



Yatco Lagoon

WETLAND MONITORING SUMMARY 2007 TO 30TH JUNE 2011

The Yatco Wetland Landcare Group (YWLG) was formed in December 2006 in response to the wetland being closed during the drought to achieve evaporative water savings for critical human needs. Although water savings were the original purpose of closing the wetland, the group has since been actively working towards managing their wetland to improve its ecological health.

The Yatco Wetland Landcare Group actively monitors the wetland with the assistance of the Loxton to Bookpurnong Local Action Planning (LBLAP) group and the SA Murray-Darling Basin Natural Resources Management (SA MDB NRM) Board.

A big thank-you to the Yatco Wetland Landcare Group for all their help and on-going enthusiasm in managing this wetland.

Maps of all monitoring sites can be found in Appendices 1 to 3.

Data Overview

- Surface water salinity has ranged between 324 and 7570 EC in the North Lagoon and 322 and 7540 EC in the South Lagoon.
- Groundwater levels under the floodplain surrounding the North Lagoon are highly responsive to the changes in surface water level in the lagoon.
- Groundwater salinity ranges between 1,680 and 55,900 EC, which is typical of groundwater in this region.
- Red gum trees that have been monitored along the river and surrounding the South Lagoon are healthier than those monitored near the North Lagoon.
- A maximum of eight native and five exotic fish species have been recorded over seven surveys since 2007.
- A total of 39 water dependent bird species have been recorded over five surveys since 2007.
- Up to four frog species have been recorded over eight surveys since 2007.
- The vegetation community surrounding the lagoons is dominated by salt tolerant species.



History of On Ground Works

Construction of the embankment commenced on the North Lagoon in November 2007 and completed in January 2008 (Figure 1). The causeway (between North and South Lagoons) was also upgraded at the same time, with the addition of sluice gates on existing infrastructure in order to manage the North and South Lagoons separately.

Due to design faults, the fish screens had to be replaced on the culverts on the embankment in August 2009 so that mature carp can be excluded from the wetland upon refilling. The initial, faulty fish screens were installed on the wetland side and trapped fish and turtles under the structure.



Figure 1: Culvert on the new embankment on the North Lagoon. Photo was taken when the lagoon was filling in March 2009. C. Nickolai, SA MDB NRM Board

In March 2008, a venting system was installed in the irrigation channel (that connects to the South Lagoon) to ensure a fresh water supply to irrigators. Water salinity in the lagoon has been high in the past (up to 1,400 EC) due to rainfall and fluctuating weir pool levels releasing salt from the surrounding floodplain. The historical development and maintenance of the creek as an irrigation supply channel also has caused the interception of saline groundwater.

In 2009, the Loxton to Bookpurnong Local Action Planning Committee (LBLAP) secured funding from the SA MDB NRM Board to control the growing population of Spiny Rush (*Juncus acutus*). Two rounds of spraying (with a frog friendly chemical, Roundup Biactive) were conducted in February 2010. It will be important to assess if new populations have established since the flooding (in 2010-2011) and determine if any follow up weed control for Spiny Rush is needed if the population has returned.





Future On-ground Works Projects

The YWLG has a number of big projects on the horizon for Yatco Lagoon.

The group would like to build an information centre with a “meeting place” that can be used by all community groups that are involved with projects in relation to sustainable farming, indigenous (aboriginal/cultural affairs) and early European history in the region. The group is currently working with local consultants using Caring For Our Country (CfoC) funding to develop promotional material around sustainable irrigated production and the history of local irrigation development, efficiency improvements and leadership in local environmental groups including the Moorook Tree Planters and the YWLG. The project will enable a website and other, portable promotional displays, signage and a concept plan for any future works at Yatco for sharing the story. The centre would also include information about the wetland group’s forefathers, their trials and tribulations during the settlement of the area, aboriginal history and education about the co-existence of primary production with the environment and supply of local produce. The creation of the meeting place will be the starting point for the project, with signage and a series of boardwalks around the wetland. It is anticipated that the signage will include information regarding points of interest, Upper Murray aboriginal names and stories attached to native flora and fauna.

Another significant project is to install four fish friendly regulators: two in the embankment, one on the causeway between the North and South Lagoons, and one on the creek to North Lagoon. The YWLG has recently received funding from the Riverine Recovery Program to complete these works.

- The YWLG would also like to install lakebed piezometers to monitor the freshwater lens, fence a part of the lagoon to prevent stock crossing the wetland while dry, and create and implement a cross-property Biodiversity Conservation Plan.
- Furthermore the LBLAP aims to seek funding for on-ground works on the eastern side of the embankment to provide better access to the floodplain.

Hydrological Management

The embankment was completed in January 2008 and the North Lagoon was subsequently dry by January 2009. The wetland received a fill volume of 3 GL in March 2009 and remained connected due to the wetland being a domestic water supply for some landholders. Prior to the wetland refilling, water was carted for the domestic users, however as funding for carting has ceased, the wetland has needed to remain open.

In spring/summer 2010/11, the region experienced its highest flow in 18 years, with peak flows reaching ~93,000 ML/day at the SA/Victorian border in February 2011. All the floodplain and infrastructure were inundated during this time.



World Wetlands Day

A wetland celebration day at Yatco Lagoon was held in February 2011 by the SA MDB NRM Board to mark World Wetlands Day. The event included a variety of displays, canoeing trips and a BBQ and was based near the Moorook boat ramp. Participants paddled to the Yatco embankment while stopping at a few locations to listen to SA MDB NRM Board staff talk about management and affects of flooding on wetlands. At the time the river was at peak levels and only the guard rails on the embankment were visible! The Yatco Wetland Day had a successful turnout with 50 people participating in the canoe day!



Figure 2: Participants enjoying the canoe day held at Moorook. C. Nickolai, SA MDB NRM Board

River Murray Youth Council Field Trip

In May 2011, 11 River Murray Youth Council (RMYC) students attended a field trip to Yatco Lagoon. Sheridan Alm, YWLG member, spoke to the students about the area's history and local irrigators' efforts to rehabilitate the lagoon, followed by the SA MDB NRM Board's Tim Inkster, who spoke about the extensive monitoring program conducted at Yatco Lagoon. The talks were followed by a canoe tour of the Southern Lagoon by Tim and then the students had the opportunity to do some yabbying, as some students had never been yabbying before!

Monitoring

An on-going monitoring program has been conducted by the SA MDB NRM Board, LBLAP and the YWLG since 2007. The monitoring has consisted of quarterly groundwater, photopoints, tree health and surface water monitoring (when weather permits) as well as seasonal surveys such as vegetation, birds, fish and frogs.

Terminology

The **embankment** refers to the larger earthen bank (with regulator) on the northern end of the North Lagoon. The **causeway** refers to the structure that divides the North and South Lagoons (also comprised of a regulator), and provides access to the surrounding floodplain.





Surface Water

Surface water quality is generally monitored on a quarterly basis, although the monitoring frequency was increased during the refill event in 2009. Sites YATSW01 to YATSW04 are located in the North Lagoon, sites YATSW05 and YATSW06 are located in the South Lagoon and YATSW07 is located on the river side of the embankment (Appendix 1).

Electrical Conductivity (EC)

Electrical Conductivity (EC) is a measure of the total dissolved salts in the surface water (column). Electrical Conductivity is usually measured as $\mu\text{S}/\text{cm}$, mS/cm or EC.

Salt concentrations in excess of 1000 EC can affect species composition in wetlands and increasing concentrations of salts within aquatic ecosystems is considered a significant threat to wetlands along the length of the River Murray in South Australia.

1000 EC (Electrical Conductivity) = 1000 $\mu\text{S}/\text{cm}$ (micro Siemens per centimetre)= 1 mS/cm (milli Siemens per centimetre)

The surface water salinity (EC) at Yatco has varied between sites overtime. Table 1 shows that the salinity at site YATSW07 has varied to a lesser extent than the other sites. This is due to the site being located on the river side of the embankment. The salinity at YATSW07 has ranged between 322 and 1201 EC during 2007 to 2011. Since May 2009, salinity at this site has been at least 150 EC units higher than that of the adjacent River Murray. The average conductivity of the river during 2007 to 2011 at Moorook was 357 EC (Surface Water Archive online). The increase in conductivity is likely to be caused by the mixing of water in the lagoon as the wind pushes the water through the open regulator.

The conductivity in the North Lagoon (sites YATSW01 to YATSW04) ranged from 324 to 7570 EC, and 322 to 7540 EC in the South Lagoon (sites YATSW05 and YATSW06). The higher values were generally recorded as the wetland levels were receding. The low values recorded in March 2011 were due to flooding occurring at the time of sampling.

Table 1: Surface Water salinity (EC) at Yatco Lagoon.

Surface Water EC							
	YATSW01	YATSW02	YATSW03	YATSW04	YATSW05	YATSW06	YATSW07
11-Jul-07	1117	1522	1523	1361	1621	1498	-
7-Sep-07	1099	1485	1442	1210	1288	1141	1071
10-Dec-07	2560	2160	2230	2530	1584	892	714
06-Mar-08	-	-	4750	-	1150	1066	364
31-Jul-08	-	-	7190	-	2730	2730	498
21-Oct-08	-	-	-	7547	-	-	440
19-Dec-08	-	-	-	2633	-	-	409
26-Mar-09	3773	-	7570	-	2667	-	367
1-Apr-09	2070	3667	3740	-	-	-	379
22-Apr-09	862	3130	2743	889	1722	1497	352
14-May-09	1994	2880	2857	1577	2090	2057	765
21-Jun-09	1712	2390	2306	-	1605	1833	507
13-Aug-09	2106	2340	1914	2473	2906	2853	680
20-Sep-09	1690	3303	2746	3030	2800	3933	572
26-Oct-09	3126	3160	3053	2723	3973	3670	685
22-Dec-09	2180	4103	3100	3423	5770	4356	1201
15-Jul-10	1833	3570	-	-	7540	-	736
20-Mar-11	324	325	-	312	328	322	322
23-Jun-11	510	583			659		553
Minimum	324	325	1442	312	328	322	322
Maximum	3773	4103	7570	7547	7540	4356	1201

Turbidity

Turbidity is a measure of how 'cloudy' or 'muddy' the water is and from this data we can infer how much light can penetrate the water body.

