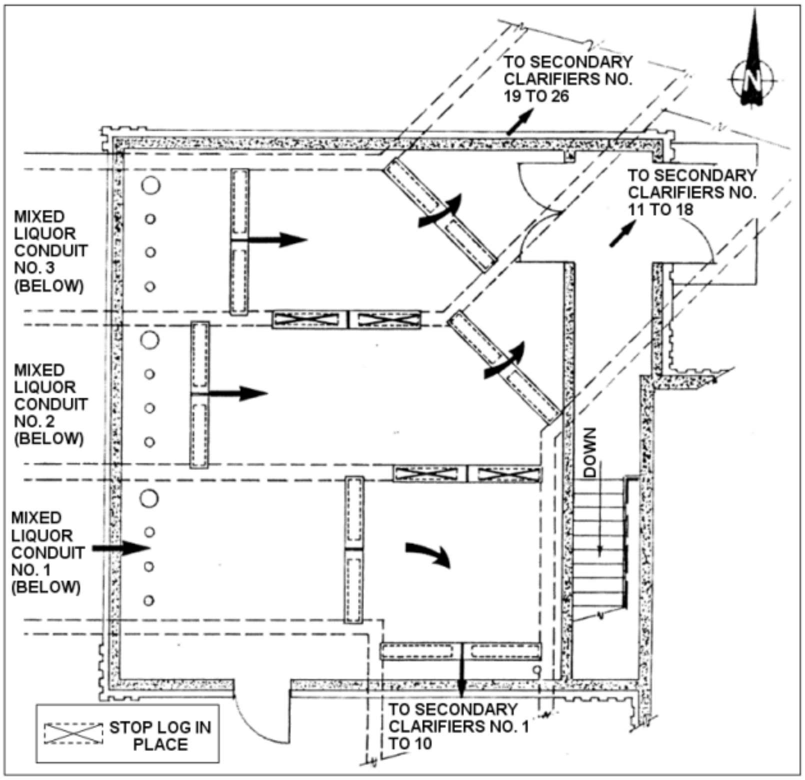

Figure 2.14 Diversion of Mixed Liquor into Conduits

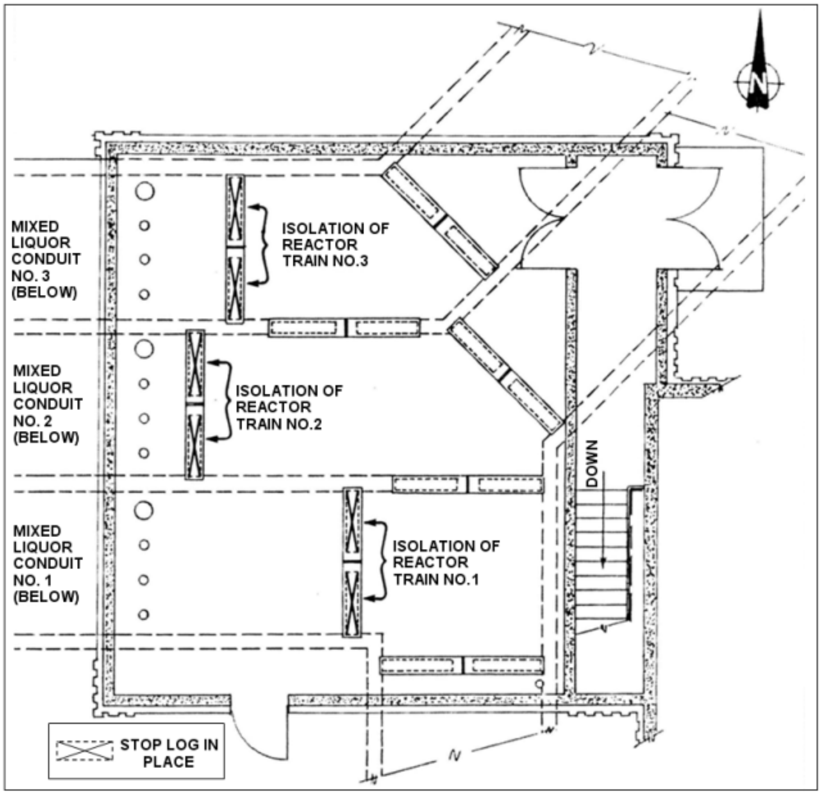

Figure 2.15 Isolation of Reactor Train and Mixed Liquor Conduit

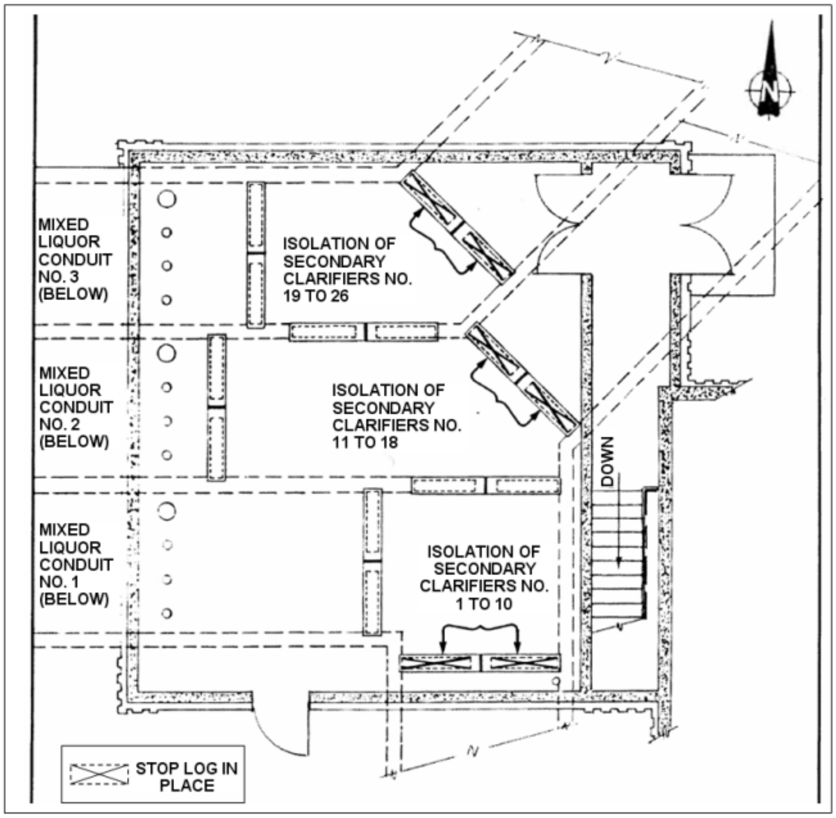

Figure 2.16 Isolation of Secondary Clarifiers

Table 2.4 HPO Tank Details

Item	Detailed item	Description
Dimensions	Tank Area (m)	70 x 17.5
	Stage (m, 4 stages each tank)	17.5 x 17.5
	Liquid depth (m, sidewall depth)	4.5
	Freeboard above liquid (m, air space) [1]	1.43 to 1.70
	Liquid volume per stage (m^3)	1300
	Vapor space volume per stage (m^3)	450
	Weir length/tank (m)	59
Design Criteria	Average annual flow (AAF, MLD)	332
	Peak flow (MLD)	598
	Current capacity (MLD)	380-400
[1] The air space is dependent on the water column pressure, which is normally 3" water column.		

2.1.5.1 Secondary Clarifiers

There are ten square clarifiers (No. 1 to 10) and sixteen rectangular clarifiers (No. 11 to 26) at NEWPCC. Physical dimensions and hydraulic characteristics of the clarifiers are detailed in Table 2.5 and are shown in Figures 2.17, 2.18 and 2.19.

The mixed liquor junction chamber diverts and balances the flow of mixed liquor to the appropriate group of secondary clarifiers as initially shown in Figures 2.14 to 2.16 and Figure 2.17. The secondary clarifiers separate the solids from the mixed liquor to produce a clarified final effluent. Sludge and scum are mechanically removed from the clarifiers. Most of the sludge is pumped back to the HPO reactors as RAS and excess sludge is pumped to the outlet of the grit building and co-thickened with raw sludge in the primaries. This is ultimately pumped to the digesters as waste activated sludge (WAS). The scum is pumped to the end of the grit building where it is mixed with WAS.

Tanks

In secondary clarifiers No. 1 to 10, mixed liquor flow is controlled by 914 mm manually operated sluice gates. Once the sluice gate is opened, mixed liquor drops down a shaft, flows through a 686mm by 686mm concrete conduit under the tank and up the influent pipe into the influent well. Sludge is scraped to a central hopper and pumped through a 300 mm diameter pipe. Scum is collected over the water surface, dewatered over a beach plate, and dumped into a hopper draining to a scum tank. Effluent flows over fiberglass V-notch weirs into a concrete trough that drains into the effluent conduit.

A 600 mm diameter knife gate valve controls the mixed liquor flow into secondary clarifiers No. 11 to 26. Once the knife gate is opened the mixed liquor flows through a 600 mm diameter pipe to a four-port distribution header. Sludge is siphoned into a RAS channel located on the side of each clarifier. Scum and effluent flow is similar to secondary clarifier # 1 to #10

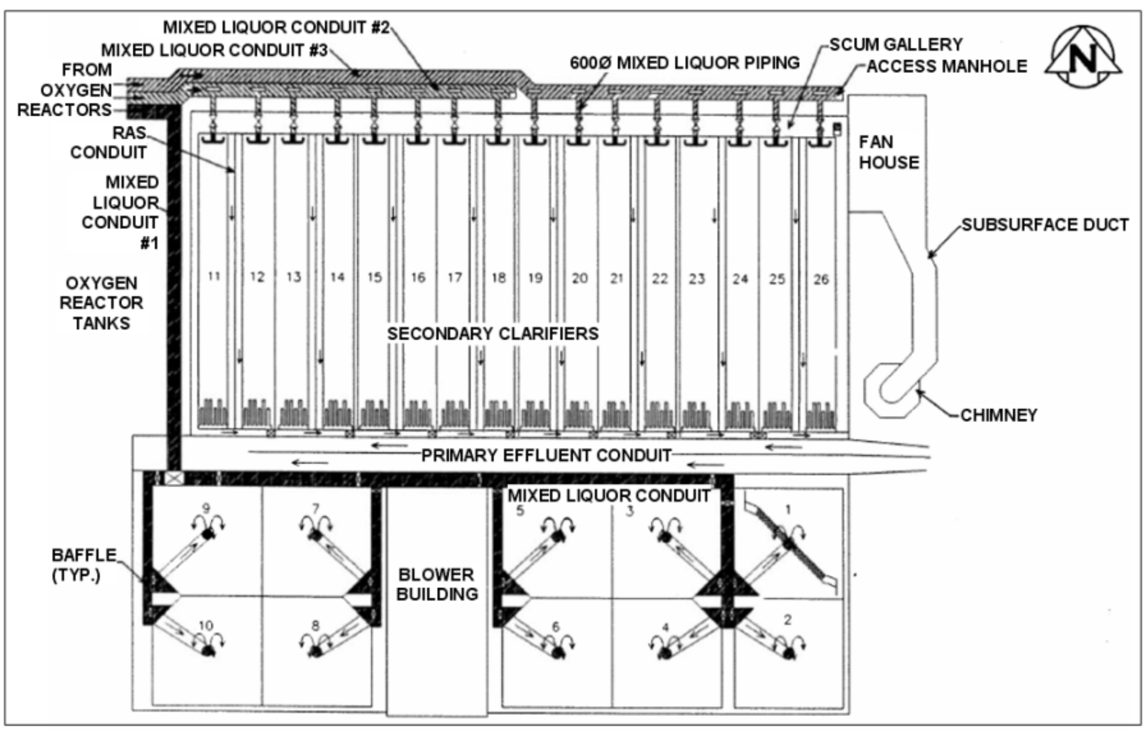

Figure 2.17 Flow of Mixed Liquor into the Secondary Clarifiers

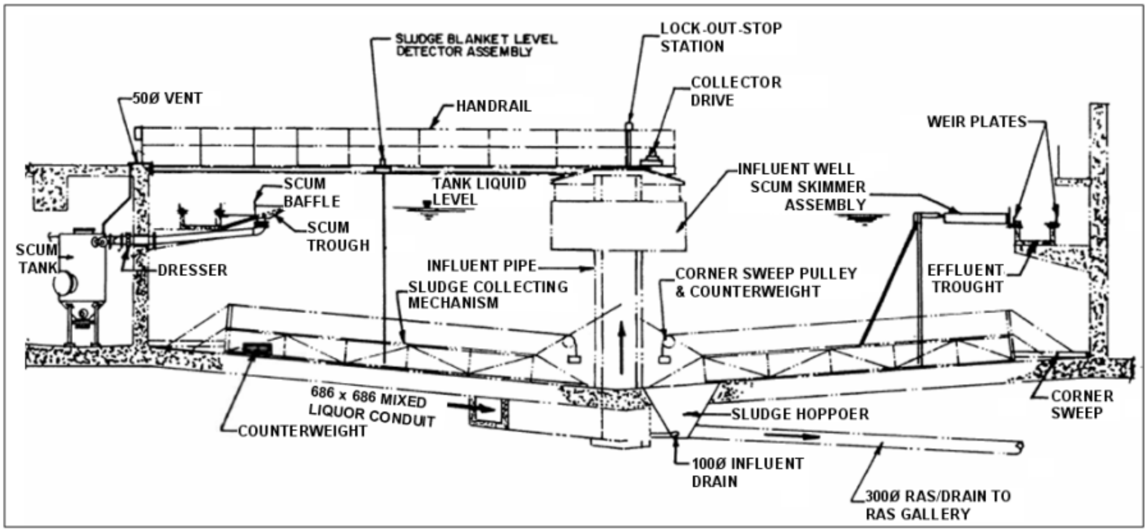

Figure 2.18 Section of Secondary Clarifiers 1 to 10

Return Activated Sludge System

The return activated sludge is withdrawn from the hoppers of the circular clarifiers through from the RAS channels by 26 RAS pumps (each dedicated to a secondary clarifier) equipped with variable speed drives. Pumping rates from the clarifiers vary with the primary effluent flows. The 16 rectangular clarifiers have 8 travelling bridge type collectors, each spanning two clarifiers. The bridge provides three siphoning points within each clarifier and travels the length of the clarifier, continuously directing sludge to these points. Sludge is conveyed up the three sludge risers and is discharged into a RAS conduit.

Detailed information on the RAS equipment is indicated in Tables 2.6 and 2.7

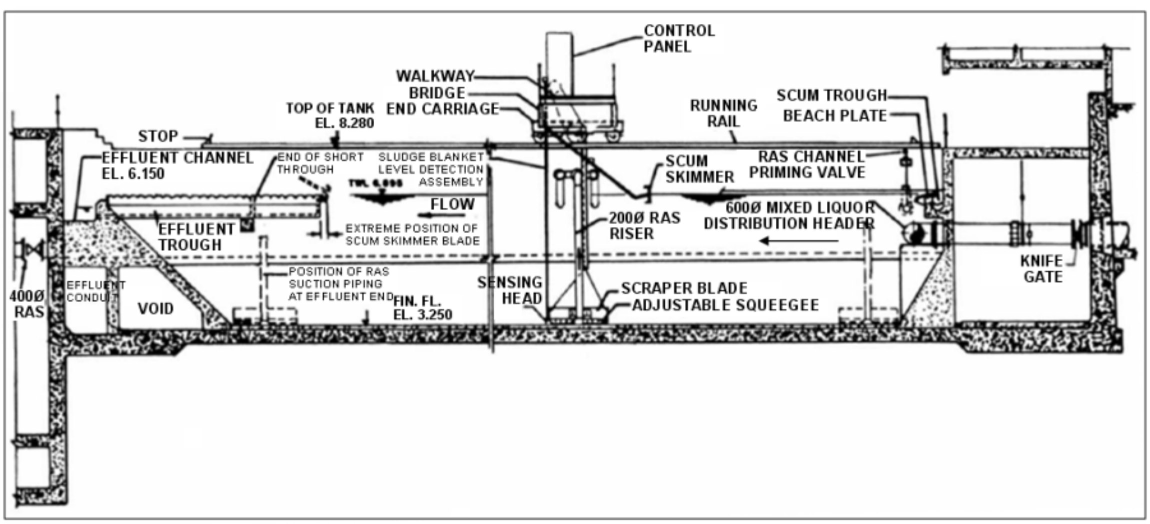

Figure 2.19 Section of Secondary Clarifiers 11 to 26

Waste Activated Sludge System

The WAS system consists of four pumps, 3 duty and 1 standby. The three operating pumps withdraw excess sludge from RAS Header No. 1, 2 and 3 to the outlet of the grit building which eventually flows to the primary clarifiers. The WAS draw off point is downstream of the last RAS pump discharge connection to the RAS header. The pumps operate on a variable speed drive.

Scum System

The scum is collected in nine separate scum tanks and pumped to the rear of the grit building as shown in Figure 2.20. However the scum is pumped to the grit building effluent conduit when primary clarifiers 4 and 5 are out of service in winter. Details of the WAS and scum pumps are provided in Table 2.8

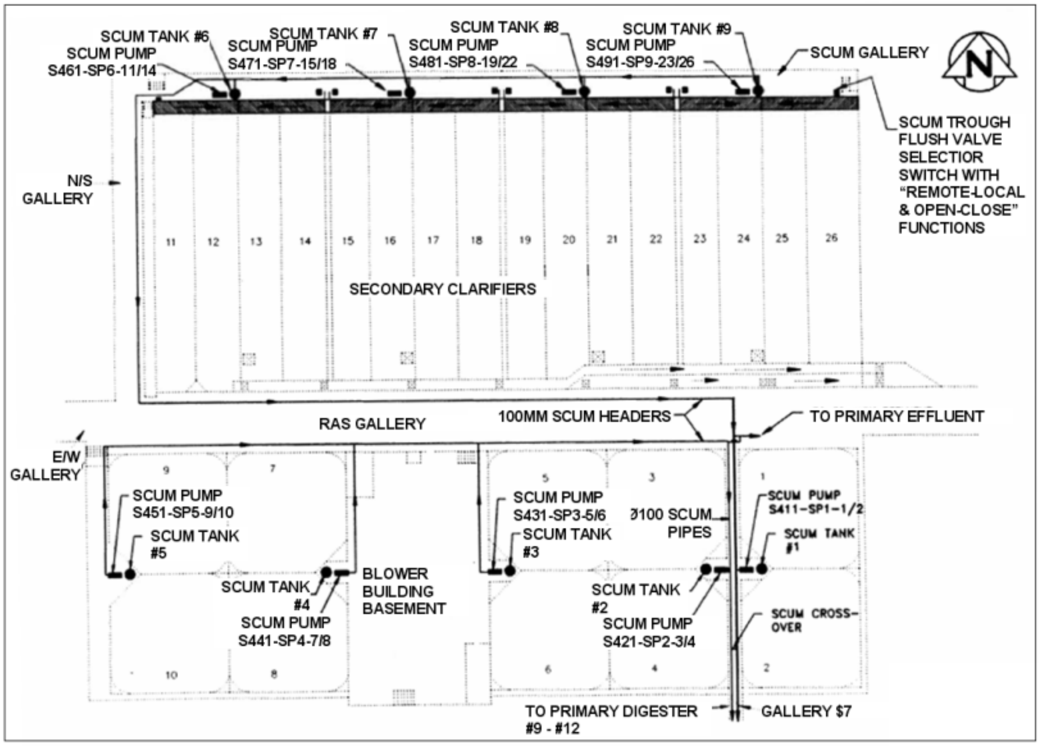

Figure 2.20 Scum System Location Plan

Secondary Effluent

Treated effluent from the secondary clarifiers is conveyed through four (4) effluent conduits to the UV disinfection system. Secondary effluent from all twenty-six clarifiers flows over V-notch weirs into concrete effluent troughs as shown on Figure 2.21.

