AdelaideAqua
Pty Ltd

Adelaide Desalination Project

EN-MP-08-A2
Marine Monitoring Plan

ENVIRONMENT PROTECTION AUTHORITY
THIS IS THE ACCEPTED Marine Monitoring Plan
REFERRED TO IN CONDITION T1036
OF EPA AUTHORISATION NUMBER 39143
SAM GAYLARD REVIEWED BY [illegible] DATE 11/10/2018
DELEGATE [redacted] DATE 11/10/2018
Shaun Thomas

Revision	Date	Description	Author	Approved
7	05/05/2012	Revised following Commissioning experience (D&C document)	JH/JC	AR
8	22/04/2015	Approved for Use	VA	TG
9	11/10/2018	Addition of objectives and data quality analysis	JA/RL	JD

Adelaide Aqua Pty Ltd

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1 Introduction

In June 2008, a development application under the Development Act 1993 was lodged by the SA Water Corporation for a desalination plant of up to 100GL per annum production capacity and based on reverse osmosis technology.

The Environmental Impact Statement (EIS) for the desalination plant was released for public comment in November 2008. SA Water released a response to public and agency submissions in February 2009.

On 26 February 2009, in the Minister's Assessment Report, development authorisation by the Minister for Urban Development and Planning (on behalf of the Governor) for the Adelaide Desalination Plant (ADP) along with the associated conditions of approval was published in the South Australian Government Gazette. Subsequent amendments to the conditions of approval were published in the Gazette on 12 March and 11 June 2009 and final development authorisation granted.

The ADP is located at Port Stanvac, south of Adelaide. It is one of SA Water's key public water supply assets, and the first large scale desalination plant delivering water into Adelaide.

AdelaideAqua Pty Ltd (AAPL) is contracted by SA Water to operate and maintain the ADP in compliance with EPA Licence No. 39143 (EPA Licence) which prescribes certain marine monitoring requirements.

2 Purpose and Scope

The purpose of this document is to:

- Describe the methodologies for all marine monitoring required to comply with the EPA Licence; and
- provide a framework for marine monitoring data acceptance criteria.

The scope of this plan is limited to the environmental marine monitoring required for the ADP for the duration of the EPA Licence. This plan and its reviews must be approved by the EPA before being implemented.

3 EPA Licence Conditions

This section describes each EPA Licence condition and provides an explanation on the purpose of each monitoring requirement and the method selected to prove compliance.

3.1 Salinity Discharge Limit

One of the potential environmental impacts of the operation of the ADP is the discharge of saline concentrate into Gulf of St Vincent. To minimise the area affected by elevated salinity levels, the discharge is diluted using duck bill valves that increase the dilution and dispersion.

Two elements can affect the dilution of the discharge: the salinity of the discharge relative to the ambient salinity and the velocity. *In situ* monitoring of the salinity demonstrates compliance with the dilution and dispersion conditions ensuring that the salinity is below the triggers that could harm the environment.

3.1.1 Licence Conditions

U-145: the average desalination outfall effluent discharge salinity must not exceed the intake salinity by a factor of 2.1 for a six-hour period. U-146: the average desalination outfall effluent discharge salinity must not exceed the intake salinity by a factor of 2.1 for a twenty-four-hour period.

3.1.2 Method

Two battery-operated Conductivity – Temperature - Depth (CTD) sensors equipped with data loggers for recording every 10min are moored 100m south (Monitoring Point 2, MP2) and north (MP4) of the outfall diffusers. The sensor heads are placed no higher than 100cm above the sea bed.

The data is downloaded and analysed every two months. If the difference salinity is higher than 1.3ppt then the procedure IN-MP-11 Exceedance of Salinity Trigger Values is applied.

The maintenance, deployment and data download of CTD systems is described in the following work instructions:

- WI-14001 Cleaning Marine Instruments
- WI-14002 Marine Instruments Service
- WI-14003 CTD Data Download
- WI-14004 CTD Deployment Procedure

Each CTD instrument is deployed for two months (maximum battery life). Each CTD is sent to CSIRO for calibration every year. A service schedule has been prepared which minimises data loss.

Figure 1 shows the location of the CTD instruments (MP2 and MP4) within the Exclusion Zone.

