Auckland Surf Park Community Water and Wastewater Treatment Plant Design Report

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Apex Water

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safe water by design

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Executive Summary

Auckland Surf Park Community (ASPC) is a multi-use land development project spanning 53 hectares, centred around a state-of-the-art artificial surf lagoon and leisure centre. While the development is centred around the surf lagoon, the development shall feature recreational facilities, three new residential neighbourhoods comprising 364 dwellings, and an industry zone centred on a hyperscale data and AI campus. To support the planning and consenting stages of this development, Apex Water has been engaged to provide water and wastewater design services for private on-site treatment.

To service the ASPC, AW Holdings, in collaboration with McKenzie & Co, have identified the need for a new Water Treatment Plant (WTP) capable of meeting a peak demand of 1,062 m^3/day, and a new Wastewater Treatment Plant (WWTP) capable of treating a peak demand of 671 m^3/day.

The proposed wastewater treatment plant will employ a hybrid biological nutrient removal system, combining advanced processes to produce exceptionally high-quality permeate. The treatment train will include a four-stage Bardenpho activated sludge process, a Membrane Aerated Biofilm Reactor (MABR), hollow-fibre ultrafiltration membranes, and reverse osmosis membranes. It is proposed that the treatment infrastructure is staged to accommodate the development as it grows and as environmental constraints require higher levels of treatment. Once fully established this system is designed to treat wastewater to an extremely high standard, producing permeate of a quality among the highest achieved by any wastewater treatment plant in New Zealand.

The discharge of treated wastewater shall be centred around an effects-based regime, where initially treated wastewater discharges shall be directed to land via irrigation. As the development grows and the discharge volume increases discharges shall be directed to a land contact device providing land contact prior to entry into the unnamed tributary of the Rangitopuni stream. Residuals produced by the water treatment plant shall be directed to the wastewater treatment plant for treatment and reverse osmosis retentate shall be irrigated to land.

An options assessment has been undertaken to determine suitable treatment technologies for the reliable treatment of potable water. Reverse osmosis and ion exchange have been identified as suitable treatment processes to meet the requirements of the Drinking Water

Standards for New Zealand based on initial source water monitoring. Final technology selection shall be confirmed during the detailed design stages of the project.

This report outlines the design of the wastewater treatment process, discusses the interface with the water treatment plant, and assesses the potential effects on the receiving environment resulting from the discharge of treated effluent.

APEX WATER

Apex Water are an engineering, procurement and construction (EPC) contractor specialising in the design and build of water and wastewater treatment systems. Throughout the past 16-years Apex Water have delivered various treatment plants utilising treatment technologies and processes including those described in this report for a range of municipal and industrial clients throughout New Zealand.

Statement of Qualifications and Experience

Matthew Savage

My full name is Dr. Matthew John Savage.

I am a Principal Engineer and founder of Apex Water. I hold a Doctorate in Chemical and Process Engineering specialising in Wastewater Treatment. I am a chartered professional engineer with Engineering New Zealand and a chartered member of the international Institute of Chemical Engineers. I have over 25 years' experience in wastewater treatment plant design.

Apex Water designs, constructs and operates drinking water and wastewater treatment plants at a similar scale to those required to service the proposed development detailed in this application.

I recently prepared assessments of environmental effects for the treatment and discharge of wastewater from a 1200 house subdivision at Karaka North Village to a level suitable for discharge to land and to water via land. This treatment plant is now complete and awaiting construction of houses in order to commence operation.

I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023 and have complied with it in preparing this evidence. I confirm that the issues addressed in this evidence are within my area of expertise and I have not omitted material facts known to me that might alter or detract from my evidence.

Jack Taylor

I am a Senior Project Manager at Apex Water. Apex Water designs, constructs and operates drinking water and wastewater treatment plants at a similar scale to those required to service the proposed development detailed in this application. I have been employed at Apex Water since August 2019.

I hold the qualification of Bachelor of Chemical and Process Engineering with Honours from the University of Canterbury, which I completed in 2012. I am a member of the Institute for Professional Engineers New Zealand.

I have 12 years of professional experience in the delivery of water and wastewater treatment projects and other relevant fields including roles such as Process Engineer, Project Engineer and Project Manager for various organisations in New Zealand, Australia and the United Kingdom. My experience includes the delivery of water and wastewater treatment infrastructure projects, such as the Project Manager overseeing the design, construction and commissioning of the Karaka North Village Water and Wastewater Treatment plants which will service a subdivision of approximately 1200 lots. The wastewater treatment plant in this application treats wastewater to a level suitable for discharge to both land and to water via land contact.

I confirm that, in my capacity as an author / reviewer of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Introduction

AW Holdings has engaged Apex Water (Apex) to deliver water and wastewater design services for private on-site treatment and discharge infrastructure in support of the planning and consenting stages of the proposed Auckland Surf Park Community (ASPC)– Stage 2.

In terms of background, resource consent for Stage 1 of the Auckland Surf Park Community (ASPC) was approved under the COVID-19 Fast-track Consenting Act 2020 on 25 June 2024. The consented development is shown below in Figure 2 and comprises of:

- Earthworks and vegetation removal and subsequent extensive re-landscaping of the site focused around the stream (Stream Park);
- The construction and operation of a surf park which included a surfing lagoon, restaurant(s), market space and 70 visitor accommodation units consisting of a lodge and eco-cabins;
- A solar farm;
- A standard data centre;
- Roading including the collector anticipated by the structure plan; and
- Three waters infrastructure. This includes infrastructure to facilitate a water take from the stream and the provision of a wastewater disposal field.

The Stage 2 proposal is for the expansion of the ASPC to include a hyperscale artificial intelligence data centre campus, three residential neighbourhoods, a village centre, work-live precinct, industrial precinct, subdivision and ancillary activities.

The Stage 2 proposal also involves variations to the development consented under Stage 1. These changes are described within the Assessment of Environmental Effects prepared by Barker and Associates.

To service the development, a 1,000m^3/day Water Treatment Plant (WTP) and a 700m^3/day Wastewater Treatment Plant (WWTP) are now proposed to meet peak daily flow requirements. During preliminary design, multiple treatment options were evaluated to identify technologies offering the best balance of reliability, treatment performance, and scalability.

The proposed wastewater treatment system will utilise a hybrid Biological Nutrient Removal (BNR) process with a semi-modular configuration able to be easily expanded as the development grows. The biological process tanks will follow a four-stage Bardenpho layout, integrating Membrane Aerated Biofilm Reactor (MABR) technology and Hollow Fibre Ultrafiltration (MBR) membranes to achieve enhanced nutrient removal and solids separation. The MBR permeate which already has almost all pathogenic bacteria and protozoa removed will undergo Reverse Osmosis (RO) polishing to achieve an exceptionally high effluent quality, comparable to processes operated internationally where treated wastewater is being prepared for full potable recycle.

The water treatment system will utilise either reverse osmosis membrane filtration or ion exchange along with UV disinfection and/or chlorination to produce drinking water that meets or exceeds the requirement of the Drinking Water Standards for New Zealand. Residuals from the water treatment plant shall be directed to the wastewater treatment plant for further treatment prior to discharge.

Discharges from the treatment plant compound shall comprise:

- The discharge of RO permeate (treated wastewater)
- The discharge of MABR-MBR permeate (treated wastewater)
- The discharge or RO retentate, or reject (a liquid waste stream from the reverse osmosis treatment process)
- The discharge of treated air from portions of the wastewater treatment process (odour control device discharge)
- The removal of dewatered sludge and screenings from site by truck

A hybrid, effects-based discharge framework is proposed to manage these streams in consideration of both preservation of the receiving environment and Te Mana o te Wai, allowing:

- Discharge of RO permeate via land contact to the unnamed tributary of the Rangitopuni stream;
- Discharge of RO retentate via land irrigation
- Discharge of MBR permeate to land during early years of the development when available irrigation land far exceeds the treated wastewater produced

The Water Treatment Plant will employ either:

- Reverse Osmosis, or
- Ion Exchange.

Along with disinfection processes such as UV and Chlorination

The final treatment configuration will be confirmed during detailed design, with infrastructure sizing presented in this report sufficient to accommodate both options for consenting purposes.

LIMITATIONS

The opinions, conclusions and recommendations in this report are based on conditions encountered and information provided at the date of preparation of the report. Apex has no responsibility or obligation to update this report to account for events or changes occurring after the date the report was prepared. The opinions, conclusions and recommendations in this report are based on assumptions made by Apex noted in this report.

Overview

SITE LOCATION

The ASPC site is located at 1320 and 1350 Dairy Flat Highway, 89 and 105 Lascelles Drive and 237 and 253 Postman Road, Dairy Flat, Auckland.

Figure 1 below demonstrates the location of the development and Figure 2 illustrates the master plan for the site, including proposed treatment plant location.

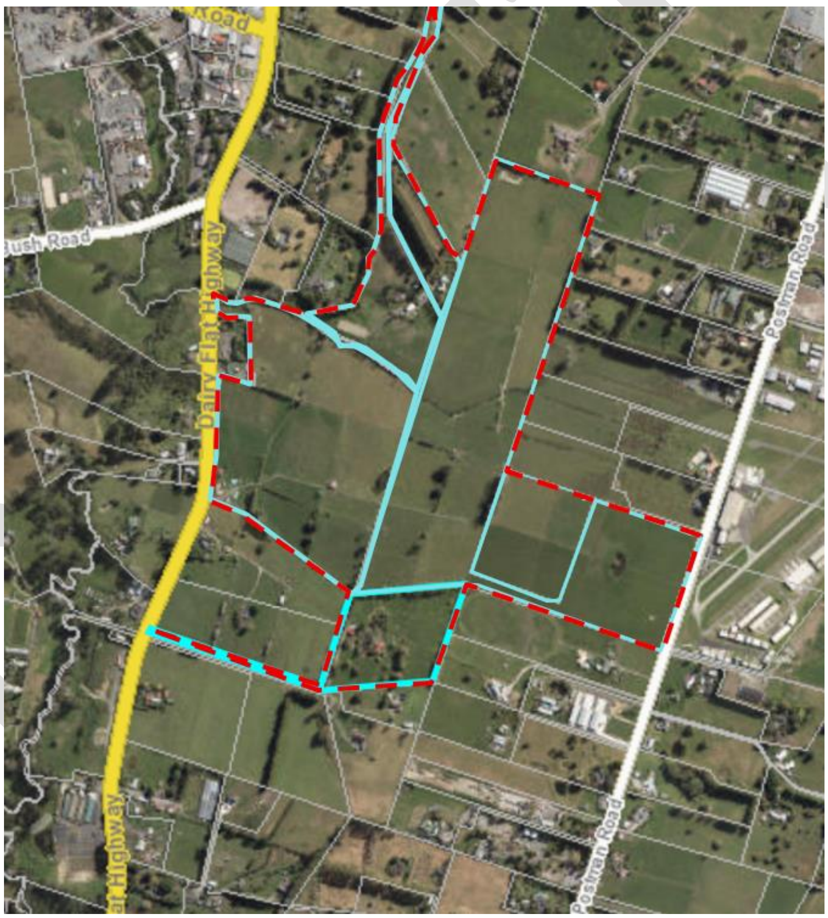

Figure 1: Surf Park development location

Figure 2: Surf Park Master plan with the proposed treatment plant compound shown

Water Treatment

DEMAND

The anticipated water demand has been established by the client's Civil Engineer, Mckenzie & Co, and with reference to the Auckland Council Code of Practice for Land Development and Subdivision – Chapter 6: Water.

Table 1: Surf Park development water demand, as advised by the client in conjunction with Mckenzie & Co

Parameter	Unit	Value
Average Daily Demand	m^3/d	604
Average Instantaneous Flow	L/s	7
Peak Daily Demand	m^3/d	1052
Peak Instantaneous Demand	L/s	27
Fire Fighting Demand	L/s	43

RAW WATER QUALITY

The raw water feed to the plant is to be supplied by a recently drilled deep ground water bore.

Two raw water grab samples were collected on the 5th of September (Sample 1) and the 17th of September (Sample 2) and analysed by Watercare Laboratories Services. A summary of the routine water profile results is demonstrated by Table 2 below.

It should be noted that Sample 1 results were collected soon after drilling and preliminary flushing of the bore. The elevated levels observed in Sample 1 for turbidity, total dissolved solids, and UVT can therefore be disregarded, as these elevated results are indicative of the partial flushing carried out post-drilling. Sample 2 shows the effect of extended flushing on these previously elevated results and is considered more representative of ongoing operation of the bore.

The numbers indicated in red in the following table demonstrate where sample results exceed the Drinking Water Standards New Zealand (DWSNZ) Maximum Acceptable Values (MAV) and those in orange are indicative of exceeding recommended level or DWSNZ Guide Values (GV).

Table 2: Bore quality results – routine water profile. Numbers in red demonstrate results exceeding DWSNZ MAV and numbers in orange demonstrate results exceeding DWSNZ GV or recommended values.

PARAMETER	UNIT	SAMPLE 1 (397829.1)	SAMPLE 2 (3987433.1)
Turbidity	NTU	9.8	0.86
pH	pH units	8.9	10
Alkalinity	g/m^3 as CaCO3	54	72
Free Carbon Dioxide	g/m^3	<1	<1
Total Hardness	g/m^3 as CaCO3	96	17.1
Electrical Conductivity	mS/cm	189.9	83.6
Electrical Conductivity	uS/cm	1899	836
Approx TDS	g/m^3	1270	480
Total Arsenic	g/m^3	<0.0011	<0.0011
Total Boron	g/m^3	5.9	7.4
Total Calcium	g/m^3	38	6.8
Total Copper	g/m^3	0.0017	<0.00053
Total Iron	g/m^3	1.18	0.056
Total Lead	g/m^3	0.00022	<0.00011
Total Magnesium	uS/cm	0.28	0.026
Total Manganese	g/m^3	0.04	0.00099
Total Potassium	g/m^3	75	11.1
Total Sodium	g/m^3	280	153
Total Zinc	g/m^3	0.21	0.021
Fluoride	g/m^3	-	3.8
Chloride	g/m^3	-	280
Nitrate-N	g/m^3	<0.05	<0.002
Sulphate	g/m^3	8.4	0.8
Absorbance	AU cm-1	0.175	
UVT	%T 1cm cell	66.8	
Total Coliforms	MPN/100mL	1	<1
E.coli	MPN/100mL	<1	<1

OPTIONS ASSESSMENT

The bore water sample results have indicated elevated concentrations of fluoride (3.8mg/L) and boron (5.9mg/L and 7mg/L) which exceed the DWSNZ maximum acceptable values of 1.5mg/L and 2.4mg/L, respectively. Options for removal of these contaminants have been assessed in the following sections.

Reverse Osmosis

Reverse Osmosis (RO) is a pressure-driven membrane separation process used to remove dissolved and suspended impurities from water. In RO filtration, water is forced through a semi-permeable membrane that permits the passage of water molecules while rejecting most dissolved salts, organic compounds, and microorganisms. The performance of RO membranes can be influenced by several factors; however, their effectiveness in removing dissolved salts, boron, and fluoride is well established under a range of operating conditions. RO offers broad-spectrum contaminant removal, producing a permeate that is virtually free of pathogens, particulates, dissolved salts, and other dissolved contaminants.

A key limitation of RO is the generation of a concentrated retentate stream, typically comprising up to 30% of the feed volume. This reduces the net yield of treated water and produces a large volume waste stream requiring appropriate management and discharge. Employing multistage or batch RO configurations can improve water recovery; however, these options involve higher capital costs, increased operational complexity, and greater ongoing operational expenditure.

Ion Exchange Resin

Ion exchange (IX) treatment involves passing water through a bed of specialised media designed to remove specific contaminants. As the water flows through the media, target ions are attracted to and captured on the media surface, effectively removing them from the liquid stream. Ion exchange media can be chosen for high selectivity toward particular ions, enabling the production of very high-quality treated water.

A key advantage of ion exchange systems for water with only a small number of non-compliant components is their high selectivity, allowing treatment to be tailored for specific contaminants while leaving non-target species unaffected. The process is also readily scalable and modular, making it adaptable to a wide range of treatment capacities.

Similar to reverse osmosis (RO), ion exchange produces a waste liquid stream that requires appropriate management. Over time, the media becomes saturated with captured contaminants and must be regenerated using chemical solutions. For this application, the integration of the water and wastewater treatment plants presents an opportunity for beneficial reuse of the regeneration waste stream.

The fluoride-specific ion exchange resin is regenerated using a sodium hydroxide (NaOH) solution. Sodium hydroxide is also required within the wastewater treatment process as a source of alkalinity, which is consumed by the biological system. In this configuration, the high-pH waste generated during resin regeneration can be redirected to the wastewater treatment plant, thereby reducing the overall chemical consumption.

Water Treatment Summary

The suitability of each technology has been assessed, and each option can be employed as the core treatment process to effectively remove each contaminant from the raw water stream. The infrastructure provided for in this design report, shall allow provision for both treatment processes to be adopted if required while working within the structures and building footprint provided.

Each of the assessed treatment technologies have their own advantages and limitations and a full assessment of these in the context of the overall project shall be carried out during the detailed design process.

Whichever core technology is employed, the water treatment plant will also include disinfection of the water utilising UV and/or chlorination to meet the level of disinfection log-credits required for this source water under DWSNZ.

Wastewater Treatment

LOADING

The anticipated wastewater loading has been established based on information provided by the client's civil engineer, Mckenzie & Co.

Table 3 below summarises information related to the wastewater loadings for the proposed treatment plant, as advised by Mckenzie & Co. The water treatment plant waste flows have been developed by Apex based on an assumed 90% recovery from the drinking water treatment process.

Table 3: Design Wastewater Flows (note design flows exclude waste flows from the water treatment plant).

Parameter	Unit	Value
Peaking Factor	-	1.2
Design Flow	m^3/d	585
Instantaneous Design Flow	L/s	6.8
Peak Wet Weather Flow (PWWF)	m^3/d	671
Instantaneous Design Flow	L/s	8.1
Water Treatment Plant Waste Flow (At Average Demand)	m^3/d	125.3

PEAKING – INFRILTRATION AND INGRESS

The ASPC will be serviced by a low-pressure sewer network. This system conveys raw sewage to the wastewater treatment plant via a network of pressurised rising mains. Each property will be equipped with its own holding tank and pump station.

The adoption of a low-pressure sewer network significantly reduces the peak hydraulic loading that the treatment plant must accommodate. This is achieved by decoupling inflow from rainfall events, as the sealed, pressurised system limits the potential for surface water and groundwater infiltration into the wastewater network.

In contrast, conventional gravity sewer networks are highly susceptible to infiltration and inflow (I&I), which can cause wet-weather flows to reach several times the average dry weather flow (ADWF). The Auckland Council Code of Practice for New Land Development – Chapter 6: Wastewater specifies a peaking factor of 6.7 × ADWF for design purposes. Infiltration typically occurs through damaged or misaligned underground pipework, while inflow arises from surface-level sources such as misconnected stormwater drains or damaged access points. Common I&I sources are illustrated in Figure 3. As all collected wastewater ultimately arrives at the treatment plant, these peak flows must be considered in system design.

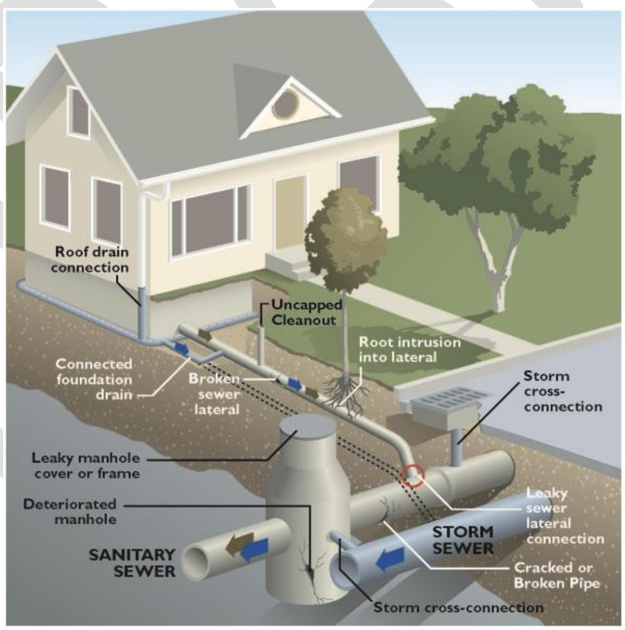

Figure 2: Sources of inflow and infiltration in a gravity sewer network (GHD Limited, 2015)

The ASPC is expected to exhibit variable wastewater generation both daily and seasonally, and throughout the growth of the staged development. Implementing a low-pressure sewer system mitigates the cost, complexity, and footprint of the treatment process while reducing impact on the receiving environment by minimising the volume of waste water produced. An additional design measure to manage flow variability is flow balancing, which buffers peak flows using a balance tank located upstream of the treatment system. The balance tank decouples the treatment process from instantaneous peak events, enabling design based on average instantaneous flow rather than peak flow, with excess volume temporarily stored for later processing.

While the Auckland Council Code of Practice prescribes a peaking factor of 6.7 for conventional gravity systems, a peaking factor of 1.2 has been adopted for the ASPC treatment plant, as advised by the client's civil engineer, McKenzie & Co.

Apex has verified based on findings from other developments utilising low pressure sewer systems that a peaking factor of 1.2 for low pressure sewer systems is appropriate.

While peaking events are significantly reduced through the adoption of a pressurised sewer network, the treatment plant design must still accommodate daily diurnal cycles as well as include provision for handling any remaining weather-related peaking. To accommodate these peaking events, the treatment plant design includes provision for inlet flow balancing, which buffers peak flows using a balance tank located upstream of the treatment system. The balance tank decouples the treatment process from instantaneous peak events, enabling a design based on average flows rather than peak flows.

As indicated in Table 3 above, a peaking factor of 1.2 has been adopted for the treatment plant itself. This peaking factor has been advised by the client's Civil Engineer, Mckenzie & Co. An example of a balance tank on a membrane bioreactor recently designed and built by Apex Water is shown in Figure 4 below.

Figure 3: Karaka North WwTP flow balancing tank for MBR process

RAW WASTE QUALITY

The wastewater stream entering the plant comprises domestic, commercial, industrial and recreational sources. In staged developments, it is common for the strength of sewage to be higher when there are fewer connections, gradually reaching a more typical sewage strength as the development expands.

A summary of guidance values used for wastewater strength is presented in Table 4 below. These values presented follow the Auckland Regional Council Guidance Document GD06 (Chen & Roberts, 2021) as well as real world historical data obtained from the similar sized Clarks Beach community.

Table 4: Expected wastewater strength

		GD06	Clarks Beach	
		Raw Wastewater	Median	95^{th} Percentile
Flow (m^3/day)		-	250	250
COD (mg/L)		-	550	1,100
COD-filtered(mg/L)		-	200	332
BOD (mg/L)		250 - 350	270	420
TSS (mg/L)		300 - 400	-	-
TKN (mg/L)		-	65	94
NH_4-N(mg/L)		-	48	65
NH_3(mg/L)		Varies	-	-
NO_3(mg/L)		<1	-	-
TN (mg/L)		Varies	-	-
PO_4(mg/L)		10 - 30	-	-
TP (mg/L)		-	10	13
Faecal coliforms (cfu/100mL)		10^8 - 10^{10}		

The design basis for ASPC focuses on ensuring compliance with treated wastewater discharge quality requirements under conditions where inflows are at the 95th percentile values reflected within the Clarks Beach results provided above. These values are considered more conservative than the equivalent outlined in GD06 and are also more applicable, as they represent real-world data from a similarly sized small community, whereas the GD06 guidelines are more suited to individual lots.

While it is generally considered conservative to design all aspects of the wastewater treatment process around 95^{th} percentile strengths, this approach does not apply to the ratio of nitrogen to carbon in the raw sewage. The nitrogen and carbon concentration of typical sewage generally makes up the basis for the design of the biological process. In scenarios where the ratio of carbon to nitrogen in the wastewater is insufficient the removal of nutrients can become more difficult to achieve. Although this situation is less pronounced in standard, mature residential catchments, it can arise in areas with numerous bars or restaurants contributing to the flow, or in the early stages of development, and where residence times in the sewer network are prolonged due to low flows, leading to BOD degradation within the network.

Although the plant con be expected to operate with nutrient ratios like those presented in the table above, the design must incorporate sufficient flexibility to accommodate the upper range of nitrogen and phosphorus concentrations, even when receiving wastewater with lower BOD and COD strength. In this case dosing of supplemental carbon in the form of acetic acid has been included to correct the C:N ration if required.

SURFACE WATER QUALITY

Ecological assessments undertaken by Viridis, have identified the receiving environment at the ASPC as sensitive and already subject to ecological stress, necessitating a high level of nutrient removal within the treatment process. A full ecological report and wastewater discharge assessment, prepared by Viridis (2025,2026), is included in the supporting documentation for the substantive application and provides a detailed assessment of the existing in-stream physicochemical conditions and ecological health. This requirement is corroborated by hydrological investigations completed by Williamson Water & Land Advisory (WWLA). While the median flow in the stream is 16.5L/s and the stream peaks as high as 127L/s, the Mean Average Low Flow (MALF) is less than 1 L/s indicating limited assimilative capacity under prolonged dry weather conditions.

These conditions support the adoption of a hybrid treated water discharge approach with treated water being applied to land via irrigation whenever possible (especially in dry weather conditions), before only water that exceeds the assimilative capacity of the receiving soils is further polished to extremely high quality by reverse osmosis and discharged to land where it may ultimately enter the water course.

OPTIONS ASSESSMENT

The suitability of various treatment systems currently in operation throughout New Zealand have been assessed for the ASPC. It should be noted that in this case the condition of the receiving environment is the limiting factor in technology selection, requiring a treatment process capable to removing all but trace levels of nutrients and other contaminants in most of the discharge scenarios assessed. The list of suitable treatment process capable of achieving the required level of nutrient removal, as assessed in this report are shown below.

- Membrane Bioreactor (MBR) with Reverse Osmosis Membranes
- Hybrid Membrane Aerated Biofilm Reactor with Tertiary Membrane Treatment. (MABR-MBR) with Reverse Osmosis Membranes

These are all biological wastewater treatment processes that employ bacteria to facilitate the removal of organic contaminants and nutrients from the wastewater. As each of the treatment processes proposed require the addition of Reverse Osmosis membranes as a final 'polishing' step, a standalone section on this technology has been included below.

Based on the need for robustness and flexibility, and the limitations imposed by the receiving environment, an MABR-MBR hybrid biological process with Reverse Osmosis membranes for final polishing to extremely high quality was identified as the most suitable option for the ASPC Wastewater Treatment Plant.

Membrane Bioreactor (MBR)

A membrane bioreactor (MBR) system combines the activated sludge process (a wastewater treatment process characterised by a suspended growth of biomass) with a micro or ultra-filtration system that rejects particles >0.1 – 0.4micron in size. By excluding particles of such a small size, the treated wastewater produced by a MBR plant can reject almost all bacteria and larger pathogens, with samples of permeate from MBR plants designed by Apex often demonstrating undetectable E. coli concentrations (<1cfu/100mL).

MBRs have two basic configurations: (1) an integrated configuration that uses membranes immersed in the bioreactor, and (2) a recirculating configuration where the mixed liquor circulates through a membrane module situated outside the bioreactor.

Figure 5 below demonstrates an example of an MBR servicing the community of Meremere designed and built by Apex Water.

Figure 4: MBR treatment plant designed and built by Apex for Watercare

The MBR represents the best available technology for the ASPC, delivering a clear effluent of low suspended solids content (generally <4mg/L even with an allowance of breakage of some filtration membranes), making it ideal for the proposed discharge and reuse applications. The key benefits of MBR technology for this application are shown in Table 5, below.

Table 5: Benefits of MBR technology

Benefit	Description
Reliability	The MBR process is well established and utilised in new wastewater treatment processes in New Zealand. Its reliability is well demonstrated with Apex Water having designed and built numerous such plants for public and private clients through the country
Compact Process	As the submerged membranes act as a physical barrier, the suspended biomass can be present a very high concentrations allowing very efficient treatment in a compact footprint
Process Flexibility	The MBR process can be operated to handle varying wastewater strengths including high strength wastewater
Membrane filtration	The membrane filtration step prevents bacteria from entering the treated water, producing exceptionally clear low turbidity permeate. This clear permeate is well suited to further treatment i.e. UV disinfection, chlorination, or Reverse Osmosis (RO).

Figure 6 provides an example of above ground concrete membrane tanks at a membrane bioreactor treatment plant that has been designed and built by Apex Water for an industrial client in New Zealand.

Figure 5: An Apex MBR membrane tank

Hybrid Membrane Aerated Bioreactor and Membrane Bioreactor (MABR + MBR Hybrid)

The Membrane Aerated Bioreactor (MABR) is a more recent modification of the activated sludge process employing gas permeable membranes that provide extremely efficient aeration and a growth surface for biofilm. Because diffusion of air through the membrane is up to 10 times more energy efficient than traditional aeration systems, biological treatment can be achieved in MABRs at a lower power consumption than conventional wastewater systems. Furthermore, the counter diffusion of oxygen and nutrients enables simultaneous nitrification-denitrification within the MABR tank. When compared to other treatment technologies, the MABR process requires a smaller footprint (i.e., smaller tanks) and uses less aeration energy to achieve the same level of nitrification, which often constitutes one of the largest operational expenses.

As a standalone process, the MABR produces effluent with a total solids concentration comparable to that produced by conventional activated sludge processes. Unless coupled with a membrane or filter to effectively separate and remove bulk solids from the treated wastewater, the treated effluent quality would be unsuitable for further tertiary disinfection (i.e. ultraviolet disinfection) or discharge to a sensitive environment. Incorporating MABR technology into an MBR process results in a highly effective nutrient removal system that occupies less space, operates more robustly, and produces effluent of an extremely high quality.

The MABR process is considered a modified activated sludge process and therefore can often be applied to enhance the performance of treatment systems based on the same process (e.g. Activated Sludge or MBR). For reasons noted above, integrating MABR technology into these processes can deliver a number of benefits, including improved performance, a reduced plant footprint, and lower operating (OPEX) costs. An image of MABR modules awaiting installation is shown in Figure 7 below.

Figure 6: Example of OxyMem type MABR modules prior to installation inside tank. Each module houses gas permeable membranes which provide a growth surface for the biomass.

The key benefits of MABR-MBR technology for this application are shown in Table 6, below.

Table 6: Benefits of Hybrid MABR-MBR technology

Benefit	Description
MBR Benefits	As the treatment process incorporates MBR into the treatment train, the same benefits are present as detailed above
Waste Production	The high efficiency of the biofilm requires less biology for the same treatment, meaning waste biology (WAS) volumes are lower compared to other conventional treatment processes.
Operational Cost	Lower sludge production and chemical dosing requirements result in lower operational and disposal costs.
Scalable and Modular	The treatment process is easily scaled and can be designed to accommodate modular implementation. The treatment process is so compact and efficient that at some scales modular, offsite construction is viable.
Energy Efficiency	The MABR technology can offer better environmental performance when measured against other conventional treatment processes.

Figure 8 below demonstrates a hybrid MABR / MBR treatment plant designed and constructed by Apex Water for Watercare.

Figure 7: Raglan WWTP.

Although the hybrid MABR-MBR system is often considered the best available technology for sewage treatment in New Zealand and is rapidly being adopted by councils throughout the country (especially those requiring surface water discharges), the receiving environment analysis by Viridis suggests an even higher level of treatment is recommended before discharging to an environment where the treated water may enter the low flow watercourse on this site. For this reason, a polishing RO treatment step is recommended for any water discharged to land that may subsequently enter the unnamed tributary of the Rangitopuni Stream.

Reverse Osmosis (RO) Polishing Membranes

To achieve this extremely high standard of treatment, a reverse osmosis (RO) polishing stage has been incorporated into each of the treatment process options considered. RO is a pressure-driven membrane separation process that allows water molecules to pass while effectively rejecting a broad spectrum of dissolved contaminants, including salts and nutrient species. This results in a high purity permeate and a concentrated retentate stream containing the removed constituents.

The treated permeate from the RO system is approximately ten times cleaner than the discharge from a traditional membrane bioreactor, which in itself is already widely accepted as best available technology for sewage treatment in New Zealand.

While the membrane bioreactor (MBR) utilises ultrafiltration membranes capable of excluding solids and microorganisms down to bacterial size, RO membranes possess significantly smaller pore sizes that also restrict the passage of dissolved ions such as ammonium, nitrate, and phosphate along with larger molecules and particles such as viruses. The inclusion of this process enables the level of nutrient reduction required to protect even the most sensitive receiving environments.

Although the application of RO in conventional wastewater treatment is uncommon, largely due to the additional cost, it is widely implemented internationally where wastewater reclamation and potable reuse is the desired outcome. The integration of RO within the ASPC treatment system is therefore an advanced design measure that will produce an exceptionally high-quality effluent, among the cleanest treated sewage discharges in New Zealand.

TREATMENT PROCESS SELECTION

A multi-criteria assessment (MCA) has been conducted on the various processes considered, to evaluate each of these on Performance, Future Proofing, Operability, Constructability, Social and Environmental Impact and Resilience and Process Resilience. For each of these parameters, the recommended Membrane Aerated Biofilm Reactor and Ultra filtration MBR membranes has been compared to the most common traditional treatment solution which consists of a 4-stage Bardenpho activated sludge treatment process.

It should be noted that RO has been excluded from this assessment, as the technology is required for each of the options presented, in order to reduce nutrients to trace levels.

Table 7: Multi Criteria Assessment on Treatment Processes Considered

Category	Criteria	Weighting	Base Option 1 MABR + MBR		Option 2 Bardenpho MBR	
			Score	Weighted Score	Score	Weighted Score
Performance	Treated Effluent Quality (suitable for Surface Water)	20%	0	0	-1	-0.1
	Reliability & Robustness	10%	0	0	-1	-0.1
Future Proofing	Phased Construction & Future Upgradability	10%	0	0	-1	-0.1
	Relocatable / Suitability for Interim plant	10%	0	0	-1	-0.1
Operability	Ease of operation	7.5%	0	0	-1	-0.075
	Process safety	7.5%	0	0	0	0
Constructability	Ease of implementation	5%	0	0	0.5	0.025
Social and Environmental Impact	Amenity impacts (noise, odour etc)	5%	0	0	0	0
	GHG emissions	5%	0	0	-0.50	-0.025
Resilience	Process stability under peak flow	5%	0	0	-0.5	-0.025

	Process stability under future load conditions	5%	0	0	1	0.05
Financial	Indicative capital cost	5%	0	0	1	0.05
	Relative operating cost	5%	0	0	-1	-0.05
Total Option Score				**0**		**-0.45**
Rank				1		2

Score	**Description**
-2	Much Worse
-1	Moderately Worse
0	Same as Base Option 1
1	Moderately Better
2	Much Better

Disadvantages of MABR-MBR-RO Hybrid System

As is the case with any process technology, the MABR-MBR hybrid system does present some limitations and disadvantages. The disadvantages associated with the treatment process are well defined and through process design can be largely mitigated. The disadvantages of the MABR-MBR system include:

Table 8: Limitations of MBR Treatment Processes

Limitation	**Description**
Flow Limitations	The membranes that provide the physical barrier between the treated wastewater and the bacteria / sewage also provide a physical limit to the total flow that the plant can handle. The surface area available for filtration, the level of membrane fouling blocking liquid flow, and the physical pressure limitations of membranes all contribute to providing a hydraulic upper limit to a membrane treatment process. On systems with large peak flows, mitigation measures (such as flow balancing, use of low-pressure sewer, or oversizing MBR membranes need to be implemented to handle these peaks.
Membrane Fouling	The blocking of membrane pores over a period of operation due to the accumulation of organic fouling or deposition of inorganic scaling restricts flow through the membrane. While Membrane fouling presents one of the largest operational complications with MBR technology, well established automated cleaning of the membranes to remove these blockages largely mitigates this risk. Cleaning processes must be performed proactively and controlled in accordance with good operational practices to ensure process performance and integrity of the membranes is maintained.
RO Retentate Stream	One issue that needs to be addressed in the use of RO filtration, is the disposal of the concentrated retentate stream, comprising contaminants that cannot pass through the membrane. Depending on the RO treatment train design, this rejects stream could produce a waste stream of approximately 10 - 30% of the total volume fed to it. While this represents an operational constraint, it is worth noting that the retentate stream that will result from the proposed ASPC WwTP is still of a high enough quality that there are various viable applications for reuse of this treated waste stream by irrigation around the development.