For Clarifiers 1 to 10, one continuous effluent trough is located within the tank and offset from the perimeter walls. The trough discharges into a drop shaft, which connects into the effluent conduit. Clarifiers 1 to 8 share the same effluent conduit and clarifiers 9 and 10 share another one. Regarding clarifiers 11 to 26, eight finger-type troughs extend into the clarifier and drain into an effluent channel, which services two clarifiers. This channel discharges into a drop shaft that connects to the effluent conduit. Clarifiers 11 to 18 share the same effluent conduit and clarifiers 19 to 26 share another one.

The four conduits discharge into two separate conduits in the effluent gate chamber at the east side of the secondary clarifier building. There is a possibility of isolating effluent conduits for secondary clarifiers 11 to 26 with the aid of sluice gates. However, this process has never been performed. The secondary effluent flows through the two conduits up to the junction chamber, where the flow can be split between the North and the South conduits. On normal operating conditions the secondary effluent flows through the North conduit into the UV facility while the sluice gate to the south conduit remains closed. During wet weather periods, excess flow is partially bypassed through openings along the common wall between the conduits into the south conduit. The bypass could also deliberately occur through the opening of sluice gate YG -12B into the south conduit (See Figure 2.23). The effluent in the south conduit bypasses the UV facility and flows directly to the outfall. It is theoretically possible to divert flow between the north and south conduits using sluice gates YG-15A & 15B. However, this has never been performed.

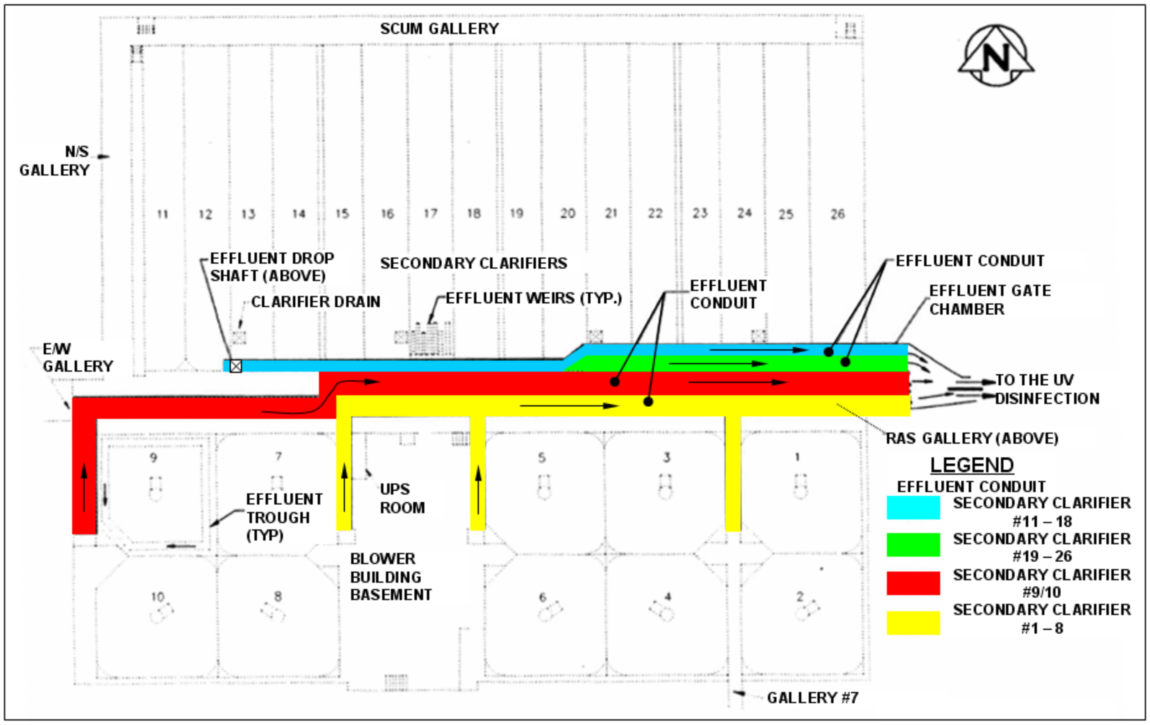

Figure 2.21 Secondary Effluent Conduit Flow Pattern

Table 2.5 Secondary Clarifiers Details

	Clarifier No. 1 to 10	Clarifier No. 11 to 26
Length (m)	24.4	70.492
Width (m)	24.384	9.1
Depth of Liquid (m)	3.688 to 4.651	3.645
Volume (m^3) / each clarifier	2380	2342
Weir Elevation (m)	6.879	6.895
Weir Length / Tank (m)	163	93
Flow / Tank (MLD) on 332 MLD	11.1	13.8
Nominal Retention Time (HR) on 332 MLD	5.1	4.0
Flow / Tank (MLD) on 400 MLD	20	24.8
Retention Time (HR) on 400 MLD	2.2	1.9

Table 2.6 RAS Flow Split

Clarifier	Header	Oxygen Reactor	WAS Pumps
1 to 10	1	1A and 1B	1 and 4
11 to 18	2	2A and 2B	2 and 4
19 to 26	3	3A and 3B	1 and 3

Table 2.7 RAS Equipment Details

Clarifier 1 to 10 Sludge Collectors	Manufacturer	Rex Chain Belt
	Year of Installation	Need to be verified
	Number of Units	10
	Capacity	360 degree travel in 25 minutes
	Motor	Westinghouse Model, 600 rpm, 550 Volt, FLA 2.1, 0.56 kW
Clarifier 11 to 26 Traveling Bridges	Manufacturer	FMC
	Year of Installation	1988
	Number of Units	8
	Drive Unit	Eurodrive No. 80-12.50022.5/2
	Vacuum Pump(s)	Busch– R5 single stage rotary Type 010
	Motor Size	0.56 kW, 1710 RPM
RAS pumps	Manufacturer	Worthington
	Year of Installation	1988
	Number of units	26
	Type	12MN14
	RPM	1175
	Motor	Reliance, 1175 rpm, 36.7 amps, 3 phase, 60 cycle, 575 volts, 29.84 HP

Table 2.8 WAS and Scum Pumps Details

Was Pumps	
Manufacturer	Worthington
Year of installation	4
Number of Units	1988
Model	6MF15
Capacity	61.18 L/s @ 10 meter of TDH
Motor	Reliance, Type P, 575 V, 16.0 amps, 60 HZ, 3 phase, 880 rpm
Scum Pumps	
Manufacturer	Hayward Gordon
Year of installation	1988
Model	XR2-12
Capacity	6.41 l/s @ 32.98 meters, 100 US GPM, 1800 rpm
Motor (scum pump 4)	Brook Crompton Parkinson, 18.65 kW, 575 V, 24 amp, 60 HZ, 3 PH, 1750 RPM, 25 HP
Motor (scum pumps 1,2,3,5,6,7,8, and 9)	Hawker Siddelay, 575 V, 24 amp, 60 HZ, 3 PH, 1750 rpm, 25 HP

2.1.6 JUNCTION CHAMBER

The Junction Chamber enables the diversion of pretreated, primary or secondary effluents to different processes (primary clarifiers, secondary treatment, UV) in the plant or directly to the outfall. It is located at the south-west corner of the pre-aeration and grit removal building (See Figure 2.9). Under normal operation conditions, the junction chamber directs the flow from the grit building to the primary clarifiers. The primary effluent then flows into the high purity oxygen (HPO) tanks which in turn flow into the secondary clarifier. Finally, the secondary effluent flows into the UV pumping station (through gate YG 12A).

This chamber consists of a series of conduits (See Figure 2.22 to Figure 2.23) through which the flow can be directed by operating sluice gates, and placing or removing stop logs.

The only sluice gate that can be automatically controlled is the gate YG 12B. Flow through this gate can direct some of the secondary effluent to the outfall, bypassing the UV disinfection. All the other gates and stop logs can only be adjusted manually. Details of the sluice gates are shown in Table 2.9.

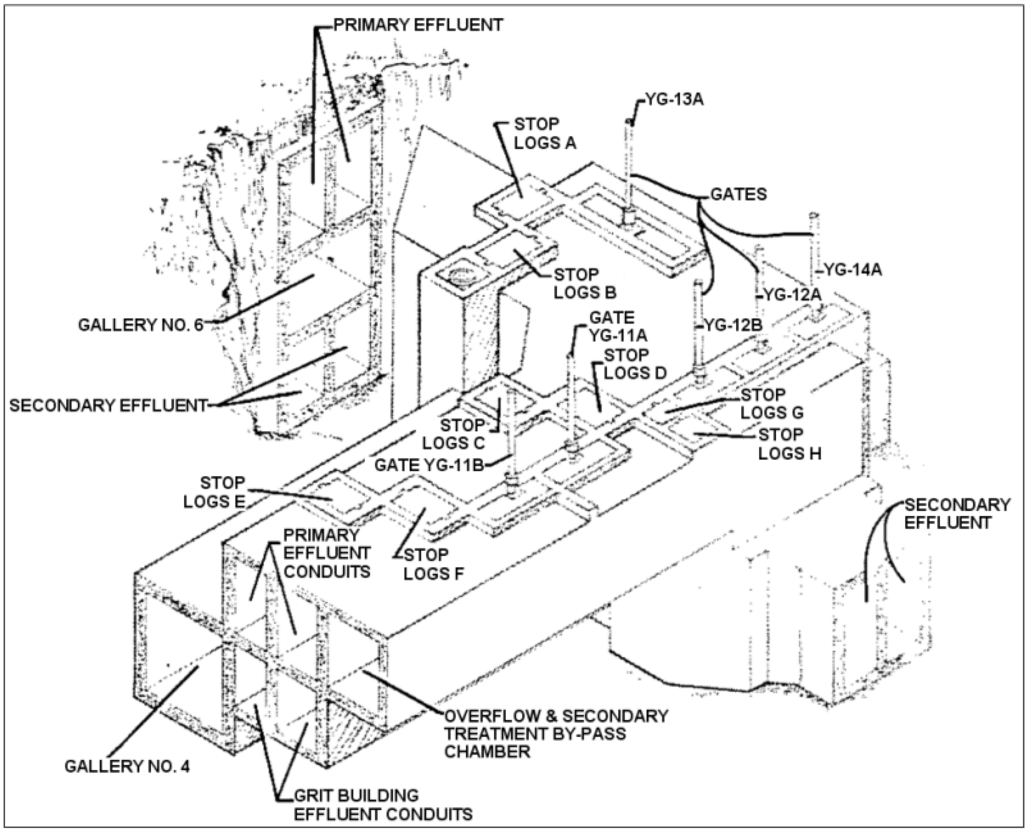

Figure 2.22 Isometric View of the Junction Chamber

Table 2.9 Junction Chamber Sluice Gates

Sluice Gate	Dimension	Manual/Motorized
YG-11A	2.13 x 0.914 m	Manual
YG-11B	2.13 x 0.914 m	Manual
YG-12A	1.22 x 2.13 m	Manual
YG-12B	1.22 x 2.13 m	Motorized
YG-13A	2.44 x 1.22 m	Manual
YG-14A	0.914 x 1.37 m	Manual
The Sluice gates were installed from 1963-1965		

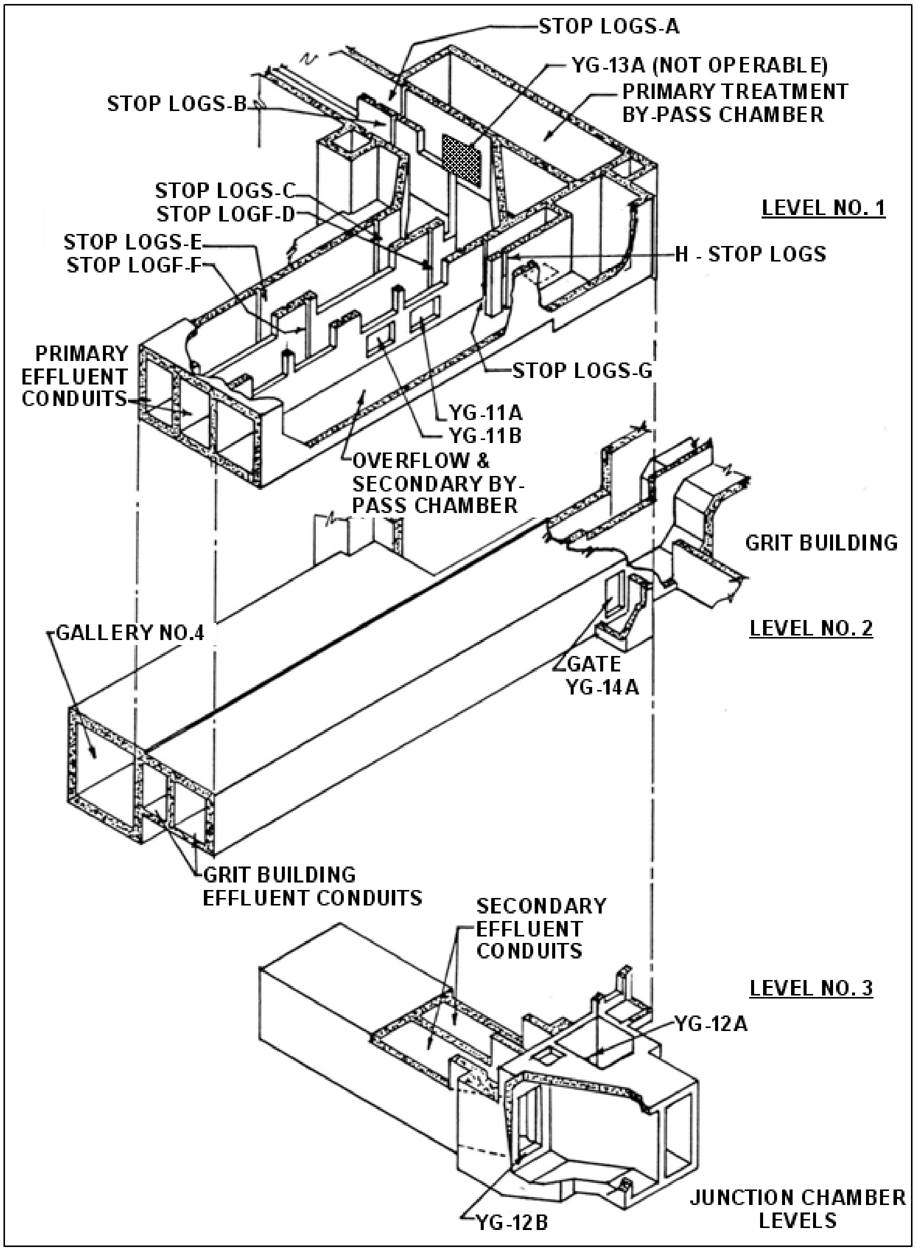

Figure 2.23 Junction Chamber Levels

2.1.6.1 Junction Chamber Operation

The junction chamber can direct flow in various ways as shown in Table 2.10.

Table 2.10 Junction Chamber Operation

#	Purpose/Condition	Possible to operate	Flow path
1	Dry weather normal operation	Yes	GB → JC → PC → JC → HPO (all flow)
2	Wet weather normal operation	Yes	GB → JC → PC → JC → HPO (Some flow) GB → JC → PC → JC → Outfall (Remaining flow)
3	Bypass secondary treatment	Yes	GB → JC → PC → JC → Outfall (all flow)
4	Bypass primary treatment	No	GB → JC → HPO (all flow)
5	Bypass both primary and secondary treatment	No	GB → JC → Outfall (all flow)

Junction chamber operation #1

During normal operating conditions, sewage flows from the pre-aeration and grit building to the primary clarifiers and then to the secondary treatment area. The stop logs and gate control are as follows and as shown in Figure 2.24:

- Remove stop logs A to H.

- Open gates YG-12A.

- Close gates YG-11A, YG-11B, YG-12B, YG-13A, and YG-14A.

