Technical note supporting the 2018 Coorong and Lower Lakes vegetation (Vegetation target success) Trend and Condition Report Card

DEW Technical note 2018/15

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Department for Environment and Water

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Consultation and acknowledgements

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Summary

This report card provides the background information, assessment methods and more detailed discussion for the 2018 Coorong and Lower Lakes vegetation (Vegetation target success) Trend and Condition Report Card for the River Murray, developed as part of the 2018? NRM Report Cards.

The report card seeks to report on the trend and condition of the aquatic vegetation of the Coorong and Lower Lakes Icon Site of the River Murray. The report card draws on data collected as part of the Living Murray Program (TLM) is a Basin-wide program that focuses on key 'Icon' sites. One of these Icon sites in the Coorong, Lower Lakes and Murray Mouth. The monitoring undertaken as part of the TLM program includes vegetation monitoring. The University of Adelaide in collaboration with DEW undertake monitoring of the *Ruppia tuberosa* in the South Lagoon of the Coorong. These data are summarised within various reports and are collated in this report to provide overall condition and trend results for the aquatic vegetation of the Coorong and Lower Lakes.

Based on the condition assessment in this report, the Lower Lakes and Coorong as a whole was classed as being in **poor** condition. This was based on an overall achievement of 5 out of 36 aquatic and littoral vegetation targets across the Coorong and Lower Lakes. Each of the smaller sub-icon sites within the wider assessment area was also classed as poor, with all areas having less than 50% of their targets met in 2017.

The condition of the Icon Site was considered **stable**. The average slope of the trend was 0.028, slightly positive but not sufficient to suggest a significant positive trend. Across the smaller sub-icon sites the results were mixed. The majority of the areas were considered stable, however, both the Goolwa Channel and Temporary Wetlands were both considered to be getting better.

The seasonal water level variability in the Lower Lakes has been maintained within an acceptable range over recent years with lake level management and barrage operations. The implementation of the Basin Plan will provide an additional up to 3200 GL of environmental water to the River Murray through recovered water, efficiency measures and relaxing constraints. This additional water will provide managers with the ability to vary the water levels in the Lower Lakes to a greater extent, and meet the needs of aquatic and littoral vegetation. These additional flows will also have a similar effect on the Coorong, providing the opportunity for increased ecological condition of the Coorong, including Ruppia.

The increasing flows down the river will also provide greater flow across the tidal barrages. This increased flow, coupled with freshwater inputs from the South-East Flows Restoration Project can have a positive effect on the Ruppia in the Coorong. Currently, the aquatic and littoral vegetation and Ruppia condition objectives assessed in this report (V2 and V3) have not been met during any monitoring event (2008–17).

The assessment of the aquatic and littoral vegetation in the Coorong and Lower Lakes was based on reliable data, rated five out of a possible five due to its currency, applicability, representation and accuracy.

1 Introduction

The *Natural Resources Management Act 2004* has a requirement 'to keep the state and condition of the natural resources of the State under review.' In order to consolidate the data collected around the state in to a simple, easy to interpret information source, the Department for Environment and Water (DEW) produces report cards for the state's natural resources. Previous rounds of report cards have reported against the targets in the South Australian Natural Resources Management Plan (Government of South Australia, 2012). However, for the next round of reporting, the report cards will not only seek to report on the state of the natural resources of South Australia, but will also form the main source of data for the State of the Environment Report.

The State of the Environment Report (SOER) is a legislated requirement under the *Environment Protection Act 1993*. The SOER has several key assessments that need to be undertaken including:

- Include an assessment of the condition of the major environmental resources of South Australia 112(3(a))

- Include a specific assessment of the state of the River Murray, especially taking into account the Objectives for a Healthy River Murray under the *River Murray Act 2003* 112(3(ab))

- Identify significant trends in environmental quality based on an analysis of indicators of environmental quality 112(3(b))

The River Murray has previously been part of the reporting process as it is a focal point of the state's natural resources. See the 2014 River Murray report cards here. However, the way that the river health has been assessed has continuously been adapted to reflect the reporting needs within the constraints of the available data and information. For the 2018? report cards, the River Murray report cards will be adapted to reflect the requirements of the SOER.

The Environment Protection Act (1993) specifically refers to the River Murray Act 2003 for the assessment of the health of the River Murray. Under the River Murray Act there is a series of objectives known as the Objectives for a Healthy River Murray (*River Murray Act 2003* 7(1-5)). These objectives cover a range of issues including:

- River health

- Environmental flows

- Water quality

- Human dimensions

The suite of River Murray report cards for 2018 were developed with specific line of sight to the objectives for a healthy River Murray to facilitate both adequate reporting on the condition of the state's natural resources as well as the requirements of the SOER.