An example of hollow fibre membranes with organic and inorganic fouling on the surface pre-cleaning can be seen in Figure 9 below.

Figure 8: Hollow membrane filter with visible fouling

Expected Wastewater Quality from MABR-MBR Hybrid System

The resulting treated effluent quality from the MABR-MBR hybrid system is of such a high quality that by the World Health Organization (WHO) Standards, it meets the requirements for bathing water quality and Queensland guidelines for Class A recycled water without further treatment processes. For similar treatment processes it is not uncommon for an MBR to have undetectable levels of *E.coli* bacteria in the discharge (e.g., <1 CFU per 100mL).

The addition of reverse osmosis membrane filtration as a polishing step provides a significantly more robust physical barrier to the discharge of solids and nutrients. This step ensures that the treated water has close to zero solids and that virtually all bacteria, protozoa and viruses are removed from the treated permeate. From a practical perspective and to allow for any minor leaks or damage to membranes, MBRs are often designed to achieve a treated water quality of <4 E. coli/100mL. Following this with UV and Reverse Osmosis would also remove or deactivate almost all viruses from the wastewater.

Table 9 below presents the expected treated effluent quality.

Table 9: Expected treated effluent quality

Parameter		**Expected Treated Water Quality Median from the RO Treatment Step**	**Expected Treated Water Quality Median from the MABR-MBR Treatment Step**	**Consent Discharge Limits for Karaka North (1250 Lots) to irrigation and to stream via land**	**Watercare Consent Limits for Direct Discharge to Ocean from Clark's Beach**
$cBOD_5$	mg/L	1.0	5	5	5
TSS	mg/L	4	4	4	5
TN	mg/L	1.0	5	5	5
TP	mg/L	0.019	2	2	Not limited
AMM-N	mg/L	0.11	2	2	2
E. Coli	MPN/100mL	<4	<4	<4	UV treatment required but no E. *Coli* limit specified

Wastewater Environmental Performance Standards 2025

The Water Services (Wastewater Environmental Performance Standards) Regulations 2025 (WWEPS) have recently been enacted by the New Zealand Government. While the regulations apply exclusively to local authorities and local authority–controlled organisations, they establish a streamlined consenting framework by prescribing discharge quality limits that treated wastewater discharges must achieve across a range of receiving environments. Where a proposed discharge demonstrably complies with the prescribed effluent quality standards, a resource consent application may be progressed on the basis of compliance alone. This approach allows for a streamlined and less expensive consenting process, with assessment focused primarily on treatment process capability and performance.

The proposed treated effluent quality for the ASPC wastewater treatment plant meets or is better than the applicable WWEPS discharge quality criteria for all specified parameters. A comparison between the WWEPS standards and the proposed treated wastewater discharge quality is presented in Table 10 below.

Table 10: A comparison of the WWEPS (2025) quality limits for discharge to a very low dilution stream compared to the proposed Surf Park discharge

Parameter	**Proposed**	**WWEPS (2025)**
cBOD5 (mg/L) – Annual Median	1.0	5.0 – Annual Median *10.0 – 90th Percentile*
TSS (mg/L) – Annual Median	4	5.0 10.0 – 90th Percentile
Amm-N (mg/L)–Median	0.11	*1.0 – 90th Percentile*
Total Nitrogen (mg/L) – Annual Median	1.0	4. 0 – Annual Median
Total Phosphorous (mg/L) – Annual Median	0.019	0.5 – Annual Median
E.coli (cfu/100mL) – 90th Percentile	<4	130

Prevalence of MABR-MBR Systems in the Auckland Region

Over the past decade, most new sewage plants within the Auckland Region and surrounding area are MBRs. These include Pukekohe, Warkworth, Clarks Beach, Waiheke, and Karaka North. In the Waiheke Island application, due to the nature, occupancy and diet over the holiday periods, the wastewater can be unusually strong with peaks up to ten times as strong as typical sewage. Despite this, the system has demonstrated treated wastewater quality as shown in Table 11 below:

Table 11: Proven treated effluent quality from MBR

Parameter	Concentration
Total Nitrogen (mg/L)	<10
cBOD5 (mg/L)	<2
Total Suspended Solids *mg/L)	<1
E. coli (CFU/100mL)	<1

The implementation of MABR processes has been much more recent within New Zealand, due to the relatively new nature of this problem, and the tendency of New Zealand municipalities to await substantial proof of reliability and successful implementation off sure before adopting new technologies.

In New Zealand, Watercare has been instrumental in the uptake of MABR technology, with the Te Kauwhata wastewater treatment plant (operational since 2023) being the first full scale example in New Zealand . This plant is designed to treat wastewater flows to reliably achieve the quality shown in Table 12 below.

Table 82: Performance of Hybrid MABR-MBR system

Parameter	Concentration
Average Flowrate (m3/d)	1,500
Peak Flowrate (m3/d)	2,000
cBOD5 (mg/L)	10
Total Nitrogen (mg/L)	5
Total Suspended Solids (mg/L)	<5

Based on proven success at Te Kauwhata WwTP, Watercare have further installed MABR upgrades with the support of Apex Water in Raglan and Meremere and are currently implementing further upgrades to Clark's Beach as well as new plants in Wellsford and Snells Beach with the same technology. Planning is also well advanced for new hybrid MABR-MBR plants in Ngruawahia, Te Kauwhata, Huntly, Hamilton South and Manapouri.

Management of Discharges

The management of discharges from the proposed wastewater treatment plant is a critical element of the overall treatment plant design. By adopting an effects-based approach to the management of discharges into the environment, the treatment processes and discharge infrastructure can be designed and operated in a way to economise the operation of the plant while minimising the environmental impact.

The proposed discharge locations for the wastewater streams are listed below:

- Discharge of RO permeate to the unnamed tributary (via application to land adjacent to the water course)
- Discharge of MABR-MBR permeate to land irrigation
- Discharge of RO retentate to land for reuse of recovered nutrients
- Water treatment plant residuals (waste stream) – Direct to the wastewater treatment plant to be included among the above disposal streams

A detailed assessment of each discharge scenario is outlined in the sections below.

Prior to the polishing of the MABR-MBR permeate via RO, the wastewater treated by the hybrid MABR-MBR plant is of such high quality that it meets Health Organisation guidelines for bathing water. This highlights the exceptionally high quality of the discharge and the protection the treatment process provides both to the environment and public health.

Whilst there are currently no specific regulations or standards for recycled water in New Zealand, the proposed system can meet the Queensland Public Health Regulations 2005 for its highest grade: Class A+ Recycled water suitable for dual reticulation, however this level of reuse is not proposed as a part of this substantive application.

Table 3 provides details of the indicative log removal required to achieve Class A+ recycled water alongside indicative log reduction of enteric pathogens and other indicator organisms as detailed within the Australian National Guidelines for Water Recycling: Managing Health and Environmental Risks for the proposed ASPC treatment process (Natural Resource Management Ministerial Council, Environment Protection and Heritage Council, Australian Health Ministers' Conference , 2006).

Table 13: Recycled Water Classifications (Department of Energy and Water Supply Queensland, 2008)

Indicative Log Removal Required to Achieve Class A+	**Proposed Treatment Log Removal**	**Microbiological Pathogens**	**Comment**
5	~11.5	Bacteria – Indicator E. coli	Each processing step provides a different level of log removal; these are typically added to provide the total – For E.coli the following applies: MBR – 3.5 - >6.0 RO - >6.0 UV – 2.0 - >4.0
6.5	~10	Viruses – Indicator F-RNA bacteriophages, Somatic coliphages	Each processing step provides a different level of log removal; these are typically added to provide the total – For viruses the following applies: MBR – 3.0 - >6.0 RO - >6.0 UV – 1.0 - >6.0
5	~12	Protozoa – Clostridium perfringens	Each processing step provides a different level of log removal; these are typically added to provide the total – For protozoa the following applies: MBR – >6.0 RO - >6.0 UV – N/A
5	~12	Helminths – Clostridium perfringens	Each processing step provides a different level of log removal; these are typically added to provide the total – For helminths the following applies: MBR – >6.0 RO - >6.0 UV – N/A

In addition to meeting the requirements for Grade A+ Recycled Water, the proposed treatment system aligns with international examples where treatment processes are utilised for drinking water re-use applications. Figure 10 below illustrates a number of international examples, as sourced from the World Health Organization report on Wastewater Re-use where wastewater is treated and re-used for drinking water applications. The proposed treatment process aligns with the portions outlined in red. (Noting that treatment steps beyond this are largely intended to improve the taste of the water and maintain pathogen protection throughout the drinking water network).

Figure 10: International Examples of Wastewater Reclamation Processes

Discharge Options at the ASPC

The proposed discharge options and the proceeding treatment steps for the ASPC site are as detailed in Figure 1 below:

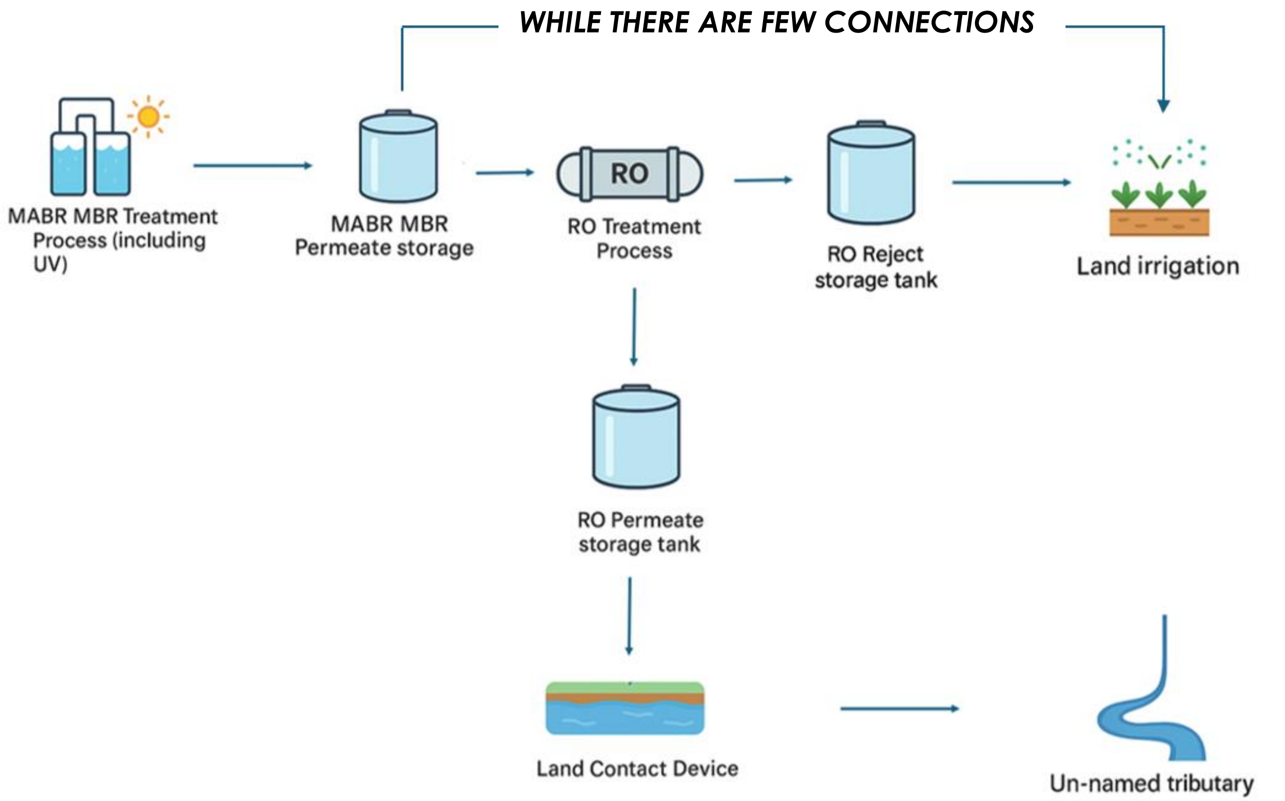

Figure 11 Discharge paths

The plant control system will be configured to automatically select the appropriate discharge path, based on real time meteorological or environmental monitoring. Site investigation by Viridis has highlighted the sensitive nature of the receiving unnamed tributary during periods of low flow. As such, mitigations have been included to ensure the discharge of nutrients to land where it may enter the stream is minimised during periods where flows may be low. This shall be managed by real time level monitoring of the stream and soil conditions feeding back to the plant's automated control system for selection of the best discharge path.

THE LAND CONTACT DEVICE

Following consultation by ASPC with local stakeholders and to align the discharge with cultural best-practice, it has been determined that the discharge shall utilise a land contact device. This device will receive treated effluent and provide land passage prior to the water entering the unnamed tributary.

While not being accounted for in the mass balance calculations to determine impact on the receiving environment, the proposed land contact will provide an opportunity for the very small amount of remaining nutrients to be assimilated into the soil and substrate matrix of the contact device and the land between the contact device and the stream, before any water may ultimately enter surface water. In their best practice guidelines for wastewater discharges to land, Beca Limited describe how land passage discharge techniques have been developed as an alternative design to direct to water discharges. These techniques have been primarily developed to incorporate Māori cultural views that wastewater should be restored or cleansed through land contact bore entering a body of water (Beca Limited, 2022).

Not only does this approach provide a more naturalised discharge by providing infrastructure that blends into the local environment, but the consultation with stakeholders also makes up one of the core tenants of the National Policy Statement for Freshwater Management 2020 (NPS-FM). A key part of the NPS-FM is the explicit requirement to manage freshwater assets in a manner that upholds Te Mana o te Wai. Constructively engaging with local stakeholders and kaitiaki to understand what giving effect to Te Mana o te Wai means in the ASPC project setting is central to fulfilling obligations under the NPS-FM, to local iwi and other stakeholders. To this end, the ASPC project team have held a number of engagement sessions with local iwi and stakeholders with regard to the entire land development project to provide an open forum for discussion. Figure 12 below, taken from Beca's report into wastewater discharges to land highlights partially built land contact rock passage.

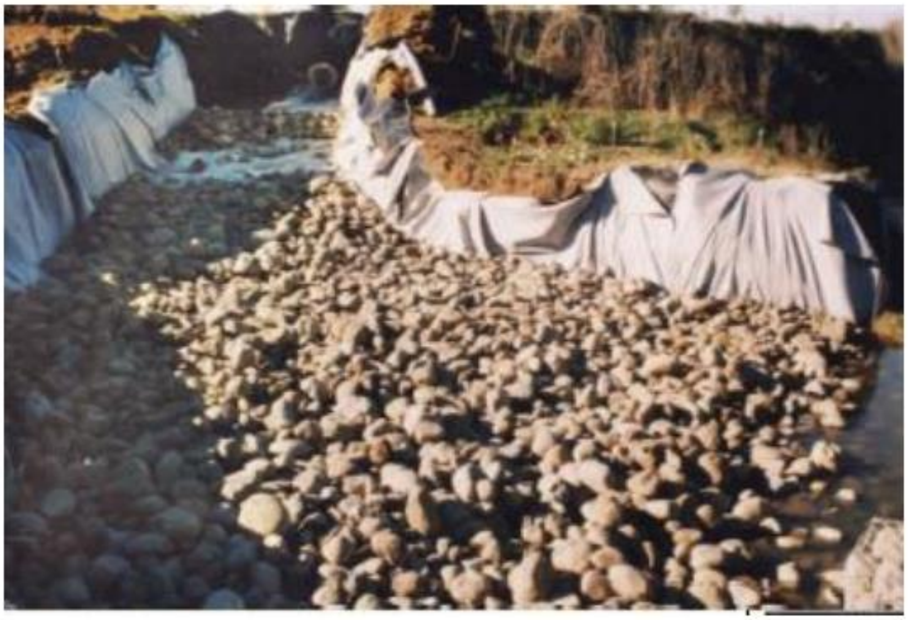

Figure 12: A rock filled trench for the contact of treated wastewater with land as a part of the wastewater treatment plant in Te Awamutu (Beca Limited, 2022).

This approach is commonplace throughout New Zealand with Apex Water having delivered many wastewater treatment plants incorporating this and other techniques into the plant discharge systems.

The finalised design of the land contact device shall be covered by the detailed design phase of the ASPC project. The principal of this design process shall be focussed on providing a naturalised discharge path, where the treated wastewater discharge is provided land contact where it can permeate through the soil. While the land contact process may not provide much additional treatment, it will make this water and any nutrients present available for uptake by planting through the area.

DISCHARGE OF MBR PERMEATE

By adopting an effect-based discharge regime, the plant shall be configured to allow for the discharge of treated wastewater from the MABR-MBR treatment process when there is sufficient environmental buffering to mitigate any impacts. In practice, this means that during the early years of the development when there is a large area available for the irrigation of treated wastewater but few connections to the treatment plant, that the MABR-MBR permeate may be discharged without first passing through the RO treatment process. It is noteworthy that the MABR-MBR process produces exceptionally high-quality treated wastewater, already widely regarded in New Zealand as best available technology for treatment of sewage prior to discharge to surface water without RO. It is a treatment process which makes up almost all new treatment plants or upgrades delivered by Watercare Services Limited in recent years where discharge to surface water is required. Figure 13 below identifies the treatment and discharge path that would be followed in this scenario.

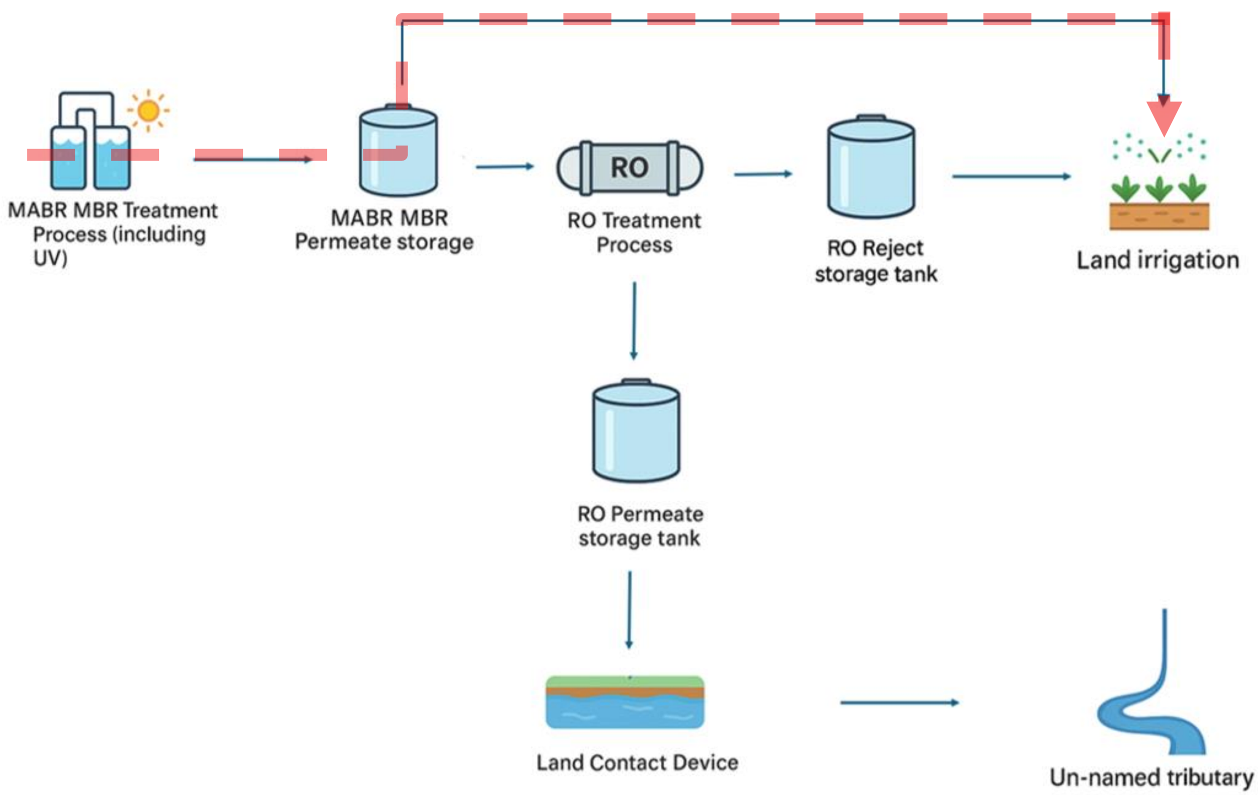

Figure 13: The discharge of MBR Permeate direct to land irrigation.

In the scenario that the MBR-MABR permeate is discharged from the site, this shall be discharged to land via the irrigation system. This approach aligns with the intent of the National Policy Statement for Freshwater Management (NPS-FW) by directing discharges when suitable to locations that protect, as best as possible sources of freshwater.

DISCHARGE OF RO PERMEATE

Once the development has grown to such an extent that the MABR-MBR permeate can no longer all be sustainably discharged to land, the Reverse Osmosis treatment process shall be established on site and discharge into the unnamed tributary of the Rangitopuni stream via land contact shall commence. This RO permeate stream shall be discharged into the land contact device which shall ultimately permeate via land contact into the stream. While the RO permeate shall discharge into the local stream (via land contact) the land available shall be held in reserve for the discharge of the concentrated RO retentate stream. The discharge of the RO retentate via irrigation is covered in the following sections. . . The discharge path covered by this section of the report can be seen in Figure 14 below.

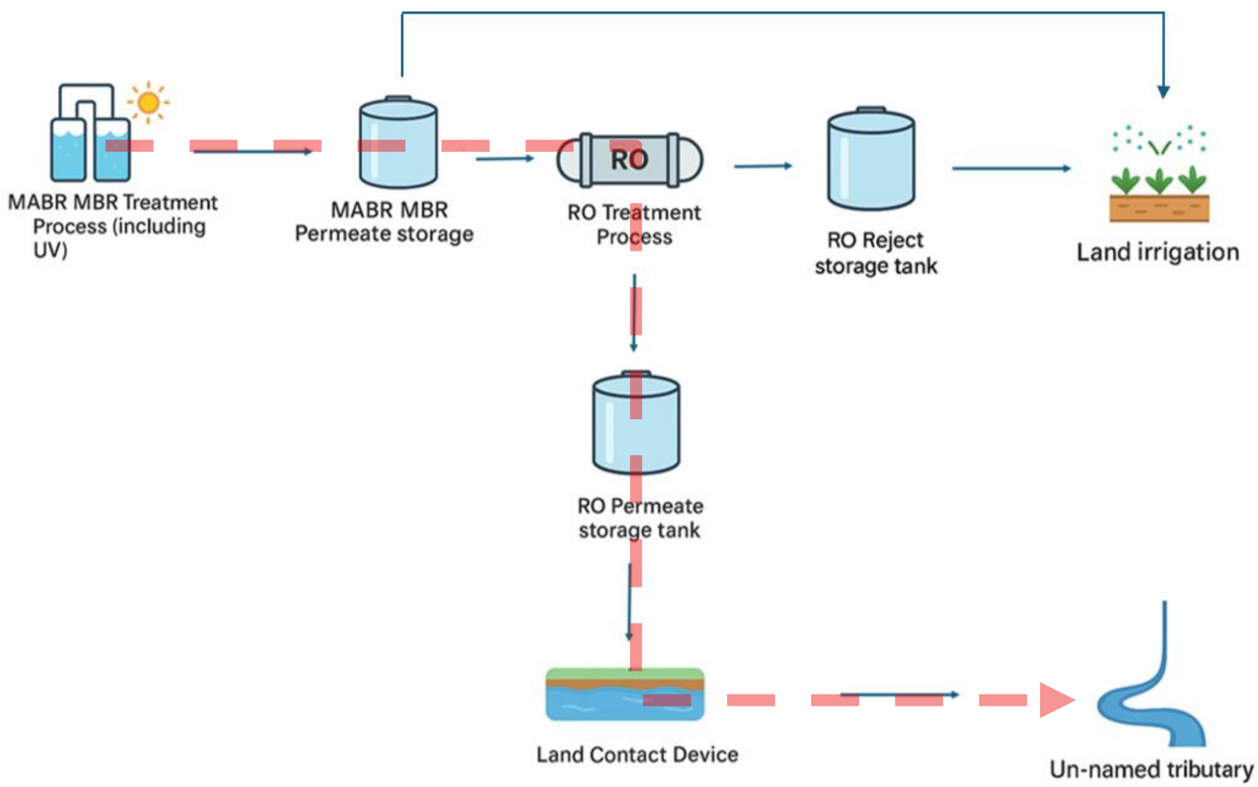

Figure 14 – The process steps for discharge into the unnamed tributary

Table 14 below outlines the average discharge quality from this treatment step.

Parameter		Proposed Treated Water Quality Median from the RO Treatment Step
$cBOD_5$	mg/L	1.0
TSS	mg/L	4
TN	mg/L	1.0
TP	mg/L	0.019
AMM-N	mg/L	0.11
E. Coli	MPN/100mL	<4

The technical assessment of the discharge carried out by Viridis highlights that treated wastewater at the quality detailed in Table 14 above is suitable for discharge into the unnamed tributary of the Rangitopuni stream under all scenarios.

DISCHARGE OF RO RETENTATE

A limitation of all RO treatment processes is that by virtue of their inherent design, the contaminants which are removed become concentrated into a second, smaller liquid waste stream. This stream requires further handling and management prior to discharge. The pathway for the discharge of RO concentrate/ retentate is detailed in Figure 15 below.

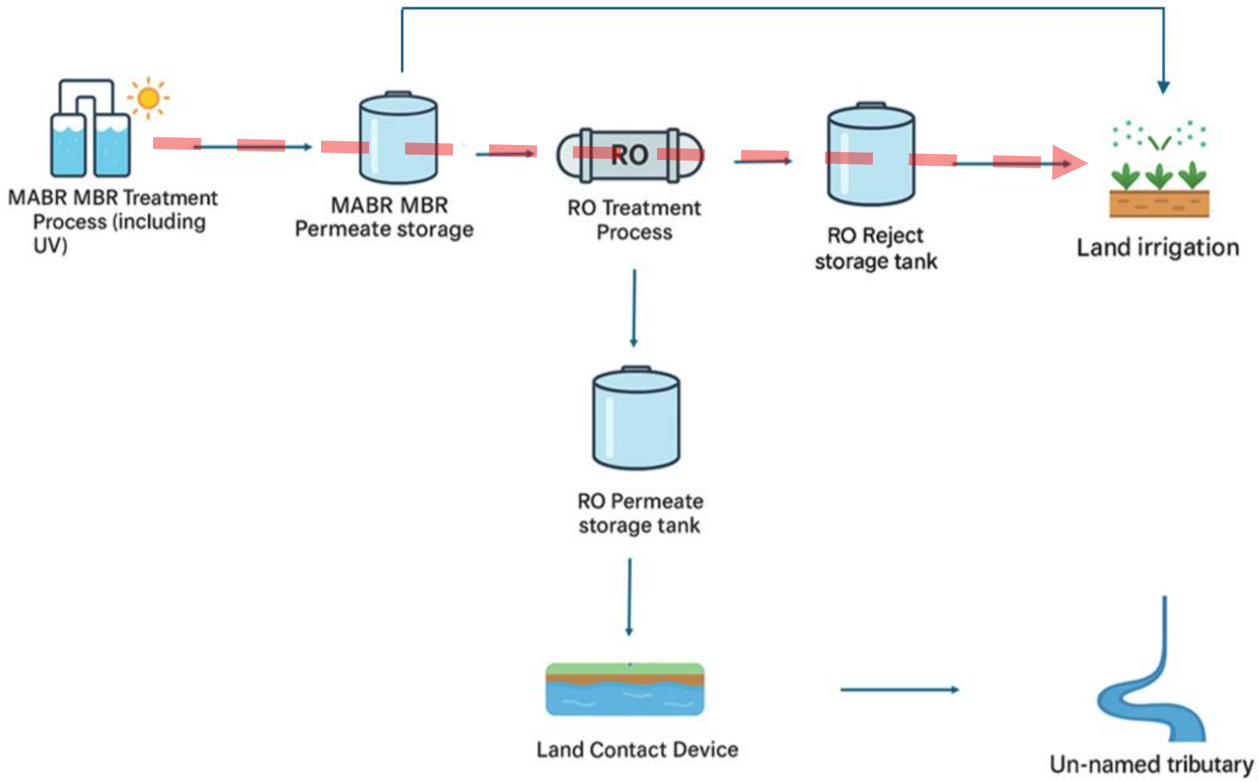

Figure 15 – The process steps for discharge of RO retentate to land irrigation

In the case of the ASPC project, the RO retentate shall be discharged to land irrigation. The proposal to irrigate discharges from the wastewater treatment plant allows for the beneficial re-use of a portion of the treated effluent through uptake by vegetation and to minimise, as best as possible, discharges to more sensitive receiving environments. Because the RO Retentate has already been treated by MBR and UV disinfection before entering the RO process, this effluent poses low risk to human health and meets the microbial requirements of Queensland Grade A recycled water for unrestricted municipal reuse. Due to this, suitable forms of irrigation reuse of this stream are:

- Spray irrigation of public areas at night
- Sub-surface irrigation of public areas when people are present
- Irrigation of landscaping

IRRIGATION RATES AND VOLUMES

An important consideration when assessing the irrigation of treated water is ensuring that this is carried out in a sustainable manner with respect to the underlying soil's ability to assimilate the volume and nutrient load discharged. Geotechnical investigations carried out across the ASPC site have indicated that the underlying soils fall into categories that are likely to have relatively low hydraulic conductivity and hence a limited ability to receive and assimilate high doses of irrigated water.

While relying solely on an assessment of the soil category to determine the sustainable application rate is an acceptable approach, this ignores evaporative losses to the atmosphere. During periods of warm weather especially over the summer months, soils are usually in moisture deficit. This means that more moisture is taken up by plant life and the evapo-transpired into the atmosphere than is replenished from rainfall. To this end, there is often a greater potential for soils to receive irrigation than that which the underlying soils can permeate through to groundwater. The discharge from the ASPC wastewater treatment plant has been modelled against 10-years of rainfall and Penman evapotranspiration records. From this, a moisture balance has been carried out including irrigation discharges from the wastewater treatment plant to determine whether the addition of this discharge will materially impact the ability of the soil and meteorological conditions to assimilate the volume irrigated.

The moisture balance has been carried out over two separate scenarios to account for the staging of treatment infrastructure, the growth of the development over time and the availability of irrigation land.

Stage 1 –

During the early years of the development, while only the first stages are complete, there will be fewer connections to the wastewater treatment plant. During this period, it is proposed that only MABR-MBR treatment process is established on site and all discharges from the treatment plant are directed to the available land irrigation areas.

During this period there will be a comparatively large area of irrigation available for use while the plant is operating well below its ultimate design capacity. As such, the first part of the treatment process, the MABR-MBR treatment plant shall be established on site for treatment of the initial load from the ASPC development. It is noteworthy that MABR-MBR treatment processes make up almost all new treatment plants in the Auckland region, many with surface water discharges, showing this to be an extremely robust solution while the discharge is directed to land.

During these early stages of the development, there will also be an excess of land available for irrigation, as the area beneath the solar panels located within the Designation for the Rapid Transit Network (RTN) area shall be available for irrigation.

Stage 2 –
Once the development growth is projected to reach the limit of what can be sustainably discharged on site (as determined by application rates and soil moisture measurements), the RO treatment plant shall be established and commissioned. The addition of the RO treatment plant shall allow for discharges of RO permeate to the unnamed tributary of the Rangitopuni stream via land contact. Once the RO treatment plant is in service, the lower volume concentrated RO retentate stream shall be directed to the irrigation area.

The two situations where the transition from scenario 1 to scenario 2 shall be required, are either through natural growth of the development resulting in a greater volume of discharged wastewater than the irrigation field can sustainably receive (as determined by soil moisture measurement), requiring a higher level of treatment and the ability to discharge to the tributary of the Rangitopuni stream via land contact, or when notification that the RTN Designation area is to be developed, and the available irrigation area is reduced.

Irrigation of MABR-MBR Permeate

For scenario 1, where the MABR-MBR permeate is to be irrigated, the assessment of the volume irrigated has been based on the assumptions listed in Table 15 below.

Table 15 Assumptions used in the calculation of MBR Permeate

Description	**Values**
Expected Land Area Available (m2)	13.47Ha (134,700m2)
Soil Percolation Rate (mm/day)	3
Nutrient concentration of discharge	MBR Permeate (refer table 9)
Maximum Irrigation Rate (incl. evapotranspiration) (mm/day)	10.8

The modelling carried out allows for the application of up to 3mm per day in all conditions but also allows for up to 10.8mm when soil and weather conditions are favourable. In practice, real time moisture monitoring of the irrigation areas is used to determine whether the soil moisture is suitable to receive greater than 3mm per day up to a maximum of 10.8mm per day. Should the monitoring indicate saturation prior to the 10.8mm application it shall limit the irrigation to 3mm/day when it determines that the soils are no longer capable of receiving additional flows.

To maximise the volume discharged to irrigation it is also proposed to buffer the discharges in a 1,200m³ irrigation tank. The benefit of including this tank is that it allows for the treatment plant to hold back flows to the irrigation field in the case that the soil conditions are saturated.

Table 16 below displays the outcomes concluded by modelling the discharge over the past 10-years of rainfall and Penman evapotranspiration data.

Description	**Values**	**Comment**
Average Sustainable Flow the Irrigation Field can receive (m3/d)	380	The RO treatment step must be put into operation prior to the average discharge volume reaching 380m3/day.
Housing Unit Equivalents (HUEs) Serviceable by the Irrigation Field	704	Note, this is equivalents only. A large portion of the flows received by the treatment plant are not related to the residential development and come from the ASPC, leisure precinct and commercial / light industrial areas.
Irrigation Tank Volume (m3)	1200	
Maximum Irrigation Tank Level Achieved Over Modelled Period (%)	89%	Over the 10-years modelled the buffer tank reaches a maximum of 89% level while buffering flows during poor weather, leaving 11% remaining. This shows that it is capable of buffering flows during wet weather periods where there is limited discharge capacity in the irrigation field.