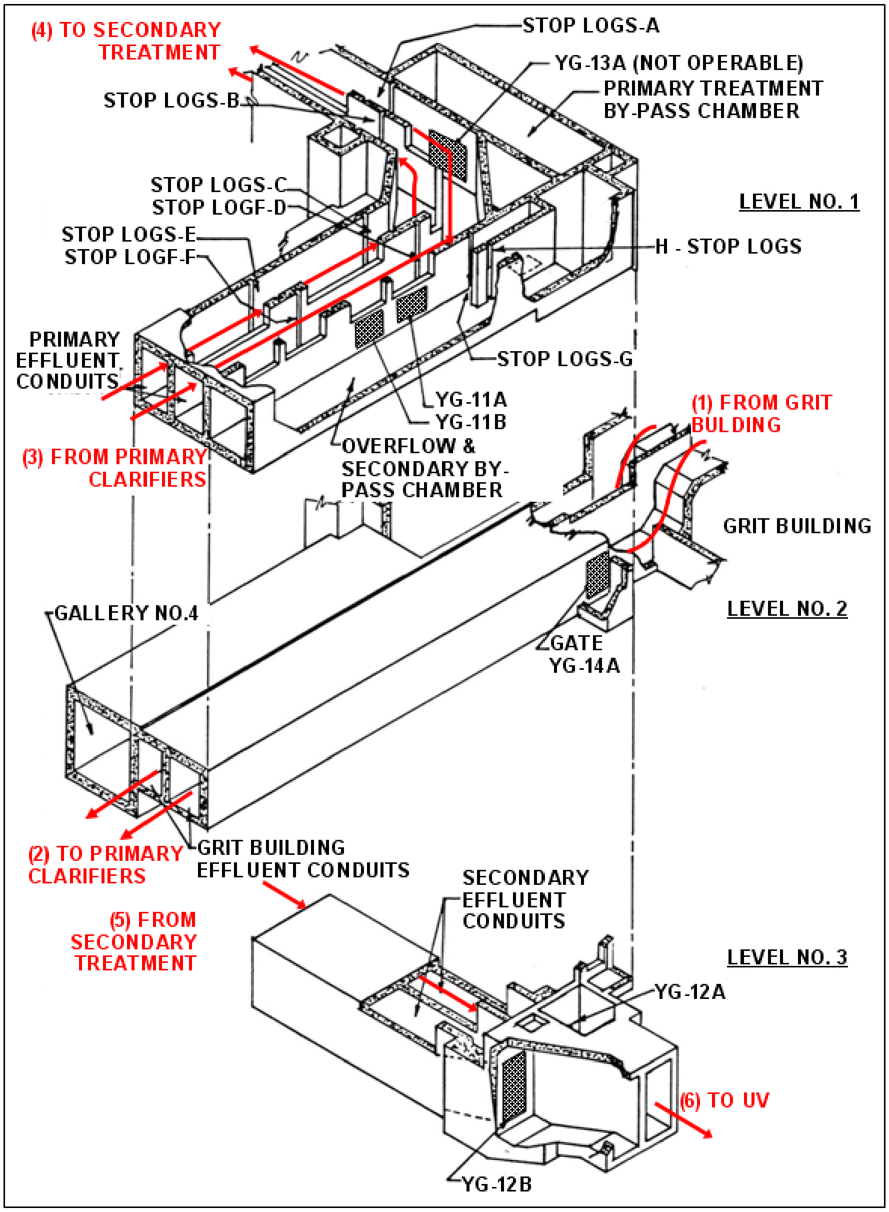

Figure 2.24 Junction Chamber Operation No.1

Junction chamber operation No. 2

This operation bypasses a portion of the primary effluent and discharges it directly into the secondary effluent conduits. Bypassed flow will not receive secondary treatment.

The stop logs and gate control are as follows and as shown in Figure 2.25

- Remove stop logs A to F.

- Open gates YG-12A and YG-12B.

- Close gates YG-11A, YG-11B, YG-12B, YG-13A, and YG-14A

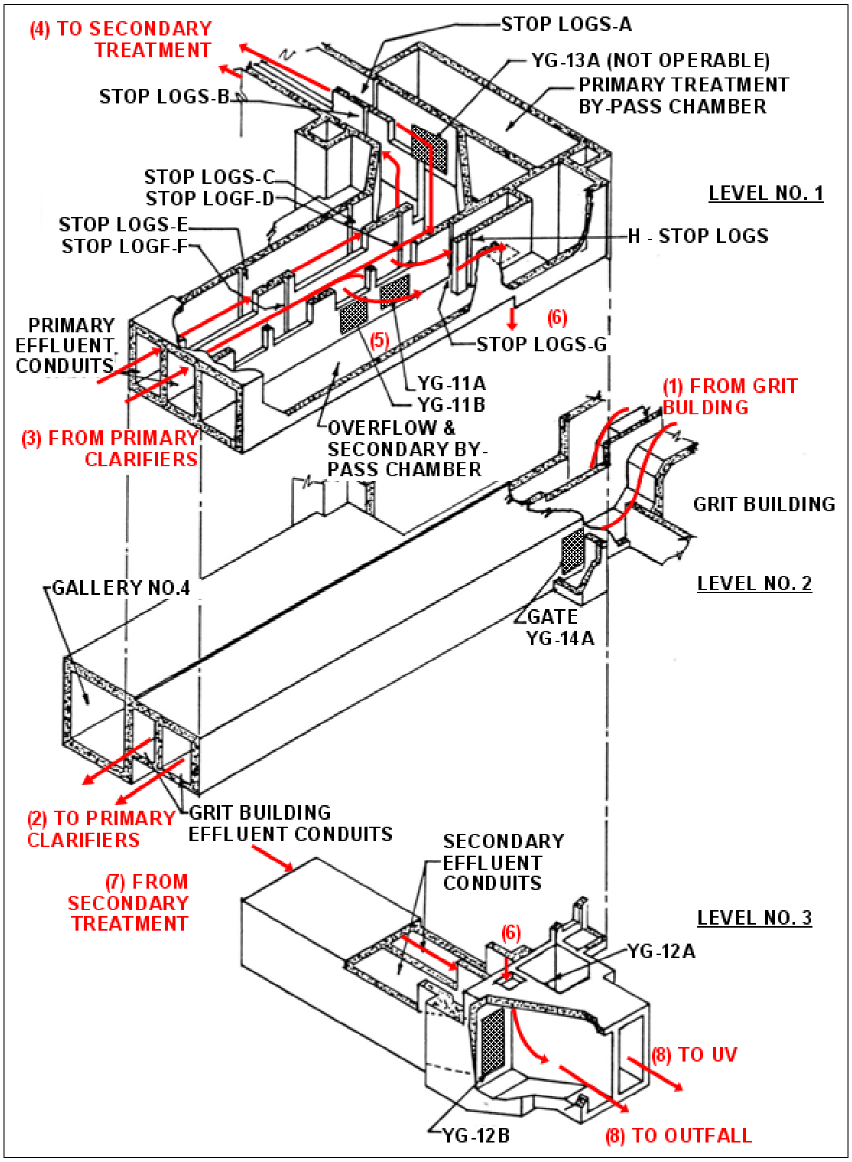

Figure 2.25 Junction Chamber Operation No.2

Junction chamber operation No. 3

This operation bypasses the secondary treatment completely and all flow goes directly from the primary clarifiers to the final effluent conduits. This option can be used to isolate the secondary treatment.

Stop logs and gate control are as follows and as shown in Figures 2.26 & 2.27

- Open gates YG-11A and YG–11B
- Remove stop logs A, B, C, D, E, F, G, and H.
- Close gates YG-13A and YG-14A.
- Install stop logs I and J.

- Close sluice gates YG-12A and YG-12B if isolating secondary treatment area.

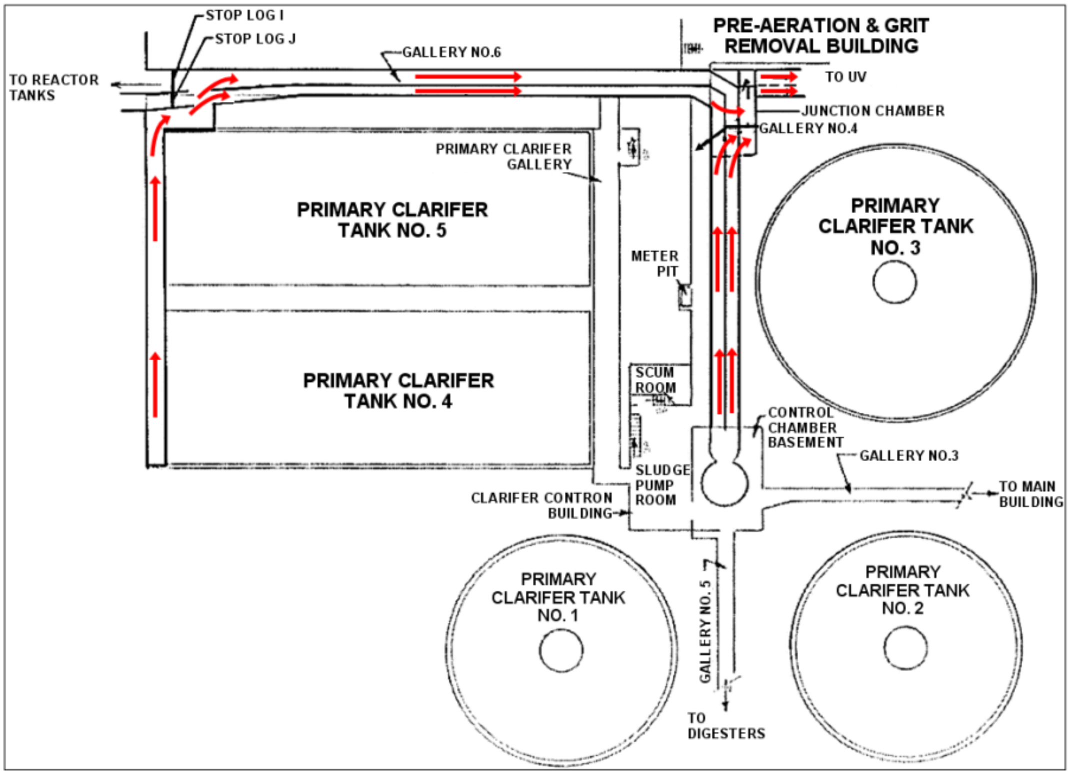

Figure 2.26 Junction Chamber Operation #3 (plan view)

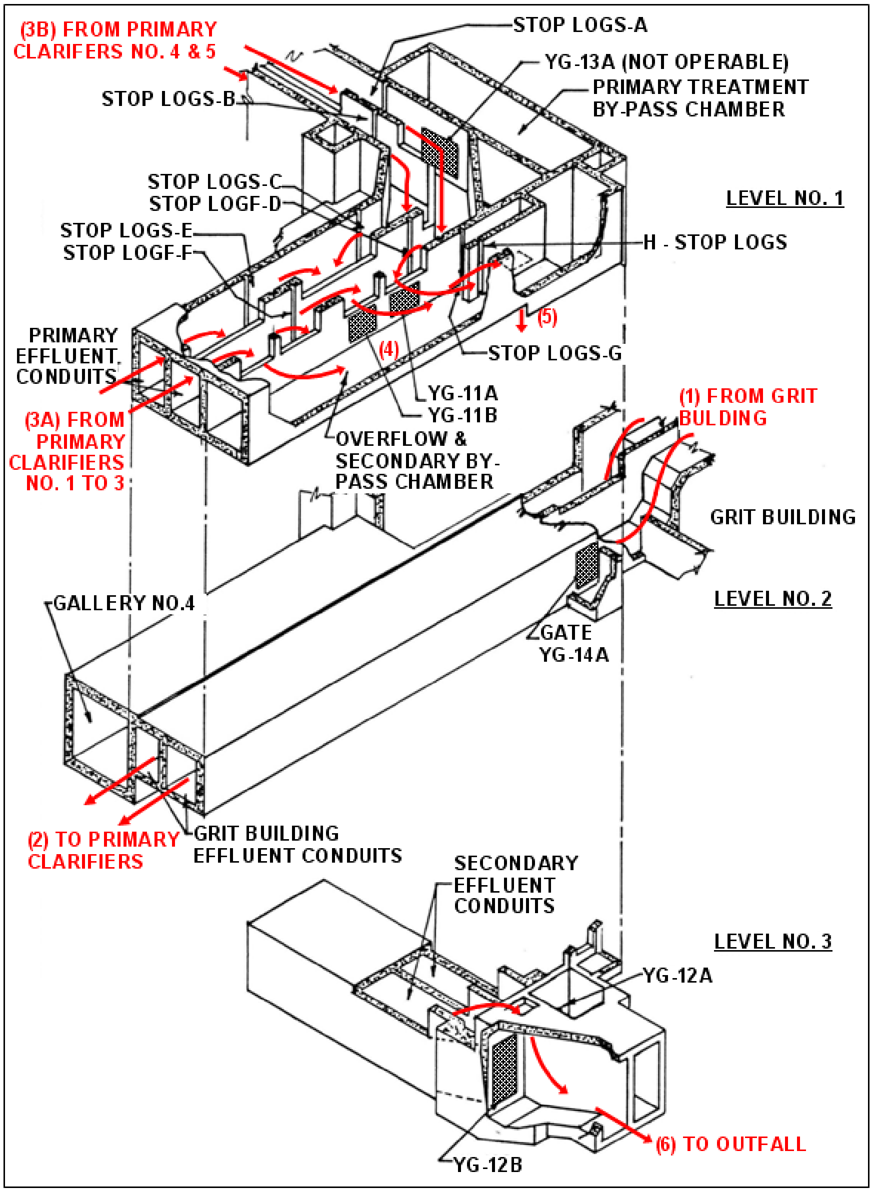

Figure 2.27 Junction Chamber Operation #3 (sectional view)

Junction chamber operation No. 4

This junction chamber operation by-passes the primary treatment enabling the sewage to flow directly from the grit building to the secondary treatment area. Currently this procedure cannot be carried out as the sluice gate YG-13A is inoperable.

It should be noted that hydraulically this operation would handle only part of the total design flows.

Junction chamber operation No. 5

This operation bypasses all treatment after the grit building. However, this operation cannot be carried out as the sluice gate on the YG-13A is inoperable.

It should be noted that hydraulically this operation would also handle only part of the total design flows.

2.1.7 ULTRAVIOLET DISINFECTION FACILITY

Only the secondary effluent is treated at the ultraviolet disinfection facility (UV facility). The UV facility is designed to disinfect a maximum flow of 380 MLD. However, the facility is designed to hydraulically pass 600MLD. The location of the UV disinfection facility is shown in Figure 2.28.

Figure 2.28 UV Disinfection Facility

Secondary effluent flows from the secondary clarifiers through a pair of rectangular conduits. Up to 400 MLD of the flow is diverted to the North conduit at the junction structure. The secondary effluent flows in the north conduit for approximately 150 m to the existing effluent gate chamber (EGC) before it is discharged into the wet well in the UV facility. The wet well houses five submersible axial flow propeller pumps installed in vertical draft tubes. Details of the UV disinfection system are indicated in Table 2.11.

Table 2.11 Specifications of the UV Disinfection System

Description	Units	Design Value
UV influent pumps		
# of Duty pumps		5
# of Standby pumps		1 (on shelf)
Maximum capacity (each)	L/s	995
Minimum capacity (each)	L/s	486
Discharge tube diameter	mm	1,000 maximum
TDH	m	6-0 - 6.5
Power, (each)	kW	127 maximum
Firm capacity total	MLD	410 – 430 (approx)
Minimum Submergence	m	1.800
Wetwell (secondary effluent) floor invert	m	223.42
Pump Intake Pipe Centre Line	m	224.32
Minimum water level at pump intake	m	226.12
Bypass weir elevation	m	227.12
Maximum water level	m	226.62
High High alarm level (bypass occurring)	m	227.12

Description	Units	Design Value
High alarm (bypass imminent)	m	226.82
Minimum water level (pump stop)	m	225.82
UV disinfection system		
Disinfection Capacity	MLD	380
Pumping Capacity	MLD	430
Hydraulic Capacity	MLD	600
UVT Transmittance	%	30
Design TSS (mg/L)	mg/L	30
E.coli	MPN/100 mL	200
Design UV Dose	mWs/cm^2	35
Number of Channels		3
Number of Banks per Channel		2
Number of UV Modules per Bank		7
Number of UV Lamps per Module		24
Total Number of UV Lamps		1,008
Minimum Rated Life of UV Lamps		5,000
Power per Lamp at Peak Power Setting	kW	3.2

Under normal operating conditions, the secondary effluent is pumped from the wet well into a common channel that feeds the disinfection facility. The flow is split into the three disinfection channels with the aid of fixed level weirs. A radar level sensor upstream of the weirs measures the flow by converting the observed depth to flow. This flow signal is used to adjust the UV dose.

The design of the UV disinfection system, including the channels and hydraulics, is based on the Trojan UV4000Plus medium-pressure, high-intensity lamp system. The UV disinfection system configuration utilizes lamps that are submerged, protected in quartz sleeves, and oriented horizontal and parallel to flow. The lamps are assembled in modules that are grouped in lamp banks. There are six banks with two in each channel. The lamps are located inside an enclosed reactor, with banks installed in series. The controls for the system modulate lamp output in response to the treated flow and the measured UV transmissivity of the effluent.

UV Bypass

.At flows up to about 250 ML/d and river level below 5.0 m, the overflow weir (UV bypass) should operate under a freefall condition, with the upstream water level at approximately 227.27 m (or 5.45 m above base level). If flows exceed 250 ML/d, the overflow weir will submerge and the upstream channel and SE Conduit water levels will increase. The north conduit should still be able to convey the flow up to about 275 ML/d. If flows exceed 275 ML/d, the capacity of the North conduit will begin to be taxed, and the water level at the secondary clarifier outlets will begin to submerge. With the secondary clarifier having a potential to overflow into the RAS channel.

If all the pumps in the UV wet well shut down, the water level at the wet well will rise and spill over the UV bypass weir located beside UV pumps. The bypass channel will fill until its water level exerts enough force to open the flap gate against the head exerted by water on the downstream side

2.1.8 THE OUTFALL

The Outfall is approximately 660m in length and was constructed in the 1930's with modifications carried out in 2006 at the effluent gate chamber due to construction of the UV disinfection facility. It conveys fully treated or partially treated wastewater from the effluent gate chamber to the Red River. It also conveys untreated and bypassed sewage from the discharge chamber to the Red River.

The outfall is composed of five sections, Legs AA to D as indicated in Figure 2.29.

LEG AA: This leg is a 2285 mm diameter concrete pipe, with no slope, connecting the secondary effluent conduit to the outfall. This section leads from the effluent gate chamber, and is about 9 m in length.

LEG A: This is a 2285 mm diameter concrete pipe laid at a slope of 0.107 percent. The length is approximately

380 m.

LEG B: A: This is also a 2285 mm diameter concrete pipe but laid at a slope of 0.961 percent. The length is approximately 380m.

LEG C: This leg is a 1980mm diameter concrete pipe laid at a slope 1.124 percent. The length is approximately 150m, discharging into the diffuser (Leg D).

LEG D: This is the diffuser through which the effluent discharges into the Red River. It consists of a rectangular concrete conduit, laid at a slope of 15.44 percent. The cross section of the conduit varies; the discharge is 1220 mm high by 3350 mm wide, while the upstream is 1714 mm high by 1968 mm wide. The length of this leg is approximately 20m.

