CAPITAL DELIVERY OFFICE

0089-REP-SELST01-DE-0204 - Detailed Design Report – Selfs Point Upgrade

50% Detailed Design Report – Macquarie Point STP Relocation

01 November 2023

Taswater Capital Development Office

TasWater CDO Program Management Alliance
GPO BOX 1393 Hobart, TAS 7001
Email: **enquiries@taswater.com.au**
Tel: 136992

ABN: 64 835 508 43

Document status

Revision	Author	Reviewer	
		Name	Date
1	M Carey	C Bren	9/3/23
2	C Bren, A Hosking	D Graham	17/11/23

Contents

Table index

Figure index

1. Introduction

1.1 Project background

TasWater is seeking to expand the existing Selfs Point Sewage Treatment Plant (STP) to accommodate predicted flow from the existing Selfs Point and Macquarie Point catchments. To allow development of the Macquarie Point precinct, the Macquarie Point STP is to be decommissioned, with all flows sent to the expanded Selfs Point STP for treatment.

An overview of the catchments, treatment plants and main Blinking Billy Outfall is shown in Fig 1 below.

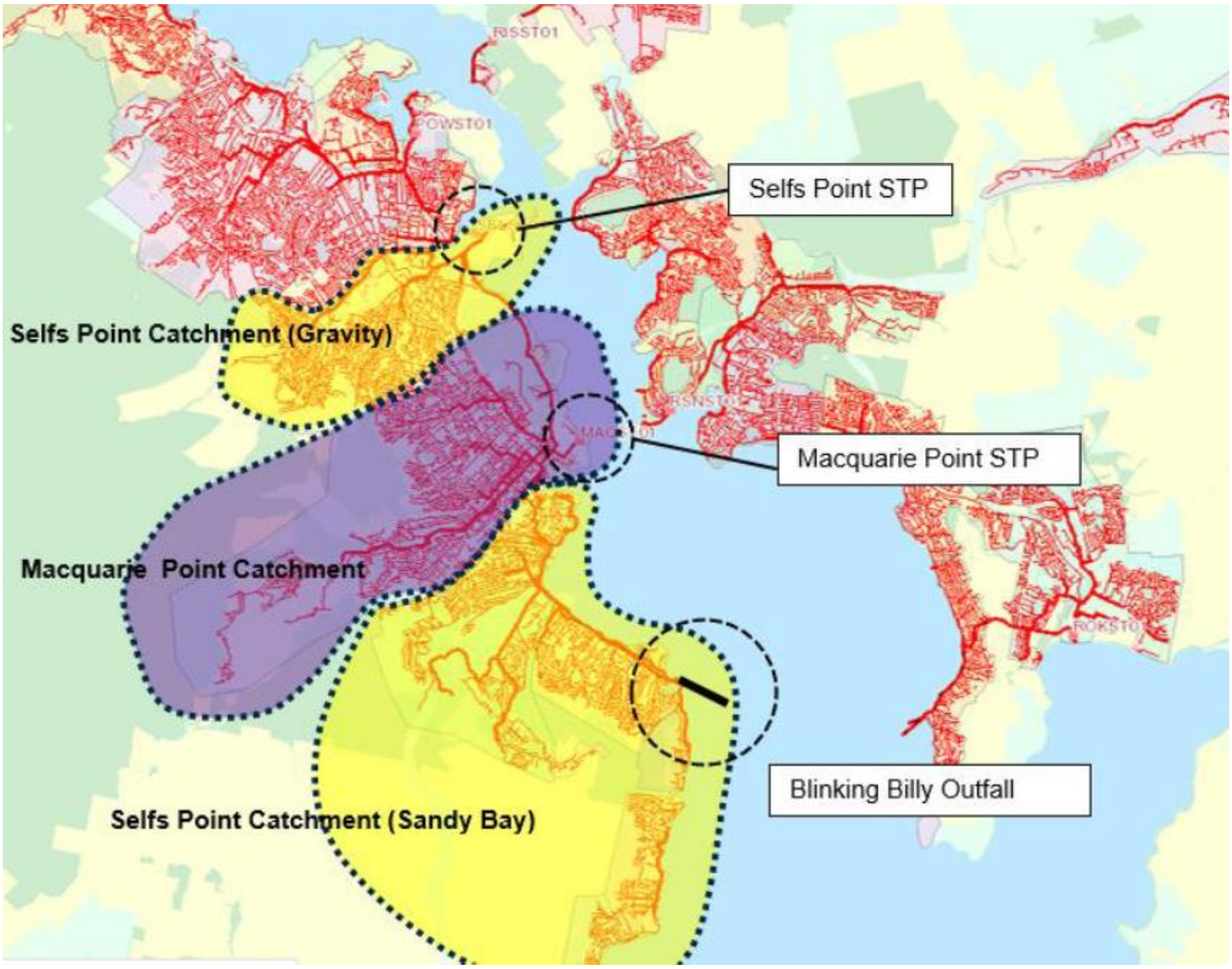


Figure 1 Overview of Selfs Point and Macquarie Point catchments

1.2 Purpose of this report

The purpose of this report is to describe the design details and design rationale for the elements included in this project and accompanies information presented within the Project Environmental Impact Statement (EIS). The Design Report is to be read in conjunction with the design drawings and design model. This revision, Revision 2, of the Detailed Design Report is provided as part of the 50% Design submission to support review of the design at this stage of the project's development.

2. Basis of Design

2.1 Flow and load projections

2.1.1 Population forecasts

- Population data within the Selfs Pt and Macquarie Pt catchments were investigated with the results summarised below.
- A growth rate to apply to the base catchment inflows was 0.9%. This considers residential growth, tourist growth and growth in the population who travel to the catchment for work or study.
- Table 2.1 summarises the equivalent population (EP) contributions to Selfs Pt and Macquarie Pt catchments from residents, tourists and non-resident workers. Note that these EP estimates are used to determine the growth rate only, and not used to calculate loads.

Table 2.1 Summary of equivalent population of residents and visitors captured by the Macquarie Pt and Selfs Pt catchments

	Start year	EP at start year	Growthrate per annum	2054 EP	Comment
Macquarie Point catchment estimated population	2016	42,506	0.73%	56,038	2016 population from 2016 concept design work Growth rate based on Treasury medium scenario population growth rate for the Hobart LGA
Selfs Point catchment estimated population	2016	36,668	0.73%	48,342	
Tourist population (average annual month)	2019	9,968	2.0%	19,936	
Net workers travelling into the area for work	2019	8,382	1.0%	11,788	
Total equivalent population (EP)		97,524		**136,104**	Note that these EP estimates are used to determine the growth rate only, and not used to calculate load
Overall growth rate			**0.9%**		**Apply this overall growth rate to plant inflows**

2.1.2 Flow projections

The adopted current and projected flows are summarised in Table 2.2.

Table 2.2 Flow projections by catchment

Catchment	ADWF (ML/d)					
	2020	2025	2035	2040	2045	2054
Macquarie Point catchment	10.4	10.8	11.8	12.3	12.9	14
Selfs Point catchment	8.1	8.4	9.2	9.6	10.0	10.9

Catchment	ADWF (ML/d)					
	2020	2025	2035	2040	2045	2054
Total flows	18.5	19.2	21.0	21.9	22.9	24.9

2.1.3 Raw sewage contaminant loads

2.1.3.1 Selfs Point STP

Influent characterisation was based on intensive sampling over a two-week period from 24th November 2015 to 8th December 2015, where flow weighted 24-hour composite samples were collected from a different location upstream of where routine samples are collected. The alternative sample location selected as routine samples are collected downstream of the scum return and other process return streams.

An additional short-term 24-hour composite sampling program was carried out in mid-2021, the results of which were reviewed as part of this work. The outcome of this review was that it is still considered reasonable to adopt the 2015 intensive sampling as the basis.

Bega Dairy and Drinks is a significant trade waste customer within the Selfs Pt STP catchment. There is a large soluble organic contribution, where on days of discharge (Monday to Saturday) the BOD and COD load is 25% and 15% of the total STP load respectively. The discharge is scheduled to occur over low diurnal loading periods to minimise the peak loads for the site.

Blue Line Laundry is the other trade waste customer of note within the Selfs Pt STP catchment, however it contributes significantly less load as shown in Table 2.3 below.

Table 2.3 Selfs Point STP trade waste contributions

Parameter	Units	Bega Dairy and Drinks	Blue Line Laundry
Flow	m^3/d	140	123
	% of Tot. SP Flow	1.6%	1.4%
BOD	mg/L	4167	414
	kg/d	583	51
	% of Total SP BOD Load	25%	2%
COD	mg/L	7117	923
	kg/d	996	114
	% of Total SP COD Load	18%	2%
TSS	mg/L	1902	149
	kg/d	266	18
	% of Total SP Load	12%	1%
TKN	mg/L	113	Not tested
	kg/d	16	-
	% of Total SP Load	4%	-
TP	mg/L	23	Not tested
	kg/d	3	-
	% of Total SP Load	5%	-

The adopted median concentrations for the Selfs Point STP catchment (excluding tankered waste) are shown in Table 2.4 below. These are based on the 2015 intensive sampling campaign. The resultant per capita loads (based on the 2054 ADWF of 10.9 ML/d and 2054 permanent catchment population of 48,342 EP) were compared to typical per capita loads. This comparison shows that the adopted BOD, COD and TKN are higher than typical, which is expected due to the contribution from Bega Dairy and Drinks.

Table 2.4 Selfs Point STP adopted concentrations and per capita load comparison

Parameters	Median Concentration (mg/L)	Adopted 2054 average load (kg/d)	Typical per capita load (g/EP/d)	Adopted per capita load (g/EP/d)	Adopted/typical per capita load
BOD	300	3,256	55	68	123%
COD	684	7,428	120	154	129%
TSS	280	3,039	65	63	97%
VSS	257	2,786	-	58	-
TKN	57	615	12	13	107%
Ammonia	33	362	-	7.4	-
Total Phosphorus	9	93	2.2	2.0	92%
Orthophosphate	5	60	-	-	
Alkalinity	273	3,249	-	-	

It is noted that since the future load is calculated by adopting the median concentration and the ADWF projection shown in Table 2.2, the trade waste load inherent within the concentration measurements will be increased at 0.9% pa in line with the domestic population. We have undertaken sensitivity analysis for varying COD/TKN ratios as part of the concept design, to ensure that the adopted process is suitable for a range of future influent conditions. The influent characteristic uncertainty is documented as a project risk.

2.1.3.2 Macquarie Point STP

The original characterisation was based on intensive sampling over a two-week period from 8th December 2015 to 3rd February 2016, where flow weighted 24-hour composite samples were collected from a different location upstream of where routine samples are collected. The sample location was moved as the routine samples are collected downstream of waste activated sludge (WAS) return.

An additional short-term 24-hour composite sampling program was carried out in mid-2021, the results of which were reviewed as part of this work. This review showed similar results and it was agreed that the 2016 intensive sampling should be retained as the basis of design.

Cascade Brewery is a significant trade waste customer within the Macquarie Pt STP catchment, however pre-treatment of trade waste is undertaken at-source, and based on previous documentation the trade waste contaminant concentrations are lower than domestic sewage. This assumption was reviewed and validated as part of this work and, as shown in Table 2.5, the organic strength (BOD, COD) of Cascade trade waste is below typical domestic sewage.

Table 2.5 Cascade Brewery typical trade waste characteristics (data from July 2017 to June 2021)

Parameter	Cascade Brewery
Flow	315 m^3/d
BOD	100 mg/L
COD	110 mg/L
TSS	60 mg/L
TKN	37 mg/L
TP	12 mg/L

The adopted median concentrations for the Macquarie STP catchment (excluding tankered waste) are shown in Table 2.6 below, based on the 2016 intensive sampling campaign. The resultant per capita loads (based on the 2054 ADWF of 14 ML/d and 2054 permanent catchment population of 56,038 EP) were compared to typical per capita loads. This comparison shows that the adopted BOD, COD and TSS are higher than typical.

The comparison also shows that the per capita TKN and TP loads are higher than typical. This is expected to be due to the transient population of workers who enter the Macquarie Point catchment for part of each day.

Table 2.6 Mac Point STP adopted concentrations and per capita load comparison

Parameters	Median Concentration (mg/L)	Adopted 2054 average load (kg/d)	Typical per capita load (g/EP/d)	Adopted per capita load (g/EP/d)	Adopted/typical per capita load
BOD	320	4,480	55	80	145%
COD	724	10,136	120	181	151%
TSS	354	4,956	65	88	136%
VSS	333	4,662	-	-	-
TKN	56	784	12	14	117%
Ammonia	40	560	-	-	-
Total Phosphorus	9.5	133	2.2	2.4	108%
Orthophosphate	5.2	73	-	-	-
Alkalinity	275	3,850	-	-	-

As outlined in Section 2.1.3.1, we have undertaken sensitivity analysis for varying COD/TKN ratios as part of the concept design.

2.1.3.3 Consolidated raw sewage concentrations

The following table presents the raw sewage concentrations for each of the streams that will contribute to the upgraded Selfs Point STP. These concentrations will be used as an input to determine the overall raw sewage characterisation, which will form a key part of the basis for the current Selfs Point Master Planning and Concept Design project.

Table 2.7 Raw sewage concentrations

Raw Sewage Parameters	Units	Selfs Point STP Influent - Median	Macquarie Point STP Influent - Median	Combined Influent - Median
BOD	mg/L	300	320	311
COD	mg/L	684	724	706
TSS	mg/L	280	354	322
VSS	mg/L	257	333	300
TKN	mg/L	57	56	56
Ammonia	mg/L	33	40	37
Total Phosphorus	mg/L	9	9.5	9
Orthophosphate	mg/L	5	5.2	5
Alkalinity	mg/L	273	275	274
Conductivity	uS/cm @ 25C	n.d.	2,340	
Temperature	°C	12-22	12-22	12-22

Note: No data (n.d.) for influent raw sewage conductivity for Selfs Pt catchment.

2.1.4 Tankered waste

The following design basis for tankered waste to be received at Selfs Point STP is proposed as:

- 50 m³/d total tankered waste volume
- Acceptance of the following waste types only:
  - Fats, oils and grease (FOG, or grease trap waste)
  - Trade Waste Consent waste and
  - TasWater Waste
- Septage, stormwater/grey water and washpit/leachate waste will be processed at alternative plants.

The percentage additional digester load contributed by the tankered waste is shown in Table 2.9 below.

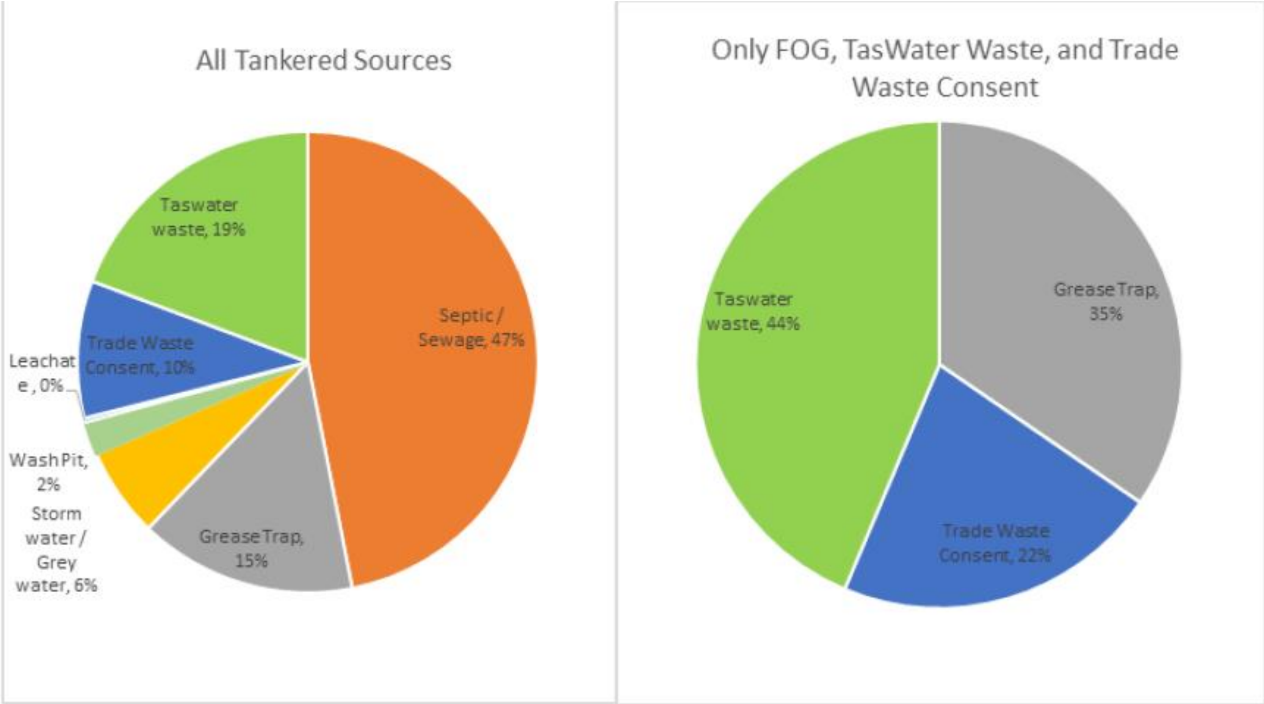


Figure 2 ***Tankered Waste Breakdown***

Table 2.8 ***Selfs Point STP tankered volumes waste characteristics***

Wastewater Parameters	Units	Total Combined Average	Septage	FOG	TasWater Waste	Trade Waste Consent	Storm Water/ Grey Water
Flows							
Proportion of total tanker volume	%	100%	-	35%	44%	22%	-
Typical volume	m³/d	50	-	17.5	22	11	-
Pollutant Concentrations/Loads							
BOD	mg/L	13,596	-	7,273	5,425	40,000	-
	kg/d (typical)	687	-	127	119	440	-
COD	mg/L	35,239	-	18,182	26,427	80,000	-
	kg/d (typical)	1,780	-	318	581	880	-
TSS	mg/L	14,143	-	9,697	23,000	3,500	-

Wastewater Parameters	Units	Total Combined Average	Septage	FOG	TasWater Waste	Trade Waste Consent	Storm Water/ Grey Water
Flows							
	kg/d (typical)	714	-	170	506	39	-
	TSS%	1.4%	-	1.0%	2.3%	0.4%	-
VSS	mg/L	10,329	-	6,667	17,182	2,450	-
	kg/d (typical)	522	-	117	378	27	-
TKN	mg/L	961	-	176	1466	1200	-
	kg/d (typical)	49	-	3	32	13	-
Ammonia	mg/L	17	-	48	0		-
	kg/d (typical)	1	-	1	0	0	-
Total Phosphorus	mg/L	633	-	12	1313	280	-
	kg/d (typical)	32	-	0	29	3	-

Table 2.9 Selfs Point STP tankered waste load as a percent of total digester load from primary sludge and WAS (2040 basis)

Wastewater Parameters	Total Combined Average	Septage	FOG	TasWater Waste	Trade Waste Consent	Storm Water/ Grey Water
COD	17.4%	-	3.1%	5.7%	8.6%	-
TSS	9.2%	-	2.2%	6.5%	0.5%	-
VSS	8.3%	-	1.8%	6.0%	0.4%	-

2.1.5 Total loads

Based on the adopted flows and raw sewage characteristics in Sections 2.1.2 and 2.1.3, load projections for the Selfs Pt and Macquarie Pt catchments were calculated and the results are summarised below.

Table 2.10 Forecast loads by wastewater source for future expanded Selfs Pt STP

Influent wastewater load parameters	Selfs Pt Catchment	Macquarie Pt Catchment	Tankered Waste[1]
	2054	2054	2054
Flow (ML/d)	10.9	14.0	0.05
BOD (kg/d)	3,256	4,469	687
COD (kg/d)	7,428	10,111	1,780
TSS (kg/d)	3,039	4,944	714
VSS (kg/d)	2,786	4,651	522
TKN (kg/d)	615	782	49
Ammonia (kg/d)	362	559	1
Total Phosphorus (kg/d)	93	133	32

Note 1) Tankered waste will be delivered straight to the digestion process, hence this load will bypass the secondary treatment process

2.1.6 Raw sewage fractionation

Key raw sewage COD and nutrient fractions calculated in the BioWin influent specifier are summarised below. The Selfs Point and Macquarie Point loads will be modelled using two separate influent streams in BioWin, which will be combined prior at the plant inlet.

Table 2.11 Combined Selfs Pt and Macquarie Pt influent wastewater characteristics

Influent Fractions	Units	Data	Comments (References)
Readily Biodegradable COD (Fbs)	gCOD/gTCOD	0.18	Estimated from measured COD, BOD and TSS
Acetate (Fac)	gCOD/grbCOD	0.12	Estimated from measured COD, BOD and TSS
Non-colloidal Slowly Biodegradable (Fxsp)	gCOD/gsbCOD	0.88	Estimated from measured COD, BOD and TSS
Unbiodegradable Soluble (Fus)	gCOD/gTCOD	0.04	Estimated from measured COD, BOD and TSS
Unbiodegradable Particulate (Fup)	gCOD/gTCOD	0.19	Estimated from measured COD, BOD and TSS

2.1.7 Diurnal flow profiles

The diurnal flow profiles for Selfs Pt and Macquarie Pt were developed. The following section summarises the flow profiles that were adopted

2.1.7.1 Selfs Point Diurnal Flow Profile

Based on multiple two-week periods when the catchments experienced little to no rainfall during the analysis period, a typical diurnal flow profile for Self's Pt STP is shown in Figure 3. The weekend and weekday peaking factors were shown to be 1.75 and 1.78 times ADWF, respectively.

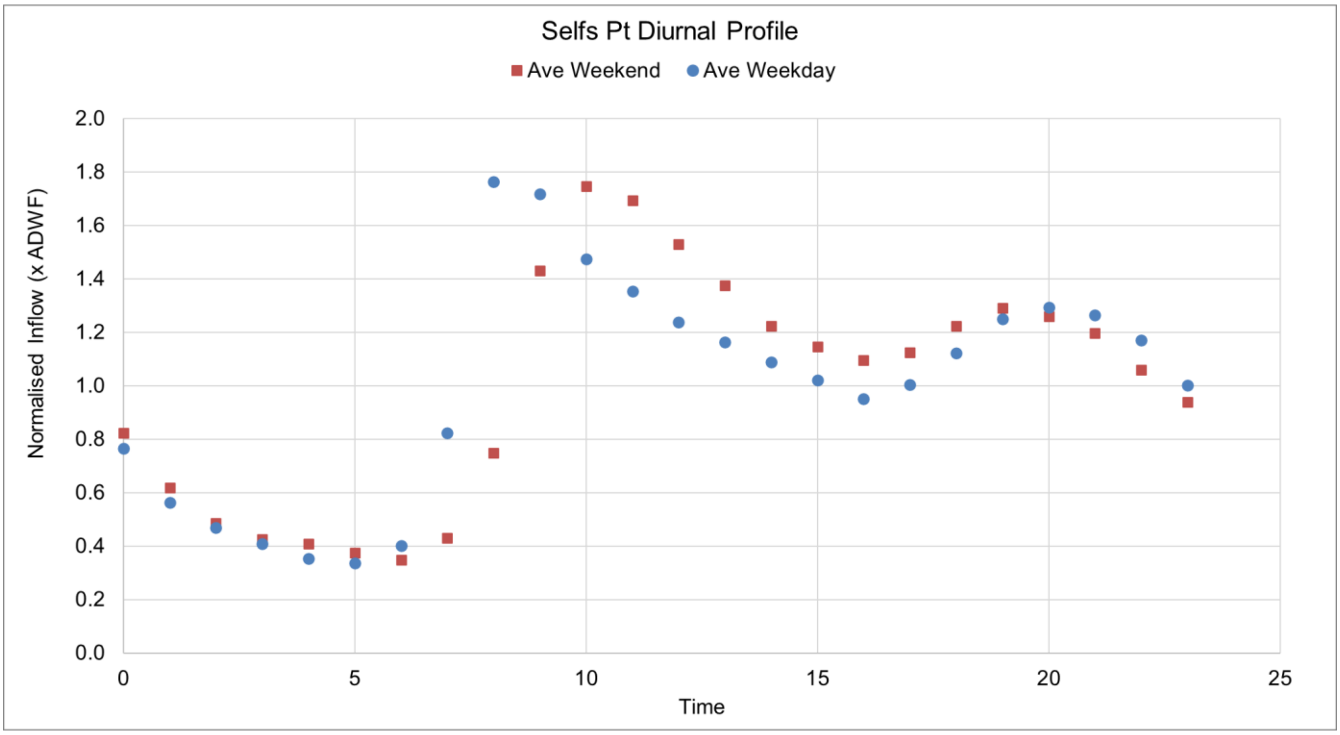


Figure 3 Selfs Pt STP diurnal flow profile (based on 2020/21 5-min interval flow data)

2.1.7.2 Macquarie Point Diurnal Flow Profile

A diurnal profile for Macquarie Pt STP is based on peaking factors of 1.68 (weekend) and 1.72 (weekday) as summarised in Table 2.12.

Figure 4 Macquarie Pt STP diurnal flow profile (as it was presented in 2016 Concept Design Report)

It should be noted that both above figures reflect the flow received at the current STP site and does not account for the flow profiles imparted by pumped sewage transfers from the new Raw Sewage Pumping Station at the Selfs Point STP site and the new Macquarie Point Sewage Pumping Station (SPS) at the Macquarie Point development precinct. It is anticipated that some stepping of flows will be required on the Macquarie Point SPS however this will be minimised where possible. A rising main flush will also be needed for the Macquarie Point SPS and this flush will be timed to occur overnight when diurnal flows are at their lowest to minimise the impact on the receiving STP processes.

A summary of the two STP catchments' influent profile is shown in Table 2.12.

Table 2.12 Adopted peaking factors for upgraded Selfs Pt STP inflows

STP	Peaking Factors (x ADWF)	Comment
Selfs Pt STP	1.75 (weekend) 1.78 (weekday)	Based on 2021 flow data (5-min interval)
Macquarie Pt STP	1.68 (weekend) 1.74 (weekday)	Based on previous work by Aurecon (*Treatment Concept Design Report*, Nov 2020)
Combined inflows	1.74 (weekend) 1.72 (weekday)	

2.2 Wet weather flow management

2.2.1 Selfs Pt PWWF

Peak wet weather flow (PWWF) into the existing Selfs Pt STP was determined from historical flow data representing long-term wet weather inflows. The PWWF assessment considered contributions from the Sandy Bay 2 Sewer Pump Station (SPS) and the New Town/Lenah Valley catchment.

The observed peak flow occurred in 2016 and totalled 603 L/s, based on 375 L/s from the gravity catchment (New Town/Lenah Valley) plus 228 L/s pumped from the Sandy Bay 2 SPS.

A safety factor has been included on top of the measured peak flow. The proposed safety factor is 87 L/s and has been included to account for:

- Growth associated with wet weather in the New Town gravity sewer catchment
- Selfs Pt STP inflow measurement uncertainty.

This information is summarised in Table 2.13, with the basis of 715 L/s adopted.