Turbidity is measured in nephelometric turbidity units (NTU). The optimal turbidity is below 100 NTU.

When the turbidity is above 100 NTU, this can inhibit the growth of aquatic vegetation as not enough light can reach the bottom of the wetland to stimulate germination.

The turbidity at site YATSW07 (river site) ranged between 30 and 132 NTU (Table 2). On four occasions the turbidity exceeded 100 NTU; however, it is likely that these results are due to water quality measurements being taken on a windy day, resulting in high turbidity readings being recorded.

The turbidity in the North Lagoon ranged between <10 to 300 NTU, and 15 to 300 NTU in the South Lagoon. The high turbidity sampled on various days may be due to windy conditions and/or the shallow nature of the water at the time of sampling or flooding events. The feeding habits of the Common Carp (*Cyprinus carpio*) can also result in high turbidity, as they feed on the wetland bed which results in the re-suspension of sediments.





High turbidity affects the growth of aquatic plants, as it limits the amount of light that can reach the wetland bed. If the light cannot reach the bed, the seeds of aquatic plants present on the wetland bed will not germinate. High turbidity can clog the feeding and breathing structures of aquatic macro-invertebrates and abrade the delicate gill structure of fish.

Following the refill in March 2009, the turbidity levels were lower than River water due to the fact that drying of the wetland bed leads to consolidation of the bed soils which, when the wetland is refilled, remain consolidated for a time.

Table 2: Surface water turbidity (NTU) at Yatco Lagoon.

Surface Water Turbidity (NTU)							
	YATSW01	YATSW02	YATSW03	YATSW04	YATSW05	YATSW06	YATSW07
11-Jul-07	60	100	100	100	100	60	-
7-Sep-07	80	80	100	100	60	80	50
10-Dec-07	60	60	100	100	60	80	40
06-Mar-08	-	-	300	-	200	300	50
31-Jul-08	-	-	300	-	80	60	40
21-Oct-08	-	-	-	400	-	-	-
19-Dec-08	-	-	-	183	-	-	-
26-Mar-09	11	-	12	-	-	-	80
1-Apr-09	198	50	27	-	-	-	109
22-Apr-09	23	10	30	33	30	15	53
14-May-09	30	17	150	60	40	80	60
21-Jun-09	15	40	17	-	50	15	67
13-Aug-09	10	7	5	-	-	-	30
20-Sep-09	15	-	-	-	-	-	40
26-Oct-09	50	-	40	-	-	-	50
22-Dec-09	15	-	-	15	15	-	40
15-Jul-10	37	44	-	-	35	-	132
20-Mar-11	114	117	-	92.8	121	103	109
23-Jun-11	243	114	-	-	193	-	190
Minimum	10	7	5	15	15	15	30
Maximum	198	117	300	400	200	300	132





Dissolved Oxygen

The dissolved oxygen (DO) (mg/L) levels at the river site (YATSW07) ranged between 8.50 to 14.87 mg/L (Table 3). On average, the levels in the North and South Lagoons were similar, ranging from 3.90 and 14.97, and 4.57 and 15.17 mg/L respectively (Table 3).

The low levels (<5 mg/l) recorded just after refill (March 2009) are likely to be caused by the breakdown of plants that had established on the wetland bed whilst dry. The DO levels were back within acceptable levels by May 2009.

Oxygen in water is necessary for the survival of aquatic plants, fish and macro-invertebrate. Fish cannot tolerate dissolved oxygen (DO) levels below 5 mg/L for extended periods of time, or sudden changes to levels. When DO levels are below optimal; this can result in a fish kill.

Dissolved oxygen levels can be highly variable throughout a single day, as it is influenced by photosynthesis and respiration. DO levels are low in the morning as the dissolved oxygen has been consumed by aquatic biota overnight (while plants are only able to photosynthesize during daylight hours), and higher in the afternoon as plant processes (photosynthesis) return oxygen back into the water.

Table 3: Surface water dissolved oxygen levels (mg/L) at Yatco Lagoon.

Surface Water Dissolved Oxygen (mg/L)							
	YATSW01	YATSW02	YATSW03	YATSW04	YATSW05	YATSW06	YATSW07
31-Mar-08	-	-	10.8	-	12.5	12.7	11.1
26-Mar-09	11.4	-	9.8	-	12.57	-	10.67
01-Apr-09	10.5	8.01	10.7	-	-	-	8.5
7-Apr-09	12.96	6.92	6.88	-	-	-	-
22-Apr-09	4.87	4.4	4.93	4	8	4.57	12.5
14-May-09	10.5	12.1	9.93	9.9	11.77	9.93	11.4
21-Jun-09	14.97	13.03	10.5	-	11.83	12.27	13.57
13-Aug-09	14.67	14.87	14.4	12.23	14	15.17	14.87
20-Sep-09	12.29	9.34	5.36	11.73	11.49	11.32	9.62
26-Oct-09	11.87	8.93	9.2	4.33	12.1	12.63	10.63
22-Dec-09	7.1	7	8.6	3.9	8.5	6.7	9.03
15-Jul-10	9.37	7.4	-	-	6.34	-	10.07
20-Mar-11	9.71	7.01	-	6.1	3.49	6.72	6.37
23-Jun-11	14.82	12.34	-	-	14.95	-	14.95
Minimum	4.87	4.40	4.93	3.90	3.49	4.57	6.37
Maximum	14.97	14.87	14.40	12.23	14.95	15.17	14.95



pH

The pH has been sampled on 13 occasions, and ranged between 6.5 and 9.71 pH across all sites, which is in the range of neutral to mildly alkaline (Table 4). The pH of water along the River Murray in South Australia is generally alkaline (>8.5pH) due to the influence of sediment originating from nearby limestone cliffs. It may also be higher due to the presence of aquatic plants, as photosynthesis can put more oxygen into the water column resulting in higher pH levels. Lower pH may be as a result of bacteria breaking down organic materials, which consumes oxygen, resulting in a very slightly lower pH. The pH levels within Yatco Lagoon are within the range seen in many wetlands along the River Murray in South Australia.

Table 4: Surface water pH at Yatco Lagoon.

Surface water pH							
	YATSW01	YATSW02	YATSW03	YATSW04	YATSW05	YATSW06	YATSW07
31-Mar-08	-	-	8.46	-	9.71	9.51	8.55
26-Mar-09	7.28	-	6.69	-	7.4	-	8.11
1-Apr-09	7.86	7.86	8.36	-	-	-	7.76
7-Apr-09	8.27	7.65	7.7	-	-	-	-
22-Apr-09	6.9	7.12	6.83	7.32	7.28	7.2	8.75
14-May-09	7.57	7.1	7.35	7.18	6.5	7.26	7.9
21-Jun-09	7.93	6.95	6.93	-	7.65	6.87	7.92
13-Aug-09	8.57	8.36	7.3	7.34	8.59	8.97	7.44
20-Sep-09	9.08	8.72	7.71	9.13	9.05	9.04	9.65
26-Oct-09	-	-	-	7.58	-	-	-
22-Dec-09	-	-	8	-	7.75	8	8
15-Jul-10	7.92	-	-	-	7.68	7.46	7.88
20-Mar-11	7.46	7.59		7.45	7.35	8.16	7.48
23-Jun-11	7.87	7.39			7.53		7.94
Minimum	6.9	6.95	6.69	7.18	6.5	6.87	7.44
Maximum	9.08	8.72	8.46	9.13	9.71	9.51	9.65

Surface Water Conclusions/Actions

- Salinity (EC) - The salinity in the North Lagoon (sites YATSW01 to YATSW04) ranged from 324 to 7570 EC, and 322 to 7540 EC in the South Lagoon (sites YATSW05 and YATSW06). The higher values were generally recorded as the wetland levels were receding. The low values recorded in March 2011 were due to flooding occurring at the time of sampling.
- Turbidity - The turbidity in the North Lagoon ranged between <10 to 300 NTU, and 15 to 300 NTU in the South Lagoon. High values (>100NTU) correlate with a dry/drying phase of the wetland management. The low values in March 2009 correlate with the refill event, as the wetland bed was consolidated as a result of drying the wetland.
- Dissolved Oxygen - The dissolved oxygen (DO) (mg/L) levels at the river site (YATSW07) ranged between 8.50 to 14.87 mg/L. On average, the levels in the North and South Lagoons were similar, ranging from 3.90 and



14.97, and 4.57 and 15.17 mg/L respectively. The low levels in March to April 2009 correspond with a refill event; hence the levels are attributed to the breakdown of plants that established on the bed whilst dry.

- pH - The pH has been sampled on 13 occasions, and ranged between 6.5 and 9.71 pH across all sites, which is in the range of neutral to mildly alkaline. The pH of water along the River Murray in South Australia is generally alkaline (>8.5pH) due to the influence of sediment originating from nearby limestone cliffs.
- Surface water will be monitored at the next monitoring day in September 2011.