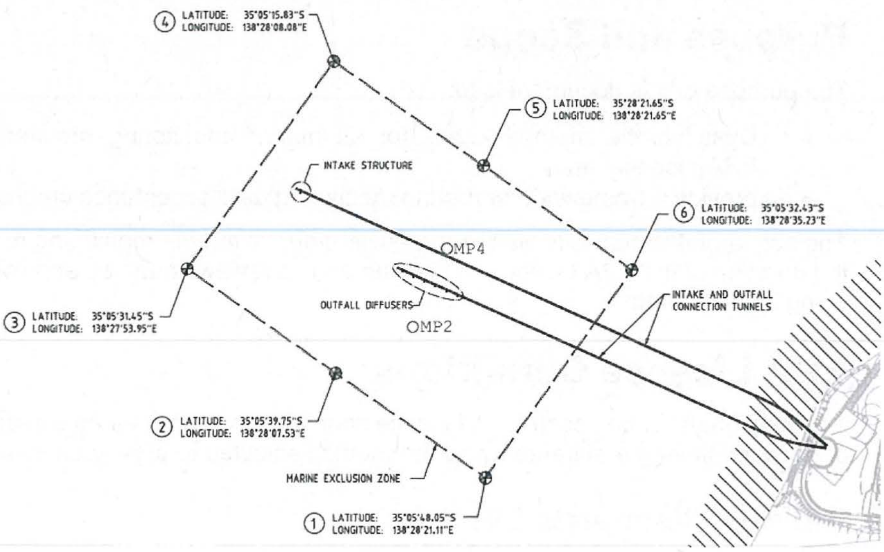

Figure 1. Location of CTD instruments MP2 and MP4

To calculate the Discharge Salinity / Intake Salinity ratio, the Supervisory Control and Data Acquisition system (SCADA) uses the Intake, Discharge and Product Water flow meters. Assuming zero salinity in the RO permeate -typically in the order of 170mg/L compared to 34,000mg/L seawater salinity-, the concentration factor (from the mass balance) is:

$$\text{Discharge Salinity / Intake Salinity} = Q_{SW} / (Q_{SW} - Q_{PER}) \qquad \text{(Eq. 1)}$$

Where:

Q_{SW}: Sea water flow entering the ADP
Q_{PER}: Permeate flow produced by the RO system

Alternatively, SCADA can use the conductivities of the intake and the different outfall streams and calculates the salinity according to Equation 2 (source AWQC):

$$TDS = 0.548\ EC + 2.2E\text{-}6\ EC^2 - 2.06E\text{-}12\ EC^3 \qquad \text{(Eq. 2)}$$

Where:

TDS: Total Dissolved Solids [mg/L]
EC: Electrical Conductivity [µS/cm] normalised to 25°C at 2% per °C, according to $EC_{25} = EC_T / [1 + 0.02\ (T - 25)]$

With the salinities obtained for every stream, SCADA can work out the mass balance to find out the discharge salinity and compares it with the intake salinity. This second method is not the preferred one since it relies on more instruments and as a result is more susceptible to errors.

If the ratio Discharge Salinity / Ambient Salinity is higher than 2.1 for 6 consecutive hours, then IN-MP-17 High Salinity Discharge is activated.

3.2 Outfall Head Loss

To achieve adequate discharge dilution, it is important to control the jet velocity. The ADP uses an array of duck bill valves that gradually open as the flow increases. This mechanism increases mixing without breaking the sea surface and it can be tracked by measuring the head loss in the outfall system. A drop in the outfall head loss can indicate the detachment of one or more duck bill valves and a higher potential environmental impact.

3.2.1 Licence Conditions

U-147: the head loss across the outfall system must not drop below the minimum allowable head loss for a six-hour period.
U-148: the head loss across the outfall system must not drop below the minimum allowable head loss for a twenty-four-hour period.

3.2.2 Method

SCADA continuously monitors the level difference between the drop shaft (below turbines floor) and the sea water. The water level at the drop shaft (h_{OUT}) is measured and the water level at the sea (h_{SEA}) is calculated from the travelling band screens wet well level (measured) and the intake flow (to calculate the intake system head loss prior to the wet well) according to Equation 3:

$$h_{SEA} = h_{WW} + \Delta h_{IN}\ (Q_{SW}) \qquad \text{(Eq. 3)}$$

Where:

h_{SEA}: Sea level [m]
h_{WW}: Wet well level [m]
Δh_{IN}: Head loss in the intake system prior to the wet well [m]
Q_{SW}: Sea water flow entering the ADP

The minimum allowable head loss across the outfall system is defined by Eq. 4, derived from a quadratic fit of the first year of operation:

$$\Delta h_{OUTmin} = -8.57E\text{-}1 + 8.12E\text{-}3 \cdot Q_{DW} + 2.69E\text{-}5 \cdot Q^2_{DW} \qquad \text{(Eq. 4)}$$

Where:

Δh_{OUTmin}: Minimum allowable head loss at the outfall [m]
Q_{DW}: Drinking Water flow [ML/d]

If the calculated outfall head loss ($h_{SEA} - h_{OUT}$) is below this minimum allowable for 6 consecutive hours, then IN-MP-18 Low Outfall Head Loss is activated.

