

**Review of DO and pH monitoring licence conditions for the Adelaide
Desalination Plant:
June 2014**

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EXECUTIVE SUMMARY

Purpose

This document represents a report on the extent to which monitoring of DO and pH from selected sites in the vicinity of Port Stanvac meets with the EPA Licence Conditions for the construction and operation of the Adelaide Desalination Plant (ADP) over the period February 2009 to 12-Dec-2013. The monitoring reports were associated with the construction (including commissioning) of the desalination plant (by AdelaideAqua D&C Consortium – AAD&C) from February 2009 to 12-Dec-2012 and to the operation of the desalination plant (AdelaideAqua Pty Ltd) from 12-Dec-2012 to 12-Dec-2013.

Background

AdelaideAqua Pty Ltd is the operator of the Adelaide Desalination Plant at Port Stanvac South Australia. Operation of the ADP requires the discharge of reject water to the marine environment; this activity was originally conducted under a licence issued to AAD&C by the Environment Protection Authority of South Australia (EPA Licence Number 26902) and subsequently under another licence issued to AAPL (EPA Licence Number 39143). These licences authorised AAD&C and AAPL to undertake a series of activities of environmental significance under Schedule 1 Part A of the Environment Protection Act 1993 (the Act). The licences had specific requirements in relation to “Discharges to Marine Waters” that are the subject of this report.

Section 14 (305-626) of the licence requires that the licensee must ensure that:

1. An independent review of all marine monitoring is conducted by independent specialist(s) as approved in writing by the EPA prior to the review commencing;
2. All marine monitoring from the period commencing with the issue of the licence and ending 12 months after project handover of the 100 GL desalination plant is included in the review; and
3. The full results of the review are provided to the EPA not more than 18 months after project handover of the 100 GL desalination plant.

The EPA has also advised that prior to appointment, the independent reviewer must be able to demonstrate to the EPA that:

1. They will use their own professional judgment;
2. They will take appropriate specialised advice when the issue is outside their expertise;
3. Their opinions will be reached independently;
4. In forming opinions, they will not be unduly influenced by the views or actions of others who may have an interest in the outcome of the review; and
5. They must declare any real or apparent conflict of interest.

With the approval of the EPA, Anthony Cheshire (the author of this report) was selected by AdelaideAqua Pty Ltd (AAPL) to undertake this review.

Approach

This review of DO and pH monitoring encompassed a study of all documentation provided by AdelaideAqua Pty Ltd which comprised a series of 16 monitoring reports each of which was produced by staff at AAD&C, AAPL or by experts contracted by the parties for that purpose.

Each report has been critically reviewed and key issues that pertain to compliance with the licence conditions have been aggregated into a summary that has been presented in this report.

Specific requirements

To consider the work done against the Scheduled Marine Monitoring Requirements detailed in Attachment A to Licences 26902 and 39143. These being:

Licence 26902 (1-Dec-2010 through 31-Dec-2012): Twice per month for at least 24 hours each time in a variety of plant operational modes and receiving environment conditions.

Licence 39143 (1-Jan-2013 through 31-Dec-2013): Twice per month for at least 24 hours each time in a variety of plant operational modes and receiving environment conditions.

General requirements

In addition the EPA require that the Independent Reviewer is to undertake a technical review of all marine monitoring results from the commencement date of the Licence 26902 (D&C) until 12 December 2013 (12 months after plant handover) in order to assess the environmental impact of the desalination plant. This matter will be addressed in a subsequent report.

Conclusion

Monitoring for DO and pH is consistent with the licence conditions in that data were collected on 183 days over the period 1-Jan-2012 to 31-Dec-2013. The licence had a minimal requirement of 48 days. These days were distributed across both years (48 days in 2012 double that required and 143 days in 2013 triple the minimum requirement) covering the full range of seasonal and operational conditions (including discharge rates between 0 and 356 MLD).

With the agreement of the EPA no data were collected for the period prior to 1-Jan-2012; it is notable that "First Water" occurred on 01-Jun-2011 and that operation of the plant was intermittent up until full production was achieved for SP1 (21-Mar-2012) and SP2 (31-May-2012). The data therefore substantively cover the periods during mid-phase testing and operational start-up.