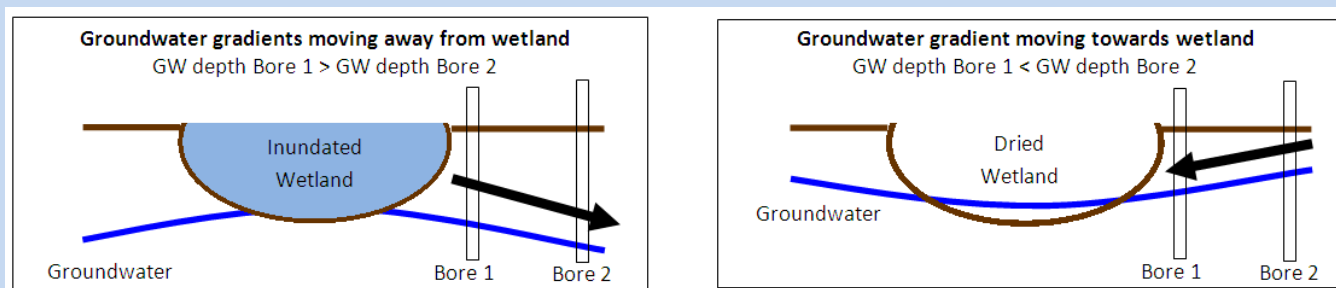
Groundwater

Gradient

Bores YATGW01 and YATGW06 are located on the eastern side of the North Lagoon (floodplain) and YATGW03 and YATGW05 are located on the western side (highlands). Bores YATGW09 and YATGW10 are located on the eastern side of the South Lagoon (floodplain) and YATGW07 and YATGW08 are located on the western side (highlands) (Appendix 1).

Assessing groundwater gradients

When bores are located in transects (e.g. two or more bores in a line), the data collected can be used to determine groundwater movement by looking at the gradient between bores relative to the wetland, and the impact this groundwater may be having on the wetland's ecology particularly in terms of salinity level.



To determine the gradient, the groundwater levels recorded in the field must be converted to mAHD so the levels can be compared.

When the groundwater level is higher near in the bore located closest to the wetland, the groundwater gradient is moving away from the wetland, therefore when the groundwater gradient is higher in the bore located furthest from the wetland, the groundwater gradient is moving towards the wetland.

Groundwater levels are usually influenced by surface water levels in nearby water bodies. Therefore when a wetland is full, the groundwater gradient usually moves away from the wetland, and when a wetland is dry the gradient moves towards the wetland.





The groundwater levels in the bores located near the North Lagoon region are very similar, with the largest differences in groundwater levels seen while the wetland was drying (2008) and during recent flooding (spring-summer 2010/11). Although the gradient was moving towards the wetland when it was permanently connected (prior to the construction of the embankment), the gradient magnitude increased slightly when the wetland was disconnected.

Since filling the wetland in March 2009, the differences in levels between YATGW01 and YATGW06 have remained the same, although the actual height has increased (Figure 2). This is likely to be due to the influence of inundation and then flooding of the wetland. Data has not been collected at these bores since September 2010 due to flooding. It is anticipated that the bores on the floodplain will be access in the September 2011 monitoring round.

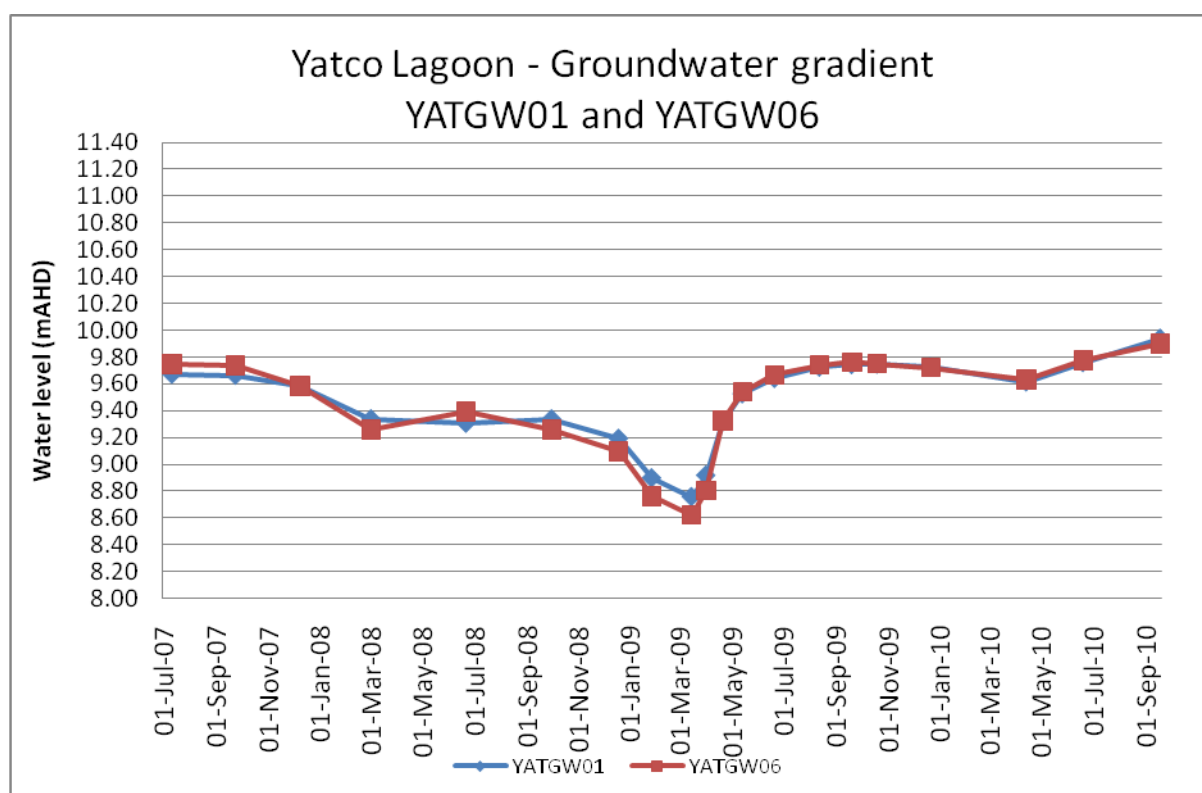


Figure 2: Graph of groundwater levels of bores YATGW01 and YATGW06 at Yatco Lagoon

The differences in groundwater levels are slightly accentuated on the highland side of the wetland. Bores YATGW03 and YATGW05 show greater difference between levels when the North Lagoon is drying in 2008 (Figure 3). The levels increase again when the wetland is reconnected in March 2009.

Prior to the wetland being reconnected in 2009, the groundwater gradient was moving towards the wetland. This indicates a risk of salinisation through the mobilisation of salt up through the soil profile. Once reconnected, the groundwater quickly changed direction to move away from the wetland. Although a few records show that the groundwater changed direction (towards the wetland) for a short amount of time while inundated, this may be due to a heavy rainfall event prior to sampling, resulting in a temporary reversal of the groundwater gradient away from the wetland.

The last record in June 2011 shows groundwater moving from the wetland (to the floodplain). It is anticipated that while the wetland remains connected, the groundwater gradient should remain in this direction.



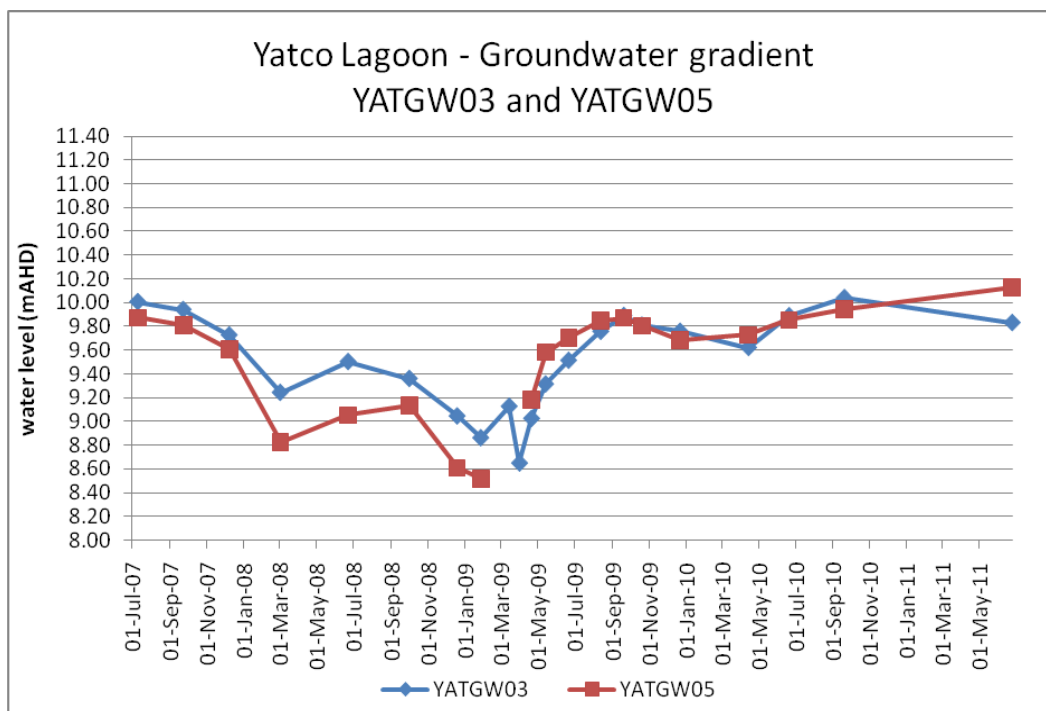


Figure 3: Graph of groundwater levels of bores YATGW03 and YATGW05 at Yatco Lagoon.