2.2.2 Macquarie Pt PWWF

Sewage from the Macquarie Pt catchment is currently treated at the Macquarie Pt STP. As part of the decommissioning of Macquarie Pt STP and expansion of Selfs Pt STP, all flows will need to be transferred to the upgraded Selfs Pt STP via a new Macquarie Pt SPS.

Based on the pump duty selected the maximum flow from this catchment to the upgraded Selfs Pt STP will be 650 L/s, as shown in Table 2.13.

Table 2.13 Adopted peak wet weather flow rates

Catchment	2054 PWWF (L/s)	PWWF to ADWF ratio (2054)	Comment
Selfs Pt	690	6.0	Based on: - New Town gravity catchment 375 L/s - Sandy Bay 2 Pump Station 228 L/s - Safety factor 87 L/s (allocated capacity to the New Town gravity sewer catchment)
Macquarie Pt	650	3.6	New Macquarie Pt SPS max flow rate.
TOTAL	**1,340**	**4.7**	

2.2.3 Outfall operation

The following key assumptions relate to flow management via discharge outfalls during wet weather:

- As a first preference, treated effluent will be discharged through the Blinking Billy Outfall (BBO) via the Effluent Pump Station at a minimum flow rate of 290 L/s)
- Flows in excess of the Blinking Billy Outfall/Effluent Pump Station capacity will be stored in the new Effluent Balance Tank.
- If the Effluent Balance Tank is full, discharge will be via the Selfs Point Local Outfall (SPLO).

2.2.4 Wet weather flow management within plant

Table 2.14 below outlines the criteria for wet weather flow management through various parts of the plant. The analysis considers the requirements over the full planning period out to 2054.

Table 2.14 Wet weather flow management at expanded Selfs Pt STP (2054)

Process Unit	Hydraulic Design Basis (2054)	Comment
Preliminary (Inlet works)	1,340 L/s plus returns	Peak capacity of Macquarie Pt SPS, Sandy Bay SPS2 and local Selfs Point gravity catchment flows.
Primary	1,340 L/s plus returns	Primary tanks are to treat full peak flows.
Biodenipho	0 L/s (decommissioned)	
Bioreactors and membranes	1,340 L/s plus returns	All flows receive secondary treatment through the new bioreactors and membranes. This avoids a bypass of primary treated sewage and avoids the need for UV treatment downstream of the new membranes.

2.3 Treated effluent quality requirements

2.3.1 Design parameters

Table 2.15 below outlines the treated effluent quality requirements adopted.

Table 2.15 Treated effluent design parameters

Parameter	Adopted 50th %ile	Adopted 90th %ile	Adopted Max	Comments on adopted parameters
BOD (mg/L)	10	15	-	Equivalent to targets for accepted modern technology (AMT) determined by EPA
TSS (mg/L)	10	20	-	Equivalent to AMT
Faecal Coliforms (cfu/100 mL)	200	500	750	Equivalent to AMT
Oil and Grease (mg/L)	2	5	-	Equivalent to AMT
TN (mg/L)	7	10	-	50%ile target to be based on typical ‘limits’ of the secondary process technology investigated
Ammonia (mg/L)	1	2	5	Equivalent to AMT
TP (mg/L)	2	5	-	Equivalent to AMT

2.4 Biosolids management

All biosolids should comply with Grade B biosolids stabilisation and contamination requirements defined in the Tasmanian Biosolids Reuse Guidelines.

Currently, biosolids are disposed offsite. The current dewatered biosolids cake produced by the duty centrifuge is around 16% dry solids (DS). The target biosolids cake dryness for the upgraded plant will depend on the biosolids treatment and dewatering process options selected.

2.5 Redundancy requirements

The proposed redundancy requirements for major process units are listed below. Note that the redundancy requirements are often process specific and the below table is a simplification of the redundancy arrangements. For detail, refer to the respective section in this report Sections 9 through 15.

Table 2.16 Plant redundancy requirements

Major process unit	Configuration	Comments
Inlet works		
Screens	N+1	Primary Band Screens (One standby at PWWF) Manually raked bar screen Secondary Fine Screens (Duty/Assist/Standby)
Grit tanks	N	PWWF should be handled hydraulically
PST	At least 2 No.	PWWF should be handled hydraulically with one unit offline and at a reduced solids capture performance
New Bioreactors	See comment	.PWWF should be handled hydraulically with one primary aerobic/anoxic oxidation ditch offline. Ability to fully nitrify under this arrangement by moving the swing zone diffuser grid of the offline ditch to the online ditch. Removable diffusers and liftable mechanical / process equipment and instrumentation to be provided.
Aeration Blowers	N+1	
Membranes	N+1	Membrane capacity should be able to treat peak flow with one train offline
Mechanical Thickening	See comments	All thickening units will be operated as a single duty for 12 - 16 hrs/day, 5 days a week under average conditions. Extended operational hours will be permitted with one thickening unit off-line. Two common standby units will be shared between the duty primary sludge, WAS and recuperative thickening rotary drum thickeners.
Mechanical Dewatering	N+1	
Digestion	N+1	Maintain 15 day SRT with one digester offline, at peak month load, 90% effective volume and a digestate dry solids content of 4.5%DS.
Biogas Management	N+1	
Odour Treatment	See Comment	BTF is duty only, with redundancy provided by the second stage A/C scrubbers. A/C scrubbers with 50% partial duty redundancy. Extraction fans with full standby.
Other Mechanical Equipment	N+1	
Chemical Storage / Dosing	N (Storage) N+1 (Dosing pumps)	Storage time dictated by usage and delivery availability.

2.6 Hydraulic design criteria

The following hydraulic criteria were adopted.

- A minimum freeboard of 300 mm is generally provided for all concrete tanks and channels for flows up to the max instantaneous flows/overflow conditions.
- A minimum freeboard of 500 mm is provided for aerated/agitated tanks.

2.7 Odour control requirements

The odour control requirements are defined by Environmental Protection Policy (Air Quality), Tasmanian Department of Tourism, Arts and the Environment, 2004. These requirements are defined in Table 2.17 below.

Table 2.17 Air quality requirements

Criteria	Averaging period	Percentile
Maximum of 2 odour units at the boundary of the facility	1 hour	99.5

Odour modelling has been undertaken by consultants Stantec based on the concept design, and their report is included as part of the project EIS submission.

The concept design odour mitigation assumptions include covering the new inlet works, primary settling tanks and flow splitter.

2.8 Design life requirements

The design life requirements for key components of the upgraded treatment plant are summarised below. These requirements apply to new infrastructure only.

Table 2.18 Plant design life requirements

Asset Minimum Design Life	
Buildings	50 years
In ground concrete structures	80 years
Buried pipe	80 years
Above ground pipe	50 years
Mechanical plant	25 years
Electrical installations/switchboards	25 years
Instruments and controls	15 years

2.9 Existing asset condition

The figure and table below summarise the preliminary asset condition assessment undertaken by Aurecon in 2016. The expected remaining life of each asset is summarised in the table, and possible next steps and additional commentary are included in the table.

GHD undertook a preliminary visual inspection of the existing assets at Selfs Pt STP on 18th August 2021. Following further development of process options, GHD will propose any additional testing for assets which will likely form part of the future plant configuration.

Figure 5　　*Existing Assets*

Table 2.19 Summary of preliminary asset condition assessment as undertaken by Aurecon in 2016

Ref	Process Stage	Asset Condition / Remaining Life (as per Aurecon condition assessment)	Comment
1	Inlet structure and wet well	Remaining life unknown as it was not inspected internally.	Internal inspection and destructive testing required to determine viability for continued use.
2	Raw sewage PS	Good condition. >30 years.	
3	Aerated grit chamber	Poor condition. Needs replacement ASAP.	Further testing not recommended. Assumed to be replaced as part of upgrade.
4	Primary sedimentation tanks	Fair condition where concrete is lined based on visual inspection. Poor condition where unlined. >30 years (if observed damage is repaired and maintained)	Recent advice from the CDO is that this asset is in poor condition and may require remedial works to retain 15 years additional life. GHD to confirm observations and suggest further testing (if required) to confirm asset life.
5	Trickling filters	Fair condition except for cracks/leakage. Uncertain if structural reinforcement is impacted by leaks.	GHD to confirm observations and suggest further testing (if required) to confirm asset life. Will likely require destructive testing to confirm reinforcement condition.
6	Bioreactors	Good condition (assuming leaking crack is repaired and hasn't caused sever reo corrosion damage) >30 years	Bioreactors and clarifiers concrete structures both showed signs of cracking/leakage in 2016. CDO to provide an update on what works (if any) have been completed since to remediate these structures. Condition and remaining life of wooden piles uncertain and condition assessment is not feasible within the timeframe of this project. Assumed that piled structures can be retained to 2040
7	Secondary clarifiers	Good condition (assuming leaking crack is repaired and hasn't caused sever reo corrosion damage) >30 years	
8	Chlorine contact tank	Good condition >30 years	Internal inspection not completed in 2016.
9	Final effluent PS	Good condition >30 years	
10	Storm tanks	Good condition >30 years	
11	Pre-fermenter tank	Good condition (based on verbal advice that tank has been recently relined) however this tank was not internally inspected.	Poor concrete condition observed during virtual site visit. Further inspection is expected to be required if the use of this asset is to be continued
12	Anaerobic digesters	Good condition (based on tank being relined in ~2005) however this tank was not internally inspected.	GHD to confirm observations and suggest further testing (if required) to confirm asset life. If retained, digesters may need to be cleaned as part of upgrade.
13	Dewatering building	Good condition >30 years	
14	Electrical	Renewals/upgrade required	Electrical assets at Selfs Pt are approaching end of life (approaching or exceeding 25 years on site)

3. Site Investigations

3.1 Geotechnical and Contaminated Land Investigation

A field investigation program was undertaken between 7-12 Oct 2021, and incorporated the following:

– Clearing test sites of concealed services. This was done with review of dial-before-you-dig and review of drawings provided by the CDO, along with physical clearance of the site by Archers Underground Services.
– Drilling through auger drilled holes / excavated test pits up to a depth of 2 metres for pre-drilling for the Cone Penetrometer Testing (CPT) and obtaining disturbed soil samples for laboratory testing. These holes were excavated using a Hitachi 3.3 tonne track-mounted excavator with an auger attachment and three toothed excavator bucket provided by Stornoway Pty Ltd (Stornoway).
– Cone Penetrometer Testing using a 11-tonne wheel-mounted CPT rig “Eileen” (IGS11) provided by Insitu Geotechnical Services Pty Ltd (IGS).
– Engineering logging of subsurface conditions within the pre-drilled holes.
- Fill/waste samples collected at varying depth intervals from each of the fifteen (15) geotechnical investigation locations. One sample from each test location was selected for analysis, based on the type of fill identified and ensuring a range of depths intervals were included.

One of the key engineering outcomes is related to the unsuitability of excavated material for reuse. Based on the ground conditions encountered as well as the levels of contamination measured, the soil present at the site (particularly the ‘wetlands’ area to the south) would be unsuitable for reuse. This is due to the presence of unnatural material such as glass, masonry, plastics, seashells and other landfill within the soil matrix, as well as characterisation as Level 3 Contaminated Soil. These outcomes have resulted in the site layout and hydraulics favouring on ground structures where possible.

The site for the proposed structures has been inferred to be covered at the surface by uncontrolled fill with significant variability in both material composition and strength / stiffness which have caused shallow refusals in most of the auger holes and CPT probing. Such materials are further underlain by very soft to firm alluvium soils which, unless mitigated, may cause significant long term settlement under bearing pressure imposed by the proposed facilities.

It is recommended that once the preferred design disturbance footprints (and depths) have been agreed, further borehole investigation is warranted to better understand the geotechnical conditions and the potential site contamination risks to the program. Consideration will also need to be given to expanding the assessment program to investigate potential constraints associated with contaminated groundwater in addition to impacted fill/waste.

3.2 SPLO Hydraulic Capacity

The existing Selfs Point local outfall (SPLO) is approximately 1 km in length and comprises mainly of a short length of 900 mm reinforced concrete pipe, followed by approx. 800 m of 990 x 660 mm oviform concrete pipe, and finally approximately 180 m of riveted steel pipe that extends into Derwent River. Refer to Figure 6 for a plan view of the alignment.

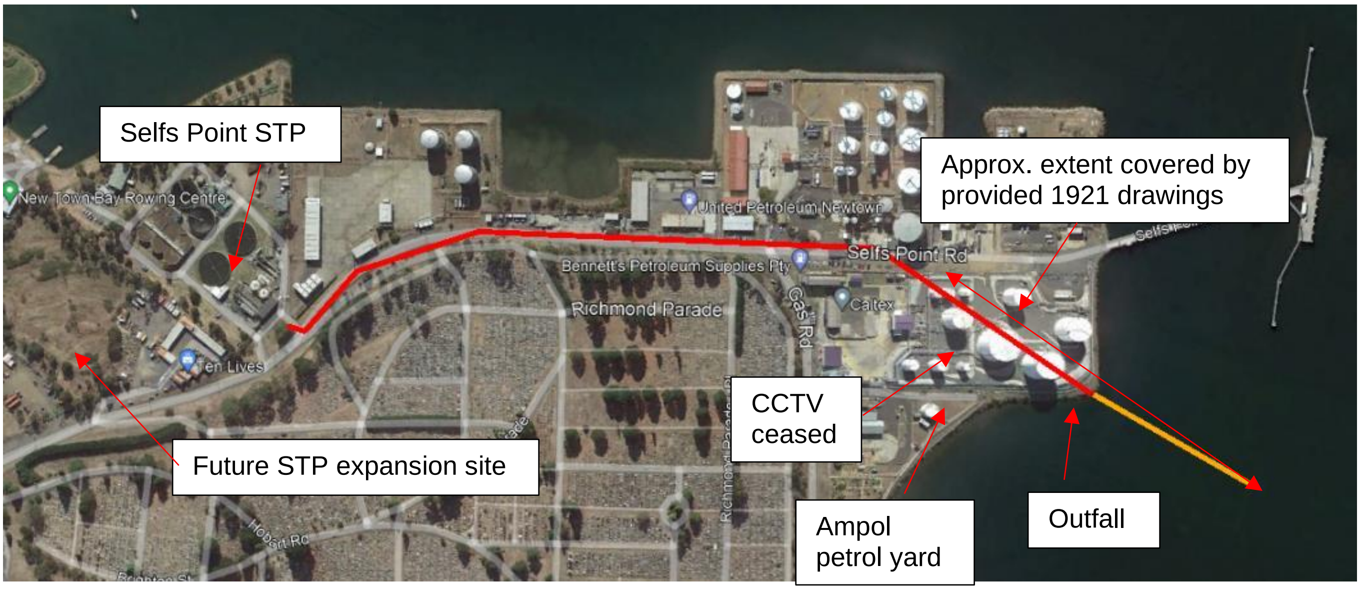


Figure 6 *Selfs Point local outfall*

Based on the information gathered during a CCTV investigation undertaken by UDM Group in November 2021, the estimated capacity of the SPLO has been reduced from 630 L/s to 340 - 360 L/s (depending on roughness) at high tide.

This reduction in capacity is primarily due to the condition of the outfall (including tree root ingress and concrete spalling) as well as more detailed calculations accounting for losses through maintenance holes (including the large screening-disintegration chamber at the end of the outfall).

The resultant overall discharge capacity from the Selfs Point STP of 695 - 720 L/s (including 345 L/s discharge via the Blinking Billy Outfall) is significantly less than the expected wet weather flows received at the plant once the Macquarie Point catchment is diverted to Selfs Point STP (PWWF = 1340 L/s). A new outfall will be required to ensure sufficient capacity is achieved. The new outfall should utilse alignment along gas road to deconflict infrastructure clashes with the adjacent petro chemical facilities.

4. Treatment Technology Selection

A structured decision making approach was undertaken to select the preferred treatment technology for the Selfs Point STP upgrade. The key outcomes are summarised below.

4.1 Initial longlist option screening

Using the hurdle criteria described below, eleven secondary process options were screened and five were taken through to the longlist. As yet unproven technology (e.g., MABR, BioMag, Nitrite shunt, etc.) were eliminated at this stage as a more conservative approach to new technology was preferred. These technologies will remain relevant as a potential future intensification pathway.

Table 4.1 Initial screening of mainstream treatment processes using hurdle criteria

	1	2	3	4	5	6	7	8	9	10	11
Mainstream treatment process	**Conventional activated sludge**	**MBR**	**MABR**	**Granular sludge**	**IFAS**	**MBBR**	**SBR**	**BioMag**	**Nitrite shunt**	**Lodomat / FNA**	**Mainstream annamox**
Hurdle criteria											
Cost is likely to be cheaper than current option	✓	✓	?	✓	?	?	✓	?	?	?	?
Technology has proven track record achieving performance criteria	✓	✓	?	✓	✓	✓	✓	✗	✗	✗	✗
Additional justification to exclude?	Nil	Nil	No full scale installations in Australia. Uncertainty regarding ability to achieve required effluent quality.	Nil	Limited full scale installations still operating in Australia. Uncertainty regarding extent of intensification achieved.	Similar to IFAS, but potentially smaller footprint. Differentiation between IFAS and MBBR to occur in future Mini-optioneering workshop if IFAS option is shortlisted.	Nil	No full scale installations in Australia. Capacity increase achieved unlikely to be sufficient to significantly reduce cost.	No long term published data for full scale installations currently operating in Australia. One full scale at WTP in VIC and pilot phase at Bundamba STP in QLD. High COD:TKN ratio at Selfs Point not favourable. Elevated risk of N_2O emission.	No full scale installations in Australia	No full scale installations in Australia
Procced to Step 2? (✓ / ✗)											
	✓	✓	✗	✓	✓	✗	✓	✗	✗	✗	✗

4.2 Longlist to shortlist options development

For each option, the following details were developed

– Preliminary process unit sizing and preliminary site layout
– A process flow diagram identifying opportunities for staging of construction
– Advantage/disadvantage assessment

For conventional activated sludge and MBR, two sub-options were developed – one with raw sewage feed and the other with primary effluent feed.

Each option was scored against a range of decision criteria in a collaborative workshop. . The results of this traffic light assessment were to carry forward the MBR option with primary effluent feed as the preferred option for concept design. The key reasons for this option being preferred were:

– Reduced capital cost due to the small footprint of this intensified process
– The small tankage also improves the ability of this option to accommodate flows beyond 2054, improves constructability and minimises open tankage (and therefore odour potential) compared to the other larger footprint options

– Good process robustness to achieve performance criteria and deal with the variability in influent quality

Alongside the MBR option, Nereda® aerobic granular sludge was identified as worth retaining through to the next stage of design. The key reason for this was the initially small footprint (similar to MBR) made possible by the enhanced bioreactor solids settleability of this process.

The Nereda option was subsequently eliminated from consideration. The main reason being that the Nereda system sizing is determined by hydraulic requirements (above approximately 3 x ADWF), further development of this concept revealed that the footprint requirement was larger than anticipated, and would not fit on the southern “greenfield” area of the site (as for the MBR option)

5. Overview and process design summary

5.1 Overview of plant configuration

The upgraded Selfs Point STP process configuration is summarised below.

– Liquid Stream
  - New raw sewage pump station
  - A new network sewage pump station or utilisation of the plant's existing raw sewage wet well to transfer the local low-lying domestic sewage catchments into the new raw sewage lift pump station.
  - New inlet works with primary screens, secondary screens and grit removal
  - New primary sedimentation tanks
  - New primary effluent pump station feeding new 4-stage bioreactor process
  - New 4-stage bioreactor and membrane solids separation
  - New odour control system
  - New effluent balance tank (effluent balancing during dry weather)

– Solids Stream
  - New sludge thickening (WAS, PS, and recuperative thickening)
  - New tankered waste receival facility
  - New anaerobic digesters
  - New biogas management and hot water facilities
  - New sludge dewatering and outloading

– Ancillaries
  - New HV and LV electrical distribution
  - New switch-rooms
  - New chemical delivery and bulk storage to support the liquid and solids streams
  - Expanded road network to suit the upgraded plant.

5.2 Redundancy

The overarching redundancy principle for the design is to provide sufficient backup so that the asset can maintain its function during all expected operational and maintenance activities[1], including reasonably foreseeable failures. The plant will be designed to allow for maintenance to be undertaken by taking equipment or process units offline and not compromising the performance requirements of the asset.

Detail on the adopted redundancy arrangements for each major process unit are provided in Sections 8 through 12. The plant redundancy requirements were reviewed at the Configuration and Redundancy Workshop (held on 30th March 2023).

[1] As per the manufacturer's requirements

5.3 Process design basis

5.3.1 Flow and load projections

5.3.1.1 Dry weather flows

The adopted dry weather capacity requirements across the design horizon, excluding internal plant returns, is summarised in Table 5.15.1.

Table 5.1 Dry weather capacity requirements

Catchment	ADWF (ML/d)					
	2020	2025	2035	2040	2045	2054
Macquarie Point catchment	10.3	10.8	11.8	12.3	12.9	14
Selfs Point catchment	8.0	8.4	9.2	9.6	10.0	10.9
Total flows	**18.5**	**19.2**	**21.0**	**21.9**	**22.9**	**24.9**

5.3.1.2 Dry weather peaking factor

The diurnal profile adopted for the combined plant is shown in Fig 7. The dry weather diurnal peaking factors are summarised in Table 5.2.

Table 5.2 Catchment dry weather diurnal peaking factors

STP	Peaking factors (x ADWF)
Selfs Point STP	1.75 (weekend) 1.78 (weekday)
Macquarie Point STP	1.68 (weekend) 1.74 (weekday)
Combined inflows	1.74 (weekend) 1.72 (weekday)

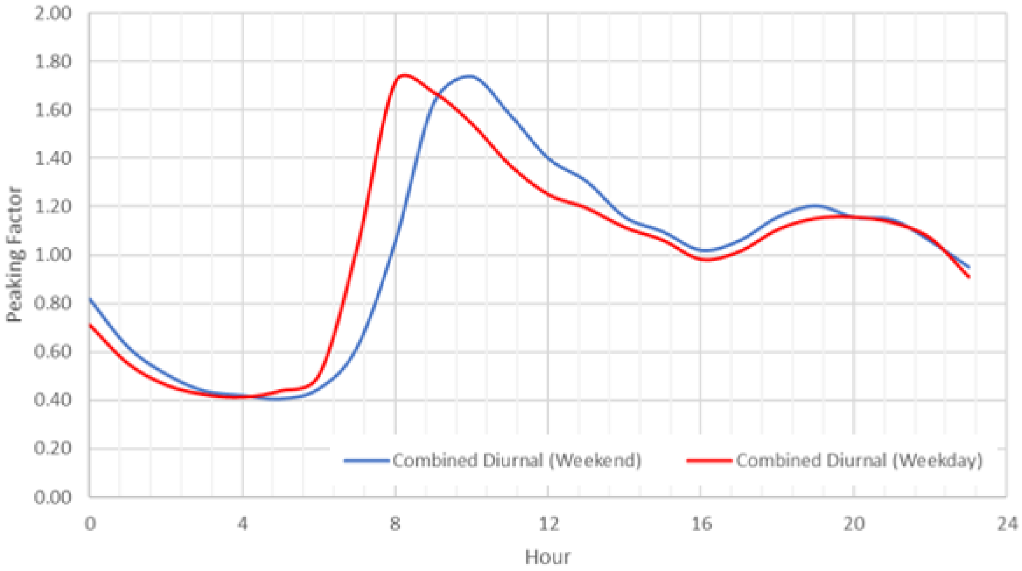


Figure 7 Combined plant diurnal flow profile

5.3.1.3 Wet weather flows

The influent peak wet weather flow (PWWF) adopted for the design, excluding internal plant returns, is summarised in Table 5.3Table 5.3.

Table 5.3 Peak wet weather influent flowrate

Catchment	PWWF (L/s)	Comment
Selfs Point	690	New Town gravity catchment 375 L/s Sandy Bay 2 Pump Station 228 L/s Safety factor 87 L/s (currently allocated to the New Town gravity catchment)
Macquarie Point	650	New Macquarie Point SPS design maximum flow rate
TOTAL	1,340	

The design has adopted the following philosophy for wet weather flow management to the plant outfalls:

- As a first preference, treated effluent will be discharged through the Blinking Billy Outfall (BBO) via the existing Effluent Pump Station (approximately 290 L/s capacity).
- Flows in excess of the BBO/Effluent Pump Station capacity will be stored in the new Effluent Balance Tank.
- If the Effluent Balance Tank is full, discharge will be via the new Selfs Point Local Outfall (SPLO).

The design basis for wet weather flows through various parts of the plant is summarised in Table 5.4.

Table 5.4 Wet weather flow design basis throughout plant

Process unit	Hydraulic design basis (2054)	Comment
Preliminary (Inlet works)	1,340 L/s plus returns	Peak capacity of Macquarie Point SPS, Sandy Bay SPS2 and local Selfs Point gravity catchment flows.
Primary	1,340 L/s plus returns	Primary tanks are to treat full peak flows.
4-stage bioreactors and membranes	1,340 L/s plus returns	All flows to receive secondary treatment through the new bioreactors and membranes. This avoids a bypass of primary treated sewage and avoids the need for UV treatment downstream of the new membranes.

5.3.1.4 Influent design concentrations

The median raw sewage concentrations adopted for the design are summarised in Table 5.5. Peak month (90th percentile) concentrations will be based on 1.2 times the median concentrations shown below, sustained for 30 days.

Table 5.5 Raw sewage concentrations

Raw sewage parameters	Units	Selfs Point STP Influent - Median	Macquarie Point STP Influent - Median	Combined Influent - Median
BOD	mg/L	300	320	311
COD	mg/L	684	724	706
TSS	mg/L	280	354	322
VSS	mg/L	257	333	300

Raw sewage parameters	Units	Selfs Point STP Influent - Median	Macquarie Point STP Influent - Median	Combined Influent - Median
TKN	mg/L	57	56	56
Ammonia	mg/L	33	40	37
Total phosphorus	mg/L	9	9.5	9
Orthophosphate	mg/L	5	5.2	5
Alkalinity	mg/L	273	275	274
Conductivity	uS/cm @ 25C	No data	2,340	
Temperature	°C	12-22	12-22	12-22

5.3.1.5 Raw sewage fractionation

The key raw sewage COD and nutrient fractions adopted for the design are summarised in Table 5.6. The Selfs Point and Macquarie Point loads will be modelled as a combined influent stream in BioWin.

Table 5.6 Combined Selfs Point and Macquarie Point influent wastewater characteristics

Influent Fractions	Units	Data
Readily Biodegradable COD (Fbs)	gCOD/gTCOD	0.18
Acetate (Fac)	gCOD/grbCOD	0.12
Non-colloidal Slowly Biodegradable (Fxsp)	gCOD/gsbCOD	0.88
Unbiodegradable Soluble (Fus)	gCOD/gTCOD	0.04
Unbiodegradable Particulate (Fup)	gCOD/gTCOD	0.19

5.3.1.6 Tankered waste loads

The tankered waste flow and load characteristics adopted are summarised in Table 5.7. The tankered waste is to be received at the new anaerobic digestion facility (via the tankered waste receival facility), bypassing the liquid stream processes.

The design for the augmented Selfs Point STP will not make provision to receive septage, stormwater, grey water or washpit/leachate waste, which will need to be carted elsewhere.