The seven report cards for the River Murray are:

- River Murray: floodplain trees (Tree condition index) Trend and Condition Report Card

- River Murray: Coorong and Lower Lakes vegetation (Vegetation target success) Trend and Condition Report Card

- River Murray: high value wetlands (Achievement of ecological targets) Trend and Condition Report Card

- River Murray: Murray Mouth (Days open) Trend and Condition Report Card

- River Murray: fish passage (Permanently wet area accessible) Trend and Condition Report Card

- River Murray: flow regime (Achievement of environmental water requirements) Trend and Condition Report Card

- River Murray: water (quantity and quality) Trend and Condition Report Card

This report provides the background information, methodology and results that will underpin the 2018? Aquatic Plant Health Report Card. The river health objectives of the River Murray Act state that "the key habitat features in the River Murray system are to be maintained, protected and restored in order to enhance ecological processes" (Section 7(2)a). The Coorong, Lower Lakes and Murray Mouth Icon Site (Coorong and Lower Lakes) represents one of the most important areas of the River Murray in South Australia. It has been listed under the Ramsar Convention as a wetland of international importance and is also a focal point of both State and Federal river management plans (e.g. The Basin Plan) and therefore is a focal area for the improvement of ecological processes.

Aquatic vegetation has been identified as a key habitat feature across the Coorong and Lower Lakes site. The aquatic vegetation of the Coorong and Lower Lakes site is vital to the ongoing ecological functioning of the site as it provides structure, stability, nutrient cycling and habitat. The condition of aquatic vegetation is determined principally by the water regime and salinity of the Coorong and Lower Lakes. This water regime is controlled by flow from upstream as well as a series of tidal barrages constructed between 1935 and 1940. The water regime to ensure all ecological targets are met is detailed in a series of environmental water requirements (EWRs) and are explored and reported against in another report card dedicated to EWRs across the South Australian River Murray. As such the success of the EWRs will not be looked at in this report card. This report card will assess the health of aquatic vegetation in the site against targets developed as part of the Living Murray (TLM) –Coorong, Lower Lakes and Murray Mouth Icon Site monitoring plan, specifically "maintain or improve aquatic and littoral vegetation in the Lower Lakes" (V3) and "Maintain or improve *Ruppia tuberosa* colonisation and reproduction" (V2) (DEWNR 2017). Under these objectives, there are several targets that will be used as part of this assessment (Appendix).

As part of commitments to the Living Murray program, both the Australian Government and the Government of South Australia invest in a monitoring program for the vegetation of the Coorong and Lower Lakes site. This monitoring program has been run for the past decade and covers several major ecological components including aquatic and littoral vegetation (DEWNR 2017, Nicol et al. 2017, Paton et al. 2017). This report utilizes the vegetation assessment from Nicol et al. (2017) to report on the targets for the Lower Lakes. The targets for the Coorong are assessed using data from Paton et al. (2017).

2   Methods

2.1   Condition assessment

The aquatic and littoral vegetation of the Lower Lakes is assessed twice a year by South Australian Research and Development Institute (Aquatic Sciences) staff. The assessment is designed to provide a comprehensive assessment of the condition of the vegetation of the Lower Lakes and incorporates assessments from multiple sub-icon sites; Lake Alexandrina, Lake Albert, Goolwa Channel, permanent and temporary wetlands. For a detailed description of the objectives, targets and methodology used for these assessments, refer to Nicol et al. (2017). The Coorong vegetation targets are assessed on an annual basis. For a detailed discussion of the methodology used for these assessments, refer to Paton et al. (2017).

The Lower Lakes data are summarised into the number of quadrats that contain species of interest. There are targets for numbers of quadrats that have *Typha, Phragmites, Paspalum* as well as native emergent, amphibious and submergent plant species. The number of quadrats is then compared to the targets described in DEWNR (2017). This provides a time series of the number of targets being met across the Lower Lakes. The Coorong Ruppia targets were assessed through visual inspection at long term monitoring sites visited twice a year against existing condition indicators, scaled up to the TLM Target (Paton et al. 2017).

In order to assess the overall condition, the number of targets met through time was modelled using Bayesian statistics. Modelling was undertaken using a binomial model looking at the number of objectives met/not met through time with the sub-icon site being assessed included as a random factor. Analysis was undertaken in R Studio (version 1.1.383, running R version 3.4.2, R Core Team, 2013) using Bayesian Generalized Linear Models (using the stan-glm function in the rstanarm package, Stan Development Team 2016).

Trend assessments were performed at two spatial scales: 1) sub-icon site (Lake Alexandrina, Lake Albert, Goolwa Channel, Permanent and Temporary Wetlands and the Coorong) and 2) whole-of Site

The percentage of targets passing was estimated at each time step, along with credible intervals.

Condition as ascribed to the results as described in Table 1.

Table 1: Condition assessment criteria for the 2018? River Murray Coorong and Lower Lakes aquatic vegetation report card.

Condition assessment	Report card definition	Percentage of targets met
Very good	The natural resource is in a state that meets all environmental, economic and social expectations, based on this indicator. Thus, desirable function can be expected for all processes/services expected of this resource, now and into the future, even during times of stress (e.g. prolonged drought)	90-100
Good	The natural resource is in a state that meets most environmental, economic and social expectations, based on this indicator. Thus, desirable function can be expected for only some processes/services expected of this resource, now and into the future, even during times of stress (e.g. prolonged drought)	70-90
Fair	The natural resource is in a state that does not meet some environmental, economic and social expectations, based on this indicator. Thus, desirable function cannot be expected from many processes/services expected of this resource, now and into the future, particularly during times of stress (e.g. prolonged drought)	50-70
Poor	The natural resource is in a state that does not meet most environmental, economic and social expectations, based on this indicator. Thus, desirable function cannot be expected from most processes/services expected of this resource, now and into the future, particularly during times of stress (e.g. prolonged drought)	<50

2.2   Trend assessment

The time series data was analysed using a Bayesian modelling approach. This modelling approach was used as it provides more information surrounding the results and allows for a more detailed assessment of trend and condition results based on variability inherent in the data, i.e. it not only provides the current trend and condition for each of the habitats sampled as well as an overall assessment at the Coorong and Lower Lakes site level, but it provides confidence intervals allowing for an objective and transparent assessment of trend and condition. Modelling was undertaken using a binomial model looking at the number of objectives met/not met through time with the habitat area being assessed included as a random factor. Analysis was undertaken in R Studio (version 1.1.383, running R version 3.4.2, R Core Team, 2013) using Bayesian Generalized Linear Models (using the stan-glm function in the rstanarm package, Stan Development Team 2016).