The levels between YATGW07 and YATGW08 have remained towards the wetland regardless of the management of the wetland (Figure 4). This may be due to irrigation influences on the highlands. It is probably worth noting that these bores recorded the lowest EC levels of all the bores that are monitored; with the EC in the range of 8,960 to 13,100 EC.

The greatest decline in levels occurred when the South Lagoon was drying in late 2008 to early 2009. When the wetland complex was reconnected in March 2009, the levels increased to similar levels as seen in 2007. The levels have increased furthermore due to the recent flooding and it is anticipated the level will decline as the water recedes.

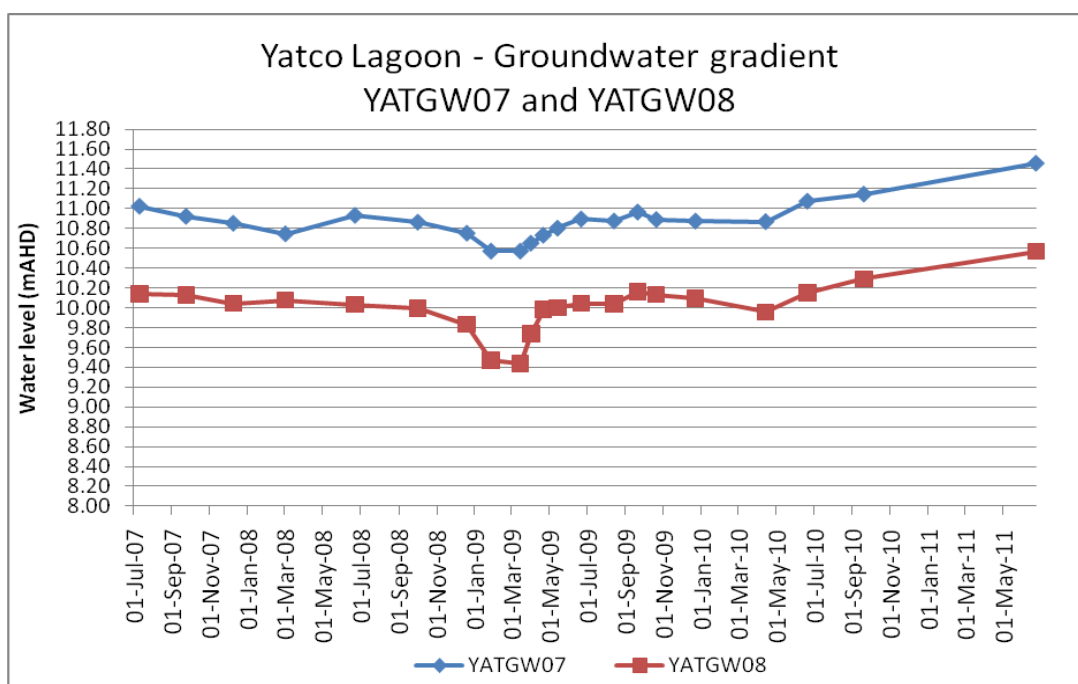


Figure 4: Graph of groundwater levels of bores YATGW07 and YATGW08 at Yatco Lagoon.



The direction of the groundwater gradient between bores YATGW09 and YATGW10 has remained away from the wetland regardless of management, although the South Lagoon has only been dry for a short amount of time between late 2008 and early 2009 (Figure 5).

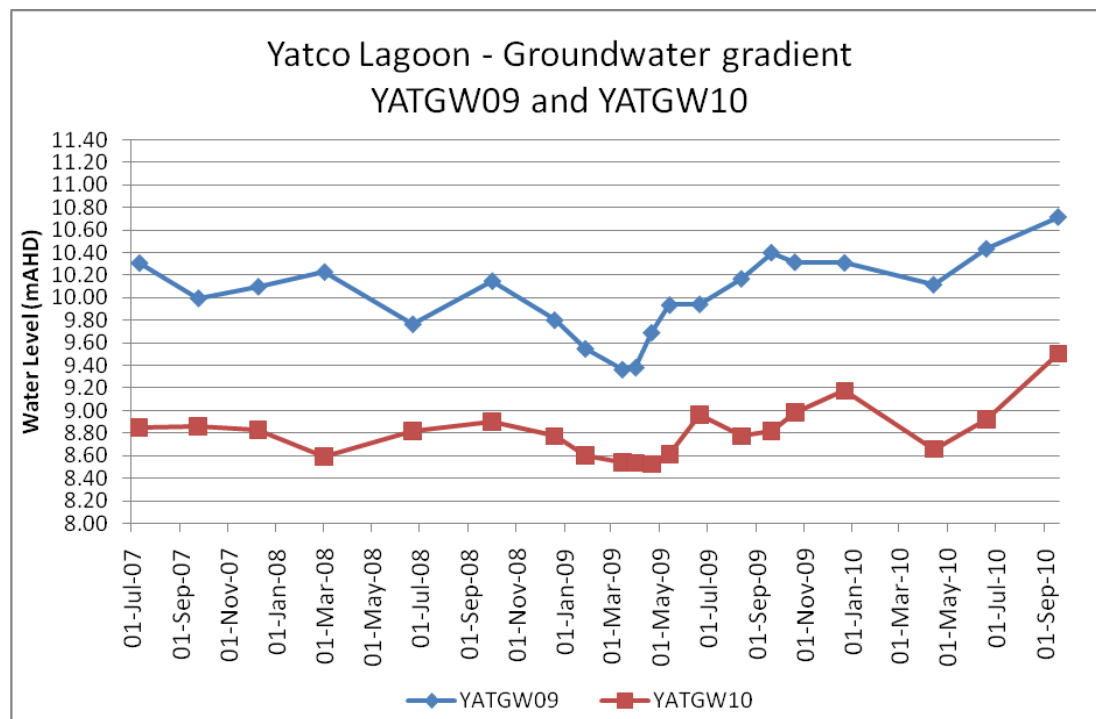


Figure 5: Graph of groundwater levels of bores YATGW09 and YATGW10 at Yatco Lagoon.

The groundwater data shows that the groundwater levels are particularly responsive to changes in water level in the North Lagoon and river levels. Due to the responsive nature of the groundwater, it is necessary to manage the wetland to ensure groundwater doesn't negatively impact on the wetland. The wetland should not be dried for longer than 6 months, as the risk of salinisation will increase the longer the wetland is dry.

Electrical Conductivity (EC)

The groundwater salinity (EC) at Yatco Lagoon varies between 8,960 and 113,000 EC (Figure 6). It is considered normal for groundwater salinities to be up to 60,000 EC throughout the Riverland due to ancient deposits of salt in the soil. Water from irrigation systems can influence the conductivity of groundwater by creating a freshening effect. When groundwater conductivities are above 60,000 EC it is likely to cause a concentration of salt. This can occur in areas where the groundwater is less than five metres from the surface. In areas where groundwater is less than five metres from the surface, water may evaporate, causing the salt to concentrate resulting in higher groundwater conductivities being recorded.

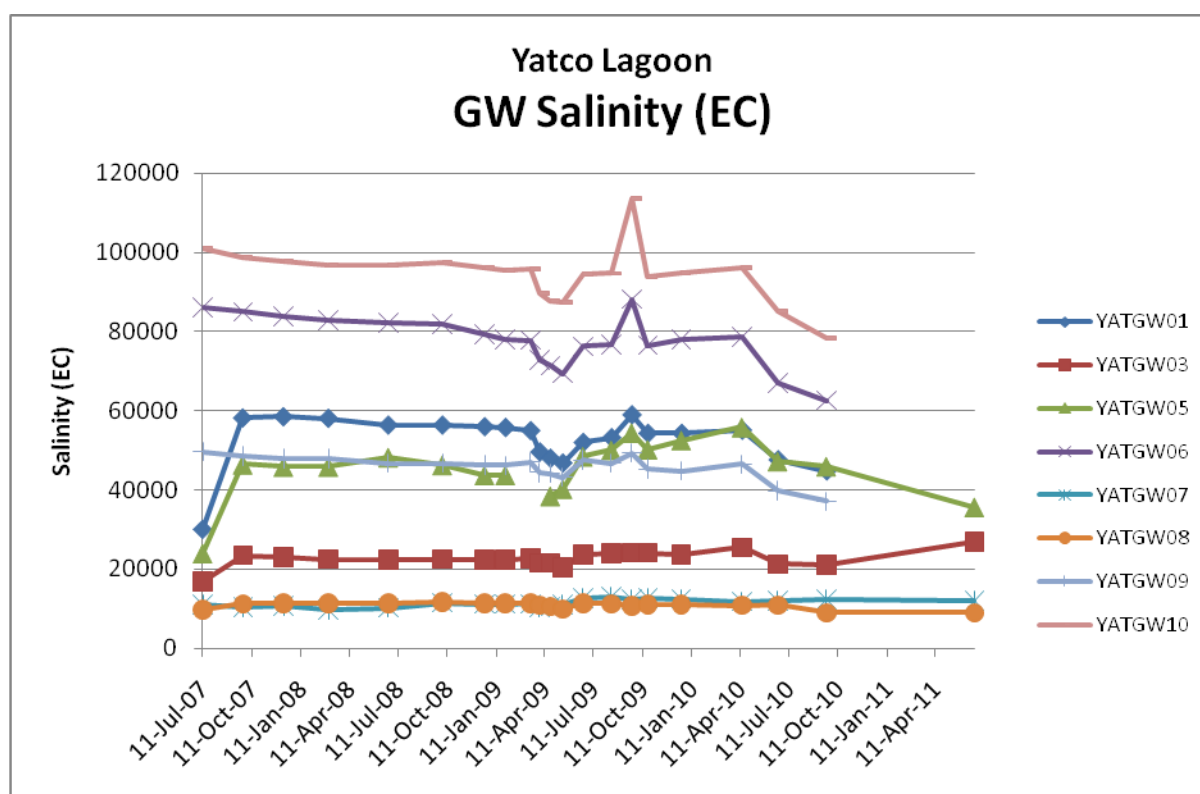


Figure 6: Graph of groundwater electrical conductivity (EC) YATGW01 and YATGW06 at Yatco Lagoon

As the conductivity of most groundwater bores is above 20,000 $\mu\text{S}/\text{cm}$ it is important for the wetland's ecology/integrity that the wetland does not remain disconnected for longer than six months as this is likely to increase the risk of salinisation.