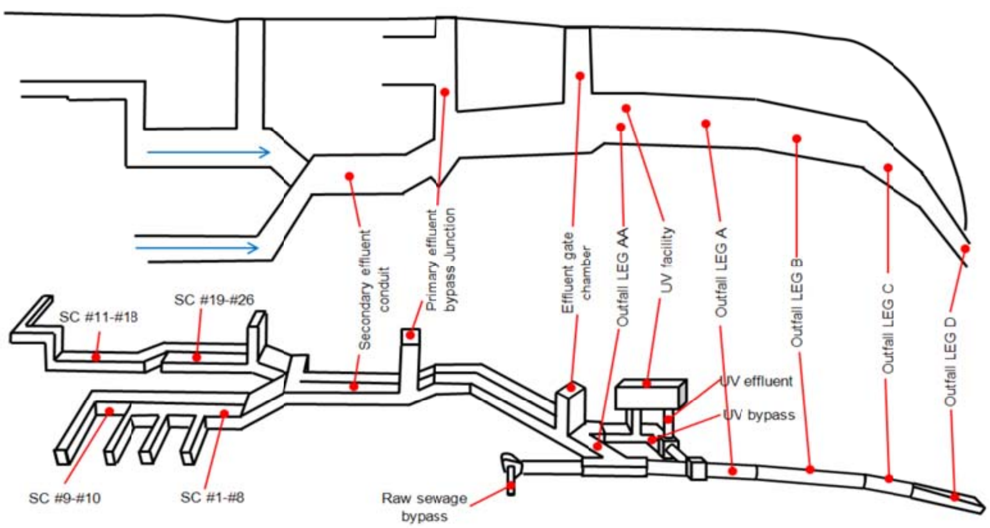

Figure 2.29 Secondary Effluent Conduit and Outfall

2.2 SLUDGE PROCESS TRAIN

The existing sludge handling train consists of anaerobic digestion system (digesters, holding tanks, pumps and accessories), centrate facility, dewatering facility, boiler room and chemical storage building as shown in Figure 2.30

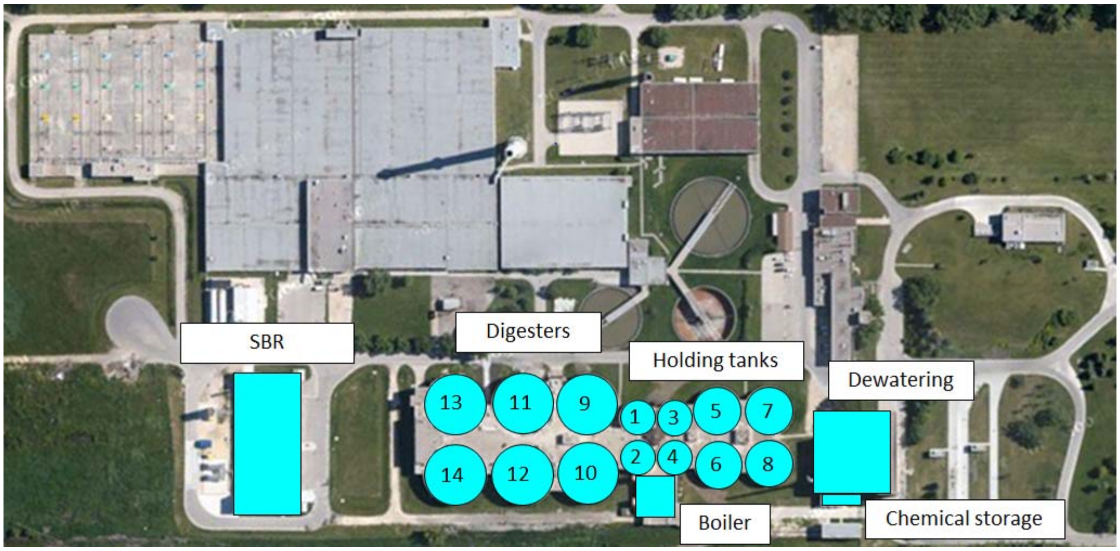

Figure 2.30 Sludge Process Train

2.2.1 ANAEROBIC DIGESTION SYSTEM

There are eight holding tanks and six digester tanks at the NEWPCC. Scum, WAS from the secondary clarifiers, and sludge from the primary clarifiers, South End Water Pollution Control Center (SEWPCC) and West End Pollution Control Center (WEWPCC) are treated in the primary digester tanks 9 to 14, and then stored in holding tanks 5 to 8.

Sludge from the primary clarifiers is pumped through 150mm or 200mm pipes within the galleries as shown in Figure 2.31. While sludge trucked from SEWPCC and WEWPCC is unloaded by two pumps into the primary clarifier headers and combined with the primary clarifier sludge flowing into the digesters (Figure 2.32).

Holding tank 1 is used for emergency overflow while holding tanks 2 to 4 are out of service. Holding tank 2 is equipped with piping system ready to receive leachate. Dimension of these tanks are included in Table 2.12.

Sludge is fed into the digester using a batch feed sequencing system which equalizes the flow of sludge to each digester. Sludge recirculation pumps and heat exchangers maintain the process at the designed temperature of about 38ºC.

Recirculating compressors and gas mixers are used to mix the digester contents to improve the process efficiency.

Under normal operating conditions, sludge is fed by gravity into the four sludge holding tanks 5, 6, 7, and 8. There are backup transfer pumps which can be used for emergency purposes. Two digested sludge pumps transfer sludge from the holding tanks to the dewatering building for dewatering and disposal.

The digestion process produces a flammable mixture of methane and carbon dioxide gases. These gases are collected by the low pressure digester gas piping systems and transferred to the boiler room. The low pressure digester gas piping system also uses compressed gas from the digester tanks to facilitate the recirculation and mixing of the digester tanks. Digester gas recirculating compressors provide the required gas compression. Waste gas burners are installed to safely burn off any excess gas produced. Further protection is provided by the gas systems safety devices.

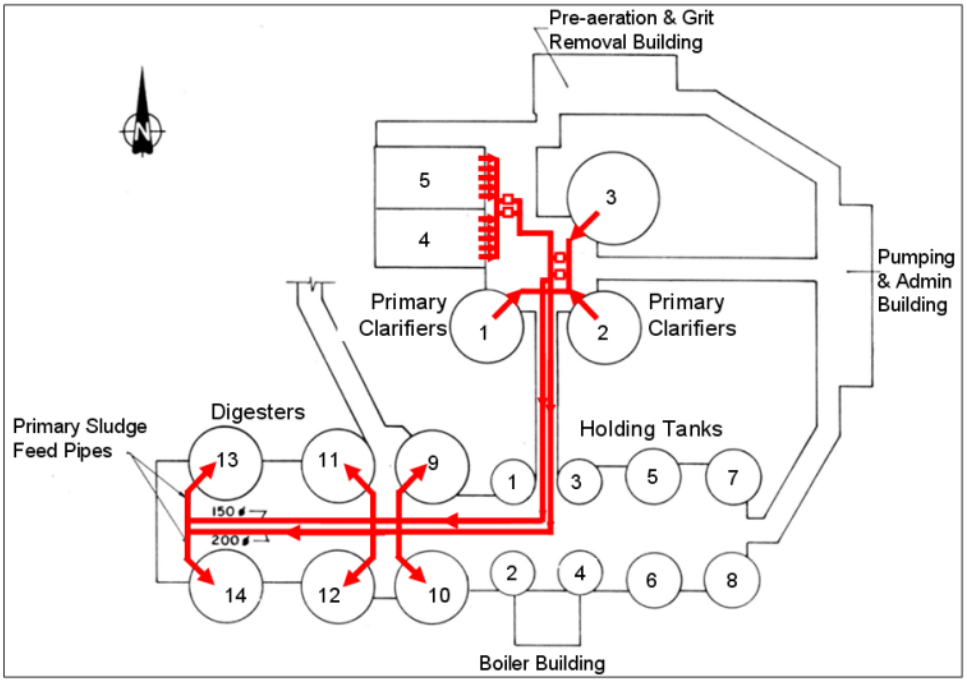

Figure 2.31 NEWPCC Sludge Feed System

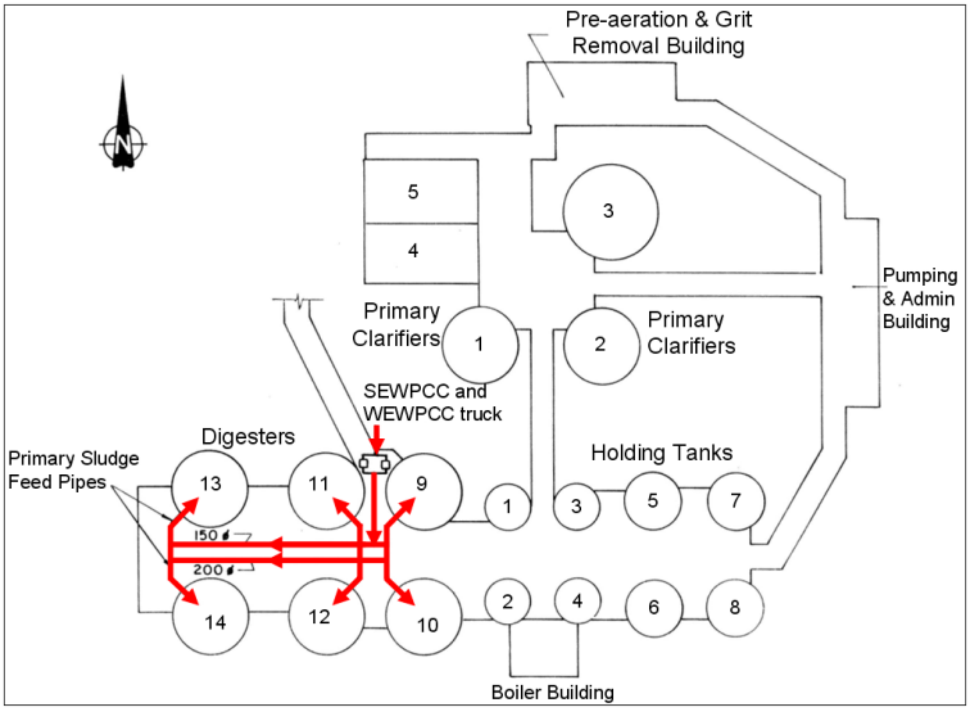

Figure 2.32 SEWPCC and WEWPCC Sludge Feed System

Table 2.12 Dimensions of Sludge Tanks

	Diameter (m)	Liquid Volume (m^3)	Bottom
Holding Tanks 5, 6, 7, and 8	26	3,850	Conical
Digesters 9, 10, 11, and 12	33.5	7,200	Flat
Digesters 13, 14	33.5	8,000	Conical
Emergency Overflow Holding Tank 1	18	1,900	Conical
Holding Tanks 2, 3, and 4 (NOT IN SERVICE)	18	1,900	Conical

The high pressure digester gas piping system transfers compressed gas from the digester area's low pressure digester gas piping system to the gas storage sphere and/or the boiler room. Digester gas booster compressors provide the required gas compression.

The holding tank gas system is designed to handle and burn off any gas produced by the sludge in the holding tanks. It is connected to the low pressure digester gas piping system.

2.2.2 BOILER ROOM

The boiler room houses the central heating plant for the NEWPCC and it is located south of digester pipe gallery number 3. The purpose of the heating plant is to provide primary heat production and distribution for the entire NEWPCC. It also includes the auxiliary mechanical and electrical systems that service the plant and the building in which the heating equipment is housed.

The primary system includes the boilers and their auxiliaries and is where all heat addition takes place. The secondary system includes the heat distribution equipment which carries the heat to locations where it is required and then applies the heat as needed.

The thermal storage tank blends the heated water from the boilers with cool return water from the system to ensure a blended return water temperature to the boilers and blended supply water temperature to the system. The result reduces the thermal shock danger to the boilers while also ensuring a constant system water supply temperature to the secondary system.

The heating plant is comprised of major and auxiliary systems. The major elements of the central heating plant system are:

- four boilers (Capacity is 11.6 GJ/hr output (boiler #1 to #3) and 17.7 GJ/hr output(boiler #4));
- feedwater system;
- pressure control system; and
- pumping systems (primary and secondary).

Auxiliary systems servicing the central heating plant are:

- boiler building heating system;
- venting and air conditioning systems; and
- electrical systems.

2.2.3 SLUDGE DEWATERING FACILITY

The Sludge Dewatering Facility consists of six centrifuges, six sludge feed pumps and six sludge cake pumps. It is operated downstream of the sludge digestion area. The primary role of this facility is the mechanical extraction of water from the stabilized digested sludge using centrifuges. Centrifuge dewatering of sludge uses rapid rotation of a cylindrical bowl to develop centrifugal forces required to separate the sludge solids and the liquids. The sludge cake and centrate are discharged separately from the centrifuge in two streams. To enhance this separation process a polyelectrolyte (polymer) is added with the sludge slurry prior to it entering the centrifuge.

The centrate is transferred to the centrate treatment facility while the sludge cakes are transported by truck to the City's Brady landfill site for co-disposal with garbage.

2.2.4 CENTRATE TREATMENT FACILITY

The Centrate facility consists of sequencing batch reactors (SBRs), blowers, soda ash feed system and methanol feed system. The centrate from the dewatering centrifuges is diverted to the SBRs for nitrogen removal. Treated centrate is discharged to the manhole in front of the dewatering building, which flow to the main interceptor and into the Surge well.

Untreated centrate flows by gravity from the Dewatering Building to the SBR, thus avoiding the need for additional pumping. This system controls the flow and temperature of the untreated centrate flowing into the Sequencing Batch Reactors. Temperature is controlled by diluting the centrate with secondary effluent (flushing water). There is a hydraulic limitation of 72L/s on the transfer system to the SBR. When this limit is exceeded, blended centrate/flushing water is bypassed to the head of the plant.

Flow of untreated centrate is split between two SBR tanks and the SBR treatment cycle is divided into three phases; Fill/React, Settling, and Decanting. The cycles between the two SBRs are offset by one-half of the cycle duration (i.e. when one SBR is beginning a cycle, the other SBR is halfway through a cycle). Centrate flows into a SBR tank during the Fill/React Phase. The Fill/React Phase is further broken down into two alternating periods; aerobic and anoxic. During aerobic periods, the centrate is aerated to allow nitrification to occur. The flow rate can be regulated manually or by the dissolved oxygen (DO) concentration in the SBR. During anoxic periods, no aeration occurs and methanol is introduced to allow de-nitrification to occur. The dosing rate is regulated by a specific dosing formula and the liquid methanol is stored in tanks located adjacent to the SBR. Soda ash solution is added to the SBRs during the Fill/React Phase to control the alkalinity and pH in the SBR. The dosing rate is regulated by a specific dosing formula. Dry bulk soda ash is stored in a silo located adjacent to the SBR where it is mixed with potable water to create the soda ash solution

After the Fill/React Phase, the Settling Phase allows sludge to settle. No centrate flows into the SBR during this Phase. During the Decanting Phase, the treated centrate in the SBR is decanted to the Equalization Basin. No centrate flows into the SBR during this Phase. The SBR treatment cycle starts again after the decant phase. WAS is returned to the HPO reactor train 1B and 2A and the biomass seeding of the SBR is carried out using biomass from the HPO when needed. Table 2.13 indicates the details for the SBR.

Table 2.13 SBR System Details

SBR		
Description	SBR #1	SBR #2
Basin Dimension L x W, meters	48 x 17.8	48 x 17.8
Selector Chamber, number	4	4
Selector Chamber, meters	9 X 1.5	9 X 1.5
Selector Volume, m^3	95	95
HRT Selector Chamber (including centrate, flushing & recycle sludge, minutes	55	55
HRT Reactor Peak Flow Condition (6.4 MLD), hours	44	44
HRT Reactor Average Flow Condition (4.3 MLD), hours	65	65
Bottom Water Level, meters	5.07	5.07
Top Water Level, meters	7.00	7.00
Reactor Volume at TWL, m^3	5800	5800
Reactor Volume at BWL, m^3	4200	4200
Low Water Depth/Top Water Depth, %	72.4	72.4
Water Depth, meters	7.0	7.0
Freeboard, meters	1.5	1.5
Blowers		
Description	SBR 1	SBR 2
Pressure, kPa	74	74
Type	PD	PD
Number, duty	2	2
Number, shared standby	1	1
kW	186	186
Airflow/blower, m^3/min	117	117
Mixers		
Description	SBR 1	SBR 2
Type	Slow Speed	Slow Speed
Number	3	3
Speed, RPM	46	46
Power (each), kW	6.4	6.4
Mixing Intensity, W/m^3	3.3	3.3

SBR		
Description	SBR #1	SBR #2
WAS Pump		
Description	SBR 1	SBR 2
Number	1	1
Flow, m^3/hour	290	290
TDH, meters	4.7	4.7
Power, kW	24	24
Mixed liquor recycle pumps		
Description	SBR 1	SBR 2
Number	1	1
Flow, L/second	8	8
TDH, meters	4.7	4.7
Power, kW	1.5	1.5
Equalization tank		
Liquid Volume, m^3	1600	
Width, meters	12.7	
Length, meters	36.0	
Water depth between TWL (3.5 meters) and BWL	3.5	
Equalization tank pumps		
Duty, number	1	
Standby, number	1	
Flow, each L/s	81	
TDH, meters	20	
Power, each, kW	24	

2.2.5 CHEMICAL PHOSPHORUS REMOVAL FACILITY

Phosphorus removal at the NEWPCC is achieved by dosing ferric chloride into the sludge and centrate piping, creating a chemical reaction that precipitates phosphorus into the sludge cake. There is also provision for the use of ferrous chloride, ferric sulphate or alum for phosphorus removal

A rail spur and railcar shelter is used for chemical unloading. Compressed air is used for padding the railcars during unloading. A chemical storage building, adjacent to the existing Dewatering Building, houses two chemical storage tanks. Each tank has a nominal capacity of 70 m^3 which is approximately 113% of the volume of one railcar. Ferric chloride can also be delivered and transferred to the storage tanks from a road tanker using the truck's compressed air system.

There are four chemical metering pumps each with a maximum capacity of 360 L/hr. The chemical pumps consists of three duty skid mounted pumps and a shelf standby pump. The pumps are magnetically driven external gear pumps with variable speed drives. Each duty pump transfers the ferric chloride to one injection point. However, inter-connections in the discharge lines allow flexibility in the choice of dosing locations for each pump. Adjustment of the dose rate is carried out manually, either local to the pump or remotely from the Plants Distributed Control System (DCS).

Ferric Chloride is pumped to any of three injection points by gear pumps. Typically only one dosing point is used at any given time for the base load dosing and another for trimming.

Ferric chloride is fed to three different injection points as follows:

- A 150 mm diameter branch line off the 200 mm diameter primary sludge line in Gallery No. 3 that transfers raw sludge to the digesters. A plug valve is included in the 200 mm line, to allow adjustment of the flow to the branch line.
- A 250 mm diameter digested sludge line in the Dewatering Building that transfers sludge to the centrifuges.
- A 300 mm diameter centrate line in the Dewatering Building that transfer centrate to the onsite sewer.

Chemical fed into the primary sludge provides the added benefit of struvite control in the downstream processes. The use of ferric chloride in this location may help in the control of hydrogen sulfide in the biogas. The dose-response relationship for phosphorus removal is relatively long due to the large retention time in the digesters.

Chemical fed to digested sludge, upstream of the centrifuges, also provides the benefit of struvite control in the downstream processes. The dose-response relationship for this location is relatively rapid.