Figure 16 below highlights in green the available land for irrigation through the ASPC development site.

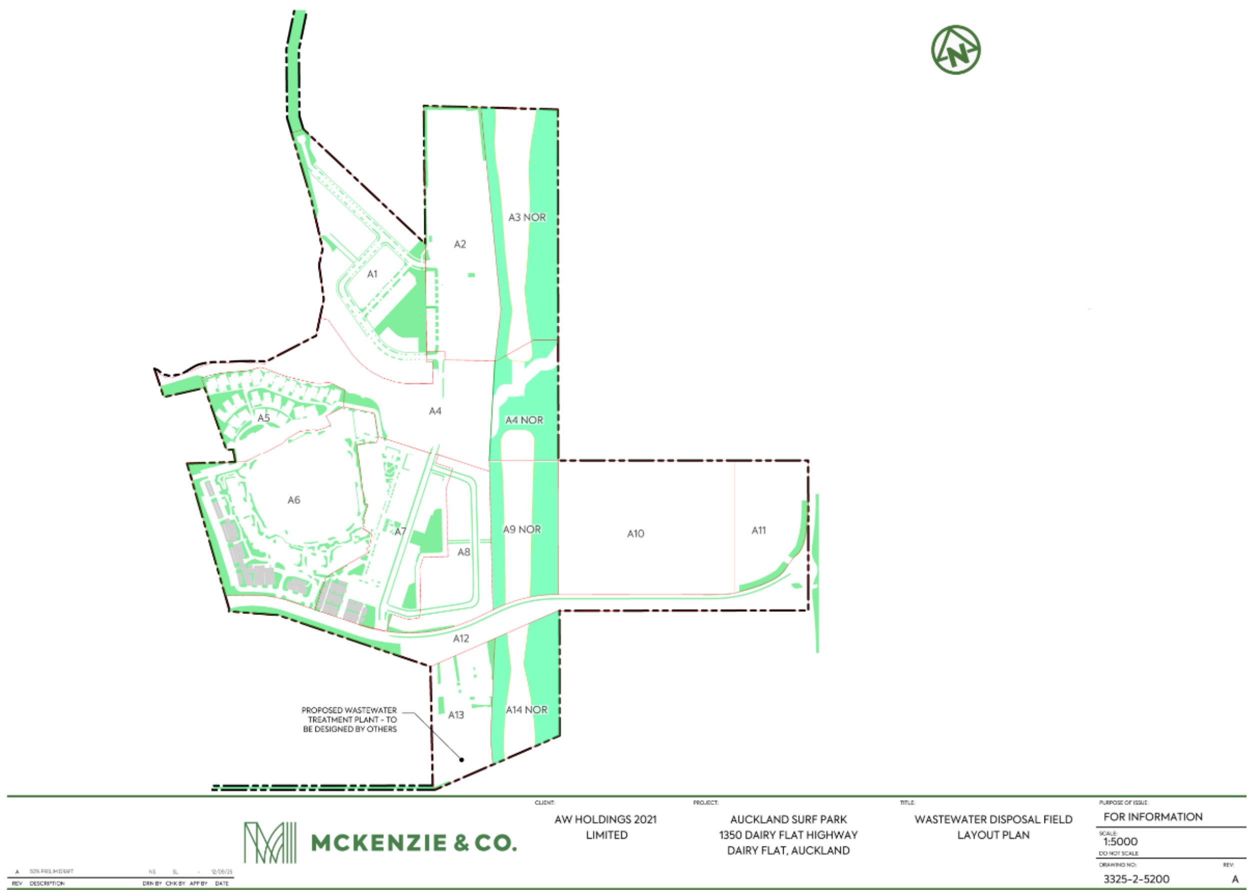

Figure 16 – The available irrigation land shown in green

Irrigation of Reverse Osmosis Retentate

For scenario 2, where the Reverse Osmosis retentate is to be irrigated, the assessment of the volume irrigated has been based on the assumptions listed in Table 17 below.

Table 17 – Assumptions used in the modelling of the discharge of RO Retentate

Description	Values
Expected Land Area Available (m2)	6.93Ha (69,300Ha)
Sustainable Irrigation Rate (mm/day)	3
RO Recovery Rate (%) *	70%
Nutrient concentration of discharge	RO Retentate rates
Maximum Irrigation Rate (mm/day)	10.8

The modelling carried out for scenario 2 utilises a smaller total irrigation area by assuming that the NOR area is not available for irrigation when the reverse osmosis treatment plant has been installed and is operational. Note that while the timing of NOR implementation is unknown, it is not expected to be called upon this soon and is more likely to likely to remain available for irrigation after the development has been substantially built out. Similarly to scenario 1, the modelling for scenario 2 allows for the application of up to 3mm per day in all conditions but also allows for up to 10.8mm per day when soil and weather conditions are favourable. It is noteworthy that at an application rate of 3mm/day, the peak volume of RO retentate produced is nearly equal to the sustainable assimilation rate of the irrigation field, prior to accounting for any evapotranspiration. This means that the irrigation field likely has a greater capacity to receive flows than are being discharged. The suggests that during prolonged periods of dry weather the irrigation zone will still likely operate at some level of moisture deficit despite receiving flows of RO retentate.

Table 18 below displays the outcomes concluded by modelling the discharge over the past 10-years of rainfall and Penman evapotranspiration data.

Table 18 – Irrigation Modelling Results

Description	**Values**	**Comment**
Irrigation Field Capacity at 3mm/day (m3/d)	207.9	
Average Retentate Flowrate (m3/day)	175.5	
Peak Retentate Flowrate (m3/day)	210.6	
Maximum Irrigation Tank Level Achieved Over Modelled Period (%)	89%	Over the 10-years modelled the buffer tank reaches a maximum of 89% level while buffering flows during poor weather, leaving in the worstcase11% remaining. This shows that it can buffer flows during wet weather periods where there is limited discharge capacity in the irrigation field.

Figure 17 below highlights in green the available land for irrigation through the ASPC development site under Scenario 2.

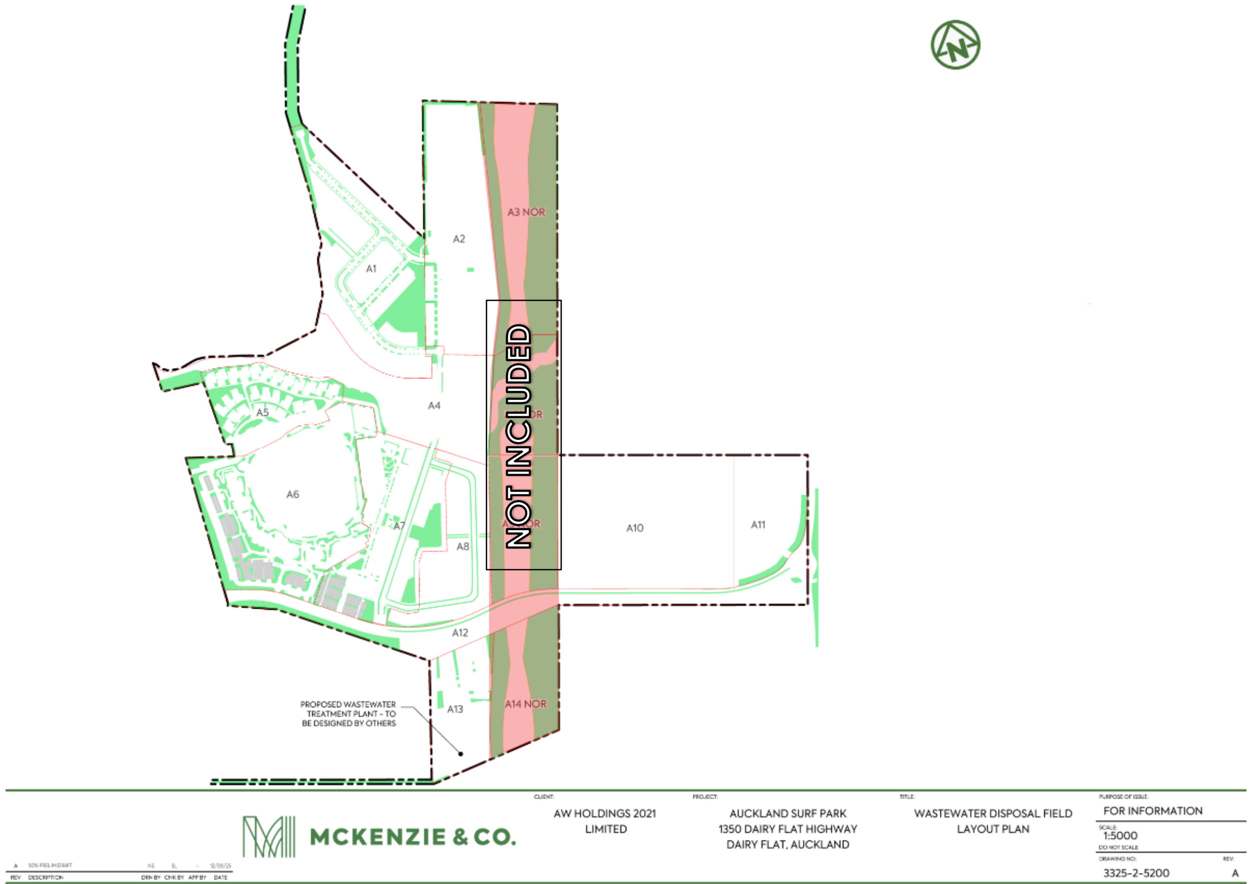

Figure 17 – The available irrigation land shown in green (excluding the area earmarked for future roading projects)

MAINTAINING SOIL HEALTH

Although the treated wastewater is of exceptionally high quality, consideration must be made to the nutrients it is providing to the soil in the irrigation field. The sustainable limits for application of nutrients to soil are as per the following table.

Table 99: Sustainable land application nutrient loading limits

Nutrient	Application Limit
Total nitrogen (TN)	150-500 kg/Ha.year
Total phosphorus (TP)	80 kg/Ha.year
Biochemical oxygen demand (BOD_5)	600 kg/Ha.day

To model application rates of nutrients into the irrigation field a mass balance has been carried out over both the MABR-MBR treatment process and the RO unit. The summary of the nutrient loading into the irrigation field is detailed in the following Table.

Table 20 : Total nutrient loading limits for irrigation options at the discharge strength permitted by the proposed conditions

Nutrient	**Application Limit**	**Scenario 1 – MABR-MBR Permeate - Proposed Application Rate**	**Scenario 2 – RO Retentate – Proposed Application Rate**
Total nitrogen (TN) kg/Ha.year	150-500	79.3	132.5
Total phosphorus (TP) kg/Ha.year	80	15.9	30.4
Biochemical oxygen demand (BOD_5) kg/Ha.year	600	0.22	0.36

Table 20 above, highlights that the nutrient loading rates to the irrigation field fall well below the sustainable rates which can be assimilated within the soil in both of the irrigation scenarios covered.

DISCHARGE OF CONTAMINANTS OF EMERGING CONCERN

Contaminants of emerging concern (CECs) are a diverse set of chemical and biological compounds that are increasingly being detected in wastewater and natural waters, often at trace levels. These compounds, often found in personal care products and pharmaceuticals are recognized as the next set of environmental pollutants due to their persistent nature and potentially toxic effects on human health and aquatic organisms, even at low concentrations. The discharge of these contaminants from industrial sources can be controlled in the Auckland-region through resource consenting and trade waste bylaws however, due to their effects at trace concentrations other smaller sources of discharge are often overlooked. Pharmaceuticals, shampoos, sunscreens, cosmetics, microplastics and detergents make up some of the common sources of CECs which make their way into the environment through wastewater treatment processes.

In the ASPC, the MABR-MBR treatment process, without the use of the RO membranes already represents an industry-wide best available technology for wastewater treatment. A study by Incheon National University showed that removal rates of CECs such as acetaminophen, ibuprofen, Diclofenac, ofloxacin, estriol, erythromycin and caffeine ranged from 90 to greater than 99% in membrane bioreactor systems, with many other CECs being removed at rates of 50-90%. In their study, Kwyon and Lee highlight that sludge retention times, sludge concentration and MBR configuration were important factors in the removal efficiency of CECs. These findings highlight the relationship between the activated sludge process at the core of the MABR-MBR and CEC removal rates. This aspect is important as it highlights that for an effects-based discharge regime like that proposed, utilising the MABR-MBR treatment process alone shall effectively control the discharge of many CECs from the proposed wastewater treatment plant.

DISHARGE EFFECTS ON SURFACE WATER QUALITY

A technical assessment of the effect of the discharge on the surface water quality has been carried out by Viridis and is presented in documentation supporting this application. The assessment has considered how discharge of treated effluent would impact the quality of the receiving environments under three different scenarios when the treatment plant is receiving its full design flows. This assessment assumes that all RO permeate is directed to the unnamed tributary and the RO retentate is direct to land. As such, the model assesses the impact on surface water quality in the worst case scenario.

A summary of these scenarios and a description of the effects are outlined in Table 21 below.

Table 21: Discharge effects on surface water quality

Scenario	**Description of Effect**
(1) Dry weather low flow discharge	Most contaminant concentrations in the receiving environment are predicted to be maintained at or improved relative to baseline; reductions in TSS, *E. coli* and total phosphorus. Minor increase in nitrate nitrogen, remaining within NPS-FM attribute A; no adverse ecological effects anticipated.
(2) Average weather discharge	Similar to dry weather conditions, with overall maintenance or improvement of water quality. Minor increase in nitrate nitrogen, remaining within NPS-FM attribute A; effects on aquatic values expected to be negligible.
(3) Peak wet weather discharge	High dilution results in parameters remaining consistent with baseline conditions; no nutrient increases predicted and effects on surface water quality expected to be negligible.

Water Treatment Plant Considerations

The water and wastewater treatment plant shall be co-located within the boundary of the same lot. There shall be a clear separation between the core infrastructure which separates the two treatment processes with the any potable water storage or handling kept as far away as practicable from any sewage storage or handling. Chemical dosing infrastructure shall be common to both plants and located near the bulk tanker load out bay. Figure 18 below highlights the separation between water and wastewater infrastructure on the site and highlights the prevailing wind blowing from the west.

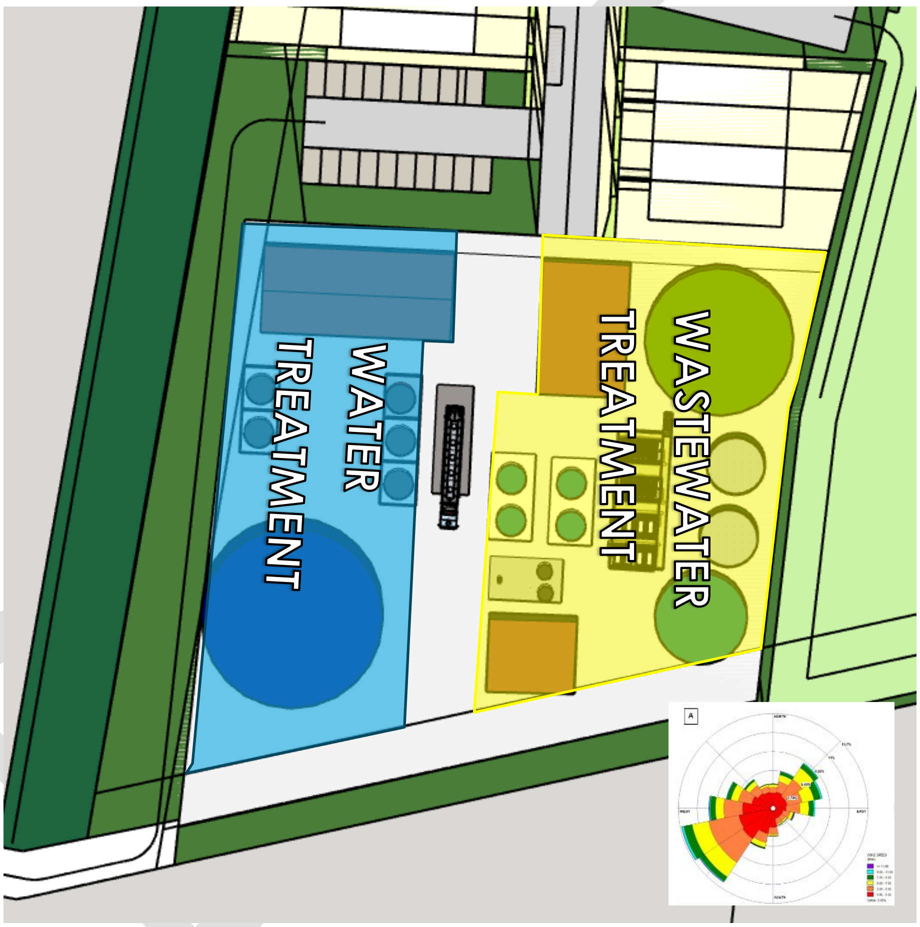

Figure 18 – The separation between water and wastewater infrastructure on the treatment plant compound site

During the detailed design process and as a requirement of becoming a registered water supplier, a water safety plan and source water risk assessment must be conducted. This process shall be carried out alongside the detailed design of the treatment plant allowing for design and operational considerations surrounding the colocation of the treatment plants to be appropriately captured and actioned.

Karaka North Village provides a reference where colocation of water and wastewater infrastructure has been implemented with the necessary precautions to protect source water and treated drinking water quality.

It should also be noted that while the bore is not located on the treatment plant site, that it extends to a significant depth of >600 metres, resulting in a very low risk of surface water infiltration. The bore and its headworks shall be constructed in accordance with drinking water standards and best practice guidelines to ensure source water protection and integrity of supply. The location of the bore on the development site can be seen in Figure 19 below.

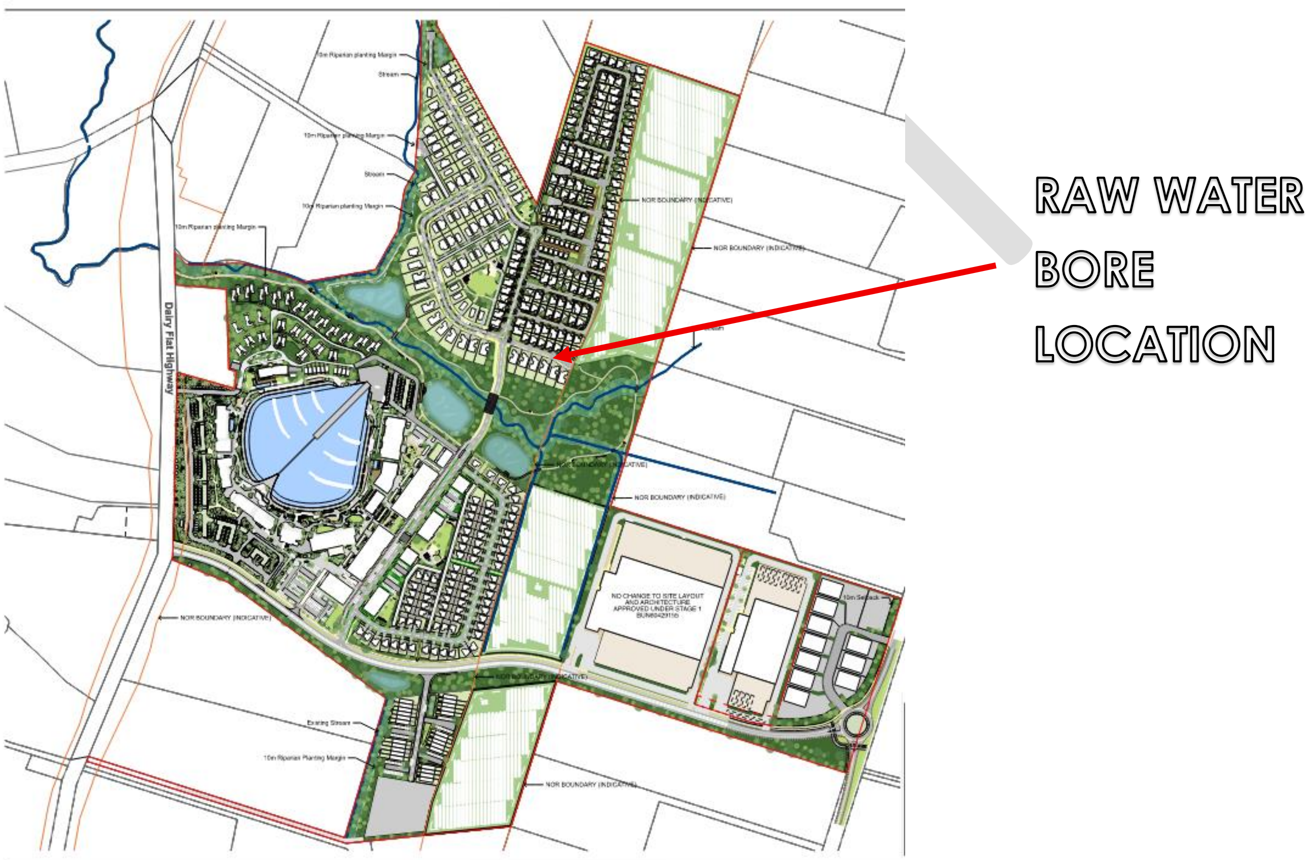

Figure 19 – The location of the raw water abstraction bore is shown on the ASPC Master Plan

Wastewater Treatment Train

Overview

A simplified process flow diagram (PFD) of the proposed MABR-MBR hybrid treatment train is illustrated in Figure 20.

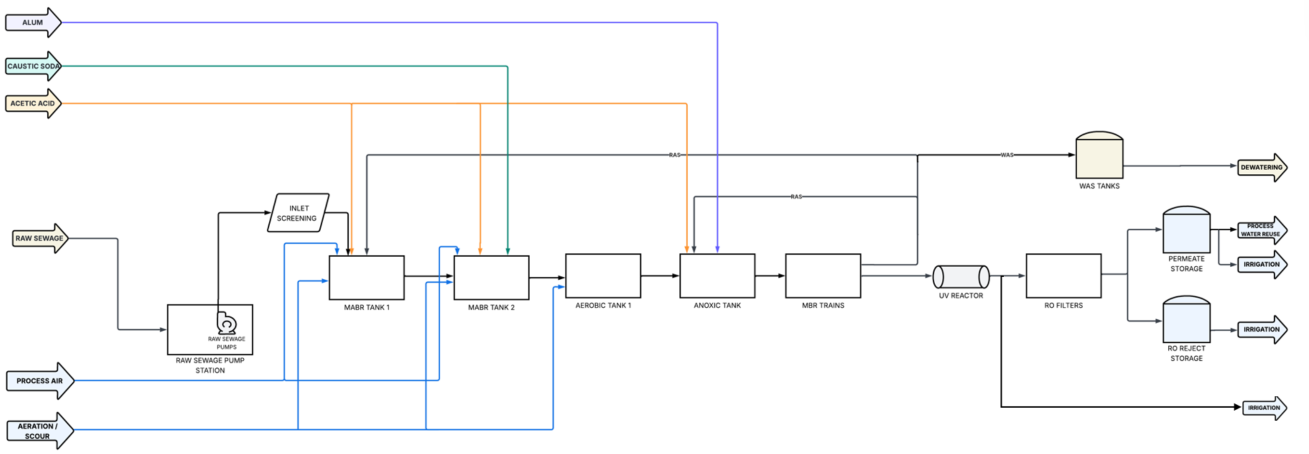

Figure 20: Process Flow Diagram

Wastewater from the various precincts enters the plant via a raw sewage pumpstation, or in the case of a pressure sewer network, directly from the pressurised network. The incoming wastewater is passed through an inlet screening process to remove solids, prior to entering a flow balancing tank.

The biological process tanks are configured in a four stage Bardenpho process:

- Pre-Anoxic Tanks (MABR Tank 1 & 2)
- Aeration Tank
- Post Anoxic Tank
- MBR Tank

The following biological process recycles are in place:

- Recycled activated sludge (RAS) from the MBR tanks to MABR tank 1 (less frequently), the aerobic tank, and the post anoxic tank (primarily).
- Waste activated sludge (WAS) is bled off the RAS line to the WAS dewatering system.

The following chemical dosing to the process tanks is in place:

- Acetic acid as a supplementary carbon source to provide food to the process.
- Sodium hydroxide to manage the pH of the treatment process. The biological process consumes alkalinity, decreasing the pH of the wastewater which is not managed negatively impacts biological activity.
- Aluminium sulphate is dosed to sequester phosphorus out of solution for removal
- Citric acid is used to remove inorganic scaling from the membrane surfaces through a Clean-in-Place (CIP) process.
- Sodium hypochlorite is used to remove organic fouling from the membrane surfaces through a CIP process.

The treated wastewater from the MBR is discharged to the UV Reactor for disinfection, prior to entering the Reverse Osmosis (RO) polishing process.

BioWin Modelling

The proposed wastewater treatment system design has been evaluated using the BioWin® biokinetic modelling software. This modelling phase is an essential part of the design process, confirming that the selected treatment configuration can effectively manage the anticipated influent flows and loadings. The results also provide critical input for project planning and consenting activities. In addition, the modelling outcomes define the preliminary sizing of key treatment units, supporting the development of initial site layout concepts.

BioWin® is an internationally recognised simulation tool that integrates biological, chemical, and physical process models to deliver detailed assessments of treatment plant performance under a variety of operational conditions. By constructing and optimising the BioWin® model, expected effluent quality can be modelled for multiple flow and load scenarios. Sensitivity analyses are then undertaken to evaluate how the proposed design responds to variations in influent characteristics, thereby testing its robustness and overall suitability.

An overview to the BioWin model is demonstrated by Figure 21 below.

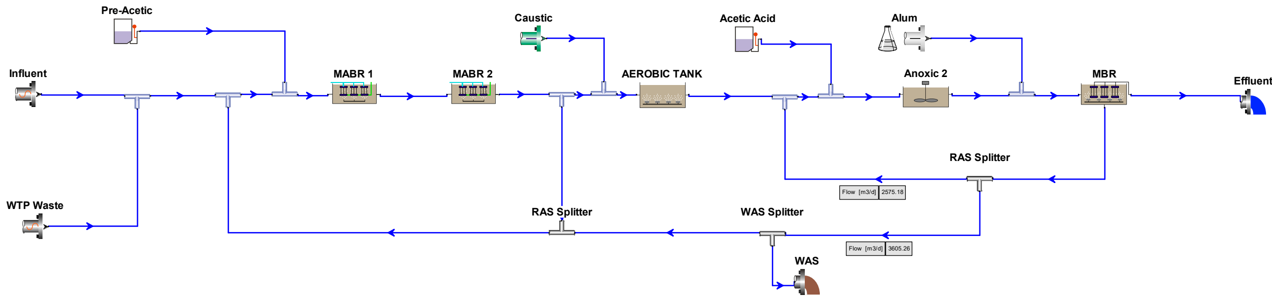

Figure 91: BioWin® PFD

Headworks Screening

To remove large solids from the wastewater prior to secondary treatment and to meet the screening requirements stipulated by MABR / MBR manufacturers, incoming wastewater is delivered directly into a headworks system. The headworks screen compactors are sized to handle the full hydraulic capacity of the ASPC development, including instantaneous peak flow conditions.

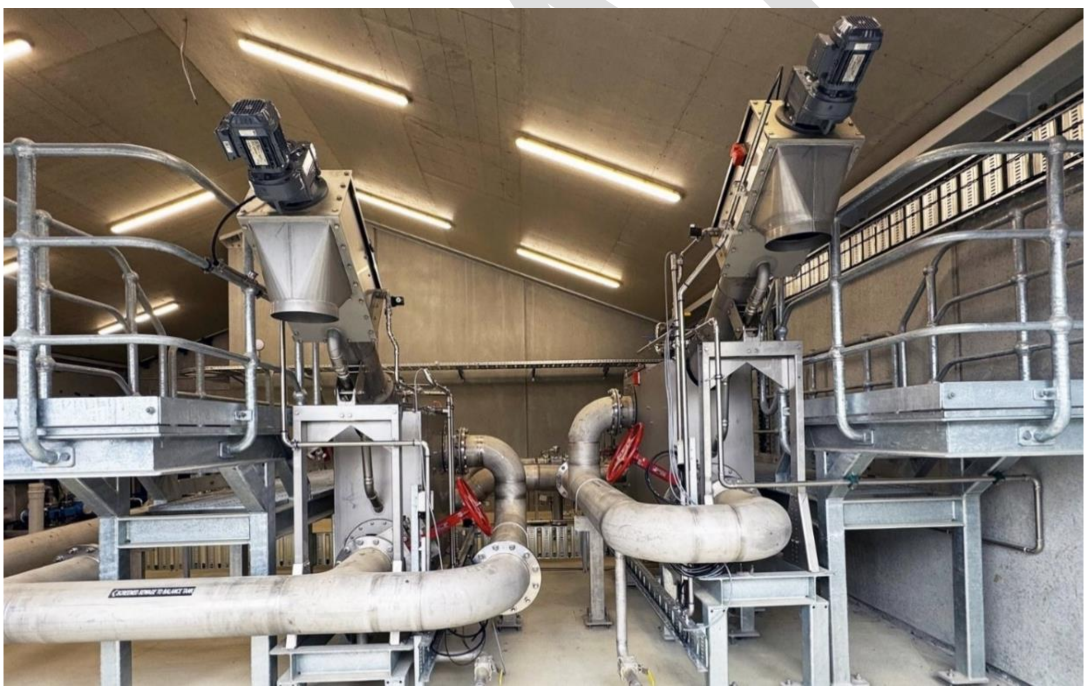

Figure 22: Inlet screening at Karaka North

Balance Tank

Screened wastewater from the inlet works is conveyed to the influent balance tank. Due to the operational nature of the ASPC, significant diurnal and seasonal variations in flow are expected, with peak loading anticipated during the summer months. The influent balance tank functions as a hydraulic buffer, attenuating these fluctuations and decoupling the downstream treatment process from short-term flow variations.

Pre-Anoxic Tanks (MABR 1 & 2)

The first stage of the biological treatment process involves transferring screened influent from the balance tank to the pre-anoxic tanks. These tanks, which contain the MABR membrane modules to provide simultaneous nitrification and denitrification are continuously mixed and maintained at a fixed operating level, with overflow directed to the subsequent treatment stage.

Provision has been made for supplementary carbon dosing using acetic acid within the pre-anoxic zone. Denitrification requires a readily available organic carbon source to achieve low residual nitrogen concentrations, particularly when the influent carbon-to-nitrogen ratio is below typical design values. In systems targeting a high level of nitrogen removal, such as the ASPC development, the wastewater may become carbon-limited, resulting in incomplete denitrification. Supplementary carbon dosing mitigates this limitation and maintains treatment performance.

The proposed carbon source is 49% acetic acid, selected for its natural origin, cost-effectiveness, and safe handling characteristics.

The pre-anoxic MABR tanks are designed as modular units, enabling staged implementation and allowing additional capacity to be installed in response to future loading or expansion requirements.

Aeration Tank

In this process stage, wastewater is aerated to oxidise residual contaminants to carbon dioxide and water. Residual ammonia in the influent is converted to nitrate for subsequent removal in the anoxic tanks.

The aeration tank uses fine-bubble diffusers to transfer oxygen efficiently into the water to support aerobic biological activity and preventing odour formation through sustained dissolved oxygen (DO) levels.

Blowers, controlled by variable speed drives (VSDs), adjust automatically based on continuous DO monitoring. An alarm is triggered if the DO falls below a set threshold (e.g. 0.1 mg/L for 8 hours), prompting operator notification to prevent anaerobic conditions from forming that may result in odour generation.

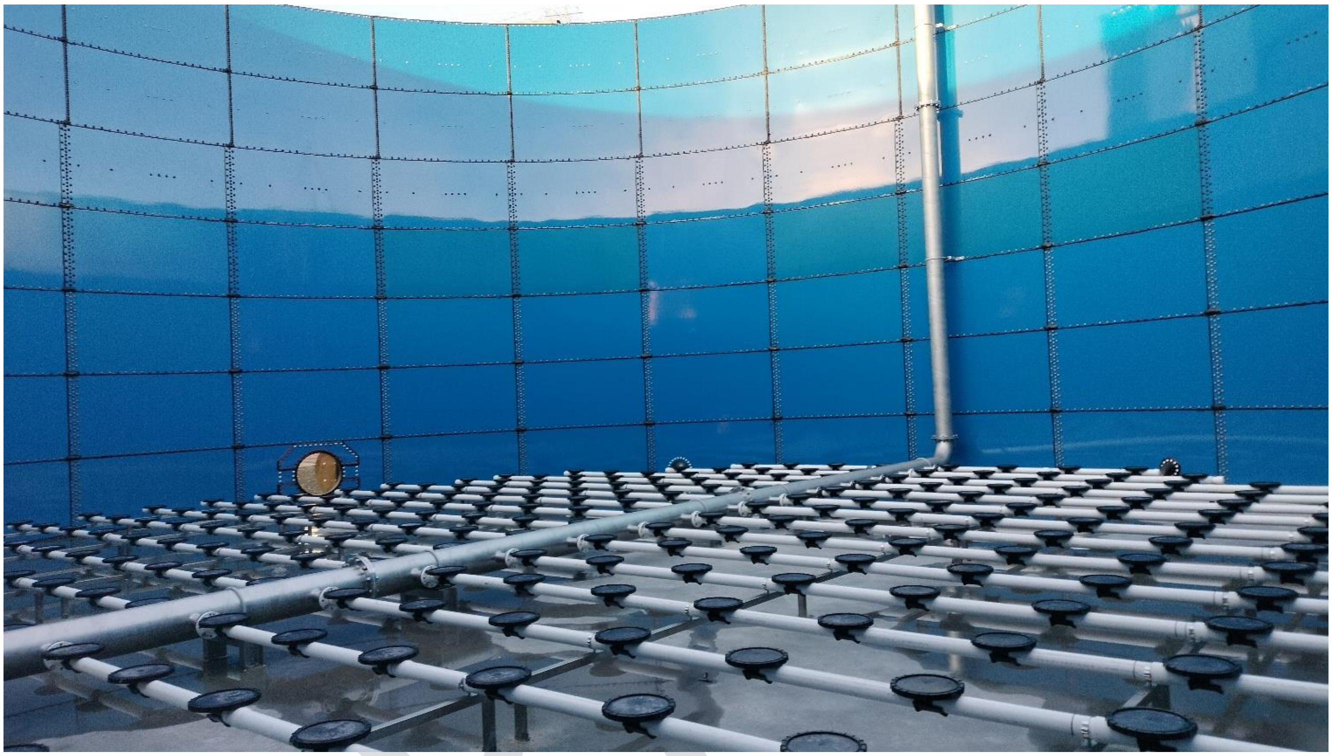

Figure 23: High efficiency fine bubble diffuser grid in the bottom of an Apex Water dairy factory wastewater tank

Post Anoxic Tank

Mixed liquor from the aeration tank flows into the post-anoxic tank, where residual nitrate is removed prior to the MBR stage. The tank receives a recycle stream of concentrated biomass from the MBR, enhancing denitrification efficiency and improving overall effluent quality. A through-wall mixer maintains solids in suspension and promotes effective contact between nitrate and available carbon.