3.3 Average Salinity Discharge Limit

The saline concentrate that results from desalinating sea water may cause harm to aquatic biota if it's not diluted. Considering the results from ecotoxicity tests, the natural variations in sea water salinity and other effects, a safe limit of 1.3 parts per thousand (ppt) salinity increase has been established.

This is different to the salinity discharge limit (section 3.1) as it measures the dilution effect out on the seabed, which is affected by a number of conditions such as:

- Salinity of the discharge
- Velocity of the discharge
- Tidal conditions
- Marine currents
- Weather

3.3.1 Licence Condition

U-149: the average salinity measured at 100m from the diffuser structure must not exceed 1.3ppt above ambient salinity.

3.3.2 Method

AAPL operates and maintains two Conductivity – Temperature – Depth (CDT) sensors and data-loggers located 100m North and South from the outfall diffusers to record water quality at the edge of the mixing zone.

AAPL downloads the data from the under-water CTD data-loggers every two months to verify that the salinity does not exceed ambient salinity by more than 1.3ppt. Since this does not provide real-time visibility of the salinity at the edge of the mixing zone, the salinity discharge and the outfall head loss (sections 3.1 and 3.2) are continuously monitored.

Equation 2 is used to calculate salinity in [mg/L] and to change the units to pass to [ppt] Eq. 5 is used:

$$\text{Salinity} = \text{TDS} / \rho_{SW} \qquad \text{(Eq.5)}$$

Where:

ρ_{SW}: Sea water density (1,026g/L for 20°C, 37ppt and 15m depth conditions).

If the average salinity measured at 100m from the diffuser structure exceeds 1.3ppt above ambient salinity, then IN-MP-11 Exceedance of Salinity Trigger Value is activated.

3.4 Seawater Intake Velocity

The intake water velocity can impact on marine biota through entrainment (sucked in) into the intake pipe and from entrapment of larger objects onto the screens. To manage this risk, the intake velocity must be set at a speed that allows for fish to safely swim away from the intake pipe.

A maximum velocity limit of 0.15m/s is considered appropriate to manage this risk.

3.4.1 Licence Condition

U-152: the seawater intake velocity at the entry to the intake structure must not exceed 0.15m/s at any time.

3.4.2 Method

Since the intake structure is static (i.e. no valves present) the intake velocity can be calculated from the seawater flow and the intake structure dimensions. The intake structure is cylindrical with the top (and bottom) covered and a grill on the circular perimeter.

Yearly inspection and removal of growth on the intake riser bars is carried out to ensure the intake velocity does not increase as a result of a partially blocked grill. Table 1 below shows the inspection frequency for different plant capacities.

Table 1. Intake Riser Inspection Frequency

Scenario	Maximum Production	Max. Intake Flow	Max. Blockage[1]	Comments
Complete shutdown	0ML/d	4.6 m^3/s	55%	Some flow needed for intake tunnel preservation
Partial shutdown	150ML/d	6.3 m^3/s	38%	Additional flow factored in for bio-growth dragging
100% available	300ML/d	9.3 m^3/s	8%	

[1] Clean grille open area: 67.7m^2

If the inspection shows a degree of blockage which is higher than the maximum blockage allowable, AAPL will increase the cleaning frequency of the bars.

AAPL provides pictures of the intake grill (prior to cleaning) to the EPA to demonstrate compliance with this licence condition.

4 Marine Monitoring Schedule

In addition to the plant process conditions above, the EPA Licence requires additional marine receiving environment monitoring to be undertaken as described in Attachment A of the licence. These conditions provide for monitoring to demonstrate whether the operation of the plant is having an impact on the adjacent biological communities.