Trend assessments were performed at two spatial scales: 1) sub-icon site (Lake Alexandrina, Lake Albert, Goolwa Channel, Permanent and Temporary Wetlands and the Coorong) and 2) whole-of Site.

The following values were estimated from the posterior distribution resulting from the Bayesian analysis:
• Slope (trend)
• Change between 2008 and 2017 (magnitude of any change).

Generic definitions for trend are provided in Table 2, including the specific values used here as thresholds to define the classes.

Table 2. Definition of trend classes

Trend	Description	Threshold
Getting better	Over a scale relevant to tracking change in the indicator it is improving in status with good confidence	Greater than 90% likelihood that target achievement trends are positive
Stable	Over a scale relevant to tracking change in the indicator it is neither improving or declining in status	Less than 90% likelihood that target achievement trends are positive or negative
Getting worse	Over a scale relevant to tracking change in the indicator it is declining in status with good confidence	Greater than 90% likelihood that target achievement trends are negative
Unknown	Data are not available, or are not available at relevant temporal scales, to determine any trend in the status of this resource	Not applicable
Not applicable	This indicator of the natural resource does not lend itself to being classified into one of the above trend classes	Not applicable

2.3   Reliability

The reliability of the data was scored using the scoring system developed for the 2018? Report Cards. This scoring system uses four scores to assess different aspects of the data used to underpin the report card. Scores for all four are then averaged to determine the final score. The four scores are:

• Information currency
• Information applicability
• Spatial representation
• Information accuracy

Scoring was undertaken according to Table 3.

Table 3: Scoring system for the reliability of the information used to underpin the analysis for the River Murray: fish passage Report Card.

Score given	Information currency	Information applicability	Spatial representation	Information accuracy
5	Information >10 years old	Data are based on expert opinion of the measure	From an area that represents less than 5% the spatial distribution of the sub-icon site within the site/state or spatial representation unknown	Better than could be expected by chance
4	Information up to 10 years old	All data based on indirect indicators of the measure	From an area that represents less than 25% the spatial distribution of the sub-icon site within the site/state	> 60% better than could be expected by chance
3	Information up to 7 years old	Most data based on indirect indicators of the measure	From an area that represents less than half the spatial distribution of the sub-icon site within the site/state	> 70 % better than could be expected by chance
2	Information up to 5 years old	Most data based on direct indicators of the measure	From across the whole site/state (or whole distribution of sub-icon site within the site/state) using a sampling design that is not stratified	> 80 % better than could be expected by chance
1	Information up to 3 years old	All data based on direct indicators of the measure	From across the whole site/state (or whole distribution of sub-icon site within the site/state) using a stratified sampling design	> 90 % better than could be expected by chance