Groundwater Conclusions/Actions

- The groundwater gradients on the floodplain of the North Lagoon are responsive to the water levels in the lagoon. It is important to only dry the wetland for a maximum of 6 months, as the risk of salinisation increases the longer the lagoon is dry.
- The groundwater gradients on the floodplain of the South Lagoon remain the same direction regardless of management.
- The groundwater salinity at Yatco Lagoon varies between 8,960 and 113,000 EC. Groundwater salinities up to 60,000 EC are common within the Riverland region due to ancient deposits of salt in the soil.
- The groundwater should be monitored ever quarter while the wetland is inundated, and every six weeks while the wetland is drying or dry.



Tree Health

Tree health has been assessed on eight occasions since 2007. The Tree Health assessment methodology in *Your Wetland: Monitoring Method* (Tucker 2004) is used at Yatco Lagoon (Table 5).

Table 5: Tree health method used at Yatco Lagoon (Your Wetland: Monitoring Manual).

Tree Health Rating	Tree Health Rating Description
5	Tree with >75% of original canopy present, Less than 5% epicormic growth, May include some dead branchlets and leaves.
4	Tree with 50 – 75% of original canopy present, Epicormic growth less than 10% of remaining canopy, Some dead branchlets (<50% of canopy)
3	Tree with 25 – 49% of original canopy present, Some epicormic growth (<50% of remaining canopy), Some small dead branches.(<50% canopy)
2	Tree with < 25% of original canopy present, Predominantly epicormic growth (>50% of remaining canopy), Some main branches dead (<50% canopy)
1	Unhealthy tree with no original canopy, All epicormic growth, Most main branches dead. (>50% canopy)
0	Dead

Transect YATTH01 is located on the eastern side of the wetland, on the river side of the embankment. YATTH02 is located on the western side of the North Lagoon, and YATTH03 is located on the eastern side of the South Lagoon (Appendix 2).

The average score of trees within transect YATTH01 has generally been above 3. Although the average has been as high as 4 in December 2007 and September 2008 to December 2009, it has dropped below 3 since April 2010 (Figure 7). A tree with a score of 3 has original canopy cover of 25 – 49%.

The average tree health score of trees within transect YATTH02 is significantly less than the other two transects with its average score approximately 2. In 2010, the score average increased up towards 3 (Figure 7).

The tree health of trees within transect YATTH03 is similar to YATTH01. The transect average has fluctuated between a score of 3 and 4 (Figure 7).

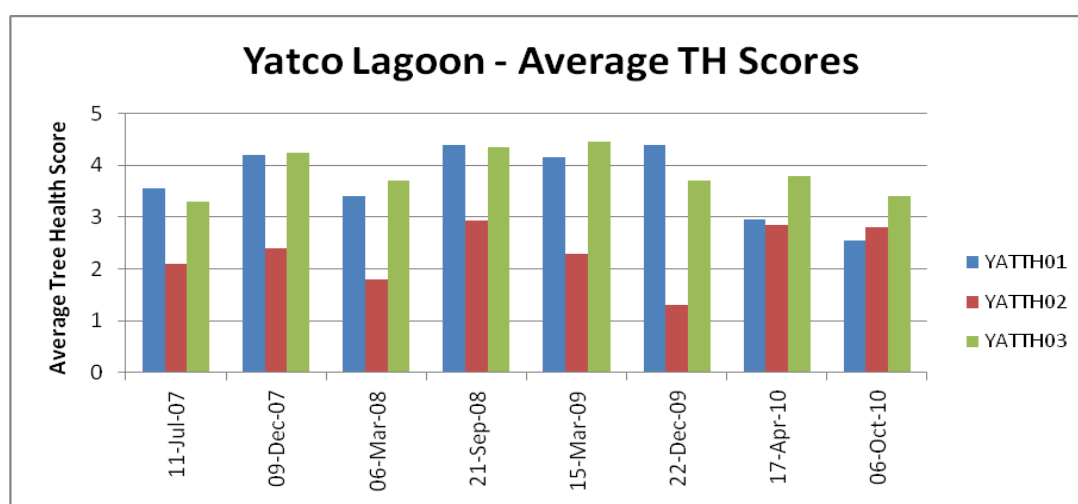


Figure 7: Graph of average tree health at Yatco Lagoon.





The tree health data for transect YATTH01 does not show any trends that can be related to management. The data varies between a score of 3 and 5 for most trees (Figure 8). The health of the trees at this site may be due their location on the river side of the embankment and close to a permanent water source. Tree 1 within transect YATTH01 is an example of a tree that has maintained its cover and density over time (Figure 9).

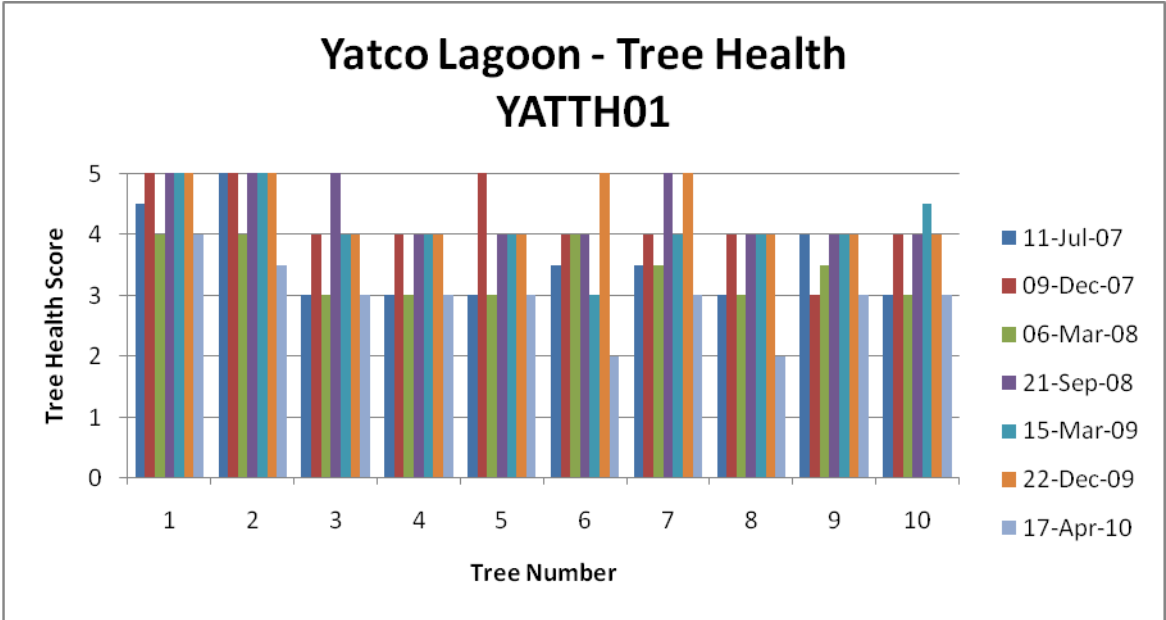


Figure 8: Graph of tree health scores for transect YATTH01.



Figure 9: Photos of Tree 1 Transect 1, Yatco Lagoon (Left: 11/07/07, Right: 12/04/11).





Health scores for the trees in transect YATTH02 are highly variable, ranging from 1 to 5, and have an on-going average approximately 3 (Figure 10).

Figure 11 shows that the health of tree 5 at transect YATTH02 has declined in canopy coverage, however there has been a slight increase in epicormic growth. It is anticipated that an improvement in canopy cover may be seen in response to the receding flood levels.

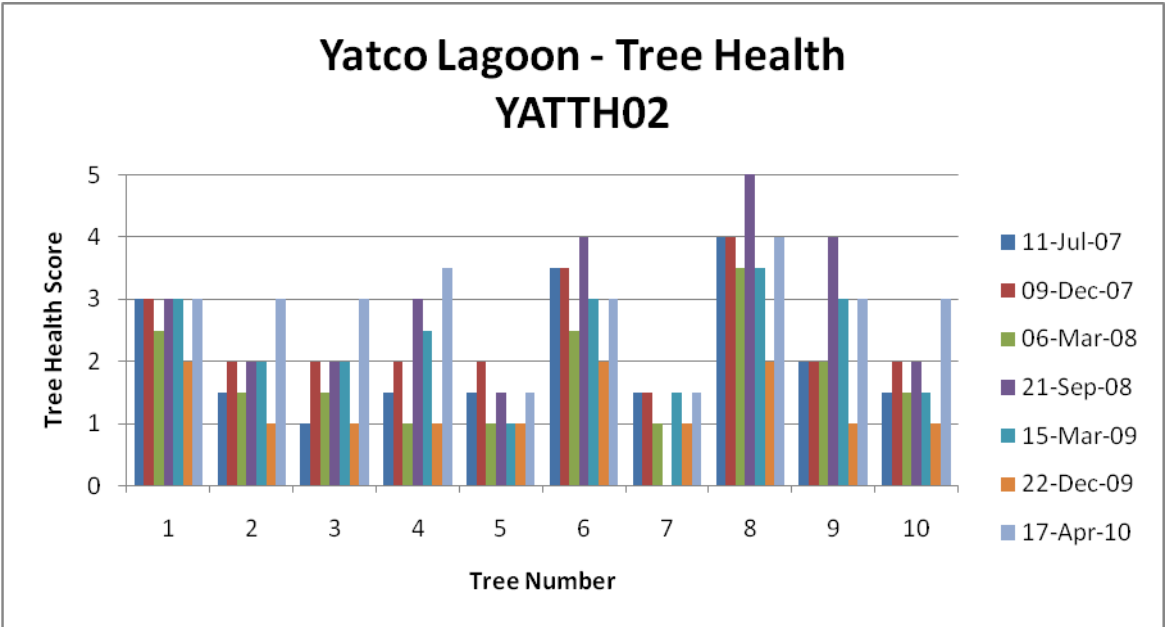


Figure 10: Graph of tree health scores for transect YATTH02.