4.1 Ambient Marine Ecological Monitoring

4.1.1 Subtidal Reef

The discharge of the saline concentrate from ADP has the potential to impact on adjacent subtidal reef communities. Adjacent reefs were first monitored in February 2009 to establish a baseline of the reef communities enabling long term comparisons at a number of sites closed to (potentially impacted) and distant from (reference) ADP.

4.1.1.1 Scope

The scope of this monitoring is to collect data on reef communities through SCUBA-based surveys of subtidal reefs at ten locations (Port Stanvac and reference sites). Monitoring using standard methods incorporating similar reefs close to (potentially impacted) and distant from the ADP discharge can determine whether any changes can be attributed to the ADP discharge.

Monitoring is undertaken once every three years, and during a monitoring year two surveys are undertaken (to study potential seasonal variability.)

Data is tested statistically to determine whether the reef communities are:

- Different at the potentially impacted locations compared to the reference locations
- Different over time (tested as a comparison to baseline as well as previous monitoring)
- Different at a site level over time (comparison to baseline and previous monitoring)

In the event of significant differences, interpretation should discuss potential causes.

Table 2. Subtidal survey monitoring sites

Site	Impact / Reference	Latitude	Longitude
Hallett Cove North	R	-35.0736	138.4943
Hallett Cove South	R	-35.0525	138.5027
Port Stanvac North	I	-35.0976	138.4775
Port Stanvac South	I	-35.1034	138.4742
Horseshoe Reef Inside	R	-35.1379	138.4629
Horseshoe Reef Outside	R	-35.1394	138.458
Noarlunga Reef Inside	R	-35.1472	138.4636
Noarlunga Reef Outside	R	-35.1474	138.4630
Moana Reef Inside	R	-35.2091	138.4643
Moana Reef Outside	R	-35.2065	138.4622

4.1.1.2 Method

Data is to be collected on the current state of subtidal reefs adjacent to the discharge of saline concentrate from theADP, and at reference sites at a distance from the discharge site. The data collected as part of this survey must be compared with previous reports. As such, all data will be collected using standard procedures and site locations that were used in the initial desalination plant site assessment (Theil & Tanner[1]) to ensure comparability, consistency and commensurability with the past (EIS and previous reports) and future works.

Data is collected during 2 seasons each monitoring year using the 'Reef Health' methods described by Turner et al[2]. This methodology uses three sampling strategies along a number of 50m transects (two in this case) to target different components of the reef flora and fauna:

- Emergent fish, i.e. those visible in the water column or above benthic organisms – a belt transect of width 5m
- Cryptic fish and larger non-sessile invertebrates – a belt transect of width 1m
- Macroalgae and sessile invertebrates – line intercept transect (first 20m only)

Similar methods are used by the Reef Life Survey[3] program, which was established by the University of Tasmania and has national uptake. In order to make the data compatible with the Reef Life Survey methodology, and therefore increase their future usefulness, additional fish and invertebrate transects are undertaken (on both sides of the transect line) and photo quadrat images are taken every 2.5m along the 50m transect line. These images also serve to provide a permanent record for audit and quality assurance of the percentage cover estimates from the line intercept transect (LIT) data.

In the event that any of the hypotheses tested above show a significant difference, discussions with the EPA will be held as soon as practicable to discuss possible mitigation measures.

[1] Theil MJ and Tanner JE (2009). *Marine characterisation study for possible seawater desalination plant to supply Adelaide, final report prepared for South Australian Water Corporation.* SARDI publication number F2008/001128-1. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. 66 pp.

[2] Turner DJ, Kildea TN and Westphalen G (2007). *Examining the health of subtidal reef environments in South Australia, Part 2: Status of selected South Australian reefs based on the results of the 2005 surveys.* South Australian Research and Development Institute (Aquatic Sciences), Adelaide, 97 pp. SARDI Publication Number RD03/0252-6.

[3] Reef Life Survey (2015). *Standardised survey procedures for monitoring rocky & coral reef ecological communities.* Reef Life Survey Program.

4.1.2 Baited Remote Underwater Video

Baited Remote Underwater Video Surveys (BRUVS) are used to assess the relative abundance, number of species and size of fish in a marine area. It also examines spatial and temporal variability of fish assemblages. BRUVS are a widely used technique for rapidly assessing fish communities without impacting upon them.

BRUVS were undertaken in 2009 – 2011 in two habitat types (unconsolidated sediment and low reef); both within and outside the predicted zone of influence of the saline outfall. This two-year program forms a baseline against which the effects from the saline concentrate discharge via outfall can be assessed.