3   Results

3.1   Trend

The site level trend assessment showed that there is a stable trend. The number of targets met through time is shown in Figure 1 (produced for the report card). The estimated value of the slope showed a slight positive trend (slope of 0.028), however, this was not above the 90% threshold required to establish a positive trend (33.3% negative slope, 65.7% positive slope) (Figure 2).
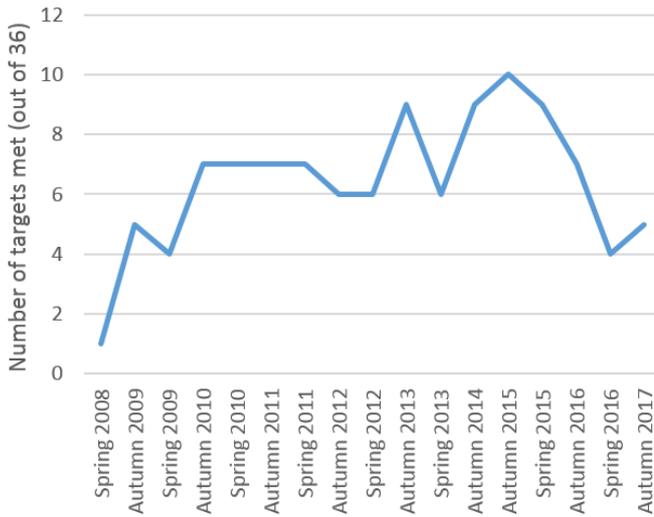
Figure 1: Number of aquatic vegetation targets met across the whole site. Figure produced for the report card.
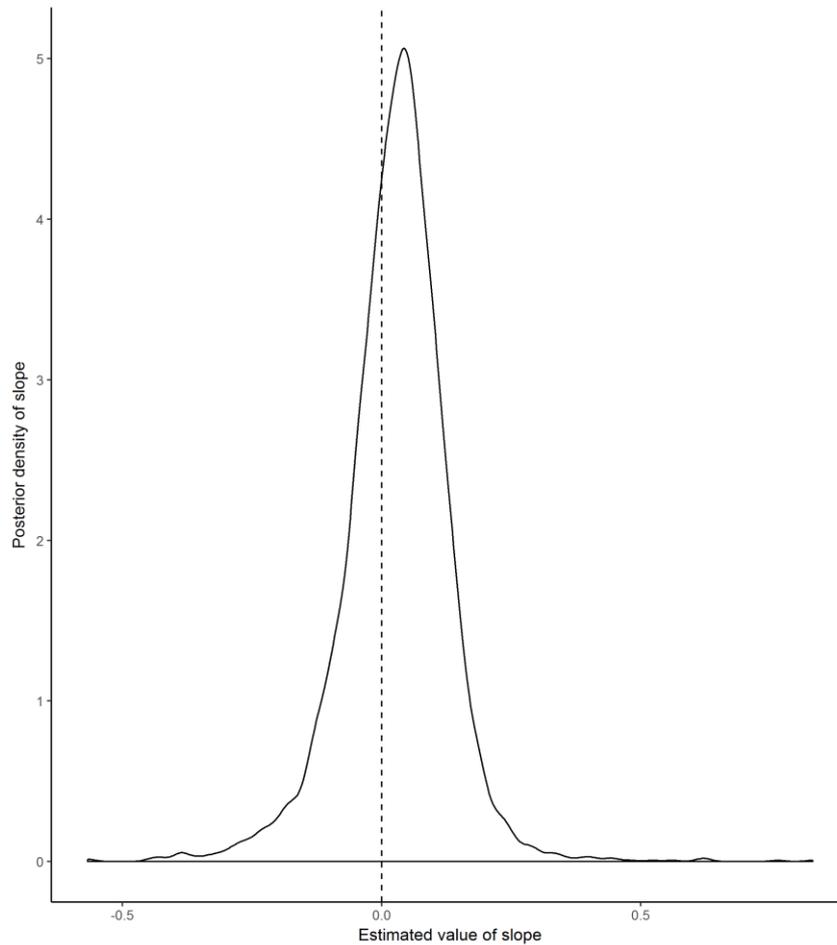
Figure 2: The estimated value of the trend for the whole Coorong and Lower Lakes Site indicating a slight positive trend, however, not sufficient to qualify as 'getting better'.

The trend assessment for the individual sub-icon sites showed a similar trend to the overall results with the majority of sub-icon sites showing a positive trend (Figure 3). Two areas, Temporary Wetlands and Goowla Channel, both showed a greater than 90% chance of a positive slope and therefore were classed as 'getting better'. The remaining sub-icon sites all failed to demonstrate greater than 90% positive or negative and were therefore classed as 'stable'. It should be noted that Lake Albert showed an 89.2% chance of a negative slope, 0.8% away from the cut off. The trend assessments are summarised in Table 4.
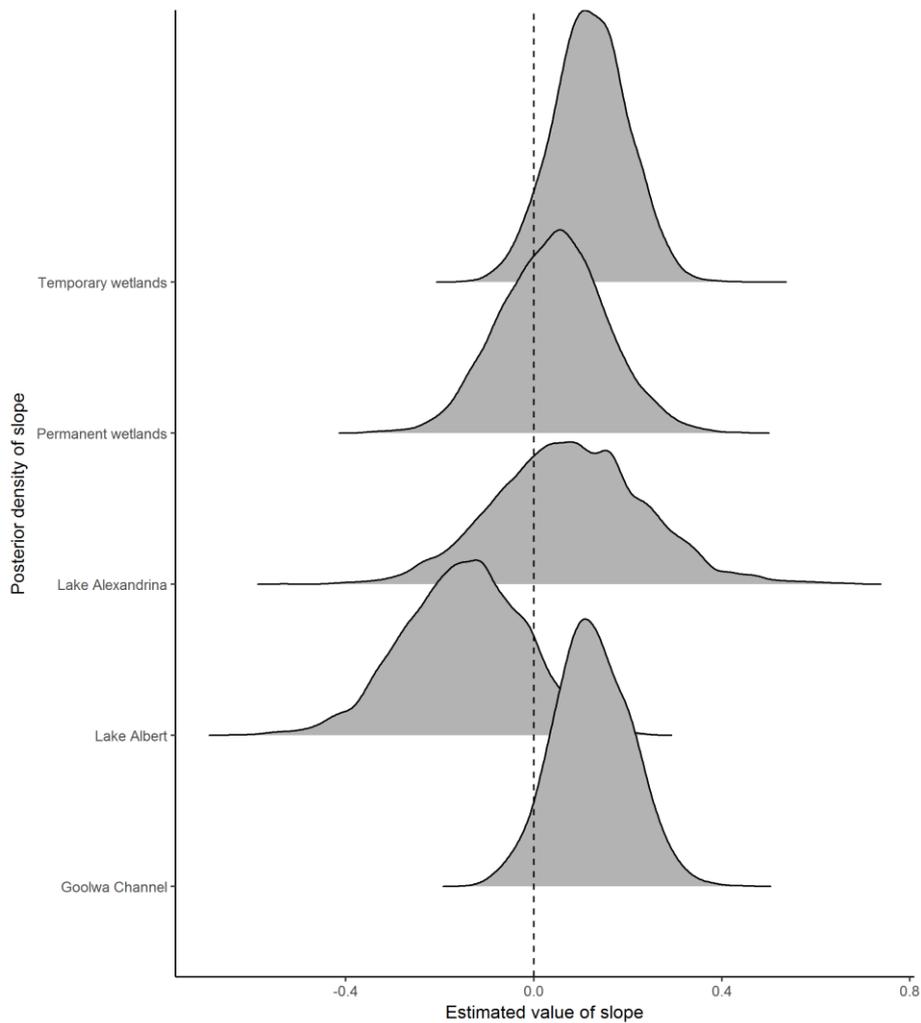
Figure 3: Estimated values for the slope for the individual sites. The Coorong has been removed from this figure for ease of viewing. The figure illustrates the overall positive trend in the data with both Temporary Wetland and Goolwa Channel having a trend of 'getting better'. Permanent Wetlands, Lake Alexandrina we both classed as 'stable' while Lake Albert was also classed as 'stable', albeit with a negative trend.