Table 5.7 Tankered waste flow and loads

Wastewater parameters	Units	Total combined average	FOG	TasWater waste	Trade waste consent
Proportion of total tanker volume	%	100%	35%	44%	22%
Typical volume	m^3/d	50	17.5	22	11
BOD	mg/L	13,596	7,273	5,425	40,000
	kg/d (typical)	687	127	119	440
COD	mg/L	35,239	18,182	26,427	80,000
	kg/d (typical)	1,780	318	581	880
TSS	mg/L	14,143	9,697	23,000	3,500
	kg/d (typical)	714	170	506	39
	TSS%	1.4%	1.0%	2.3%	0.4%
VSS	mg/L	10,329	6,667	17,182	2,450
	kg/d (typical)	522	117	378	27

Wastewater parameters	Units	Total combined average	FOG	TasWater waste	Trade waste consent
TKN	mg/L	961	176	1466	1200
	kg/d (typical)	49	3	32	13
Ammonia	mg/L	17	48	0	
	kg/d (typical)	1	1	0	0
Total Phosphorus	mg/L	633	12	1313	280
	kg/d (typical)	32	0	29	3

5.3.1.7 Total plant loads

The median total loads that will be adopted by the design are summarised in Table 5.8. Peak month (90th percentile) loads are assumed to be 1.2 times these median loads, sustained for 30 days.

Table 5.8 Total plant load

Influent wastewater load parameters (median)	Selfs Point catchment	Macquarie Point catchment	Tankered waste[2]	Total load
	2054	2054	2054	2054
Flow (ML/d)	10.9	14.0	0.05	24.9
BOD (kg/d)	3,256	4,469	687	7,750
COD (kg/d)	7,428	10,111	1,780	17,592
TSS (kg/d)	3,039	4,944	714	8,008
VSS (kg/d)	2,786	4,651	522	7,463
TKN (kg/d)	615	782	49	1,405
Ammonia (kg/d)	362	559	1	920
Total Phosphorus (kg/d)	93	133	32	231

5.3.2 Treated effluent quality

The upgraded Selfs Point STP will meet the treated effluent quality requirements in Table 5.9.

[2] Tankered waste will be delivered straight to the digestion process (via the tankered waste receival facility), hence this load will bypass the secondary treatment process and is not included in the total load summation

Table 5.9 Combined treated effluent quality requirements

Parameter	Units	50th percentile	90th percentile	Maximum
Biological Oxygen Demand	mg/L	10	15	N/A
Total Suspended Solids	mg/L	10	20	N/A
E.Coli	cfu/100mL	200	500	750
Oil and Grease	mg/L	2	5	N/A
Total Nitrogen	mg/L	7	10	N/A
Ammonia	mg/L	1	2	5
Total Phosphorus	mg/L	2	5	NA
Total Combined Residual Chlorine*	mg/L			<0.1

*Compliance point deemed to be at the outlet of the Blinking Billy Outfall. All other effluent quality parameters will be sampled at the STP.

5.3.3 Biosolids quality

All biosolids should comply with Grade B biosolids stabilisation and contamination requirements defined in the Tasmanian Biosolids Reuse Guidelines 2020. The biosolids cake dryness must achieve >22% dry solids (DS).

5.3.4 Future master-planning considerations

Following the completion this STP upgrade, the existing plant area is made largely available for future upgrades. Freeing up the existing site area provides TasWater with usable land tenure to accommodate future growth without the need for complex brownfield upgrades.

The existing trickling filters, inlet works, PSTs, biodenipho, secondary clarifiers, digesters and sludge handling equipment will all be decommissioned as part of these works.

6. Safety in Design

A Safety in Design process has commenced in accordance with TasWater CDO Safety in Design Guideline to identify and mitigate through design the risk associated with the hazards identified so far as is reasonably practicable (SFAIRP). A series of workshops will be conducted with Safety in Design Workshop #1 scheduled to occur in June 2023. Evidence of hazard identification and assessment will be summarised in a separate Safety in Design report and associated design hazard register.

7. Package 2000 – Inlet Works & Primary Treatment

7.1 Package scope

Package 2000 – Inlet Works & Primary Treatment includes the following infrastructure:

- Raw sewage pump station, including diversion of the existing gravity sewer lines,
- Diversion of existing Sandy Bay 2 Rising Main from adjacent the site boundary to the new inlet
- Integration of new Macquarie Point Rising main into the inlet works
- Inlet works structure including;
  - Primary screening,
  - Secondary screening for MBR protection,
  - Grit removal,
- Screenings handling (for primary and secondary screenings),
- Grit handling,
- Primary treatment including primary settlement tanks (PSTs), primary sludge pumps and primary effluent pumps,
- Inlet works drainage pump station (IWDPS).

7.2 Process description

7.2.1 Raw sewage conveyance

Raw sewage is conveyed to the Selfs Point STP from:

- The Selfs Point gravity catchment (via an existing gravity main)
- The Selfs Point local low-level gravity sewer catchment (via an existing gravity main)
- The Sandy Bay 2 Pump Station (pumped directly to the new inlet works)
- The Macquarie Point SPS (pumped directly to the new inlet works).

The gravity main from the Selfs Point gravity catchment and the low-level catchment is directed into the Raw Sewage Pump Station.

7.2.2 Raw sewage pump station

The Raw Sewage Pump Station will collect flow from the Selfs Point gravity catchment. The Selfs Point local low-level gravity sewer catchment will be separately transferred using a small sewage pumping station into this Raw Sewage Pumping Station .and overflows from the new STPs return pumping stations (IWDPS and GPPS) will discharge into the Raw Sewage Pumping Station(refer PK1000 for details).

The pump station includes four submersible pumps (duty/assist/assist/standby configuration) in a wet well. The pumps have VSDs and modulate speed to maintain a target level in the wet well. This control arrangement is proposed to reduce intermittent pumping and smooth the flow rate received by the PSTs (to improve capture). The wet well is connected to odour control.

7.2.3 Inlet works

Three incoming rising mains discharge to the receival chamber of the inlet works structure (rising mains from the Raw Sewage Pump Station, Sandy Bay 2 Pump Station and Macquarie Point SPS). A flowmeter is provided on each rising main (3 no. total) before entry to the receival chamber for raw sewage flow metering to the plant.

Flow gravitates through the inlet works structure, which consists of:

- Primary screening consisting of two 'centre flow' band screens (to be confirmed following vendor selection, duty/standby).
- A bypass channel, with manually raked bar screen, is provide upstream of the primary screens, in the event of failure of the primary screens. The manually raked bar screen is provided with a screenings launder directed to a dedicated mobile bin. If the manually raked bar screen becomes blinded, unscreened raw sewage will overtop the bar screen and be directed into the bypass channel towards the secondary screens.
- Secondary screening which includes three band screens (to be confirmed following vendor selection, duty/assist/standby). These are required to protect the membranes from gross fouling and for this reason there is no manual bypass around the secondary screens.
- An emergency overflow is provided upstream of the secondary screens in the event of a failure of the secondary screens. This emergency overflow consists of a high-level weir which would overflow if the secondary screens failed and blinded excessively or if penstocks downstream are closed. A high level switch is provided to provide an alarm that the overflow has started. This emergency overflow connects to same bypass line used by the primary effluent wet well overflow and discharges into the permeate line between the new MBR and the Effluent Balance Tank (refer package 4000).
- Grit removal which includes a duty only grit vortex tank (with bypass), equipped with a vortex mixer, duty only grit removal pump (cold stand-by grit pump to be maintained on site) and a single grit washer / classifier.
- Chemical dosing (alum) occurs in the channel downstream of the grit vortex tank, refer Package 6000. A spare chemical conduit is provided between the polymer room of the sludge treatment area (refer Package 5000) to enable a future polymer dose if required. A mixer is provided in the channel for rapid mix of these chemicals before the primary sedimentation tanks.
- An autosampler draws a representative raw sewage sample from a well-mixed location for analysis, prior to contamination from the Inlet Works Drainage Pump Station return stream. An influent sample panel draws from the same location as the autosampler, this includes online process analysers (COD, H_2S, pH, temperature and electrical conductivity).

Screenings from the primary and secondary screens are directed into a common screenings launder which can divert screenings to one of three screenings washpresses (only one washpress can operate at a time). Each washpress has a dedicated bin with odour control (three screenings bins total). Storage bins include level and weight transmitters to indicate when full and are removed from site and replaced by truck.

The grit classifier discharges to a single bin with odour control and level/weight transmitters. During the changeover of the grit bin, the grit pump is stopped, allowing grit to collect in the cone of the grit vortex tank. Grit and screenings bins are the same size and designed to be interchangeable to allow operators to move one of the three screenings bins to the grit classifier discharge if required.

A concrete bund is provided around the grit pumps, grit classifier, screenings washpresses and grit/screenings bins which drain to a sump. This sump also collects filtrate from the grit classifier and washpresses and drains to the Inlet Works Drainage Pump Station (IWDPS).

The inlet works and screenings/grit handling equipment are covered and foul air is drawn from under covers and directed to the odour control system, refer Package 6000.

7.2.4 Primary treatment

All flows from the secondary screens are received in the new primary sedimentation tank flow splitter. The flow splitter provides an even flow split to each of the four PSTs. Each PST contains a longitudinal chain and flight scraper which scrapes sludge across the tank floor towards the inlet end of the tank and propels floating scum across the liquid surface to the outlet end of the tank. At the inlet end of each PST are hoppers which collect primary sludge.

Dedicated primary sludge pumps remove sludge from the hoppers. Four pumps are provided for the four PSTs. A manually actuated valve with position switches is provided to cross connect the primary sludge pump suction lines between PST 2201 and 2202 as well as between PST 2203 and 2204, this allows one primary sludge pump to de-sludge two PSTs if a pump was offline. Solids removed in the PSTs are pumped to the sludge handling area for primary sludge thickening. The primary sludge pumps cycle between the hoppers. The duration and flow rate for each pump cycle is an operator setpoint in order to achieve ~2 %DS in the primary sludge feed to the sludge handling area (refer package 5000).

A 'yo-yo' type sludge level transmitter is provided in one hopper of each PST for online monitoring of the hopper sludge level.

Scum is removed from the surface of each tank via the chain and flight scraper and discharges to a rotating scum trough in each PST. The scum troughs of each pair of PSTs gravitate to a scum sump. PST 2201 and 2202 gravitate to SMP-2401 (PST 1 and 2 Scum Sump) and PST 2203 and 2204 gravitate to SMP-2402 (PST 3 and 4 Scum Sump). A duty scum pump is provided at each sump, these pumps transfer scum from the sump into the primary sludge line.

GRP odour covers are provided. Foul air is drawn from under the covers and directed to the odour control system. Access to covers and foul air ducting is achieved via a stairway and a series of platforms and walkways. A mobile crane is brought to site to remove odour covers to access the PST for maintenance. This mobile crane will lower a temporary submersible pump into the PST to drain the tank for maintenance of the chain and flight scrapers. Alternatively, there is a provision on the primary sludge withdrawal pipework between the PST hoppers and the primary sludge pumps to connect a temporary pump that can drain the PST.

At the discharge end of the PSTs, primary effluent overflows the discharge weirs and gravitates into the primary effluent wet well. The primary effluent pump station pumps from this wet well to the new 4 stage bioreactors. The primary effluent pumps modulate to provide a constant level in the primary effluent wet well. An emergency overflow is provided within this primary effluent wet well in the event of failure of the primary effluent pumps or a failure of the downstream secondary process that would limit what could be pumped to the new 4-stage bioreactors if partially or fully isolated. This overflow connects to the same emergency bypass line used by the inlet works emergency overflow, which includes a flowmeter to monitor bypass flows. After flow metering, the line discharges into the permeate line between the new MBR and the Effluent Balance Tank (refer package 4000).

The design of the PSTs incorporates chemically enhanced primary treatment (CEPT) by alum dosing. Alum is dosed prior to the PSTs (dosed into the downstream channel of the inlet works) and provision is also made to dose alum downstream of the PSTs (dosing primary effluent separately to the 4-stage bioreactor). The design incorporates this flexibility to allow the alum dose to be tuned to balance TSS capture in the PSTs, providing sufficient carbon to the bioreactors, whilst achieving the required phosphorous removal to meet the required effluent total phosphorus concentration compliance limits. Additional flexibility to tune the TSS capture of the PSTs is provided by allowing PSTs to be isolated using the automated inlet penstocks to each tank to increase or decrease the surface loading rate at different flow rates.

7.2.5 Inlet Works Drainage Pump Station (IWDPS)

General purpose pump stations are required on site to accommodate process return streams and local site drainage. Based on the layout and topography of the site, two local pump stations are provided (Inlet Works Drainage Pump Station and General Purpose Pump Station) to service the Selfs Point STP. Refer to Package 1000 Section 12.2.4 for details on the General Purpose Pump Station (GPPS).

The IWDPS collets process flows (via local gravity sewers) from the inlet works and primary treatment as well as contaminated bunded area drainage which cannot be sent to stormwater. Flows are returned to the process upstream of the secondary screens. In summary, the IWDPS collects the following flows:

- Grit classifier and screenings washpress sump drainage (grit classifier and screenings filtrate, and stormwater and maintenance washdown from bunded area)
- Manual bypass screen channel drainage.
- Primary and fine screens washing drainage.
- Stormwater and maintenance washdown from PST Primary Sludge Pump Bund.

- Sludge Handling Building & Poly Room floor drainage (refer Package 5000).
- Biosolids Outloading Bund drainage (refer Package 5000).
- Tankered Waste Screenings Wash Press filtrate (refer Package 5000).
- Tankered Waste Delivery Bund (refer Package 5000).
- Odour Control Facility Bund drainage (refer Package 6000).
- Biotrickling Filter blowdown, Activated Carbon Filter drainage and Odour Stack discharge drainage (refer Package 6000).

The IWDPS overflows to the raw sewage pump station.

7.3 Design basis

7.3.1 Redundancy

Equipment and process redundancy for the inlet works and primary treatment package are detailed in Table 7.1.

Table 7.1 Package 2000 redundancy requirements

Major process unit	Configuration	Comments
Primary screens	N+1	One standby mechanical screen at 2054 PWWF. Manually raked bar screen for primary screens emergency bypass screening.
Screening washing and dewatering	N+1 At least 3 No.	Ability to manage 2054 ADWF screenings load for 7 days Ability to manage 2054 PWWF screenings load for 1 peak wet weather event Combined screenings load from primary screens and secondary screens
Screenings bin	Refer comment	1 No. screenings bin dedicated to each washpress, redundancy integrated with washpress
Grit tanks	N	2054 PWWF should be handled hydraulically with all units online. Grit storage in grit tank will allow grit tanks to continue operation for 6 hours following grit pump failure.
Grit classifier	N	With hydraulic bypass.
Grit bin redundancy	N	Single odour controlled, self-levelling grit bin with grit stored in vortex cone during bin change-over
Secondary screens	N+1	At 2054 PWWF Full PWWF to be passed through secondary screens
General purpose pumps	N+1	Per pump station
PST	At least 2 No.	2054 PWWF should be handled hydraulically with one PST offline.
Primary sludge pumps	N+1 per pair of PSTs	Suction manifold configured to allow each pump to draw from two PSTs (providing a redundant pump for each pair of PSTs).
PST scum pumps	N per pair of PSTs	Revised to two pumps (one pump for each pair of PSTs). Revised from 30% design based on vendor feedback.
Primary effluent pumps	N+1	
Inlet works drainage pump station	N + 1	

7.3.2 Performance and technical requirements

The performance and technical requirements for the inlet works and primary treatment package are detailed in Table 7.2 through 8.30

Table 7.2 Raw sewage pump station and course screens technical requirements

Parameter	Unit	Value	Comments
Inlet pumping			
Selfs Point gravity catchment PWWF	L/s	462	Design capacity of Raw Sewage Pump Station New Town gravity catchment 375 L/s Safety factor 87 L/s
Sandy Bay 2 PS PWWF	L/s	228	
Macquarie Pt PS PWWF	L/s	650	
Total PWWF	L/s	1340	Excluding Recycle Flows from IWDPS
IWDPS Maximum Flow	L/s	57.1	
Total PWWF (Including IWDPS)	L/s	1397	Excludes service water flows associated with screen sprays that will recycle through the screen (to be confirmed following vendor selection).

Table 7.3 Primary screens technical requirements

Parameter	Unit	Value	Comments
Primary screens and grit			
Screen type	Centre Flow Band screen		
Screenings capture rate	>85 %		
Dewatered screenings product quality	>35% DS		
Screen perforation diameter	6 mm		Not specified but was basis of concept design
Odour treatment	All screens, channels and grit handing equipment to be fully enclosed and vented to the odour control system.		
Protective coating	Provided for internal channel surfaces.		
Foul water returns			
Detention time	No detention storage provided.		

Table 7.4 Secondary screens technical requirements

Parameter	Unit	Value	Comments
Screen type	Centre Flow Band screen		
Screen aperture	mm	2	Required by membrane suppliers
Screenings capture rate	%	85	Clarify with vendors (screens and MBR membranes) whether possible and/or required.
Washing and dewatering	Shared system with primary screens		
Odour treatment	All screens and channels to be fully enclosed and vented to the odour control system.		
Protective coating	Provided for internal channel surfaces.		

Table 7.5 Grit removal technical requirements

Parameter	Value	Comments
Grit Removal		
Grit tank type	Vortex	
Grit capture rate	>95% for particle diameter ≥0.150 mm	
Grit product quality	>90% DS	TBD with vendor
Required screenings and grit storage time	7 days at 2054 ADWF 1 peak wet weather event at 2054 PWWF	Change from project specification (0089-SPC-SELST01-DE-0001)
Instrumentation	Online analysers provided for pH, temperature, COD, H_2S, EC (upstream of grit collection). Autosampler provided upstream of grit collection.	
Odour treatment	All screens, channels and grit handing equipment to be fully enclosed and vented to the odour control system.	
Protective coating	Provided for internal channel surfaces.	

Table 7.6 Primary treatment technical requirements

Parameter	Unit	Value	Comments
Hydraulic retention time	hours	3	Minimum with all tanks online at 2054 ADWF.
Surface loading rate	$m^3/m^2.d$	35	All tanks online at 2054 ADWF.
Target TSS removal	%	60	Note that some deterioration in TSS removal performance is acceptable at PWWF and with one tank offline. This has been considered as part of the process modelling risk assessment.
Scum removal system	Mechanical scum removal required for each PST		
Odour treatment	PSTs to be fully covered and foul air vented to the odour control system.		
Instrumentation	Sludge blanket level detection (yo-yo type with automated service water spray) Suction and discharge side pressure switches on each primary sludge pump One Pressure transmitter for the four primary sludge pumps One Flowmeter for the four primary sludge pumps		
Mixing (alum dosing)	Rapid mixer provided in downstream channel of inlet works (which will be the dose point for alum prior to the PSTs).		
Primary Sludge Removal Capacity	Maximum primary sludge removal capacity should be based on 2054 Flows, Max Month Loads, 70% PST Capture, Peak Diurnal Flows + 20% Safety Factor. Allow for at least 2 primary sludge pumps to operate simultaneously at max duty. Allow for 3 primary sludge pumps to operate simultaneously, however the flow rate could be inhibited if there were constraints running all 3 at max duty.		

7.4 Design summary

The key inlet works and primary treatment elements are detailed in the tables following.

Table 7.7 Incoming sewer design summary

Parameter	Unit	Value	Comments
Selfs Point gravity catchment	DN	900	Match existing upstream.
	Material	GRP	Class to be confirmed following confirmation of construction methodology
	%	1.00	Grade to comply with WSA 02_2014

Parameter	Unit	Value	Comments
Selfs Point low-level gravity sewer catchment	DN	150	Assumed existing to be DN150. Match existing.
	Material	uPVC	To be confirmed following confirmation of construction methodology
	%	0.67	Grade to comply with WSA 02_2014

Table 7.8 Raw sewage pump station design summary

Parameter	Unit	Value	Comments
Wet well type		Cast In-situ	
Wet well width	m	3.84	Internal width
Wet well length	m	4.92	Internal length
Wet well depth	m	5.60	TOC to Wet well IL
Wet well material		Reinforced concrete with internal coating system	
Number of pumps	No.	4 (D/A/A/S)	
Total Pump Station design flow rate	L/s	462	3 pumps operating
Pump Duty (each) – Peak instantaneous flow rate	L/s	212	
Pump Duty (each) – Peak instantaneous flow head	m	15.4	
Pump Duty (each) – Minimum instantaneous flow rate	L/s	21	Pumps to operate at min speed to achieve min diurnal flow
Pump Duty (each) – Minimum instantaneous flow head	m	12	
Pump type		Submersible	
Rising main		MSCL	
Rising main instrumentation		Magnetic Flowmeter	
Pump station valving		One (1) Swing check NRV per pump One (1) Isolation Knife Gate Valve per pump One (1) Air Valve per pump Above ground valve assembly	
Wet well instrumentation		Level Transmitter Level Switch Low Level Switch High	
Wet well operating volume	kL	17.3	
Allowable number of starts per hour	starts/hr	8	Pump speed to vary to follow diurnal inflow to PS.
Emergency storage volume	kL	35	Based on assumed overflow level
Overflow level	mRL	TBC	TBC following confirmation of RFIs
Overflow configuration		TBC	TBC following confirmation of RFIs

Table 7.9 Primary screens design summary

Parameter	Unit	Value	Comments
Screen type		Centre flow band screens	

Parameter	Unit	Value	Comments
Number of primary screens	No.	2 (1D/1S)	
Design capacity (including internal recycles)	L/s	1340 L/s (2054 PWWF) 57.1 L/s (Inlet Works Drainage Pump Station Returns) Total: 1397 L/s	Excludes service water flows associated with screen sprays that will recycle through the screen (to be confirmed following vendor selection).
Primary screen design flow	L/s	1397	As per note above on service water sprays. PWWF at 2054
Screenings in influent (ADWF)	kg DS/ML influent	16	Based on similar value adopted by Sydney Water. CDO to confirm if existing plant data can be used to verify this assumption.
Screenings captured by screens	kg DS/ML influent	13.6	Based on 85% capture at primary screens
Wet mass of screenings discharged to launder (ADWF at 2054)	kg/d	2,258	Based on 15% w/v solids concentration of screenings discharged to Launder
Screenings peak factor (maximum day)		5	Multiplied by the screenings captured at ADWF
Screenings peak factor (maximum hour)		10	Multiplied by the screenings captured at ADWF
Service water requirements – Screen – Washpress	L/s	TBC	TBC following vendor selection.

Table 7.10 Primary screens bypass design summary

Parameter	Unit	Value	Comments
Screen type		Manually raked bar screen	
Number of screens	No.	1	
Manual screen bypass capacity	L/s	1340 L/s (2054 PWWF) 57.1 L/s (Inlet Works Drainage Pump Station Returns) Total: 1397 L/s	Excludes service water flows associated with screen sprays that will recycle through the screen (to be confirmed following vendor selection).
Aperture	mm	20mm spacings	
Number of launders	No.	1	Single launder for manually raked screenings to dedicated mobile bin
Unscreened bypass operation		Bar screen 'overtop' level set to only operate following blinding of manual screen	The manual screen will overtop once it is blinded until it can be cleaned.

Table 7.11 Secondary screens design summary

Parameter	Unit	Value	Comments
Screen type		Centre flow band screens	To be confirmed following vendor engagement.
Number of secondary screens		3 (D/A/S)	

Parameter	Unit	Value	Comments
Design capacity (including internal recycles)	L/s	1340 L/s (2054 PWWF) 57.1 L/s (Inlet Works Drainage Pump Station Returns) Total: 1397 L/s	Excludes service water flows associated with screen sprays that will recycle through the primary and secondary screens (to be confirmed following vendor selection).
Secondary screen design flow (maximum)		1397 L/s	As per note above on service water sprays.
Screenings in influent (ADWF at 2054)	kg DS/ML influent	2.4	Assuming 16 kgDS/ML influent to primary screens and 85% capture at the primary screens
Screenings captured by secondary screens	kg DS/ML influent	2.0	Based on 85% capture of secondary screens
Wet mass of screenings discharged to launder (ADWF at 2054)	kg/d	339	Based on 15% w/v solids concentration of screenings discharged to Launder
Screenings peak factor (maximum day)		5	Multiplied by the screenings captured at ADWF
Screenings peak factor (maximum hour)		10	Multiplied by the screenings captured at ADWF
Service water requirements – Screen – Washpress		TBC	TBC following vendor selection.
Number of launders		1	Shared with primary screens.

Table 7.12 Screening handling design summary

Parameter	Unit	Value	Comments
Method of conveyance		Launder	
Number of launders	No.	1	Shared launder used for primary and secondary screenings.
Screenings washing and dewatering equipment type		Washpress	
Number of washpresses/bins for screenings	No.	3	Three bins proposed to provide more than one week of storage at ADWF. One washpress per bin (this will avoid requiring any screw conveyors).
Total volume of discharged screenings (ADWF at 2054)	m^3/day	1.3	Combined primary and secondary screenings Assuming bulk density of discharged screenings of 800 kg/m^3
Peak day volume of discharged screenings (2054)	m^3/day	6.6	Using peaking factor of 5 times ADWF
Peak hour volume of discharged screenings (2054)	m^3/day m^3/hour	13.2 0.55	Using peaking factor of 10 times ADWF
Total bin volume	m^3	10	
Maximum fill weight of bin	tonne	11	Based on Spirotainer® 10 m^3 bin. Note that the bin will be limited by the usable volume before reaching the maximum weight limit of the bin.
Usable bin volume	m^3	4.7	Based on advice from Spirotainer® and assumed angle of repose of 40 degrees for screenings. To be confirmed following vendor selection.

Parameter	Unit	Value	Comments
Time to fill one bin at ADWF screenings load	Days	3.6	At 2054
Time to fill one bin at peak day screenings load	Hours	17	At 2054
Time to fill one bin at peak hour screenings load	Hours	8.5	At 2054
Time to fill all screenings bins at ADWF	Days	10.8	Based on three bins

Table 7.13 Grit removal design summary

Parameter	Unit	Value	Comments
Design flow (average)	L/s	297 L/s (2054 ADWF)	
Design flow (PWWF)	L/s	1340 L/s (2054 PWWF) 57.1 L/s (Inlet Works Drainage Pump Station Returns) Total: 1397 L/s	Excludes service water flows associated with screen and grit sprays that will recycle through the primary and secondary screens (to be confirmed following vendor selection).
Number	No.	1	Vortex Grit Chamber
Hydraulic capacity (maximum) per unit to achieve grit removal performance		1397 L/s	See comment above regarding service water flows.
No. of grit extraction pumps	No.	1	Duty, cold standby stored at the plant.
Grit extraction flow rate per pump	L/s	TBC	To be confirmed following vendor selection.