Chemical fed into the centrate allows the phosphorus precipitate to be removed in the primary clarifiers. This in turn provides some control on struvite in the sludge system, although the dose-response relationship is relatively long. This dosing point allows dilution of the chloride ions (from the ferric chloride) with the mainstream wastewater, minimizing the risk of corrosion caused by high chloride concentrations.

2.3 ELECTRICAL AND CONTROLS

Electrical

NEWPCC went through two major electrical expansions in 1964 and 1983. The 1964 expansion saw the bulk of the core electrical distribution throughout the site being installed at a distribution level of 4160 Volts for the bulk of the distribution and used directly on larger equipment such as the inlet pumps. 4160 volt to 600 volt / 575 volt transformation systems were then installed local to process areas as required for lower voltage system. The major expansion in 1983 saw a second large expansion of the 4160 volt and 600 volt / 575 volt systems to support the larger process. These 1983 electrical expansions were tied directly to existing 1964 installations or fed via existing 1964 installation. These electrical systems have remained relatively unchanged or modernized other than replacement of a limited number of single failed pieces of equipment and cables.

Control system

The control system at the NEWPCC consists of an ABB Harmony/INFI 90 DCS (Distributed Control System), as well as stand-alone and networked PLCs (Programmable Logic Controllers). The age of the control hardware varies from about 1985 to present day.

The DCS PCU is located in the following areas and there may be one or more in each area:

- Administrative building
- Grit and aeration building
- Primary treatment
- HPO Reactors
- Secondary treatment
- Digesters
- Boiler room
- Dewatering building
- Phosphorus removal facility
- Centrate treatment facility

PLCs are located in various areas across the plant and in the control rooms.

There are 14 PCUs, the DCS communicates to all its PCUs (Process Control Units) in all the process areas over its dedicated redundant Plant Loop ring. The NEWPCC consist of ethernet network and are built of fibre and UTP cabling. The MODBUS TCP protocol is used where the DCS and PLCs communicate to one other.

NEWPCC Operator has the ability to monitor and control any of the process areas from any of the 11 plant-wide DCS PCV (Process Control View software) version 5 HMI (Human Machine Interface) PC workstations running the QNX4 Operating System. The PCV interface to the DCS is via ABB serial CIU gateways. HMI types such as Wonderware and Magelis touch panels are also available in some process areas for specific local uses. Table 2.14 indicates the locations of the various HMI. There may be one or more DCS PSV in one location.

Table 2.14 NEWPCC HMI Locations

PCV	Wonderware	Magelis
Secondary treatment area	Administrative building	Lab HVAC
Administrative building	Dewatering building	
UV building	UV building	
Dewatering building		
Centrate treatment facility		
Digester area		
Maintenance building		

NEWPCC also has a variety of input sensors and control actuators, from single function digital or analog, to smart multi-variable devices, like VFDs (Variable Frequency Drives) using ABB S800 Remote I/O over fibre.

NEWPCC PCV consoles have the ability to receive after-hour alarms from the South End and West End Water Pollution Control Centres. These alarms are relayed to NEWPCC over the dedicated Process WAN (Wide Area Network).

2.4 ADMINISTRATIVE AND MAINTENANCE BUILDINGS

Administrative Building

Administrative building contains the administrative offices, main plant controls system and the laboratory. It also includes the surge well, raw sewage pumps and the discharge chamber.

Maintenance Building

The NEWPCC Maintenance building is equipped to carry out mechanical, electrical and instrumentation-related work necessary to maintain reliable treatment operations of the plant. The shop facilitates installations, repairs, preventative maintenance, inspections and calibrations to mechanical, electrical and instrumentation equipment including a diverse range of pumps, internal combustion engines, compressors, sludge centrifuges, overhead cranes, moving bridges, meters, plant instrumentation and control systems. Welding, plumbing and fabrication needs, as well as general civil maintenance activities are carried out in this building. In short, the upgraded or new maintenance facility is to be designed and equipped to have the capabilities to safely perform corrective and preventative maintenance in line with all the site OEM’s requirements.

3 PROPOSED NEWPCC UPGRADE

A general schematic of the proposed NEWPCC upgrade is shown in Figure 3.1. The project area for the upgrade is shown in Figure 3.2.

3.1 EFFLUENT QUALITY PARAMETERS

The expected effluent quality parameters (Table 3.1) for the upgraded NEWPCC are based on the letter provided to the City by Manitoba Conservation and Water Stewardship in 2012.

Table 3.1 2012 Expected Effluent Quality Parameters for the City of Winnipeg North End Water Pollution Control Centre (NEWPCC)

Effluent Parameters for flows up to 705 MLD	Limits
Five-Day Carbonaceous Biochemical Oxygen Demand ($CBOD_5$)	25 milligrams per litre (annual 98% compliance)
Total Suspended Solids(TSS)	25 milligrams per litre (annual 98% compliance)
E. coli	200 MPN per 100 millilitres as determined by the monthly geometric mean
Total Residual chlorine	0.02 milligrams per litre, if effluent is chlorinated
Total Phosphorus (P)	1.0 milligram per litre as determined by the thirty-day rolling average
Total Nitrogen (N)	15 milligrams per litre as determined by the thirty-day rolling average
Ammonia Nitrogen content (as N)	

Month	Ammonia Nitrogen (as N) (Kgs/any 24 hour period)
January	7580
February	8675
March	13057
April	29021
May	13331
June	7312
July	4507
August	2262
September	2663
October	3415
November	4035
December	5774

3.2 INFLUENT DATA – 2037 & 2067

The following data presented in this document are to be used for responding to the RFP 182-2015. Once selected, the Consultant will be responsible to review the City's Flows and Loads and other data and recommend the data to be included as part of the RFP for the Design-Builder.

2037 Projected Population

The population of the NEWPCC catchment area for 2037 is estimated at 550,000 inhabitants. The population projection was based on the 2011 Census information and the City's Department of Property Planning and Development's projection. The population of the neighboring municipalities that may connect to the NEWPCC in the future was also considered.

2037 Design Flows and Loads

The breakdown of flows entering the NEWPCC is as follows:

i) Domestic wastewater (residential + commercial),

ii) Industrial wastewater,

iii) Inflow & infiltration (I&I),

iv) Hauled liquid waste (septage and leachate),

v) Wet weather flow (WWF) and

vi) Centreport flow.

The domestic and the septage flows are directly related to the population and have been extrapolated to 2037 based on the population projections. With no detailed information about the industrial water consumption being available, the industrial flows were assumed to be population related as well. A per capita domestic and industrial flow was calculated for every month of the years 2005 to 2013 using the City's Water Consumption Summary. This allowed estimating the domestic and industrial fraction of the influent flow and extrapolating it to 2037 by using the projected population of 2037. It was assumed that water conservation effort will reduce per-capita water consumption by 10% in 2037. Based on the historical data, the flow contribution of centrate and leachate was considered insignificant compared to the other components.

The actual I&I and WWF were estimated by subtracting the domestic, industrial, septage, leachate and centrate flows from the existing influent flow records. Due to the type of urban development expected at the NEWPCC catchment area, the City assumed that I&I and WWF will not increase in the future from the existing catchment area. However, newly-added catchment areas including new development within the City and neighbouring municipalities will contribute I&I and WWF. This increase has been assumed to be proportional to the increase in catchment area estimated as 25%.

The maximum daily flow to the NEWPCC is estimated to be 860 MLD (firm capacity) to maintain the City's existing level of service. The NEWPCC 2037 influent flows and loads are indicated in Table 3.2

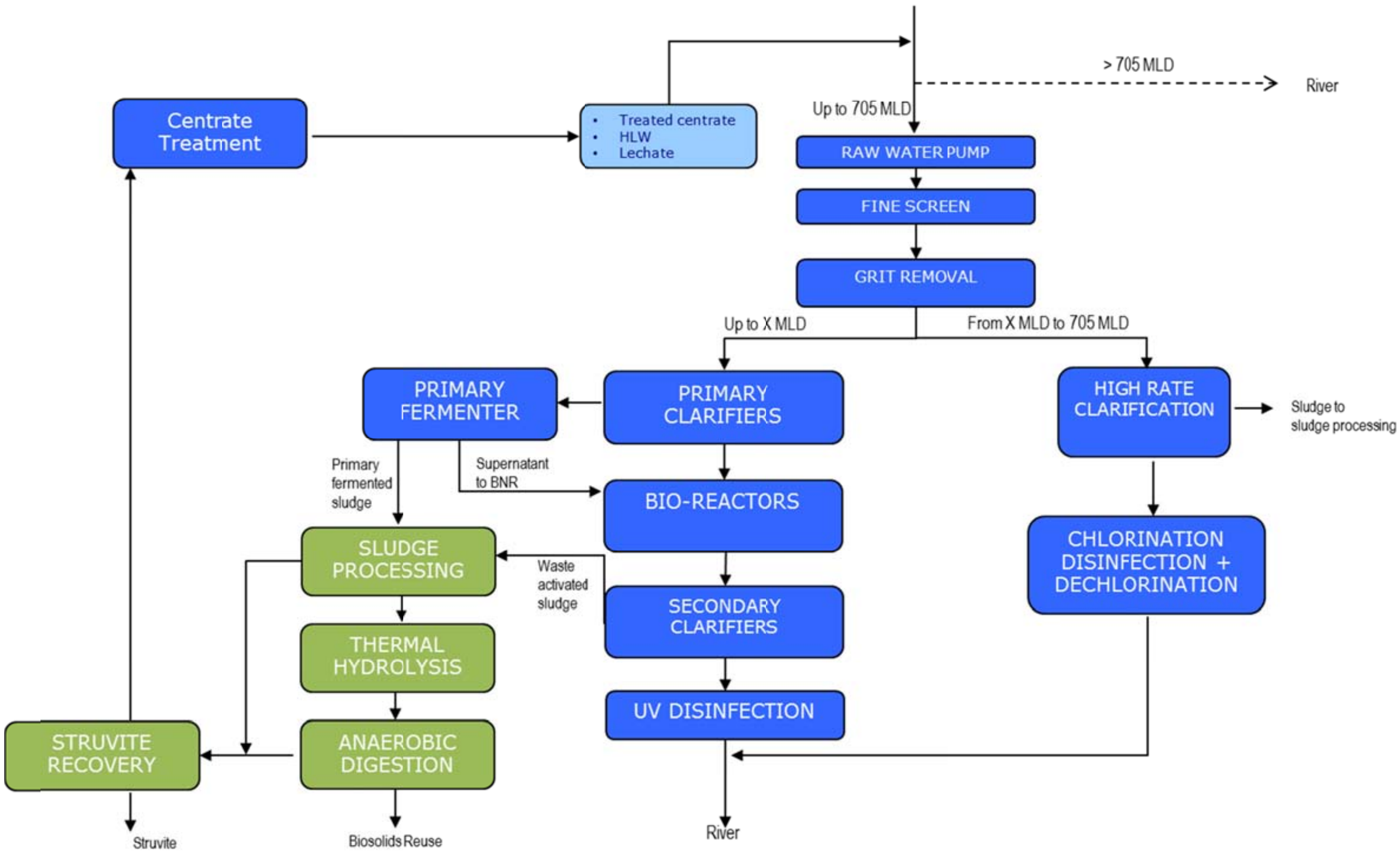

Figure 3.1 High Level Process Flow Diagram for the NEWPCC Upgrade

Notes: 1. Schematic does not depict all steps in wet stream or sludge stream processes nor sludge hauled in from other locations.

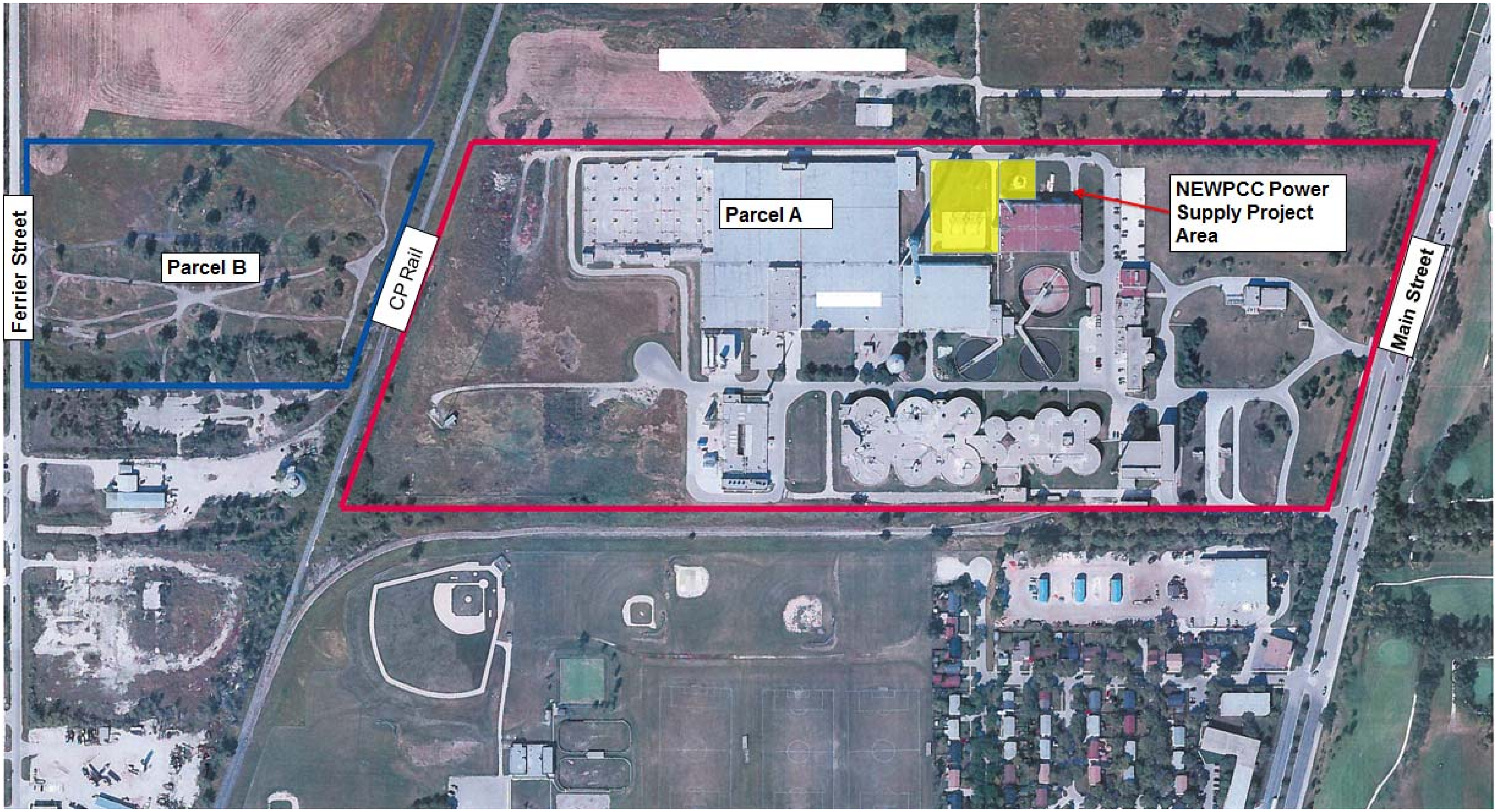

Figure 3.2 NEWPCC Upgrade Project Areas
(Parcel A and Parcel B are available for the NEWPCC Upgrade)

Table 3.2 Influent Flows and Loads for 2037

		FLOW	*LOAD*			
			TSS	BOD	TKN	TP
		MLD	Kg/d	Kg/d	Kg/d	Kg/d
WINTER	Daily average	177	50,803	47,990	9,317	1,281
	Max 30d rolling average	218	69,829	62,702	10,345	1,429
	Max day	264	132,889	87,946	13,235	2,040
SPRING	Daily average	294	71,870	52,147	9,667	1,308
	Max 30d rolling average	447	94,852	59,257	10,706	1,489
	Max day	705	186,183	95,966	15,057	2,198
SUMMER	Daily average	257	62,078	49,749	8,754	1,265
	Max 30d rolling average	531	98,164	62,702	10,538	1,500
	Max day	705	188,271	96,836	15,718	2,409
FALL	Daily average	197	55,131	49,167	9,106	1,322
	Max 30d rolling average	233	77,659	62,686	10,326	1,541
	Max day	521	180,976	93,522	14,374	2,272
AVERAGE		232	60,029	49,774	9,211	1,294

2067 Design Flows and Loads

The 2067 flows and loads were calculated assuming that:

- the population growth rate between 2037 and 2067 will remain the same as that between 2011 and 2037
- the industrial loads, the septage and the leachate will have the same growth rates considered for the period 2011-2037
- there will be no further water conservation beyond 2037

The results of the extrapolation of the influent flows and loads to 2067 are as presented in Table 3.3.

Table 3.3: 2067 Flow and Loads

		FLOW	LOAD			
			TSS	BOD	TKN	TP
		MLD	Kg/d	Kg/d	Kg/d	Kg/d
WINTER	Daily average	207	59,360	56,226	11,024	1,519
	Max 30d rolling average	250	81,444	74,697	12,730	1,767
	Max day	300	156,793	107,636	16,267	2,516
SPRING	Daily average	329	82,959	60,903	11,366	1,542
	Max 30d rolling average	486	111,127	71,190	12,870	1,784
	Max day	780	219,492	117,420	18,497	2,710
SUMMER	Daily average	293	72,561	59,237	10,598	1,537
	Max 30d rolling average	567	108,661	74,567	12,946	1,767
	Max day	780	221,947	118,481	19,305	2,970
FALL	Daily average	230	64,622	57,866	10,877	1,582
	Max 30d rolling average	269	90,962	74,697	12,302	1,835
	Max day	564	213,366	114,439	17,661	2,802
AVERAGE	Average	265	69,942	58,571	10,966	1,545

Wastewater Temperature

Wastewater temperature plays a significant role in any biological process. Therefore the information of the temperature profile of the influent is crucial for the subsequent design steps.

Based on the historical (2011, 2012, 2013 and 2014) influent temperature records, the projected 2037 temperatures entering NEWPCC are as shown in Table 3.4 below.

Table 3.4 Projected 2037 Influent Wastewater Temperatures (Degrees C)

	Winter	Spring	Summer	Fall	Annual Average
Average	12.4	11.6	18.1	17.0	14.8
Min day	9.4	6.3	12.0	10.2	------
Max day	14.7	15.1	20.9	20.8	------
Lowest 7 day rolling average*	10.5	7.6	12.8	12.7	------
Lowest 30 day rolling average*	11.8	8.3	11.64	14.2	------
'* The lowest 7 day and 30 day rolling averages are based on 2013 and 2014 temperature data as primary effluent data prior to those years did not exist.					