Table 4: Trend results for the Coorong and Lower Lakes site and individual areas assessed for the vegetation report card.

Area	Average slope	Trend
Goolwa Channel	0.436	Getting better
Lake Albert	-0.153	Stable
Lake Alexandrina	0.081	Stable
Permanent wetlands	0.037	Stable
Temporary wetlands	0.122	Getting better
Coorong Lagoon	0.000	Stable
Coorong and Lower Lakes Site	0.0305	Stable

3.2   Condition

The overall condition of the Coorong and Lower Lakes Site in 2017 was identified as poor with an estimate of only 14% (5 out of 36) of targets being met across the whole site at the last time measurements were undertaken (Autumn 2017). This is slightly higher than the estimated number of targets that were recorded as met for the 2017 year (16%). The modelled outputs show that nearly 100% of the modelled outputs for 2017 were below 50% threshold (Figure 4).
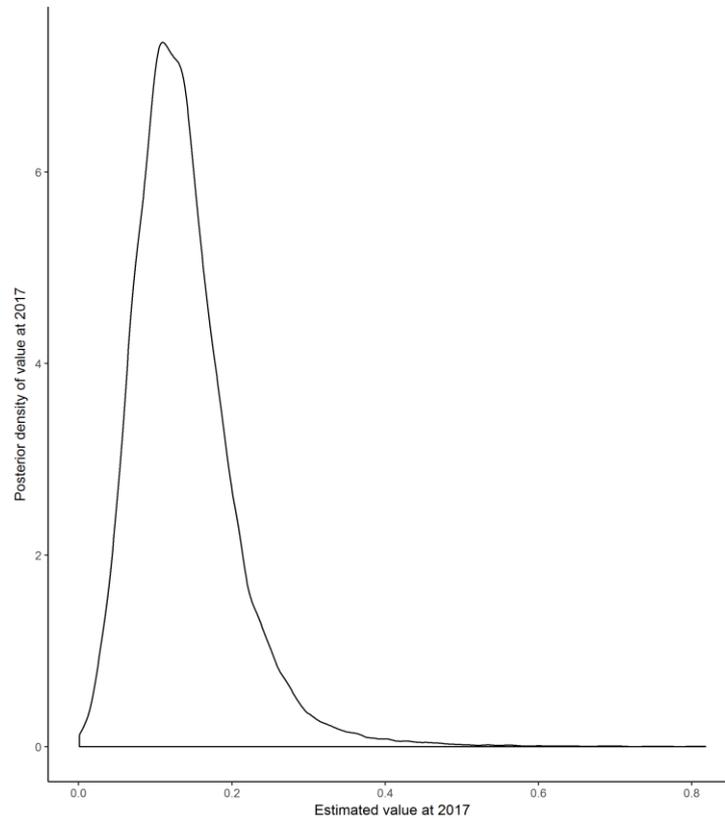
Figure 4: Estimated percentage of targets passes in 2017 for the whole Coorong and Lower Lakes site

Based on the actual measured results from the monitoring in 2017 all of the areas in the Coorong and Lower Lakes site were classed as 'poor' with two areas not meeting any targets (Coorong and Lake Albert) (Table 5). The modelled results generally align with the measured results with the exception of Temporary Wetland where the estimated percentage of targets met is 57% based on improving results from the previous years, whereas the actual measured result was 17%. Estimated condition through time is shown in Figure 5. Figure 6 shows the same information without the confidence intervals, developed for the report card.

Table 5: Estimates and measured percentage of targets met across all of the individual assessment areas as well as over the whole Coorong and Lower Lakes Site along with condition assessments for 2017