The continuous nitrate supply, combined with the short hydraulic residence time (typically 1–2 hours), prevents the development of anaerobic conditions and associated odour risks. As with the pre-anoxic zone, provision is made for supplemental carbon dosing using 49% acetic acid to support complete nitrogen removal.

In order to facilitate phosphorus removal, aluminium sulphate (alum) is dosed into the post-anoxic tank to precipitate dissolved phosphorus. The resulting solids are separated from the treated wastewater stream by the MBR membranes which are removed from the system with waste sludge.

Membrane Bioreactor (MBR)

The Membrane Bioreactor (MBR) incorporates an integrated membrane filtration system that separates biomass and suspended solids from the treated effluent. Submerged membranes with pore sizes smaller than individual bacteria provide an effective physical barrier, ensuring the production of high-quality, virtually bacteria-free permeate. This separation mechanism allows the system to maintain biomass concentrations approximately two to three times higher than those achievable in conventional gravity-settled systems, resulting in efficient treatment in a compact plant footprint. An example of a modular containerised MBR system is shown in Figure 24.

Figure 2410: Modular containerised MBR plant designed and built for Watercare

The proposed plant will employ submerged membranes, which are continuously air-scoured to minimise fouling and maintain consistent permeability. Air is supplied by dedicated blowers located within the treatment building, to reduce external noise emissions.

Given that membrane fouling is a key operational risk which is controlled through continuous scouring, the blowers are arranged in a duty/standby configuration to provide full redundancy. Continuous aeration of the MBR tanks also maintains a positive dissolved oxygen concentration, preventing the development of anaerobic conditions and associated odour generation.

UV Disinfection

Permeate from the MBR undergoes ultraviolet (UV) disinfection prior to reverse osmosis (RO) treatment. High-intensity UV light deactivates microorganisms, preventing reproduction and achieving over 99.9% removal of residual bacteria and viruses in addition to those retained by the MBR membranes. Locating the UV reactor upstream of the RO system also mitigates biofilm formation on the membranes, a common source of fouling during operation.

The UV system comprises multiple lamps housed within a reactor controlled by a dedicated local control panel. The control system manages dose adjustment, monitors UV intensity and temperature, and operates mechanical wipers for sleeve cleaning. Adequate clearance is provided around the reactor for lamp and quartz sleeve maintenance.

Operation of the UV unit is coordinated by the main PLC based on MBR production. The UV reactor starts automatically before MBR discharge to allow a brief warm-up period (approximately three minutes) and remains active for a short delay following flow cessation to avoid frequent start–stop cycling. As MBR permeate flow is typically continuous, the UV system operates under stable and efficient conditions.

Membrane Bioreactor Permeate Balancing

Following UV disinfection, the treated wastewater is directed to a permeate storage tank. At this stage, the water quality is already exceptionally high and is suitable for various beneficial reuse applications including unrestricted municipal irrigation and as process water in the wastewater treatment plant. To support an effects-based discharge approach, provision is made for controlled discharge of the Membrane Bioreactor permeate when environmental conditions permit this.

Reverse Osmosis (RO)

The wastewater treated through the Membrane Bioreactor and UV disinfection stages achieves a quality suitable for various beneficial reuse applications. However, Viridis have identified that additional treatment is still recommended to minimise potential effects on the receiving environment during periods of low flow in the unnamed tributary of the Rangitopuni Stream. Accordingly, the treated wastewater undergoes an additional Reverse Osmosis (RO) treatment stage to further reduce residual contaminants to trace levels when the flow in this stream is measured to be below the trigger level for this scenario.

In this process, disinfected water from the UV reactor is pumped under pressure across the surface of semi-permeable RO membranes. The membranes allow water molecules to pass while rejecting dissolved salts, nutrients, bacteria, and other contaminants. As filtration proceeds, solute concentration increases in the feed stream, resulting in two separate outputs: an RO permeate stream of high-quality treated water, and an RO retentate stream containing concentrated residual contaminants.

RO Permeate Storage

A small volume of storage for RO permeate shall be maintained onsite. As the discharge of RO permeate is unrestricted, it will be discharged as it is produced. Process redundancy shall be provided by the MBR permeate tank which balances flows out of the MBR treatment process.

Solids Management

Waste activated sludge is an inherent by-product of biological wastewater treatment processes. The activated sludge comprises the microbial population responsible for nutrient removal and is continuously recycled between the biological tanks as return activated sludge (RAS) to treat incoming wastewater. The biological process relies on naturally occurring bacteria to convert contaminants into water, carbon dioxide, nitrogen gas, and additional biomass.

Excess biomass is periodically removed from the system as waste activated sludge (WAS). In the MBR process, solids are continuously concentrated and recycled; therefore, a portion of this stream is diverted to sludge storage tanks.

The WAS is pumped to aerated storage tanks, where it is further treated prior to being allowed to settle and thicken prior to dewatering. Dewatering is achieved using a decanter centrifuge located within the treatment building to minimise noise and odour emissions. The centrifuge produces sludge with a solids content of approximately 18-24%, thereby reducing the volume requiring off-site disposal.

Dewatered sludge is discharged into a covered skip connected to the site's odour extraction system. At full design flow, the skip is expected to require emptying one to two times per month. The sludge holding and skip storage areas are sealed, bunded, and graded to drain directly back to the wastewater treatment process, providing secondary containment and facilitating easy wash-down.

Dewatered biosolids will be collected and transported by a licensed waste contractor to an approved facility capable of accepting wastewater treatment biosolids, such as the Hampton Downs landfill.

Figure 25: Example of sludge holding tanks at another WwTP

Chemical Systems

Table 22 below presents the chemical dosing systems that will be incorporated in the plant.

Table 22: Chemical dosing systems

Chemicals	Purpose / Details	Dose Point	Estimated Approx. Consumption
Acetic Acid (49%)	Supplementary carbon source to provide food to the process.	**Wastewater Treatment Plant** Pre-Anoxic Tank Post Anoxic Tank	180L/day
Caustic Soda (30%)	pH management of the wastewater alkalinity Possible regeneration of the Ion exchange media	**Wastewater Treatment Plant** Aeration Tank **Water Treatment Plant** Ion exchange media regeneration	50L/day
Aluminium sulphate (Alum)	Residual Phosphorus removal.	**Wastewater Treatment Plant** Post-Anoxic Tank	40L/day
Citric Acid	Removal of inorganic scaling from membrane surfaces (CIP).	**Wastewater Treatment Plant** Membrane Bioreactor	100L/month
Sodium Hypochlorite	Removal of organic fouling from membrane surfaces (CIP) Disinfection of drinking water via FAC residual	**Wastewater Treatment Plant** Membrane Bioreactor **Water Treatment Plant** Disinfection of potable water	10,000L/month
Sulphuric Acid (30%)	pH control of raw feed water to the water treatment plant	**Water Treatment Plant** Disinfection of potable water	10,000L/month

Hazardous Substances

Auckland Unitary Plan Zoning (AUP)

Figure 26 below demonstrates the location of the development and the current AUP zoning map.

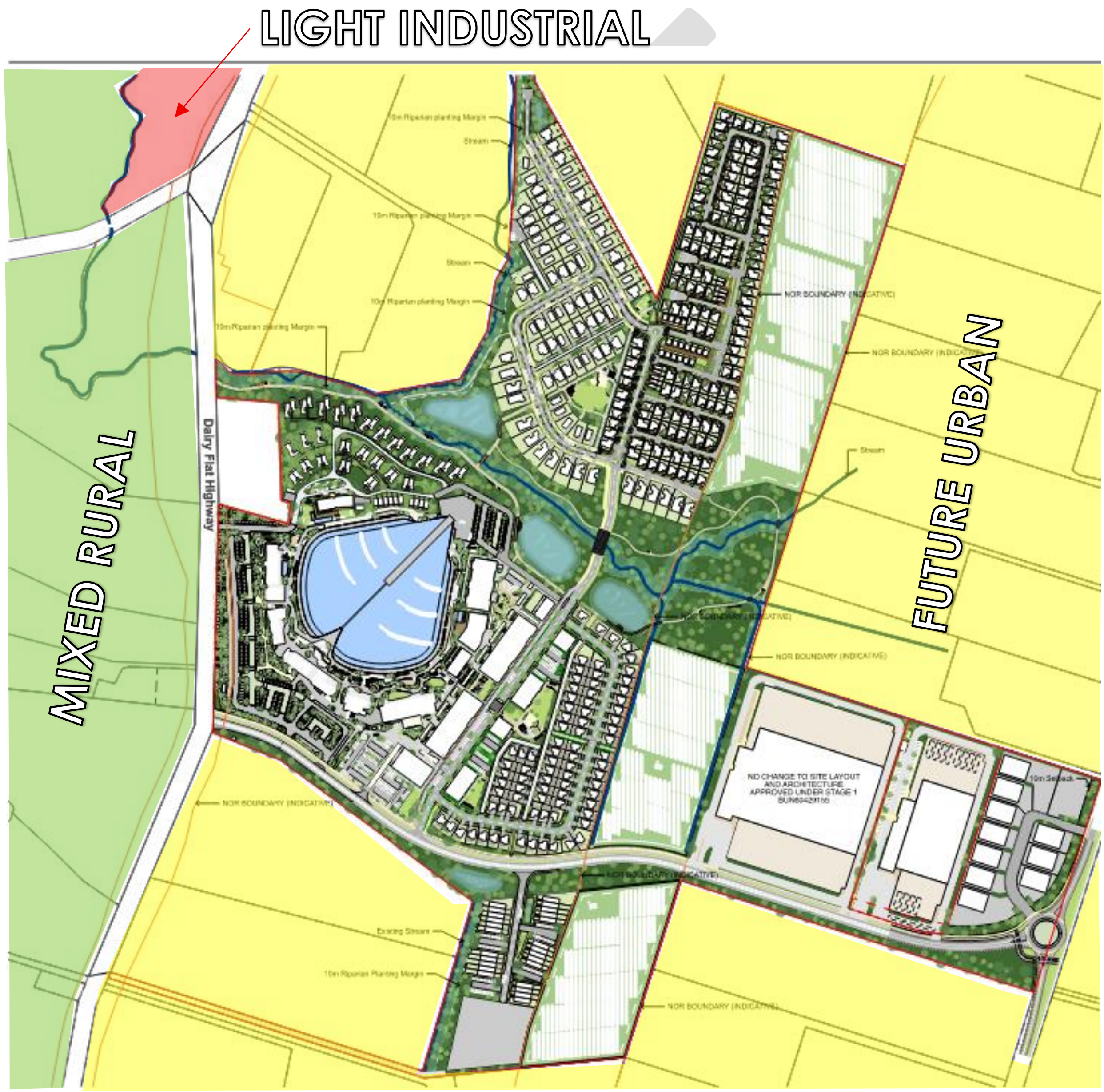

Figure 26: Surf Park development master plan (supplied by AW Holdings) with proposed wastewater/ water treatment plant indicated

Sensitivity of the Local Area

The treatment compound sits within the Future Urban Zone shown in Figure 26 above. The overall development is located on the boundary between Future Urban and Mixed Rural Zones. The Auckland ASPC Community (ASPC) Stage 2 proposal is described in Introductory sections above.

The closest existing dwelling located on land not owned by the developer is approximately 45m to the south of the proposed treatment compound boundary. Other existing dwellings are located approximately within 180m from the compound boundary which provides a large separation distance to minimise the risk from the proposed activity.

Proposed Hazardous Substances

Table 23 below presents the chemical dosing systems that will be incorporated in the plant.

Table 23: Chemical dosing systems

Chemicals	Purpose / Details	Dose Point	Approx. Consumption
Acetic Acid (49%)	Supplementary carbon source to provide food to the process.	**Wastewater Treatment Plant** Pre-Anoxic Tank Post Anoxic Tank	180L/day
Caustic Soda (30%)	pH management of the wastewater alkalinity Possible regeneration of the Ion exchange media	**Wastewater Treatment Plant** Aeration Tank **Water Treatment Plant** Ion exchange media regeneration	50L/day
Aluminium sulphate(28%) (Alum)	Residual Phosphorus removal.	**Wastewater Treatment Plant** Post-Anoxic Tank	40L/day
Citric Acid	Removal of inorganic scaling from membrane surfaces (CIP).	**Wastewater Treatment Plant** Membrane Bioreactor	100L/month
Sodium Hypochlorite (1%)	Removal of organic fouling from membrane surfaces (CIP)	**Wastewater Treatment Plant** Membrane Bioreactor **Water Treatment Plant** Disinfection of potable water	10,000L/month

	Disinfection of drinking water via FAC residual		
Sulphuric Acid (30%)	pH control of raw feed water to the water treatment plant	**Water Treatment Plant** Disinfection of potable water	10,000L/month

Diesel Generator

The treatment plant compound includes provision for a diesel generator with an internal fuel tank to provide redundancy to the key elements of the process in the event of power failure. This allows critical systems such as the water treatment plant and portions of the wastewater treatment plant required to protect the environment from untreated discharges and maintain aerobic process conditions to mitigation odour discharges to continue operating in a power cut.

The internal fuel tank in the generator has a capacity for approximately 400L and the combined unit shall be located near the water treatment plant building.

Chemical Deliveries

The chemicals utilised in the treatment processes are delivered both as packaged products (20 – 1000L containers) and in bulk delivered by tanker. The plant has provision for a chemical delivery bay which is a bunded location with separate drainage and secondary containment where chemical delivery trucks can park during the transfer, or delivery of chemicals. Should a chemical spill occur during the transfer of chemicals, the delivery bay bund shall capture and ensure that the spilled material does not enter stormwater network on site. This protects against accidental discharges into the environment.

Packaged chemicals shall be stored in line with HSNO requirements inside designated chemical storage areas on spill containment bunds.

An example of a chemical delivery bund and packaged product spill containment bunds are shown in Figure 27 below

Figure 27 – An example of a bulk chemical load out bay

Description of Surface Drainage

The treatment plant compound shall be composed of a mixture of impermeable and permeable surfaces including hardstand areas, buildings, storage and treatment tanks and landscaped areas. A breakdown of the proposed surface types is detailed further in Table 24.

Table 24: Proposed breakdown of surface types at the treatment compound.

Surface Type	Area (m2)
Permeable (m2)	**2617**
Impermeable (m2)	**3248**
Total (m2)	**5865**

Bunded or Separated Drainage Zones

The proposed hazardous chemical storage and unloading areas pose the largest risk of accidental release to the environment. These areas shall be designed to capture and hold any spill or accidental release. Once captured, these spills can be recovered for removal, neutralised in place or diverted into dedicated drainage that is separate from the site's stormwater handling. The following spill mitigation controls shall be implemented

- Bulk chemical storage tanks shall be located within their own secondary containment bunds of at least 110% the capacity of the largest vessel contained
- Packaged chemical storage being made up of secondary containment bunding for packaged chemical to captures leaks, spills or full loss of containment where

necessary. Additionally, internal chemical storage areas shall contain slot drains where any spills are directed to dedicated drainage for recovery or treatment.

Hazardous Substance Classifications

Table 25 below details the quantity of hazardous substances that are proposed to be stored on the treatment plant site for use within the two processes. Under the Hazardous Substances and New Organisms Act (HSNO) 1996, these substances are assigned classifications. The quantity, HSNO classification, storage type and state are detailed in the table below.

Table 25 Hazardous substance storage quantities

Substance	Proposed Volume (m3)	Proposed Location	HSNO Classification Description	State
Acetic Acid (49% solution)	10	Bulk Storage	Acute toxicity (oral) Category 4 Specific target organ toxicity – repeated exposure Category 2 Corrosive to metals Category 1 Skin corrosion Category 1C Serious eye damage Category 1 Hazardous to the aquatic environment chronic Category 4 Hazardous to terrestrial vertebrates	Liquid

Substance	Proposed Volume (m3)	Proposed Location	HSNO Classification Description	State
Sulphuric Acid (20% Solution)	10	Bulk Storage	Acute toxicity Category 4 Carcinogenicity Category 1 Specific target organ toxicity Category 1 Corrosive to metals Category 1 Skin corrosion Category 1B Serious eye damage Category 1 Hazardous to the aquatic environment chronic Category 3	Liquid
Sodium Hydroxide (30% solution)	10	Bulk Storage	Acute toxicity (oral) Category 4 Corrosive to metals Category 1 Skin corrosion Category 1B Serious eye damage Category 1 Hazardous to the aquatic environment chronic Category 4	Liquid
Sodium Hypochlorite	10	Bulk Storage	No classification	Liquid

Substance	Proposed Volume (m3)	Proposed Location	HSNO Classification Description	State
Solution (1% solution)				
Aluminium Sulphate Solution (28% Solution)	2 x 1	Packaged Chemical Storage	Acute toxicity (oral) Category 4 Skin irritation Category 2 Eye irritation Category 2 Corrosive to metals Category 1 Hazardous to the aquatic environment chronic Category 2 Hazardous to terrestrial vertebrates	Liquid
Polyaluminium Chloride	2 x 1	Packaged Chemical Storage	No classification	Liquid
Citric Acid Solution (49%)	2 x 1	Packaged Chemical Storage	Skin Irritation Category 3 Serious eye damage Category 1	Liquid
Diesel	0.4	Packaged Chemical Storage	Flammable liquids Category 4, Aspiration Hazard Category 1, Skin Irritation Category 3 Carcinogenicity Category 2, Hazardous to the aquatic	Liquid

Substance	Proposed Volume (m3)	Proposed Location	HSNO Classification Description	State
			environment chronic Category 2	

Although not provided with a HSNO Classification, the Auckland Unitary Plan (AUP) does include thresholds for substances high in biological oxygen demand (BOD_5) due to the risk these substances can pose if released into the environment. While at various stages of treatment the BOD5 concentration of the wastewater will be elevated, the only location where it could exceed the AUP definition of high BOD_5 material being greater than 10,000mg/L is when the removed biomass is dewatered and hence concentrated to the point where it is considered a solid rather than a liquid. The removal of biomass is critical to the performance of the wastewater treatment plant biological process, and the proposed treatment plant includes provision for the dewatering of this waste stream for disposal offsite. By weight, this dewatered waste biomass, referred to as waste activated sludge (WAS) is concentrated to 18% and is solid in consistency and stored within a waste bin or skip. As a solid, the risk of loss of containment of the dewatered sludge entering a local waterway or the stormwater network on site is low.

Controls for the Management and Containment of Hazardous Substances

The Health and Safety at Work (Hazardous Substances) (HSW-HS) requires various control measures to be implemented based on the volumes proposed for storage and use at the treatment plant compound. A summary of the requirements triggered are detailed below in Table 26

Table 26 : HSW-HS Legislative Requirements - Controls

Substance	***Requirements***
Acetic Acid (49% solution)	Emergency Response Plan Secondary containment Signage Stationary container compliance certification Segregation from all Class 1, Class 4.3, Class 5, Class 6.1 toxic cyanides and Class 8.2 corrosive alkalis
Sulphuric Acid (20% Solution)	Emergency Response Plan Secondary containment Signage Secured from unauthorized access Hazardous substance location compliance certificate Segregation from all Class 1, Class 4.3, Class 5, Class 6.1 toxic cyanides and Class 8.2 corrosive alkalis Separation of 5 m from the boundary
Sodium Hydroxide (30% solution)	Emergency Response Plan Secondary containment Signage Stationary container compliance certification Segregation from all Class 1, Class 4.3, Class 5, Class 6.1 toxic cyanides and Class 8.2 corrosive acids Separation of 5 m from the boundary
Sodium Hypochlorite Solution (1% solution)	No requirements
Aluminium Sulphate Solution (28% Solution)	Emergency Response Plan Secondary containment Signage Segregation from all Class 1, Class 4.3, Class 5, Class 6.1 toxic cyanides and Class 8.2 corrosive alkalis

Polyaluminium Chloride	No requirements
Citric Acid Solution (49%)	Signage Segregation from alkali
Diesel	Emergency Response Plan 2 x fire extinguishers Secondary containment Signage Segregation from all Class 1, Class 2, Class 3.2, Class 4 and Class 5 substances Hazardous area excluding ignition sources in vicinity of generator

Other Generic Requirements

There are various other requirements both operational and design-based to be incorporated into the treatment plant and its operation that are either required through HSW-HS legislation, council requirements or industry best practice. The final design, construction and operation of the facilities shall adhere to these requirements, which include but are not limited to:

- **Signage** – HAZCHEM signage where required by HSNO legislation, as well as pipework labelling, labelling of primary equipment to alert people and first responders of hazards present

- **Secondary Containment** – Bunding around the hazardous chemicals shall be impervious and capable of holding 110% of the large container stored within it. It shall also be designed such that the crest locus limits are considered for punctures.

- **Separation Distances** – Separation distances to protected placed shall be considered in the detailed design stage to ensure that all protected and public places are a sufficient distance away from chemicals stored above the specified thresholds. A protected place can include as factory, workshop, office, store, stop or building where people regularly employed, whether within or outside the property boundary of a place where a hazardous substance location is situated." A protected place excludes a small office or other small building associated with a place where storage, handling, use, manufacture, or disposal of a Class 2, 3, 4, 5, 6, or substance is a major function, and therefore we can consider the WTP and WWTP buildings on site exempt. A public place is one that is open to and frequented by the public and includes public roads.

- **Segregation of incompatible substances** – All incompatible substances shall be kept in segregated areas. These include strong acids and alkalis, chemicals that generate excessive heat if mixed, chemicals that generate toxic fumes if mixed and any other hazardous condition.

- **Environmental Management Plan** – A specific environmental management plan shall be developed for the site which shall be tailored to meet the requirement of the Industrial and Trade Related Activities requirements of the Auckland Unitary Plan. This shall outline potential hazards, risks, control and responses in the event of spills and any preventative inspections and maintenance.

- **Spill response plan** – A specific plan and set of procedures shall be developed to address the appropriate response in the event of a spill. This shall include use of spill kits, correct PPE use, who to notify and when to call for external support.

Resource Consent Requirements

Hazardous Substances

Chapter E31 of the AUP sets out the provisions for Hazardous Substances. An assessment of the threshold quantities versus the proposed volumes to be used has been carried out, which outlines that the proposed storage volumes fall above the threshold quantities for several of the required chemicals stored and used in the treatment plant processes. A summary of the proposed volumes versus the activity threshold values for Future Urban Zones are shown in Table 27 below.

Table 27: AUP Thresholds for Future Urban Zones

Rule	Classification	Permitted Activity Threshold	Restricted Discretionary Threshold	Proposed Maximum	Consent Status
A101	Sub-class 6.1C and 6.3-6.9 within 50m of a more sensitive zone	299kg	300kg	15,000L	Discretionary
A102	Sub-class 8.1, 8.2A and 8.3	49kg	50kg	20,000L	Discretionary
A103	Sub-class 8.2B and 8.2C	299kg	300kg	20,000L	Restricted Discretionary

Rule	Classification	Permitted Activity Threshold	Restricted Discretionary Threshold	Proposed Maximum	Consent Status
A106	Sub-class 9.1B, 9.2B, 9.3B and 9.4B	9,999kg	10,000kg	5,000L	Permitted
A107	Sub-class 9.1B, 9.2B, 9.3B and 9.4B within 30m of a watercourse	2,999kg	3,000kg	5,000L	Permitted (beyond minimum distance)
A108	Sub-class 9.1C, 9.2C, 9.3C and 9.4C	29,999kg	30,000kg	15,000L	Permitted
A109	Sub-class 9.1C, 9.2C, 9.3C and 9.4C within 30m of a watercourse	9,999kg	10,000kg	15,000L	Permitted (beyond minimum distance)
A110	High BOD5 (>10,000 mg/l) within 30 metres of a watercourse	19,000kg	20,000kg	10,000L	Permitted

Industrial and Trade Related Activities

Chapter E33 of the AUP details sets out the provisions for Industrial and Trade Related Activities. Within chapter E33, Table E33.4.3 provides a list of specific industrial and trade related activities and provides a classification of risk. The proposed treatment compound falls within two categories for the handling and treatment of sewage, as follows:

- 'Environmentally hazardous substances storage or use' which would categorise 'no activity area' as moderate risk and 'any activity area' as high risk. The activity is never low risk.
- 'Sewage solids storage' which would categorise an activity area of less than 1,000 m^2 as low risk, more than 1,000 m^2 but less than 5,000 m^2 as moderate risk, and an activity area of greater than 5,000 m^2 as high risk.

As the proposed treatment plant compound has been designed to ensure any areas where the storage or handling of hazardous materials drain into their own separated systems, or are located indoors, there are no activity areas that discharge stormwater to land or water. In this case, there are no rules applicable for discharges from the proposed site under E33.4.2 of Chapter E33.

Risk Assessment for Hazardous Substances

A risk assessment has been carried out to cover the storage and handling of the hazardous substances at the treatment plant compound. This assessment has been carried out in line with guidelines provided by the Ministry for the Environment Guidance for Hazardous Facilities. The identification of hazards related to the activities carried out on site are shown in Table 28 below.

Table 108: Hazard identification

Substance	On-site Hazardous Property	Failure Mode	Exposure to	Hazard Rating	Offsite Impacts	Controls Against Offsite Impacts
Acetic Acid	Human health, Ecotoxicity	Tank leak, rupture, spill during tank filling	Personnel on site or local ecosystem	Low hazard to human health via ingestion and skin contact Low hazard to ecosystems	Yes – If secondary containment failure, or leaks / spills not identified and contained (primarily ecological, not to the public)	Sufficiently protected with secondary containment
Sulphuric Acid	Human health, Ecotoxicity	Tank leak, rupture, spill during tank filling	Personnel on site or local ecosystem	Low hazard to human health via ingestion and medium hazard via skin contact Medium hazard to ecosystems	Yes – If secondary containment failure, or leaks / spills not identified and contained (primarily ecological, not to the public)	
Citric Acid		Tank leak, rupture, spill during tank filling	Personnel on site or local ecosystem	Low hazard to human health via ingestion and medium	Yes – If secondary containment failure, or leaks /	

				hazard via skin contact Medium hazard to ecosystems	spills not identified and contained (primarily ecological, not to the public)	
Polyaluminium Chloride	No classification	Tank leak, rupture, spill during handling of package	Personnel on site or local ecosystem	No classification	Yes – If spill not contained (primarily ecological, not to the public)	
Aluminium Sulphate	Human health, Ecotoxicity	Tank leak, rupture, spill during handling of package	Personnel on site or local ecosystem	Low hazard to human health via ingestion and skin contact Low hazard to ecosystems	Yes – If spill not contained (primarily ecological, not to the public)	
Sodium hypochlorite (1%)	No classification	Tank leak, rupture, spill during tank filling	Personnel on site or local ecosystem	No classification	No classification	
Sodium hydroxide	Human health, Ecotoxicity	Tank leak, rupture, spill during tank filling	Personnel on site or local ecosystem	Low hazard to human health via ingestion and skin contact	Yes – If secondary containment failure, or leaks / spills not identified and contained	

				Low hazard to ecosystems	(primarily ecological, not to the public)	
Diesel	Fire/Explosion Ecotoxicity	Tank leak, rupture, spill during tank filling	Personnel on site or local ecosystem	Low hazard for effects of fire (diesel not explosive, only combustible) Medium hazard to ecosystems	Yes – If leaks / spills not identified and contained (primarily ecological, not to the public)	

A full qualitative risk assessment of the identified hazards has been carried out in Table 29 below. This assessment follows the guidelines followed by the Ministry for the Environment and applies a frequency (likelihood) of a failure occurring and measures this against the consequences of any impacts. The likelihood and consequence are calibrated against qualitative criteria and a risk matrix assessing the likelihood and consequence is used to assess the risk, before and after mitigations are made.

The qualitative assessment of likelihood is shown in Table 29 below.

Table 119: Qualitative assessment of likelihood

Frequency rating	Descriptor	Explanation
A	Almost certain	The event is expected to occur in most circumstances
B	Likely	The event will probably occur in most circumstances
C	Moderate	The event should occur at some time
D	Unlikely	The event could occur at some time
E	Rare	The event may occur only in exceptional circumstances

The qualitative assessment of consequence is shown in Table 30 below.

Table 30: Qualitative assessment of consequences

Effects rating	Descriptor	Explanation
1	Insignificant	No injuries, negligible environmental damage
2	Minor	First aid treatment required, on-site release contained, minor damage to property
3	Moderate	First aid treatment required, minor environmental damage, damage to off-site property
4	Major	Extensive injuries, major environmental damage to immediate environment, moderate damage to off-site property

5	Catastrophic	Fatalities both on and off-site, major and widespread environmental damage, exposure to toxic release by numerous people.

The risk matrix used to assess likelihood and consequence is shown in Table 31 below.

Table 31: Risk matrix

Consequence Likelihood	**Severity**				
	Insignificant (1)	**Minor (2)**	**Moderate (3)**	**Major (4)**	**Catastrophic (5)**
Almost certain (A)	Significant	Significant	High	High	High
Likely (B)	Moderate	Significant	Significant	High	High
Moderate (C)	Low	Moderate	Significant	High	High
Unlikely (D)	Low	Low	Moderate	Significant	High
Rare (E)	Low	Low	Moderate	Significant	Significant

The assessment of any residual risk is detailed below in Table 32.

Table 32: Assessment of residual risk

Event	**Key Controls**	**Likelihood**	**Consequence**	**Residual Risk**
Container leak or rupture during	Unloading in bunded chemical apron; trained personnel; spill response plan and kits	Unlikely	Minor	Low

unloading of packaged ecotoxic liquids				
Tank leak or overfill during delivery of bulk ecotoxic liquids	Bunded containment; segregated acid/base storage; tank alarms and vents; supervised filling	Rare	Minor	Low
Hose rupture or spill during bulk delivery	Designated unloading apron; suitable, maintained hoses; supervised transfer; spill plan	Unlikely	Minor	Low
Fire in diesel generator fuel tank	Emergency response plan; extinguishers; ignition exclusion zone; segregated location	Unlikely	Minor	Low
Tank overflow or rupture during refilling of diesel generator fuel tank	Training, supervised transfer; spill plan,	Unlikely	Minor	Low
Hose rupture during transfer of diesel from stationary tank to generators	Training; suitable, maintained hoses; supervised transfer; spill plan	Unlikely	Minor	Low

Odour Management

ODOUR SOURCES

Odour generation at wastewater treatment plants primarily results from the anaerobic decomposition of organic matter, producing gases such as hydrogen sulphide, ammonia, and methane. Effective odour mitigation through process control and source treatment is critical given the proximity of the wastewater treatment plant to residential areas and recreational facilities.

While odour formation within the upstream collection network cannot be fully controlled, emissions can be effectively managed within the treatment process. The following table summarises the potential odour sources and the corresponding mitigation measures to be implemented.

Table 33: Odour sources and mitigation techniques

Treatment Process	**Potential Odour Source**	**Mitigation Measure**
Headworks screens	Raw sewage and screenings	System (including screening bins) is fully enclosed and connected to the odour extraction and treatment system under negative pressure.
Balance Tank	Raw screened sewage	The tank is to be sealed and connected to the odour extraction network under negative pressure. In routine operation this tank will be operated at low level to minimise odour generation potential.
Pre-Anoxic Tank	Raw screened sewage	Continuously recycle flow from the aeration tank, providing large quantities of nitrate rich water, and preventing anaerobic conditions from developing. The MABR system also generates nitrates in this tank which prevent anaerobic conditions forming. The Oxidation-Reduction potential of the contents of this tank is continuously monitored which allows the contents to be monitored for potential generation of anaerobic conditions

Aeration Tank	Anaerobic conditions from overloading of the biological system or failure of aeration equipment can generate offensive odour.	The aeration tanks are fitted with fine bubble diffusers to efficiently transfer oxygen from the air into the water. By maintaining a positive level of dissolved oxygen in the aeration tank, odour emissions are minimised meaning that this tank does not need to be covered.
Post Anoxic Tank	Anaerobic conditions from overloading of the biological system or failure of equipment can generate offensive odour.	Continuous supply of nitrate to this anoxic tank, combined with its mechanical agitator and very short hydraulic residence times prevents anaerobic conditions from developing.
MBR Tank	Anaerobic conditions from overloading of the biological system or failure of aeration equipment can generate offensive odour.	The membranes in these tanks are continuously cleaned by scouring with air. The contents of this tank have already had almost all dissolved contaminants (e.g. organic load and nutrients) removed by previous steps in the process. Therefore, the membrane tanks have a very high concentration of dissolved oxygen in them. These factors combine to mitigate the risk of the membrane tanks generating offensive odours.
WAS Tank	Contains sludge which has a high risk of releasing offensive odour.	The WAS tanks are fully enclosed and connected to the odour extraction and treatment network. The WAS is aerated to maintain conditions which mitigate the formation of offensive odours.
Sludge dewatering and dewatered sludge storage	Processes sludge which has a high risk of releasing offensive odour.	The sludge dewatering plant is fully enclosed and connected directly to the odour removal and treatment system. It is also housed in a building separately connected to the odour extraction and treatment network.
Site wastewater sump	Fully enclosed and underground collection tank that receives discharges from any sludge dewatering /settling, any	Sump is fully enclosed and connected to the odour extraction and treatment network

spillages of wastewater around the site and black water from the site's own amenities and toilets.	

ODOUR CONTROL UNITS

As odour formation within the incoming wastewater network cannot be controlled, dedicated infrastructure is required to capture and treat odorous air within the treatment facility. An odour control unit (OCU) is employed to remove or neutralise odorous compounds and other contaminants from extracted air. Air is typically drawn from enclosed areas with the highest odour potential, such as inlet works, sludge storage tanks, skips, dewatering systems, and sumps.

The following table provides an overview of the odour control technologies assessed for this development.

Table 34: Odour sources and mitigation measures

Technology	**Operation**	**Advantages**	**Disadvantages**
Biofilter	Uses aerobic bacteria growing on a bed of bark chips to oxidise contaminants such as hydrogen sulphide (the primary offensive odour compound from sewage). Air is extracted from plant odour sources by fan and passed through the bed of bark prior to being discharged to air.	• Well established technology. • Low capital and operating cost.	• Treatment can fail if the moisture and pH of the bark bed is not kept within the correct operating range. • Larger biofilters can be prone to short-circuiting. • Larger biofilters can produce a plume of 'bark' scented air from passing high volumes of air (generally considered inoffensive but

			can be noticeable on neighbouring properties).
Carbon Scrubber	Uses an activated carbon pallet bed. Odour causing compounds are adsorbed onto the activated carbon pallets and thereby removed from the air stream. The carbon pallets can also be doped with sodium or potassium hydroxide, which significantly increases the ability of the carbon to remove and neutralise acidic gasses, such as hydrogen sulphide from sewage and sludge.	• System relies on physical adsorption so is more robust and reliable than biological oxidation.	• Higher capital and operating costs than a biofilter. • Carbon requires replacing every one to three years.
Multistage chemical scrubber	Uses product specific bed(s) to remove contaminants.	• Able to tailor removal to specific pollutants.	• Complex system. • Higher capital and operating costs. • More suitable for industrial sites where specific gaseous pollutants are targeted in conjunction with dust or other particulate matter.