Figure 11: Photos of Tree 5 Transect YATTH02, Yatco Lagoon.





The tree health scores for transect YATTH03 vary between 2 and 5, with an average trees score of approximately 3 (Figure 12). Figure 13 shows a considerable decline in the canopy cover of tree 9. It is anticipated that an improvement of health is likely to be seen as the water recedes, allowing water to be drawn away from the roots.

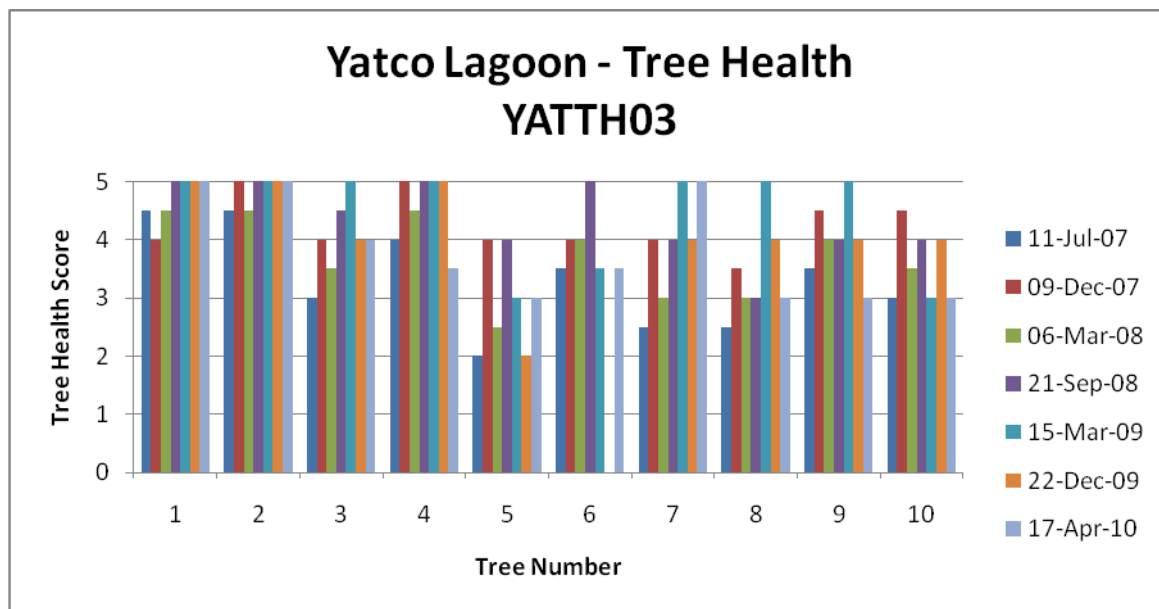


Figure 12: Graph of tree health scores for transect YATTH03.



Figure 13: Photos of Tree 9 Transect YATTH03, Yatco Lagoon.





In the future, more transects may be set up for monitoring the health of Black Box to assess the response to flooding in this species.

It is important to understand the effect of the recent high flows on the success of recruitment of River Red Gums and Black Box on the floodplain, and in the next coming months the SA MDB NRM Board is interested in working with the YWLG to record the location of any new recruits of River Red Gums and Black Box at the Yatco Lagoon (Figure 14). If you have found any on the floodplain, please let the SA MDB NRM Board know as this will help with mapping of the recruits.



Figure 14: Example of River Red Gum recruits at Murbpook Lagoon. C. Nickolai, SA MDB NRM Board

The SA MDB NRM Board has recently commenced using The Living Murray (TLM) Tree Assessment method at all sites. This is to ensure our data is comparable with the Department of Environment Natural Resources (DENR) and Department for Water (DFW). The TLM method is more detailed and provides more information about the tree health as it records additional aspects related to tree health such as dieback and mistletoe.

Tree Health Conclusions/Actions

- The tree health shows that on average, the trees monitored on the river and surrounding the South Lagoon are healthier than those monitored near the North Lagoon.
- It is anticipated that there should be signs of new growth (canopy and new buds) appearing by summer 2011.
- There are early signs of new River Red Gum recruits at Yatco Lagoon.
- Tree health is to be monitored every 6 months.



Fish

Fish surveys have been conducted on seven occasions since 2007. Nine different sites have been used throughout the wetland, including three on the flood runner creek which joins the River channel to the North Lagoon on the eastern side of the wetland.

A fish survey was conducted in the flood runner creek in March 2009, prior to works that involved dredging the creek to allow better flow through during refill of the North Lagoon. It was necessary to conduct the survey to ensure that no significant fish communities were living in the creek, as dredging would have been highly likely to disturb these.

In total eight native fish species have been recorded across all surveys (including the flood runner creek) (Table 6). One Catfish was recorded in the March 2009 survey (Figure 15). The Freshwater Catfish (*Tandanus tandanus*) is described as endangered in the Murraylands region (DENR 2011) and are protected under the Fisheries Management Act 2007 (listed as vulnerable).

A total of five exotic species have been recorded at Yatco Lagoon, with Goldfish (*Carassius auratus*) being the most abundant (Table 7). The Carp/Goldfish hybrid (*Cyprinus carpio* X *Carassius auratus*) was also recorded. They generally look more like Common Carp (*Cyprinus carpio*), but with no barbels (whiskers) (Carter and Pierce undated).

Although no state or nationally threatened species were recorded in the managed section of the wetland, the surveys did record the Dwarf Flathead Gudgeon (*Philypnodon macrostomus*) and Rainbow Fish (*Melanotaenia fluviatilis*), which are generally found in lower numbers in the region. DENR (2011) lists Dwarf Flathead Gudgeon as Near Threatened (in the region). The Freshwater Catfish was recorded in the flood runner creek, not in the managed wetland itself.



Figure 15: The Catfish caught at Yatco Lagoon. C. Nickolai, SA MDB NRM Board



Table 6: Native Fish recorded in Yatco Lagoon.

Native Fish Species and Number							
	7-Sep-07	20-Dec-07	13-Mar-09	15-May-09	23-Oct-09	23-Nov-10	Grand Total
Flat Head Gudgeon	19	25	2	4	86	55	191
Bony Bream	47	65	28	15	3	39	197
Unspeck Hardyhead	47	774	7	108	135	1535	2606
Smelt	1271	84	5	472	7955	34	9821
DFHG	1	0	0	0	0	6	7
Carp Gudgeon	6	239	63	102	274	3840	4524
Rainbow	1	12	0	0	0	1	14
Catfish	0	0	1	0	0	0	1
Grand Total	1392	1199	106	701	8453	5510	17361

Table 7: Exotic Fish recorded in Yatco Lagoon.

Exotic Fish Species and Number							
	7-Sep-07	20-Dec-07	13-Mar-09	15-May-09	23-Oct-09	23-Nov-10	Grand Total
Red Fin	6	2	2	0	0	0	10
Goldfish	0	113	0	0	19	55	187
Gambusia	0	19	7	0	0	0	26
Carp	0	0	4	0	2	5	11
Carp X Goldfish Hybrid	0	0	1	5	0	0	6
Grand Total	6	134	14	5	21	60	240

The species diversity is dominated by natives, with a minimum of five species recorded during each survey, and a maximum of seven, although a total of eight species has been captured across all surveys (Figure 16). Maximum native fish diversity was captured during the 2010-11 high flow event. A minimum of one exotic species was recorded in May 2009 and a maximum of four species were recorded in March and May 2009. The March survey recorded fish in the flood runner creek prior to refill, and the May survey was conducted approximately two months following the wetland being inundated, after Yatco Lagoon had been through its first complete dry event since Locks and Weirs were installed in the 1920s.



