APEX WATER

OPERATION AND MAINTENANCE MANUAL

SURF PARK WASTEWATER TREATMENT PLANT

Contract Number

Project Number

Customer

Installation Address

Date of Installation

Revision No.

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The following documentation should be referred to in conjunction with this manual:

- As-built drawings
- Engineering calculations
- OEM manual
- Standard operating procedures
- Functional description
- Commissioning records

1 INTRODUCTION

2 PROCESS OVERVIEW

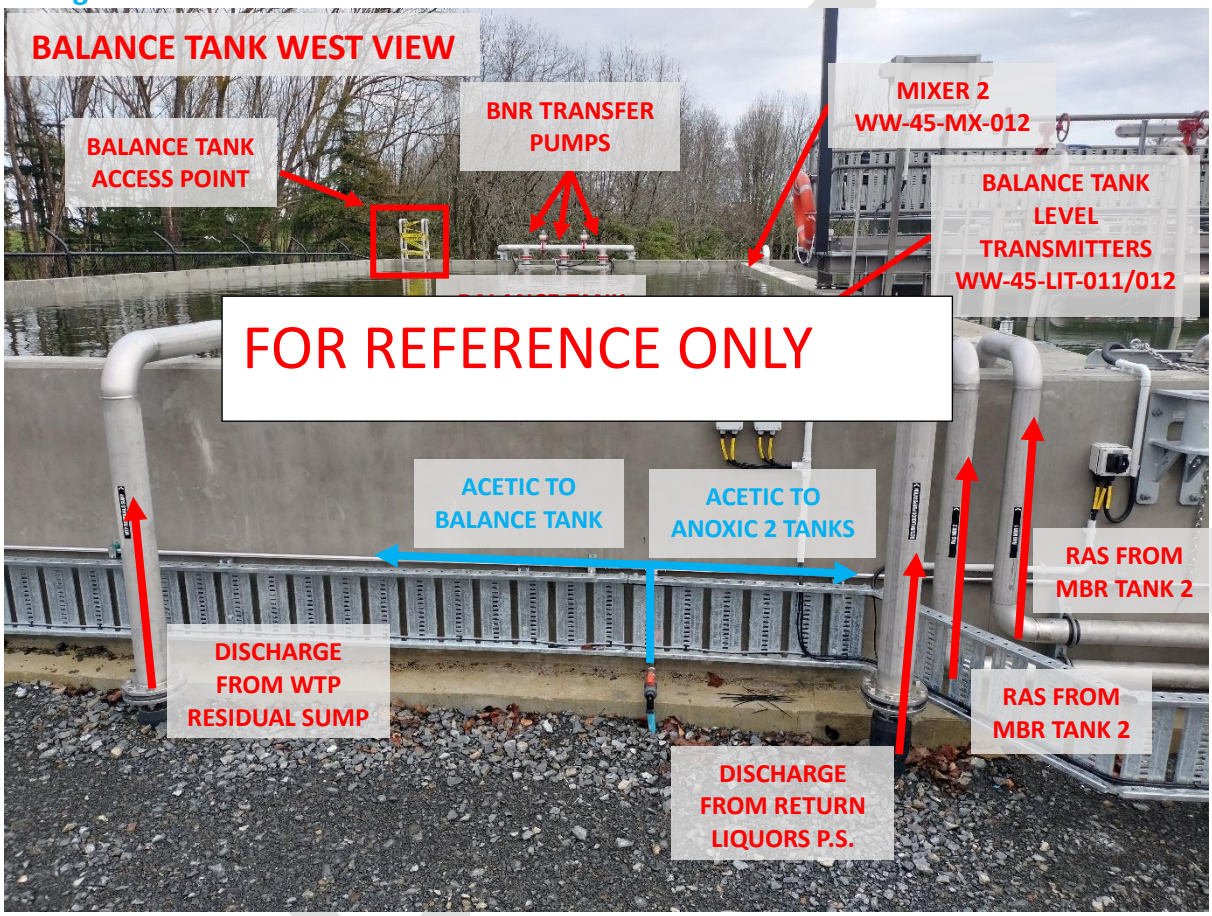
The following provides a brief overview of the control philosophy. Refer to the Functional Description and P&IDs for further detail.