Table 7.14 Grit handling design summary

Parameter	Unit	Value	Comments
No of grit washing/dewatering units	No.	1	Grit classifier type
Grit washing/dewatering unit hydraulic capacity	L/s	TBC	Pending vendor selection.
Grit load to plant (ADWF at 2054)	kg DS/ML	22.2	
Grit load extracted (ADWF at 2054)	kg DS/ML	21.1	Based on 95% capture
Grit extraction peak factor (maximum day)		2.6	
Grit extraction peak factor (maximum hour)		10	
Wet mass of discharged grit (ADWF at 2054)	kg/d	656	Based on 80% w/v solids concentration of discharged grit (from classifier)
Volume of discharged grit (ADWF at 2054)	m^3/d	0.5	
Number of grit bins	No.	1	
Total bin volume	m^3	10	
Maximum fill weight of bin	tonne	11	Based on Spirotainer® 10 m^3 bin. Note that the bin will be volume limited by the usable bin volume before reaching the maximum weight limit of the bin.

Parameter	Unit	Value	Comments
Usable bin volume	m^3	5.3	Based on advice from Spirotainer® and assumed angle of repose of 35 degrees for grit.
Time to fill one bin at ADWF grit load	Days	11.3	Provides more than a week of storage at ADWF at 2054 loading
Time to fill one bin at peak day grit load	Days	4.3	At 2054 loading
Time to fill one bin at peak hour grit load	Hours	27	At 2054 at loading

Table 7.15 IWDPS design flow summary

Contributing Component	Units	Average Design Flow	Peak Design Flow	Comment
Inlet works primary and secondary screens washing	L/s	1.3	16.0	To be confirmed based on vendor selection.
Inlet works grit classifier filtrate (incl. grit pump flush water)	L/s	0.5	6.1	To be confirmed based on vendor selection.
Inlet works screenings wash press filtrate	L/s	2.0	2.0	To be confirmed based on vendor selection.
Inlet works grit and screenings area bund drainage	L/s	-	9.0	
PST area bund drainage (primary sludge pumps)	L/s	-	0.5	
Biosolids outloading area bund drainage	L/s	-	7.0	
Odour control facility bund	L/s	-	12.0	
Biotrickling filter blowdown	L/s	2.0	3.0	To be confirmed based on vendor selection.
General allowance for hose down	L/s	0.0	1.5	
Total	**L/s**	**5.8**	**57.1**	

Table 7.16 IWDPS design summary

Parameter	Units	Value	Comments
Wet Well Type	-	Concrete cast insitu	
Wet Well Diameter	m	3.0	
Wet Well Depth	m	4.48	To be confirmed.
Wet Well Material	-	Reinforced concrete	
Pump Duty	L/s	57.1	To be confirmed based on vendor selection.
Number of Pumps	No.	Two (2)	
Pump Configuration	-	Duty / Standby	
Pump Type	--	Submersible	
Rising Main		OD280 PE100 PN16	
Rising Main Instrumentation		DN200 Magflo meter	
Pump Station Valving	-	One (1) Swing check NRV per pump One (1) Isolation Gate Valve per pump Arrangement aboveground on slab	

Parameter	Units	Value	Comments
Wet Well Instrumentation		Level Transmitter Level Switch Low Level Switch High	
Wet Well Operating Volume	kL	3.0	To be confirmed.
Allowable number of starts per hr	Start/hr	12 start/hr	
Emergency Storage	kL	NA	
Overflow Level	m	8.65	To be confirmed.
Overflow configuration	-	Overflow via DN300 gravity sewer to RSPS	To be confirmed.

Table 7.17 Primary sedimentation tanks design summary

Parameter	Unit	Value at2040	Value at 2054	Comments
Number of PSTs	No.	4		
Length per tank	m	27.7		
Width per tank	m	7		
Depth per tank	m	4.64		Average, 4.78 m at deep end, 4.5 m at shallow end (1% fall provided towards primary sludge hopper).
Area per tank	m^2	193.9		
Overflow rate at ADWF (all tanks online), excluding IWDPS recycles	$m^3/m^2.d$	28.2	32.1	Does not include plant recycles from IWDPS. Design basis maximum 35.0 $m^3/m^2.d$ at ADWF
Overflow rate at ADWF (all tanks online)	$m^3/m^2.d$	31.6	35.5	Including IWDPS recycles (which are TBC pending vendor information). Design basis maximum 35.0 $m^3/m^2.d$ at ADWF.
Overflow rate at ADWF (one tank offline)	$m^3/m^2.d$	42	47	Including IWDPS recycles (which are TBC pending vendor information).
Overflow rate at PDWF (all tanks online)	$m^3/m^2.d$	53	59	
Overflow rate at PDWF (one tank offline)	$m^3/m^2.d$	70	79	
Overflow rate at PWWF	$m^3/m^2.d$	149	159	
Overflow rate at PWWF (one tank offline)	$m^3/m^2.d$	198	212	
Hydraulic retention time at ADWF (all tanks online)	Hours	3.5	3.1	Target 3.0 hours Including IWDPS recycles (which are TBC pending vendor information).
Hydraulic retention time at PWWF (all tanks online)	Hours	0.7	0.7	Including IWDPS recycles (which are TBC pending vendor information).

Table 7.18 Primary sludge pumps design summary

Parameter	Unit	Value	Comments
Type of pumps		Positive Displacement (helical rotor)	
Number of pumps	No.	4	One per PST. Suction cross connection provided on each pair of PSTs. If a primary sludge pump was offline, the other pump in the pair could de-sludge the PST.
Required Duty (Each) - Flowrate	L/s	4.1	Based on design basis for maximum duty documented in Table 7.6. Sized to allow two PSTs to be de-sludged at one time at maximum duty (i.e. with four PSTs and four primary sludge pumps online, each primary sludge pump would operate 50% of the time). Flow rate would be inhibited below this to de-sludge three PSTs at one time.
Maximum Duty (Each) - Flowrate	L/s	6.1	Based on indicative vendor selection.
Maximum Duty (Each) - Head	m	TBC	
Minimum Duty (Each) - Flowrate	L/s	TBC	
Minimum Duty (Each) - Head	m	TBC	

Table 7.19 Primary effluent pump station technical requirements

Parameter	Unit	Value	Comments
Primary effluent pumps to feed 4-stage bioreactor			
Type of pumps		End Suction Centrifugal	
Number of pumps	No.	3 high flow pumps (D/A/S) 2 low flow pumps (D/S)	High and low flow pumps required due to large turndown required.
Duty (total) – ADWF at 2054	L/s	317	Duty influenced by service water recycles which are to be confirmed pending vendor information.
Duty (total) – maximum flow rate	L/s	1415	PWWF at 2054 Duty influenced by service water recycles which are to be confirmed pending vendor information.

8. Package 3000 – Bioreactor & MBR

8.1 Package scope

Package 3000 – Bioreactor & MBR includes the following infrastructure:

- 4-Stage Bioreactor Flow Splitter for even flow split to the bioreactors,
- 2 No. 4-stage bioreactors for secondary treatment, including diffused aeration, scum removal and mixed liquor recycles,
- MBR for solids removal, including membrane feed pumps, membrane trains, membrane air scouring, permeate pumps, backwash pumps, and the permeate storage tank; and
- WAS pumping.

8.2 Process description

8.2.1 Bioreactors

The 4-Stage Bioreactor Flow Splitter provides an even flow split over a fixed weir to the two carousel type oxidation ditches. The flow splitter includes a central chamber which accepts pumped flows from the PST Effluent and General Purpose Pump Station. Flow is measured upstream in the combined primary effluent flow to the bioreactor flow splitter. Double isolation of a oxidation ditch stage is provided by inserting a stopboard and actuated penstock at the tank entry to the oxidation ditch from the central flow split chamber.

Each carousel oxidation ditch stage includes a primary anoxic zone, a swing zone, two primary aerobic zones and a deaeration zone. The deaeration zone of each oxidation ditch flows into a common secondary anoxic and secondary aerobic zones. The common secondary anoxic and aerobic zones can be double isolated and flows bypassed directly to the MBR feed pump well if maintenance is required on those areas by inserting feed stopboards and actuated penstocks into the secondary anoxic feed cannels from each oxidation ditch.

Return Activated Sludge (RAS) from the MBR is discharged to Primary Aerobic Zone 2 for each oxidation ditch (via a RAS flow splitting chamber in the MBR structure). Waste Activated Sludge (WAS) and surface scum from each oxidation ditch overflows a modulating offtake weir to an in-built well of the oxidation ditch structure where it is pumped for mechanical thickening before being fed to the anerobic digestion process.

Each bioreactor includes a fine bubble diffused aeration system consisting of removable diffuser grids, blowers (located in a designated blower room), stainless steel pipework, valving, DO probes and other instrumentation. There are six blowers in total (operating as duty/duty/assist/assist/assist/standby) with most-open-valve control allowing the duty blower(s) to provide process air to the bioreactors. Removal of the aeration grids for maintenance/cleaning requires a mobile crane. Designated washdown diffuser laydown areas (2 of) is provided adjacent to each oxidation ditch where crane lifting to each washdown pad can occur with reach to the bioreactor aeration racks and the MBR membranes.

The anoxic and deaeration zones are mixed using submersible propeller mixers.

Scum removal within each oxidation ditch is done via the WAS offtake weir with surface sprays located across the ditch to move scum to that location. Another mechanical scum harvester is located at the end of the common secondary anoxic zone which redirects accumulated scum via a set of scum pumps to each WAS collection well.

8.2.2 Membrane tank

The membrane tank includes six trains in parallel, which operate as five duty and one standby. Each train contains a set of membrane cassettes.

Each MBR train has a dedicated MBR Feed Pump located in the MBR Feed Channel. The feed pumps transfer 5 x inflow into each membrane train. This enables a discharge of 4 x inflow RAS return from the membrane trains to a common RAS channel from which dedicated flow splitting chambers transfer RAS to the primary aerobic zone 2 in each oxidation ditch.

The removal of MBR cassettes requires a mobile crane. Two designated laydown and washdown areas for the membrane cassettes is provided adjacent to each oxidation ditch.

Each membrane train has an associated permeate pump that are dry-mounted end suction centrifugal type pumps drawing from individual permeate headers and discharging into the Permeate Tank which shares a wall with the RAS Channel. A high level bellmouth outlet from the Permeate Tank transfers permeate to the Effluent Balance Tank.

Two backpulse pumps are provided (duty/standby). These pumps draw permeate from the Permeate Tank and discharge into the individual permeate extraction pipework for each MBR train. Clean in place (CIP) chemicals are dosed to the downstream side of the backpulse pumps for maintenance and recovery cleans of the membranes. Control valves facilitate the isolation of the permeate pump to allow for backpulsing of a single train while all other duty trains remaining in operation.

Two membrane drain down pumps are provided (duty/standby). These pumps are sized to facilitate emptying of one membrane train within 30 minutes and returning flow to the common RAS channel.

Five membrane aeration blowers are provided (4 duty / 1 standby) for membrane aeration. The membrane blowers are located in a shared blower room with the bioreactor blowers.

8.3 Design basis

8.3.1 Redundancy

Equipment and process redundancy for the bioreactor and MBR package are detailed in Table 8.15.1.

Table 8.1 Package 3000 redundancy requirements

Major process unit	Configuration	Comments
New bioreactors	See comment	Partial bioreactor redundancy to be provided. Removable aeration diffusers, liftable mechanical/process equipment and liftable instrumentation are provided without draining a bioreactor stage. Partial redundancy under 2054 loading conditions provided by continuing to fully nitrify with one oxidation ditch offline. This will be achieved by relocating a diffuser grid from the offline oxidation ditch and installing it in the online ditch to increase air transfer.
New plant WAS pumps	N+1	
Bioreactor scum pumps	N	
Bioreactor mixers	N	Commonality provided between mixers. Uninstalled spare for each mixer type/size.
Bioreactor aeration blowers	N+1	System allowed to operate with N redundancy during rare events
Membrane feed pumps	N+1	One pump per MBR train, with one redundant MBR train
Membranes	N+1	Membrane capacity to treat a peak flow with one membrane train offline when allowing for membrane cycling between treatment and back pulsing.
Permeate pumps	N+1	Redundancy provided with redundant MBR train as dedicated pump per membrane train
Back pulse pumps	N+1	Dedicated standby pump
Membrane blowers	N+1	

Major process unit	Configuration	Comments
Bioreactor scum pumps	N	One pump per oxidation ditch.
Drain down pumps	N+1	

8.3.2 Performance and technical requirements

The performance and technical requirements for the bioreactor and MBR package are detailed in Table 8.2 through Table 8.4.

Table 8.2 4 stage bioreactor and MBR overarching technical requirements

Parameter	Unit	Value	Comments
Design ADWF (2054)	*ML/d*	*24.9*	*2054 ADWF, existing process decommissioned*
PDWF:ADWF	ratio	1.74	
PWWF (2054)	*L/s*	*1479*	1340 L/s 2054 PWWF. Additional 139 L/s allowed for on top of this for plant recycles (i.e. service water recycles that will recirculate through the membranes).
Return Flows	Return flows and loads to account for 50 kL/d tankered waste receival to digesters. Return flowrate to be controlled to ensure no adverse impact on secondary process, particularly due to high strength returns from dewatering and recuperative thickening. Return flows will be directed primarily to the new 4-stage bioreactor plant..		

Table 8.3 4 stage bioreactor technical requirements

Parameter	Unit	Value	Comments
4 stage bioreactor			
Minimum SRT with all trains online	days	20	
Summer mixed liquor temperature	°C	25	Increased from existing aeration tank maximum temperature to account for increase due to diffused aeration and climate change.
Winter mixed liquor temperature	°C	15	
Minimum instrumentation requirements (each oxidation ditch): – Nitrate and soluble phosphorus – Ammonia – TSS – DO (multi point measurement) – pH			Duty only
Bioreactor aeration system			
Blower type	Screw or turbo		To be confirmed during procurement.
Aeration diffuser type	Fine bubble removable diffusers		
Aeration requirements			
SOTR (minimum)	2025 with all process units online Swing zone unaerated 20 day SRT Median influent concentrations Daily average flow		

Parameter	Unit	Value	Comments
SOTR (peak, all bioreactors online)	2054 with both bioreactors online Swing zone aerated Peak month influent concentrations Diurnal maximum (1.74 x ADWF)		
SOTR (peak, one oxidation ditch offline)	2054 with one oxidation ditch and common secondary aerobic zone online Swing zone aerated and extra diffuser grit from offline ditch relocated to the online ditch Peak month influent concentrations Diurnal maximum (1.74 x ADWF)		

Table 8.4 MBR technical requirements

Parameter	Unit	Value	Comments
Membrane tank			
Design duration of PWWF event	hours	12	Refer RFI037 response from CDO.
MLSS design temperature for membrane flux	Deg C	15	Refer RFI037 response from CDO.
Maximum net flux	LMH (Litre/m^2/h)	39.4	Based on 12-hour PWWF duration at 15 degree MLSS temperature with the redundant train offline
Maximum MLSS in MBR for maximum day and peak hour conditions	g/L	12	
Minimum instrumentation requirements (permeate tank outlet): - Nitrate Soluble P Ammonia Minimum instrumentation requirements(each permeate train) - Turbidity			Duty only nitrate, ammonia and soluble P included in common permeate tank
Membrane Tank Blowers			
Blower type	Screw or high speed turbo		To be confirmed during procurement.

8.4 Design summary

Bioreactors and membrane infrastructure is summarised in Table 8.5. Allowance has been made to consider a stage development which would allow for stage 1 flows through to accommodate the first 15 years of planning growth, and a stage 2 to accommodate flows through to 2054. The project currently intends to accommodate the full 2054 capacity in the initial build.

The key detailed design outputs for the Bioreactor and MBR package are detailed in Table 8.5 through Table 8.8.

Table 8.5 Bioreactor (Stage 1) design summary

Parameter	Unit	Value	Comments
4 stage compartmentalised bioreactor	No.	2	
Total bioreactor volume	ML	7.1	Both trains
Primary anoxic zone	ML	2.1	Fraction = 30%
Swing Zone	ML	0.7	Fraction = 10%
Primary aerobic zone	ML	2.45	Fraction = 35%

Parameter	Unit	Value	Comments
Deaeration zone	ML	0.70	Fraction = 10%
Secondary anoxic zone	ML	0.70	Fraction = 10%
Secondary aerobic zone	ML	0.41	Fraction = 5%
Water depth	m	6 to 6.5	500 mm working volume for MBR flow balancing
Return flow allowance for process modelling	ML/d	0.8	940 kg/d TSS (12% of raw sewage load) 150 kg/d ammonia (16% of raw sewage load) 40 kg/d phosphorus (17% of raw sewage load) Return flows are all directed to new 4 Stage Bioreactor (upstream of secondary screens)
Nitrate recycle pumps	No.	4	Duty/duty per bioreactor train Axial flow impeller pumps with backflow flap valve on outlet
Nitrate recycle pumps duty flow	L/s	704	Duty per pump to achieve 20 x inflow
Nitrate recycle pump motor size	kW	TBC	To be confirmed following vendor selection. Variable Speed Drive
Mixers	No	14	7 per bioreactor (4 No. in anoxic zones, 1 No. in swing zone, 1 No. in deration zone 1 No. in secondary anoxic zone) Number to be confirmed following vendor selection.
Primary anoxic zone mixer power	kW	7.5	Per mixer, to be confirmed following vendor selection.
Swing zone and deaeration zone mixer power	kW	3	Per mixer, to be confirmed following vendor selection.
WAS pumps	No.	2	Duty/standby Dry mounted submersible
WAS pump duty flow - Maximum	L/s	25	
WAS pump duty head at maximum flow	m	TBC	To be confirmed following vendor selection.
WAS pump duty flow – Average	L/s	19	
WAS pump duty head at average flow	m	TBC	To be confirmed following vendor selection.
WAS pump motor size	kW	TBC	To be confirmed following vendor selection. Variable Speed Drive
Scum Harvester Pumps	No.	2	One per scum harvester. One harvester in each of the two secondary anoxic zones. Scum is primarily harvested from secondary anoxic zone.
Scum Harvester Pump Duty Flow	L/s	4.3	Based on VoR system. To be confirmed following vendor selection.
Scum Harvester Pump Type	-	Positive displacement, rotary lobe	Variable Speed Drive
Scum Skimmer Pump	No.	1	One Scum Skimmer for Stage 1 located in end of Secondary Aerobic Zone. Collects any scum not captured by primary scum extraction point.
Scum Skimmer Pump Duty Flow	L/s	2.5	Based on Tsurumi FSP System. To be confirmed following vendor selection.
Scum Skimmer Pump Type	-	Submersible	Fixed Speed

Table 8.6 MBR design summary- staged development considered

Parameter	Unit	Value	Comments
MBR volume	ML	1.2	Total for 7 trains (excluding feed and RAS channel)
Membrane feed pumps	No.	7	Duty per membrane train (stage 1) Axial flow impeller pumps
Membrane feed pump – Maximum Duty	L/s	760	Minimum achievable turndown to be confirmed following vendor selection. Note that in Stage 1, given the PWWF per bioreactor is very high, a lower recycle rate will be accepted at high inflows (but high enough to ensure the MLSS concentration in the tank remains below 12 g/L to protect the membranes). At PWWF, the recycle rate will drop to 2.2 x inflow.
Membrane feed pump type	-	Axial flow impeller pump	
Membrane feed pump motor size	kW	TBC	To be confirmed following vendor selection. Variable speed drive.
Membrane trains	No.	7	7 trains required at Stage 1 (6+1) 1 additional train required for Stage 2 (7+1) (Should a staged development option be considered)
Membrane cassettes	No.	63 total	9 No. cassettes per membrane train. Based on ZeeWeed 500D membranes (by Suez)
Flux	LMH	43.1	Maximum 12 hour flow (pending final vendor selection)
	LMH	36.3	Maximum 24 hour flow (pending final vendor selection)
	LMH	30.2	Maximum 30 day flow (pending final vendor selection)
Permeate pumps	No.	7	1 No. per membrane train
Permeate pumps maximum duty flow	L/s	249	Per pump
Permeate pumps average duty flow	L/s	135	Per pump
Permeate pumps minimum duty flow	L/s	76	Per pump
Permeate pump type	-	End suction centrifugal	
Permeate pump motor size	kW	TBC	To be confirmed following vendor selection. Variable speed drive
Backpulse pumps	No.	2	Duty/standby
Backpulse pumps maximum duty flow	L/s	249	Vendor package
Backpulse pump type	-	End suction centrifugal	
Backpulse pump motor size	kW	TBC	To be confirmed following vendor selection. Variable speed drive
Air scour blowers	No.	5	4 duty plus 1 standby (additional 2 no. blowers added for Stage 2 under a staged development). To address large turndown requirements, air scour blower sizing has assumed that a minimum of two membrane trains will be aerated at all times.

Parameter	Unit	Value	Comments
Air scour blowers peak aeration demand	Nm^3/hour	22,869	Seven trains in operation at Leap-Lo (9 x Veolia 500D membranes) Increases to 26,136 Nm^3/hour at Stage 2.
Air scour blowers minimum aeration demand	Nm^3/hour	3,276	Two trains in operation at Leap-Lo (9 x Veolia 500D membranes).
Air scour blower nameplate motor power	kW	50	To be confirmed following vendor selection.
Drain down pumps	No.	2	Duty/standby
Drain down pump duty flow	L/s	93	To enable one membrane tank to be drained in 30 minutes
Drain down pump type	-	Dry mounted submersible	
Drain down pump motor size	kW	TBC	To be confirmed following vendor selection.

Table 8.7 4-Stage bioreactor aeration design summary

Parameter	Unit	Peak Demand (standby blower operating)	Peak Demand (all bioreactors online)		Average Demand	Minimum Demand	Comments
SOTR scenario	-	SOTR (peak, one clarifier offline)	SOTR (peak, all bioreactors online)		SOTR (average)	SOTR (minimum)	Refer scenario descriptions in Table 8.3
Mixed liquor temperature	^oC	15	15		19	25	
No. duty blowers	-		N (standby operating)	N + 1	N + 1	N + 1	
Aeration requirements (2054)							
SRT	days	N/A	20		N/A	N/A	
MLSS	g/L		N/A	6.9	N/A	N/A	
Alpha factor	-	N/A	0.49		N/A	N/A	Includes 0.9 fouling factor (for peak and average cases only).
Beta factor	-	N/A	0.95		N/A	N/A	
DO set point	mg/L		DO set points varied diurnally to avoid overaerating during diurnal minimums and to provide additional aeration during peaks. Further detail on the aeration design and modelling will be provided in Rev B of the process modelling report (to be provided following 50% design submission).				
SOTR (swing zone)	kgO_2/h.zone		119		N/A	N/A	
SOTR (total primary aerobic)	kgO_2/h.zone		332		N/A	N/A	Total of primary aerobic zones 1, 2 and 3.
SOTR (secondary aerobic)	kgO_2/h.zone		83		N/A	N/A	
SOTE	%		Varies depending on reactor depth, diffuser density and airflow per diffuser. For preliminary airflow calculation this has been based on the performance curves published for the Xylem Sanitaire Sliver Series II diffuser.				

Parameter	Unit	Peak Demand (standby blower operating)	Peak Demand (all bioreactors online)	Average Demand	Minimum Demand	Comments
Airflow (total)	Nm^3/h		20,900	N/A	N/A	Preliminary numbers. TBC following diffuser procurement. 10% safety factor on peak demand airflow applied. @ 6m water depth.

Table 8.8 4-stage bioreactor blower design summary

Parameter	Unit	Value	Comment
Type	-	Screw or High Speed Turbo	To be confirmed following vendor selection.
Number of blowers	-	4 (3+1) at Stage 1	Will increase to 6 (5+1) at Stage 2, additional 2 blowers required.
Blower motor size	kW	TBC	To be confirmed following vendor selection.

9. Package 4000 – Existing Site, Effluent Balance Tank & Local Outfall

9.1 Package scope

Package 4000 – Existing Site, Effluent Balance Tank & Local Outfall includes the following infrastructure:

- Effluent storage in the new effluent balance tank (EBT),
- Chlorine dosing for biofilm control of existing Blinking Billy Outfall (from existing chlorine gas storage and dosing facility), and
- The Selfs Point Local Outfall (SPLO) under PWWF and rare downstream limiting levels.

9.2 Process description

As a priority, effluent from the MBR permeate tank are discharged to the existing STP chlorine contact tank for pumping via the Blinking Billy Pumping Station to the Blinking Billy Outfall. If effluent flows from the new Bioreactor/MBR process is greater than the capacity of the Blinking Billy pump set (nominally 290l/s) then effluent stored in an 8.5ML Effluent Balance Tank to limit local discharges to the new Selfs Point local outfall under all dry weather conditions and some minor wet weather events.

The new Self Point local outfall is connected to the Effluent Balance Tank overflow line and will operate when the capacity of the balance tank is exceeded. A flow control valve on the MBR permeate line regulates flow between the Effluent Balance Tank and the existing chlorine contact tank which is the extraction point for the Blinking Billy Pumping Station.

The existing chlorine dosing point at the inlet of the existing chlorine contact tank will be maintained in this revised plant configuration to allow secondary disinfection of the Blinking Billy Outfall to control biofilm build-up on this line. The operational control philosophy for the Blinking Billy pump set is to achieve a set level range in the chlorine contact tank and this component of the plant's operation remains unchanged with the STP upgrade.

9.2.1 Effluent storage and outfall

Treated effluent gravitates to the existing Wet Well which serves as the Blinking Billy Outfall (BBO) effluent pump station wet well. A flow/ level control valve targets a preset level in the BBO wet well.

Level control is preferred to minimise the dependence on multiple flow meters, continuous calculations and a "set point" pumpstation capacity.

Surplus 4-stage plant permeate during peak times backs-up, upstream of the control valve and is temporarily stored in the Effluent Balance Tank (EBT) and drawn down later in the day. It is estimated 4 ML of the EBT storage is utilised daily for diurnal flow management.

During dry weather, the total daily effluent from the plant remains below the daily capacity of BBO and hence all flows are discharged via the final effluent wet well.

During wet weather, when the daily flow exceeds the capacity of the BBO, the effluent balance tank completely fills until it discharges excess effluent to the new SPLO. After the wet weather event passes, the residual level in the effluent balance tank is drawn down via the BBO effluent pumps as normal operation resumes.

An emergency, fail-to-closed valve is provided to mitigate the risk of flooding the existing low lying existing Wet Well, Effluent Pumps and Storm Tank area, particularly when the EBT is full. Additional mitigation is provided via engineered overflows to local stormwater, which is oversized to DN600 to maximise the overflow capacity to ~600 L/s (vs 196L/s) in the event of a failed flow control valve and fail-to-closed function, with a full EBT. The intent is to minimize the potential for low area flooding and damage to infrastructure.

The existing chlorine gas system doses chlorine to the inlet of the final effluent wet well. This is retained for biofilm control of the BBO pipeline only, with no changes proposed to the existing chlorine gas system.

If the effluent pumps are offline the control valve will close to store permeate in the EBT.

The control of the BBO effluent pumps is by others, however as the level in the effluent wet well will remain constant, the suggested strategy would be to bring BBO pumps on, as the level in the EBT rises and drop pumps off as it lowers. This “level control” may be via pressure upstream of the control valve, to avoid control complexities when the EBT is by-passed.

9.3 Design basis

9.3.1 Performance and technical requirements

The existing process components are separated as the PWWF differs from that considered for the EBT and Outfall.

The performance and technical requirements for the reconfiguration of the existing process, effluent storage and disinfection, and Selfs Point Local Outfall package are detailed in Table 9.1 to 9.4.