Temperature of the wastewater at the end of the primary clarifiers based on 2013 and 2014 data indicates no appreciable difference from the raw wastewater temperature. This is probably due to the three open primary clarifiers at the NEWPCC which are the only ones in use in the winter. However, review of existing temperature data from the City's wastewater treatment plant located at the south of the City (South End Water Pollution Control Centre - SEWPCC) indicates that there is about a degree increase in temperature. This one degree increase is probably due to the sewage flowing through the influent screens, grit chambers, and primary clarifiers which are covered and heated at the SEWPCC.

3.3 PROPOSED LIQUID STREAM UPGRADES

3.3.1 HAULED LIQUID WASTE AND LEACHATE FACILITY

Septage and leachate received through the existing Hauled Liquid Waste and Leachate Facility (HLWF) will flow into the existing main interceptor and then to the head of the plant.

The City is looking into modifying and optimizing the HLWF. The modifications and optimizations are not within the scope of the NEWPCC Upgrade. The modifications will not include pretreatment of the hauled liquid waste. However, the facility will impact traffic assessments to be carried out by the Consultant for the NEWPCC upgrade.

3.3.2 RAW WATER PUMPING STATION

The wastewater enters the site via underground gravity interceptor and flow must be pumped into the plant. The existing surge well and raw sewage pump station have been determined not to be re-useable for the upgrade; therefore, a new raw sewage pumping station will be necessary. Due to the depth of the incoming sewage, the City has decided not to screen the wastewater prior to the raw sewage pumps. The raw sewage pumping station will need to lift all the wastewater coming into the plant for treatment.

3.3.3 HEADWORKS

The raw sewage will be pumped up to a new headworks building where removal of grit, grease and screenings will take place. The grit removal system will need to be a non-aerated grit system where both grit and grease can be collected and removed from the wastewater. The screens, which might be a one stage or two stages, will need the final stage openings to be no larger than 6mm in diameter or possibly finer if required by the biological process requirements. The design will also need to consider that the sludge treatment processes may require finer screening than that required by the biological process.

The impact of pumping raw sewage from a combined sewer system onto the fine screens must be evaluated. It needs to be determined if a coarser screen setup should precede the grit and grease tanks and the fine screens located downstream of the grit and grease tanks or possibly prior to the biological nutrient removal reactors.

3.3.4 WET WEATHER FLOWS

The raw sewage, during high flows, will be split into two different treatment schemes. The flow split is to be determined by the Consultant during the WSTP Level 1 and 2 design in a manner that will allow the facility to comply with the effluent quality parameter. Some of the flow will go to the existing primary clarifiers while the rest will go to a high rate clarification process preselected as the High Rate Clarification (HRC) ACTIFLO© process. This flow is to be treated in the ACTIFLO© system with a coagulant and polymer and subsequently sent to chlorination/dechlorination prior to blending with the remainder of the plant effluent. The blended treated wastewater flow must then meet the effluent quality parameter requirements. As the blending strategy may not allow attaining discharge limits 100% of the time for all parameters, the Consultant must determine the annual percentage compliance for all parameters. Sludge from the HRC may need to flow to a sludge well and then pumped to HRC sludge storage tank(s) for blending with the remainder of the plant's sludge. It is anticipated that existing secondary clarifiers #11 to #26 will be modified and used for chlorination and dechlorination tanks. Actual number of tanks to be used is to be determined by the Consultant.

3.3.5 PRIMARY TREATMENT

The effluent from the headworks building which does not go to the HRC for treatment will be sent to the primary clarifiers. The effluent of the primary clarifiers will flow to the new biological nutrient removal tanks for treatment. The existing primary clarifiers have recently been rehabilitated. However, some issues related to the primary clarifiers remain and business cases will be required to make these determinations. The existing plant arrangement is for the waste activated sludge (WAS) to be co-settled with the primary sludge. In the upgrade, the WAS will be handled separately and the primary clarifiers will not receive any WAS.

3.3.6 PRIMARY SLUDGE FERMENTERS

The sludge from the primary clarifiers will be pumped to new covered primary sludge fermenters. The sludge from the fermenters will be pumped to the sludge facilities described below. Overflow from the fermenters will be pumped to the appropriate locations in the Biological Nutrient Removal reactors and possibly to phosphorus release tanks.

3.3.7 INTERMEDIATE PUMPING FACILITY

It is anticipated that, due to existing plant hydraulics, an intermediate pumping station will be required to lift the wastewater from the primary clarifier effluent into the Biological Nutrient Removal reactors. This intermediate pumping facility will probably be located near the Biological Nutrient Reactors. The intermediate pumping facility is envisioned to be similar to the existing UV Lift Station.

3.3.8 BIOLOGICAL NUTRIENT REMOVAL (BNR) REACTORS

This will be an entirely new system for the biological removal of nutrients (nitrogen and phosphorus) from the wastewater. The system will consist of multiple trains of reactors and be designed around the Integrated Fixed Film Activate Sludge Process (IFAS). The vendor of the IFAS media and associated equipment and systems has been pre-selected as Veolia Water Solutions and Technologies Canada Inc.

3.3.9 SECONDARY CLARIFIERS

The effluent from the BNR reactors will flow by gravity to secondary clarifiers. Some flow will go to the existing secondary clarifiers' #s 1 to 10 and some flow will go by gravity to new secondary clarifiers. The waste activated sludge from the secondary clarifiers will be pumped to the sludge handling and treatment process described below. The effluent from the new and existing secondary clarifiers will flow by gravity to the lift station at the Ultra Violet (UV) disinfection facility. The Consultant will need to evaluate the elevation of the new secondary clarifiers and the BNR treatment system during the WSTP Level 1 design. This is to allow effluent flow by gravity to the existing UV disinfection facility.

Previous high level evaluations indicate that the existing secondary clarifiers #1 to 10 can flood during high river level; therefore, the existing YG12 gate downstream of the secondary clarifiers must be closed during certain river levels.

The new secondary treatment processes are to be designed at such an elevation to allow their peak flow capacity to pass to the river during high river levels.

Secondary clarifiers' #s 1 to 10 were assessed and rehabilitated from 2011 to 2013. Rehabilitation work included

- Rehabilitation of the overflow weir plate (removed, replaced, and applied waterproofing)
- Rehabilitation of the wall wear plate (replaced and coated plates)
- Rehabilitation of the sludge collector mechanism
    - Replace tension rod
    - Modify support steel
    - Replace pivot support members and complete coating spot reports to fixed portion
- Replacement of the corner sweep mechanism
- Rehabilitation of the counterweight mechanism assembly
- Replacement of the scum collector assembly for clarifiers 1 to 6
- Replacement of handrail on access walkways.
- Concrete repairs (spall repairs) to concrete launder and spall repair to walls from potential damage during existing wear plate removal.
- Procurement of spare drive motors for clarifiers 7 to 10.

Clarifiers #1 to 10 concrete were visually assessed, typical depths of deterioration were a maximum of 3 to 4mm. The deterioration was considered as sulphate attack. The damage was confined to the outer layer with no significant impact to the concrete strength and integrity. The clarifiers showed signs of minor surface wear above or below the wear plate due to the corner sweep rollers. There were no signs of concrete cracking, rebar deterioration or spalling. Detailed assessment report will be provided on request to the successful consultant. The Sluice gates associated with the clarifiers were not assessed nor rehabilitated.

3.3.10 UV DISINFECTION FACILITY

The UV facility is relatively new and no upgrade to the system is anticipated as long as the flow does not exceed the flow the UV system was designed to disinfect. However, Tie-ins into the UV facility must be reviewed to ensure there is sufficient capacity and functionality to meet the intent of the overall design for the NEWPCC upgrade. Also, tie-ins into the UV facility will be required for pipes from the new secondary clarifiers. The UV facility may also be modified based on the outcome of the evaluation for the disinfection of wet weather flows.

3.3.11 OUTFALL

Tie-ins into the outfall will be required from the proposed HRC/chlorination/dechlorination system. The hydraulics and assessment of the outfall piping is to be evaluated as part of the WSTP Level 1 and 2 designs to allow peak flow to be discharged during the high river elevation events.

3.4 PROPOSED SLUDGE STORAGE, HANDLING AND TREATMENT

The quantities and characteristics of sludge produced by the City are to be determined during the WSTP Level 1 and 2 design. The proposed sludge storage, handling and treatment systems are expected to be new construction including buildings (or covers which must be evaluated on a case by case basis) to house all systems except those required to be outside and open to the atmosphere. The exception to new construction may be to:

- repurpose two existing digesters for wet weather sludge storage so that sludge can be fed into the rest of the sludge stream overtime and
- repurpose the existing dewatering building for a use presently un-determined.

The expected major sources of sludge to be processed at the proposed NEWPCC facility will be from the

- primary fermented sludge from the primary fermenters,

- waste activated sludge from the Biological Nutrient Removal (BNR) process,
- waste sludge from the centrate treatment process,
- sludge from the wet weather high rate clarification (HRC) system and
- sludge hauled in from the West End Water Pollution Control Centre (WEWPCC) and SEWPCC.

3.4.1 SEWPCC, WEWPCC AND HRC SLUDGE

A receiving tank(s) is to be provided to hold the WEWPCC combined primary and WAS. WEWPCC sludge will be thickened at WEWPCC to about 6% solids before it is transported to NEWPCC. The sludge will then be pumped to the phosphorus release tank(s) from the receiving tank(s). SEWPCC sludge will be dewatered to about 15-20% solids at SEWPCC before it is transported to NEWPCC. The transportation of WEWPCC sludge and SEWPCC sludge is outside the scope of the 182-2015 RFP. However, the NEWPCC Upgrade project is to include the design and construction of the receiving facilities at NEWPCC.

For process flexibility, redundancy, and robustness; new HRC sludge storage tanks are to be included in the upgrade. It is anticipated that two sets of sludge storage tanks will be required for the HRC process or as required by the HRC ACTIFLO© process. It is anticipated that there will be a set of smaller tanks at the HRC to serve as wet wells for the sludge pumps to transfer the sludge over to two larger tanks near the solids handling area. The larger HRC storage tanks will allow sludge to be pumped over-time to the sludge processing systems.

3.4.2 PHOSPHORUS RELEASE TANKS

The phosphorus release tank(s) is (are) to be provided to receive the WAS sludge from NEWPCC together with the sludge from WEWPCC. Volatile Fatty Acids (VFAs) will be added to the phosphorus release tank(s) and the tank(s)' contents mixed with mechanical mixers. Although the source of VFAs is to be determined during the WSTP Level 1 design, the upgrade is to include the pumping of some overflow from the fermenters to phosphorus release tanks.

3.4.3 SLUDGE SCREENS AND INTERMEDIATE DEWATERING

The sludge from the phosphorus release tank, NEWPCC primary fermented sludge and HRC sludge will be pumped through fine sludge screens (5 mm opening or as required by the THP vendor) and fed directly into Intermediate dewatering systems.

Intermediate dewatering is required for the NEWPCC and WEWPCC sludge to produce sludge of about 15%-20% solids. The Consultant will need to determine if the sludge should be combined and completely mixed prior to the intermediate dewatering system. The Consultant will also need to determine if dedicated intermediate dewatering equipment is required for some sludge sources to achieve a better process function and be more cost efficient. An evaluation and business case of sludge dewatering equipment will be required to assure the appropriate equipment is selected for this application.

3.4.4 THERMAL HYDROLYSIS PROCESS

The sludge from the intermediate dewatering will discharge into tank(s) where it will be combined with the SEWPCC sludge which will have been screened and dewatered to about 15%-20% solids. From this tank the sludge will be pumped to the Thermal Hydrolysis process.

The Thermal Hydrolysis Process (THP) is a proprietary process (City to pre-select the vendor and the selected vendor will specify the sludge thickness required) which through the application of high pressure and steam the biomass cell walls are opened up allowing better breakdown in the anaerobic digesters and increased production of biogas. The Consultant will work with the pre-selected vendor to size and specify the equipment, buildings and systems required for the THP process. Following the THP, all the sludge will be sent to Mesophillic Anaerobic Digestion (MAD). All sludge will need to be pre-screened prior to thickening or as required by the THP vendor.

3.4.5 MESOPHILIC ANAEROBIC DIGESTION

The digestion process has been selected by the City to be the Mesophylic Anaerobic Digestion (MAD) process. An equipment vendor will not be preselected for this process. New gas storage and flaring is to be provided as part of the new MAD system. The biogas is to be maximized and pretreated as required for reuse.

3.4.6 COMBINED HEAT AND POWER FACILITY

As the THP requires steam, a business case must be made for either installing boilers to produce the steam or installing a Combined Heat and Power (CHP) facility which can produce steam, recover heat and produce power for use at the plant. It is anticipated that boilers or CHP plant will also be used to provide heat to the MAD process. The Consultant will need to prepare a business case evaluating the options, of providing boilers or providing CHP with a standby boiler for the steam, needed for the THP and to heat the MAD process.

During the planning stage, a feasibility study of a CHP Plant at the NEWPCC was prepared for the City. The study concluded that a CHP facility would be feasible. However, actual sludge production loads will be required to determine the economic feasibility of the CHP in order for the City to make a final decision. The information provided in the study was used to allocate a footprint on the site plan for a possible CHP facility. Details of the study will be provided to the successful consultant.

3.4.7 PHOSPHORUS RECOVERY PROCESSES

The liquid from the dewatering processes (prior to THP and after Anaerobic Digestion) will be sent to a new phosphorus recovery facility the vendor of which is being preselected by the City. Provisions shall be made for adequate enclosed storage (a minimum of 50 bags, each 2 tons bags) for the struvite as well as hauling off the site. The liquid off the phosphorus recovery process will then go to the existing centrate facility for nitrogen removal.

3.4.8 CENTRATE FACILITY

The City is currently modifying and optimizing the centrate facility for the current plant operation.

3.4.9 FINAL DEWATERING

The digested sludge will be pumped to dewatering equipment for final dewatering. The Consultant will also need to perform an evaluation and business case of sludge dewatering equipment to ensure the appropriate equipment is selected for this application. The final sludge from the dewatering equipment is to be about 30% solids to make the sludge cake ready for final biosolids reuse.

3.4.10 FINAL BIOSOLIDS REUSE

Final biosolids reuse is not within the scope of this project and a final decision has not been made regarding the final biosolids reuse. However, the sludge cake must meet pathogen reduction requirements for Class A as defined by US EPA with the ability of loading into trucks for further handling.

Since final disposal has not been finalized an area on the NEWPCC layout needs to be identified for further treatment.

3.4.11 ODOUR CONTROL

Odorous air is to be collected transported and treated on site prior to release to the atmosphere. The City is leaning towards a physical-chemical process with 3 treatment towers (1 acid and 2 alkaline) for odour control. Process chemicals systems are to be in buildings unless required by code. If a chemical is required to be stored outside, the installation of roofs for weather protection over the systems need to be evaluated. The ventilated air from covered tanks or processes (liquid stream and sludge) is to be collected. The collected air will either be sent directly to the odour stack or first treated and then sent to the odour stack depending on the quality of the air.

3.4.12 BOILER PLANT

The centralized boiler plant equipment and piping dates back to the 1960's. The Consultant will need to evaluate continued use of the boiler plant.

3.5 SUPPORT SYSTEMS

3.5.1 INTERCONNECTING PIPING, CONDUITS, TUNNELS, ETC

The overall upgrade will include all interconnecting piping, conduits, tunnels, sumps and sump pumps, heating and ventilation, lighting, fire alarms and where appropriate fire suppression systems for a comprehensive design. These have not been evaluated in the planning stage.

3.5.2 ELECTRICAL AND INSTRUMENTATION & CONTROL

Electrical

The existing electrical systems and circuits which are to be retained will be identified and justified. These electrical systems and circuits must be assessed to ensure there is sufficient service life for continued safe and reliable operation to the year 2037 horizon.

Instrumentation, Control and Automation

A new hardened secure central control room suitable for 24 hour human occupancy and new dedicated data and historian server room are to be provided with the two rooms physically isolated. This new control room will monitor and control all of the NEWPCC facility. This new control room will also be able to monitor and control the SEWPCC facility remotely and have the ability to be expanded in future to monitor and control the WEWPCC facility as well as key City wastewater pumping stations.

The upgraded NEWPCC will be controlled via an HMI and PLC based system. The City will be moving all existing DCS, HMI and PLC systems that will remain in the future to the new HMI and PLC based system. A replacement strategy is required to move all existing facility DCS, HMI and PLC systems that will remain in the future to the new HMI and PLC based system. This system will ensure a fully integrated site wide system is in place upon completion of the new facility.

The City has chosen to standardize a number of E&IC equipment types to ensure consistency of equipment and integration between the City's Wastewater facilities. The Consultant shall design and require the design builder/Contractor to use the standardized equipment.

The following lists the vendor for standardized equipment.

1. Control System and Motor Control Equipment – RFP 331-2014: Covering voltages of 600V and lower for MCC's both intelligent and standard, MCC related equipment such as semiconductor based drives, metering and switchgear. PLC's, HMI's, historians, software and related protocol and communication equipment. Preselected vendor is Schneider Electric Canada Inc.

2. Electric Valve Actuators RFP 331-2014: Covering electric valve actuators in the range of >150 Nm for the applications of multi-turn and quarter-turn applications. The preselected vendor is Rotork Controls Canada Ltd.

3. Gas Detection Equipment RFP 123-2014: Covering fixed gas detection systems. The preselected vendor is Mine Safety Appliances LLC.

4. Uninterruptible Power Supplies RFP 341-2013: Covering three phase Uninterruptable Power Supplies (UPS). The preselected vendor is Eecol Electric.

5. Instrumentation RFP 449-2014: Covering flow, level, pressure and temperature instrumentation of all types. The vendor is yet to be selected.

3.5.3 CHEMICAL RECEIVING, STORAGE & FEED SYSTEMS

The NEWPCC has chemical receiving, storage and feed systems. The Consultant must review the existing and incorporate new facilities into the NEWPCC upgrade if appropriate. Recommendations regarding the reuse of the existing chemical receiving, storage and feed systems are to be made during the WSTP Level 1 design. Both truck and rail access for chemical receiving are to be considered.

3.6 ADMINISTRATION BUILDING

Administration Building will continue to be used for its administrative purposes. The surge well, raw sewage pumping station and discharge chamber will be decommissioned, demolished or possibly isolated from the building and made safe. The existing dry wells will need to be gutted off its process equipment and supporting systems and made safe with the first floor room possibly re-purposed. These decisions will need to be made during the WSTP Level 1 design. The existing control room is expected to be relocated within the building and made larger. The new control room is to be located such that it supports the needs of the upgraded plant. The location is to be determined during the WSTP Level 1 design.