3 PLANT OVERVIEW

SOME IMAGES HAVE BEEN SHOWN FOR REFERENCE ONLY

Plant inflow:

Biological Treatment Tanks:



MBR discharge pipework:
UV disinfection and pumping:
Process water pumps:

WAS tanks:

Recycled Water Tanks (Permeate):

Gas detectors:

Blowers:

Aeration Blowers, HVAC and Compressors

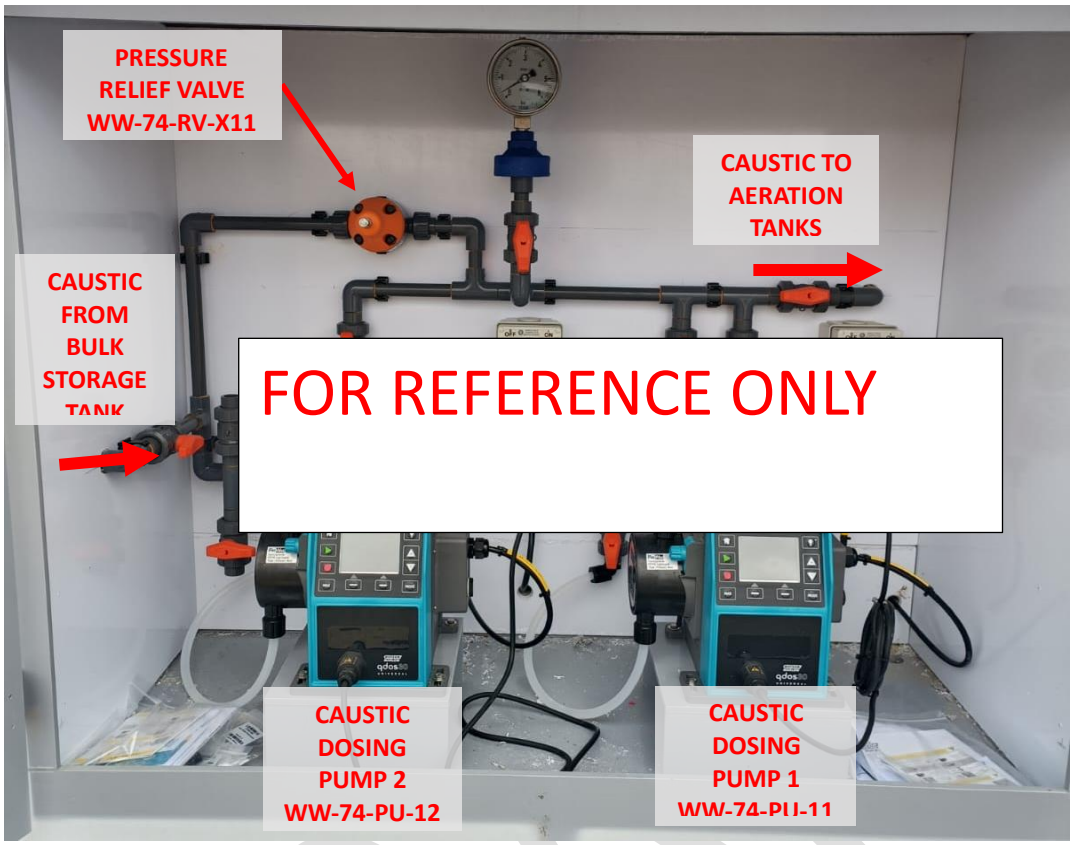
Waste Activated Sludge Handling (WAS):

Alum dosing board:

Caustic storage:

Alum Dosing Cabinet

Caustic Dosing Cabinet



Acetic Acid Dosing Board

Sodium Hypochlorite (Hypo) Dosing Board:

Chemical Load out Bay:

Site generator:

MCC and switchboard:

Odour Control:

4 CONTROL SYSTEM

The plant is controlled by a xxxxxx PLc. The plant has a local SCADA PLC, which has an Application Object Server (AOS), I/O server, workstation and historian.

The main PLC communicates with the following:

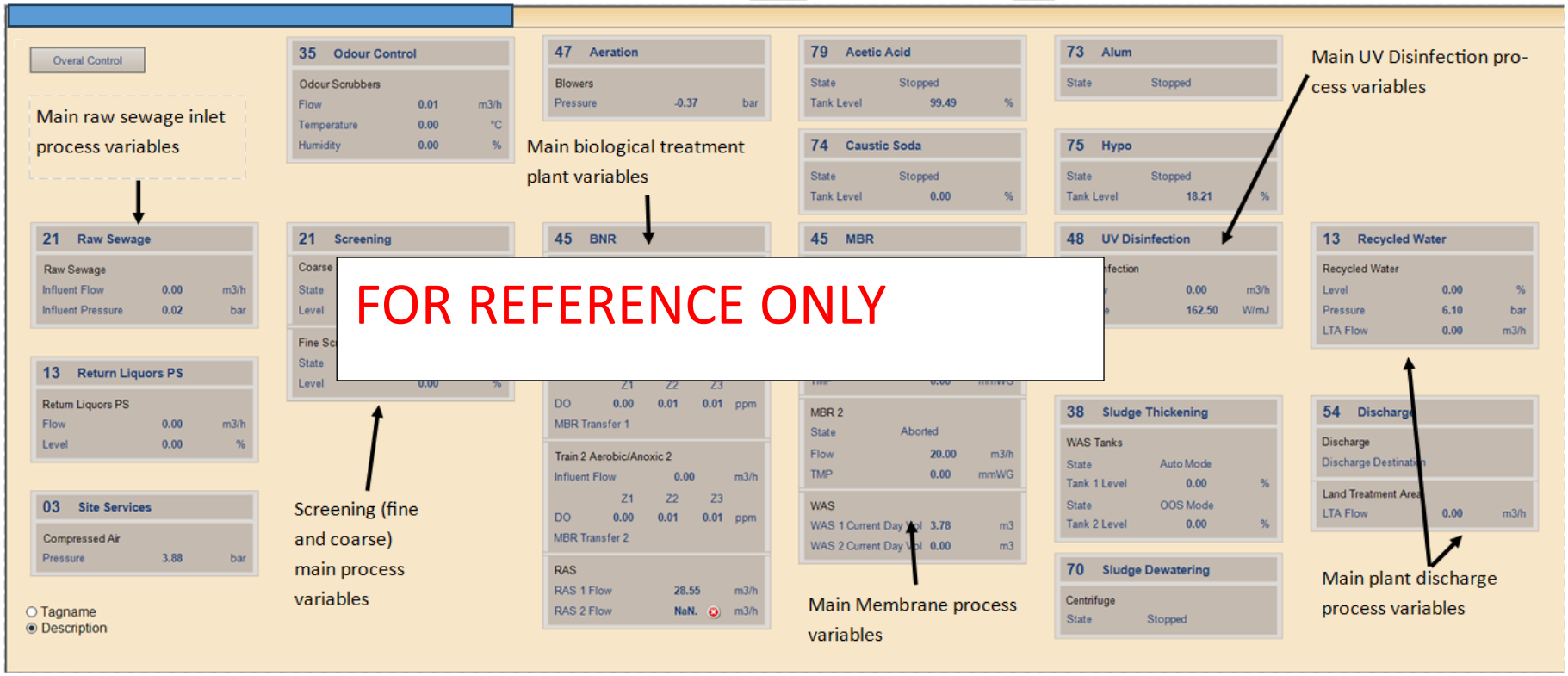
- Dewatering centrifuge
- Motor VSDs
- Analyser transmitters
- UV reactors
- Process water pumps

The following screenshots provide a guide of how to navigate the SCADA system. Do not reference the process values at the time of the screenshot. Refer to the setpoint list in the functional description for the intended values.

Overall plant monitoring:

SOME INFORMATION HAS BEEN SHOWN BELOW FOR REFERENCE ONLY

This page is the landing page for all things related to the wastewater treatment plant. The critical process variables of each area are displayed within the individual boxes, which are broken down according to Watercare area codes. From this page an operator can view everything from a high level that is required to oversee the operation of the plant in automatic. The operator must go further into the process and equipment to troubleshoot or change specific parameters. Each specific process areas and their parameters are shown on their related page (see below)