4.1.2.1 Scope

The aim of this monitoring program is to monitor local fish populations in four distinct study areas: Distant Soft; Distant Reef; Near Soft and Near Reef .

Two seasonal video fish traps need to be undertaken each monitoring year, with one monitoring year every three calendar years. Each survey must comprise 3 measurements made on each of two consecutive days (6 replicate observations) at each site.

The reef sites to undertake BRUVS will be same used for the subtidal monitoring (see Table 2.) No BRUVS will be undertaken in seagrass or soft-sediment locations.

Data is tested statistically to determine whether the fish communities within each habitat type are:

- Different at the potential impacted (near) locations compared to the reference (distant) locations
- Different over time (tested as a comparison to baseline as well as previous monitoring)
- Different at a site level over time (comparison to baseline and previous monitoring)

In the event of significant differences, interpretation should discuss potential causes.

4.1.2.2 Method

Each BRUVS system consists of two video cameras orientated along the horizontal plane relative to the seabed floor. The cameras are fitted with a wide-angle lens and attached to a steel frame. The use of a stereo camera BRUVS system allows the assessment of species diversity, numbers and size distributions.

The resulting data will be analysed to enable a statistical comparison between potentially impacted desalination sites, against reference sites to determine if there is a difference in fish communities (species diversity, numbers and size of distributions) attributable to the operations of the desalination plant discharge.

In the event that any of the hypotheses tested above show a significant difference, discussions with the EPA will be held as soon as practicable to discuss possible mitigation measures.

4.1.3 Infauna Survey

Infauna surveys have been undertaken since May 2009 to provide baseline data on reference sites, thereby allowing assessment of the extent to which the operation of the ADP could have an impact on ecological communities within sediments.

4.1.3.1 Scope

The scope of this monitoring is to collect samples of the seabed substrate and analyse the meiofauna (all 26 taxa) and macrofauna (the 25 most important species only).

Two surveys need to be undertaken each monitoring year, with one monitoring year every three calendar years.

Table 3. Infauna survey monitoring sites

Site	GPS Southing	GPS Easting
Pt Stanvac 1	35'05.932	138'27.805
Pt Stanvac 2	35'05.727	138'27.625
Pt Stanvac 3	35'05.296	138'27.676
Pt Stanvac 4	35'05.101	138'28.224
Pt Stanvac 5	35'05.172	138'28.518
Pt Stanvac 6	35'05.796	138'28.142
Pt Stanvac 7	35'05.623	138'27.974
Pt Stanvac 8	35'05.437	138'27.948
Pt Stanvac 9	35'05.372	138'28.315
Pt Stanvac 10	35'05.440	138'28.395
Pt Noarlunga 1	35'08.710	138'26.432
Pt Noarlunga 2	35'09.084	138'25.871
Pt Noarlunga 3	35'09.088	138'26.258
Pt Noarlunga 4	35'09.134	138'26.744
Pt Noarlunga 5	35'09.440	138'26.287
Glenelg 1	35'00.377	138'26.971
Glenelg 2	34'59.880	138'26.385
Glenelg 3	34'59.622	138'25.674
Glenelg 4	34'59.140	138'25.079
Glenelg 5	34'59.533	138'25.247

4.1.3.2 Method

The sampling method will be consistent with previous monitoring to enable valid comparisons over time.

For each survey, samples are collected from 20 sites including 10 sites in the vicinity of the ADP discharge (potentially impacted) and an additional 10 reference sites distributed evenly over 12km north and 7km south at similar depths and with the similar bottom types.

The following metrics will be assessed for both meiofauna and macrofauna:

- Taxa richness and diversity
- Abundances
- Community structure
- Sediment relationship

Data is tested statistically to determine whether the benthic communities are:

- Different at the potentially impacted (near) locations compared to the reference (distant) locations
- Different over time (tested as a comparison to baseline as well as previous monitoring)

In the event that any of the hypotheses tested above show a significant difference, discussions with the EPA will be held as soon as practicable to discuss possible mitigation measures.

4.2 Intake Monitoring

4.2.1 Seawater Characteristics

Seawater quality characteristics are measured and recorded from the intake to allow a direct comparison to the seawater characteristics of the discharge. This ensures that the quality of the discharge is consistent with predictions of normal operations and whether any issue with quality is attributed to external water quality (i.e. not related to the ADP).