3.7 MAINTENANCE BUILDING

The Maintenance Building will need to be reconfigured and possibly enlarged to support the needs of the upgraded NEWPCC facility and support for the collection systems pumping stations, SEWPCC and WEWPCC. The Consultant will need to work with the City to program the needs of the maintenance facility and then to develop alternative layouts for consideration by the City. The Maintenance Building will need to include secure stock rooms for tools, materials and spare parts, maintenance floors, office areas, lunchroom, toilets, locker rooms with showers for the maintenance team along with adequate parking, delivery access, waste metal dumpsters for recycling, hazardous materials storage, and waste handling areas. The Maintenance Building will also have a clean area for a SCADA terminal with full access to the NEWPCC, collection systems pumping stations, SEWPCC and WEWPCC. These decisions will need to be made during the WSTP Level 1 design.

3.8 ONSITE UTILITIES

Onsite utilities include but not limited to process water, potable water, fire suppression, natural gas, communication systems (including telephone, internet, and on-site systems), fiber optics, on-site drainage, on-site sewers roadways, parking areas with outdoor receptacles for block heaters, site lighting, delivery areas, site fencing and gates, and security systems. These utilities will need to be incorporated into the upgrade work and the size, capacity and condition of all existing on-site utilities will need to be evaluated during the WSTP Level 1 design to assure the remaining life of each is adequate to serve trouble free until 2037.

3.9 SITE ACCESS

Traffic studies will need to be developed during the WSTP Level 1 design to ensure safe access is provided during construction and for future operational needs through 2037. This is to include road and rail traffic including any rail crossings. Pipes crossing rail lines may also be required if the Consultant determine that the use of the parcel of land across the rail lines is necessary. Access from and to the site via Ferrier Street and crossing the CP rail line is required even if usage of the parcel across the rail tracks is not required. The parcel is zoned M2 and suitable for upgrade of the NEWPCC.

The City has determined that an access off of the Chief Peguis Trail extension along the north side of the site will not be allowed.

3.10 DECOMMISSIONING AND DEMOLITION

The onsite Cryogenic plant will be decommissioned by the owner of the plant, Praxair. The contract the City has with Praxair states that: “If the agreement to supply oxygen is not renewed and the Contractor’s (Praxair) plant is not purchased by the City, remove (Praxair) all the plant and leave the site in its original condition.” There is more language in the contract relative to this issue. Obviously, the oxygen plant must be maintained in operation until the NEWPCC upgrade is complete and all deliveries, personnel, etc. must be allowed to continue access for proper operation of the oxygen plant.

During the WSTP Level 1 design phase recommendations for decommissioning and demolition of existing NEWPCC not to be reused or re-purposed is required. This includes buildings, structures, piling, conduits, pipes, utilities, and appurtenances. Although not an exhaustive list some major items to be demolished include: grit building, secondary clarifiers which are not to be re-purposed, HPO reactors, anaerobic digesters and sludge storage tanks not to be reused, gas storage sphere and flare and all associated plant appurtenances related to the fore mentioned.

4 NEWPCC POWER SUPPLY UPGRADE

The NEWPCC existing power is provided by Manitoba Hydro through two (2) 66 kV / 4160 V 7.5 MVA and one (1) 5 MVA oil filled transformers. The two (2) 7.5 MVA transformers are owned by Manitoba Hydro while the 5 MVA transformer is owned by the City. The 5 MVA transformer powers the UV disinfection building while the 7.5 MVA transformers power the rest of the plant.

The existing electrical power supply at the NEWPCC is in the process of being upgraded as electrical loads associated with the future NEWPCC upgrades exceed the current power supply capacity. The professional engineering consulting services for the NEWPCC Power Supply Upgrade was awarded in November 2014.

The City intends to deliver the construction of the NEWPCC Power Supply Upgrade using the design build procurement method. The successful consultant for the NEWPCC Upgrade will be require to coordinate with the consultant for the NEWPCC Power Upgrade to define tie-in locations, scheduling requirements and other specific design, construction, and commissioning needs for the NEWPCC Upgrade.

5 NEWPCC UPGRADE PROJECT PLANNING PHASE

5.1 BACKGROUND

The Winnipeg Sewage Treatment Program (WSTP) developed an overall concept for the NEWPCC upgrades, in order to determine the Program’s plan. The planning phase commenced in 2011 and used data available at that time to select the major process elements, evaluate greenfield vs. brownfield, predict the physical requirements of an upgrade, and determine if such upgrade would fit within parcel A as shown in Figure 3.2. The Program’s overall site plan for the upgrade, based on the data available up to 2011, is shown in Figure 5.1. The data and resulting calculations for the sizing of the upgrade are included in subsequent sections.

This information is provided to the Consultant as the basis of design for the layout in Figure 5.1. The City realizes that since this basis of design and the layout was developed; the flows and loads entering the NEWPCC have been re-evaluated with more recent data. The Consultant shall be required to prepare their own calculations and recommended layout based on the latest flows and loads such that the proposed NEWPCC upgrade meets City, Regulatory, and Code requirements and compliance with the discharge licence.

Figure 5.1 NEWPCC Upgrade Planning Layout

5.2 Planning Phase Flows and Loads

In 2014, the WSTP re-evaluated the flows and loads coming to the NEWPCC by incorporating the latest wastewater data from 2012 and 2103 and the latest population growth projections from the 2011 Census information and City's Planning, Property and Development Department's projections. These were used to predict the flows and loads for 2037 and as far as 2067. These new projections, which are included in Section 3 of this document, are different and higher than the flows and loads data used in the planning phase in Tables 5.1 and 5.2 below. The planning phase investigations and calculations were used to justify the overall concept of the NEWPCC Upgrade. The sizing of the facilities and the layout must be updated using the latest flows and loads for 2037 and 2067 during the upcoming WSTP Level 1 and WSTP Level 2 design to ensure the design will comply with the effluent quality parameters.

Table 5.1 2037 Planning Flows and Loads

2037 NEWPCC DESIGN FLOWS & LOADS (centrate included)		**FLOWS (MLD)**	**LOADS** TSS (Kg/d)	BOD (Kg/d)	TKN (Kg/d)	TP (Kg/d)
WINTER	Daily average	187	46,971	44,966	8,797	1,193
	Max 30d rolling average	223	70,265	54,535	9,734	1,313
	Max day	239	114,664	77,180	12,382	1,894
SPRING	Daily average	299	72,154	50,692	8,898	1,200
	Max 30d rolling average	406	96,025	56,999	9,941	1,324
	Max day	692	189,683	93,752	14,215	1,898
SUMMER	Daily average	264	67,048	48,135	8,145	1,187
	Max 30d rolling average	470	101,971	60,721	9,275	1,394
	Max day	705	191,820	94,609	14,845	2,277
FALL	Daily average	205	56,378	47,880	8,639	1,253
	Max 30d rolling average	231	78,239	60,721	9,658	1,438
	Max day	426	168,420	91,345	12,922	2,146
ANNUAL	**Average**	**239**	**60,724**	**47,934**	**8,619**	**1,208**
	98%ile max day	**537**	**144,597**	**75,517**	**12,081**	**1,776**

Table 5.2 2067 Planning Flows and Loads

2067 NEWPCC DESIGN FLOWS & LOADS (with centrate)		FLOWS (MLD)	LOADS			
			TSS (Kg/d)	BOD (Kg/d)	TKN (Kg/d)	TP (Kg/d)
WINTER	Daily average	217	55,095	54,882	10,800	1,471
	Max 30d rolling average	254	82,289	66,555	11,953	1,619
	Max day	268	134,537	94,153	15,204	2,334
SPRING	Daily average	329	84,560	61,888	10,919	1,479
	Max 30d rolling average	438	112,625	69,554	12,194	1,632
	Max day	705	222,549	114,369	17,454	2,338
SUMMER	Daily average	297	78,625	58,747	9,989	1,463
	Max 30d rolling average	501	118,908	74,153	11,385	1,717
	Max day	705	225,055	115,413	18,228	2,805
FALL	Daily average	236	66,192	58,456	10,603	1,544
	Max 30d rolling average	266	91,803	74,113	11,855	1,772
	Max day	461	197,603	111,432	15,867	2,644
ANNUAL	**Average**	**270**	**71,219**	**58,513**	**10,576**	**1,489**
	98%ile max day	**568**	**169,655**	**92,124**	**14,834**	**2,188**

5.3 REUSE OF EXISTING FACILITY

The planning phase's overall concept for the NEWPCC upgrade included an assessment of the major facilities, the condition of them and how they may fit into the upgrade needed to comply with the more stringent Licence requirements. An overview of that assessment is included below; however, the final determination of the fate of some systems and associated work required to demolish, re-purpose or reuse each will need to be made during the WSTP Level 1 and Level 2 work by the City's Consultant.

Many of the existing facilities at the NEWPCC can be reused as part of the upgrade; however, the City performed re-usability assessments of the existing facilities and determined some of the facility's assets will not be reused in the upgrade for a number of reasons. Table 5.3 shows a list of the major assets at the NEWPCC.

Table 5.3 Assessment of the Re-usability of the Existing Facilities

	CONDITION ASSESSMENT		ABILITY TO BE RE-USED	Comment
	CIVIL	M&E		
SURGE WELL	Bad to decent 80% life time	Equipment not adapted	Not as a surge well	
INFLUENT PUMPS		End of Life	No	
DISCHARGE WELL	Envelope issues	End of Life	No	
SCREENING		80% life time Un-adapted size	No	
GRIT REMOVAL	Good	Good	No (inappropriate geometry & type)	
PRIMARY CLARIFIERS	Good for clarifiers End of life	End of life for bridges #4 & #5	Yes,	

	CONDITION ASSESSMENT		ABILITY TO BE RE-USED	Comment
	CIVIL	M&E		
	suspected for central ring of Control Chamber			
HPO Reactors	Unknown	End of life	Unknown	
Cryogenic Oxygen Plant	Unknown	End of Contract	City does not own oxygen plant	To be removed by Owner, Praxair
SECONDARY CLARIFIERS	Decent	See comments.	Yes	Reuse #1 to #10 as clarifiers, #11 to #26 re-purpose for chlorination / dechlorination tanks
UV	Good	Good	Yes	Reuse as UV
ANAEROBIC DIGESTERS	Fair to Poor	End of Life	Significant Upgrade Required	
SLUDGE STORAGE TANKS	Fair	Out of Service for 20+ Years	Significant Upgrade Required	
SLUDGE DEWATERING BUILDING	Good	Some M&E Equipment End of Life	Yes	
GAS STORAGE SPHERE	Good	Various Code Issues	Significant upgrade required	

5.4 PRELIMINARY SIZING OF THE TREATMENT PROCESSES

The following information demonstrates how the City, during the Planning Phase, estimated the sizing of the upgrade and also provides some indication as to the City's approach to redundancy of equipment. As the flows and loads have changed, all the information provided below is expected to change. The Consultant shall be required to prepare their own calculations and recommended layout based on the latest flows and loads such that the proposed NEWPCC upgrade meets City, Regulatory, and Code requirements and compliance with the discharge licence.

5.4.1 RAW SEWAGE PUMPS

The planning concept developed is for a new pumping station with eight (8) new submersible wet well pumps (see Table 5.4) replacing the existing pumping station. The old surge well and dry well would be decommissioned and demolished or isolated and made safe once the new station is complete and online. As the existing pumping station does not include bar racks or coarse screens prior to the inlet of the pumps, no bar racks or coarse screens would be proposed for the new pumping station. The raw sewage would be pumped to a new headworks building which would contain sewage screening, grit and grease removal systems.

Table 5.4: Raw Sewage Pumps Characteristics

Parameter	Unit	Value
Maximum flow to be lifted	m^3/d m^3/h	920,000 38,300
Average flow to be lifted	m^3/d m^3/h	239,000 9,958
Number of duty pumps	units	8
Number of stand-by pumps	units	1
Nominal flow of each pump	m^3/h	5,000
Total Meters Head (TMH)	mWC	20
Type of pump	-	Submersible pumps

5.4.2 FINE SCREENS

Seven (7) fine screens of no larger than 6mm in diameter openings would be located downstream of the raw sewage pumps and prior to the grit and grease tanks. Table 5.5 assumes the fine screens would be located prior to the grit tanks.

Table 5.5 Fine Screens Characteristics

Parameter	Unit	Value
Maximum flow to be screened	m^3/d m^3/h	920,000 38,300
Average flow to be screened	m^3/d m^3/h	239,000 9,958
Total number of channels	units	7
Number of duty screens	units	6
Number of stand by screens	units	1
Screen Openings (maximum diameter)	mm	6
Width of channel	m	2.4
Upstream water depth	m	2.5
Screenings production ratio	kgTSS/1000 m^3	10
Yearly average Screenings	tTSS/d	2.4
Dryness before compaction	%	10
Dryness after compaction	%	35
Density of compacted screenings	t/m^3	0.85
Daily volume after compaction	m^3/d	2.8

5.4.3 GRIT AND GREASE REMOVAL

For the grit and grease removal tanks (Tables 5.6 and 5.7), nine (9) vortex type grit & grease removal units that do not rely on air for the separation of the organics from the grit would be installed.

Table 5.6 Grit and Grease Removal Tanks Characteristics

Parameter	Unit	Value
Peak Flow	m^3/h	38,300
Average flow	m^3/h	9,958
Number of units in service (Vortex-type)	u	9
Number of units stand by (Vortex-type)	u	1
Diameter of each unit	m	7.9

Table 5.7 Grit and Grease Production

Parameter	Unit	Value
Sand production ratio	kgTSS/1000 m^3	10
Average Daily production	Kg TSS/d	2,390

5.4.4 PRIMARY CLARIFIERS

The existing primary clarifiers would be reused and they would be upgraded as required so they are good for another 25 years. The high level design of the primary sludge train was based on the fall max day production (Table 5.8) which is the most stringent case.

Table 5.8 Primary Sludge Production

Parameters	Units	Annual Average	Max Daily Production
Total primary sludge production	kg SS/d	34,857	107,903
Primary sludge concentration	g SS/L	5	5
Volatile Suspended Solids (VSS)	% of SS	60	60
Total primary sludge flow	m^3/d	6,971	22,382

5.4.5 PRIMARY SLUDGE FERMENTERS

All primary sludge would be pumped into four (4) new primary sludge fermenters. The estimated sludge values, parameters, and sizing of the fermenters are shown in Table 5.9. The liquid from the fermenters would be sent into the BNR process and the sludge pumped to the sludge process train.

Table 5.9 Parameters for the Primary Fermenters

Parameters	Unit	Value
Concentration of PS sludge	%	0.5
VSS/TSS of PS		0.6
Design SRT of primary fermenter	days	7
VSS reduction via primary fermentation	%	25
Average TSS concentration at the bottom	%	6
Average TSS concentration not at the bottom	%	3
Elutriation flow ratio		1
Depth of fermenter	m	5.5
Depth of liquid portion in fermenter	m	5
Number of primary fermenter	unit	4
Annual average PS TSS loading to fermenter	kg/d	34,857
Annual average PS flow rate to fermenter	m^3/d	6,971
PS loading after fermentation for wasting	kg/d	29,617
Flow rate of wasting sludge	m^3/d	494
Elutriation flow rate	m^3/d	6,969
Fermenter supernatant flow rate	m^3/d	13,444
Required fermenter volume	m^3	6,911
Diameter of one fermenter	m	21.0
Odour ventilation	Yes	
Covered	Yes	
Equipment	(1+1) x 30 m^3/h @ 8 m eccentric pumps, 6% DS	

5.4.6 INTERMEDIATE PUMPING STATION

The effluent from the primary clarifiers would flow to the biological nutrient removal (BNR) reactors; however, during the planning phase it was determined that the wastewater would need to be lifted into the BNR system via a new intermediate pumping station. The high level design for the Intermediate Pumping Station included seven (7) new submersible pumps of similar type to those existing at the UV pumping station. The pump characteristics are shown in Table 5.10.

Table 5.10 Intermediate Pumps Characteristics

Parameter	Unit	Value
Maximum flow to be lifted	m^3/d m^3/h	380,000 15,850
Number of duty pumps	units	6
Number of stand-by pumps	units	1
Nominal flow of each pump	m^3/h	2,640
TMH	mWC	6
Type of pump	-	Submersible pumps

5.4.7 BIOLOGICAL NUTRIENT REMOVAL REACTORS

The planning phase considered several applicable biological nutrient removal concepts and the one selected for the NEWPCC is as shown in the Figure 5.2. The City recently pre-selected Veolia Water solutions and Technologies of Canada as the IFAS vendor and the Consultant will need to work with the pre-selected IFAS vendor to develop the design specifics for the latest flows and loads. The Biological Nutrient Removal (BNR) reactors as depicted will allow both nitrogen and phosphorus to be biologically removed from the wastewater with the least amount of chemicals.

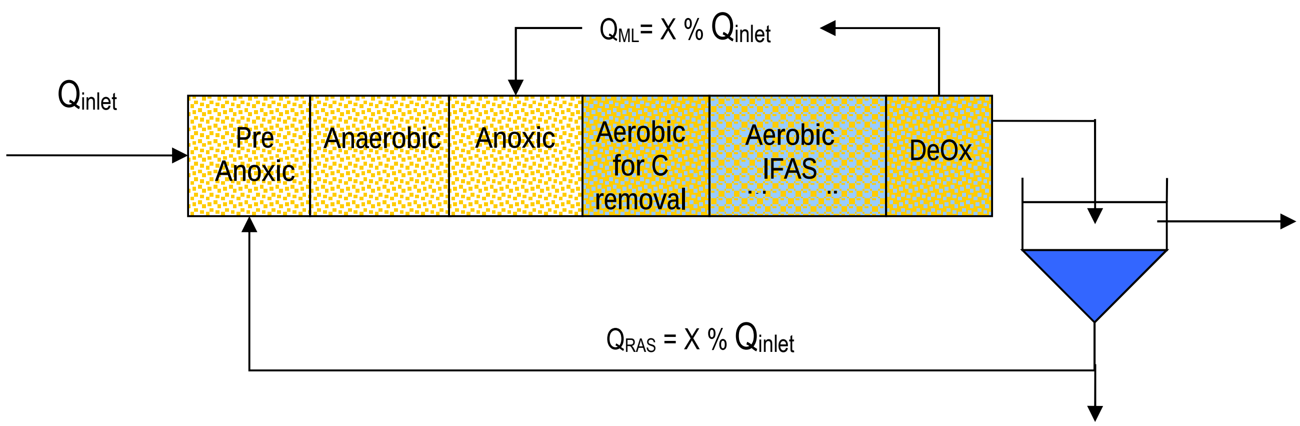

Figure 5.2 General Schematic of an IFAS process

Tables 5.11 to 5.15 indicate, the size of the individual tanks, IFAS media requirements, mixing requirements, mixed liquor recirculation rates, air requirements, and sizing of the blowers developed during the planning process which were proposed for the flows and loads to be treated.