Table 9.1 Effluent Balance Tank technical requirements

Parameter	Unit	Value	Comments
Storage working volume	ML	8.5	Total water volume of 9 ML, during normal operation up to 200mm below the SPLO overflow.
Instrumentation	Level transmitter and high/low level switches		
Freeboard	mm	300	Above max TWL during full by-pass
Overflow to SPLO capacity	L/s	1340	The effluent balance tank and SPLO is designed for the full range of flows, up to the PWWF of 1,340 L/s..
Downstream pipework to Final Effluent Wet Well	L/s	290	Reduced pipe size to “choke” flows in case of failed FCV and reduce fitting sizes/ cost. Fail to close valving included to minimise potential for damage/ local flooding if FCV fails with full EBT.
Emergency failure	L/s	650	In the event the flow control valve, and fail to close valves fail to operate, with a full EBT, the calculated discharge to the Wet well is 650 L/s. The overflow to local SW has been oversized to enable a controlled discharge to the local SW, to reduce the potential for localised flooding.
Additional information	2% fall to floors adopted to aid with drainage during normal EBT draw down, and maintenance cleaning. A central sump was adopted, to minimise the fall required and allow the ring beam and walls to all be the same i.e. for ease and speed of construction. Sump in floor provided to optimise use of the full volume (delayed suction vortexing) and ease of cleaning. Man-catcher grids provided to both the centre well and the SPLO overflow bellmouth. Service water hose reels provided for cleaning.		

Table 9.2 SPLO technical requirements

Parameter	Unit	Value	Comments
PWWF capacity	L/s	1340	PWWF capacity

Table 9.3 Effluent pump station wet well technical requirements

Parameter	Unit	Value	Comments
Design capacity	L/s	290	Maximum pump set capacity.
Additional information	No change to chlorine dosing location		
Instrumentation	Ne chlorine analysers before and after Blinking Billy Pumping Station. Existing level transmitter and low-level switch retained. New flowmeter MBR permeate flowmeter (after the flow control valve) used for flow pacing of the chlorine dose.		

9.4 Design summary

9.4.1 Effluent storage and outfall

9.4.1.1 Final Effluent Wet Well

A new DN450 connection to upstream of the Final Effluent Wet Well is required. The existing chlorine dosing point (into the Final Effluent Wet Well) and system will be retained.

Figure 8 and Figure 9, show the reconfigured arrangement of the existing Final Effluent Wet Well under various flow conditions. Refer to discussion in Section 9.4.2 for explanation of these flow conditions and the SPLO overflow arrangement.

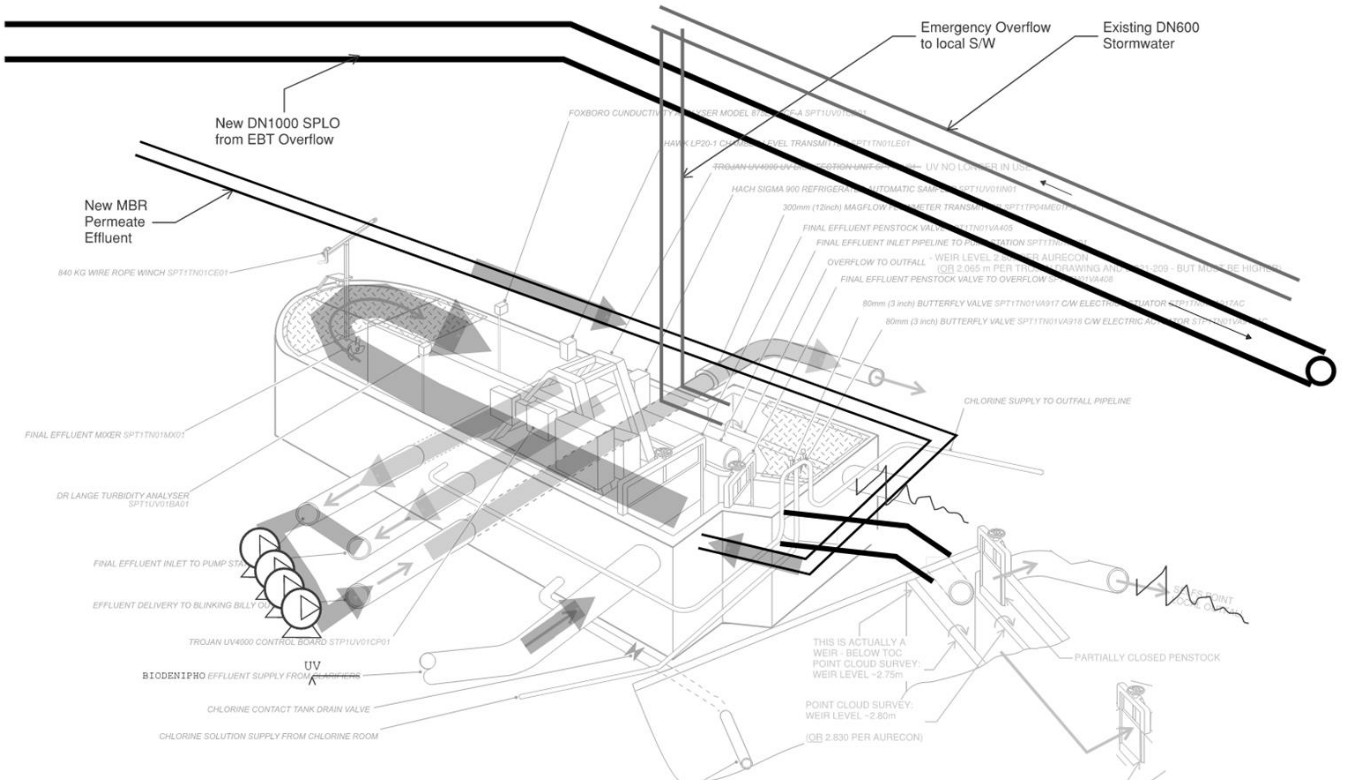


Figure 8 Final Effluent Wet Well flow path during normal operation

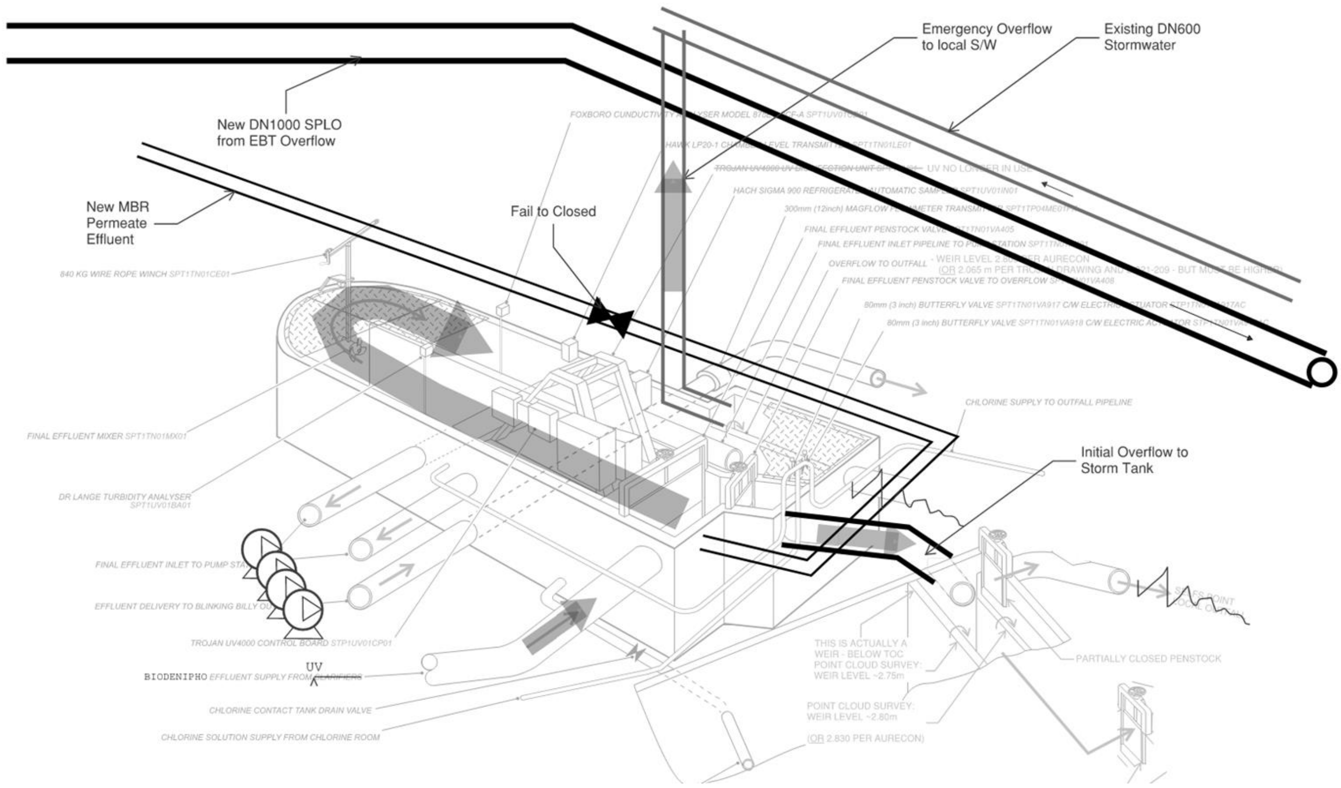
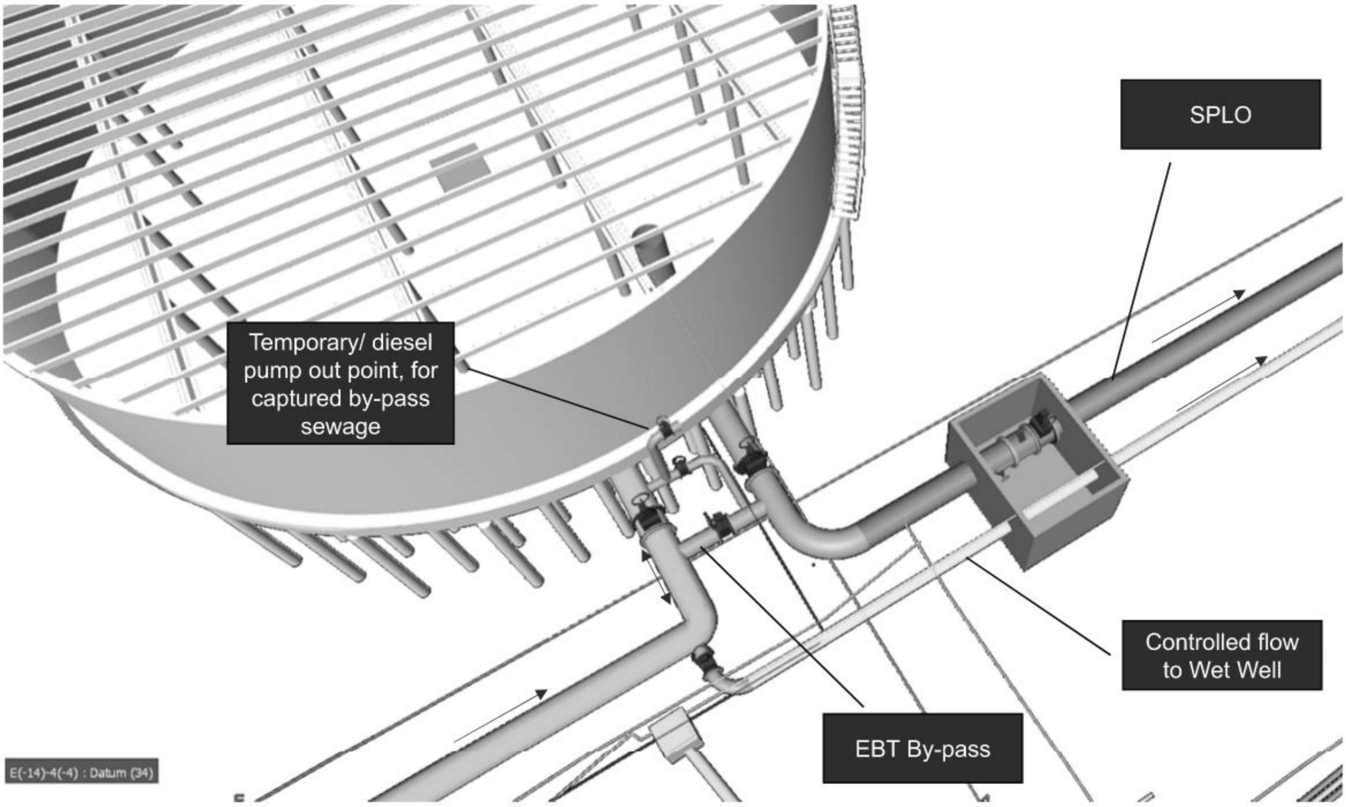


Figure 9 Final Effluent Wet Well emergency overflow to local stormwater

9.4.1.2 Effluent Balance Tank

The Effluent Balance Tank is fitted with a low level drain to enable complete drainage for maintenance requirements. Bulk drainage of the EBT will occur via normal operation of the BBO effluent pumps during low flow periods.



9.4.2 Selfs Point Local Outfall

The key detailed design outputs for the SPLO are detailed in Table 9.4.

Table 9.4 Selfs Point Local Outfall (SPLO) design summary

Parameter	Unit	Value	Comments
Total outfall length	m	1236	
Section 1: EBT to Gas Road	m DN Material Class ID HWC k-value	930 1000 GRP PN10 990 140 5	
Section 2: Gas Road to Offshore start	m DN Material Class ID HWC k-value	60 1000 PE100 PN6 924 140 2	
Section 3: Offshore	m DN Material Class ID HWC k-value	246 1400 PE100 PN10 1233 140 1	

Parameter	Unit	Value	Comments
Outfall depth	mAHD	-7.7	Depth at discharge
Diffuser length	m	50	To be confirmed
Diffuser nominal diameter	mm	1400	Proposed OD1400 PE100
Ports	No.	20	150mm inside diameter

9.4.2.1 SPLO onshore

On the basis that all low-level overflows will be diverted to local stormwater, a new DN1000 outfall is designed from the EBT overflow level to the River Derwent. Exclusion of the low-level overflows, which were hydraulically limiting under certain downstream conditions, enabled the SPLO pipe to be designed at a shallower depth and a positive grade, to a high-point adjacent to the Gas Works. The shallower depth offers significant constructability advantages, including; less groundwater management, rock excavation and excavated material management.

Due to limited space the design alignment the existing outfall from chainage 158m to 264m, out of the existing STP access road, and the first section on Selfs Point Road. From chainage 264m the alignment is on the southern half of Selfs Point road, to minimise interactions with existing services and enabling single lane access to be maintained during construction.

9.4.2.2 SPLO offshore

The SPLO will be installed in the Derwent and will include a series of diffusers to achieve the required mixing. The offshore diffuser design is an output from the diffuser and dilution modelling undertaken by Bonneville Consulting (BC) in 2022. The design includes a approximately 20 150mm ID ports with a vertical angle of 45° spaced at 5m intervals, with 10 north and 10 south facing parts. A 1400DN SDR 21 PE pipe is proposed for the offshore section. The pipeline will be sunk onto the sea floor using precast concrete collars spaced at 5 to 6m intervals.

10. Package 5000 – Sludge Treatment & Tankered Waste

10.1 Package scope

Package 5000 – Sludge Treatment & Tankered Waste includes the following infrastructure:

- Tankered waste receival and screening system,
- WAS thickening and balancing,
- Primary sludge thickening and balancing,
- Recuperative thickening,
- Anaerobic digesters, including sludge recirculation, transfer pumps, digester mixing and digester heating,
- Biogas storage, flare and blowers,
- Cogeneration system,
- Digested sludge balancing storage and dewatering,
- Dewatered sludge storage and outloading, and
- Polymer dosing for all thickening and dewatering systems.

10.2 Process description

10.2.1 Tankered waste receival

The tankered waste receival station is required to accept, screen, buffer and heat tankered waste imported to the site prior to anaerobic digestion.

Tankers enter the site and unload waste via a camlock connection. The tankered waste is macerated and pumped (using duty/standby macerators followed by duty/standby unloading pumps) through 2 no. rotary drum screens (also operating in duty/standby). Screening is required to remove any debris that may be present in the tankered waste.

The screened waste discharges via gravity to two adjacent holding/balancing tanks. The holding tanks are above-ground, cylindrical, fully enclosed, fabricated stainless steel tanks with a conical bottom and clad with insulation, operating in a duty/duty arrangement.

The contents of the holding tanks are heated using a common heat exchanger. Each tank has a dedicated dry mounted recirculation pump which transfers the tankered waste through the heat exchanger. Hot water for the heat exchanger is supplied by the digester hot water loop. The holding tank heating circuit is also used to provide pumped mixing for the tanks.

Two dry mounted transfer pumps (operating duty/standby) are shared between the two holding tanks to transfer the tankered waste to the digesters. The tankered waste is split between both digesters when operating in parallel mode (sequentially feeding an equal volume to each), where it is discharged downstream of the digester heat exchangers and blended in-pipe with the recirculated digested sludge. When the digesters are operating in series mode, the tankered waste is fed to the primary digester.

10.2.2 Sludge thickening

Thickening of primary sludge (PS), waste activated sludge (WAS) and recuperative thickening of digested sludge is provided in the sludge handling building.

PS and scum is pumped to the PS feed averaging tank (FAT) from Package 2000. Sludge is pumped from the PS FAT and mixed with polymer in a flocculator prior to gravity feeding to a rotary drum thickeners (RDTs).

WAS and scum is pumped from the 4 stage bioreactor/MBR in Package and mixed with polymer (Section 8.2.6) in a flocculator prior to gravity feeding into the selected RDT.

Digester sludge is pumped from either digester to a flocculator for mixing with polymer (Section 8.2.6) prior to gravity feeding to a single RDT for recuperative thickening (RT). The redundancy philosophy for the RDTs is to have common spares shared across the three thickening process streams. As a result the three duty RDTs have 2 standby units and any RDT unit can be selected for PS, Recup of WAS thickening.

Filtrate from all RDTs flows by gravity to the general purpose pumping station (GPPS) in Package 1000.

Thickened sludge from each RDT drops under gravity into a dedicated hopper and is subsequently pumped to the digesters. Under normal operation when the digesters are operating in parallel mode, the thickened PS (TPS) and thickened WAS (TWAS) streams are split evenly between the digesters, while RT sludge is returned to the source digester. In series mode, TPS and TWAS are pumped to the primary digester only, while RTS is sourced from the secondary digester and returned to the primary digester.

During maintenance scenarios, when one digester is offline, the standby PS RDT will operate as an assist RT RDT to meet the required recuperative thickening loads.

10.2.3 Anaerobic digesters

Anaerobic digesters (2 no.) stabilise sludge generated at the STP and treat the tankered waste imported to site. The anaerobic digesters stabilise the biodegradable portion of PS, WAS, scum and tankered waste in the absence of oxygen. The digesters have the flexibility to operate in parallel (primary operation mode) or in series. When operated in series, only Digester 1 is able to operate as the primary digester.

10.2.3.1 Digested sludge recirculation and heat exchanges

Digested sludge is recirculated from the digesters to the pipework feeding the heat exchangers. When the digesters are operating in parallel, each digester has a dedicated heat exchanger, plus a common standby heat exchanger. When operating in series, Digester 1 has a duty/assist heat exchanger and Digester 2 a duty only heat exchanger.

There are four heat exchanger feed pumps shared between the three heat exchangers (operating duty/duty/assist/standby). Each heat exchanger is fed from a common pump discharge header and can therefore be fed by any of the four feed pumps, except where it would conflict with the flow path of an adjacent heat exchanger. The thickened sludges and the tankered waste are blended with the heated recirculated digested sludge downstream of the heat exchangers.

10.2.3.2 Digested sludge mixing

Separate to the digested sludge recirculation and heating, sludge is also to be pumped from various levels within the digester through the mixing pumps and into the mixing system within the digester. The mixing system is a vendor design which has not been detailed at this stage of design. Each digester has two dedicated mixing pumps (operating duty/standby).

10.2.3.3 Digester 2 transfer and dewatering feed pumps

One Digester 1 to 2 transfer pump and one dewatering feed pump also draw off the digesters. These pumps are typically each operated as duty only, with a cross connection to allow each pump to pull from either digester. The Digester 1 to 2 transfer pump transfers partially digested sludge from Digester 1 to Digester 2 when the digesters are operating in series or product sludge to the digested sludge FAT in parallel operation. The dewatering feed pump transfers digested sludge from Digester 2 to the dewatering system.

10.2.4 Biogas and heating systems

Biogas is produced in the anaerobic digesters due to the degradation of organic material. The biogas contains a significant portion of methane, providing a source of energy for heating and electricity production at the site.

Biogas is stored in the headspace under the floating roofs on top of each digester. Biogas produced from the digestion process is drawn off from the headspace in Digesters 1 and 2. The biogas lines from each digester are connected so that both digesters are operating at the same pressure.

The produced biogas is collected in a header and transferred via 2 no. biogas blowers (operating duty/standby) to the hot water heaters and cogeneration system. A candlestick flare is used for emergency relief or when there is excess biogas.

Biogas requires treatment to remove free water, hydrogen sulfide and particulates prior to the hot water heaters and cogeneration. As the biogas is saturated, liquids drop out of the gas as it flows through the biogas piping system and its pressure and temperature decreases. Condensate and sediment traps are provided at points throughout the system where liquid accumulates, to mitigate corrosion and equipment damage. Two duty/standby activated carbon filters are provided upstream of the cogeneration system to remove H_2S and siloxanes from the gas prior to combustion.

The co-generation engine and the hot water heaters produce hot water that is used for heating the sludge in the digesters and the tanked waste. This maintains the digester's sludge temperature at approximately 38°C. There are two hot water heaters (duty/standby), both fitted with dual-fired burners capable of burning biogas or natural gas. A natural gas connection from the gas main on Selfs Point Road is provided to supply pilot flames and back-up gas for heating.

10.2.5 Dewatering and outloading

Digested sludge is pumped from the digesters to the digested sludge FAT. The sludge is then mixed with polymer (Section 8.2.6) and pumped to duty/standby centrifuges for dewatering.

Dewatered sludge drops under gravity onto a horizontal conveyor located directly under the centrifuges and transferred to another horizontal conveyor which transfers to the receiving outloading bins.

Centrate from the centrifuges flows by gravity to the general purpose pumping station (GPPS) in Package 1000.

Polymer is dosed to the feed of each centrifuge. Polymer batching and dosing is discussed in Section 10.2.6.

10.2.6 Polymer dosing

Three new powdered polymer batching and dosing systems are provided for the thickening and dewatering systems. Systems capable of handling powdered polymer primarily and liquid polymer as a backup are provided. The required dose rate per tonne of dry solids is subject to thickening and dewatering vendor performance guarantees.

A separate polymer system is provided for each sludge type, this being:

– One system for PS and recuperative thickening processes,
– One system for WAS thickening, and
– One system for digested sludge dewatering.

10.3 Design basis

10.3.1 Redundancy

Equipment and process redundancy for the sludge treatment and tankered waste package are detailed in Table 10.1.

Table 10.1 Package 5000 redundancy requirements

Major process unit	Configuration	Comments
Tankered waste screen	N+1	
Tankered waste holding tank	N+1	Each tank sized for storage capacity for one day of average tankered waste volume.
Tankered waste transfer pumps (to digester)	N+1	
Tankered waste recirculation pumps (heat exchanger feed and mixing)	N+1	
Tankered waste heat exchanger	N	
Thickening and dewatering	N – with common shared spares (thickening) N+1 (dewatering)	All thickening and dewatering units will aim to be designed for maximum 16 hrs operation per day, 5 days a week operation with all units operating. Actual operating hours are expected to be different. Extended operational hours will be permitted with one unit off-line. Further detail or changes to this will be provided in design development. Two common spares shared across the three RDT duty units.
Thickening and dewatering feed pumps	N+1	Per thickening or dewatering system, i.e. one feed pump per thickening and dewatering unit.
Thickened sludge pumps	N	One per thickener unit
Dewatered sludge conveyor	N	
Dewatered sludge bins	N+1	To allow for instance that one bin is removed from site for unloading. Space allowance to be made for additional bin volume required if dewatered biosolids bulk density (when discharged to bin) is 700 kg/m^3.
Polymer powder storage	N per system	Allowance for 28 days storage at average usage
FAT mixing	N	
Digestion	N+1	Maintain 15 day SRT with one digester offline, peak month load, 4.5% digestate TSR and 90% effective volume
Digester mixing pumps	N+1	Per digester
Digester heat exchanger feed pumps	N+1	Common standby between 3 no. heat exchangers
Digester heat exchangers	N+1 (parallel) N (series)	3 no. heat exchangers
Digester 1 to 2 transfer pumps	N	Cross connection allows dewatering feed pump to be used as a standby
Dewatering feed pumps	N	Cross connection allows Digester 1 to 2 transfer pump to be used as a standby
Biogas blowers	N+1	
Hot water heaters	N+1	Dual fuel burners (biogas and natural gas)
Hot water pumps	N+1	
Hot water shunt pumps	N+1	
Biogas flare	N	Sized for peak instantaneous biogas production plus 20% (and no hot water heater and cogen use)
Cogeneration engine	N	Duty only

10.3.2 Performance and technical requirements

The performance and technical requirements for the sludge treatment and tankered waste are detailed in Table 10.2 through Table 10.8.