4.2.1.1 Scope (online)

The aim of this marine monitoring component is to measure conductivity, temperature, pH and dissolved oxygen (DO) of the seawater at the intake every 10min. The instruments will be calibrated as per the manufacturer's specification.

4.2.1.2 Method (online)

Data is downloaded in 10min intervals from the following plant instruments:

- For SP1:
  - Conductivity (301-CIT-1501 and 301-CIT-1502)
  - Temperature (301-TIT-1501)
  - pH (301-AIT-1501)
  - Dissolved oxygen (301-AIT-1506)
- For SP2:
  - Conductivity (301-CIT-2501 and 301-CIT-2502)
  - Temperature (301-TIT-2501)
  - pH (301-AIT-2501)
  - Dissolved oxygen (301-AIT-2506)

4.2.1.3 Scope (not online)

Quarterly seawater analysis of the following parameters:

- Biological Oxygen Demand (BOD)
- Suspended solids
- Total nitrogen (as N)
- Total phosphorus (as P)
- Metals (Zinc, Lead and Copper)

4.2.1.4 Method (not online)

Samples are collected by a flow-weighted composite sampler over a 24h period and sent to a NATA accredited laboratory for analysis on the same day or else within NATA-accredited laboratory sample holding timeframe.

All sampling is conducted by trained personnel (laboratory technician, operator assistant or process controller). Samples are collected under representative plant conditions (i.e. when plant is running continuously until a steady state flow is achieved).

4.2.2 Intake Volume

The intake volume, together with the discharge volume, can be used to calculate the recovery of the plant (i.e. how much water is desalinated for every unit of water pumped out of the sea.)

It is necessary to note that whilst a high recovery indicates an efficient use of the seawater, it also increases the salinity of the discharge and the electricity consumption of the desalination process.

4.2.2.1 Scope

Seawater volume is monitored daily via the online flow meter and recorded through the SCADA system.

4.2.2.2 Method

Data is downloaded in 10min intervals from the flowing plant instruments:

- Flow meter (301-FIT-1501) for SP1
- Flow meter (301-FIT-2501) for SP2

4.3 Discharge Monitoring (Outfall)

4.3.1 Discharge Volume

The water discharged to the Gulf of St Vincent constitutes the main waste stream from the desalination process and can have a negative effect on the receiving environment. In addition to salinity (which is monitored as described in sections 3.1 and 3.3 above), other characteristics have the potential to impact on local water quality. These are measured and compared to the quality of the seawater through the intake.

Discharge volume can be used to calculate the recovery of the plant (i.e. the amount of desalinated water produced for every unit of seawater pumped from the sea).

4.3.1.1 Scope

Water discharge volume is monitored daily via the online flow meter and recorded through the SCADA system.

4.3.1.2 Method

It is necessary to download the 10min data from the flowing trends at the outfall and calculate the ML:

- Flow meter (951-FIT-1001B) from SCBT1
- Flow meter (951-FIT-2001B) from SCBT2
- Flow meter (951-FIT-1001A) from the overflow line

4.3.2 Discharge Characteristics

4.3.2.1 Scope (online)

The scope is to measure conductivity, temperature, pH, DO and chlorine (or alternatively Oxidation / Reduction Potential, ORP) of the whole effluent discharge every 10min. Measured and reported for each stream separately.

4.3.2.2 Method (online)

It is necessary to download the 10min data from the flowing trends at the discharge:

- For Saline Concentrate Buffering Tank 1 (SCBT1):
  - Conductivity (951-CIT-1501)
  - Temperature (951-TIT-1501)
  - pH (951-AIT-1504)
  - Dissolved oxygen (951-AIT-1502)
  - Chlorine (951-AIT-1501)
- For SCBT2:
  - Conductivity (951-CIT-2501)
  - Temperature (951-TIT-2501)
  - pH (951-AIT-2504)
  - Dissolved oxygen (951-AIT-2502)
  - Chlorine (951-AIT-2501)

- For UF CIP Neutralization Tank 1:
  - Conductivity (910-CIT-1001E)
  - Temperature (910-TIT-1001)
  - pH (910-AIT-1001A)
  - Dissolved oxygen (910-AIT-1001F)
  - Chlorine (910-AIT-1001C)
- For UF CIP Neutralization Tank 2:
  - Conductivity (910-CIT-2001E)
  - Temperature (910-TIT-2001)
  - pH (910-AIT-2001A)
  - Dissolved oxygen (910-AIT-2001F)
  - Chlorine (910-AIT-2001C)
- For Holding Tank:
  - Conductivity (904-CIT-0204)
  - Temperature (904-TIT-0002)
  - pH (904-AIT-0201)
  - Dissolved oxygen (904-AIT-0205)
  - Chlorine (904-AIT-0202)
- For Waste and Drains Tank:
  - Conductivity (904-CIT-0204)
  - Temperature (904-TIT-0001)
  - pH (904-AIT-0101)
  - Dissolved oxygen (904-AIT-0205)
  - Chlorine (904-AIT-0102)