LICENCE CONDITION: DO AND PH MONITORING

In the following the specific requirements pertaining to the licence condition (DO and pH monitoring) are summarised along with information about the documents that have been reviewed.

Documents reviewed for this licence condition:

Document Name	Reference
salinity_ph_do_feb12.pdf	Kildea, T.N. and Andreacchio, L. (2012). Salinity, pH and dissolved oxygen water quality data from the ADP marine exclusion zone, February 2012. Australian Water Quality Centre, Adelaide.
salinity_ph_do_mar12.pdf	Kildea, T.N. and Andreacchio, L. (2012). Salinity, pH and dissolved oxygen water quality data from the ADP marine exclusion zone, March 2012. Australian Water Quality Centre, Adelaide.
salinity_ph_do_may12.pdf	Kildea, T.N. and Andreacchio, L. (2012). Adelaide Desalination Project: Salinity, pH and dissolved oxygen water quality data, marine exclusion zone. February 2012. Australian Water Quality Centre. Note: The title should read May 2012.
salinity_ph_do_sep12.pdf	Kildea, T.N. and Andreacchio, L. (2012). Adelaide Desalination Project: Salinity, pH and dissolved oxygen water quality data, marine exclusion zone. March 2012. Australian Water Quality Centre, Adelaide. Note: The title should read September 2012
ADP Dissolved Oxygen and pH October 2012.pdf	Kildea, T.N. and Andreacchio, L. (2012). Adelaide Desalination Project: Salinity, pH and dissolved oxygen water quality data, marine exclusion zone. October 2012. Australian Water Quality Centre, Adelaide.
ADP Dissolved Oxygen and pH November 2012.pdf	Kildea, T.N. and Andreacchio, L. (1). Adelaide Desalination Project: Salinity, pH and dissolved oxygen water quality data, marine exclusion zone. November 2012. Australian Water Quality Centre, Adelaide.
ADP Dissolved Oxygen and pH January 2013.pdf	Andreacchio, L. and Kildea, T.N. (2013). Adelaide Desalination Project: Salinity, pH and dissolved oxygen water quality data, marine exclusion zone. January 2013. Australian Water Quality Centre, Adelaide.
ADP Dissolved Oxygen and pH February 2013.pdf	Kildea, T.N. and Andreacchio, L. (2013). Adelaide Desalination Project: Salinity, pH and dissolved oxygen water quality data, marine exclusion zone. February 2013. Australian Water Quality Centre, Adelaide.
ADP Dissolved Oxygen and pH March 2013.pdf	Kildea, T.N. and Andreacchio, L. (2013). Adelaide Desalination Project: Salinity, pH and dissolved oxygen water quality data, marine exclusion zone. March 2013. Australian Water Quality Centre, Adelaide.
ADP Dissolved Oxygen and pH April 2013.pdf	Andreacchio, L. and Kildea, T.N. (2013). Adelaide Desalination Project: Salinity, pH and dissolved oxygen water quality data, marine exclusion zone. April 2013. Australian Water Quality Centre, Adelaide.
ADP Dissolved Oxygen and pH May_June 2013.pdf	Andreacchio, L. and Kildea, T.N. (2013). Adelaide Desalination Project: Salinity, pH and dissolved oxygen water quality data, marine exclusion zone. May/June 2013. Australian Water Quality Centre, Adelaide.