SELECTION OF ODOUR CONTROL DEVICE

Based on the assessment of odour control technologies presented in Table 34, a carbon scrubber has been identified as the preferred system. This selection is supported by its proven reliability, effective performance, and operational simplicity, as well as the ease with which the system can be designed, installed, and maintained.

Figure 28: Activated Carbon odour control unit at Karaka North WwTP

Operation into Service

Commissioning of biological nutrient reduction (BNR) processes is inherently complex and requires experienced technical oversight from personnel familiar with both the design and operation of such systems. As the core nutrient removal mechanisms are biologically driven, sufficient biomass (microbial population) must be established to effectively metabolise contaminants in the incoming wastewater. Based on Apex's experience, for a seeded and supplement-fed biological process, biomass development typically requires up to, and in some cases more than two months following the first introduction of wastewater, depending on site-specific conditions. For greenfield installations, this period can be extended, as the process capacity initially exceeds the influent loading during early stages of connection.

Optimal biomass performance is dependent on maintaining stable environmental and operational conditions. Any disturbance to these conditions can impair treatment efficiency or nutrient removal performance. During commissioning, operational parameters will be progressively adjusted to support biomass growth and ensure stable process conditions. Key factors influencing biomass health include:

Organic loading: Insufficient carbon-based contaminants may limit biomass growth, while excessive organic loading relative to biomass concentration may overload the system during early commissioning.

Alkalinity: Adequate alkalinity is required to sustain nutrient removal; levels will be monitored and supplemented as necessary.

Dissolved oxygen: DO concentrations must be maintained to support aerobic biological activity without inhibiting denitrification.

Sludge age (SRT): Appropriate biomass retention time is critical to maintaining treatment performance and will be closely monitored and controlled.

As biomass growth is dependent on the consistent receipt of wastewater, the full biological commissioning will not occur prior to inflow from the network reaching levels where biomass can be sustained without excessive supplementary carbon and nutrient dosing.

Proposed Site Layout

Treatment Plant Compound Location and Layout

The proposed treatment plant compound is shown in Figures 29 through 32 below.

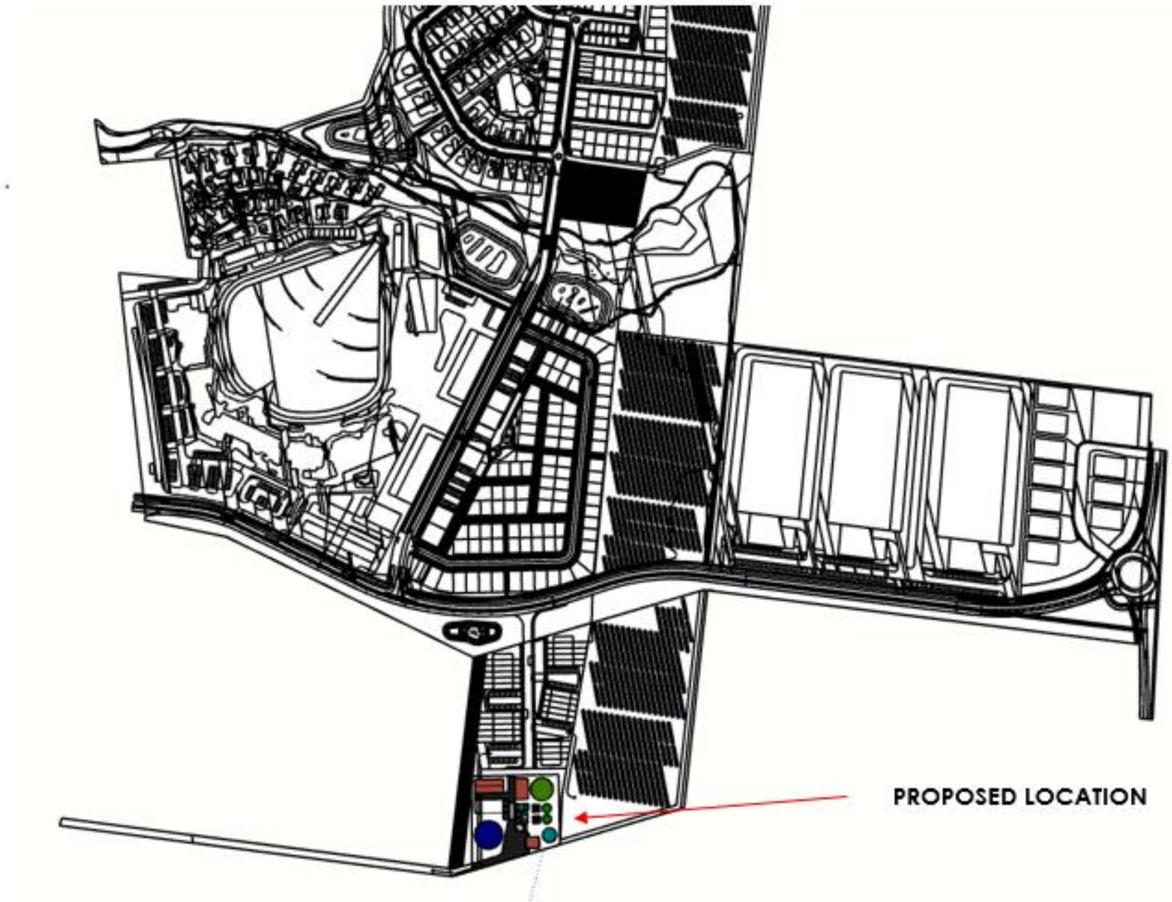

Figure 29 – The overall ASPC site

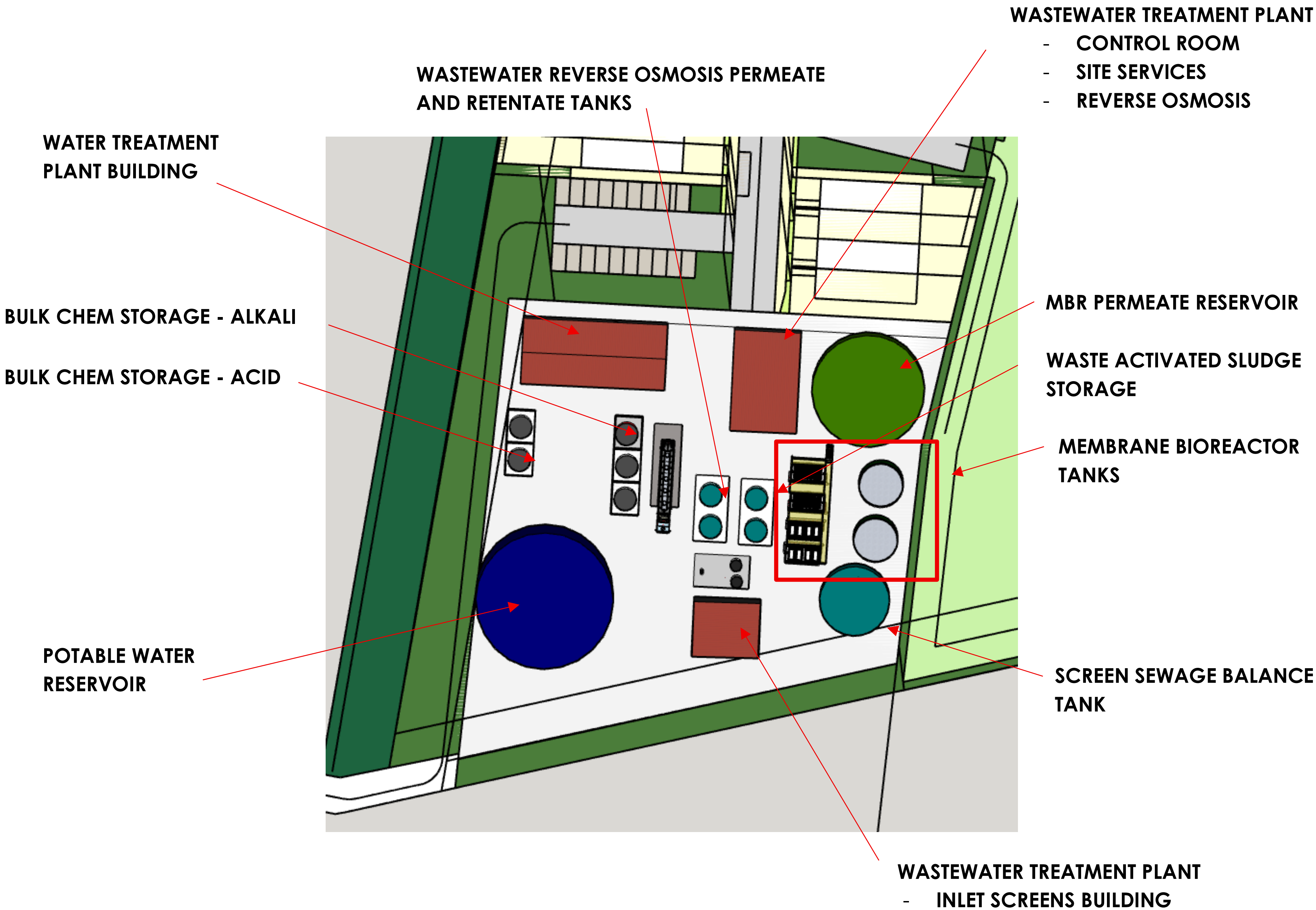

Figure 30 – The treatment plant compound site

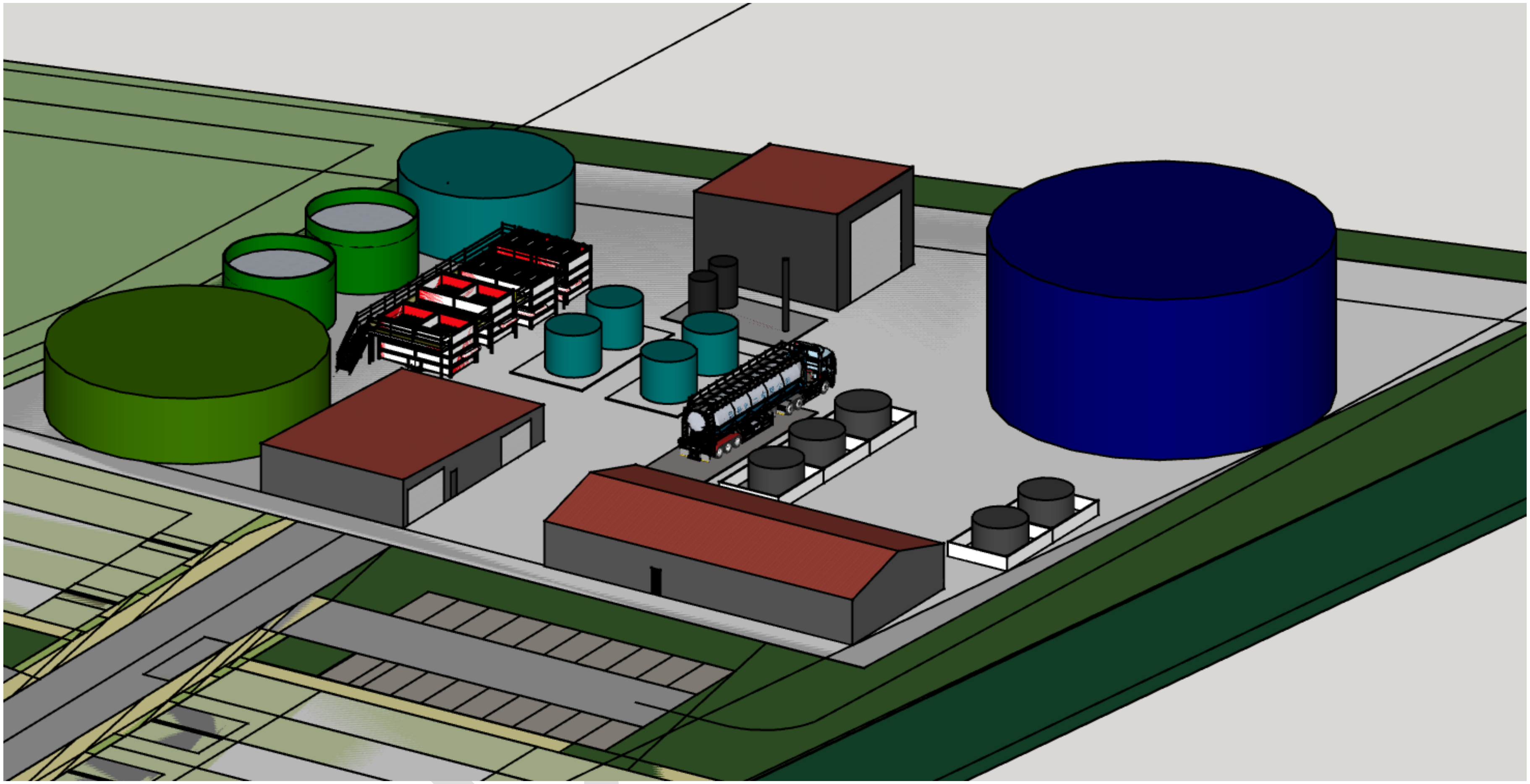

Figure 31 – The treatment plant compound site

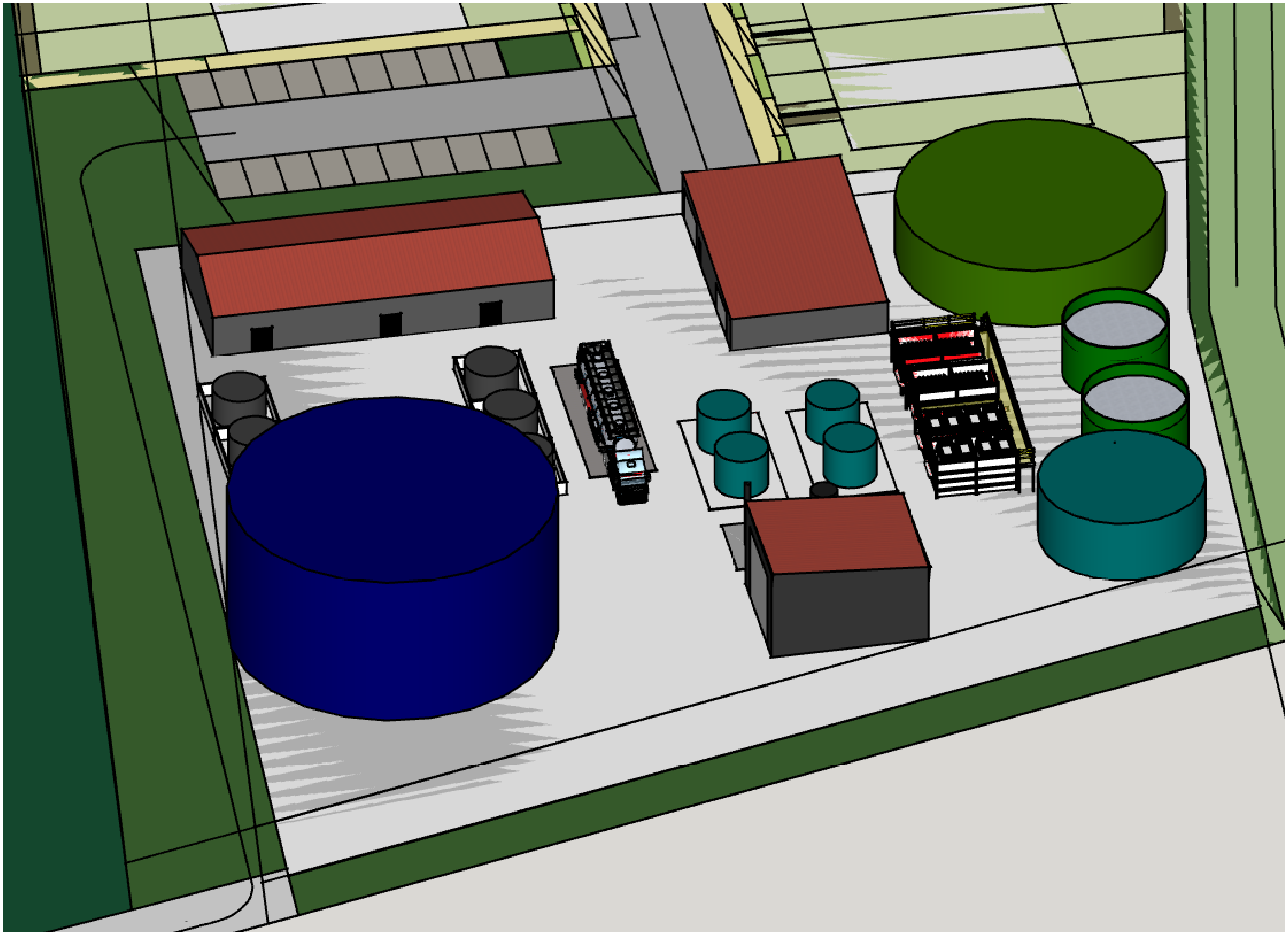

Figure 32 – The treatment plant compound site

Plant Structures

Inlet Screens Building

The inlet screens building houses the inlet screens which remove bulk solids from the raw sewage. Its final height shall be determined through the detailed design process by the overall site hydraulics.

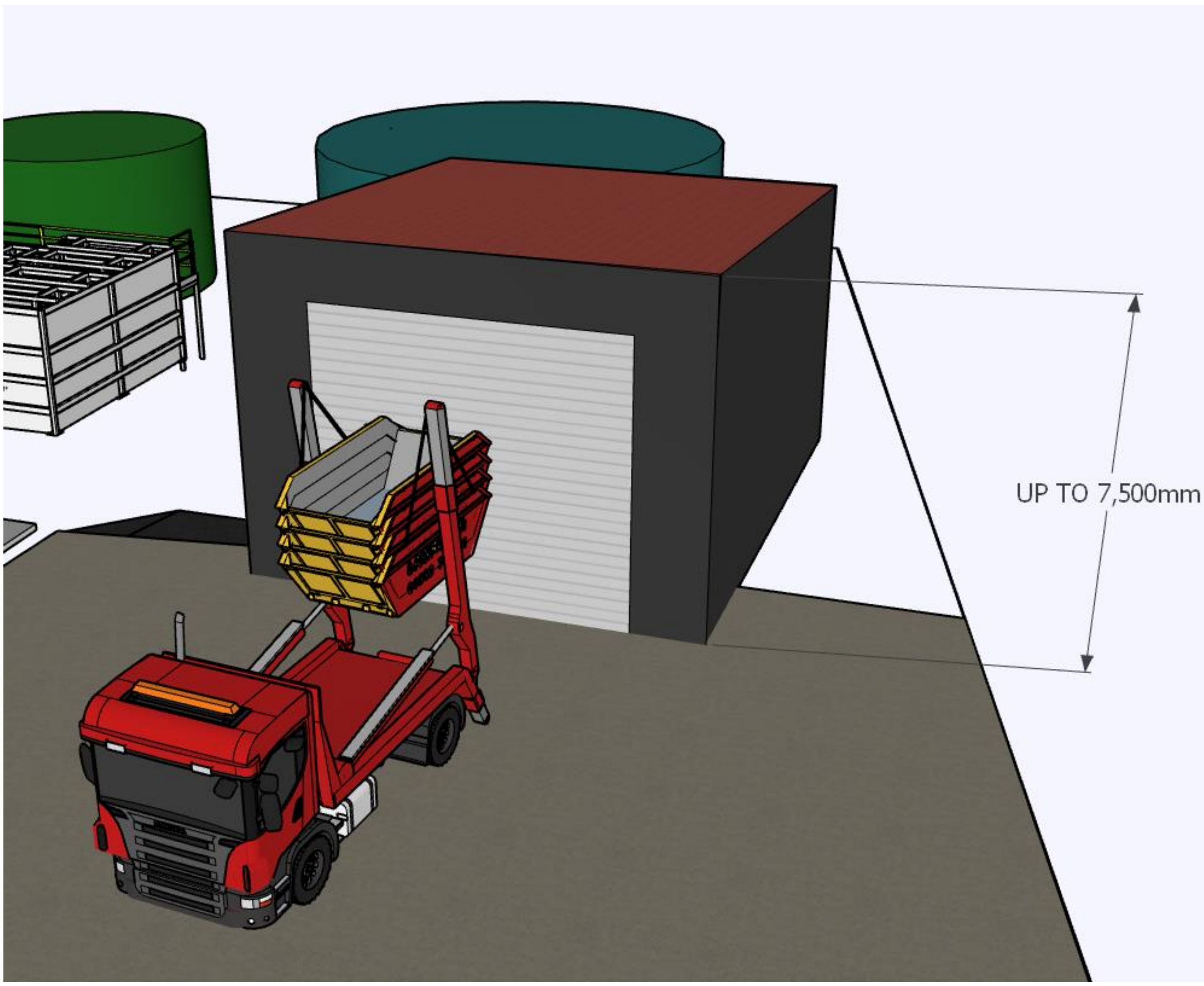

Figure 33 – The Inlet Screens Building

Screened Sewage Balance Tank

The screened sewage shall flow under gravity into the screened sewage balance tank. Under normal conditions this tank shall operate at near empty and will only accumulate volume to balance peak flows or allow for process flexibility downstream.

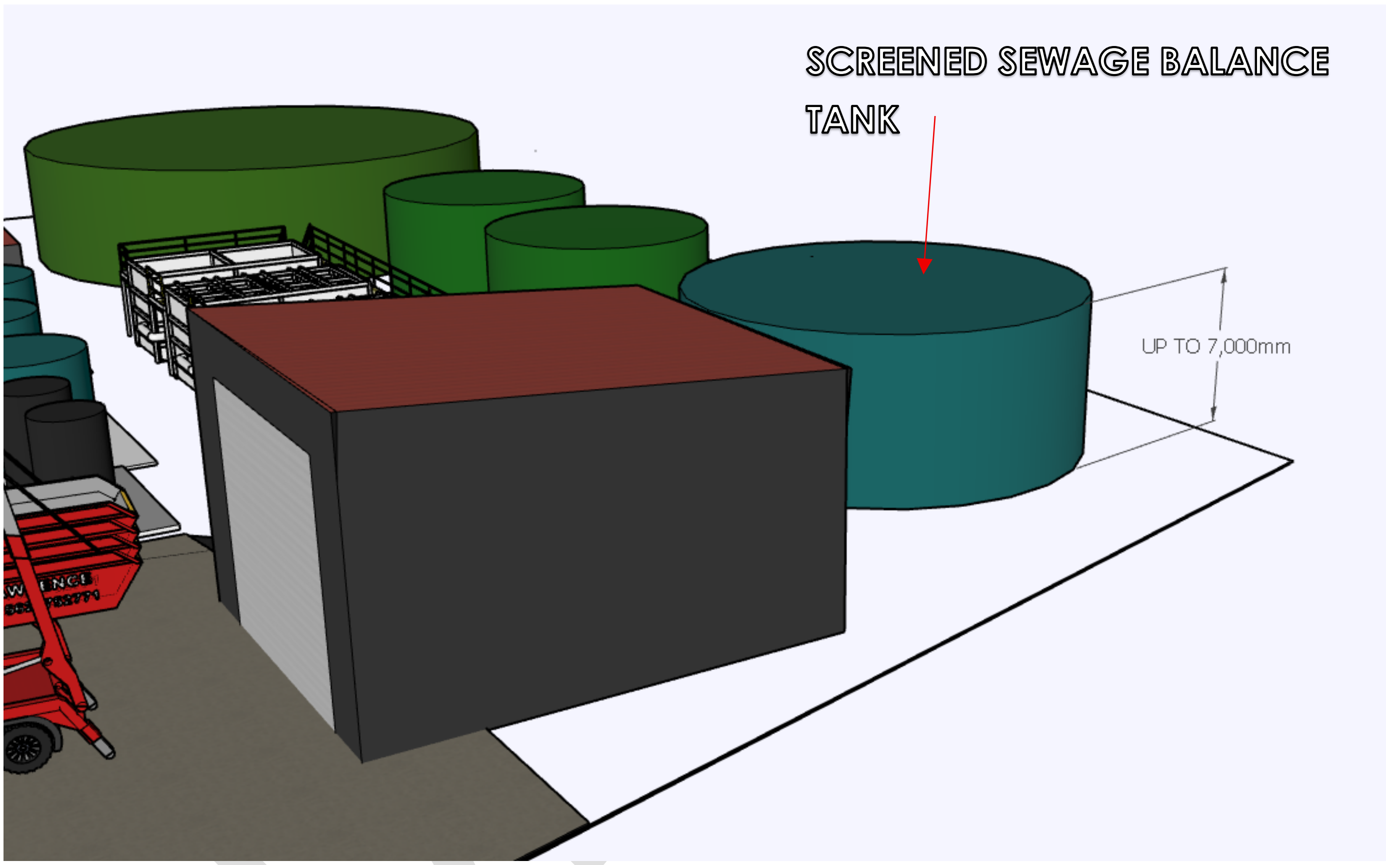

Figure 34 – The Screened Sewage Balance Tank

Membrane Bioreactor

This part of the process makes up the membrane bioreactor. The screened sewage passed through this process producing a very high quality permeate. During the early years of the development, it is proposed that this permeate is discharged to land via irrigation. The Pre-Anoxic, Post-Anoxic, the MABR modules and hollow fibre membranes housed within these are modular and can be installed in stages to suit load received by the treatment plant as the development grows.

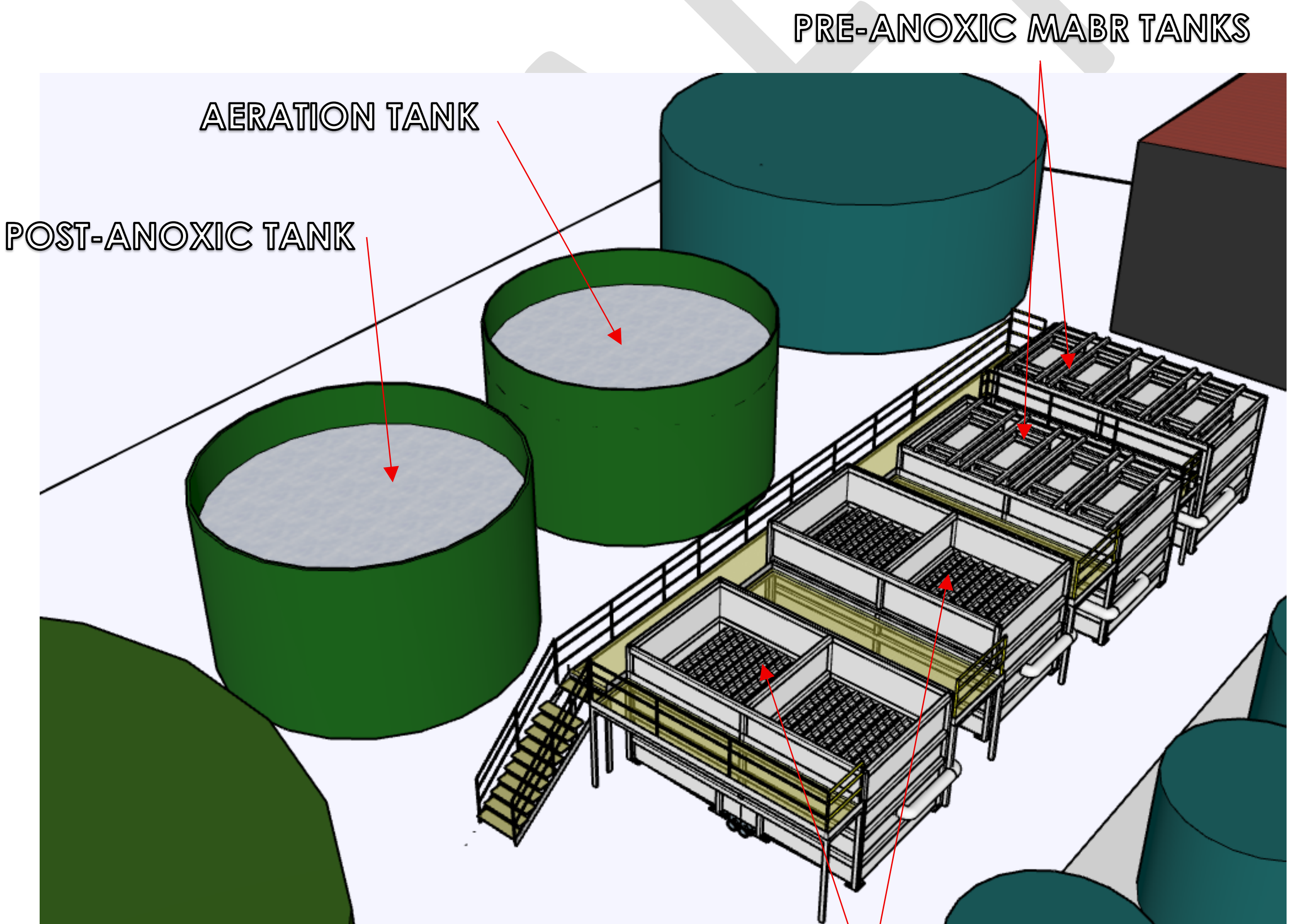

Figure 35 – The Biological Treatment Process

MBR Permeate Tank

Permeate from the MBR treatment process shall pass into the MBR permeate tank. This tank shall allow for the balancing of treatment plant flows where they shall be made available for discharge to the irrigation field. By providing a large capacity for the buffering of flow, the proportion of flows discharged to land can be maximised by holding back discharges when irrigation conditions are unfavourable.

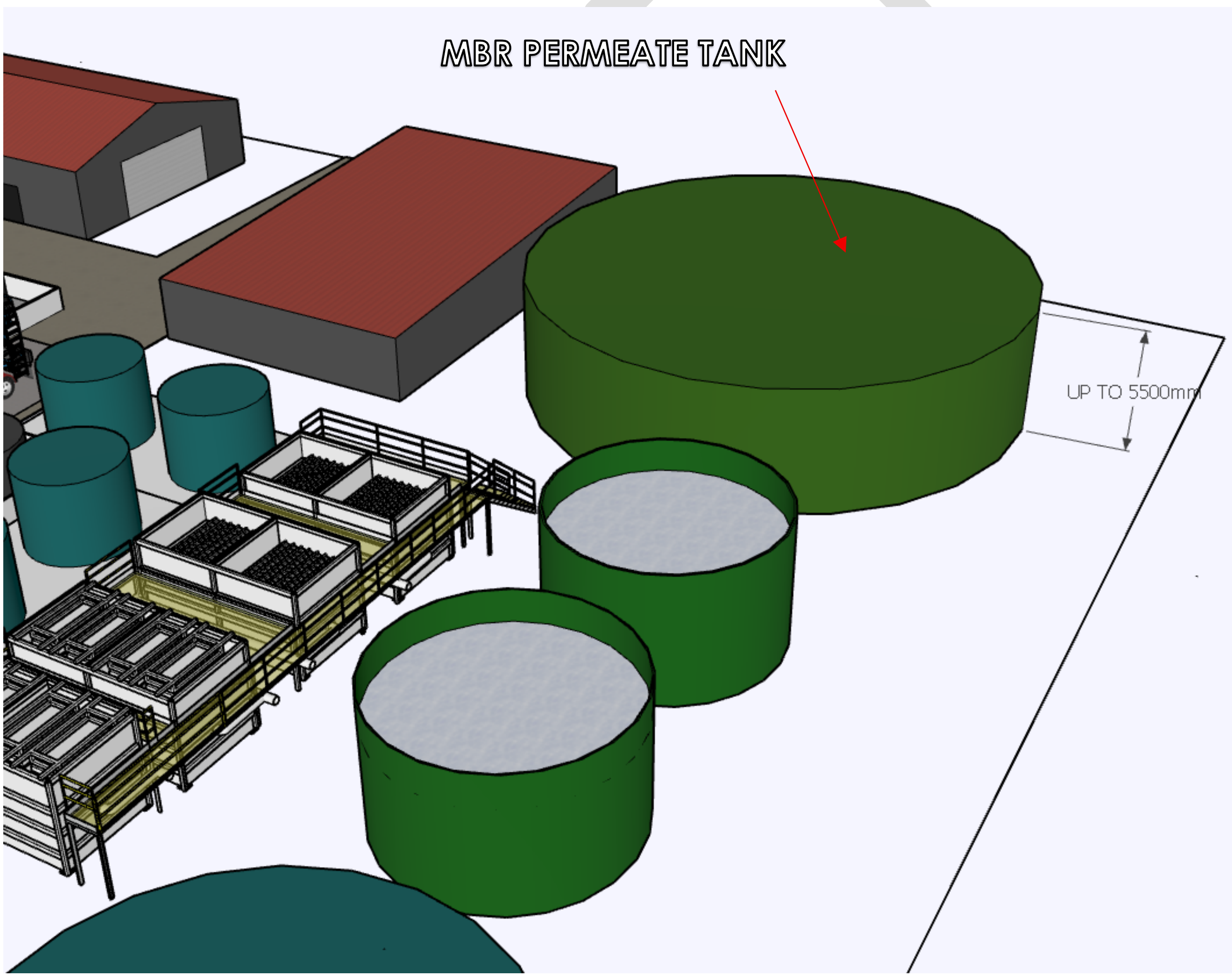

Figure 36 – The MBR Permeate Tank

Wastewater Treatment Plant Control and Plant Building

The wastewater treatment plant control and plant building contains the electrical switchboard, aeration blowers, site services and the reverse osmosis membrane treatment plant. This building shall include segregated storage for wastewater specific equipment, including dediicated tools to minimise the risk of contamination between the water and wastewater parts of the treatment plant compound.