Table 5.11 Bioreactor Process High Level Design

Parameters	Units	Average
Temperature in bioreactor (Average, min, max)	°C	16.5, 7.5, 21.8
Total volume	m^3	69,500
Total pre anoxic	m^3	3,500
Total anaerobic zone	m^3	7,000
Total anoxic zone	m^3	20,000

Parameters	Units	Average
Total Aerobic zone - C removal stage - IFAS reactor for nitrification - DeOx zone	m³ m³ m³ m³	39,000 6,000 27,000 6,000
Depth	m	6
MLSS concentration	mg/L	2,000 – 4,000
Volatile Suspended Solids (VSS)	% of SS	80
Return activated sludge (RAS)	%	50 - 100
Mixed liquor recirculation rate (MLR)	%	250 – 400

Table 5.12 Bioreactor Size

Parameters	Units	Design
Total volume	m³	69,500
Total number of trains	u	6
Volume per one train	m³	11,583
Dimensions of one train	m (W)x m(L) x m (D)	38.6 x 50 x 6

Table 5.13 IFAS Media

Parameters	Units	Average
Media type		N/A
Media effective area	m²/m³	500
Media filling in aerobic nitrification zone	%	50
Total media volume	m³	13,500

Table 5.14 Oxygen Requirement

Parameters	Units	Maximum condition	Yearly Average
Temperature	°C	20	15
Air requirement in the first aeration tank	m³/hr	9,983	4,901
Air requirement in the last aeration tank	m³/hr	1,066	256
Air requirement in the media tank	m³/hr	85,958	55,712
Diffuser type		Medium bubbles	
Diffusers submerged depth	m	5.75	5.75
Transfer rate in clean water in nitrification tanks	%	0.25	
Factor K		0.62	0.62

Table 5.15 Process Aeration Design

Parameters	Units	Design
Duty blowers	u	3
Stand-by blowers	u	1
Design Flowrate	Nm³/h	33,750
Head	mbar	750
Type	Turbo	

Mixed Liquor Recirculation

The purpose of the internal recycle (Table 5.16) is to send the nitrates created in the aerobic zones from the de-aeration zone to the anoxic zone for denitrification. The mixed liquor recirculation rate was estimated at approximately 300% of the annual average flow. It can be increased up to 5 times of the annual average flow, i.e. up to 1,160 MLD.

Table 5.16 Internal Recycle Pumps

Parameters	Units	Design
Duty pumps	u	10
Stand-by pumps	m	5
High level design flow rate per pump	m3/h	4,833
Head	bar	0.2

Waste Activated Sludge

The waste activated sludge would be withdrawn from the end of the bioreactor rather than from the return activated sludge line. The purpose of withdrawing from the bioreactor is that SRT control is much more convenient in this configuration, as the concentration fluctuation of RAS is higher than that of the bioreactor MLSS. High level design for the waste activated sludge is indicated in Tables 5.17 to 5.19.

Table 5.17 Waste Activated Sludge Production

Parameters	Units	Design	Yearly Average
WAS concentration	mg/L	4,000	2,700
WAS flowrate	MLD	12	9
WAS generation	Kg SS/d	48,000	24,300
Volatile Suspended Solids (VSS)	% of SS	75%	80%

Table 5.18 WAS Pumps

Parameters	Units	Value
Duty pumps	u	6
Stand-by pumps	u	6
Design Flowrate per pump	m^3/h	83
Head	bar	5

Table 5.19: Degasing Tanks

Parameters	Units	Value
Maximum flow (including recirculation)	m^3/h	31,666
Number of unit	u	3
Maximum velocity in the tank	m/h	100
Diameter of the tank	m	14.2
Contact time	min	3
Useful water depth	m	5

5.4.8 SECONDARY CLARIFIERS

The Planning Phase concept for secondary clarifiers is included and as shown in Tables 5.20 to 5.22:

- Reuse of the existing secondary clarifiers #1 to #10,
- Standard light refurbishment works on clarifiers # 1 to 10 (if required), and
- Construction of 8 new rectangular clarifiers for a total surface of 8,850 m^2.

Table 5.20 Secondary Clarifiers

	UPGRADE REQUIREMENTS	EXISTING SECONDARY CLARIFIERS (1 to 10)	NEW SECONDARY CLARIFIERS
Capacity	Up to 380 MLD for 2037 Up to 400 MLD for 2067	N/A	N/A
Total Volume	72,600 m^3	24,020 m^3	44,176 m^3
Total clarification surface	14,520 m^2	5,760 m^2	8,835 m^2
# of units	N/A	10 existing	8 new
Each unit's configuration	N/A	Squircle 24m x 24m x (3.7m ~ 4.7m)	Rectangular 46.6m x 23.7m x 5m

The recirculation high level design flow was 100% of the annual average flowrate, 230 MLD. The plan was for the RAS flowrate not to exceed 150% of 230 MLD (345 MLD) to prevent a short retention time in the bioreactor.

Table 5.21 RAS Pumps

Parameters	Units	Design
Duty pumps	u	5
Stand-by pumps	u	2
Design flowrate per pump	m3/h	2,875
Head	bar	0.3

Table 5.22 Expected Secondary Effluent Characteristics:

Parameters	Units	Yearly Average
COD	mg/l	40
BOD5	mg/l	12
SS	mg/l	15
NH4	mg/l	1
N-NO3	mg/l	6
Total N	mg/l	< 15
Total P	mg/l	< 1.0

5.4.9 UV DISINFECTION FACILITY

The UV facility which has a maximum design capacity of 380 MLD would have been reused.

5.4.10 HIGH RATE CLARIFICATION

The High Rate Clarification (HRC) process selected during the planning phase for wet weather high flow treatment was to use HRC followed by chlorination/dechlorination. Subsequently, the City preselected the Actiflo© process for the HRC process. Tables 5.23 to 5.28 shows the high level design for the wet weather flow.

Table 5.23: HRC Sizing

Parameters	Units	Values
Chemical injection ($FeCl_3$)	mg/l	50
Chemical Injection (polymer)	mg/l	1
Number of clarifier	Qty	2
Diameter of each clarifier	m	15
Mirror area of each clarifier	m²	175
Unit area of the settling zones	m²	116
Total area of the settling zones	m²	232
Spring Max day velocity	m/h	56
Summer max day velocity	m/h	58
Fall max day velocity	m/h	8

Table 5.24 Expected Efficiency of the HRC

Parameters	Units	Spring max day	Summer max day	Fall max day
Expected Removal Efficiency				
COD	%	67	70	73
$cBOD_5$	%	64	67	70
TSS	%	86	84	92
TKN	%	22	23	24
Total P	%	44	44	58
Expected Settled Wastewater Quality				
COD	mg/l	56	50	93
$cBOD_5$	mg/l	30	25	47
TSS	mg/l	25	31	25
TKN	mg/l	10	10	22
Total P	mg/l	1.0	1.0	1.8

Table 5.25 HRC Sludge Production

Parameters	Load	Concentration	Occurrences
	kg/day	g/l	Days/year
Wet weather sludge production - spring max day	57 383	10	10
Wet weather sludge production- summer max day	66 809	10	10
Wet weather sludge production - fall max day	14 604	10	10

For the planning stage, the following table represents the dosages of ferric chloride and polymer which were considered. The number, size, location, storage and feed system, type, storage, mixing, feed arrangements for ferric chloride and for polymer and type of polymer are still to be determined.

Table 5.26 Wet Weather Treatment Train Chemical Consumption

Chemical Injection	$FeCl_3$ dosage	Polymer dosage	Occurrences
	mg/l	mg/l	Days/year
Spring max day	50	1	10
Summer max day	50	1	10
Fall max day	50	1	10

The disinfection unit was designed for the treated wastewater characteristics presented in Tables 5.27 and 5.28. The storage and feed systems are to be determined.

Table 5.27 WWF Disinfection High Level Design Criteria

Parameters	Units	Values
Summer max daily flow	m^3/d	325,000
TSS	mg/l	30
E. Coli inlet disinfection	MPN/100ml	$\leq 10^{5.5}$
E. Coli treated water	MPN/100ml	$\leq 10^{3}$

Table 5.28 Chlorination/Dechlorination Systems

Parameters	Units	Values
Disinfection System		
Requirement Volume of Chlorine contact tank	m^3	13,540
Chlorine dose	mg/l pure Cl_2	20
Average contact time during summer max day	min	60
Active Cl daily dose (during summer max day)	kg/d	6,500
NaOCl commercial solution (48°)	kg sol/d	51,181
NaOCl commercial solution (48°)	m^3/d	41
NaOCl storage on site (5 days storage)	m^3	205
Dechlorination System		
$NaHSO_3$ dose	mg/l	40
$NaHSO_3$ daily dose	kg/d	13,000
$NaHSO_3$ commercial solution (25%, 315 g/l of SO3-2, d=1.32)	m^3/d	40
$NaHSO_3$ storage on site (5 days storage)	m^3	200

5.4.11 ODOUR TREATMENT

Only airflows from the pretreatment, the primary settlers, the HRC, primary fermenters and an allowance carried for thickened sludge process was considered to require treatment. Dissolved air flotation was used to estimate the amount of airflow for the thickened sludge process. However, a recommendation of the sludge thickening equipment based on a business case has yet to be performed.

Air flow from the rest of the process areas was considered to be extracted and sent to the existing stacks for dispersion. Out of the total airflow of 940,700 m^3/h the airflow to be treated is 381,500 m^3/h. High Level design for the odour control unit (OCU) are indicated in Tables 5.29 to 5.35

Table 5.29 Airflows and Ventilation Rates

Location	Ventilation rate	Airflow (m^3/h)
Pretreatment (grit & grease removal)	11	63,000
Pretreatment (the rest)	8	59,000
Primary settlers	6	180,000
IFAS activated sludge	4	180,000
Clarifier	4	291,600
UV	4	30,000
HRC	6	22,000
WWF disinfection	4	57,600
SludgeThickener	10	22,500
Primary fermenter	10	35,000

Location	Ventilation rate	Airflow (m^3/h)
TOTAL	-	940,700

The assumptions on the fouled air concentrations was based on the "less polluted air" quality standards of the odour unit control sizing software and the planners experience in sulphide stripping in sewage treatment plant as indicated in Table 5.30.

Table 5.30 Inlet Concentrations of Fouled Air

Parameters	Units	Average	Maximum
NH_3	mg/m^3	5	10
Organic N	mg/m^3	0.5	1
H_2S	mg/m^3	2	4
RSH	mg/m^3	0.5	1

The plan was to carry out the physical-chemical treatment in three steps, each taking place in a specific scrubber as described below:

- The first stage would operate at pH 3 by injecting sulphuric acid (H_2SO4) to eliminate all nitrogen compounds (NH_3 and amines).
- The second scrubber and the third scrubber would be used for the elimination of all sulphur compounds (H_2S and RSH). The second scrubber will work at pH 8.8 by adding NaOH and chlorine to remove H_2S.
- Finally, the third scrubber would work at pH 11 by adding NaOH and chlorine to remove RSH. The content of active chlorine in the sediment will range from 0.5 to 1 g/l Cl_2. The oxidation would be obtained by adding bleach.

Table 5.31: OCU Operating Characteristics

Parameters	Units	Values
Treated throughput	m^3/h	381,500
Number of treatment lines	u	5
Number of towers per line	u	3
Fouled air temperature	°C	12
Water temperature	°C	12
CO_2 content in air	mg/m^3	648

Table 5.32 Expected Concentrations at the Outlet of the OCU

Parameters	Units	Values
NH_3	mg/m^3	0.11
Organic N	mg/m^3	<0.01
H_2S	mg/m^3	< 0.01
RSH	mg/m^3	< 0.01

Table 5.33 OCU Scrubber Characteristics

Scrubber Parameters	Units	Values
Diameter of acidic tower	m	4
Packing height	m	3

Scrubber Parameters	Units	Values
Type of packing	-	Raluflow or equivalent
Air velocity	m/s	1.7
Contact time	s	1.8
Cleaning solution recirculation	m^3/h	230

Table 5.34 OCU Reagents and Water Consumption

Parameters	Units	1st scrubber	2nd scrubber	3rd scrubber
H_2SO_4 average	l/h	0.7		
H_2SO_4 max	l/h	1.3		
NaOH average	l/h		0.9	6.6
NaOH max	l/h		1.4	6.8
NaOCl average	l/h		10.7	2.9
NaOCl max	l/h		19.7	5.3
Drain flow rate	l/h	29.3	110.6	16.1
Total service water per line	l/h	610,0		

Table 5.35 OCU Chemicals Storage Capacities

Parameters	Storage capacity	Storage Volume (m^3)
H_2SO_4 98%	1 month	3
NaOH 50%	1 month	30
NaOCl 48°chlorine (when using only concentrated NaOCl)	15 days	25

5.4.12 SLUDGE HANDLING AND TREATMENT TRAIN

As with the wet stream treatment, the sludge handling and treatment train was based on the flows and loads available at the time and the following must be revised based on the latest flows and loads. Tables 5.36 to 5.45 include the basis of the design used in sizing the overall sludge facilities indicated in Figure 5.1.

Table 5.36 Sludge Receiving Facility

Description	Value
Buffer tank	
Number	1
Diameter	∅ 12 m
Height	5 m
Odour ventilation	Yes
Covered	Yes
Pumping plant	
Number	1
Length	2 m
Width	2 m
Height	3 m
Odour	Yes

Description	Value
ventilation	
Covered	No
Equipment	(1+1) x 20m³/h @ 15 m eccentric pumps
Screen structure / platform	
Number	1
Length	12 m
Width	6 m
Height	5 m
Odour ventilation	Yes
Covered	No
Equipment	1 x 30 m³/h screen like Huber Strain-Press
Notes	WEWPCC sludge unloaded from truck in reception buffer tank.Pumped to P-release tank, via screening

Table 5.37 WEWPCC & NEWPCC WAS P-Release

Item	Value
Number	2
Diameter	23 m
Height	5 m
Odour ventilation	Yes
Covered	Yes
Equipment	8 x 7.5 kW submerged propeller / vertical thrust mixers (2+1) x 150 m³/h @ 8 m eccentric pumps, 1% DS

Table 5.38 Intermediate Dewatering (before digestion)

	WWF sludge	WEWPCC & NEWPCC combined sludge	NEWPCC fermented sludge
Number of Tanks	1	3	3
Length	8 m	11 m	8 m
Width	12 m	12 m	12 m
Height	5 m	5 m	5 m
Odour ventilation	Yes	Yes	Yes
Covered	No	No	No
Equipment	(1+1) x 30 m³/h @ 8 m eccentric pumps (1+1) x automatic preparation and dosing units 2 kg/h (1+1) x centrifuges	(2+1) x centrifuges inlet 0.83% DS, outlet 22% DS, 146 m³/h 4 screw conveyors of total capacity of 22 m³/h (1+1) x automatic	(1+1) x 40 m³/h @ 8 m eccentric pumps, 6% DS (1+1) x automatic preparation and dosing units 12 kg/h (1+1) x centrifuges inlet

	inlet 2.5% DS, outlet 6% DS, 24 m³/h	preparation and dosing units 2 kg/h (1+1) x 130 m³/h @ 5 m centrifugal pumps, 0.1% DS	6% DS, outlet 22% DS, 31 m³/h
Others		Collection tank / pumping station for centrate. 75 m³.	
	Buffer silo for dewatered sludge before pumping to thermal hydrolysis. Retention time approx.. 6 hours. 110 m³.		

Fine screening of the sludge which may be required by the Thermal Hydrolysis process was not accounted for in Figure 5.1.

Table 5.39 Thermal Hydrolysis

Parameter	Value
Number	5 lines
Type	DN 600 x 12 m
Length	11 m
Width	34 m
Height	15 m
Odour ventilation	No
Covered	Yes

Table 5.40 Mesophilic Anaerobic Digestion

Parameters	Value
Number of tanks	4
Capacity of each tank	6,500 m³
Diameter	∅ 21 m
Height	21 m
Building for heat exchangers	21 m x 17 m x 4 m
Buffer tank for digested sludge	2 tanks ∅ 16 m x 10 m
Equipment	- 4 x 375 m³/h centrifugal pumps - 4 x 37 kW vertical axis slow-revolving propeller mixers - 2 x 2.2 kW submerged propeller, vertical thrust mixers

Table 5.41 Biogas System

	Concrete slab for biogas tank	Foundation for flare	Structure for boiler/steam generator	Wells for condensate removal
Number	1	1	1	6
Diameter /Length	∅ 19 m	5 m	6 m	2 m

Width	-	5 m	12 m	2 m
Height	-	-	4 m	2 m
Odour ventilation	No	No	No	No
Covered	-	-	No	No
Equipment	- 1 vertical pipe hidden flare 1,500 Nm^3/h - 1 cylindrical three pass low temperature hot water boiler biogas and natural gas 1,370 Nm^3/h @ 60% biogas CH4 - 2 high pressure steam generators			

Table 5.42 Final Dewatering (after digestion)

	Area for dewatering machines	Area for polymer preparation and drive-through area	Collection tank / pumping station for centrate	Storage for dewatered sludge, approx. 3 days storage
Number	1	1	1	1
Length	14 m	21 m	3 m	10 m
Width	14 m	21 m	3 m	14 m
Height	4 m	9 m	3 m	5 m
Odour ventilation	Yes (Machines are enclosed)	No	Yes	Yes
Equipment	(3+1) x 28 m^3/h @ 5.7% DS eccentric screw pumps (3+2) centrifuges inlet 5.7% DS, outlet >30% DS, 23 m^3/h (1+1) x automatic preparation and dosing units 40 kg/h (1+1) x 80 m^3/h @ 0.1% DS centrifugal pumps			

Table 5.43 Phosphorus recovery system

Parameters	Value
Number	2
Type	PEARL 2000 units (City has not yet pre-selected this system)
Length	20 m
Width	26 m
Height	11.5 m
Odour ventilation	Yes if primary sludge is added in P-release. Otherwise normal ventilation is enough.
Covered	Yes

Table 5.44 Odour Treatment (For sludge facilities only)

Parameter	Value
Type	Biological filter possibly with carbon polishing filter as add-on
Length	8 m
Width	3.5 m

Parameter	Value
Height	5 m
Odour ventilation	-o
Covered	Yes

Table 5.45 HRC Sludge - Storage Tanks

Parameters	Value
Number	2
Capacity / tank	3,000 m^3
Diameter	∅ 21 m
Height	9 m
Comments	Reuse of existing digesters 13 & 14
Equipment	12 x 7.5 kW submerged propeller / vertical thrust mixers