Document Name	Reference
ADP Dissolved Oxygen and pH July 2013.pdf	Andreacchio, L. and Kildea, T.N. (2013). Adelaide Desalination Project: Salinity, pH and dissolved oxygen water quality data, marine exclusion zone. July 2013. Australian Water Quality Centre, Adelaide.
DO and pH report August_September 2013.pdf	Andreacchio, L. and Kildea, T.N. (2013). Adelaide Desalination Project: Salinity, pH and dissolved oxygen water quality data, marine exclusion zone. August/September 2013. Australian Water Quality Centre, Adelaide.
DO and pH report September_October 2013.pdf	Andreacchio, L. and Kildea, T.N. (2013). Adelaide Desalination Project: Salinity, pH and dissolved oxygen water quality data, marine exclusion zone. September/October 2013. Australian Water Quality Centre, Adelaide.
DO and pH report October_November 2013.pdf	Andreacchio, L. and Kildea, T.N. (2014). Adelaide Desalination Project: Salinity, pH and dissolved oxygen water quality data, marine exclusion zone. October/November 2013. Australian Water Quality Centre, Adelaide.
DO and pH report November_December 2013.pdf	Kildea, T.N., (2014). Adelaide Desalination Project: Salinity, pH and dissolved oxygen water quality data, marine exclusion zone. November/December 2013. Australian Water Quality Centre, Adelaide.

Specific requirement (see Attachment A – Marine Monitoring Schedule):

Licence 26902 (1-Dec-2010 through 31-Dec-2012): Twice per month for at least 24 hours each time in a variety of plant operational modes and receiving environment conditions.

Licence 39143 (1-Jan-2013 through 31-Dec-2013): Twice per month for at least 24 hours each time in a variety of plant operational modes and receiving environment conditions.

Overall summary in relation to DO and pH monitoring

The objective of the monitoring program was to ensure that DO (dissolved oxygen) and pH (measure of acidity or basicity) were not adversely impacted by the discharge of saline concentrate into receiving waters. DO is a critical measure of ecosystem health in that oxygen is essential for all life and pH is a physico-chemical property of seawater that regulates many chemical and bio-physical processes in marine ecosystems (e.g. shell formation in molluscs, activity of nitrifying bacteria or the growth of calcified algae).

DO is generally close to saturation levels in well mixed coastal waters (typically 6.5 to 9 mg/L and this varies with temperature) while pH is strongly buffered in seawater at a more or less constant level of 8.1 (8.0-8.2). The desalination process involves the acidification of water taken into the plant to improve operational performance (which can result in a drop in pH below ambient levels). Similarly, DO is often reduced as a result of desalination. Normal plant operations include processes to readjust both DO and pH back to ambient levels prior to discharge; it is necessary therefore to monitor these parameters to ensure that discharge waters do not impact on ambient water quality.

Specific objectives for the monitoring program were:

1. To make measurements for at least 24 hours twice per month OR
2. To make measurements over an extended period during the month across a range of plant operational modes and environmental conditions.

Each measurement series was undertaken using a sensor package incorporating a DO (dissolved oxygen), pH, temperature and salinity probe; data were logged every 10 minutes. Data were also obtained on water depth above the instrument which provided a proxy for tidal fluctuations throughout the period of the deployment. The probe was deployed 0.5 m above the sea floor and attached to a monitoring buoy at a site approximately 100 m north of the ADP diffuser. The probe was typically deployed for a minimum of 2 to 4 days (twice per month) or 10 to 14 days (once per month), and then retrieved and the data downloaded. The data presented generally includes all data collected over the period of the deployment. If there was any bio-fouling or measurement failure during the period of deployment the last correct 24 hour readings were used.

Water quality assessment criteria were set at a pH of 8.1 and an expected DO concentration of greater than 6 mg/L (note that some documents report percent saturation but this varies with temperature and salinity and therefore an absolute measure of dissolved oxygen concentration is deemed to be more biologically and ecologically meaningful).

As detailed below (Table 1) both DO and pH were collected periodically over the period from January 2012 to December 2013. Data were generally collected monthly although some months were missed with the agreement of the EPA (Table 1) in some cases the collection period was more extended and covered the full range of operational conditions (defined in terms of plant production volumes) as well as covering a wide range of environmental conditions (seasonal and tidal fluctuations).

In summary, monitoring data were recorded over 183 days between 1-January-2012 and 31-Dec-2012 which is equivalent to 25% of all days over this period. The specific licence condition calls for a minimum monitoring intensity of 2 days per month (24 days per year) equivalent to 6.6% of all days over the period. Even taking account of the days on which the equipment failed the monitoring intensity was at least three times that required under the licence conditions and spanned the full range of operating conditions from zero production through to full production (discharge rate of 356 MLD).