Area	Estimated % metrics met	Measured % metrics met	Condition score
Coorong Lagoon	1.5%	0.0%	Poor
Goolwa Channel	33.5%	25.0%	Poor
Lake Albert	5.9%	0.0%	Poor
Lake Alexandrina	8.5%	14.3%	Poor
Permanent wetlands	14.0%	14.3%	Poor
Temporary wetlands	56.9%	16.7%	Poor
Coorong and Lower Lakes Site	15.9%	13.8%	Poor
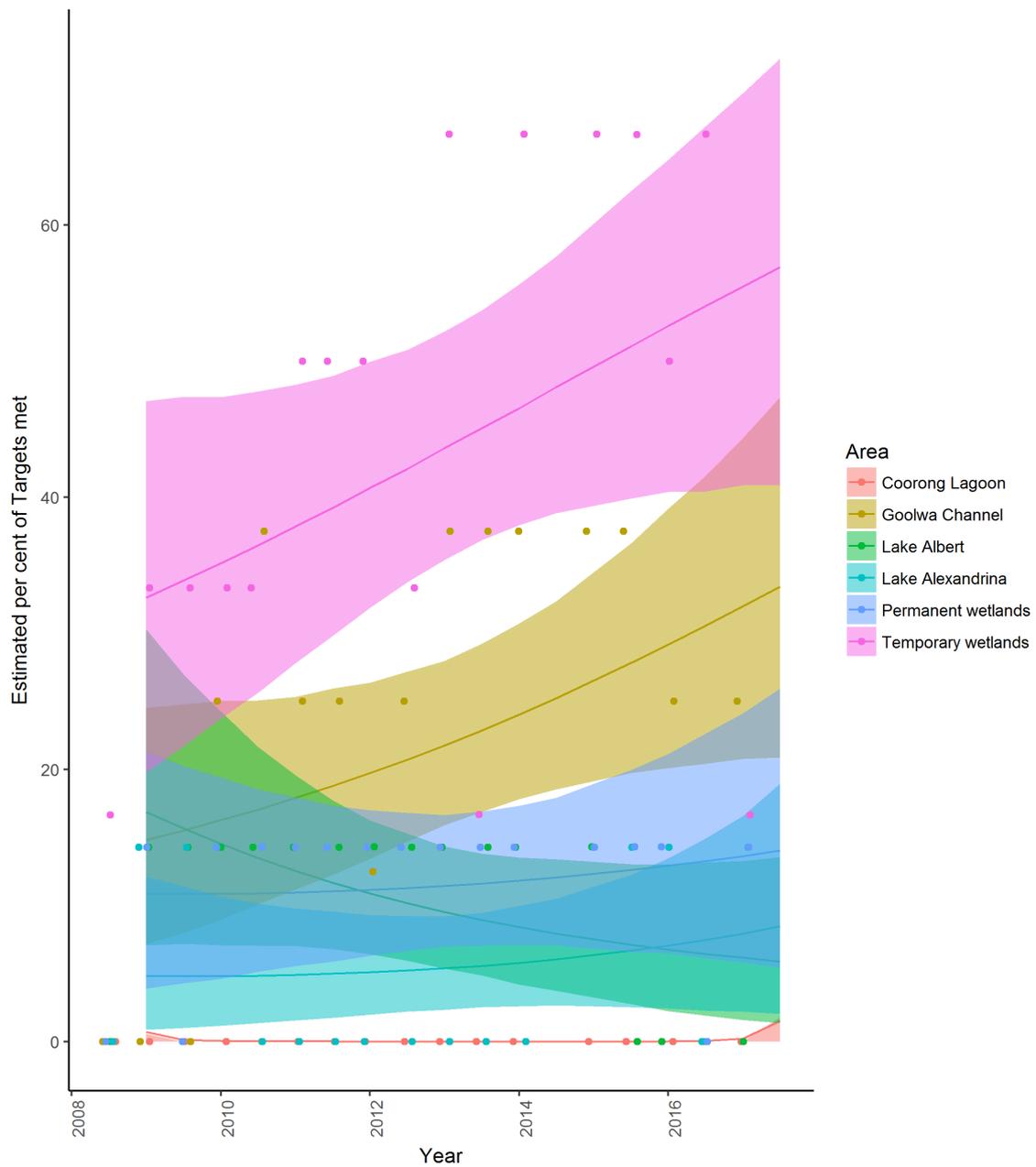
Figure 5: Estimated percentage of targets met (2008-2017) based on the Bayesian modelling. Shaded area indicates 90% credible intervals. Dots are actual observed values.
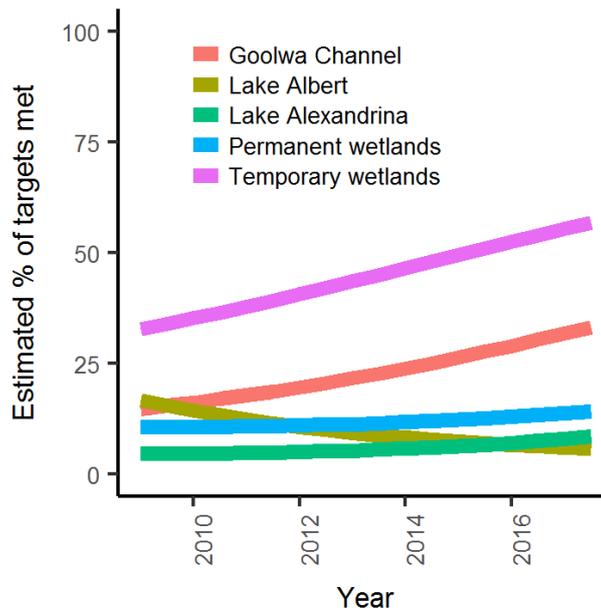
Figure 6: Estimated percentage of targets met based on the Bayesian modelling across the different areas of the lower lakes. Figure developed for the report card.

3.3 Reliability

The scores for each of the four guides along with justification is provided in Table 6.