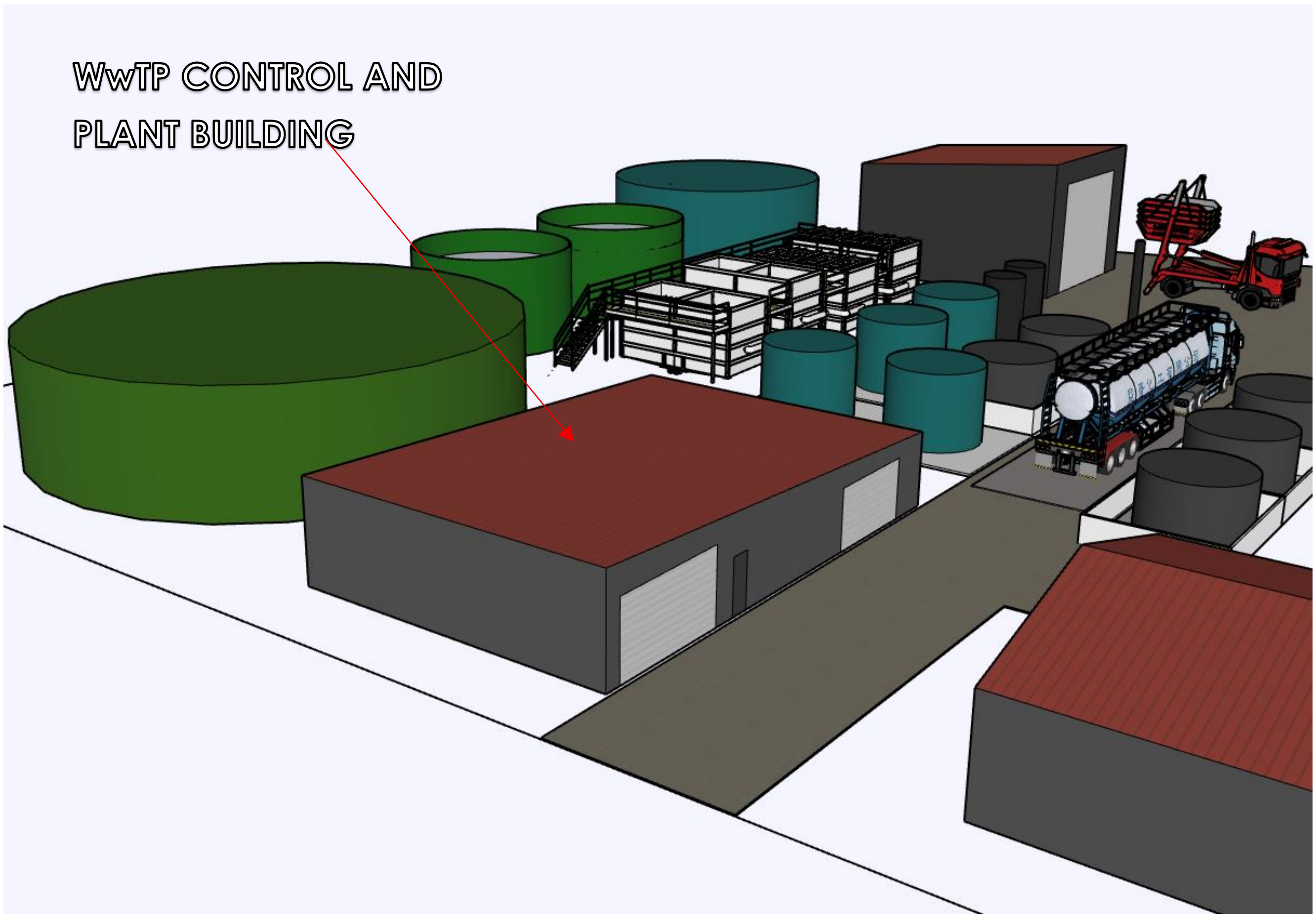

Figure 37 – The WwTP Control and Plant Building

Water Treatment Plant Building

The water treatment plant building shall house the control room, control panel and electrical switchgear and process equipment related to the water treatment plant process. The raw water shall be fed to the treatment plant building; the water shall be treated and then it will be stored in the on-site reservoir before distribution throughout the development.

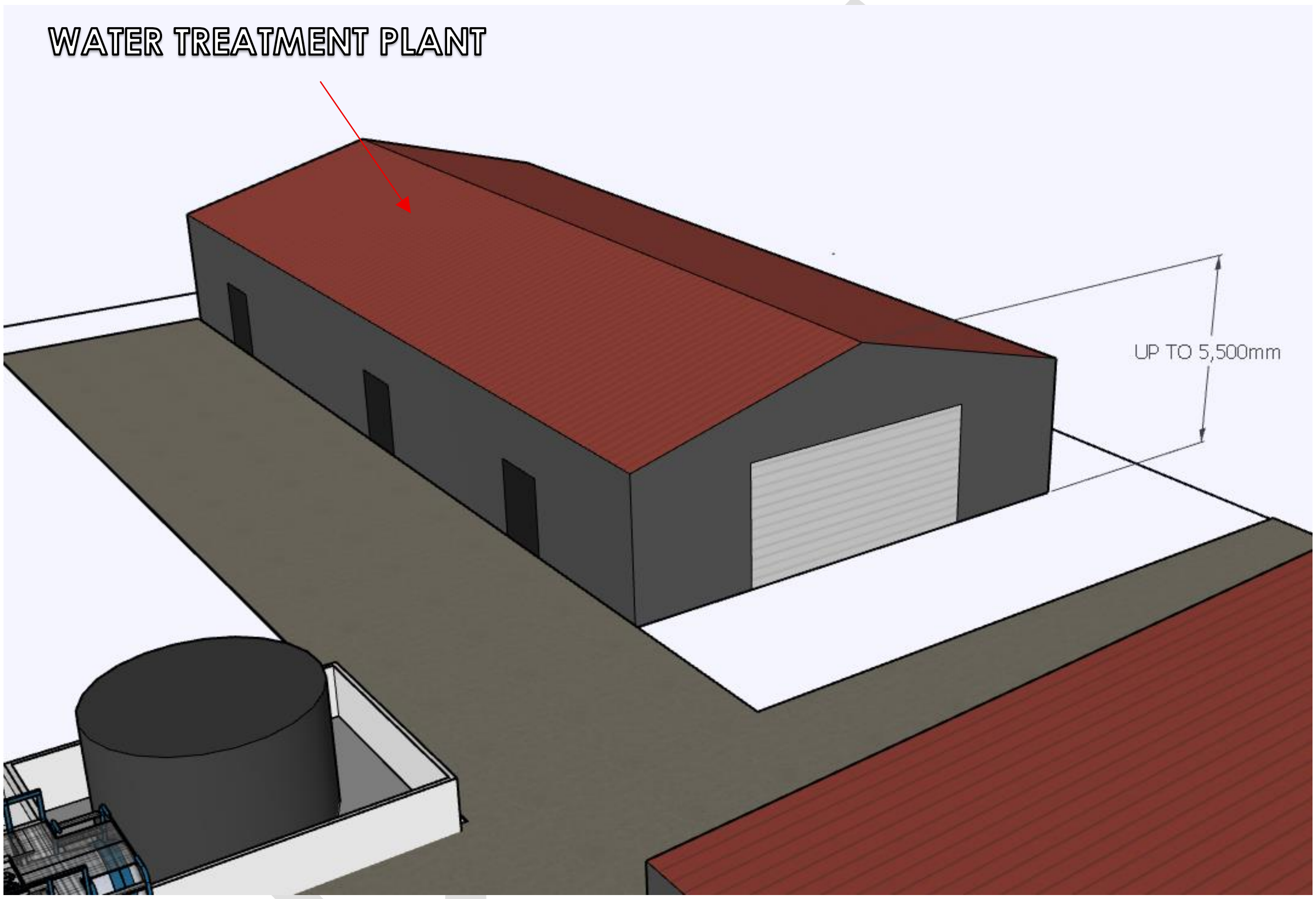

Figure 38 – The Water Treatment Plant Building

Potable Water Reservoir

The drinking water produced by the water treatment plant shall be stored on site in the potable water reservoir. The client has indicated that the Surf Lagoon and other high demand users require 2,500m3 of reservoir space. Additional reservoirs may be established outside of the treatment plant compound as required in the future.

Once complete, the water treatment plant will operate below design capacity for a long period of time while the development grows. Due to large volume stored within the reservoir, there may be a requirement to operate on smaller modular tanks to minimise the likelihood of stagnation resulting in operating a large reservoir where there is little drinking water demand.

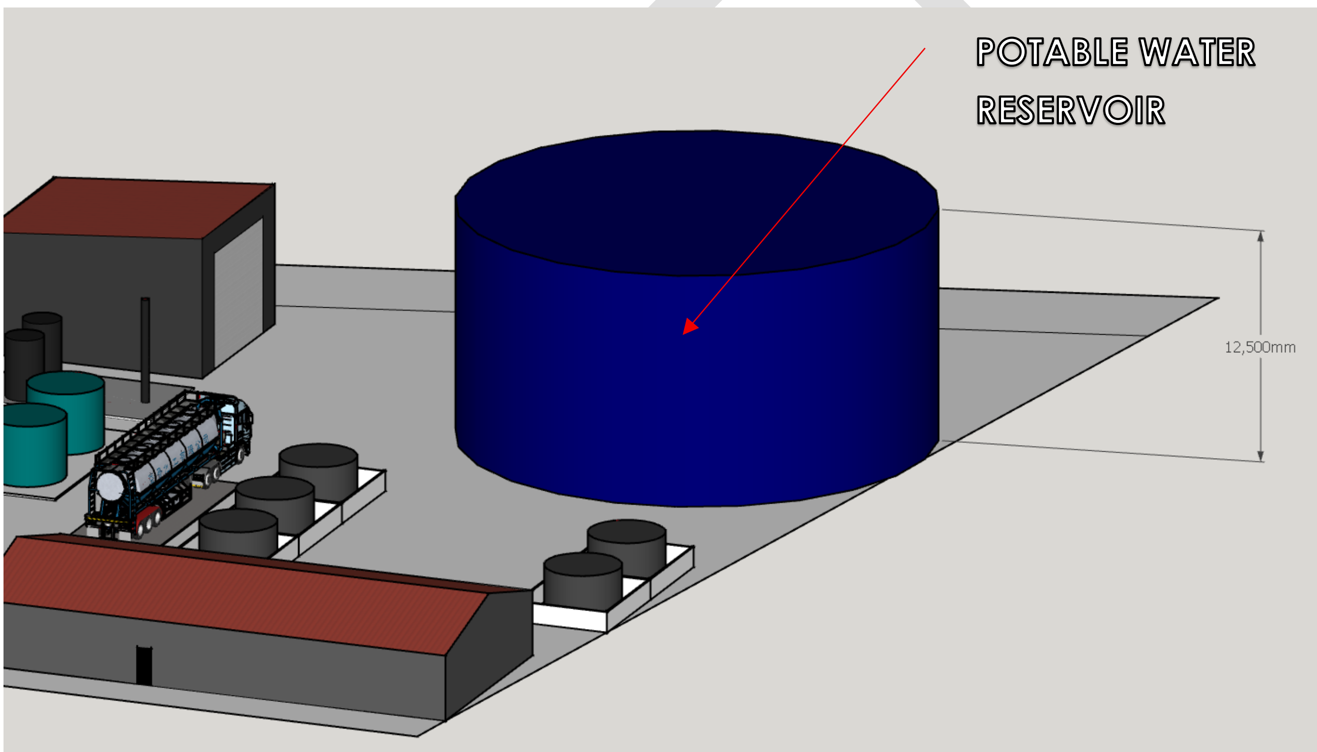

Figure 39 – The Drinking Water Reservoir

Conclusions and Recommendations

Wastewater

Due to the high level of nutrient removal required for unconditional discharge to the local unnamed tributary, the treatment process shall consist of a hybrid 4-stage Bardenpho activated sludge treatment process, including a Membrane Aerated Biofilm Reactor and submerged Ultra-Filtration membranes. The permeate from this treatment process shall be further polished via a Reverse Osmosis membrane filtration step before any discharge to land contact device where it may enter surface water.

The treatment plant shall be staged, semi-modular in design to allow for the addition of membrane modules, gas diffusion membranes for the MABR, the reverse osmosis treatment process and additional treatment tanks. These semi-modular portions shall be able to be integrated into the treatment train as demand requires or an increased level of treatment is required.

An effects-based discharge regime shall be adopted, allowing for the staging of treatment infrastructure favouring discharges to land of either MABR-MBR permeate or Reverse Osmosis retentate, depending on the volume received by the treatment plant and hence the completeness of the development. A discharge of reverse osmosis permeate into the unnamed tributary of the Rangitopuni stream shall occur once the development has grown to the size that there is insufficient land available to sustainably accommodate the discharge of treated wastewater to land alone (based on soil moisture monitoring). All discharges of treated wastewater that may ultimately end up in the unnamed tributary shall be directed to a land contact device designed to allow for wastewater flows to permeate through land in line with cultural best practices.

The reverse osmosis retentate stream shall be irrigated to land via low impact surface spray irrigation or surface mounted, or sub surface drip irrigation in locations with very limited public access.

Water

An options assessment has been carried out on suitable water treatment technologies; this has identified the requirement for either reverse osmosis or ion exchange as the suitable technologies. Based on the profile of the raw water source available, these two technologies combined with UV and chlorine disinfection are both capable of producing potable water that meets or exceeds the requirements of the Drinking Water Standards for New Zealand.

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Appendix 1 – Draft Operations and Maintenance Manual

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

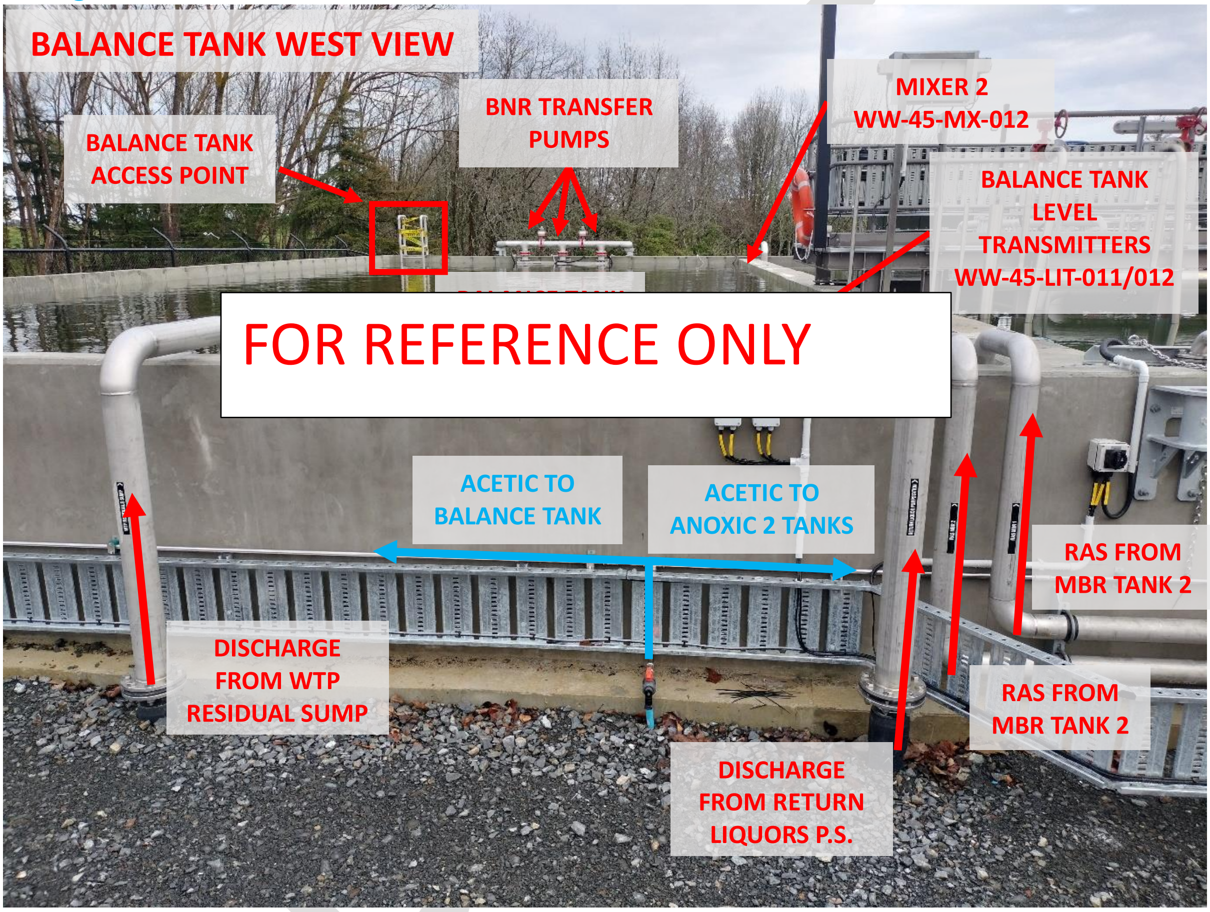
The following provides a brief overview of the control philosophy. Refer to the Functional Description and P&IDs for further detail.

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

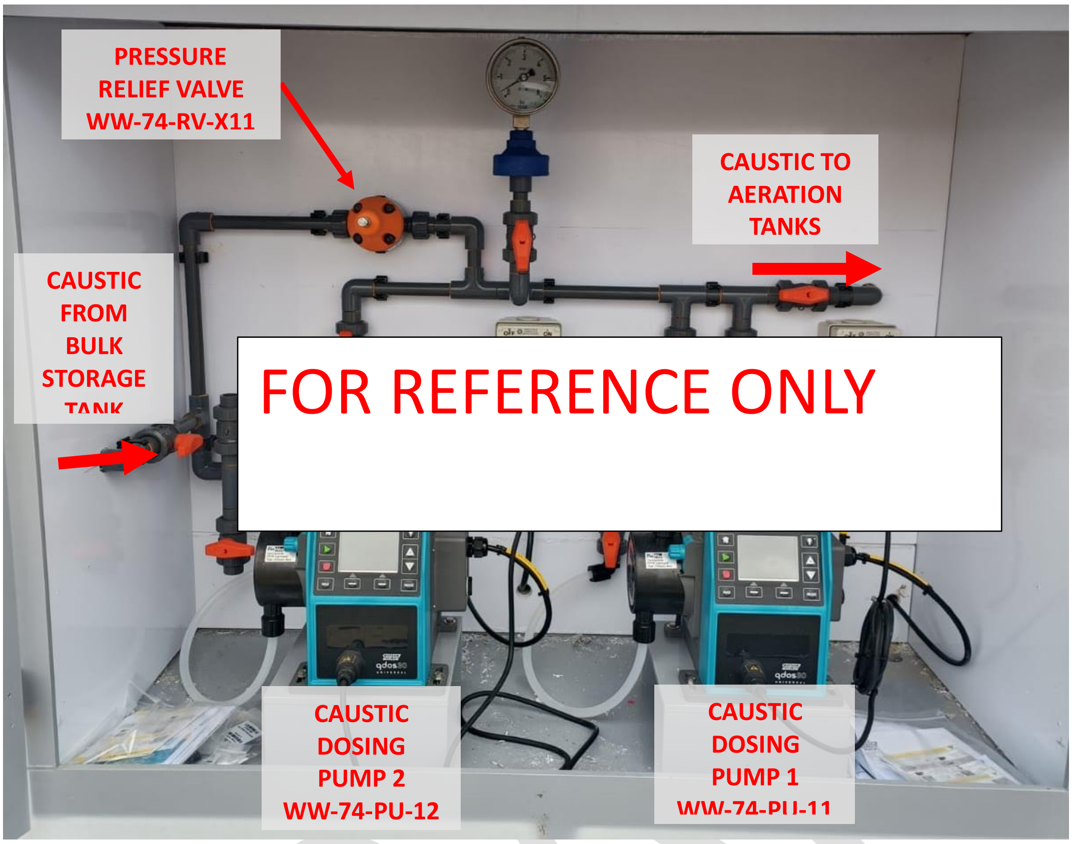
Waste Activated Sludge Handling (WAS):

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:

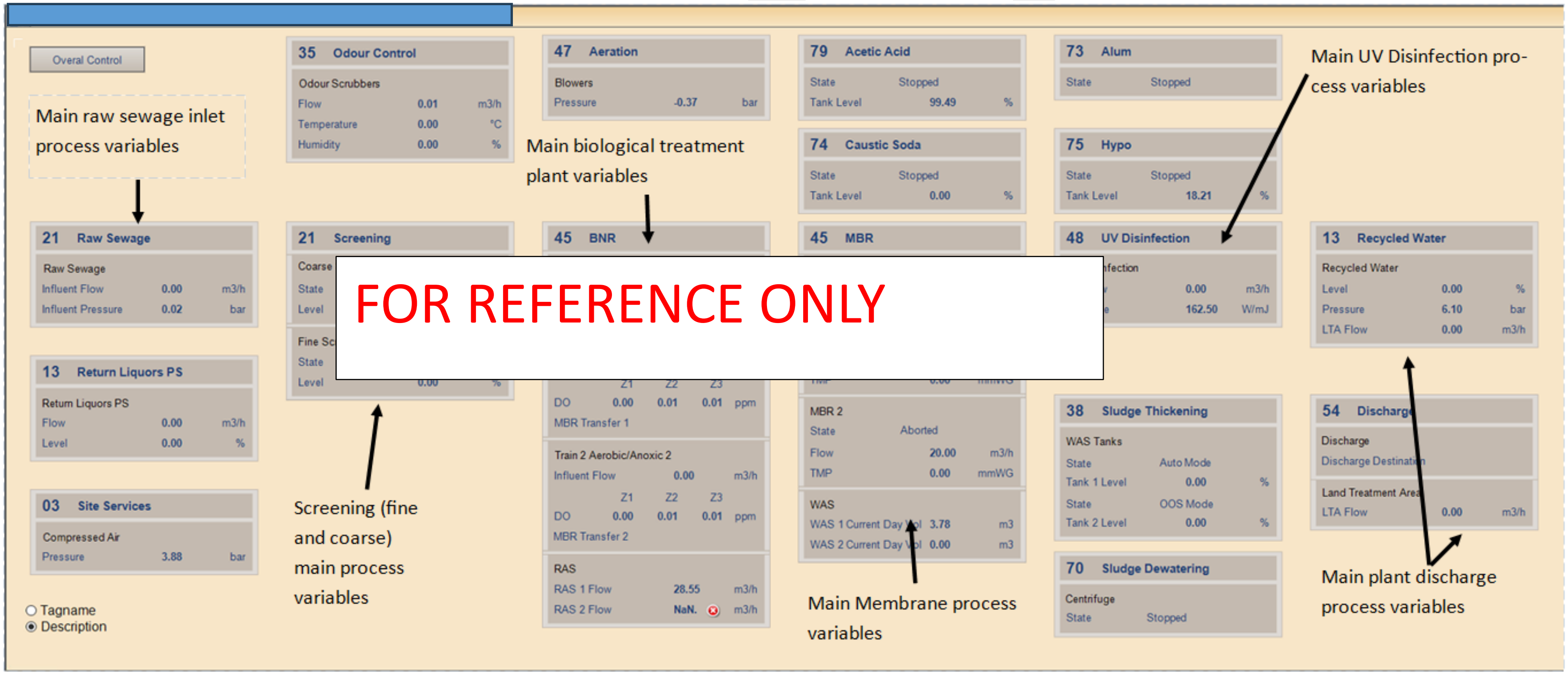
- Dewatering centrifuge
- Motor VSDs
- Analyser transmitters
- UV reactors
- Process water pumps

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)

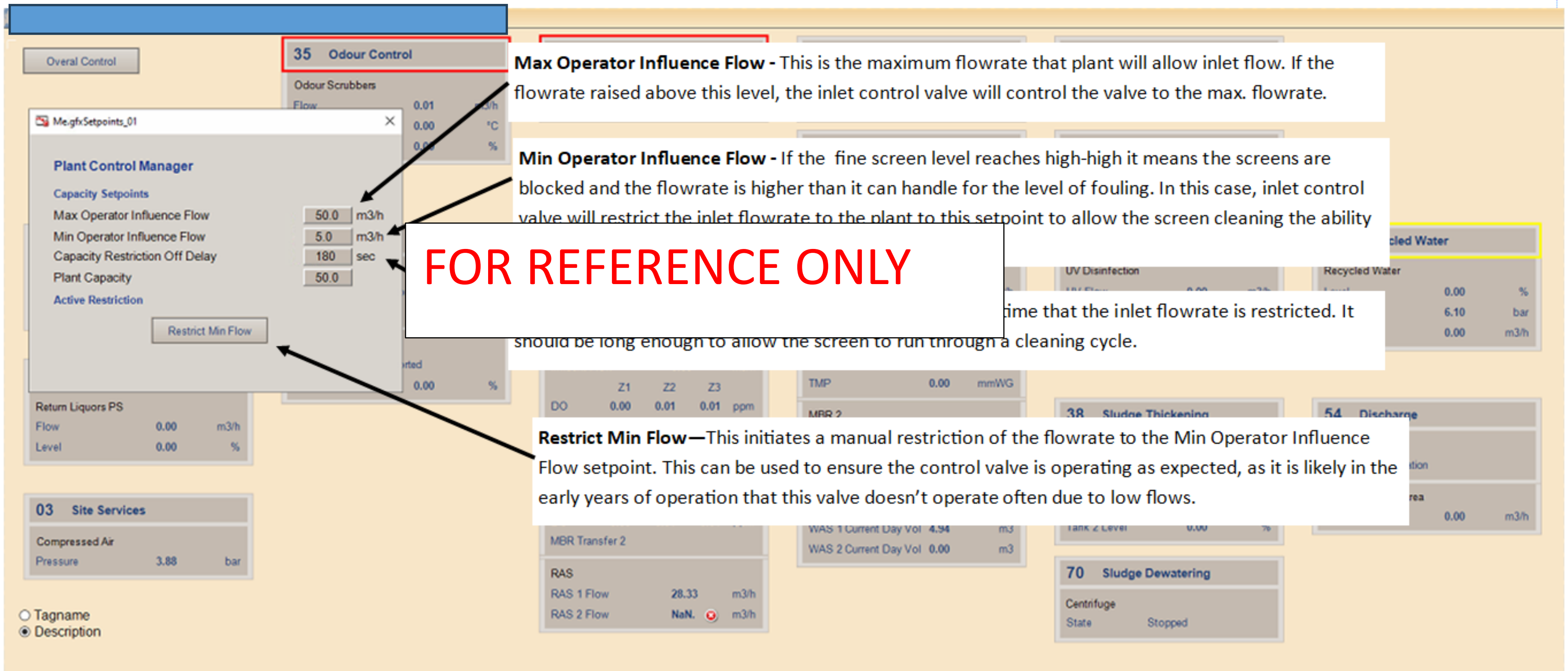


Navigating the home page:

Overall Plant Control Setpoints:

INFORMATION FOR REFERENCE ONLY

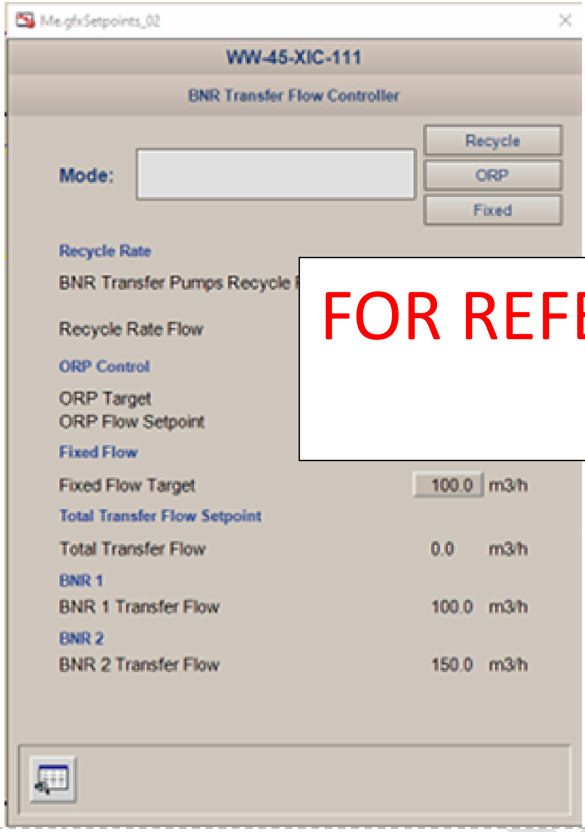
A overview and description of the overall plant control setpoints can be seen below.



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 corre- ... process is targeting optimal deni- ...

... tpoint.

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

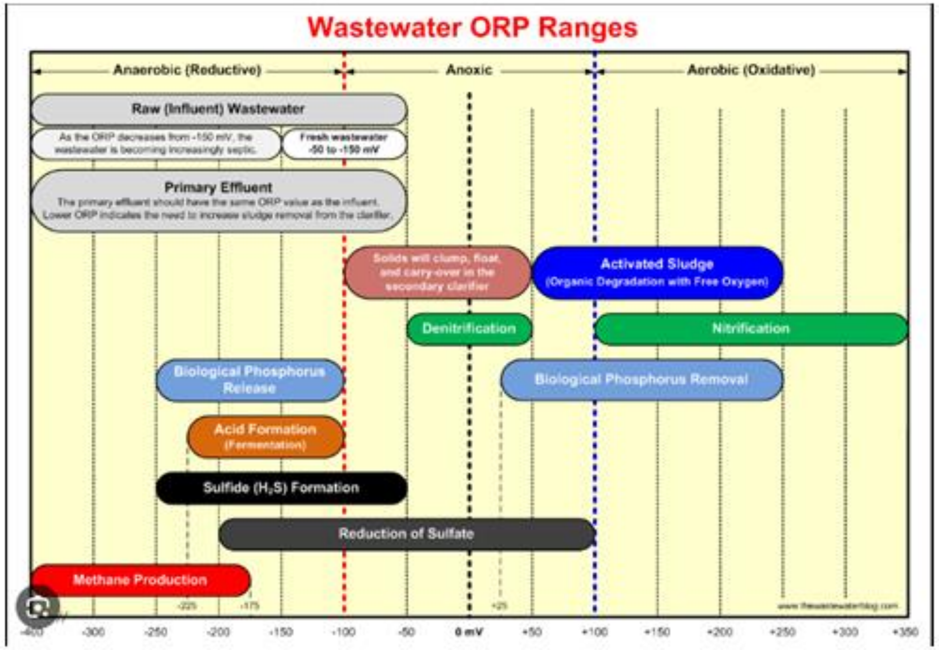
Fixed Flow Target— This is the fixed flowrate target setpoint if the fixed flow mode is selected.

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 Reactions and Corresponding ORP Values	
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: • MBR train 2 TMP: Schedule a CIP is the TMP is greater than xxxx mm	_______ mm _______ 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
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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)	•

Appendix 2 – Draft Emergency Response Plan

Apex Water

Emergency Response Plan

Surf Park Wastewater Treatment Plant

PROJECT NUMBER: 241101

Revision 1
22 January 2026

Principal	
Site Address	
Project Number	
Revision	**1**
Date	22 January 2026
File Location	

REVISION HISTORY

Revision	Date	Purpose	Author	Reviewed
1				

DISTRIBUTION LIST

Date	Name	Title/Role	Organization

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Appendix B	Record for Emergency Response Plan testing

5 June 2025

Lead Compliance Officer – Northern Region
Licensing and Regulatory Compliance
Auckland Council
135 Albert Street
AUCKLAND CENTRAL
Emergency Response Plan –Consent BUNXXXXXXXX

1. INTRODUCTION

Consents have been issued for the construction wastewater treatment infrastructure at ADDRESS under consent reference BUNXXXXXXXX. The operation of plant and equipment associated with the treatment plant compound may present risks to personnel and the environment. While the Environmental Management Plan addresses how risks to the environment are handled from the hazardous substances stored and handled on site, this Emergency Response Plan identifies risks to personnel on site and within the vicinity of the plant and how these shall be responded to in the event of an emergency.

Apex Water have been engaged to design and build the treatment infrastructure, including chemical storage and handling facilities. This letter and the associated Emergency Response Plan has been prepared to fulfil Condition XX of BUNXXXXXXXX.

2. SITE OVERVIEW

The Surf Park Wastewater Treatment Plant and its associated equipment and infrastructure can be seen in **Figure 1**, below. The main items related to the storage or handling of hazardous substances have been highlighted in red.

Figure 1 – Surf Park Wastewater Treatment Plant

Description of Site Activities

The development of the Surf Park Treatment Plant has been driven by the need to provide wastewater treatment infrastructure to the Surf Park community. This compound contains a plant for wastewater treatment and discharge.

WASTEWATER TREATMENT

The core unit processes that comprise the wastewater treatment plant are:

- Raw sewage screening
- Anoxic Stage 1 Treatment and Flow Balancing
- Aerobic Treatment
- Anoxic Stage 2 Treatment
- Membrane filtration
- Ultraviolet Light Disinfection
- Sodium Hypochlorite Disinfection
- Permeate Storage
- Permeate Discharge
- Waste Activated Sludge Storage
- Waste Activated Sludge Dewatering

ANCILLIARY INFRASTRUCTURE

Ancillary infrastructure services both treatment plants and comprise of the following:

- 1% Sodium Hypochlorite Generation
- Centralised Plant Control
- Bulk Chemical Load Out
- Bulk Chemical Storage – 1% Sodium Hypochlorite solution
- Bulk Chemical Storage – 30% Sodium Hydroxide solution
- Bulk Chemical Storage – 49% Acetic Acid
- Back-up Generator (Diesel driven)

-

3. SUMMARY OF HAZARDOUS SCENARIOS

Emergency Type	Hazard	Scenario	Consequence	Location	Potential Offsite Effects	Control
Injury to Personnel (On-site)	Exposure to Hazardous substances stored on site.	Mishandling packaged chemicals.	Harm to personnel with the potential to cause long term injury, disability or death.	Site wide	N/A*	
Injury to Personnel (On-site)	Exposure to Hazardous substances stored on site.	Leak from chemical handling pipework or equipment.	Harm to personnel with the potential to cause long term injury, disability or death.	Site Wide	N/A*	
Injury to Personnel (On-site)	Exposure to Hazardous substances stored on site.	Maintaining chemical handling equipment or pipework.	Harm to personnel with the potential to cause long term injury, disability or death.	Site Wide	N/A*	
Injury to Personnel (On-site)	Exposure to Hydrogen Sulphide	Confined Space Entry	Harm to personnel with the potential to cause long term injury, disability or death.	Return Liquor Pump Station	N/A*	
Injury to Personnel (On-site)	Exposure to Hydrogen Sulphide.	Accumulation in the working areas (Screens room)	Harm to personnel with the potential to cause long term injury, disability or death.	Screens Room	N/A*	
Injury to Personnel (On-site)	Exposure to Low Oxygen Atmospheres.	Confined Space Entry (Residuals Pump Station, Return Liquor Pump Station)	Harm to personnel with the potential to cause long term injury, disability or death.	Liquor Pump Station	N/A*	
Injury to Personnel (On-site)	Exposure to Chlorine gas.	Pumping of acid into Sodium Hypochlorite tank	Harm to personnel with the potential to cause long term injury, disability or death.	Site Wide	N/A	
Injury to Personnel (On-site)	Slip, trip or fall.	Moving around site	Harm to personnel with the potential to cause long term injury, disability or death.	Site Wide	N/A*	
Injury to Personnel (On-site)	Harm caused by powered or non-powered tools.	Maintenance on plant and equipment	Harm to personnel with the potential to cause long term injury, disability or death.	Site Wide	N/A*	
Injury to Personnel (On-site)	Manual Handling.	Moving equipment or material around site	Harm to personnel with the potential to cause long term injury, disability or death.	Site Wide	N/A*	
Injury to Personnel (On-site)	Electrocution	Interacting with electrical system (lights, control systems, pumps, motors, computers etc.)	Harm to personnel with the potential to cause long term injury, disability or death.	Site Wide	N/A*	
Injury to Personnel (On-site)	Harm caused by moving machinery.	Automatically starting and stopping mechanical equipment	Harm to personnel with the potential to cause long term injury, disability or death.	Site Wide	N/A*	

Emergency Type	Hazard	Scenario	Consequence	Location	Potential Offsite Effects	Control
Injury to Personnel (On-site)	Harm caused by vehicle movements.	Movement of vehicles around site where pedestrians may be present	Harm to personnel with the potential to cause long term injury, disability or death.	Site Wide	N/A*	
Injury to Personnel (On-site and Off-site)	Fire or explosion	Electrical fault or spark resulting in fire or explosion	Harm to personnel with the potential to cause long term injury, disability or death.	Site Wide	Potential for offsite effects	
Environmental Disaster	Earthquake, Tsunami	Environmental Disaster	Harm to personnel with the potential to cause long term injury, disability or death.	Site Wide	N/A*	

* - Environmental offsite effects covered under the Environmental Management Plan

4. SPECIALIST TRAINING REQUIREMENTS

CHEMICAL SPILL - MINOR

In the event of a minor chemical spill that can be managed by the site operational staff, the Operator or responder shall be an approved Chemical Handler and be briefed on the use of the spill response kit.