It is also noted that with the agreement of the EPA¹ surveys were not undertaken in months when the plant was not operating in 2011 or 2012; on this basis there are no reports for 2011 or for the months of January 2012, April 2012, June 2012, July 2012, August 2012 or December 2012.

¹ The EPA had agreed that water quality measurements were not required for these months as background water quality data were still being collected from the monthly water quality profiles and the intention of measuring dissolved oxygen and pH over 24 hours was to substantiate that ambient concentrations were above water quality policy criteria (Environment Protection Water Quality Policy 2003) when the plant was operating.

Table 1 – Summary of data collected over monitoring program with additional commentary on data quality. Data were collected on 142 days over the 2 year period including 115 days when the plant was operating. While some data were rejected due to sensor failure, 88% of data readings were considered valid.

Month	Deployment				Daily discharge volumes (MLD) during deployment		Data quality		Additional comments
	Start Date	End Date	Period (days)	Plant operating (days)	Minimum	Maximum	DO	pH	
January	16-Jan-12	23-Jan-12	8	8	129	230	OK	OK	
February	21-Feb-12	24-Feb-12	4	4	5	56	OK	OK	
March	19-Mar-12	22-Mar-12	4	4	79	182	OK	Poor	pH electrode likely to have failed
May	4-May-12	14-May-12	11	9	0	97	OK	no data	pH electrode failed
September	11-Sep-12	17-Sep-12	7	7	30	148	OK	OK	
October	4-Oct-12	9-Oct-12	6	6	82	145	OK	OK	
November	30-Oct-12	06-Nov-12	8	8	50	317	OK	OK	
February	5-Feb-13	14-Feb-13	11	11	147	241	OK	OK	
March	15-Mar-13	24-Mar-13	10	10	65	196	OK	OK	
April	5-Apr-13	19-Apr-13	15	3	169	174	OK	OK	
May	28-May-13	31-May-13	3	3	7	180	OK	OK	
June	1-Jun-13	11-Jun-13	12	12	136	356	OK	OK	
July	16-Jul-13	26-Jul-13	11	11	61	88	OK	OK	
August	28-Aug-13	31-Aug-13	4	0	0	0	OK	OK	Planned shutdown from 28-Aug-2013 to 8-Sep-2013
September	1-Sep-13	11-Sep-13	12	3	45	95	OK	OK	
September	24-Sep-13	30-Sep-13	7	7	156	223	Poor	OK	DO mg/L not provided only % sat - not clear how %saturation was determined given failure of salinity sensor
October	1-Oct-13	8-Oct-13	9	9	128	260	Poor	OK	
November	25-Oct-2013	15-Nov-2013	21	21	113	322	OK	OK	
December	27-Nov-2013	17-Dec-2013	20	20	0	277	OK	OK	
Summary	1-Jan-12	31-Dec-13	183	293	0	356	91%	92%	% = valid measurements

Appendix A KEY DATES IN PLANT CONSTRUCTION AND OPERATION

The following provides a list of key dates in the construction and operation of the plant. This material provides background to the review and in particular places the analysis and interpretation of each of the monitoring reports into context with the activities that were occurring on-site in the period leading up to the monitoring event.

Date	Activity
01-Feb-2009	Construction activities commenced
16-Nov-2009	Maritime platform arrived on site
08-Jul-2010	Maritime platform completed operations
01-Jun-2011	First discharge and first intake of seawater
14-Oct-2011	First Water – plant production was (30 MLD)
21-Mar-2012	SP1 – Full production from first half the plant (150 MLD)
31-May-2012	SP2 – Full production from second half of the plant (150 MLD)
24-Oct-2012	Performance test – plant running at full production for 7 days (150 MLD)
07-Nov-2012	Performance test – plant running at full production for 7 days (150 MLD)
21-Nov-2012	Reliability test – continuous running at various production rates
12-Dec-2012	Plant handover from commissioning