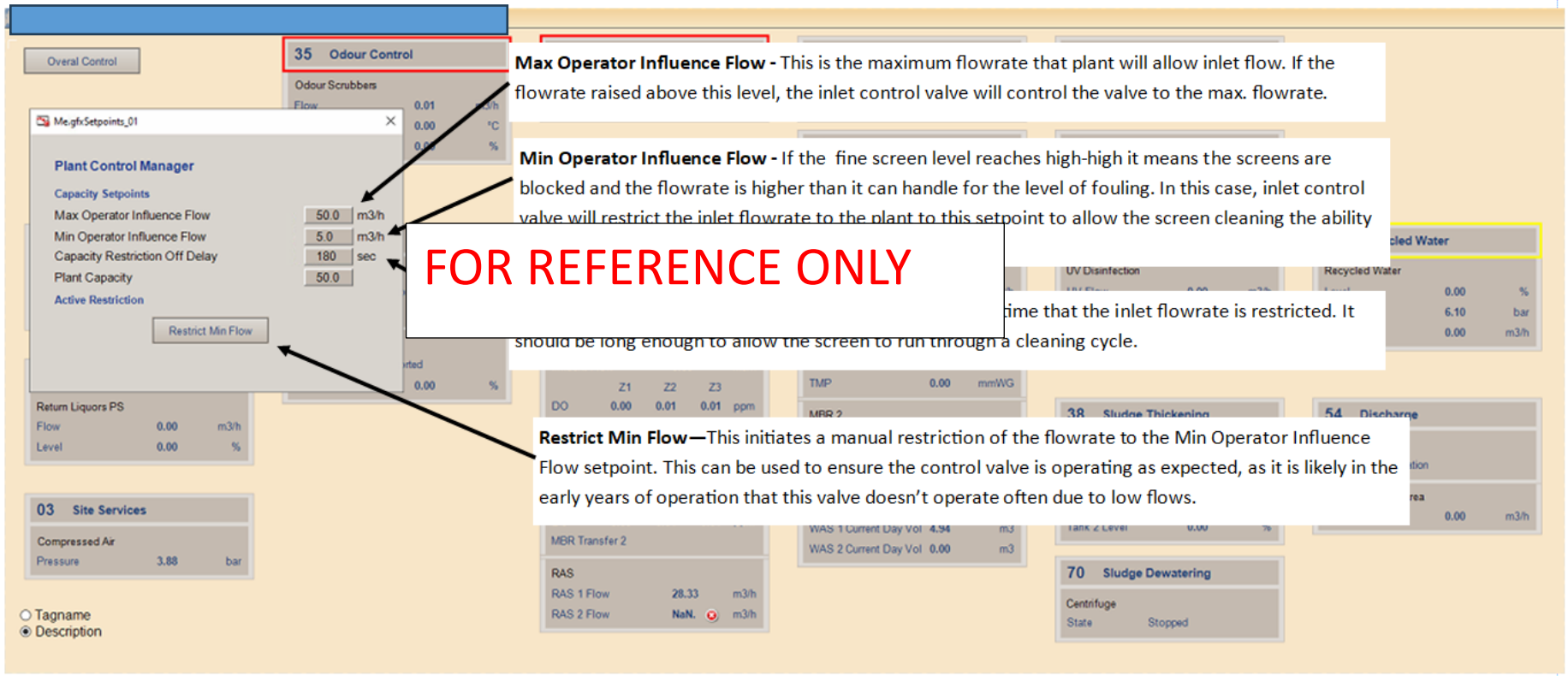


Navigating the home page:

Overall Plant Control Setpoints:

INFORMATION FOR REFERENCE ONLY

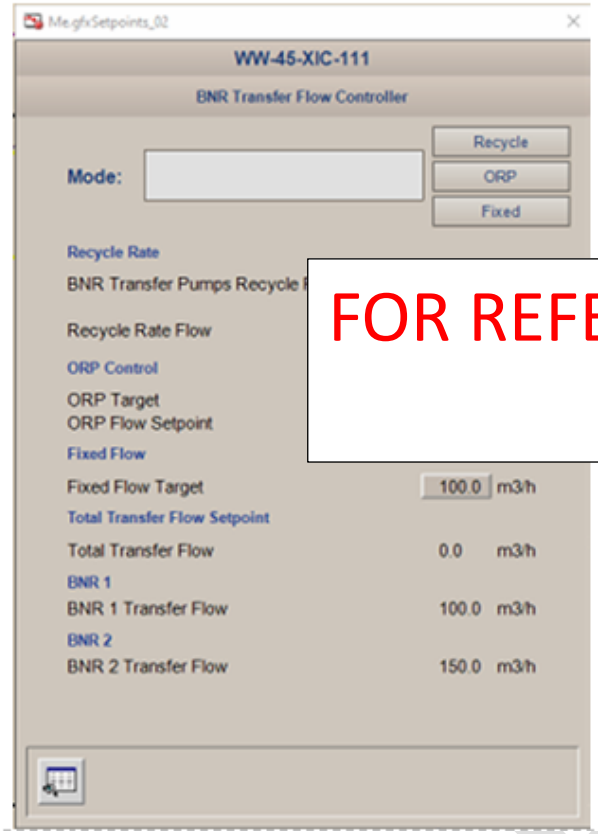
A overview and description of the overall plant control setpoints can be seen below.



Anoxic Balance Tank Setpoints

INFORMATION FOR REFERENCE ONLY

The BnR (Biological Nutrient Reduction) transfer pumps are the heart of the treatment process. These pumps control the bioloigcal process and can be operated in a number of ways.A description of the setpoints and controL modes is shown below. It is important to note that a core understanding of biological processes, specifically Activated Sludge Processes is required to operate this plant from which provides context of the different control modes. The O&M manual does not replace wastewater ptreatment plant training, experience and knowledge.



Mode—Highlights the current control mode of the BnR transfer pumps (Recycle, ORP or Fixed)

Recycle Mode— If the Recycle mode is selected the BnR pumps operate to recycle the flowrate through the aeration tanks at a multiple of the plant inlet flowrate (ie, if the inlet flowrate is 1m3/hr and the Recycle rate was set to 10, the transfer pumps will be targeting 10m3/hr recycle flowrate. 10x the incoming flow rate)

ORP Mode— If ORP mode is selected, the BnR pumps adjust their speed to recycle the flowrate through the aeration tanks to achieve an ORP setpoint value (see ORP Control setpoint below). ORP levels correprocess is targeting optimal denitpoint.