Table 6: Results of the reliability assessment of the Coorong and Lower Lakes Vegetation data

Guide	Score	Justification
Currency	5	Data available up to date
Applicability	5	Data is a direct measure of the indicator
Spatial representation	5	Data covers all of the targets covering all of the area
Accuracy	5	Data is specifically collected to report against the targets in this report. It is collected by trained staff in the manner described in Nicol et al. (2017) and Paton et al. (2017).

4 Discussion

4.1 Trend

The trend across the whole of the Coorong and Lower Lakes site is considered to be stable, though the mean estimated trend is slightly positive. Through the last decade the Coorong and Lower Lakes site has seen some significant events that will have a direct impact on the vegetation. The early part of the assessment window was during the Millennium Drought. This drought had a severe negative effect on many ecological processes, including the vegetation of the Lower Lakes and Coorong. Towards the end of the drought, plant communities showed improvements that corresponded to increases in water level in the Lower Lakes (Nicol et al., 2017). Ruppia did not show a similar response due to several contributing factors including salinity levels, filamentous algae and water levels (Paton et al., 2017).

The vegetation of the Coorong and Lower Lakes site requires variability in water levels in order to achieve its targets (between +0.5 (autumn) to +0.9 m AHD (spring) and water levels in the South Lagoon of the Coorong higher than +0.2 m AHD until early summer) (DEW 2017). The seasonal water-level variability in the Lower Lakes has been maintained within an acceptable range over recent years with lake level management and barrage operations. The implementation of the Basin Plan will provide up to an additional 3200 GL (long-term average) of environmental water to the River Murray through recovered water, efficiency measures and relaxing constraints. This will contribute to managers' ability to vary the water levels in the Lower Lakes to meet the needs of aquatic and littoral vegetation.

These additional flows will also have a similar effect on the Coorong providing the opportunity for increased ecological condition of the Coorong, including Ruppia. The South Lagoon of the Coorong is also the focus of the South East Flows Restoration Project which aims to deliver water from the South East to the Coorong via Salt Creek with the aim of assisting in managing salinity in the South Lagoon, in order to maintain a healthy ecosystem. Combined with the additional River Murray water recovered through the Basin Plan there is a greater chance of achieving the targets for Ruppia. Currently, the *Ruppia* condition targets assessed in this report have not been met during any monitoring event.

Individual habitat areas for the Lower Lakes are discussed in detail in Nicol et al. (2017). Coorong vegetation is discussed in detail in Paton et al. (2017)

4.2 Condition

The condition of the aquatic and littoral vegetation of the Coorong and Lower Lakes has been assessed as being in poor condition across all of the sub-icon sites present as well as at a whole of site scale. This result is not overly surprising given that the vegetation of the site was severely degraded through multiple factors including water resource development, degrading water quality, alien species compounded by the low water levels due to the Millennium Drought (Nicol et al. 2017).

The modelling used to predict the results and to assess the trend across the site suggested that the temporary wetlands should be in fair condition. The reason for the difference stems from the general improvement in the condition of the temporary wetlands through to 2016 on which the models are based. The actual data from 2017 showed that only 17% of targets were met in 2017, a significant deviation from the results expected given the previous few years. A detailed investigation of these sites shows an increasing abundance of *Paspalum* and *Cenchrus* which is limiting the ability of other plants to respond. This is a major risk inherent in the process to restore vegetation condition and is also present in the Coorong (in the form of filamentous green algae). However, other positive signs are noted and it is expected that this habitat will continue to improve into the future. These are discussed in greater detail in Nicol et al. (2017) and Paton et al. (2017).

The assessment of the high-level Ruppia target showed that it was never met across the whole reporting period. However, it should be noted that the increased flows in late 2016 resulted in increased extent and abundance of Ruppia in the South Lagoon of the Coorong. This positive response was muted by the presence of dense mats of filamentous algae resulting in poor reproductive success.

The current trends suggest that the current hydrological and salinity regimes are contributing to a whole of system improvement in condition and in general, the plant communities are recovering from the low water levels and increased salinities in the Coorong of the recent drought. Further improvement would be expected as the full flows from the Basin Plan are delivered to the Lower Lakes and Coorong.

5   References

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6   Appendix

Lower Lakes, Coorong and Murray Mouth vegetation targets under Objective V3 (DEWNR 2017)