Table 10.2 Tankered waste technical requirements

Parameter	Unit	Value	Comments
Volume per tanker	kL	10 – 20	
Maximum no. tankers per day	-	5	
Maximum no. tankers per hour	-	1	
Minimum unloading time	min	15	
Drum screen			
Screen type	Drum screen		
Tankered waste flow to drum screen	L/s	23	Allowance for 20 kL tanker unloading waste over a 15 minute duration.
Screen perforation diameter	mm	6	
Holding tank			
Tankered waste holding tank retention time	d	1	Including allowance for inlet screens flushing water
Heat exchangers			
Tankered waste received temperature (minimum)	ºC	12	Aligns with raw sewage
Tankered waste received temperature (maximum)	ºC	22	Aligns with raw sewage
Tankered waste target temperature	ºC	40	
Other requirements			
Hot water flush	TBD based on further design development		
Odour treatment	Storage tank to be fully enclosed and vented to the odour control system		

Table 10.3 WAS thickening technical requirements

Parameter	Unit	Value	Comments
Thickener type		Rotary drum thickeners (RDTs)	
Target thickened WAS (TWAS) TSR	%DS	4	Minimum
WAS FAT detention time (min)	h	4	2054 average loads
De-rating factor	%	75	i.e. RDTs can be run at a maximum of 75% of their name plate capacity
Maximum run time (basis of sizing)	h/d	16	With all bioreactors online. Increased run time acceptable if bioreactor is offline and SRT is reduced. Actual operating hours are expected to be different. Further detail or changes to this will be provided in the design report.
	d/week	5	
Solids capture (minimum)	%	95	Will be compared against vendor guarantees during design development.
Minimum instrument requirements	Flowmeter, TSS analyser and pressure sensors		

Table 10.4 Primary sludge thickening technical requirements

Parameter	Unit	Value	Comments
Thickener type		RDTs	
Thickened PS TSR	%DS	6 - 9	Design to enable thickened primary sludge at up to 9% DS to be successfully pumped to the digesters
PS FAT detention time (min)	h	6	2054 average loads
De-rating factor	%	75	i.e. RDTs can be run at a maximum of 75% of their name plate capacity
Maximum run time	h	16	Actual operating hours are expected to be different. Further detail or changes to this will be provided in the design report.
	d/week	5	
Solids capture (minimum)	%	95	Will be compared against vendor guarantees during design development.
Minimum instrument requirements	Flowmeter, TSS analyser and pressure sensors		

Table 10.5 Recuperative thickening technical requirements

Parameter	Unit	Value	Comments
Thickener type		RDTs	
RT sludge TSR	%DS	6 - 9	Design to enable thickened sludge at up to 9% DS to be successfully pumped to the digesters
De-rating factor	%	75	i.e. RDTs can be run at a maximum of 75% of their name plate capacity
Maximum run time	h	16	Actual operating hours are expected to be different. Further detail or changes to this will be provided in the design report.
	d/week	5	
Solids capture	%	95	Reduced from 98% used in concept design. Will be compared against vendor guarantees during design development.
Minimum instrument requirements	Flowmeter, TSS analyser and pressure sensors		

Table 10.6 Anaerobic digestion technical requirements

Parameter	Unit	Value	Comments
VSS:TSS ratio in TWAS	%VS	83 66	4 stage bioreactor WAS
Volatile solids destruction of TWAS	%VSD	28	
VSS:TSS ratio in TPS	%VS	93	
Volatile solids destruction of TPS	%VSD	63	
VSS:TSS ratio in tankered waste	%VS	73	
Volatile solids destruction of tankered waste	%VSD	50	
Biogas production rate	m3 biogas produced / kg VS destroyed	0.95	
Digesters			
Minimum SRT	days	15	
Maximum digester solids concentration	%DS	4.5%	Maximum to enable mixing, subject to rheological testing.

Parameter	Unit	Value	Comments
Digester effective volume	%	90	
Volatile solids reduction (min – max)	%	45 - 50	Change from project specification (0089-SPC-SELST01-DE-0001) – specified range
Peak month solids factor	To be calculated from peak month WWTP feed loading rather than explicit peak month solids factor		
Digester operation	Batch transfer. Each digester fed and transfers to dewatering FAT sequentially.		
Minimum instrument requirements	Sludge: Level, temperature, pH Biogas: Level, pressure Floating roof: Service water level		
Sludge recirculation and heating			
Digested sludge recirculation ratio	To be calculated based on digester heating requirements and heat exchanger design		
Digester mixing			
Mixing requirements	Mixing system will be designed to provide effective mixing in anaerobic digesters and achieve the digester effective volume requirement listed above.		
Mixing type	Pumped		
Digester 1 to 2 transfer			
Digester operation	The digesters have the flexibility to operate in parallel (primary operation mode) or in series. When operated in series, only Digester 1 is able to operate as the primary digester.		

Table 10.7 Biogas and heating systems technical requirements

Parameter	Unit	Value	Comments
Biogas general			
Peak biogas production	2054 peak month PS and WAS loads, coinciding with a day where all tanker deliveries are high strength trade waste[3]		
Methane concentration	%	63	60 – 65% to be considered as a sensitivity analysis
Methane lower heating value	MJ/Nm^3	35.7	
Biogas capture	%	TBC with vendors	Includes digesters and all biogas pipework and handling equipment
Flare efficiency	%	TBC with vendors	
Biogas treatment	TBC if required by biogas heater and cogeneration vendors. Duty/standby activated carbon filters allowed for on cogeneration feed in the site layout.		
Biogas storage			
Storage type	Floating roof gas holder on top of digesters with water seal		
Pressure	kPag	3	
Vacuum	kPag	0.24	

[3] High strength trade waste has been interpreted as peak month tankered waste loads (i.e. 1.2 times the average)

Parameter	Unit	Value	Comments
Safety zone	m	5	No smoking, open light, fire and storage of flammable materials in this area. Safety zone distance and requirements to be confirmed through hazardous area assessment during design.
Pressure relief valves	2 no. minimum		
Biogas flare			
Exclusion zone	7.5m from the road and 15m from digesters (as per AS3184)		
Flare type	Candlestick		
Digester heat exchangers			
Heat exchanger duty (per heat exchanger)	kW	330	Three heat exchangers, one per digester plus one standby (assist in series operation)
Digester feed waste temperature (winter)	°C	PS: 12 4SB WAS: 15 Tankered waste: 12	
Digester feed waste temperature (summer)	°C	PS: 22 4SB WAS: 25 Tankered waste: 22	
Ambient temperature (winter)	°C	4.1	Lowest mean winter temp from BoM data.
Ambient temperature (summer)	°C	32.6	Highest mean summer temp from BoM data.
Ground temperature (winter)	°C	5.5	Assumed as average minimum winter temp from BoM data
Ground temperature (summer)	°C	22.6	Assumed as average maximum summer temp from BoM data
Design operating temperature (typical)	°C	38	
Digester operating temperature (minimum)	°C	35	
Hot water heaters			
Type	Dual fired (biogas and natural gas)		
Hot water heater duty	kW	600	Sized to maintain <0.5°C temperature variation within the digesters under 2054 peak month loading conditions on the coldest day in winter when the cogeneration unit is offline.
Cogeneration			

Parameter	Unit	Value	Comments
Maximum recoverable thermal output	kW	530	Sized to maintain maximum 0.5°C temperature variation within the digesters under 2054 peak month loading conditions on the coldest day in winter while maximising turndown capability.
Cogeneration thermal efficiency	%	>40	Gross thermal efficiency
Instrumentation	Biogas analyser for CH_4, H_2S, O_2 and CO_2		
Activated carbon filters	To provide pre-treatment of biogas to meet feed gas quality requirements as specified by the CHP vendor (TBC with vendors)		

Table 10.8 Dewatering and outloading technical requirements

Parameter	Unit	Value	Comments
Digested sludge			
Digested sludge FAT retention time (min)	h	7	2054 average loads
Dewatering			
De-rating factor	%	75	i.e. Centrifuges can be run at a maximum of 75% of their name plate capacity
Maximum run time	h/d	12	Actual operating hours are expected to be different. Further detail or changes to this will be provided in the design report.
	d/week	5	
Centrifuge redundancy		N+1	During peak load with one unit offline
Solids capture	%	95	Reduced from 98% used in concept design. Will be compared against vendor guarantees during design development.
Biosolids TSR	%	>22	
Minimum instrument requirements	Flowmeter, TSS analyser and pressure sensors		
Storage and outloading			
Peak dewatered biosolids load	At peak digested sludge load – TBD		
Dewatered biosolids bulk density	kg/m^3	Maximum: 1080 Minimum: 700	
Horizontal conveyors	Type	Belt or screw	Horizontal screw conveyers may be used for loading bins

Table 10.9 Polymer dosing technical requirements

Polymer		
Arrangement	WAS thickening	Separate polymer batching and dosing system required for WAS
	Primary sludge thickening	Combined polymer batching and dosing system with recuperative thickening
	Recuperative thickening	Combined polymer batching and dosing system with primary sludge thickening
	Dewatering	Separate polymer batching and dosing system adopted

Polymer	
Polymer type	Normally run on powdered polymer from bulky bags, with flexibility provided to connect a liquid IBC if required
Polymer dose rate	As required to achieve specified %DS for each sludge type
Mixing	Polymer to be dosed directly into unthickened sludge line, then mixed in a flocculator

10.4 Design summary

The key detailed design outputs for the sludge treatment and tankered waste package are detailed in Table 10.10 through Table 10.17.

Table 10.10 Tankered waste design summary

Parameter	Unit	Value	Comments
Drum screen			
Number of screens	No.	2	
Drum screen duty	L/s	23	Allows for one 20 kL tanker to unload waste over a 15 minute duration
Perforation	mm	6	
Screenings capture rate	%	85	
Screenings bin			
Number of screenings bins	No.	1	
Total bin volume	m^3	10	
Usable bin volume	m^3	4.7	Based on advice from Spirotainer® and assumed angle of repose of 40 degrees for screenings.
Maximum fill weight of bin	tonne	11	Based on Spirotainer® 10 m^3 bin. Note that the bin will be limited by the usable volume before reaching the maximum weight limit of the bin. CDO to confirm if there is a weight limit for their waste contractor.
Total volume of discharged screenings	wet tonnes/ML	130	
	L/d	7	Assuming bulk density of discharged screenings of 800 kg/m^3
Time to fill bin	days	35	Based on standard 240 L bin
Holding tank			
Number of holding tanks	No.	2	
Tankered waste holding tank (active volume) per tank	m^3	50	Sized to hold a day of tankered waste (average flows) plus drum screen service water plus 15% contingency
Heat exchanger			
Number of recirculation pumps (heat exchanger feed)	No.	1	
Recirculation pump duty	L/s	16	
Number of heat exchangers	No.	1	
Heat exchanger duty	kW	90	At 40C cold side inlet temperature
Hot water flow requirement	L/s	4.4	

Parameter	Unit	Value	Comments
Transfer pumps			
Number of tankered waste transfer pumps	No.	2	Duty/standby operation
Tankered waste transfer pump duty	L/s	5	

Table 10.11 WAS thickening design summary

Parameter	Unit	Value	Comments
WAS flow (average)	kL/d	700	4 stage bioreactor wasting from oxidation ditch. Numbers presented are based on alum dosing to bioreactor scenario.
WAS solids load (average)	kg DS/d	3967	
WAS flow (peak)	kL/d	700	
WAS solids load (peak)	kg DS/d	5388	
Design hydraulic loading rate (peak)	kL/hr	62	Based on operating hours nominated in design basis
Design solids loading rate (peak)	kg DS/hr	472	Based on operating hours nominated in design basis
Feed solids range	%DS	0.5 – 0.8	
WAS RDT sizing			
Number of WAS RDTs	No.	2	4 stage bioreactor WAS for Stage 1
Number of duty WAS RDTs	No.	1	
Maximum HLR	kL/hr	70	
Maximum SLR	kg DS/hr	400	
Derated maximum HLR	kL/hr	52.5	
Derated maximum SLR	kg DS/hr	300	
Limiting criteria	-	SLR	
Number of WAS RDT feed pumps	No.	2	One duty per RDT with cross connection
WAS RDT feed pump duty flow	L/s	20	Capable of feeding RDTs at nameplate HLR Pipework to be designed to be capable of pumping 40 L/s WAS for the instance that both WAS RDTs are operated in duty/duty mode.
Number TWAS pumps per RDT unit	No.	1	Dedicated pump per thickened sludge hopper. No cross connection available.
TWAS pump duty flow	L/s	4	Capable of pumping TWAS at 4 %DS when RDT is operated at maximum loading.

Table 10.12 Primary sludge thickening design summary

Parameter	Unit	Value	Comments
PS flow (average)	kL/d	241	
PS solids load (average)	kg DS/d	4810	
PS flow (peak)	kL/d	289	

Parameter	Unit	Value	Comments
PS solids load (peak)	kg DS/d	5772	
Design hydraulic loading rate	kL/hr	25	Based on operating hours nominated in design basis
Design solids loading rate	kg DS/hr	505	Based on operating hours nominated in design basis
Feed solids range	%DS	2 – 2.5	
Active volume	kL		
Number of PS RDTs	No.	2	
Number of duty PS RDTs	No.	1	
Maximum HLR	kL/hr	70	Alfa Laval G3 Mega RDT
Maximum SLR	kg/hr	400	Alfa Laval G3 Mega RDT
Derated maximum HLR	kL/hr	52.5	Alfa Laval G3 Mega RDT
Derated maximum SLR	kg DS/hr	750	Alfa Laval G3 Mega RDT
Limiting criteria	-	SLR	
Number of PS RDT feed pumps	No.	2	One duty per RDT with cross connection
PS RDT feed pump duty flow	L/s	20	Capable of feeding RDTs at nameplate HLR Pipework to be designed to be capable of pumping 40 L/s PS for the instance that both PS RDTs are operated in duty/duty mode.
Number TPS pumps per RDT unit	No.	1	Dedicated pump per thickened sludge hopper. No cross connection available.
TPS pump duty flow	L/s	6.5	Capable of pumping TPS at 9 %DS when RDT is operated at maximum loading.

Table 10.13 Recuperative thickening design summary

Parameter	Unit	Value	Comments
RT flow (average)	kL/d	10	All digesters online
		222	One digester offline
RT solids load (average)	kg DS/d	256	All digesters online
		8450	One digester offline
RT flow (peak)	kL/d	125	All digesters online
		600	One digester offline
RT solids load (peak)	kg DS/d	3984	All digesters online
		27580	One digester offline
Design hydraulic loading rate (peak, one digester offline)	kL/hr	52.5	Based on operating hours nominated in design basis
Design solids loading rate (peak, one digester offline)	kg DS/hr	2413	Based on operating hours nominated in design basis
Feed solids range	%DS	2.7 – 4.6	
Number of RT RDTs	No.	1	

Parameter	Unit	Value	Comments
Number of duty RDTs	No.	1	Standby primary sludge unit required to operate as a recuperative thickener when one digester is offline
Maximum HLR	kL/hr	70	Alfa Laval G3 Mega RDT
Maximum SLR	kg/hr	800	Alfa Laval G3 Mega RDT
Derated maximum HLR	kL/hr	52.5	Alfa Laval G3 Mega RDT
Derated maximum SLR	kg DS/hr	600	Alfa Laval G3 Mega RDT
Limiting criteria	-	SLR	
Number of RT RDT feed pumps	No.	2	
RT RDT feed pump duty flow	L/s	20	Capable of feeding RDT at nameplate HLR
Number RTS pumps per RDT unit	No.	1	Dedicated pump per thickened sludge hopper. No cross connection available.
RTS pump duty flow	L/s	15	Capable of pumping RTS at 6 %DS when RDT is operated at maximum loading.

Table 10.14 Anaerobic digestion design summary

Parameter	Unit	Value	Comments
Digesters			
Number of digesters	No.	2	
Total volume (per digester)	ML	2.5	Liquid volume only
Active volume (per digester)	ML	2.3	
Active volume (total)	ML	4.6	
Digester diameter	m	16.5	Per digester Internal diameter
Digester height (active)	m	10.6	
Digester height (total; sidewall)	m	13.6	
Diameter to height ratio	-	1.2	Based on total height
Solids retention time	days	>15	
Digester mixing			
Digester mixing pumps	No.	4	Duty/standby pumps per digester
Digester mixing pump duty	L/s	TBD	Subject to rheological testing and vendor design
Digester solids concentration range	%DS	<4	Higher solids concentration (up to 4.6 %DS) to be discussed with mixing vendors
Tank turnover	No. per hour	TBD	Subject to rheological testing and vendor design
Mixing nozzles per digester	No.	TBD	Subject to rheological testing and vendor design
Digester 1 to 2 transfer pumps			
Digester 1 to 2 transfer pumps	No.	1	

Parameter	Unit	Value	Comments
Digester 1 to 2 transfer pump duty	L/s	11.7	To be sized to accommodate dewatering feed duty as well
Dewatering feed pumps			
Dewatering feed pumps	No.	1	
Dewatering feed pump duty	L/s	8.9	To be sized to accommodate Digester 1 to 2 transfer duty as well

Table 10.15 Biogas and heating systems design summary

Parameter	Unit	Value	Comments
Biogas			
Biogas production (peak day)	Nm^3/d	5388	Includes 20% safety factor
Biogas production (peak instantaneous)	Nm^3/hr	273	Includes 20% safety factor
Biogas treatment units	No. Type	2 Activated carbon	Duty/standby TBC required by biogas heater and cogeneration vendors. Currently located upstream of cogeneration unit.
Number of biogas flares	No.	1	Duty only
Biogas flare capacity	Nm^3/d	273	Sized for peak biogas production plus 20% (and no hot water heater and cogen use)
Digester heat exchangers			
Heat exchanger feed pumps	No.	4	
Heat exchanger feed pumps duty flow (per pump)	L/s	25	
Number of heat exchangers	No.	2	
Heat exchanger duty (per heat exchanger)	kW	330	
Heat exchanger peak hot water flow requirement (per heat exchanger)	L/s	16	
Hot water heaters			
Number of hot water heaters	No.	2	Dual fired burners with biogas and natural gas Duty/standby
Heater efficiency	%	85	Subject to vendor confirmation
Heater duty (per heater)	kWt	600	
Hot water heater flow capacity (peak) (per heater)	L/s	41	
Cogeneration			
Number of cogeneration units	No.	1	
Cogen duty	kWt kWe	526 550	At 100% load

Table 10.16 Dewatering and outloading design summary

Parameter	Unit	Value	Comments
Digested sludge flow (average)	kL/d	211	

Parameter	Unit	Value	Comments
Digested sludge solids load (average)	kg DS/d	5403	
Digested sludge flow (peak)	kL/d	213	
Digested sludge solids load (peak)	kg DS/d	6787	
Design hydraulic loading rate (peak)	kL/hr	24.8	Based on operating hours nominated in design basis
Design solids loading rate (peak)	kg DS/hr	791	Based on operating hours nominated in design basis
Feed solids range	%DS	2.4 – 4.6	
Active volume	kL		
Number of centrifuges	No.	2	
Number of duty centrifuges	No.	1	
Maximum HLR	kL/hr	25	
Maximum SLR	kg/hr	1200	
Derated maximum HLR	kL/hr	18.8.5	
Derated maximum SLR	kg DS/hr	900	
Limiting criteria	-	HLR	
Number of centrifuge feed pumps	No.	2	One duty per centrifuge with cross connection
Centrifuge feed pump duty flow	L/s	7	Capable of feeding centrifuges at nameplate HLR Pipework to be designed to be capable of pumping 14 L/s for the instance that both centrifuges are operated in duty/duty mode.
Dewatered biosolids TSR	%DS	22	
Dewatered biosolids load (peak)	kg/hr	1091	
Number of conveyors	No.	1	
Required conveyor capacity	m^3/hr	14.2	At dewatered biosolids TSR of 22 %DS, minimum biosolids density of 700 kg/m^3 and allowing for both centrifuges to be running
Number of biosolids storage bins	No.	4	Duty/duty/duty/standby
Bin capacity (active)	m^3	54	20 m^3 per bin with 30 degree angle of repose considered Three bins will need to be emptied per day at minimum density. During the concept design TasWater estimated that bins could be removed from site for up to four hours and therefore a fourth bin may be necessary.

Table 10.17 Polymer design summary

Parameter	Unit	Value	Comments
WAS thickening			

Parameter	Unit	Value	Comments
Polymer type	-	Powder	
Polymer dose rate for WAS thickening	kg/t DS	6	
Polymer make-up concentration	% w/w	0.25 – 0.5	Polymer dilution water calcs allow for dilution of polymer from 0.5% to 0.25%
Polymer dosing concentration	% w/w	0.25	
Minimum storage hopper volume	kL	1.2	Provides approx. 28 days storage at 2054 average demand. Assumes polymer density of 600 kg/m^3.
Minimum make-up tank volume	kL	3	Allows sufficient number of batches to be prepared each day to meet capacity of 2 no. WAS RDTs at maximum derated SLR
Minimum dosing tank volume	kL	3	Allows new batch to be prepared before dosing tank is drained
Polymer requirement (peak)	kg active polymer per day	86.4	
	L/hr	2880	At make-up concentration
Number of transfer pumps	No.	2	Duty/standby
Transfer pumps duty flow	L/s	3.3	TBC pending vendor design
Number of dosing pumps	No.	2	Duty/standby
Dosing pumps duty flow	L/hr	1500	TBC pending vendor design
Make-up water flow	L/s	1.7	
Dilution water flow	L/hr	1440	
PS thickening & recuperative thickening			
Polymer type	-	Powder	
Polymer dose rate for PS thickening	kg/t DS	6	
Polymer dose rate for recuperative thickening	kg/t DS	5	
Polymer make-up concentration	% w/w	0.25 – 0.5	Polymer dilution water calcs allow for dilution of polymer from 0.5% to 0.25%
Polymer dosing concentration	% w/w	0.25	
Minimum storage hopper volume	kL	1.5	Provides approx. 28 days storage at 2054 average demand. Assumes polymer density of 600 kg/m^3.
Minimum make-up tank volume	kL	9	Allows sufficient number of batches to be prepared each day to meet capacity of 1 no. PS RDT at maximum derated SLR and 2 no. RT RDTs at maximum derated SLR
Minimum dosing tank volume	kL	9	Allows new batch to be prepared before dosing tank is drained
Polymer requirement (peak)	kg active polymer per day	252.0	
	L/hr	8400	At make-up concentration
Number of transfer pumps	No.	2	Duty/standby
Transfer pumps duty flow	L/s	10.0	TBC pending vendor design
Number of dosing pumps	No.	2	Duty/standby

Parameter	Unit	Value	Comments
Dosing pumps duty flow	L/hr	4200	TBC pending vendor design
Make-up water flow	L/s	5.0	
Dilution water flow	L/hr	4200	
Dewatering			
Polymer type	-	Powder	
Polymer dose rate for dewatering thickening	kg/t DS	10	
Polymer make-up concentration	% w/w	0.25 – 0.5	Polymer dilution water calcs allow for dilution of polymer from 0.5% to 0.25%
Polymer dosing concentration	% w/w	0.25	
Minimum storage hopper volume	kL	2.5	Provides approx. 28 days storage at 2054 average demand. Assumes polymer density of 600 kg/m^3.
Minimum make-up tank volume	kL	15	Allows sufficient number of batches to be prepared each day to meet capacity of 2 no. centrifuge at maximum SLR
Minimum dosing tank volume	kL	15	Allows new batch to be prepared before dosing tank is drained
Polymer requirement (peak)	kg active polymer per day	432	
	L/hr	14400	At make-up concentration
Number of transfer pumps	No.	2	Duty/standby
Transfer pumps duty flow	L/s	16.7	TBC pending vendor design
Number of dosing pumps	No.	2	Duty/standby
Dosing pumps duty flow	L/hr	7200	TBC pending vendor design
Make-up water flow	L/s	8.3	
Dilution water flow	L/hr	7200	

11. Package 6000 – Chemicals & Odour

11.1 Package scope

Package 6000 – Chemicals & Odour includes the following infrastructure:

- Chemical storage and dosing systems for the following chemicals:
  - Alum dosing for chemical phosphorus removal and enhanced PST performance,
  - Caustic soda for pH correction,
  - Membrane clean-in-place chemicals sodium hypochlorite and citric acid,
  - Methanol or ethanol (to be confirmed, provisional only, not currently in scope) as a source of carbon,
- Odour control system including foul air extraction and ductwork

11.2 Process description

11.2.1 Chemical storage and dosing

New chemical storage and dosing systems are provided for the new treatment processes to meet effluent quality and process performance targets. The new chemical systems are aluminium sulphate (alum) for phosphorus removal and PST performance improvement, caustic soda for alkalinity addition and sodium hypochlorite (hypo) and citric acid for the MBR clean in place (CIP) system. Provision is also made for the inclusion of ethanol storage and dosing for external carbon addition if required.

Storage tanks for alum, caustic, hypo and citric are located in separate chemical storage bunds, co-located in a single chemical storage area. A combined delivery bund is provided for alum and citric acid, and a second combined delivery bund is provided for caustic and hypo. The provisional carbon dosing storage is not co-located with the other chemicals and has its own dedicated delivery bund.

11.2.1.1 Alum

Alum dosing is used in several locations around the plant to remove soluble phosphorus from the wastewater and assist with coagulation and suspended solids removal in the PSTs and bioreactors.

The chemical storage system for alum consists of 2 No. 22.5 kL above-ground tanks, cross-linked to operate as one duty/duty storage, but with the ability to take one tank offline for maintenance. 46% w/w alum is delivered to the dedicated alum delivery bund by a bulk tanker and transferred into the duty tank(s) via the chemical fill point control panel, located within the chemical storage bund. The alum delivery bund is fitted with a sump that free-drains to the site stormwater under normal operations This can be isolated during chemical deliveries to contain chemical waste (e.g. from spills) within the bund.

6 No. chemical dosing pumps (3 duty and 3 standby) are provided to transfer neat alum solution to the various dosing points. Provision is made to dose alum into the following three locations:

- Grit vortex tank outlet channel
- 4-stage bioreactor feed pumps discharge
- Digested sludge FAT

Each dosing location has a dedicated pair of duty/standby dosing pumps. Dosing pumps and associated equipment are mounted on a dosing panel located adjacent to the chemical storage bund. All dosing pumps are sized to transfer the full flow rate of alum to each dose point to provide operators the flexibility to optimise the alum dosing to suit plant conditions.

11.2.1.2 Caustic soda

Caustic soda is used to provide alkalinity to the treatment process. It is primarily used in the design to replace alkalinity lost due to alum dosing and is not anticipated to be required to provide additional alkalinity for nitrification.

The chemical storage system for caustic consists of 1 No. 30 kL above-ground tank. 30% w/w caustic solution (potentially 46% w/w during summer months) is delivered to the caustic delivery bund by a bulk tanker and transferred into the duty tank via the caustic chemical fill point control panel, located within the caustic chemical storage bund. The combined caustic/hypo/citric chemical delivery bund is fitted with a sump that free-drains to the site stormwater under normal operations or into a dedicated chemical waste collection tank during chemical deliveries.

2 No. chemical dosing pumps (duty /standby) are provided to transfer neat caustic solution to the dosing point. Provision is made to dose caustic into 4-stage bioreactor feed pumps discharge

Dosing pumps and associated equipment are mounted on a dosing panel located adjacent to the chemical storage bund. All dosing pumps are sized to transfer the full flow rate of caustic chemical to each dose point to provide operators the flexibility to optimise the caustic dosing to suit plant conditions.

11.2.1.3 CIP chemicals

Sodium hypochlorite and citric acid are required to conduct regular CIP cleans of the MBR membranes. The storage systems for each chemical consist of 1 No. 7 kL tank and associated chemical storage bund, plus 2 No. duty/standby dosing pumps. The hypo and citric storage tanks receive chemical deliveries by bulk tanker or IBC, with separate fill point control panels provided for each chemical. Hypo shares a delivery bund with caustic as they are both classified as ADG and will spill into a separate chemical spill tank, while citric shares a delivery bund with alum. The design allows for 13% w/w sodium hypochlorite solution and 50% w/w citric acid solution as per membrane supplier specifications.

Both hypo and citric are dosed into the MBR backpulse pump discharge header as required for CIP cleaning procedures. The dose rate is controlled by the MBR train management system to achieve the required concentrations for maintenance and recovery cleans.

11.2.1.4 Methanol or ethanol (provisional)

The need for carbon dosing is dependent on the actual COD/TKN ratio of the raw sewage feed in future. Provision has been made within the design to dose up to 650 L/d of methanol or 470 L/d of ethanol to the 4-stage bioreactor secondary anoxic zones.

The carbon dosing system will consist of three dosing pumps (duty/duty/standby) and an underground, double-walled storage tank. There will be a chemical unloading bund and chemical storage bund for spill containment.