ORP Flow Setpoint—This is the flowrate the ORP controller is targeting from the BnR pumps in this mode.

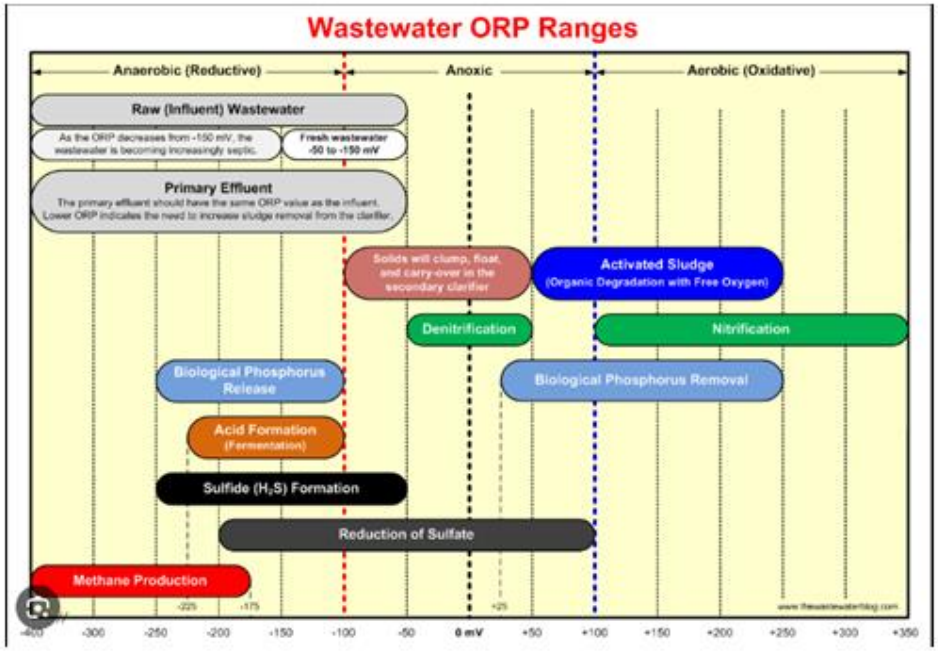
Fixed Flow Target— This is the fixed flowrate target setpoint if the fixed flow mode is selected.

Total Transfer Flow—This is the current total instantaneous flowrate into the aeration tank(s). Combined outlet flowrate of both BnR transfer pumps

BnR 1 Transfer Flow—Current instantaneous flowrate from BnR 1 transfer pumps

BnR 2 Transfer Flow—Current instantaneous flowrate from BnR 2 transfer pumps

A general overview of how ORP infers to the state of an activated sludge process can be seen below, however, this shouldn't be used to inform setpoint changes which should be made in conjunction with engineering support if knowledge and expertise is not known.



Biochemical Reaction	ORP, mV
Nitrification	+100 to +350
cBOD degradation with free molecular oxygen	+50 to +250
Biological phosphorus removal	+25 to +250
Denitrification	+50 to -50
Sulfide (H_2S) formation	-50 to -250
Biological phosphorus release	-100 to -250
Acid formation (fermentation)	-100 to -225
Methane production	-175 to -400

Nitrification—This process occurs mainly in the aeration tanks

cBOD Degradation - This is broadly the range that the biology will use free molecule oxygen (DO) to proliferate and consume cBOD as a consequence

Denitrification - This is broadly the ORP range that will result in the biology removing nitrogen from the wastewater. These are the conditions we want to promote in the balance tank.

RED ZONE— These are the ORP conditions we want to avoid as they can risk odour generation.

A

Aerobic and Anoxic 2 Reactor Trains:

Aerobic and Anoxic 2 Setpoints:

MBR Tanks

The annotated mimic below shows the SCADA mimic related to the Membrane portion of the process

MBR Tank Setpoints

The MBR Tank pop-ups and a description of their setpoints can be seen below.

Permeate Pumps

UV Disinfection

The SCADA mimic outlining the UV Reactors and the respective process equipment and instrumentation can be seen below.

Recycled water:

This mimic displays the tanks and process water pumps, and their related controls and parameters.

Waste Activated Sludge Tanks

The Waste Activated Sludge storage and settlement can be seen on the SCADA mimic page below.

Return Liquor Pump Station

The Return Liquors Pump Station receives liquid waste from a number of process areas and recycles it through the treatment plant. The SCADA mimic with annotations of this process area can be seen below.