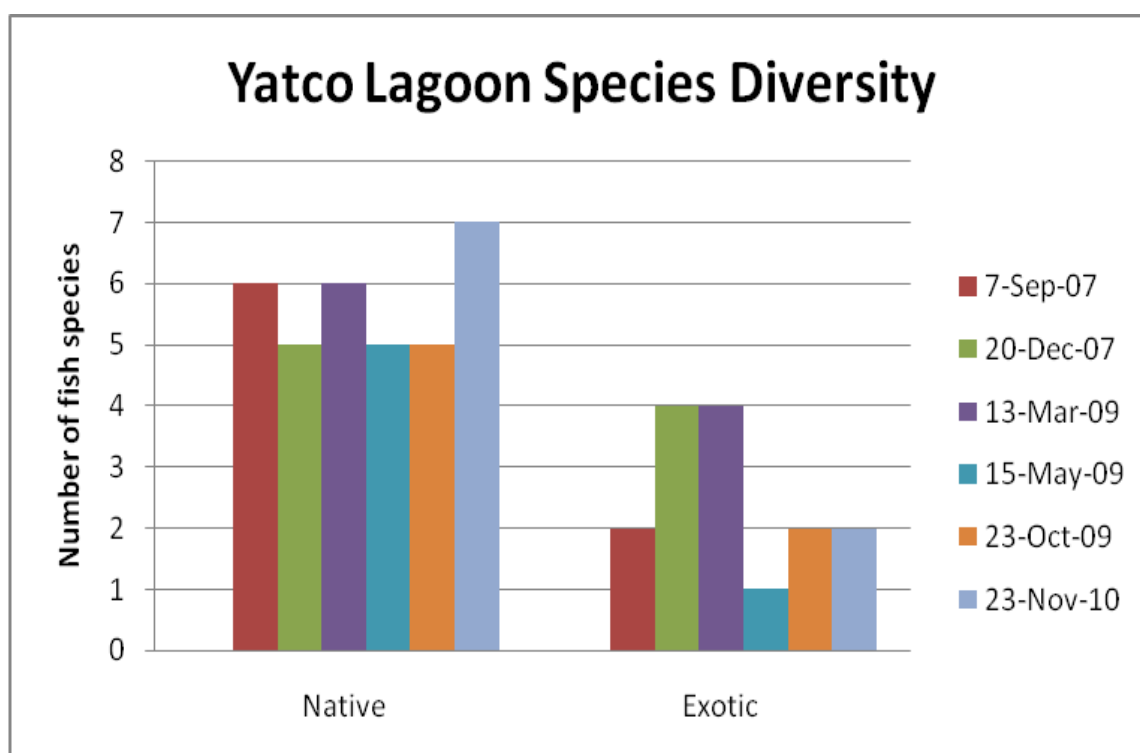


Figure 16: Yatco Lagoon fish species diversity.

The species abundance has varied between native and exotic species (Figure 17). The abundance of native species caught during surveys ranged between 106 and 8453 individuals. The abundance of exotic fish has been lower than native fish, with the number of individual fish caught during each survey varying between five and 146. The highest abundance of native fish was recorded in October 2009, which is approximately seven months following inundation (after a complete dry). The high numbers may be a result of fish response to inundation. When a wetland is inundated, a number of ecological responses occur. Macroinvertebrates are the first to respond, with eggs hatching in the wet mud. This creates the ideal breeding environment for fish, birds and frogs as macroinvertebrates provide a vital food source for many water dependent fauna.



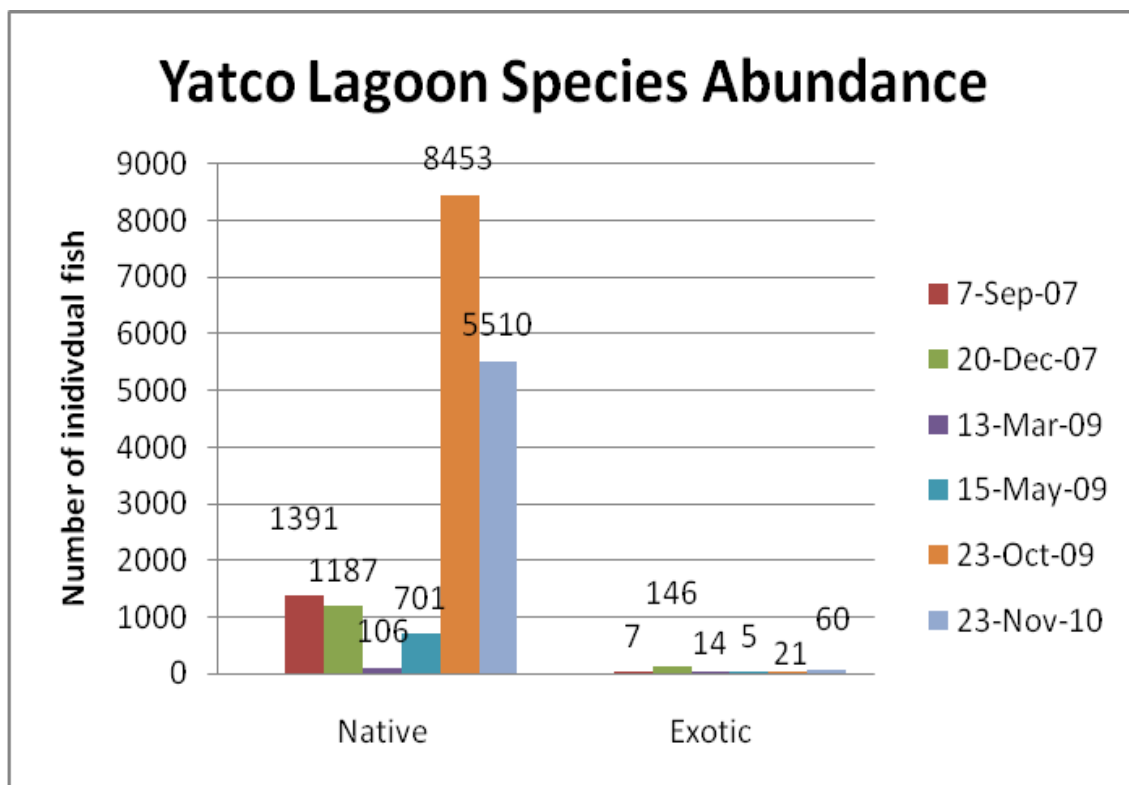


Figure 17: Yatco Lagoon fish species abundance.

Fish Conclusions/Actions

- A maximum of eight native and five exotic fish species have been recorded over 7 surveys since 2007
- Although five exotic species were recorded at Yatco (which is relatively high compared with other wetlands in the region) they were found in less abundance than native species, with the highest exotic fish abundance recorded as 146 individual, compared with 1187 natives during the same survey
- Maximum native fish diversity was captured during the 2010-11 high flow event (7 native species)
- The next fish survey will be conducted in spring 2011.

Birds

Birds have been monitored on five occasions since 2007 (Appendix 3). The surveys have been undertaken by the SA MDB NRM Board and a Riverland bird interest group. A total of 39 water dependent species have been recorded across all surveys, with 23 species recorded prior to the wetland being completely dried, and 33 since the wetland has been refilled (Appendix 4). Ten duck species have been recorded including the Australasian Shoveller (*Anas rhynchos*), Blue Bill Duck (*Oxyura australis*) and Musk Duck (*Biziura lobata*), which are all listed as rare in South Australia. Another state rare species, the Great Crested Grebe (*Podiceps cristatus*), was recorded at Yatco in November 2009, and was also recorded with young during the March 2010 survey. In 2009, there was a fantastic aquatic vegetation response in the South Lagoon, with a high abundance of Red Milfoil (*Myriophyllum verrucosum*) covering the lagoon. As a result, hundreds of swans inhabited the South Lagoon around October/November 2009 (Figure 18).





Figure 18: Many swans inhabited Yatco Lagoon in 2009. C. Nickolai, SA MDB NRM Board

As the wetland is relatively large, it has the capacity to support many birds over time. It would be of benefit to the Yatco Lagoon wetland management to involve the Riverland bird interest group in monitoring, as this would ensure that bird monitoring is done on a more frequent basis, which will in turn capture the species utilise the wetland over time and between surveys.

Bird Conclusions/Actions

- A total of 39 water dependent bird species have been recorded over five surveys since 2007, which is considered to be high species diversity for a Riverland wetland
- It is important to conduct frequent bird surveys, especially during spring and summer. If you are interested in conducting additional bird surveys, please contact the SA MDB NRM Board
- The next bird survey will be conducted in spring 2011.



Frogs

Frog surveys have been conducted on eight occasions since 2007 (Appendix 5). A total of four species have been recorded including the Southern Bell Frog (*Litoria raniformis*) (Figure 19), which is listed as vulnerable in SA (*National Parks and Wildlife Act 1972*) and listed as vulnerable nationally (*Environment Protection and Biodiversity Conservation 1999*). High abundances of the Southern Bell Frog were recorded during the December 2009 survey, which is approximately nine months after the wetland was refilled.



Figure 19: Southern Bell Frog (*Litoria raniformis*). C. Nickolai, SA MDB NRM Board

Frog kits will be available to loan in spring. If you are interested, please contact the SA MDB NRM Board.

Frog Conclusions/Actions

- A total of four frog species has been recorded during eight surveys since 2007
- Any additional frog survey data would be very useful. If you are interested in borrowing a frog survey loan kit, please contact the SA MDB NRM Board
- The next frog survey will be conducted in September 2011.



Photopoints

Photopoints are monitored every quarter at Yatco Lagoon. Figure 20 shows the changes in water level over time at site YATPP01. Figure 21 is taken from the cliff top photopoint (YATPP02). Groundwater intrusion coming from under the road is visible on the bottom of the photo take in March 2009. In the November 2009, the photo shows a large patch of Red Milfoil in the North Lagoon. The photo in February 2011 was taken at the peak of the recent flood.



Figure 20: Photopoint YATPP01 (Top left, 15/03/09, Top right, 22/12/09, Bottom left 20/03/11, Bottom right 23/06/11).

Photopoint Conclusions/Actions

- Photopoints is a useful method for capturing the rise and fall of water levels, and the presence and absence of vegetation over time.
- Photopoints will be monitored at the next quarterly monitoring day, in spring 2011.