A Standard Operating Procedure (SOP) covers the details of sampling points and procedures. Note that the limit of reading for chlorine is 0.1mg/L. Any reading less than 0.1mg/L is treated as no chlorine.

Conductivity, temperature, DO, pH and Cl2 of whole of effluent discharge every 10min is calculated based the discharge flow of each stream.

4.3.2.3 Scope (not online)

Quarterly seawater analysis of the following parameters:

- Biological Oxygen Demand (BOD)
- Suspended solids
- Total nitrogen (as N)
- Total phosphorus (as P)
- Metals (zinc, lead and copper)

4.3.2.4 Method

Samples are collected by a flow-weighted composite sampler over a 24h period and sent to a NATA accredited laboratory for analysis on the same day or else within NATA-accredited laboratory sample holding timeframe.

All sampling is conducted by trained personnel (laboratory technician, operator assistant or process controller). Samples are collected under representative plant conditions (i.e. when plant is running continuously until a steady state flow is achieved).

4.4 Receiving Environment Monitoring (Diffuser Performance Validation)

4.4.1 Salinity (100 metres)

Salinity and temperature of seawater is measured at MP2 and MP4 every 10 minutes to provide sufficient data to prove compliance with Licence condition U-149 (see section 3.1 above.)

5 Data validation

For validation of the data obtained from instrumentation, AAPL have adopted the following considerations:

- When the servers go off-line as a result of a fault and there is no data available, no data is provided. The ADP has redundant servers to limit the instances when this occurs. Typically resetting the servers fixes the issues. The ADP has 24/7 on-call personnel that can do this.
- On-line analytical instrumentations used on the ADP are of a type that requires constant flow to operate optimally.
- When the plant is shut down there won't be any flow through the instruments.
- On line analytical instruments are validated and calibrated (adjusted) according to the manufacturers recommendations.
- If any data is excluded from the reports, this is clearly stated in the data commentary and only excluded based on a valid scientific justification which will be also reported. Only verified and checked data is included in the report.
- When there is duplication in the instruments, the one in use is called 'duty' and the second one will be called 'standby'. For reporting purposes only the 'duty' instrument must be considered.

5.1 Seawater Characteristics Instrumentation

Data related to this condition will be discarded when flow meters (301-FIT-1501 and 301-FIT-2501) show $0m^3/h$.

Table 4 below provides a summary of the normal operation conditions at this location (intake).

Table 4. Instrumentation used for Seawater Characteristics

Condition	Tag	Normal Operation Range	Comments
Conductivity	301-CIT-1501	Based on salinity	
Conductivity	301-CIT-1502	Based on salinity	
Conductivity	301-CIT-2501	Based on salinity	
Conductivity	301-CIT-2502	Based on salinity	
Salinity	calculation	32-42 ppt	Plant design within this salinity range
Temperature	301-TIT-1501	No limit	
Temperature	301-TIT-2501	No limit	
pH	301-AIT-1501	8.0-8.5	Seawater normal pH is 8.0-8.3. Could be below 8.0 when performing an acid or a combined shock.
pH	301-AIT-2501	8.0-8.5	Seawater normal pH is 8.0-8.3. Could be below 8.0 when performing an acid or a combined shock.
DO	301-AIT-1506	6.5-11.5 mg/L	DO depends on temperature and this is the normal DO range for seawater.
DO	301-AIT-2506	6.5-11.5 mg/L	DO depends on temperature and this is the normal DO range for seawater.

5.2 Discharge Characteristic Instrumentation

The discharge characteristics for the outfall are made up out of several streams from different parts of the plant. The tables below provide details of the tanks and the instrumentation used for reporting purposes.

Data related to SCBT 1 is discarded when flow meter 951-FIT-1001B shows 0m³/h and data related to SCBT 2 is discarded when flow meter 951-FIT-2001B shows 0m³/h because the instrument doesn't have enough flow for the sensor.