SMALL FIRE

In the event of a fire occurring that can be put out using the fire extinguishers located around the site, this can be attempted. Instruction of the use of fire extinguishers, the different types and their areas of use must be provided. Location of fire extinguishers on-site is shown in Appendix A.

ALL OTHER EMERGENCIES

For all other emergencies, remediation of the hazardous conditions shall be carried out by external trained specialists or emergency services. In the event of an emergency, the main priority shall be to evacuate as many people as possible into places of safety and to address any individual harmed.

5. EMERGENCY EQUIPMENT

FIRST AID KIT

The Surf Park treatment plant houses various first aid kits. The location of these first aid kits on a site layout can be seen in Appendix A. The location of these is to be highlighted during the induction of personnel onto the site and each shall be identifiable by the placement of a First Aid station sign.

The first aid signage (**Figure 1**) is in close proximity to the respective first aid kit.

Figure 1 – First Aid Kit Signage.

Each First Aid Kit includes at a minimum:

- Bandages
- Burn dressing
- Different types of wound dressings
- Foil blanket
- Nitrile Gloves
- Washproof plasters
- Resuscitation face shield with valve

- Shears
- Microporous tape
- Wound cleansing wipes box
- Saline eyewash pods
- Splinter probes

The inspection of each First Aid kit shall be carried out as a part of the regular weekly site inspection to ensure it is well stocked and in good condition.

SAFETY SHOWER STATION

Safety shower is for washing down hazardous substances off a person in the event of a chemical spill. There are X safety shower stations located on Surf Park site. A safety shower station is located on the chemical load out bay, by the dosing cabinets, at the entrance to the walkway and one inside the main room. See **Figure 2 and 3** for their specific locations.

Figure 2 – Location of Safety Shower Stations near the Wastewater Treatment Plant

Figure 3 – Location of Safety Shower Stations near Wastewater Treatment Plant.

CHEMICAL SPILL KIT

The spill kit, for the Wastewater Treatment plant is located central to the site on the bulk chemical location out pad. All of the spill response equipment is located within the yellow wheely bin highlighted below (**Figure 4**).

Figure 4 – Spill Kit location.

The spill kit includes:

- Absorbent pads, pillows and socks
- Waste disposable bags
- Cable ties + breakaway red cable tie
- Disposable gloves
- Instruction card

Detailed instructions on the use and application of chemical spill kit is described in Code of Practice W-00-COP-004 The Use of and Application of Chemical Spill Kits. The Spill kit can be used to clean up minor spills that can be controlled and safely cleaned up. All hazardous spills shall be handled by trained personnel.

FIRE EXTINGUISHER

Fire extinguishers are to be used only for extinguishing small fires and under condition that it is safe to do so. There are X No. 4.5kg Dry Powder fire extinguishers located around the treatment plant compound, each extinguisher is located adjacent signage, as shown in **Figure 5** below.

Figure 5 – A location sign of the fire extinguisher.

Dry powder fire extinguishers are suitable for the following types of fire:

- flammable solids (paper, plastic etc),
- flammable liquids (petrol, oil etc),
- flammable gases (hydrogen sulphide, hydrogen gas etc),
- electrical equipment (cables, computers, switchboards etc).

Fire extinguishers shall be inspected and tagged according to legislative requirements.

6. NOTABLE PERSONNEL

Treatment Plant Operator

The duty treatment plant operator is responsible for the day-to-day operation of the site and shall be the first responder to any emergency situations. They shall act as the Emergency Controller and Fire Warden until such a time that they are relieved of their duty by Emergency Services, in which case they shall support the response through their intimate knowledge of the treatment plant compound. All operators shall be First Aid Trained to the Level 2 certification.

Surf Park - Land Development Representative

Surf Park is the ultimate owner of the wastewater treatment plant. They hold all consents associated with the treatment plant and its operations. Third party stakeholders shall direct all enquiries, complaints or identified issues with the networked supplies to Surf Park who shall action these accordingly between their operations and maintenance partners.

7. RESPONSE PLAN

GENERAL INFORMATION

Designated Emergency Assembly Point:The Main Gate

Site First Aid location:	Main Plant Control Room
Site Fire Extinguishers location:	Various locations, refer attached
Site Emergency Spill Kit location:	Chemical Load Out Bay

Emergency phone number:	111
Healthline:	0800 611 116
Worksafe:	0800 20 90 20
Civil Defence:	111
Poison Centre:	0800 76 47 66
The Doctors Drury:	09 xxxx xxxx (not for emergencies)
The Franklin Hospital:	09 xxxx xxxx (not for emergencies)

Medical Facilities for Minor Injuries

ADDRESS

See **Figure 6** for the route to the DOCTORS NAME

Figure 6 - Screenshot of Google Maps route to nearest medical facility with directions.

Medical Facilities for More Severe Injuries

ALWAYS CALL 111 AND SPEAK TO THE OPERATOR FOR A SERIOUS INJURY. IF THE ADVICE IS TO DRIVE THE INDIVIDUAL TO THE HOSPITAL REQUEST INFORMATION ON THE BEST HOSPITAL.

NEVER LET THE INJURED PERSON DRIVE THEMSELVES IF THE INJURY IS SERIOUS.

See **Figure 7** for the route to LOCAL HOSPITAL
Figure 7 - Screenshot of Google Maps route to nearest hospital with directions.

Emergency Call Dialogue

The emergency phone numbers for Fire, Ambulance, Police, Gas, Chemical Spills:

Dial 111

When calling 111, read the following:

We have an emergency at:	Surf Park Wastewater Treatment Plant, it is located at ADDRESS
We need help from:	Ambulance / Fire / Police
Directions to the emergency are:	DIRECTIONs. Someone will guide you into site, if available.
Our phone number is:	Duty Operator phone number
The medical problem seems to be:	Medical, Chemical, Fire, Explosion (all of the above)

Send someone outside to meet the emergency services.

Response in the Event of Injury to Personnel (On-site)

Before helping someone, who is injured, all workers must remember to:

STOP – LOOK – ASSESS – AND DON'T TAKE ANY RISKS!

If you are the person injured:

1) If you're seriously injured and you are able to do so, call 111 immediately and follow their instructions.
2) If you're injured, but you don't think it is serious, notify your nearby co-worker or if that is not possible, call your supervisor or on-site co-worker.
3) If possible, get another co-worker to find or call the trained first aider on-site.
4) If no-one is available and you have assessed your injury as non-serious and you are capable of driving, take yourself to the nearest Accident and Emergency medical center.

If you come across an injured person / people:

1) STOP – LOOK – ASSESS – AND DON'T TAKE ANY RISKS!
2) Do not approach the individual(s) until you are certain you are not putting yourself at risk.
3) Call 111 immediately, follow the dialogue above.
4) Notify a nearby co-worker, the Operator or any other person close by to support you.
5) If you are First Aid trained and it is safe to do so, commence First Aid.
6) DO NOT LEAVE THE INJURED PERSON BY THEMSELVES.
7) Request the support person to bring anything you require to support the injured individual (ie, First Aid kit)
8) If possible, send someone outside to meet the ambulance.
9) Once the ambulance arrives, brief them on the situation and hand over the response.

Complete incident report and notify Surf Park after the emergency. The effectiveness of the emergency plan shall be reviewed. Surf Park shall investigate the cause and carry out steps to prevent it from repeating if possible.

Response in the Event of a Fire Emergency

The first concern in an event of fire is always the immediate safety of all people present.

In the event of small fire on-site that can be extinguish with fire extinguisher and it is safe to do so, follow this procedure:

1) Retrieve the nearest extinguisher and follow the steps below to extinguish the fire.
2) Locate the closest fire extinguisher and emergency exits.
3) Ensure you are using the correct extinguisher for the fire type.
4) Ensure you always keep an emergency exit or exit path behind you, away from the fire.
5) Stay low to avoid the effects from heat and smoke.
6) Direct the extinguisher stream at the base of the flames.
7) Move the extinguisher stream in a side-to-side sweeping motion.
8) If the fire gets to the point where you are no longer able to control it or there is too much heat or smoke, retreat and close the doors.
9) Call 111 immediately.
10) Notify the Fire Warden – Duty Operator, who shall retrieve the sign-in sheet, sounds the alarm and ensure the site is clear of personnel.
1) If possible, send someone to meet the emergency services and direct the services to the emergency event.
11) Notify Surf Park who can manage any response within the community.

In the event of large fire on-site the following procedure must be followed:

1) Notify the Fire Warden – Duty Operator.
2) The Fire Warden shall coordinate evacuation.
3) Call 111 and notify Surf Park.
4) When calling 111, read the emergency dialogue above.
5) Send someone to meet the emergency services and direct the services to the emergency event.

Incident report shall be completed, and the effectiveness of the emergency plan shall be reviewed after the emergency. Surf Park shall investigate the cause and carry out steps to prevent it from repeating if possible.

Response in the Event of a Chemical Spill Emergency

Refer to Environmental Management Plan for detailed spill response.

Response in the Event of a Gas Emergency

Gas detection is installed in the Screens Room to notify personnel in the event of the detection of potentially hazardous gases. These detectors monitor for the presence of Hydrogen Sulphide (H_2S), Lower Explosive Limit (LEL), Carbon Monoxide (CO) and Oxygen (O_2).

In the event of a detection, an audio-visual alarm located at the pedestrian entrance to each of these rooms shall energise highlighting the potentially hazardous conditions. These alarm limits shall be set far below the limits at which there is a risk to personnel on site. The control system shall also alarm notifying the operator in the Control Room. If this occurs outside of the manned site hours, an SMS shall be sent to the operator.

In the event of gas detector alarming, follow this procedure:

1) If you are inside Screens Room, immediately evacuate the room and close the door behind you.
2) If you are not inside the Screens Room, do not enter the room if you hear the alarm and see flashing visual alert above the entrance door.
3) Notify the duty Operator immediately who shall manually increase the ventilation rate of these rooms.

Response in the Event of a Natural Disaster

When disaster strikes follow this procedure:

- The priority is the protection of people over anything else. Get yourself and others to a safe location whether that is offsite, or on-site.
- In the event of an earthquake, tsunami or volcanic eruption, get yourself to the nearest safe location. This may be off-site.
- Do not return inside any buildings or to any locations where hazardous substances may be kept until it is safe to do so.
- If the site emergency back-up generator auto-change over has occurred and the plant is energised, the control system may be available remotely.
- The treatment plant is designed to be resilient in the event of an emergency and shall operate to feed the water supply to the development in the case of fires or emergency needs. Do not turn the plant off unless you have received guidance from emergency personnel.

If earthquake strikes remember:

- Keep calm
- Stay indoors where practical
- Drop, cover and hold (Get under something that covers you, like a strong table or other sturdy structure. Hold onto it if you can.)
- Keep away from windows and heavy furniture
- If necessary (the earthquake is too strong or lasts more than a minute), evacuate using a previously identified route
- After the earthquake, proceed immediately by the safest identifiable route to the designated emergency assembly point
- Remain there, until all persons are accounted for and the Duty Operator has given the official clearance to return to work or leave site.

During the volcanic eruption:

- Stay indoors as much as possible.
- Save water as early as possible as supplies may become contaminated.
- If it is safe to do so, keep gutters and the roof clear of ash to prevent your roof collapsing.
- If you must go outside, use protective clothing, cover your head, breathe through a mask and carry a torch.
- Wait for Civil Defence instruction and follow their recommendations.

8. HAZARDOUS SUBSTANCES

Where to Find Information on Hazardous Substances

Information on Hazardous Substances can be found in several locations. These are detailed below:

If the hazardous substance emergency occurs around the location of storage or use, the best location to receive all relevant information is the Main Control Room as this will minimise any risk to personnel involved. Collect the MSDS folder from the control room.

Location	Colour Reference	Description
Main Control Room		The MSDS and chemical inventory
Bulk Storage		On each bulk tank HSNO Pictograms are shown identifying the hazards associated with the chemical stored
Bulk Storage		On each bulk tank HSNO Pictograms are shown identifying the hazards associated with the chemical stored
Packaged Chemical Storage		On each package of packaged chemicals HSNO information is shown on the label
Chemical Dosing Pumps		On each of the dosing cabinets, HSNO pictograms identify what chemical is being pumped.

Hazardous Substance Inventory

The chemical inventory is a live document which is updated if any new chemicals are delivered to site, regardless of the volume held. A general inventory can be found in Appendix C of the Environmental Management Plan, however this contains the maximum volumes allowable under the Industrial and Trade Activity consent and does not include incidental chemical that may also be found on site, such as cleaning chemicals, oils for motors and gear boxes, chemicals used in the maintenance and repair of plastic pipework, paints etc.

Hazardous Substances Locations

Hazardous substances are stored on site either in bulk or packaged. Chemicals stored in bulk are shown in **Figure 8**. Each bulk chemical storage tank has a secondary containment – a chemical bund. Alkalis and acids are separated. Acid storage includes Sulphuric Acid tank and Acetic Acid tank. Alkali storage includes Sodium Hydroxide tank and Sodium Hypochlorite tank.

Figure 8 – Location of Bulk Chemical Substances.

Figure 10 – Packaged chemical storage in the wastewater treatment plant.

9. TESTING THE PLAN

The Emergency Response Plan is to be tested annually. The results of the testing will be recorded in Appendix B.

10. AUDITING PROGRAMME

The site shall be subjected to yearly management audits to ensure it is adhering to the requirements of this Emergency Response Plan. XXXXXX as the operator of the treatment plant does not stipulate the external auditing requirements, however it is expected that the owner of the plants shall be carrying out regular audits to ensure conformance to this plan and their requirements.

11. STAFF TRAINING

All staff and subcontractors working or regularly visiting the Surf Park Treatment PLant shall be inducted prior to commencing activities on site. Within this induction, the requirements of the site's emergency response plan shall be outlined.

If a change in this document occurs, these changes shall be distributed and re-briefed to all staff.

Surf Park holds a training register that is managed by the company's health and safety personnel. This register identifies training requirements, stores certifications and provides automated notifications when training needs to be updates.

Appendix A

Appendix B

Appendix 3 – Draft Environmental Management Plan

Environmental Management Plan

Surf Park Wastewater Treatment Plant

PROJECT NUMBER: 241104

Revision 1

Principal	Surf Park
Site Address	
Project Number	
Revision	**1**
Date	
File Location	

REVISION HISTORY

Revision	Date	Purpose	Author	Reviewed
1	17/03/2025	Outline Document		

DISTRIBUTION LIST

Date	Name	Title/Role	Organization

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Appendix D	Daily Inspection Sheet

Date:
Lead Compliance Officer – Northern Region
Licensing and Regulatory Compliance
Auckland Council
135 Albert Street
AUCKLAND CENTRAL
Industrial and Trade Activities Environmental Management Plan

1. INTRODUCTION

Consents have been granted to Surf Park for Industrial or Trade Activities related to the operation of wastewater infrastructure at ADDRESS. This includes the storage and handling of volumes of chemicals utilised in the treatment processes which fall above the permitted activity threshold limits required by the Auckland Unitary Plan.

This letter and the associated Environmental Management Plan appended has been prepared to fulfil Condition XX of consent BUNXXXXXXXXX.

2. ENVIRONMENTAL MANAGEMENT

Site Overview

The Surf Park Wastewater Treatment Compound and its associated equipment and infrastructure can be seen in **Figure 1**, below. The main items related to the storage or handling of Hazardous Substances related to the Industrial or Trade Activities consent have been highlighted in red.

Figure 1 – Surf Park Wastewater Treatment Compound

Description of Site Activities

The development of the Surf Park Wastewater Treatment Plant has been driven by the need to provide wastewater treatment infrastructure to the Surf Park community. This compound contains plants for wastewater treatment and discharge which utilise a number of chemicals and hazardous substances within their unit processes.

WASTEWATER TREATMENT

The core unit processes that comprise the wastewater treatment plant are:

- Raw sewage screening
- Anoxic Stage 1 Treatment and Flow Balancing
- Aerobic Treatment
- Anoxic Stage 2 Treatment
- Membrane filtration
- Ultraviolet Light Disinfection
- Sodium Hypochlorite Disinfection
- Permeate Storage
- Permeate Discharge
- Waste Activated Sludge Storage
- Waste Activated Sludge Dewatering

ANCILLARY INFRASTRUCTURE

Ancillary infrastructure services both treatment plants and comprise of the following:

- 1% Sodium hypochlorite Generation
- Centralised Plant Control
- Bulk chemical load out
- Bulk Chemical Storage – 1% Sodium hypochlorite solution
- Bulk Chemical Storage – 30% Sodium hydroxide solution
- Bulk Chemical Storage – 49% Acetic acid
- Back-up Generator (Diesel driven)

Site Specific Activities

HAZARDOUS SUBSTANCES

The hazardous substances utilised within the treatment processes can be seen in **Table 2.1** below. Refer to Appendix A to respective SDS.

Table 2.1 Hazardous substances volumes and classifications

Substance	HSNO Classification	Classification Definition	State	Volume	Location

**- The dewatered waste activated sludge isn't well characterised, but may contain BOD levels above 10,000mg/L*

HAZARD IDENTIFICATION

Table 2.2 below outlines the mechanism for hazardous substances stored or handled on the Surf Park site entering the local environment.

Table 2.2: Risks and contaminants of the Industrial and Trade Activity

Activity	Pollution Risk	Contaminants

Management of Environmental Risks

The basis of design of the treatment plant compound has considered the storage of hazardous substances on the site as a central element of the design process. In addition to the design elements, operational controls are in place to ensure the likelihood of spillages and mishandling is minimised.

GENERAL OPERATIONAL CONTROLS

Numerous general operation controls are in place to aid in the effective and safe operational of the treatment plants. These controls pertain to the handling and storage of hazardous substances or anything that may be contaminated with a hazardous substance. Further information on these can be found with the site's overall Standard Operating Procedures, which include but are not limited to:

- Standard Operating Procedure – The Use of and Application of Chemical Spill kits
- Standard Operating Procedure - Secondary containment rainwater testing and discharge.
- Standard Operating Procedure – Removal and Replacement of Bins for Dewatered Waste Activated Sludge
- Standard Operating Procedure – Handling and Storage of Packaged Chemicals
- Standard Operating Procedure – Bulk Chemical Handling (provided by Ixom)

BULK CHEMICAL STORAGE

Each bulk chemical storage tank sits within a chemical bund which has been designed to conform with the requirement of the Hazardous Substances and New Organisms Act, this includes:

- Bulk tank secondary containment capable of containing in excess of 110% of the volume of the largest tank.
- Separation of incompatible substances
- Redundancy in the tank level instrumentation with automatic fail over with high and high-high level alarming
- Tank overfill protections, see the Bulk Load out section below.
- HSNO compliant labelling
- Bulk secondary containment bund dimensions to account for tank dimensions and crest locus of the bulk chemical storage can be seen in **Figures 2** and **3** below.

-

Figure 2 –Site layout with bulk chemical storage locations highlighted.

Figure 3 –Bulk chemical storage locations

PACKAGED CHEMICAL STORAGE

Packaged chemicals are utilised through the two treatment processes for conditioning of water or waste streams. The conditioning of wastewater is typically carried out to aid the treatment processes, or to ensure the wastewater meets any compliance requirements.

The packaged chemicals utilised on the Surf Park site are as follows:

- Sodium hypochlorite
- Aluminium Sulphate

A conservative approach to the storage of packaged chemicals has been taken to ensure that there is sufficient space available to allow for volumes of storage that will provide for prolonged periods of treatment without a requirement to re-stock regularly.

Each packaged chemical sits within or on a dedicated containment bund or spill collection bund. Where applicable HSNO requirements exist, these have been adhered to, or otherwise an engineered *off the shelf* storage solution has been procured for storing packaged chemical products, these include:

- 20l Carboys – Drip trays or containment bunds
- 200L Drums – Drip trays or containment bunds
- 1000L Intermediate Bulk Containers – Drip trays or containment bunds

The configuration of the location of packaged chemical storage can be seen in **Figures 4** and **5** below.

Figure 5 – Packaged chemical storage in the wastewater treatment plant.

BULK AND PACKAGED CHEMICAL DELIVERIES AND HANDLING

The delivery of bulk chemicals and packaged chemicals represents the activity with the highest risk of spillage. Bulk chemical deliveries are made directly from tankers which pump their products into the corresponding bulk storage tank. The delivery of packaged chemical products is carried out by approved dangerous goods transportation companies which are offloaded by site operational staff and stored in the corresponding packaged chemical storage locations identified in **Figures 4** and **5** above.

Bulk Chemical Deliveries

Bulk chemical deliveries will be carried out by Ixom Chemicals Limited. They are specialist producers and suppliers of chemicals into the water treatment industry of New Zealand and own a fleet of chemical tankers whose operators are specifically trained in the handling and unloading of hazardous chemicals. The bulk unloading infrastructure has been designed in coordination with Ixom to ensure their high standards are met and that all HSNO and other relevant legislative requirements are adhered to.

All bulk deliveries are to be made on the dedicated load out pad. This load out pad contains the following controls to ensure any spillages are appropriately contained:

- Dedicated and separate drainage
- Capacity to contain a volume greater than the largest compartment of the delivery tanker
- Dedicated load in point for each chemical
- Dedicated digital display for each bulk storage tank, with current volume and safe fill volumes displayed.
- Dedicated overfill flashing light and siren for each bulk chemical storage tank.

The dedicated bulk chemical load out pad can be seen in **Figure 6** below.

Figure 6 – Bulk chemical delivery load out pad

Packaged Chemical Deliveries

Packaged chemical deliveries will be carried out by an approved chemical supply company. These companies hold the certifications for transporting hazardous substances in volumes greater than typically allowed by other standard delivery organisations.

Once the delivery vehicle has arrived on site, the unloading process will be handled by the site's operation staff. This will either be by hand for smaller packages, or forklift for larger volumes.

All packaged chemicals shall be unloaded onto the chemical load out pad before being transported to their respective storage locations.

The delivery vehicle shall park adjacent the load out pad and the forklift shall operate on the load out pad to remove the packages and place them onto the contained area, before relocating these to their final positions.

The dedicated packaged chemical load out pad can be seen in **Figure 7** below.

Figure 7 – Packaged chemicals load out pad

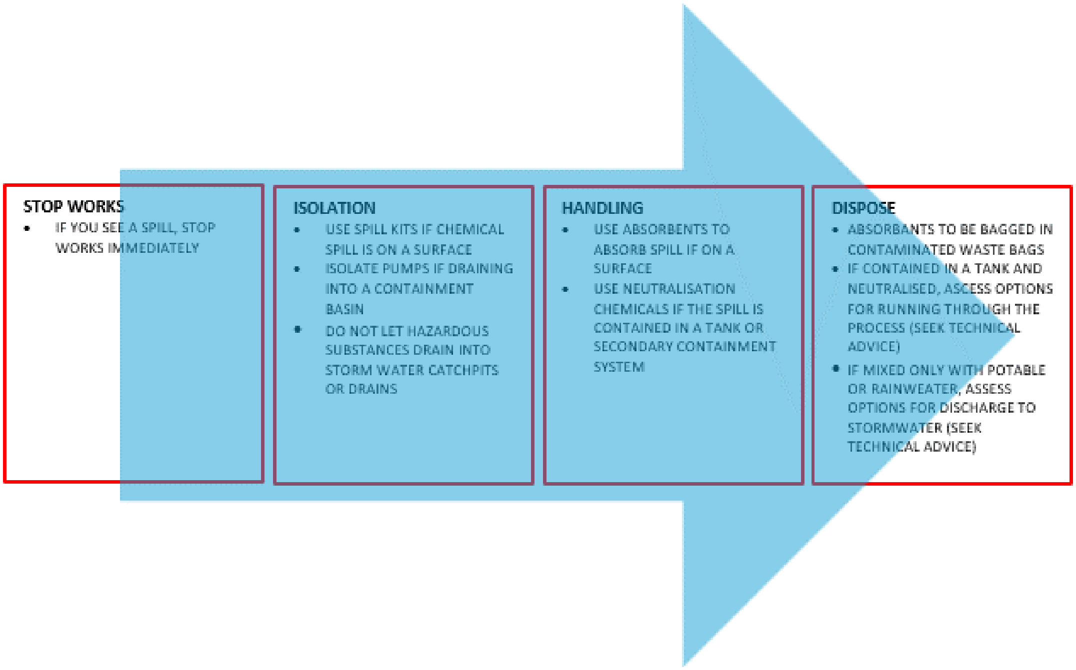
Handling

The handling and movement of chemicals on site presents the high risk of chemical exposure to personnel and any sensitive environments.

All individuals handling or relocating chemicals shall be appropriately trained and competent in both the handling of chemicals and the operation of supporting plant or equipment.

A training register is maintained by Apex Water which contains records or training and any certifications held by staff. This is managed by the company's Health and Safety personnel and is updated to ensure training and certification remains up to date.

Spill Response Plan



DO NOT ALLOW ANY CHEMICALS OR HAZARDOUS SUBSTANCES TO ENTER THE STORMWATER SYSTEM

If a spill is identified and safe to do so, it must be prevented spreading into protected places. It must be confined to the immediate area. If safe to do so, barriers must be put in place or drain covers installed to block access to stormwater catchpits.

Notify people in the immediate area of the hazard and send someone to report this to Site Management immediately after it has been contained. If the substance is known, ensure its location and an idea of the volume is reported.

Using the site's Material Safety Datasheet (MSDS) register, identify the substance spilled and identify the precautions that must be taken (is it flammable, is there a risk of explosion, gassing off, is it corrosive, is there a risk of it combining with an incompatible material etc.)

Using the Personal Protective Equipment stipulated on the MSDS as a minimum and anything else identified as necessary commence the tidy up of the spilled substance.

For minor spills that can be controlled and safely cleaned up, place the contaminated material into Hazardous Waste bags and have these stored and disposed of appropriately.

DO NOT WASH DOWN THE AREA

For large spills or hazardous spills that are either too large or dangerous to clean up, contact the Fire Brigade on 111 and follow emergency procedures.

A major spill is:

- Any amount of flammable, very toxic substance
- Anything with a product label says EXTREMELY FLAMMABLE, TOXIC, OXIDISER or CORROSIVE
- More than 200L of any substance

A minor spill is:

- A spill involving 200L or less any other substances or fuel

Immediately report the spill to the Auckland Council's 24-Hour Pollution Hotline 09 377 3107 if:

a) Spill is over 20 litres.
b) Environmentally Hazardous substances (see pictogram in SDS and below) has entered the stormwater system.
c) Environmentally Hazardous substances (see pictogram in SDS and below) has entered a waterbody.
d) Environmentally Hazardous substances (see pictogram in SDS and below) has contacted unsealed ground.

Any incidents resulting in the discharge of hazardous substances to the environment shall be reported to the Council of within 24 hours of incident occurring.

Site Drainage Plan

Refer to Appendix B of this document for site drainage plan which identifies catchpits, channel drains, treatment devices and discharge points.

Chemical Inventory

The chemical inventory is a live document which is updated if any new chemicals are delivered to site, regardless of the volume held. A general inventory can be found in Appendix C of this documents, however this contains the maximum volumes allowable under the Industrial and Trade Activity consent and does not include incidental chemical that may also be found on site, such as cleaning chemicals, oils for motors and gear boxes, chemicals used in the maintenance and repair of plastic pipework, paints, cedar oil etc.

Risk Register

A qualitative risk assessment of the identified hazards/failure modes has been undertaken in **Table 2.6** for all of the scenarios identified in **Table 2.2** where there are potential for offsite effects. The qualitative risk assessment has been carried out to assess the associated risks with chemical storage and handling. The risk assessment has been carried out by applying a qualitative rating to the frequency (likelihood) of the failure occurring and the consequence (severity) of impacts if the event were to occur. The likelihood and consequence ratings take into account the controls (mitigation and management measures) that will be in place.

The qualitative likelihood and effects ratings are described in **Table 2.3** and **Table 2.4**, respectively.

Table 2.3: Qualitative rating of likelihood

Frequency rating	Descriptor	Explanation
A	Almost certain	The event is expected to occur in most circumstances
B	Likely	The event will probably occur in most circumstances
C	Moderate	The event should occur at some time
D	Unlikely	The event could occur at some time
E	Rare	The event may occur only in exceptional circumstances

Table 2.4: Qualitative rating of consequence

Effects rating	Descriptor	Explanation
1	Insignificant	No injuries, negligible environmental damage
2	Minor	First aid treatment required, on-site release contained, minor damage to property
3	Moderate	First aid treatment required, minor environmental damage, damage to off-site property
4	Major	Extensive injuries, major environmental damage to immediate environment, moderate damage to off-site property
5	Catastrophic	Fatalities both on and off-site, major and widespread environmental damage, exposure to toxic release by numerous people.

The likelihood and consequence ratings are then combined to qualitatively assess the overall level of risk associated with each hazard. The risk assessment matrix is shown in **Table 2.5**.

Table 2.5: Risk matrix

Consequence Likelihood	Severity				
	Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Almost certain (A)	Significant	Significant	High	High	High
Likely (B)	Moderate	Significant	Significant	High	High
Moderate (C)	Low	Moderate	Significant	High	High
Unlikely (D)	Low	Low	Moderate	Significant	High
Rare (E)	Low	Low	Moderate	Significant	Significant

Table 2.6: Risk management

		Residual risk		
Event	**Controls (Mitigation/ Management Measures)**	**Likelihood**	**Consequence**	**Risk**

Inspection and Maintenance Requirement

The Operational and Maintenance manuals for the treatment plant includes provision for the ongoing maintenance and inspection of systems storing or handling hazardous substances.

Please refer to the Operational and Maintenance manuals for the plant and the overall site for specific inspection and maintenance activities, these include but are not limited to:

- Daily visual inspections of all chemical dosing lines, pumps, and cabinets for the leaks.
- Daily visual inspections of all chemical tanks and bunds for accumulated rainwater, leaks, or signs of damage.
- Daily visual inspections of all Waste Activated sludge tanks, pipelines, and associated equipment.
- Daily visual inspections of all stored packaged chemicals.

An example of a daily inspection sheet can be found in Appendix D.

Auditing Programme

The site shall be subjected to monthly management audits to ensure it is adhering to the requirements of this Environmental Management Plan. Apex Water as the operator of the treatment plant does not stipulate the external auditing requirements, however it is expected that the owner of the plants shall be carrying out regular audits to ensure conformance to this plan.

Staff Training

All staff and subcontractors working or regularly visiting the Surf Park Wastewater Treatment compound shall be inducted prior to commencing activities on site. Within this induction, the requirements of the site's environmental management shall be outlined.

If a change in this document occurs, these changes shall be distributed and re-briefed to all staff.

Apex Water holds a training register that is managed by the company's health and safety personnel. This register identifies training requirements, stores certifications and provides automated notifications when training needs to be updates.

Appendix A

Appendix B

Appendix C

Appendix D

DRAFT

Appendix4 – Draft Odour O&M

Operations and Maintenance Manual – Odour Control

Surf Park WwTP

PROJECT NUMBER: 241104

Revision 1
21 January 2026

Principal	Delmore
Site Address	
Project Number	
Revision	**1**
Date	21 January 2026
File Location	

REVISION HISTORY

Revision	Date	Purpose	Author	Reviewed
1				

DISTRIBUTION LIST

Date	Name	Title/Role	Organization

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Appendix A Vacuum Pressure Inspection Sheet
Appendix B Saturation of Adsorptive Media Sheet
Appendix C Complaints Procedure

DATE

Lead Compliance Officer – Northern Region
Licensing and Regulatory Compliance
Auckland Council
135 Albert Street
AUCKLAND CENTRAL

Operations and Maintenance Plan – Odour Control –– Consent BUNXXXXXX

1. INTRODUCTION

Consents have been granted to Surf Park for the discharge of non-hazardous vapours to the air which are associated with to the operation of wastewater infrastructure.

This letter and the associated Operations and Maintenance Manual – Odour Control appended has been prepared to fulfil Condition XXX of BUNXXXXXXXX.

2. OVERVIEW OF SITE OPERATIONS

PURPOSE OF THE FACILITY

The Surf Park Wastewater Treatment Plant has been established to meet the community's need for effective wastewater processing. The facility design anticipates and addresses the potential for odour emissions, particularly fugitive odours, arising from the treatment process.

CORE WASTEWATER TREATMENT PROCESSES

The facility includes the following key treatment stages:

- Preliminary Screening – Removal of large solids from raw sewage.
- Stage 1 Anoxic Treatment & Flow Equalization – Initial nutrient removal under low-oxygen conditions.
- Aerobic Biological Treatment – Oxygenated treatment to further break down waste.
- Stage 2 Anoxic Treatment – Additional denitrification and nutrient removal.
- Membrane Filtration – Fine filtration of treated water.
- Ultraviolet Disinfection – UV exposure to inactivate pathogens.
- Chemical Disinfection with Sodium Hypochlorite – Final disinfection using chlorination.
- Permeate Storage – Holding of treated effluent before disposal.
- Permeate Disposal – Discharge to land treatment or rapid infiltration systems.
- Waste Activated Sludge (WAS) Storage – Interim holding of biological solids.
- Sludge Dewatering – Reduction of sludge volume through water removal.

SUPPORTING INFRASTRUCTURE

The following ancillary systems support plant operation:

- Centralized control and automation systems
- Loading facilities for bulk chemical transfer
- Storage for:
  - 1% Sodium hypochlorite
  - 30% Sodium hydroxide
  - 49% Acetic acid
- Emergency diesel-powered backup generator

2. AIR EMISSIONS AND ODOUR MANAGEMENT

PRINCIPAL ODOUR GENERATION MECHANISMS

Odour emissions at the plant are primarily due to anaerobic bacterial activity, which occurs when organic waste breaks down in the absence of oxygen. These conditions can arise when:
The biological oxygen demand of wastewater exceeds the available dissolved or molecular oxygen.
Although anaerobic processes are standard in some wastewater systems, the Surf Park plant is specifically engineered to prevent anaerobic conditions through:

- Continuous aeration,
- Monitoring of oxygen levels,
- Redundant systems for fail-safe operation.

Key odour risk areas include:

- Raw sewage reception and screening
- Waste activated sludge (WAS) handling and thickening
- Raw Sewage Reception
- Sewage is delivered via a pump station connected to the gravity sewer network.
- Longer retention times in the sewer can lead to oxygen depletion and the formation of odours before arrival at the plant.
- The screening system is therefore a high-risk area for odour emissions.
- Waste Activated Sludge (WAS) Handling
- Proper solids retention time (SRT) is crucial to maintain process stability.
- Sludge that remains too long in storage tanks may become anaerobic, generating odours.
- Consistent sludge removal and forced aeration help mitigate this risk.