11.2.2 Odour control

Key odour sources around the plant are covered and ventilated by extraction to a new centralised odour treatment facility (OTF) for treatment. Foul air is conveyed to the OTF from each of the covered process units by ductwork equipped with dampers at extraction points and key convergence points. The damper positions are configurable on-site to balance the foul air extraction rates across the plant. Extracted air is treated by the OTF to remove H_2S and other contaminants before being discharged to atmosphere.

The OTF extracts and treats foul air from the following processes:

- Raw Sewage Pump Station
- General Purpose Pump Station
- Inlet works drainage pump station
- Inlet works
- Primary screening
- Secondary screening
- Screenings and grit handling
- Primary flow splitter
- Primary sedimentation tanks
  - 4Stage Bioreactor flow splitter chamber

– Thickening and dewatering equipment
– Solids handling FATs
– Tankered waste receival
– Anaerobic digester outlet chambers

Foul air extraction is performed by 2 No. foul air fans operating in duty/standby configuration. Upon reaching the odour head works foul air from around the plant combines into a single duct before entering the foul air intake plenum, where a gas analyser measures the H_2S concentration. It then enters the 2 No. duty biotrickling filters (BTFs) to remove H_2S before passing through the foul air extraction fans. A two-stage moisture filter upstream of the fans and a heating coil immediately downstream of the fans serve to decrease the humidity of the air before it passes through the 2 No. duty/duty activated carbon filters (ACFs). Treated air is discharged to atmosphere via a stack. A gas analyser measures the H_2S concentration of the treated air prior to discharge to provide an indicator of OTF performance.

11.3 Design basis

11.3.1 Redundancy

Equipment and process redundancy for the chemicals and odour package are detailed in Table 11.1.

Table 11.1 Package 6000 redundancy requirements

Major process unit	Configuration	Comments
Odour extraction fans	N+1	
Odour biotrickling filters	At least 2 No	Partial duty/duty arrangement with manual bypass
Odour activated carbon filters	At least 2 No	Partial duty/duty arrangement with manual bypass
Alum storage	N	Partial duty/duty arrangement. Sized for 1x 27 tonne bulk tanker delivery + 7 days additional storage at 2054 peak month ADWF
Caustic storage	N	Sized for 1x 27 tonne bulk tanker delivery + 7 days additional storage at peak month ADWF
Hypo storage	N	Allowance for 28 days storage at average usage (2x maintenance cleans per membrane train per week plus allowance for 2x recovery cleans)
Citric storage	N	Allowance for 28 days storage at average usage (2x maintenance cleans per membrane train per week plus allowance for 2x recovery cleans)
Methanol / ethanol storage	N	Allowance for 28 days storage at average usage
Chemical dosing pumps	N+1	

11.3.2 Performance and technical requirements

The performance and technical requirements for the chemicals and odour package are detailed in Table 11.2 and Table 11.3.

Table 11.2 Chemical storage and dosing technical requirements

Parameter	Unit	Value	Comments
General			
Alum and caustic storage requirement	Sized for 1x 27 tonne bulk tanker delivery + 7 days additional storage at 2054 peak month ADWF		
Hypo and citric storage requirement	days	28	At average usage

Parameter	Unit	Value	Comments
Active volume	%	90	
Alum			
Dosing locations	Flexibility to dose to upstream of PSTs, secondary process and digested sludge FAT		
Mixing	Alum to be dosed to a location that provides mixing energy. Rapid mixing to be used at primary treatment dose point. Hydraulic mixing energy to be used at other dose points.		
Al:P ratio	mol AL/mol P	1.3	
Caustic soda			
Dosing locations	Secondary process		
Mixing	Caustic to be dosed to a location that provides mixing energy. Hydraulic mixing energy to be used at secondary process dose points.		
Target effluent alkalinity	mg $CaCO_3$/L	100	Target based on Hartley (2013), *Tuning Biological Nutrient Removal Plants*. Below 50 mg $CaCO_3$/L pH becomes unstable and can drop rapidly.
Methanol / ethanol			
COD/TKN ratio sensitivity	Requirement for carbon dosing to be determined based on COD/TKN ratio sensitivity analysis (with worst case COD/TKN ratio of 10 to be adopted).		
Dosing location	To bioreactor secondary anoxic zone		
Storage	Underground double walled storage tank		
Membrane clean-in-place (CIP)			
Storage system	IBC storage is not acceptable		
Expected chemicals	Sodium hypochlorite Citric acid		

Table 11.3 Odour control technical requirements

Parameter	Unit	Value	Comments
Foul air extraction			
Total volumetric extraction rate across covered units	m^3/hr	30,000	
Covered units	Raw Sewage Pump Station General Purpose Pump Station Inlet Works Drainage Pump Station Inlet Works Primary Screening Secondary Screening Screenings and Grit Handling Primary Flow Splitter Primary Sedimentation Tanks 4 Stage Bioreactor Flow Split Chamber Thickening and Dewatering Equipment Solids Handling FATs Tankered Waste Receival Anaerobic Digester Outlet Chambers		
Odour control system			
Stack height	m	14	

Parameter	Unit	Value	Comments
Stack exit velocity	m/s	12.5	
Treatment technology	BTF + AC		
Treatment technology performance	OU	500	
Odour control performance requirement	Maximum of 2 odour units (99.5 %ile) at the boundary of the facility, or as agreed with the Tasmanian EPA, over a 1 hour averaging period.		

11.4 Design summary

The key detailed design outputs for the chemicals and odour package are detailed in Table 11.4 through Table 11.5.

Table 11.4 Chemical storage and dosing design summary

Parameter	Unit	Value	Comments
Aluminium sulphate			
Process fluid		Aluminium sulphate $Al_2(SO_4)_3 \cdot 14H_2O$	
Storage concentration	% w/w	46	
Stage 2 chemical volume required	kL	36.6	Sized to achieve 2 mg P/L in the MBR permeate
Stage 2 storage volume adopted	kL	45.0	
No. of tanks adopted	No.	2	duty/duty arrangement
No. of dosing pumps	No.	6	3 duty + 3 standby
Maximum required dose rate	L/h	165.8	Peak dose rate to the 4-stage bioreactor in 2054
Caustic soda			
Process fluid		Sodium hydroxide NaOH	
Storage concentration	% w/w	30	Allowance for 46% during summer months
Chemical volume required	kL	32.0	Sized to recover alkalinity lost due to alum dosing and achieve an effluent alkalinity of at least 100 mg/L
Storage volume adopted	kL	30.0	
No. of tanks adopted	No.	1	
No. of dosing pumps	No.	2	Duty + Standby
Maximum required dose rate	L/h	111.2	Peak dose rate to the 4-stage bioreactor using 30% solution. This is anticipated to occur in (2040) peak month due to a deficit in alkalinity to achieve >100mg/L $CaCO_3$ in the effluent.
Sodium hypochlorite			
Process fluid		Sodium hypochlorite NaOCl	
Storage concentration	% w/w	13	
2054 chemical volume required	kL	5.8	
2054 storage volume adopted	kL	7.0	Subject to the CIP usage of the selected MBR supplier

Parameter	Unit	Value	Comments
No. of tanks adopted	No.	1	
No. of dosing pumps	No.	2	duty + standby
Minimum required dose rate	L/h	438	for maintenance cleans
Maximum required dose rate	L/h	2408	for recovery cleans
Citric acid			
Process fluid		Citric acid $C_6H_8O_7$	
Storage concentration	% w/w	50	
2054 chemical volume required	kL	5.9	
2054 storage volume adopted	kL	7.0	Subject to the CIP usage of the selected MBR supplier
No. of tanks adopted	No.	1	
No. of dosing pumps	No.	2	duty + standby
Minimum required dose rate	L/h	1072	for maintenance cleans
Maximum required dose rate	L/h	1180	for recovery cleans
Methanol / Ethanol (provisional)			
Process fluid		Methanol (CH_3OH) or Ethanol (C_2H_5OH)	
Storage concentration	% w/w	100%	
2054 chemical volume required	kL	Methanol: 18.2 Ethanol: 13.1	
2054 storage volume adopted	kL	Methanol: 20.0 Ethanol: 15.0	
No. of tanks adopted	No.	1	
No. of dosing pumps	No.	3	2 duty + 1 standby
Minimum required dose rate	L/h	TBC	
Maximum required dose rate	L/h	TBC	

Table 11.5 Odour control system design summary

Parameter	Unit	Value	Comments
Odour control system			
Odour control system design TBC pending finalisation of basis of design			

12. Package 1000 – Site Wide Services

12.1 Package scope

Package 1000 – Site Wide Services includes the following systems:

- Service water,
- Potable water,
- Fire Hydrant system,
- General purpose pumping,
- Compressed air,
- Natural gas,
- Earthing,
- Site external lighting,
- Conduits and pits, and
- Building services and security.

12.2 Process description

12.2.1 Service water

The existing service water system (recycled water drawn from the existing CCT) remains in place to supply the existing plant service water demands as required.

Service water for the new plant is MBR permeate. Permeate pumps draw service water directly from the permeate tank to supply the service water reticulation network.

Service water is supplied throughout the new plant for various functions such as flushing and cleaning of inlet works equipment, scum sprays, thickening and dewatering equipment as well as to supply hose reels throughout the site.

12.2.2 Potable water

Potable water supply, from the Authority main located in Selfs Point Road, is provided to the primary and secondary screens as a backup to the service water supply. Potable water is also supplied to emergency showers and eyewash stations throughout the new plant.

12.2.3 Fire Hydrant system

The new site will be protected with a fire hydrant system (attack system).

The fire hydrant system for the site will be a reticulated mains feed hydrant system, connected to the DN150 DICL Authority main located in Selfs Point Road.

A Fire Brigade booster assembly with back flow prevention device will be located in view of the main entrance, as required under AS2419.1 and provide fire water to external fire hydrants, to protect buildings and plants.

12.2.4 General purpose pumping (GPPS)

The GPPS mainly collects filtrate/centrate from thickening and dewatering, however, also collects nearby drainage streams (e.g., Digester service water seal drainage). These process flows are returned upstream of the 4-Stage Bioreactor flow splitter. The GPPS overflows to the raw sewage pump station.

12.2.5 Compressed air

A compressed air system is provided for pneumatic valves, ancillaries and instrumentation (if required) associated with the new plant infrastructure.

12.2.6 Natural gas

Natural gas is provided to the dual fired hot water heaters as backup supply to biogas and as a pilot. Natural gas is also provided to the flare as a pilot.

12.3 Design basis

12.3.1 Redundancy

Equipment and process redundancy for the site services package are detailed in Table 12.1.

Table 12.1 Package 1000 redundancy requirements

Major process unit	Configuration	Comments
Service water pumps	N + 1	
General purpose pump station	N + 1	
Air compressors	N + 1	

12.4 Design summary

12.4.1 Service water

12.4.1.1 Reticulation

The service water system is supplied by the service water pumps which draw from the MBR permeate tank. The reticulation network circles around the perimeter of the new plant site with branches and offtakes to process treatment areas and structures.

PE100 has been identified as preferred pipeline material candidate for the service water reticulation. The use of PE100 minimises the need for concrete thrust restraints through the use of a fully welded jointing system. Alternative materials may be considered as the design develops.

12.4.1.2 Pumps

The service water pumps are located at the permeate tank. Details of the service water pumps are provided in Table 12.2.

Table 12.2 Service water pump design summary

Parameter	Units	Equipment details
Type of pumps		Vertical Multistage Centrifugal Pump package proposed but selection left open for vendor proposals.
Number of pumps	5	Initial selection of 5 pumps made to cater for large range of possible flows. The final number will be dependent on vendor selection.
Maximum duty flow (for pump set)	L/s	85.1
Required dynamic head @ maximum flow	m	82
Average duty flow (for pump set)	L/s	48.8

Parameter	Units	Equipment details
Minimum dynamic head	m	41.6

12.4.2 Potable water

The potable water system will be delivered from a new supply connection at the southern side of the site. Similar to the service water network, the potable water network circles around the perimeter of the new plant site with offtakes to process areas as required.

PE100 has been identified as preferred pipeline material candidate for the potable water reticulation. The use of PE100 minimises the need for concrete thrust restraints through the use of a fully welded jointing system. Alternative materials may be considered as the design develops.

12.4.3 Fire water supply

12.4.3.1 Reticulation

The proposed Self Point Sewage Treatment Plant will require a new DN150 connection to the existing main in Selfs Point Road main.

Dual headed fire hydrants will be provided across the site to provide fire hydrant coverage to all plant sections and buildings and will be located accessible from the service roads. Fire hydrants will provide a residual water pressure of 350kPa. The fire hydrant main on site will create a ring main and will be isolated by increments of 30% of the ring, by means of underground isolation valves.

The fire hydrant ring main will follow the site wide reticulation network, running mostly parallel to the service water pipework under the street.

Following initial information from the local water Authorities the existing water main in Selfs Point Road appears to be capable to furnish the proposed fire hydrant system with sufficient flow and pressure as required under the relevant codes. Initial modelling has been undertaken by the Authorities, indicating that flows of 30L/s can be provided and residual pressures in excess of 500kPa can be achieved, over a period of more than 4h. Based on these initial modelling it appears unlikely that onsite fire water storage will be required and even fire booster pumps might not be required.

A formal statement of available pressure and flow however, will be required from the Authorities in a later stage of the project, to enable the certification process of the fire system as it is required under the statutory requirements.

12.4.3.2 Design Criteria

Table 12.3 provides an overview of the current firefighting design criteria.

Table 12.3 fire hydrant design criteria

Hydrant system flow	Coverage
20L/s (for 4h)	2 hoses (60m) plus 10m spray

(*)The adopted operation of 2 simultaneous fire hydrants is based on an assumed maximum building fire compartment of <5,000m^2 or a maximum ‘open yard’ area of <9,000m^2. This will have to be confirmed by the Certifying Authority in a later stage of the project.

12.4.3.3 Fire hydrant system

The hydrant system will consist of a reticulated services ring main, supplied by the dedicated fire water connection to the main. Fire hydrants will form the primary firefighting component for the attending fire crews as a 'first attack' option.

The fire hydrants will be spaced out accordingly and strategically located, along paths of travel and protected from trafficable movement, hazardous areas, and combustible building elements. Hydrants will be located so that each area requiring protection, is within 60 m of but not less than 10 m from a hydrant under any conditions of fire or wind.

12.4.3.4 Fire pumps[4]

Following with the water Authorities and their initial water supply modelling, it appears that the existing main will be able to satisfy the flow and pressure requirements of the fire hydrant system and the requirements for on-site fire pumps appears not likely.

A formal statement of available pressure and flow however, will be required from the Authorities in a later stage of the project, to satisfy statutory requirements and certification processes.

12.4.3.5 Hydrant booster assembly

The fire hydrant booster assembly will be located in *sight of the principal pedestrian entrance,* as per statutory requirements. At this stage of the project it is assumed that the entrance to site will be via the existing sewer works entrance and that this existing entrance will remain the principle pedestrian entrance.

To satisfy statutory requirements the new fire hydrant booster assembly will be located in site of this existing entrance.

The booster assembly will consist of 2 booster ports.

12.4.3.6 Fire hose reels and fire extinguishers

Under the BCA fire hose reels are quired for buildings with a floor area larger than 500m^2. Currently none of the buildings appear to be larger than 500m^2, it is therefore not envisaged that fire hose reels will be required.

Fire extinguishers will be readily available and displayed in a prominent position along paths of travel for occupant 'first attack' firefighting means and adjacent to major switch boards.

12.4.4 General purpose pumping

The proposed GPPS is located on the northern side of the new STP site adjacent the existing Biodenipho Plant and access road. The GPPS inflows are predominately process element return streams from the sludge handling and polymer buildings with a marginal allowance for additional hose down flows/drainage flows. Inflows are collected via a gravity sewer network and pumped from the GPPS wet well to a connection point along the primary effluent transfer pipeline before discharging into the bioreactor flow splitter. The inflows of the pump station are summarised in Table 12.4 below:

Table 12.4 GPPS design flows

Contributing Component	Units	Average Design Flow	Peak Design Flow
WAS RDT filtrate and washwater	L/s	14.2	14.3
Primary sludge RDT filtrate and washwater	L/s	5.9	8.8
Recuperative thickening RDT filtrate and washwater	L/s	1.9	1.8
Centrate from centrifuges and washwater	L/s	4.8	7.2

[4] The requirement for fire hydrant pumps is subject to the Authorities' statement of available pressure and flow. Outstanding information.

Contributing Component	Units	Average Design Flow	Peak Design Flow
General hose down allowance	L/s	0.0	1.0
Total	**L/s**	**26.8**	**33.1**

The pump station civil works and conveyance system shall be designed to accommodate a nominated peak design flow once the catchment and process demands (primarily associated with vendor information) have been confirmed.

A summary of the GPPS design and equipment is summarised below in Table 12.5.

Table 12.5 GPPS design summary

Parameter	Units	Equipment details
Wet Well Type	-	Concrete cast insitu
Wet Well Diameter	m	3.0 m
Wet Well Depth	m	4.5 m (TBC)
Wet Well Material	-	Reinforced concrete
Pump Duty	-	33.1 L/s (TBC)
Number of Pumps	-	Two (2)
Pump Configuration	-	Duty / Standby
Pump Type	--	Submersible
Rising Main		OD225 PE100 PN16
Rising Main Instrumentation		DN200 Magflo meter
Pump Station Valving	-	One (1) Swing check NRV per pump One (1) Isolation gate valve per pump Arrangement aboveground on slab
Wet Well Instrumentation		Level Transmitter Level Switch Low Level Switch High
Wet Well Operating Volume	kL	15 kL (TBC)
Allowable number of starts per hr	Start/hr	12 start/hr
Emergency Storage	kL	NA
Overflow Level	m	3.2 m AHD (TBC)
Overflow configuration	-	Overflow via DN300 gravity sewer to RSPS (TBC)

12.4.5 Compressed air

12.4.5.1 Reticulation

The compressed air system is supplied from the compressor house (located in the blower building). Similar to service water and potable water, the compressed air ring main follows the service corridors around the perimeter of the site with offtakes as required.

12.4.5.2 Equipment

The compressed air system equipment details —subject to vendor selection and final equipment duties – are summarised in Table 12.6 below.

Table 12.6 Compressed air system design summary

Parameter	Equipment Detail
Type of compressor	Screw compressor, oil cooled.
Number of compressors	3 (Duty/Assist/Standby)
Total compressed air system capacity, Nm3/h (FAD)	940m3/hr
Operating pressure setpoints	Pressure relief setpoint – 900kPa Compressor cut-out setpoint – 800kPa Compressor cut-in setpoint – 720kPa Minimum operating pressure – 700kPa
Receivers	1 x 3000L – Main receiver (and MBR)
Field receives	2 x 2000L – Inlet works, Sludge handling

12.4.6 Natural gas

The dual fired hot water heaters and flare will be supplied directly from the new natural gas connection (location TBD). The natural gas connection a 63mm SDR11 PE100 pipe branch offtake from the TasGas network, along with the necessary metering assembly and isolation. At the site tie in point, the maximum expected natural gas usage is 68.9 Sm3/h (51.7 kg/h) at a minimum required pressure of 7 kPag.

12.4.7 Earthing

To be developed in subsequent phases of design.

12.4.8 Site external lighting

The Site external lighting within the plant is categorized into Carpark, Roadway, and Outdoor Workplace Area. The individual plant / workplace area lighting will be developed in the next design phase. The current design is only for general outdoor area.

Lighting design for carpark areas is based on AS/NZS 1158.3.1:2020 – Lighting for Roads & Public Spaces – Pedestrian Area (Category P) Lighting. As per Table 2.5 – Lighting Subcategories for Outdoor Carparks the new lab carpark will fall under the subcategory PC3 and PCD for the designated parking space specifically intended for people with disabilities.

As a justification to lighting category PC3 the new lab carpark is considered to have a low vehicle and low pedestrian movement during night-time and low fear of crime as the facility is a secured industrial environment with a general through traffic of site inducted personnel / pedestrian access only.

All new carpark lights are proposed to be weatherproof marine grade pole mounted LED luminaires mounted on a 4m marine grade 316 stainless steel hinged pole similar to Swivelpole G5 series with 750mm outreach arm.

Refer to Appendix D for Carpark Lighting Calculations.

The Lighting design for Roadway within the facility is based on AS/NZS 1158.1.1-2022 Lighting for Roads & Public Spaces Part 1.1 Vehicular Traffic (Category V) Lighting.

The new roadway within the facility is considered to be as a sub-arterial road that connects areas of development within the region or that carry traffic directly from one part of the region to another part.

This roadway has a mixed vehicle and pedestrian movement with a low traffic generation from abutting properties with a moderate vehicular activity with a low to moderate vehicle speed and low pedestrian activity during daytime and night-time. Based on Table 2.1 – Category V Lighting & Typical Applications of AS/NZS 1158.1.1-2022 this new roadway will fall under the subcategory V4.

Lighting parameters for the new roadway shall meet the requirements of lighting subcategory V4 of Table 3.1 – Values of Light Technical Parameters for Category V Lighting. New roadway lighting is proposed to be weatherproof marine grade pole mounted LED luminaires mounted on an 8m marine grade 316 stainless steel hinged pole similar to Swivelpole G5 Series with 750mm outreach arm.

Refer to Appendix D for Roadway Lighting Calculations.

Lighting design for the Outdoor workplace areas within the facility is based on AS/NZS 1680.5-2012 Part 5: Outdoor Workplace Lighting. Under Table 3.1 – Recommended Light Technical Parameters for General Outdoor Areas with a basic operating characteristic of loading and unloading of trucks by manual labour and/or forklift including manually moving objects between the truck and another form of transport shall meet the required average illuminance (Eav) of 40lux and minimum illuminance (Emin) of 5lux with 5 as the uniformity of illuminance and a CIE glare rating of not more than 45.

Outdoor workplace area lighting is proposed to be a combination of weatherproof marine grade pole mounted LED luminaires mounted on an 8m marine grade 316 stainless steel hinged pole similar to Swivelpole G5 series with 750mm outreach arm and weatherproof LED floodlights mounted on a 6m marine grade 316 stainless steel hinged pole similar to Swivelpole G5 series via flood light mounting brackets.

Refer to Appendix D for Outdoor Workplace Lighting Calculations.

The new pole mounted lighting for the facility has the potential to impact commercial establishments and neighbouring public spaces. The public space which is Millington's Cemeteries is approximately 60m from the accessible roadway across the selfs point roadside of the facility. On the Marine esplanade side of the facility, it is 15m away from the accessible roadway to the New Town Bay Rowing Centre Carpark.

AS/NZS 4282 will be utilised to assess the impact of light pollution on the surrounding areas. Based on Table 3.1 of AS4282, for the purpose of this project, the environment zone that is applicable for the external areas of the project is considered to be A3 a suburban area in towns and cities with a medium district brightness.

Refer to Appendix D for Obtrusive Lighting Calculations.

TABLE 3.1

ENVIRONMENTAL ZONES

Zones	Description	Examples
A0	Intrinsically dark	UNESCO Starlight Reserve. IDA Dark Sky Parks. Major optical observatories No road lighting -unless specifically required by the road controlling authority
A1	Dark	Relatively uninhabited rural areas No road lighting - unless specifically required by the road controlling authority
A2	Low district brightness	Sparsely inhabited rural and semi-rural areas
A3	Medium district brightness	Suburban areas in towns and cities
A4	High district brightness	Town and city centres and other commercial areas Residential areas abutting commercial areas
TV	High district brightness	Vicinity of major sports stadium during TV broadcasts
V	Residences near traffic routes	Refer AS/NZS1158.1.1
R1	Residences near local roads with significant setback	Refer AS/NZS 1158.3.1
R2	Residences near local roads	Refer AS/NZS 1158.3.1
R3	Residences near a roundabout or local area traffic management device	Refer AS/NZS 1158.3.1
RX	Residences near a pedestrian crossing	Refer AS/NZS 1158.4

NOTE: Recreational areas are not considered commercial.

Figure 10 ***Extract of Table 3.1 AS/NZS 4282***

TABLE 3.2

MAXIMUM VALUES OF LIGHT TECHNICAL PARAMETERS

Zones	Vertical illuminance levels (E_v) lx		Threshold increment (TI)		Sky glow
	Non-curfew	Curfew	%	Default adaptation level (L_{ad})	Upward light ratio
A0	See Note 1	0	N/A	N/A	0
A1	2	0.1	N/A	N/A	0
A2	5	1	20%	0.2	0.01
A3	10	2	20%	1	0.02
A4	25	5	20%	5	0.03
TV	See Table 3.4	N/A	20%	10	0.08
V	N/A	4	Note 2	Note 2	Note 2
R1	N/A	1	20%	0.1	Note 3
R2	N/A	2	20%	0.1	Note 3
R3	N/A	4	20%	0.1	Note 3
RX	N/A	4	20%	5	Note 4

NOTES:

1 For A0, E_v shall be as close to zero as practicable without impacting safety considerations.

2 Refer to AS/NZS 1158.1.1.

3 Refer to AS/NZS 1158.3.1.

4 Refer to AS/NZS 1158.4.

5 N/A means 'Not Applicable'.

6 For an internally illuminated sign in an A2 zone, $L_{ad} \leq 0.25$ cd/m^2.

Figure 11 Extract of Table 3.2 AS/NZS 4282

12.4.9 Conduits and pits

To be developed in subsequent phases of design.

12.4.10 Building services and security

To be developed in subsequent phases of design.

12.4.11 Service corridors

An initial assessment of underground site service routings throughout site has been conducted. This considered process pipework, potable water, service water, fire water, sludge handling (package 5000), GPPS/IWDPS rising mains, storm water, compressed air, electrical HV and site wide electrical reticulation.

Pipe diameters were conservatively calculated/assumed, with WSAA code (MRWA Version) standards adopted for minimum clearances and separations between services (where possible). An offset of 1.5 m was allowed for from structure slabs to allow for excavation without disturbance to the CMC pile granular capping material.

A primary north-south service corridor running under the central north-south roadway was identified. The preliminary design indicates a 14 m (approx.) wide corridor is required to accommodate the necessary services. This has been achieved by utilising the available 13 m wide access road and verge and running the LV electrical service under the foundation slab of the proposed switchrooms.

Another primary service corridor 8 m wide (approx.) was identified running east-west from the blower building toward inlet works. The services through this corridor have been accommodated in the road and road verge.

A third primary service corridor was identified along the south-eastern side of the site near the inlet works. The required width of this corridor varies due to the crossing and bending of multiple service alignments. The services through this corridor have been accommodated in the 6 m road and available road verge that is estimated to generally be 8.5 m wide in total.

13. Package 7000 – Site Wide Civil

13.1 Package scope

Package 7000 – Site Wide Civil includes the following infrastructure:

- Below ground process pipework
- Roads and pavements
- Landscaping
- Site Fencing and External Security
- Earthworks
- Storm Water Drainage
- Remediation

13.2 Design summary

13.2.1 Below ground process pipework

Refer to Packages 2000, 3000, 4000 and 5000 for specific design summaries related to below ground process pipework. A general summary is provided below.