Figure 21: Photopoint YATPP02, panoramic photo. C. Nickolai, SA MDB NRM Board



Thanks again!

Thanks again to the Yatco Wetland Landcare Group for their enthusiasm for managing Yatco Lagoon.



Figure 22: The group having a well earned glass of wine after a monitoring day. C. Nickolai, SA MDB NRM Board

If you are interested in attending quarterly monitoring day, please contact the SA MDB NRM Board.

Additional information

Spring and summer is always a busy time for wetland monitoring! If you are interested in participating in frog, fish or bird surveys or are interested in borrowing a frog monitoring loan kit, please contact the SA MDB NRM Board.

Don't forget to report any River Red Gum or Black Box recruits you find on the floodplain!

If you have any other questions please feel free to contact Callie Nickolai at the SA MDB NRM Board on 8582 4477 or callie.nickolai@samdbnrm.sa.gov.au



APPENDIX 1: Map of Surface Water and Groundwater Sites at Yatco Lagoon.



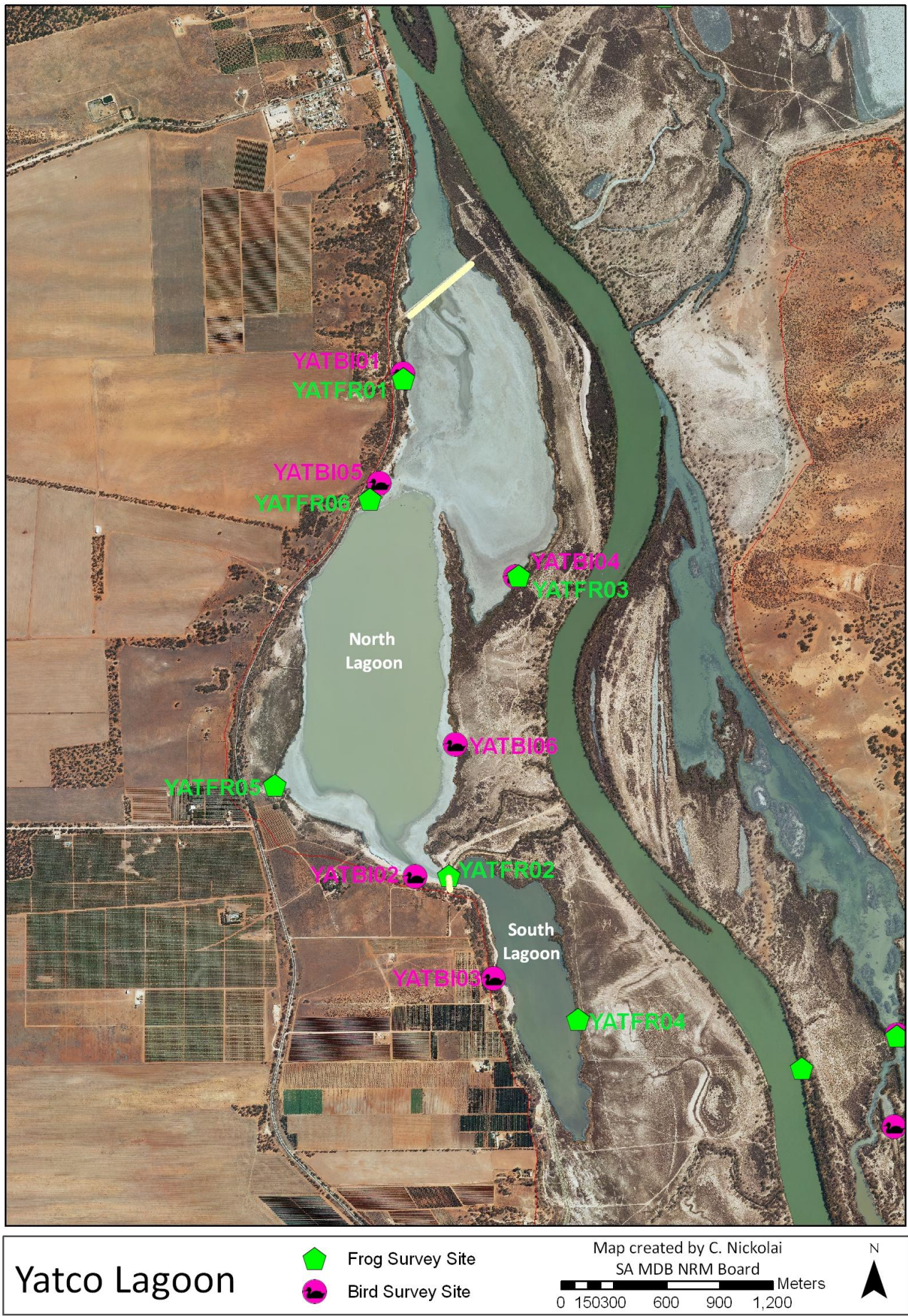


APPENDIX 2: Map of Photopoint, Fish and Tree Health survey sites at Yatco Lagoon.





APPENDIX 3: Map of Frog and Bird Survey Sites at Yatco Lagoon.



APPENDIX 4: Table of Bird Survey Data from Yatco Lagoon.

Date	11-Oct-07				22-Jan-08		4-Nov-09	13-Mar-10	18-Apr-10	
	YATBI01	YATBI02	YATBI03	YATBI04	YATBI01	YATBI02	YATBI01	YATBI01	YATBI01	YATBI03
Australasian Shoveller										P
Australian Darter	4	1						P	P	
Australian Ibis					14	3		P	P	P
Australian Pelican	7	6	19		454	70	22	P	P	P
Australian Shelduck			50+		6	2			P	P
Australian Wood Duck						22		P	P	
Black Fronted Dotterel										P
Black Swan	6	1	31	3	200	14	50	with young	P	P
Black-tailed Native-hen							1			
Black-winged Stilt					60					
Blue-billed Duck							1			P
Brown Falcon									P	P
Caspian Tern		5		1		5		P		
Chestnut Teal								P		P
Dusky Moorhen	6									
Eurasian Coot							1000+			
Great (Large) Egret									P	
Great Cormorant	1							P		
Great Crested Grebe							12	with young		
Grey Teal	13	27	20		24		200+	P	P	P
Hardhead					6		200+			P
Intermediate Egret					6	1				
Little Black Cormorant	6			1			10		P	P
Little Pied Cormorant	43	1	1					P	P	P
Musk Duck							2	displaying	P	
Pied Cormorant					13	4				
Purple Swamphen									P	P
Rainbow Bee-eater								P		
Red-kneed Dotterel		4	1		10	20				
Red-necked Avocet			1							
Reed Warbler							2		P	P
Royal Spoonbill			1		3					P
Silver Gull						2	3	P		P
Straw-necked Ibis										P
Swamp Harrier								P		
Variegated Fairy Wren								P	P	
Whistling Kite						3		P		P
White-faced Heron					1			P	P	P
Yellow-billed Spoonbill			1				1		P	



APPENDIX 5: Table of Frog Survey Data from Yatco Lagoon.

Date	Site	Common Name	Scientific Name	Abundance
25-Oct-07	YATFR01	NO FROGS		-
	YATFR02	NO FROGS		-
	YATFR03	NO FROGS		-
	YATFR04	Peron's Tree Frog	<i>Litoria peroni</i>	One
04-Dec-07	YATFR01	NO FROGS		-
	YATFR02	Peron's Tree Frog	<i>Litoria peroni</i>	Few (2-9)
	YATFR03	NO FROGS		-
	YATFR04	NO FROGS		-
02-Sep-08	YATFR01	NO FROGS		-
	YATFR02	Eastern Banjo Frog	<i>Limnodynastes dumerili</i>	Many (10-50)
	YATFR03	NO FROGS		-
	YATFR04	Eastern Banjo Frog	<i>Limnodynastes dumerili</i>	Many (10-50)
06-Apr-09	YATFR01	Spotted Grass Frog	<i>Limnodynastes tasmaniensis</i>	One
	YATFR02	NO FROGS		-
	YATFR03	NO FROGS		-
	YATFR04	NO FROGS		-
16-Apr-09	YATFR01	NO FROGS		-
	YATFR02	NO FROGS		-
	YATFR04	NO FROGS		-
	YATFR05	Spotted Grass Frog	<i>Limnodynastes tasmaniensis</i>	Few (2-9)
22-Dec-09	YATFR01	NO FROGS		-
	YATFR02	Peron's Tree Frog	<i>Litoria peroni</i>	Many (10-50)
	YATFR02	Southern bell frogs	<i>Litoria raniformis</i>	lots
	YATFR03	Southern bell frogs	<i>Litoria raniformis</i>	Lots (50+)
	YATFR04	Southern bell frogs	<i>Litoria raniformis</i>	Many (10-50)
	YATFR04	Peron's Tree Frog	<i>Litoria peroni</i>	Few (2-9)
	YATFR05	Southern bell frogs	<i>Litoria raniformis</i>	lots
	YATFR06	Peron's Tree Frog	<i>Litoria peroni</i>	Few (2-9)
	YATFR06	NO FROGS		-
14-Sep-10	YATFR01	Spotted Grass Frog	<i>Limnodynastes tasmaniensis</i>	Few (2-9)
	YATFR01	Eastern Banjo Frog	<i>Limnodynastes dumerili</i>	One
	YATFR02	Eastern Banjo Frog	<i>Limnodynastes dumerili</i>	Few (2-9)
	YATFR04	Eastern Banjo Frog	<i>Limnodynastes dumerili</i>	Many (10-50)
	YATFR05	Eastern Banjo Frog	<i>Limnodynastes dumerili</i>	One
	YATFR06	NO FROGS		-





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