ADDITIONAL POTENTIAL ODOUR SOURCES

Other areas that could emit odours under certain conditions include:

- Inlet screening units
- Screenings collection skips
- Decanter centrifuge for sludge dewatering
- Skips containing dewatered sludge
- Return liquor pump station
- Main plant building (housing screening and dewatering equipment)
- WAS storage tanks
- Biological treatment stages
- The Odour Control Unit itself

ODOUR CONTROL MEASURES

Inlet Screening Area

1. Located in a sealed plant room maintained under negative pressure.

2. Vapours from the screening chamber and skip bins are extracted and treated via the Odour Control Unit.

Decanter Centrifuge

1. Treats aerated WAS to prevent anaerobic conditions.

2. Centrifuge housing is negatively pressurized and connected to the odour extraction system.
3. Associated skips are also enclosed and ventilated.

Return Liquor Pump Station

1. Collects liquid residuals from various process areas.
2. The pump station is continuously vented under negative pressure to the Odour Control Unit.

Main Plant Building

1. Contains major odour sources including screens and centrifuge.
2. Maintained under slight negative pressure to prevent fugitive emissions.
3. Ventilated air is treated prior to discharge.

WAS Storage Tanks

1. Continuously aerated to prevent the formation of anaerobic conditions.
2. Tank headspace is extracted at a higher flow rate than the aeration input, ensuring containment.

Biological Treatment Zones

1. To balance nutrient removal and odour control, the plant uses targeted aeration and monitoring:
2. Anoxic Stage 1: Receives recycled aerated water. Oxidation-reduction potential (ORP) is monitored to prevent anaerobic activity.
3. Aeration Stage: Dissolved oxygen (DO) is continuously measured to maintain optimal aerobic conditions.
4. Anoxic Stage 2: Mirrors Stage 1 control strategy using ORP monitoring.
5. Membrane Stage: Aeration supports both treatment and membrane scouring.

3. ODOUR CONTROL UNIT SPECIFICATIONS

The Odour Control Unit treats air extracted from all high-risk zones, including:

- Headworks screening
- Sludge tanks and skips
- Dewatering equipment
- Wastewater sumps
- Main process room

Design parameters include:

- Use of activated carbon media impregnated with chemicals like sodium hydroxide or potassium iodide.
- Media depth designed for minimum 3 seconds residence time at maximum airflow.
- Maximum gas velocity through media: 0.2 m/s, unless approved otherwise.

SUMMARY OF KEY OPERATIONAL PARAMETERS

Table 1 below summarises each area of potential fugitive odour generation and the design features or operational parameters that exist to prevent against odour release.

Table 1 – Barriers and Mitigations to Fugitive Odour Release.

Source	Primary Barrier and Operational Parameters	Secondary Barrier and Operational Parameters	Tertiary+ Barriers and Operational Parameters	Other
Raw Sewage Inlet Screens	**BARRIER** 1. Enclosed headspace **OPERATIONAL PARAMETER** 1. N/A	**BARRIER** 1. Inlet Screens are located inside. **OPERATIONAL PARAMETER** 1. N/A	**BARRIER** 1. Headspace maintained at negative pressure. **OPERATIONAL PARAMETER** 1. Confirmation of vacuum pressure monitored and recorded weekly	
Dewatering Centrifuge	**BARRIER** 1. Enclosed headspace **OPERATIONAL PARAMETER** 1. N/A	**BARRIER** 2. Dewatering centrifuge is located inside. **OPERATIONAL PARAMETER** 1. N/A	**BARRIER** 1. Headspace maintained at negative pressure. **OPERATIONAL PARAMETER** 1. Confirmation of vacuum pressure monitored and recorded weekly	
Main Plant Room	**BARRIER** 1. Room has forced ventilation. **OPERATIONAL PARAMETER** 1. N/A			
Waste Activated Sludge Tank	**BARRIER** 1. Headspace maintained at a negative pressure **OPERATIONAL PARAMETER** 1. Confirmation of vacuum pressure monitored and recorded weekly	**BARRIER** 1. Forced aeration of tank contents to avoid anaerobic conditions **OPERATIONAL PARAMETER** 1. Aeration blowers operational and available		The aeration system has been designed and installed with the following redundancy: - Three blowers in the configuration of Duty, Standby and Jockey have been installed. - An emergency back-up generator with auto changeover will power these units in the event of a power failure. - UPS system to ensure power of the control system in the event of a power change over or total power failure
Return Liquor Pump Station	**BARRIER** 1. Enclosed headspace **OPERATIONAL PARAMETER** 1. N/A	**BARRIER** 1. Headspace maintained at negative pressure **OPERATIONAL PARAMETER** 1. Confirmation of vacuum pressure monitored and recorded weekly		
Biological Treatment Process	**BARRIER** 1. Anoxic 1 ORP Continuous Monitoring 2. Aeration Dissolved Oxygen Concentration Monitoring 3. Anoxic 2 ORP Continuous Monitoring 4. Membrane Tank Forced Aeration			The aeration system has been designed and installed with the following redundancy: - Three blowers in the configuration of Duty, Standby and Jockey have been installed. - An emergency back-up generator with auto changeover will power these units in the event of a power failure.

	OPERATIONAL PARAMETER 1. Refer Functional Description 2. Dissolved Oxygen Concentration must not drop below 0.1mg/L for more than 12 hours. 3. Refer Functional Description 4. Refer Functional Description			- UPS system to ensure power of the control system in the event of a power change over or total power failure
Odour Scrubber Unit	**BARRIER** 1. Chemically impregnated, steam activated carbon bed. **OPERATIONAL PARAMETER** 1. Inline duct heater capable of reducing the RH of the incoming air at the maximum design flowrate from 100% to 70% at 20 degrees Celsius 2. Residence time of minimum 3 seconds in carbon bed at maximum flowrate 3. Maximum gas velocity of 0.2m/s through the carbon bed, exceptions with Auckland Council approval 4. Monitoring of saturation of adsorptive media monthly 5. Weekly monitoring of temperature and RH of airflow into and out of the heater			An emergency back-up generator with auto changeover will power the Odour Control Unit in the event of a power failure. A UPS system ensures power of the control system and monitoring systems in the event of a power change over or total power failure

3.1. Critical Spares

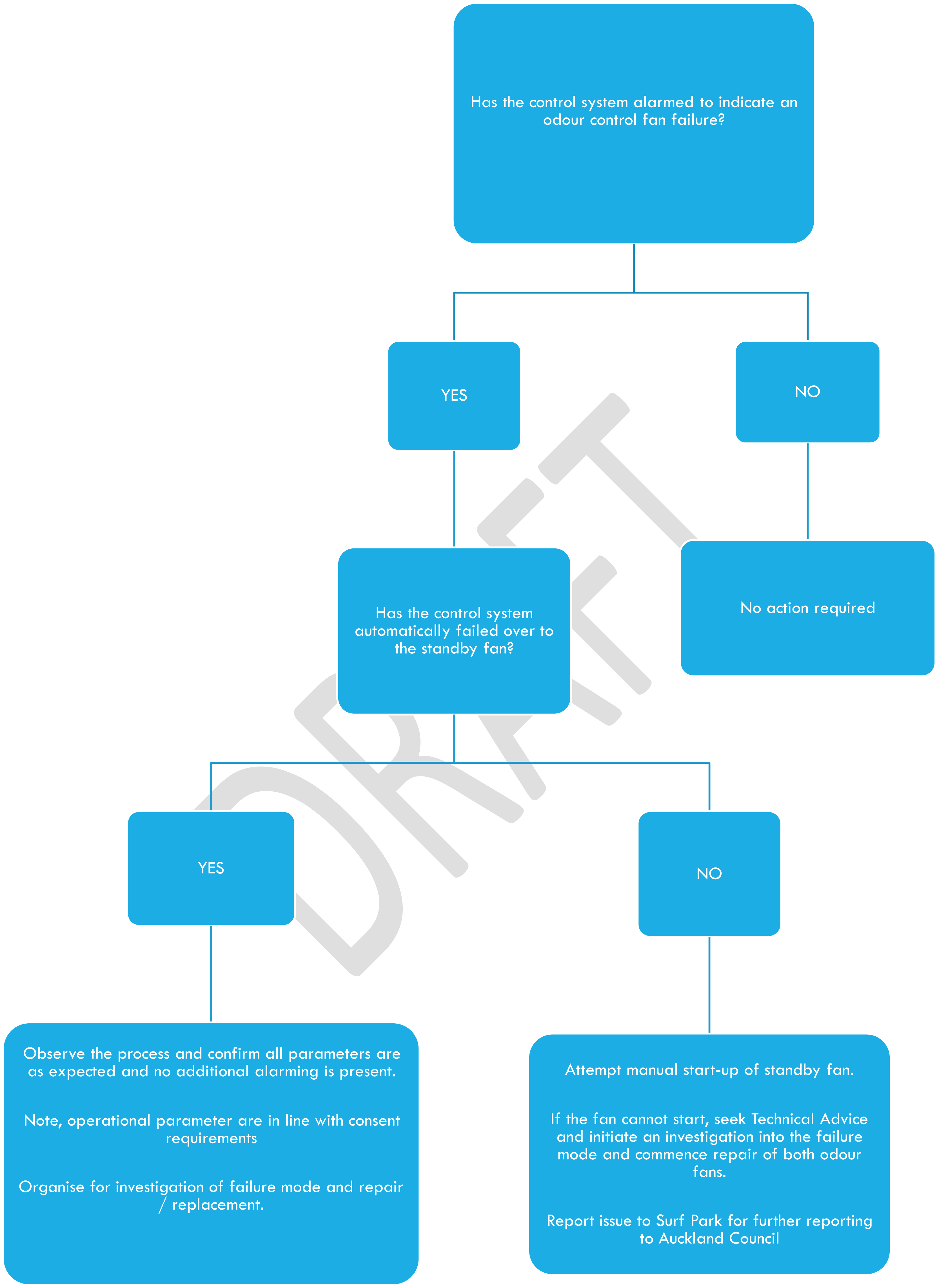
The following items have been identified as critical spares which must be held on site or must be regularly stocked items held by third parties, or by the Apex Water Service and Sales Team. Criticality is qualified by the item being necessary for the operation of any system that protects against fugitive odour generation or emission. Table 2 below, outlines the critical spares identified.

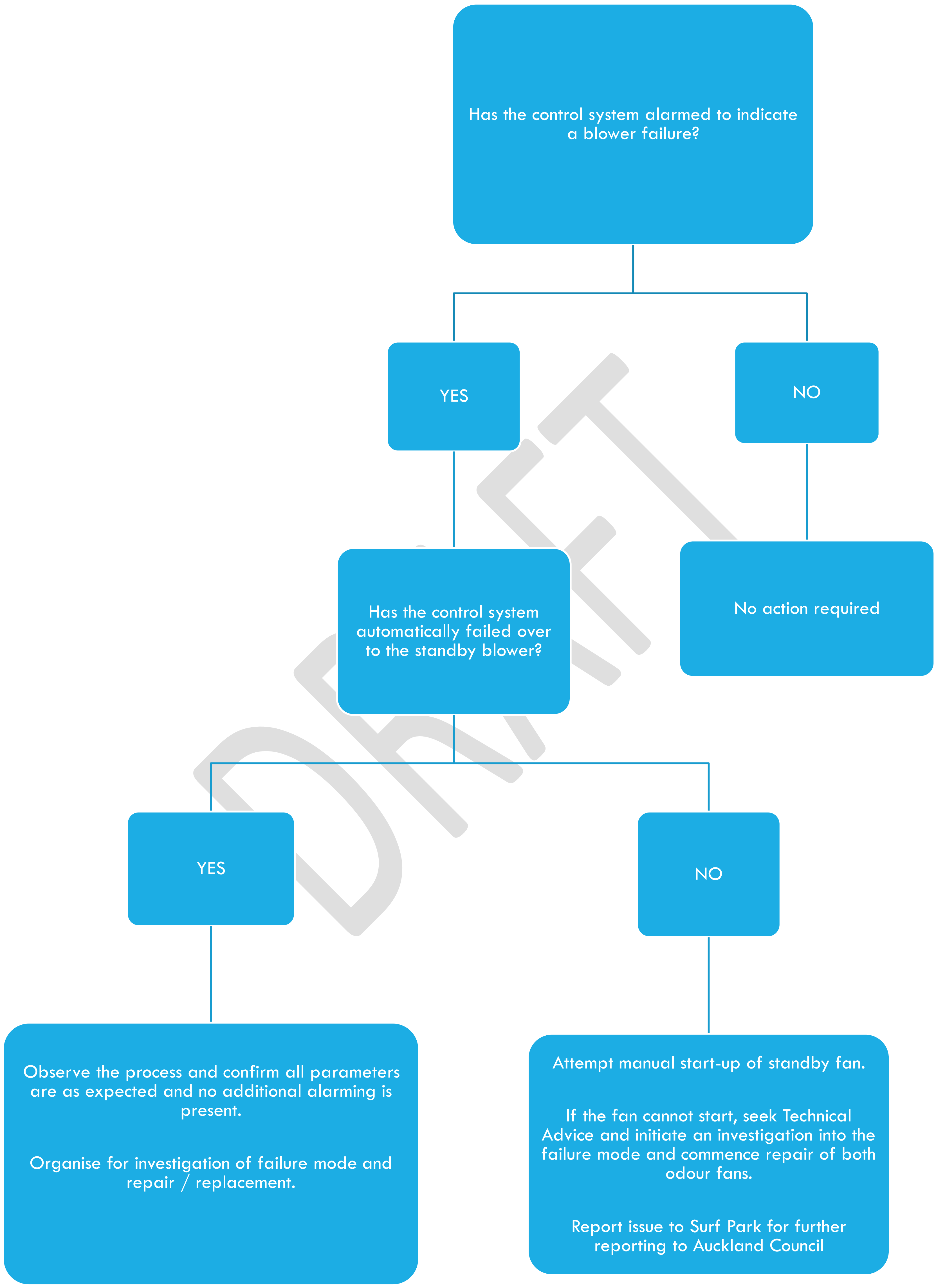
Table 2 – Critical Spares required for Odour Control.

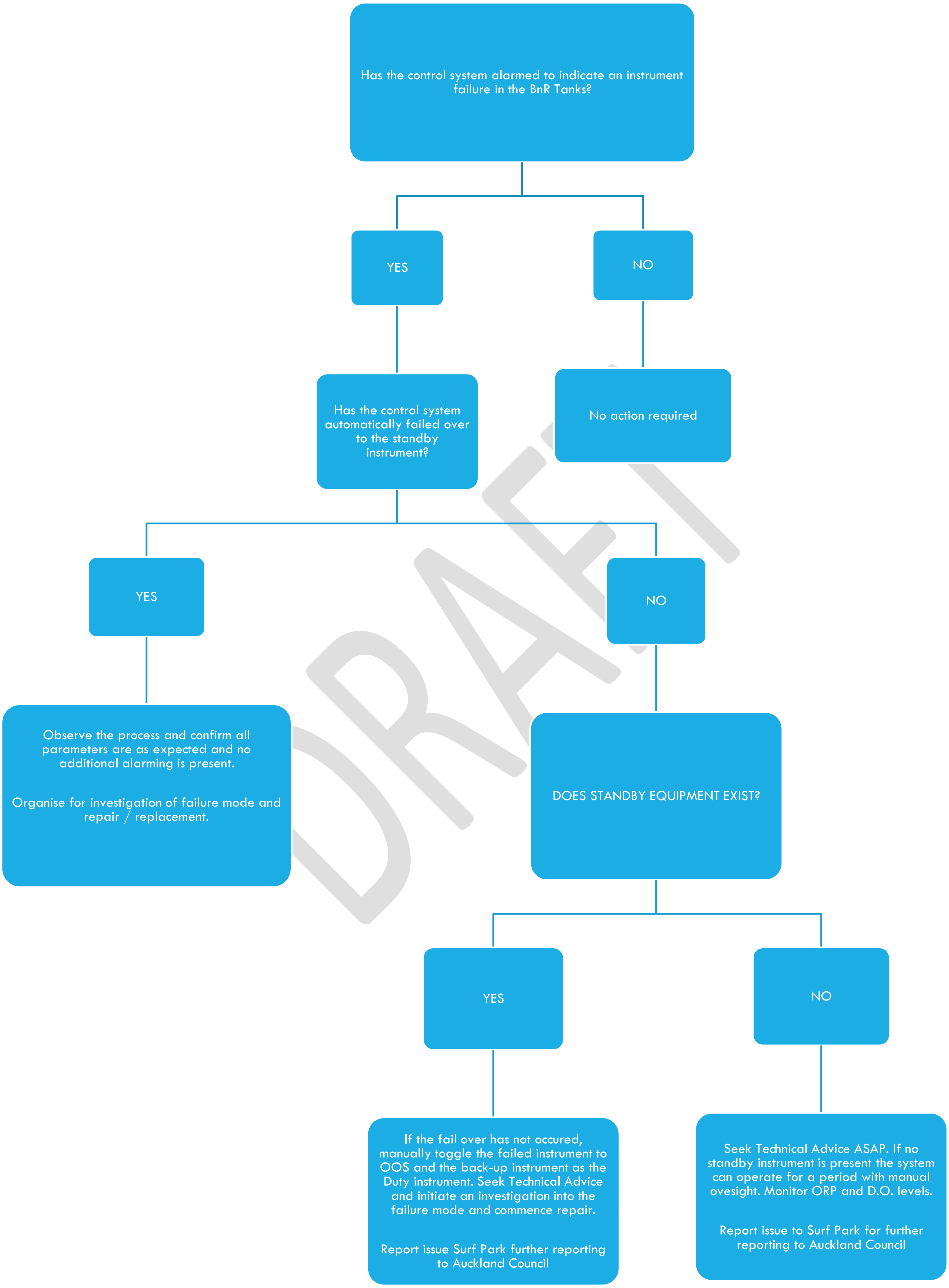
Description	Location	Function	Requirement

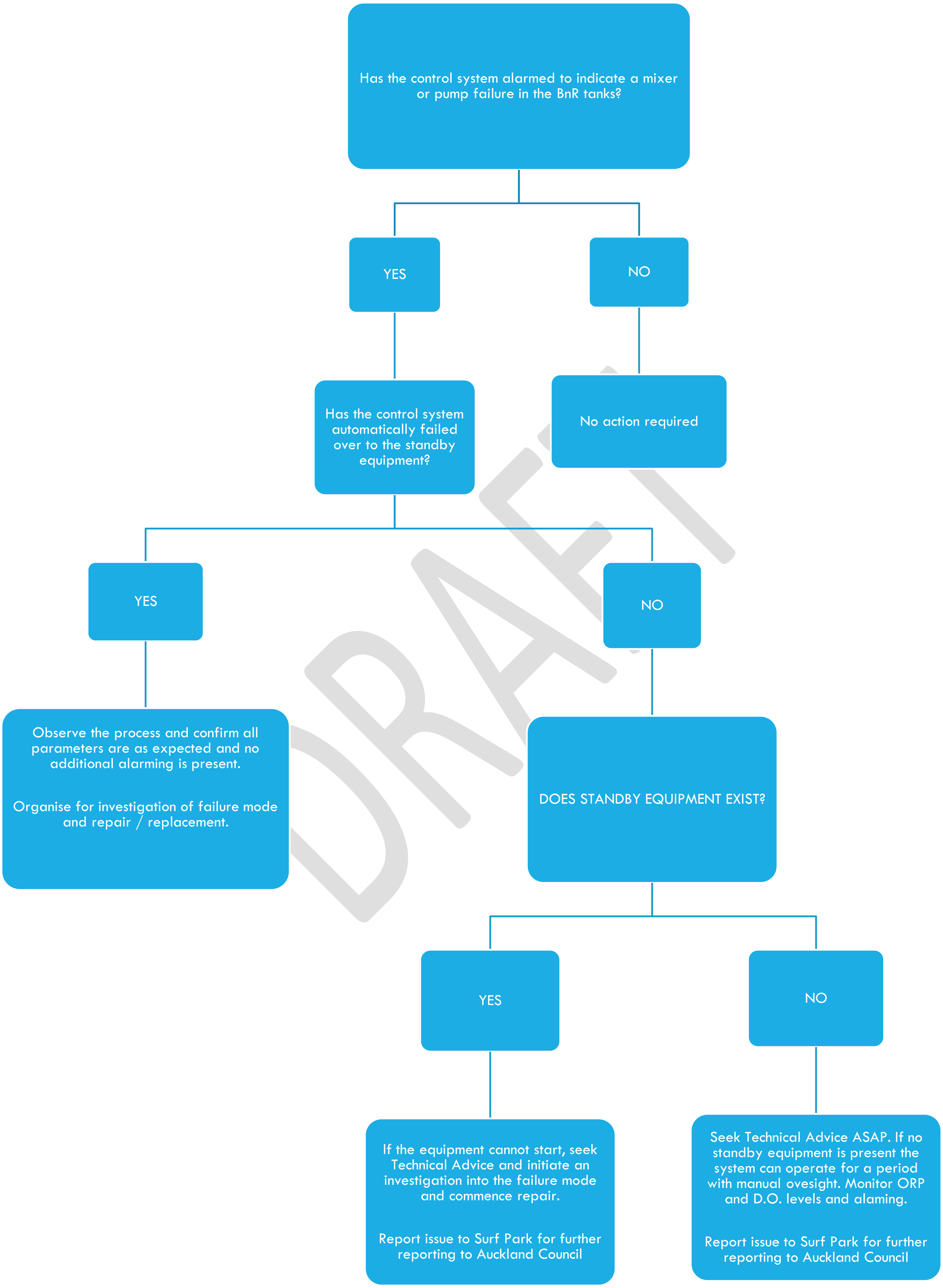
3.2. Contingency Procedures

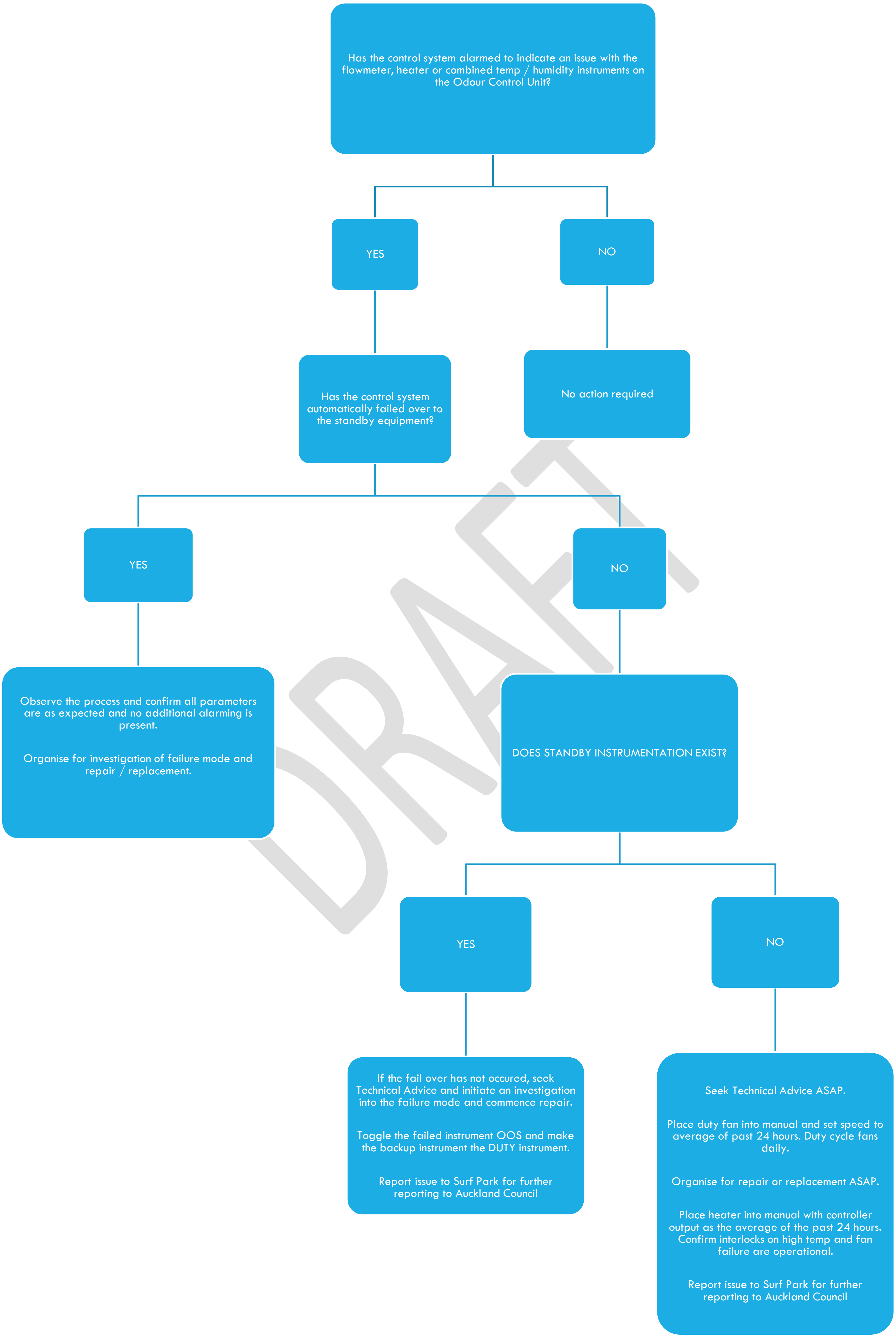
As the plant is largely automated and has been designed to include redundancy for critical elements, the control system will in most cases automatically respond to any plant breakdowns, equipment failures or malfunctions. Although the plant control system will manage most failures, flowcharts below outline a response to the failure of equipment or instrumentation which may impact the Odour Control Unit or equipment central to the protection against fugitive odours.


Has the control system alarmed to indicate an odour control fan failure?
YES
NO
Has the control system automatically failed over to the standby fan?
No action required
YES
NO
Observe the process and confirm all parameters are as expected and no additional alarming is present.
Note, operational parameter are in line with consent requirements
Organise for investigation of failure mode and repair / replacement.
Attempt manual start-up of standby fan.
If the fan cannot start, seek Technical Advice and initiate an investigation into the failure mode and commence repair of both odour fans.
Report issue to Surf Park for further reporting to Auckland Council


Has the control system alarmed to indicate a blower failure?
YES
NO
Has the control system automatically failed over to the standby blower?
No action required
YES
NO
Observe the process and confirm all parameters are as expected and no additional alarming is present.
Organise for investigation of failure mode and repair / replacement.
Attempt manual start-up of standby fan.
If the fan cannot start, seek Technical Advice and initiate an investigation into the failure mode and commence repair of both odour fans.
Report issue to Surf Park for further reporting to Auckland Council


Has the control system alarmed to indicate an instrument failure in the BnR Tanks?
YES
NO
Has the control system automatically failed over to the standby instrument?
No action required
YES
NO
Observe the process and confirm all parameters are as expected and no additional alarming is present.
Organise for investigation of failure mode and repair / replacement.
DOES STANDBY EQUIPMENT EXIST?
YES
NO
If the fail over has not occured, manually toggle the failed instrument to OOS and the back-up instrument as the Duty instrument. Seek Technical Advice and initiate an investigation into the failure mode and commence repair.
Report issue Surf Park further reporting to Auckland Council
Seek Technical Advice ASAP. If no standby instrument is present the system can operate for a period with manual ovesight. Monitor ORP and D.O. levels.
Report issue to Surf Park for further reporting to Auckland Council
DRAFT


Has the control system alarmed to indicate a mixer or pump failure in the BnR tanks?
YES
NO
Has the control system automatically failed over to the standby equipment?
No action required
YES
NO
Observe the process and confirm all parameters are as expected and no additional alarming is present.
Organise for investigation of failure mode and repair / replacement.
DOES STANDBY EQUIPMENT EXIST?
YES
NO
If the equipment cannot start, seek Technical Advice and initiate an investigation into the failure mode and commence repair.
Report issue to Surf Park for further reporting to Auckland Council
Seek Technical Advice ASAP. If no standby equipment is present the system can operate for a period with manual oversight. Monitor ORP and D.O. levels and alaming.
Report issue to Surf Park for further reporting to Auckland Council
DRAFT


Has the control system alarmed to indicate an issue with the flowmeter, heater or combined temp / humidity instruments on the Odour Control Unit?
YES
NO
Has the control system automatically failed over to the standby equipment?
No action required
YES
NO
Observe the process and confirm all parameters are as expected and no additional alarming is present.
Organise for investigation of failure mode and repair / replacement.
DOES STANDBY INSTRUMENTATION EXIST?
YES
NO
If the fail over has not occured, seek Technical Advice and initiate an investigation into the failure mode and commence repair.
Toggle the failed instrument OOS and make the backup instrument the DUTY instrument.
Report issue to Surf Park for further reporting to Auckland Council
Seek Technical Advice ASAP.
Place duty fan into manual and set speed to average of past 24 hours. Duty cycle fans daily.
Organise for repair or replacement ASAP.
Place heater into manual with controller output as the average of the past 24 hours. Confirm interlocks on high temp and fan failure are operational.
Report issue to Surf Park for further reporting to Auckland Council

3.3. Compliance Monitoring Procedures

Table 3 below outlines the processes by which Resource Consent compliance is obtained.

Table 3 – Resource Consent conditions relevant to Odour management.

Condition Number	Wording	Compliance

3.4. Personnel Training and Induction

Personnel operating the wastewater treatment plant on the Surf Park wastewater treatment plant shall at a minimum hold experience in the operation of wastewater processes or shall be trained according to Apex's Operator Training Manual and working towards a formal certification. Refresher training and site-specific scenario awareness training is conducted by the Apex Technical and Operation team and is tailored according to the requirements of the operator and the plant. A training plan shall be created for each new operator with regular auditing and review by the appropriate management staff.

Induction shall be provided to all personnel and subcontractors working on the treatment plant to highlight hazards associated with the site and general controls on works. Works cannot be carried out before an induction is carried out.

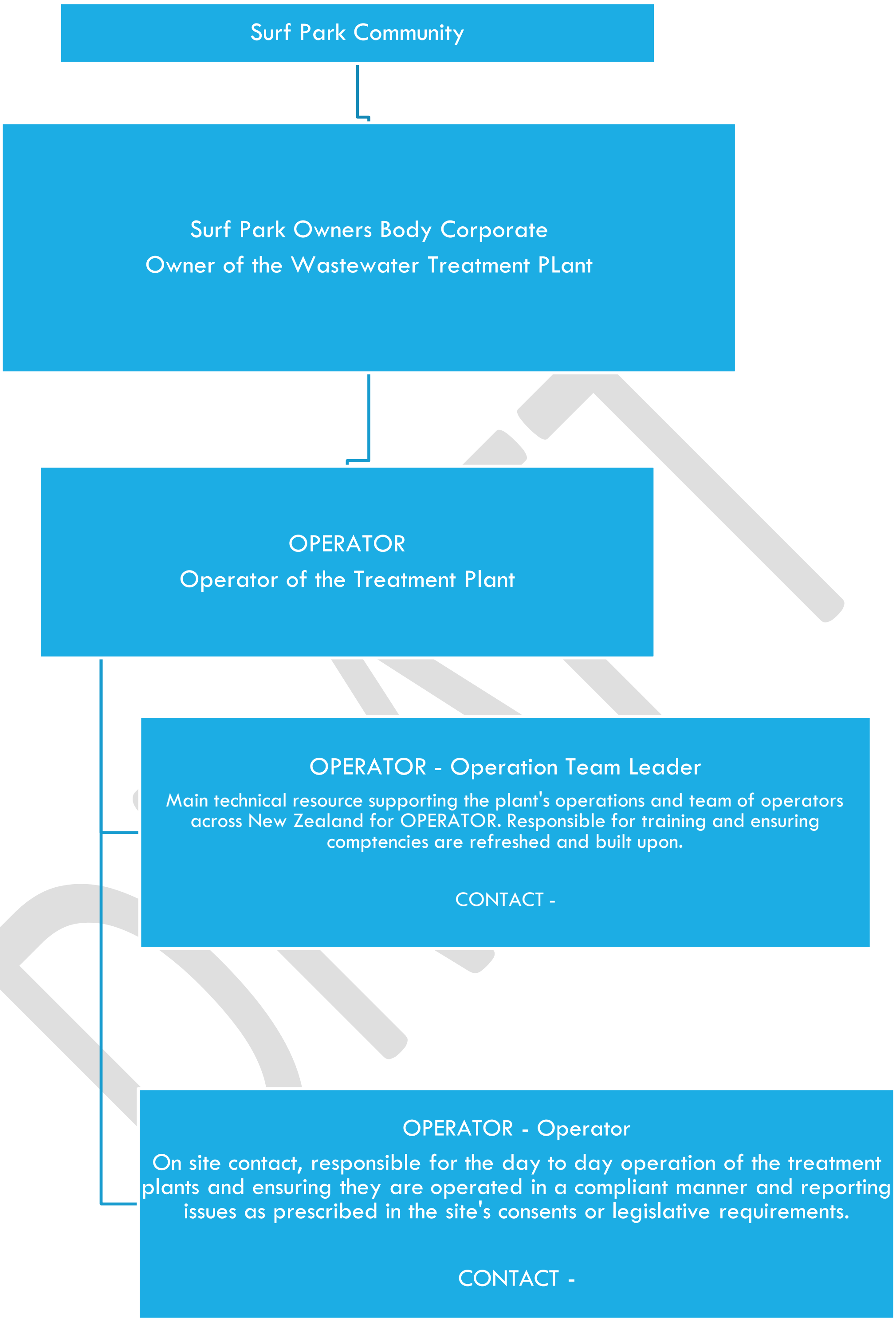
3.5. Responding to Complaints

As a rule, Apex Water shall not respond to complaints directly. Complaints shall be handled by Surf Park or their nominated party. Apex Water staff will be briefed on interaction with the public and shall direct any verbal complaints received to the appropriate parties.

Apex Water at their discretion may hand out a copy of the generic complaints form shown in Appendix C to any individual complainant at the gate of the treatment compound. They may scan and pass this information onto their contact at Delmore. The generic complaint form includes a section where the bearing of the complainant (North-South-East-West) can be noted, alongside the direction of the wind, as measured at the treatment plant on day and time in question.

3.6. Roles and Responsibilities

Apex Water is to abide by this OMM and makes sure every employee is introduced to it. Every employee must read and understand this OMM before starting to work in WwTP. It is up to employee's responsibility to ask the employer if something is not understandable. An employee's signature is needed as acknowledgment. All records are to be kept by the Operator and presented if needed. A summary of the roles and responsibilities held by the site are detailed below, with a hierarchy through to the plant owner.


Surf Park Community
Surf Park Owners Body Corporate
Owner of the Wastewater Treatment PLant
OPERATOR
Operator of the Treatment Plant
OPERATOR - Operation Team Leader
Main technical resource supporting the plant's operations and team of operators across New Zealand for OPERATOR. Responsible for training and ensuring comptencies are refreshed and built upon.
CONTACT -
OPERATOR - Operator
On site contact, responsible for the day to day operation of the treatment plants and ensuring they are operated in a compliant manner and reporting issues as prescribed in the site's consents or legislative requirements.
CONTACT -

3.7. Reviewing and Improving OMM

The OMM will be reviewed every 2 years and updated. All staff must be introduced to any changes. This review shall be conducted and carried out in coordination with Delmore.