Return Liquor Pump Station Setpoints

Aeration Blowers:

The aeration blowers primarily feed the aeration tanks, the MBR tanks and the WAS tanks. The annotated SCADA mimic can be seen below which highlights the key items of equipment, instrumentation and other related items.

Aeration Blower Setpoints:

Odour Control:

The Odour Scrubber annotated SCADA mimic can be seen below.

Sludge Dewatering

The Dewatering Centrifuge annotated SCADA mimic can be seen below.

Acetic Acid Dosing

The annotated acetic acid dosing SCADA mimic can be seen below.

Acetic Acid Dosing Setpoints

Caustic Dosing

The annotated Caustic Dosing SCADA mimic can be seen below.

Caustic Soda Dosing Setpoints

Alum Dosing:

The annotated Alum dosing SCADA mimic can be seen below.

Alum Dosing Setpoints

Sodium Hypochlorite Dosing

The annotated Sodium hypochlorite dosing mimic can be seen below.

Compressed Air & Services:

The annotated Compressed air and other services SCADA mimic can be seen below.

5 FUNCTIONAL DESCRIPTION

SITE HAZARDS

5.1 HAZARD SIGNAGE

Lock out plant before performing maintenance procedures.

Beware of hot surfaces such as the blowers and stainless-steel pipework from blowers.

Take necessary precautions including wearing personal protective equipment and thoroughly sanitise hands when working around biological hazards, such as wastewater.

Adhere to working at heights safety requirements, safe and correct use of work platforms and ladders when working at heights.

Take necessary precautions including wearing personal protective equipment when working around chemicals, such as sulphuric acid, PACl and sodium hypochlorite.

Do not enter confined spaces without a permit to work. Be aware of the potential for toxic gases to accumulate in confined spaces.

5.2 HAZARD INFORMATION

5.2.1 Biological System

Both raw and treated wastewater can contain different types of bacteria, viruses, or other pathogens. To reduce the risk of becoming ill from infections caused by these microbes, follow the guidelines below:

- Thoroughly clean your hands/arms, or any body part that has come into contact with the fluid, with water and soap or disinfectant. You should also use disinfectant on clothes or tools that have come into contact with wastewater.

- Always wear rubber gloves, particularly if you have an injury, and/or abrasion on the skin.
- Do not eat, drink or smoke with dirty hands or in the vicinity of the treatment plant.
- Immediately wash clothing that was worn while working on the treatment plant.
- Immediately consult a doctor if you swallow any fluid.

5.2.2 Electricity / Electrocution

Power should be isolated to plant/equipment before any diagnostic or maintenance work is completed. Only trained personnel are to conduct this diagnostic work.

Only trained personnel shall open the plant's control system and MCC, as these contain live wires that can cause electrocution.

5.2.3 Confined Spaces

Potential by-products of wastewater and stagnant potable or raw water are methane, carbon monoxide, carbon dioxide and hydrogen sulphide. These gases are all potentially fatal upon direct exposure. The nature of these gases is that they sit at the bottom of holes/chambers/access points. Under no circumstances should you enter any tank or any chamber, whether it is full or empty, that has been classified as a confined space, without taking the necessary precautions.

5.2.4 Hot Surfaces

The blowers generate heat when running and the blowers and associated pipework can reach temperatures above 60°C. Do not touch the blower surfaces when they are operating; wait for them to stop and cool down. Observe the warning signs posted on the blowers and associated pipework.

All blower parts are made from a high-quality aluminium alloy (except for the motor rotor, stator, shaft, and fan) to ensure efficient cooling of the hot surfaces once no more heat is generated.

The metallic pipelines leading from the blowers to the aeration tanks can remain hot for an extended period of time.

Having the heat generating equipment installed in a small, enclosed plant room will increase the temperature in the room significantly, especially in the already warmer summer months. A ventilation fan is located inside the site shed to ensure temperatures remain acceptable for working in. It is important that the site fan is working at all times.

5.2.5 Noise

All rotating machinery will generate noise when operating. It is recommended that operators wear hearing protection if performing tasks inside the site building for any length of time while the plant is operating.

5.2.6 Chemical Hazards

The following chemicals are stored and utilised onsite:

- Acetic acid is dosed to anoxic tank 1 and 2 in the wastewater treatment plant.
- Aluminium sulphate (alum) is dosed to anoxic tank 2 in the wastewater treatment plant.

- Caustic soda (caustic) is dosed to aeration tanks 1 and 3 in the wastewater treatment plant.
- Sodium hypochlorite (hypo) are dosed into the raw water and filtrate in the water treatment plant, as well as the permeate in the wastewater treatment plant.
- Sulphuric Acid is dosed into the raw water in the water treatment plant.