Table 5. Instrumentation used for Discharge Characteristics (SCBTs)

Condition	Tag	Normal Operation Range	Comments
Conductivity	951-CIT-1501	Based on salinity	
Conductivity	951-CIT-2501	Based on salinity	
Salinity	calculation	32-85 ppt	Maximum plant recovery 50%
Temperature	951-TIT-1501	No limit	
Temperature	951-TIT-2501	No limit	
pH	951-AIT-1504	7.5-8.5	Could be below 7.5 when performing an acid or a combined shock; or when discharging SBS solution from rack preservation
pH	951-AIT-2504	7.5-8.5	Could be below 7.5 when performing an acid or a combined shock; or when discharging SBS solution from rack preservation
DO	951-AIT-1502	6.5-11.5 mg/L	Could be below 6.5 when performing an acid or a combined shock; or when discharging SBS solution from rack preservation
DO	951-AIT-2502	6.5-11.5 mg/L	Could be below 6.5 when performing an acid or a combined shock; or when discharging SBS solution from rack preservation
chlorine	951-AIT-1501	<0.1 mg/L	0.1 is the low limit detection of the chlorine instrument
chlorine	951-AIT-2501	<0.1 mg/L	0.1 is the low limit detection of the chlorine online instrument

Data related to UF CIP Neutralization Tank 1 is discarded when valve 910-XV-1001E is <1% open and data related to UF CIP Neutralization Tank 2 is discarded when valve 910-XV-2001E is <1% open because those tanks work in batch mode.

Sometimes the valve is left opened after the tank is drained; in these instances the data is also discarded.

Table 6. Instrumentation used for Discharge Characteristics (UF CIP Neutralization Tanks)

Condition	Tag	Normal Operation Range	Comments
Conductivity	910-CIT-1001E	Based on salinity	
Conductivity	910-CIT-2001E		
Salinity	calculation	No limit	Filtrate seawater is used for UF CIP or UF maintenance backwashes
Temperature	910-TIT-1001	No limit	
Temperature	910-TIT-2001	No limit	
pH	910-AIT-1001A	7.5-8.5	Normal operation range after neutralization Could be higher or lower is the neutralization has not done properly
pH	910-AIT-2001A	7.5-8.5	Normal operation range after neutralization Could be higher or lower is the neutralization has not done properly

Table 6. Instrumentation used for Discharge Characteristics (UF CIP Neutralization Tanks) (cont.)

Condition	Tag	Normal Operation Range	Comments
DO	910-AIT-1001F	6.5-11.5	Could be below 6.5 when over neutralised chlorine with SBS solution.
DO	910-AIT-2001F	6.5-11.5	Could be below 6.5 when over neutralised chlorine with SBS solution.
Chlorine	910-AIT-1001C	<0.1 mg/L	0.1 is the low limit detection of the chlorine online instrument
Chlorine	910-AIT-2001C	<0.1 mg/L	0.1 is the low limit detection of the chlorine online instrument

Data related to the Holding Tank is discarded when valve 904-XV-0002 is <1% open because this tank works in batch mode.

Sometimes the valve is left opened after the tank is drained; in these instances the data is also discarded.

Table 7. Instrumentation used for Discharge Characteristics (Holding Tank)

Condition	Tag	Normal Operation Range	Comments
Conductivity	904-CIT-0204	Based on salinity	
Salinity	calculation	No limit	
Temperature	904-TIT-0002	No limit	
pH	904-AIT-0201	7.5-8.5	Could be higher pH when Lime clarifier is getting emptied
DO	904-AIT-0205	6.5-11.5	Could be below 6.5 when over neutralised chlorine with SBS solution
chlorine	904-AIT-0202	<0.1 mg/L	0.1 is the low limit detection of the chlorine online instrument

Data related to the Waste and Drains Tank is discarded when valve 904-XV-0008 is <1% open. because this tank works in batch mode.

Table 8. Instrumentation used for Discharge Characteristics (Waste and Drains Tank)

Condition	Tag	Normal Operation Range	Comments
Conductivity	904-CIT-0204	Based on salinity	
Salinity	calculation	No limit	
Temperature	904-TIT-0001	No limit	
pH	904-AIT-0101	7.5-8.5	Could be higher pH when Lime clarifier is getting emptied
DO	904-AIT-0205	6.5-11.5	
chlorine	904-AIT-0102	<0.1 mg/L	0.1 is the low limit detection of the chlorine online instrument