Sub-icon site	Elevation	Target
Lake Alexandrina	Littoral +0.8 to +0.6 m AHD	<40% of quadrats in any given survey containing >75% combined cover (Braun-Blanquet score 5) of Typha and Phragmites.
		<20% of quadrats in any given survey containing >50% combined cover (Braun-Blanquet score 4 or greater) of Cenchrus and Paspalum.
		Minimum of 50% of quadrats in any given survey contain native amphibious species with a combined cover of >5% (Braun-Blanquet score 2 or greater).
		Minimum of 50% of quadrats in any given survey contain native emergent species (other than Typha and Phragmites) with a combined cover of >5% (Braun-Blanquet score 2 or greater).
	Aquatic +0.4 to 0 m AHD	<40% of quadrats in any given survey containing >50% combined cover (Braun-Blanquet score 4 or greater) of Typha and Phragmites.
		Minimum of 20% of quadrats in any given survey contain native emergent species (other than Typha and Phragmites) with a combined cover of >5% (Braun-Blanquet score 2 or greater).
		Minimum of 35% of quadrats in any given survey contain native submergent species with a combined cover of >5% (Braun-Blanquet score 2 or greater).
Lake Albert	Littoral +0.8 to +0.6 m AHD	<40% of quadrats in any given survey containing >75% combined cover (Braun-Blanquet score 5 or greater) of Typha and Phragmites.
		<20% of quadrats in any given survey containing >50% combined cover (Braun-Blanquet score 4 or greater) of Cenchrus and Paspalum.
		Minimum of 35% of quadrats in any given survey contain native amphibious species with a combined cover of >5% (Braun-Blanquet score 2 or greater).
		Minimum of 35% of quadrats in any given survey contain native emergent species (other than Typha and Phragmites) with a combined cover of >5% (Braun-Blanquet score 2 or greater).
	Aquatic +0.4 to 0 m AHD	<40% of quadrats in any given survey containing >50% combined cover (Braun-Blanquet score 4 or greater) of Typha and Phragmites.
		Minimum of 20% of quadrats in any given survey contain emergent species (other than Typha and Phragmites) with a combined cover of >5% (Braun-Blanquet score 2 or greater).

		Minimum of 20% of quadrats in any given survey contain submergent species with a combined cover of >5% (Braun-Blanquet score 2 or greater).
Goolwa Channel	Littoral +0.8 to +0.6 m AHD	<50% of quadrats in any given survey containing >75% combined cover (Braun-Blanquet score 5 or greater) of Typha and Phragmites.
		<20% of quadrats in any given survey containing >50% combined cover (Braun-Blanquet score 4 or greater) of Cenchrus and Paspalum.
		Minimum of 50% of quadrats in any given survey contain native amphibious species with a combined cover of >5% (Braun-Blanquet score 2 or greater).
		Minimum of 50% of quadrats in any given survey contain native emergent species (other than Typha and Phragmites) with a combined cover of >5% (Braun-Blanquet score 2 or greater).
	Aquatic +0.4 to 0 m AHD	<50% of quadrats in any given survey containing >50% combined cover (Braun-Blanquet score 4 or greater) of Typha and Phragmites.
		Minimum of 20% of quadrats in any given survey contain native emergent species (other than Typha and Phragmites) with a combined cover of >5% (Braun-Blanquet score 2 or greater).
		Minimum of 40% of quadrats in any given survey contain native submergent species with a combined cover of >5% (Braun-Blanquet score 2 or greater).
	Deep water <0 m AHD	Minimum of 20% of quadrats in any given survey contain native submergent species with a combined cover of >5% (Braun-Blanquet score 2 or greater).
Permanent wetlands	Littoral >+0.6 m AHD	<35% of quadrats in any given survey containing >75% combined cover (Braun-Blanquet score 5 or greater) of Typha and Phragmites.
		<20% of quadrats in any given survey containing >50% combined cover (Braun-Blanquet score 4 or greater) of Cenchrus and Paspalum.
		Minimum of 50% of quadrats in any given survey contain native amphibious species with a combined cover of >5% (Braun-Blanquet score 2 or greater).
		Minimum of 50% of quadrats in any given survey contain native emergent species (other than Typha and Phragmites) with a combined cover of >5% (Braun-Blanquet score 2 or greater).
	Aquatic <+0.6 m AHD	<40% of quadrats in any given survey containing >50% combined cover (Braun-Blanquet score 4 or greater) of Typha and Phragmites.
		Minimum of 20% of quadrats in any given survey contain native emergent species (other than Typha and Phragmites) with a combined cover of >5% (Braun-Blanquet score 2 or greater).

		Minimum of 50% of quadrats in any given survey contain native submergent species with a combined cover of 5 to 50% (Braun-Blanquet score 2 to 4).
Temporary wetlands in spring	Edge	<20% of quadrats in any given survey containing >50% combined cover (Braun-Blanquet score 4 or greater) of Cenchrus and Paspalum.
		Minimum of 50% of quadrats in any given survey contain native amphibious species with a combined cover of >5% (Braun-Blanquet score 2 or greater).
		Minimum of 50% of quadrats in any given survey contain native emergent species with a combined cover of >5% (Braun-Blanquet score 2 or greater).
	Bed	Minimum of 20% of quadrats in any given survey contain native emergent species with a combined cover of >5% (Braun-Blanquet score 2 or greater).
		Minimum of 50% of quadrats in any given survey contain native submergent species with a combined cover of >25% (Braun-Blanquet score 3 or greater).
		Minimum of 25% of quadrats in any given survey contain native amphibious species with a combined cover of >5% (Braun-Blanquet score 2 or greater).
Temporary wetlands in autumn	Edge	<20% of quadrats in any given survey containing >50% combined cover (Braun-Blanquet score 4 or greater) of Cenchrus and Paspalum.
		Minimum of 50% of quadrats in any given survey contain native amphibious species with a combined cover of >5% (Braun-Blanquet score 2 or greater).
		Minimum of 50% of quadrats in any given survey contain native emergent species with a combined cover of >5% (Braun-Blanquet score 2 or greater).
	Bed	Minimum of 20% of quadrats in any given survey contain native emergent species with a combined cover of >5% (Braun-Blanquet score 2 or greater).
		Minimum of 25% of quadrats in any given survey contain native amphibious species with a combined cover of >5% (Braun-Blanquet score 2 or greater).