It is critical that the safety data sheets (SDS) for each chemical are strictly followed to ensure the safe storage, handling, and disposal of onsite chemicals.

Avoid or minimise handling of these chemical substances to reduce the risk of exposure and always wear the required PPE when handling these chemicals.

In the event of a chemical spill, follow the site emergency procedure, which must comply with the emergency procedures in the relevant SDS.

6 TASKLISTS

6.1 DAILY TASKLIST

INFORMATION FOR REFERENCE ONLY
The following task list should be completed daily when operator is on site.

Task	Description	Checked/Value
1.	Check over all plant for visible and audible issues.	
2.	Check the SCADA and investigate any active alarms.	
3.	Check the coarse screen for blockages, obstructions and fat build-up, and reset on the SCADA once the lid is closed.	
4.	Check the fine screen for blockages, obstructions and fat build-up, and reset on the SCADA once the lid is closed.	
5.	Confirm process water is available and reset the process water pumps locally if they have tripped.	
6.	Compare yesterday's total raw sewage flow with yesterday's anoxic balance tank discharge to aeration tanks • Yesterday's total raw sewage flow • Anoxic balance tank discharge to aeration tank 1 • Anoxic balance tank discharge to aeration tank 2	 _____ m^3 _____ m^3 _____ m^3
7.	Document yesterday's total treated effluent discharge from the	
8.	Manually clean the ORP probe	

Task	Description	Checked/Value
9.	Manually clean the DO probes and confirm the dissolved oxygen in the aerobic BNR tanks is within the appropriate range and close to the SCADA setpoint (between 0.5 – 2.0 ppm) • _____ ppm • _____ ppm • _____ ppm • _____ ppm • _____ ppm • _____ ppm	
10.	Manually clean the pH probes and confirm the pH within the aerobic tanks is within the appropriate range (between 6 – 8 pH units). • _____ pH • _____ pH • _____ pH • _____ pH	
11.	Manually clean the TSS probes and confirm the TSS within the aerobic tanks is within the appropriate range (between mg/L). • _____ mg/L • _____ mg/L	
12.	Manually clean the ORP probes in the anoxic 2 tanks. • •	
13.	Confirm the TMP across the MBR trains is below 1,900 mm. • MBR train 1 TMP: _____ mm • MBR train 2 TMP: _____ mm Schedule a CIP is the TMP is greater than xxxx mm	

Task	Description	Checked/Value
14.	Manually clean the pH probes and confirm the pH within the MBR tanks is within the appropriate range (between 6 – 8 pH units). • •	 _____ pH _____ pH
15.	Manually clean the MBR TSS probes and confirm the total suspended solids within the MBR tanks is within the appropriate range (between mg/L). • •	 _____ mg/L _____ mg/L
16.	Check for scum build-up, foaming or leaks on the BNR and MBR tanks and hose down if required. If foaming occurs, check sludge waste history and increase wasting if MLSS levels are acceptable (old bugs can increase foam production).	
17.	Check chemical dosing cabinets and bunds for leaks.	
18.	Monitor levels of chemical tanks and drums. • Emulsion polymer tank (approximate): • Acetic acid tank • Alum drum (approximate): • Caustic tank	 _____ % _____ % _____ % _____ %

Name _____ Signature _____ Date _____

6.2 WEEKLY TASKLIST

Task	Description	Checked/Value
1.	Complete the following checks on the coarse screen • Run manually in the field and listen for scraping or knocking. • Confirm solenoid wash valves are actuating and spraying efficiently • Spray down screen internals with washdown hose	
2.	Complete the following checks on the fine screen • Run manually in the field and listen for scraping or knocking. • Confirm solenoid wash valves are actuating and spraying efficiently • Spray down screen internals with washdown hose	
3.	Check the blowers are well ventilated and sound healthy. • Plant blower 1	
4.	Open the condensate valve on each of the aerobic tanks' zones to check for moisture in the aeration manifold. • • • • • •	

Task	Description	Checked/Value
5.	Inspect the air pattern across the aeration tank zones for even distribution. Any unusually high towers of air in one point indicate diffuser failure or leakage, and scheduled maintenance is required. • • • • • •	
6.	Check the sludge age and adjust the sludge wasting setpoints as appropriate.	