Line	Package	Size, Material and Class	Comments on sizing
Raw Sewage SRM	2000	OD502 MSCL WT6mm	WSA04
Sandy Bay 2 SRM	2000	OD450 PE100 PN16	Sized to match existing SRM
Macquarie Point SRM	2000	OD600 MSCL WT6mm	Sizing indicative to be confirmed with Macquarie point SRM designer
Inlet Works/PST Overflow	2000	OD1067 MSCL WT12mm	
Primary Sludge to FAT	2000	OD110 PE100 PN16	Indicative sizing pending vendor input
Primary effluent feed to 4-stage bioreactor flow splitter	2000	OD800 MSCL WT12mm	WSA04
Bioreactor inlets (current)	3000	OD800 MSCL WT12mm	
Bioreactor inlets (future)	3000	OD914 MSCL WT12mm	
Bioreactor overflows	3000	OD914 MSCL WT12mm	
Mixed Liquor line	3000	OD1500 MSCL WT12mm	
RAS line	3000	OD914 MSCL WT12mm	
Permeate outlet pipeline tie in to EBT	3000	OD1067 MSCL WT12mm	
WAS (from 4-Stage bioreactors)	3000	OD180 PE100 PN16	Indicative sizing pending vendor input
Effluent balance tank to wet well	4000	OD450 MSCL WT6mm	Refer section 9.4 for details
Selfs Point Local Outfall	4000	DN1000 GRP	Refer section 9.4.2 for detail
Digested Sludge	5000	OD315 PE100 PN16	Indicative sizing pending vendor input
Blended Sludge	5000	OD180 PE100 PN16	Indicative sizing pending vendor input
Tankered Waste	5000	OD180 PE100 PN16	Indicative sizing pending vendor input

13.2.1.1 Alignments

Horizontal alignments through service corridors have been designed to minimise clashes between pipework, process units and buildings, whilst also trying to minimise pipework lengths, bends and headlosses. Further detail on this is provided in 12.4.11.

Horizontal alignments through areas with limited space, such as package 3000, have generally been driven by the geometry of standard bends and fittings.

Vertical alignments will be considered in subsequent design stages.

13.2.1.2 Materials

MSCL pipework has been selected as the piping material for the large bore critical process pipework and PE100 for small bore lines. These are expected to provide the best trade-off between capital cost, constructability, durability and maintenance.

As the design develops alternate materials maybe found to be more suitable.

13.2.1.3 Jointing

Jointing will be confirmed in subsequent design phases. However, it is expected that fully restrained jointing system will be required around most of the site due the limited space available to install thrust restraints.

13.2.1.4 Embedment and backfill

Embedment and backfill will be considered in subsequent design stages. However, it is expected that standard trenching materials will be acceptable for the majority of the site with concrete, cement stabilised sand and other materials required through steep embankments and where minimum clearance and/or cover cannot be achieved.

13.2.2 Roads and pavements

13.2.2.1 General

The road network is designed to accommodate the access requirements to the various areas of the STP. The road network consists of:

- A single main two-way access road providing access from the existing STP road network to the new STP area.
- Traffic flows in a generally clockwise one-way direction around site. The exception to this is for alum and caustic chemical deliveries which will be required to go in the opposite direction.
- An area has been allocated for up to two tankered waste delivery trucks to be queued preceding the tankered waste unloading area. The tankered waste is situated on the existing site where current administration building parking is located. This parking area is to be demolished. A new location is pending decision from the CDO.
- Reconstruction of the existing road from the treatment works entrance to the proposed ramp will be required to accommodate underground services. The vertical and horizontal alignment of this road will not be altered.

Road widths are generally 6m but are up to 12m in certain places to accommodate vehicular access. Vehicle swept paths have been completed for site roads, chemical deliveries, transformer access, digester/membrane crane access, and bin access. Fire truck access around site was also reviewed and considered acceptable.

The road geometry allows for the following vehicle movements:

- 19 m semi-trailer access around site roads and to chemical unloading area, poly unloading area, tankered waste receiving area and transformers
- 12.5 m truck access to the grit bins and sludge bins
- 250t crane access to the digesters including roof laydown area
- 150t crane access to the southern MBR area
- Light vehicle (passenger or utility) access to other areas

Roads generally consist of unbound granular pavements with asphalt surfacing, with some areas requiring rigid concrete pavements to accommodate loadings such as the digester roof laydown area. Areas between buildings or general hardstand areas will consist of gravel crushed rock (unsealed pavements).

13.2.2.2 Signage and linemarking

To be considered in subsequent design stages.

13.2.2.3 Safety barriers

The requirement for safety barriers and bollards will be considered in subsequent design stages.

13.2.2.4 Light vehicle carparks

19 new carpark spaces, including 1 DDA parking space, has been proposed for the existing lab building to replace those that will be lost due to the new access road to site. The CDO have been requested to confirm their requirements for any additional parking at the new STP site.

13.2.2.5 Pavement

Pavement designs will be considered in subsequent design phases. Pavements are anticipated to be primarily flexible pavements across the site with the application of rigid pavements in isolated areas as required or based on subgrade conditions.

Unsealed pavements are proposed for general hardstands and access tracks required outside site roads for crane access and maintenance (e.g., crane access to the south side of the membranes).

Concrete pavement will be required at the sludge and grit bin’s collection areas.

Ground improvement and the construction of temporary working platforms for crane access, which will later act as pavement subbase, will also be considered in subsequent design stages. The use of recycled materials such as crushed concrete will be considered for this work as part of the value engineering process.

13.2.3 Landscaping

Landscaping design will be considered in subsequent design stages. The scope or works is anticipated to include vegetation along the south and west property boundaries and to all batters within the site.

Requirements for perimeter screening will impact clearance zones from property boundaries. The vegetated screen along the perimeter will include small trees, large shrubs, and native grasses. Small trees, shrubs and grasses are to provide long term screening. Target screening height is 5-7m within 5 to 10 years. Required clearance from the edge of proposed road to the perimeter fence is 3m where practicable.

13.2.4 Site fencing and external security

Site fencing consists of 2100mm high galvanized chain mesh fence with three strands barbed wire per AS1725. Where retaining walls are near the property boundary, site fencing will be placed on top of the retaining walls.

A double swing access gate (6m wide) is provided on the boundary of Self’s Point Road near the switching station. Additionally, an existing gate will be relocated behind the laboratory.

13.2.5 Earthworks

13.2.5.1 Site description

The site for the STP facility is generally flat with undulations and drains from the southeast toward the northwest. The Derwent River is located just beyond the northwest corner. The site consists of engineered wetlands which are understood to have ceased operations around 2009. The wetlands were built over a reclaimed landfill site situated approximately 4 m above the existing STP facility levels. The area is currently dry and overgrown.

13.2.5.2 General

Initially, 150mm thick site stripping from existing surface will be undertaken. It is assumed that this stripping layer is contaminated and needs to be hauled off to an applicable location.

Earthworks on the contaminated site were balanced as best possible to reduce imported fill or excess cut material to be hauled off site. Cut material will be ‘spread’ over the site and where applicable use as fill material in the balancing process.

The site requires retaining walls in certain areas in lieu of batter slopes to mitigate encroachment over the property boundary. This accommodates proposed infrastructure in close proximity to the property boundary.

13.2.5.3 Groundwater

Groundwater was measured at elevations of 1 to 1.7 m AHD on the existing STP site and 0.75 to 0.9 m AHD on the proposed STP site. Dewatering is not anticipated to be required for excavations on the proposed STP site but is expected to be required for excavations on the existing STP site.

13.2.5.4 Fill material

Due to the existing soil condition an engineering fill (bridging) layer of approximately 1 m thick is required to mitigate differential settlements.

All surfaces are to be free of depressions, potholes and loose materials in readiness for structure or pavement construction.

Recycled crushed concrete from AWC’s Cambridge recycling facility may be considered for construction of the ground improvement /bridging layer to provide a suitable working platform across the site.

13.2.5.5 Finished surface

The finished surface has been developed such that there is generally a minimum 150 mm drop from finished floor level to finished surface level. This has been adopted as a means to reduce quantity of fill material and long-term settlements. For thicker slabs a larger drop from finished floor level to finished surface level will be adopted.

The finished surface slopes away from structures toward drainage pits. Slopes across site are generally between 1% minimum to 5% maximum. Roads have been provided with generally 2% cross fall slopes, minimum of 1% longitudinal slopes and a maximum longitudinal slope of 6% for the main access road leading up to site. The finished surface levels for the site itself are generally flat.

Kerbs, gutters and concrete lined drains will be provided generally with 1% minimum slopes. Isolated areas of minimum 0.5% slope may be required.

13.2.5.6 Embankments

The site embankments are based on a preference for 1V:4H, primarily for maintenance access and for stability. However, space constraints in several areas govern with 1V:2H batter slopes are required in the majority of locations across site.

13.2.5.7 Erosion and sediment control

An Erosion and Sediment Control Plan will need to be prepared by the CDO that incorporates erosion and sediment control measures such as sediment fencing around the site perimeter and application of a temporary sediment basin at the northwest corner of the project at the site of the proposed biofiltration basin.

13.2.6 Storm water drainage

13.2.6.1 General

Site drainage will consist of a series of pits and pipes generally flowing from the east and south sides of the project toward the northwest corner where a storm water quality treatment unit is proposed. The outflow from the treatment unit is then piped together with the carpark to the reinstated outfall to New Town Bay.

13.2.6.2 Storm water gravity pipelines

Pipe sizing calculations have been performed and will be refined in subsequent design phases. The pipe network has been modelled in the DRAINS 1-D hydraulic design software in accordance with *Australian Rainfall and Runoff* 2019 (ARR19)[5].

Pipes have been designed generally at 1% slope. A minimum 0.5% pipe slope may be required in some areas.

The internal road graded towards a series of grated sag pits located along the road centreline interspersed by ridgelines. This arrangement has been adopted to minimise fill above the minimum required for stabilisation.

Use of open drains across the project site will be minimal with drainage primarily being conveyed by the pit and pipe network.

Settlement is expected across the site. While this will be reduced by significant engineered fill and ground improvement, in areas subject to settlement, we have selected Polyethylene (PE100) pipe. This pipe is flexible allowing for some differential settlement without pulling joints apart. PN10 has been selected to achieve reasonable durability, however this may be refined as further information around expected settlement becomes available. Where differential settlement is not expected to be significant, we have selected ribbed polypropylene (PP) SN8 (i.e. BlackMAX or StormPRO) with rubber ring joints (RRJ).

Precast concrete pits have been selected for their ease of installation and durability.

Minor ponding has been allowed at the sag pits in the Minor storm event. A Minor storm design probability of 5% AEP has been adopted based on discussions with City of Council officers, however, a 2% AEP may be required. This would require pipe diameter increases (only). No impact on serviceability expected during the minor storm event. All areas remain safe in the Major event (1% AEP).

The outflow pipe for the stormwater has been sized to accept future flows from the existing plant site if diverted in the future. No works to divert flows from the existing are included in this contract.

13.2.6.3 Storm water quantity

On-site detention of storm water is not proposed as the project will outfall storm water directly to the Derwent River.

13.2.6.4 Storm water quality

Storm water quality treatment is proposed primarily through an Atlan Ecoceptor located near the existing lab. This Stormwater Quality Improvement Device is designed to capture hydrocarbon, silt, and suspended solids with tested treatment efficiencies as shown in Table 13.1.

Table 13.1 Stormwater Quality Improvement Device Tested Treatment Efficiencies

Pollutant	Efficiency
Gross Pollutants	95%
Total Suspended Solids	71%
Total Phosphorus	69%
Total Nitrogen	47%
Petroleum Hydrocarbon	93%

In order to reduce the frequency of maintenance and increase gross pollutant capture, in pit litter baskets are proposed at the grated pits. A MUSIC model has been developed for the site demonstrating a treatment train effectiveness better than that required in the planning scheme.

Table 13.2 Stormwater Treatment Requirements

Pollutant	Treatment Train Effectiveness
Total Suspended Solids	>80%
Total Phosphorus	>45%
Total Nitrogen	>45%

A high flow bypass is included within the Ecoceptor and each of the litter baskets.

13.2.6.5 Emergency storm water conveyance

Finished surface levels across site have been developed such that during the 1% Annual Exceedance Probability (AEP) storm event, storm water can be safely conveyed across site without flooding of structures in the event of blockages in the underground storm water reticulation system.

14. Package 8000 – Electrical & SCADA

14.1 Package scope

Package 8000 – Electrical & SCADA includes the following infrastructure:

- Incoming 11 kV power supply switching stations
- 11 kV site ring main
- 11/0.4 kV kiosk transformers at each switchroom
- Switchrooms at the following locations within the plant:
  - primary treatment
  - secondary treatment
  - blowers
  - sludge handling
- Low voltage main switchboards and motor control centres.
- Uninterruptible power supplies at each switchroom including UPS power distribution boards
- General lighting and power distribution boards
- PLC panels
- Low voltage power and instrumentation cabling, ducting and support systems
- Field devices and instrumentation.

14.2 Performance and technical requirements

The fundamental principles for the electrical and control systems are as follows:

- High personnel safety
- Minimise transformer sizes to reduce arc flash
- Distribution location to align with major loads
- Use 11 kV distribution to reduce LV cable run lengths
- Design to align with construction and commissioning stages
- Redundancy to align with process redundancy
- Implement automated packaged plant in the plant control system and agree preferred platform.

14.3 Design summary

The 30% electrical design has focussed on defining the base requirements for the plant. This is essentially power supply and switchroom locations.

At the 30% stage of the design the following items have been developed:

- 11 kV ring main cable route
- Maximum demand calculation
- Transformer sizing
- Switchboard and switchroom sizing
- Plant overview single line diagram.

14.3.1 11 kV ring main

The 11 kV reticulation has been designed as a ring main supply with a normally open switch at the midpoint of the ring to allow the reticulation to normally operate as an “A” supply and a “B” supply. Two switching stations are located at the plant boundary which receive supply from TasNetworks. The switching stations supply the plant ring

"A" and "B" feeders with a bus tie provided between the two switching stations. Interlocking is provided between the switching station incomer isolator and the ring open point switch to ensure that the incoming TasNetworks supplies cannot be connected in parallel.

The 11 kV cable route has been designed as a linear route with take-offs to a pair of transformers located at each switchroom. Clearance between conduits is planned to be 1500 mm minimum to ensure that an event affecting one side of the ring (e.g. the "A" side) does not also affect the other side. This is subject to further underground services design.

Pits have been allowed for at changes in direction and at 50 m intervals. Separate pits have been used for the A and B feeders. Conduit cross-overs are inevitable and efforts will be undertaken to minimise cross-overs as the design is progressed.

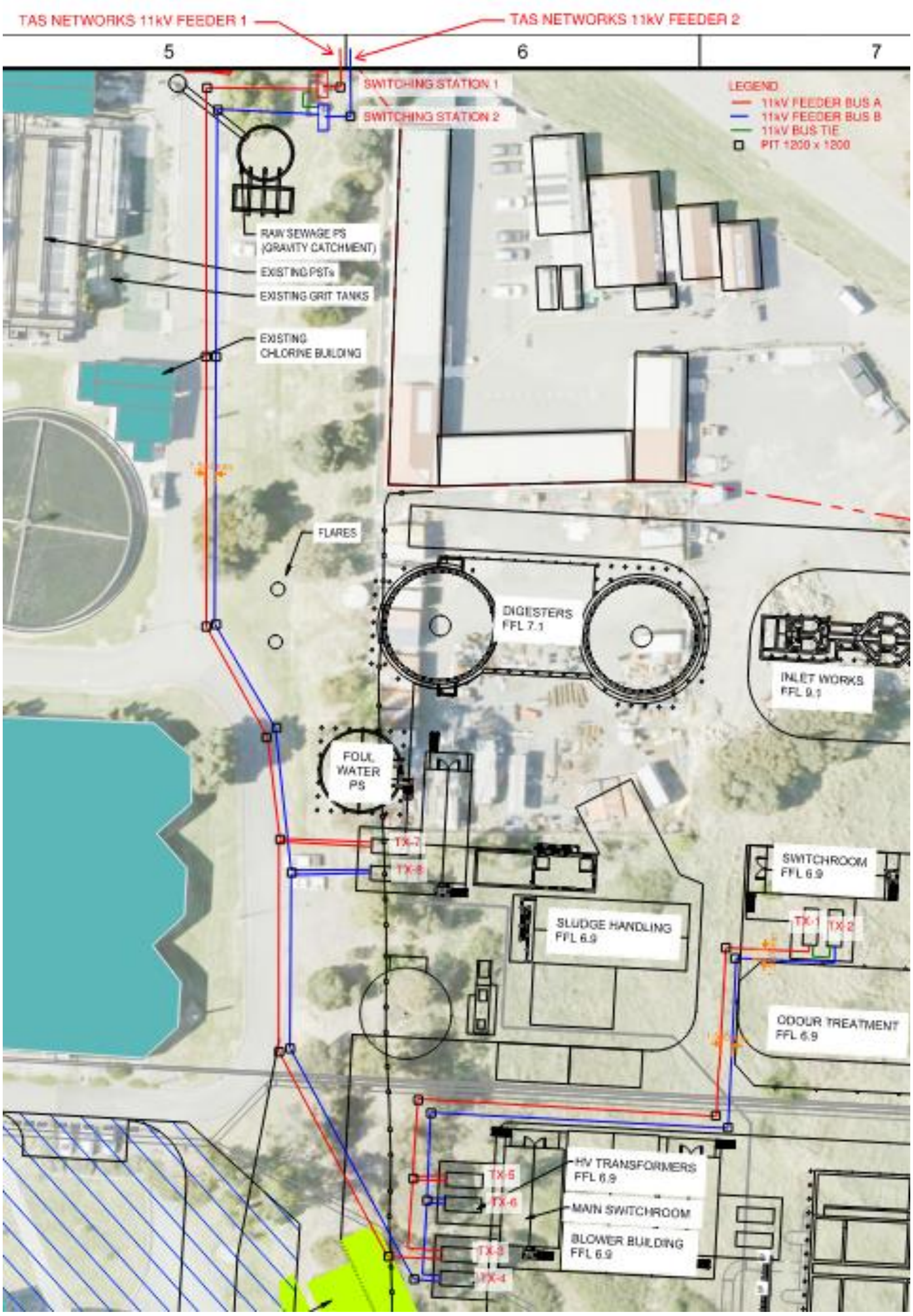


Figure 12 11 kV cable route

14.3.2 Power supply and switchrooms

During the development of the maximum demand calculation it became evident that with consolidated switchrooms supplying multiple plant areas the low voltage load and required transformer size would be relatively large. In order to reduce the concentrated low voltage loads, additional switchrooms would be required. In turn, this would not only reduce the size of the required transformer but reduce the fault levels and LV arc flash energy at the switchboards. Therefore, the plant loads have been distributed into four main areas:

– Primary treatment
– Secondary treatment
– Blowers
– Sludge handling

A switchroom is allocated to each area. Each switchroom is comprised of a main switchboard (MSB), two MCCs ('A' bus and 'B' bus), variable speed drives, UPS, distribution boards and PLC equipment.

Each MSB has two bus sections connected with a bus tie. A pair of 100% rated kiosk transformers provides power to each bus of the MSB i.e. Bus A and Bus B. Refer to the plant overview single line diagrams 0089-DWG-SELSTP01-EP-8001 AND 8002.

The design is based on dry type kiosk transformers with integral HV switchgear. TasWater preference is for kiosks to also include LV switchgear. The inclusion of LV switchgear is subject to space constraints and is yet to be confirmed.

MSB Bus A and Bus B supply their respective MCCs. Duty and standby loads have been balanced across the MCCs.

14.3.3 Maximum demand

Loads have been distributed across the MCCs based on their process area, duty and standby, physical location and size.

Diversity of individual loads has been assessed with duty loads assigned as their full motor load rating and standby as zero load. A common diversity factor was then assigned to each MSB. The diversity factor has been assigned as 0.8.

Transformers have been sized with a 20% spare capacity allowance. The chosen transformer rating are based on industry standard sizes in 500 kVA multiples. Transformer ratings are provided in Table 14.1.

Table 14.1 Transformer ratings

Plant area	MSB	MSB diversified load (kVA)	Transformer rating (kVA)[1]
Primary treatment	MSB-1	789	1000
Secondary treatment	MSB-2	1492	2000
Blowers	MSB-3	1955	2500
Sludge handling	MSB-4	628	1000

1. Includes 20% spare capacity

14.3.4 Switchboard and switchroom sizing

The main switchboard and MCCs are the primary items which govern the size of each switchroom. Secondary items such as PLC panels, wall mounted variable speed drives, UPS, distribution boards have also been allowed for.

Switchrooms have been sized for clearances around panels in accordance with AS 3000 and based on manufacturer published data. The drives and feeders listed in the maximum demand calculation were used to determine switchboard tier and cell sizes. Switchboard form of separation is Form 4a with a PLC tier on one side.

Switchrooms allow for 25% expansion of MCCs in length. As the MCCs are divided into two, flexibility is provided such that one MCC can be replaced without removing the other MCC from service. Therefore, free floor space has not been allocated for any new MCC to be installed in the the future.

Typical arrangements for MSB's and MCC's have been used for sizing each switchboard. Refer to Fig 13 to 15.

	3200				
	800	400	800	400	800
400	Bus Zone		Bus Zone		Bus Zone
400	SPACE 800x400	Cable zone	BUS TIE 800x1600	BUS BAR 400x1600	GL&P DB FEEDER 800x400
400	METERING 800x400				METERING 800x400
800	INCOMING ACB 800x800				INCOMING ACB 800x800
200	Cable Zone		Cable Zone		Cable Zone

Figure 13 ***MSB typical arrangement***

	600	400	600	400	600	400	600	400
400	Bus Zone		Bus Zone		Bus Zone		Bus Zone	
400	400V PROCESS CHASSIS 600x600	Cable zone	VSD 600x200	Cable zone	VSD 600x200	Cable zone	SOFTSTARTER 600x400	Cable zone
			VSD 600x200		VSD 600x200			
400	UPS FEEDER 600x300		VSD 600x200		VSD 600x200		SOFTSTARTER 600x400	
			VSD 600x200		VSD 600x200			
800	VSD 600x200		VSD 600x200		VSD 600x200		SOFTSTARTER 600x400	
	VSD 600x200		VSD 600x200		VSD 600x200			
	SPACE 600x300		VSD 600x200		VSD 600x200		FEEDER 600x200	
			VSD 600x200		SPACE 600x200		SPACE 600x200	
200	Cable Zone		Cable Zone		Cable Zone		Cable Zone	

Figure 14 ***MCC typical arrangement LHS (image split to fit page)***

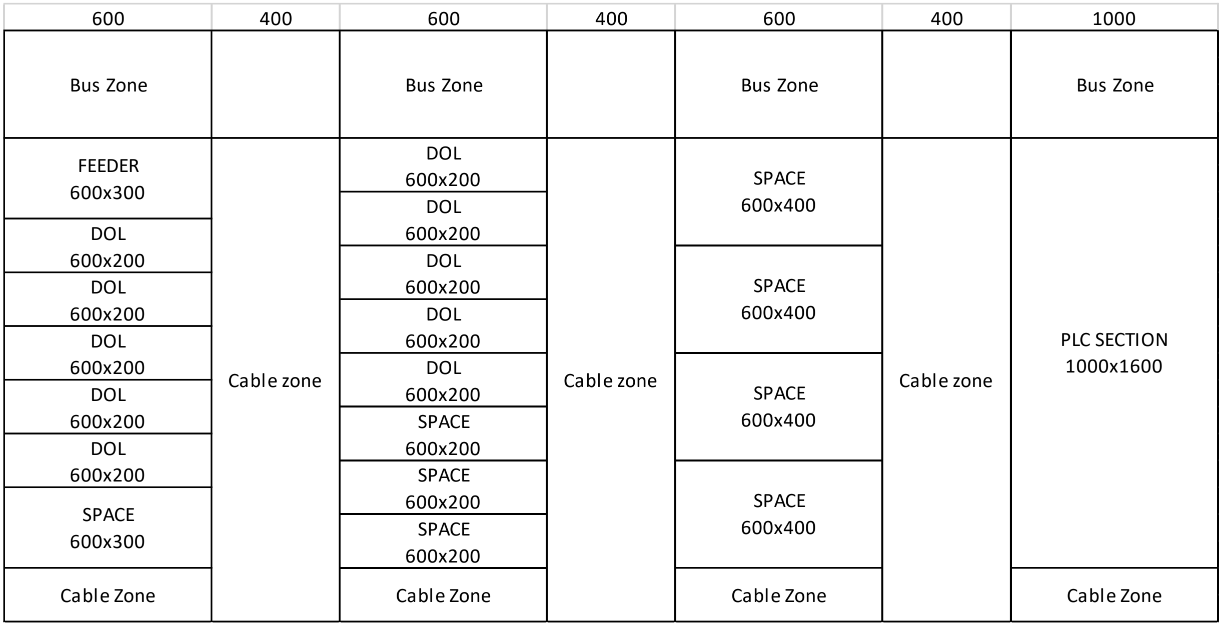


Figure 15 MCC typical arrangement RHS (image split to fit page)

Table 14.2 provides the dimensions of each switchboard.

Table 14.2 Switchboard dimensions

Switchboard	Length (m)
MSB-1	3200
MCC-1A	10200
MCC-1B	8200
MSB-2	3200
MCC-2A	9000
MCC-2B	9000
MSB-3	3200
MCC-3A	8000
MCC-3B	7000
MSB-4	3200
MCC-4A	8000
MCC-4B	9000

All switchboards are based on 620 mm deep, single sided and located in the centre of the switchroom. In accordance with the TasWater electrical standard 25% spare space in the form of switchboard width has been allowed for.

14.4 Design inputs and assumptions

14.4.1 Design input from other providers and stakeholders

Inputs from other providers and stakeholders associated with this design package are detailed in Table 14.3.

Table 14.3 Design input from other providers and stakeholders

ID	Description	Reference
DI-2000-001	Not applicable	-

14.4.2 Design assumptions

Assumptions associated with this design package are detailed in Table 14.4.

Table 14.4 Design assumptions

ID	Description	Validation
DA-2000-001	Not applicable	-

14.5 Design changes, departures and alternatives

14.5.1 Design changes

Details of any changes to this design package from the previous design stage or the Basis of Design Report and the reasons for the changes are provided in Table 14.5.

Table 14.5 Design changes from previous design stage

ID	Stage	Description	Reason for change
DC-8000-001	-	Not applicable.	-

14.6 Value engineering

Value engineering opportunities associated with this design package are summarised in Table 14.6.

Table 14.6 Value engineering assessments

ID	Description	Implemented in design
VE-8000-001	Not applicable.	N/A

14.7 Outstanding issues that may affect the design

Outstanding issues associate with this design package that may affect the design are summarised in Table 14.7.

Table 14.7 Outstanding issues

Description	Impact on design
Power supply for existing MCC1	The 30% design is based on provide an LV feeder to the existing MCC1 from the blower MCC-3A. However, there are considerations in extending the 11 kV ring main to include two additional transformers to supply this MCC. If this option is chosen then the cable routing will require amending.
Vendor data	Vendor data for transformers and switchboards is required to confirmed spatial allowances. Since AS61439 has become mandatory, we have noticed that to provide a switchboard complying with the validation requirements of AS 61439 has in some cases results in vendors offering switchboards larger than anticipated.