Name _____ Signature _____ Date _____

6.3 MONTHLY TASKLIST

Task	Description	Checked/Value
1.	Note run hours and check all pumps for any unusual noise, knocking, vibration and underperformance (refer to flow and / or pressure trends).	
	•	_____ hours
	•	_____ hours
	•	_____ hours
	•	_____ hours
	•	_____ hours
	•	_____ hours
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	•	_____ hours
	•	_____ hours
	•	_____ hours
	If pumps are underperforming, investigate (as appropriate) the pump alignment and coupling condition, bearing condition, wear plate condition, oil level in bearing assembly, impeller condition and blockage by debris or rag.	
2.	Visually inspect and actuate each actuated valve to confirm correct movement.	
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Task	Description	Checked/Value
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3.	Calibrate the aerobic tanks' DO probes	
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Task	Description	Checked/Value
4.	Note the run hours and clean the air filters on the plant blowers. The blowers require full inspection after every 4000 hours of operation.	
	• Plant blower 1	_____ hours
	• Plant blower 2	_____ hours
	•	_____ hours
5.	Check the calibration of the of the analyser for the following parameters:	
	•	
	•	
	•	
	•	
	•	
6.	Complete the dose time calibration of the chemical dose pumps and note the time to pump 100 mL.	
	•	_____ sec
	•	_____ sec
	•	_____ sec
	•	_____ sec
	•	_____ sec
	•	_____ sec

Name _____ Signature _____ Date _____

6.4 SIX-MONTHLY TASKLIST

Task	Description	Checked/Value
1.	UV lamps need to be replaced after every 8000 hours of operation. Note run hours for the following equipment. • Permeate UV reactor 1 • Permeate UV reactor 2	 _____hours _____hours
2.	Lower the water level in the MBR to 100 mm below the top of the membrane modules and visually check the condition of permeate manifold and suction tubes. • Avoid entering the tanks and if entry is required, treat as confined space entry • Hose down the top of the membranes and the suction tubes to clean exterior sludge off them • If any suction tubes are discoloured on the inside, the associated membrane and tube should be replaced • Check for sludge accumulation between membrane sheets. If the gap between sheets is filled with sludge cake, or water does not drain from between the sheets as the level is lowered, then sludge will need to be manually removed by extracting the sheet and scraping the sludge off it with a rubber window cleaning blade or by hose.	
3.	If required, undertake a CIP hypo clean.	
4.	If the CIP hypo clean (above) does not restore the TMP, complete a CIP citric acid clean.	
5.	Complete a six-monthly inspection of analyser.	
6.	Manually test all process stops for functionality.	

Name _____ Signature _____ Date _____

7 PROPRIETARY INFORMATION

8 TROUBLESHOOTING GUIDE

NOTE: This is provided as a guide only.

Ref	Fault	Possible cause/remedy
1.	Raw sewage flow () is much higher than the combined flow from anoxic tank 1 to the BNR trains (	• Check if the permeate flow setpoint is too low for incoming flows – increase on MBR setpoint page if required. • Check if coarse screen is tripped, blocked, and/or overflowing. • Check if fine screen is tripped, blocked, and/or overflowing. • Check if the anoxic balance tank low level alarm is active, interlocking the BNR transfer pumps • Check if the either BNR aerobic tanks' level () is above the high working level setpoint, interlocking the BNR transfer pumps. • Check the BNR transfer pump operation (compared to flow data to establish if there is poor pump performance or a blockage.
2.	BNR transfer pump(s) not operating	• Check if pump is in auto or manual on MCC panel. • Overload in MCC panel may have tripped. Reset and contact maintenance staff if it trips again. • Confirm the plant sequence that is currently running. • Check if any e-stops are triggered. • Check if any of the BNR transfer pump interlocks are active: - Anoxic balance tank low level - BNR transfer flowmeters low flow - BNR aerobic tank 1 or 2 high level
3.	BNR tanks overflowing.	•
4.	Aerobic tanks – aeration bubbles appear to be concentrated in one area or in a stream.	•
5.	Low dissolved oxygen in the aerobic BNR tanks	•

Ref	Fault	Possible cause/remedy
6.	Plant blowers are not operating	•
7.	Blower pressure relief valves venting when operating	•
8.	Foaming	This could be caused by: • Poor system start-up, especially if a healthy bacterial seed is unavailable. • Changes in influent waste quality, such as chemicals in industrial discharges • Filamentous bacterial. Carry out microscopic examination and treat system for excess filaments. • Low food to mass ratio if the system has been starved. • Nutrient deficiency if the nitrogen removal rate is too high. Reduce acetic acid dose if this is the case. • After a membrane chemical clean, watch for foaming due to residual cleaning chemicals in the system.
9.	MBR transfer pumps not operating or not producing flow.	-
10.	Permeate pumps not operating or not producing flow	-
11.	MBR tank(s) overflowing	•
12.	Low TMP and low permeate flow	• .
13.	High TMP and low permeate flow	• .
14.	Poor permeate flow following a CIP clean	•
15.	Chemical not penetrating the membranes during a CIP clean	•
16.		•

Ref	Fault	Possible cause/remedy
17.	UV unit interlocked.	•
18.	Process water not available (no hose water or water to the screens and sludge decanter)	•