



Long Term Intervention Monitoring Project Edward-Wakool River System Selected Area Project Progress Report #11

Reporting period: 1 January to 31 March 2017 (2016-17 Watering Year)

Watts R.J., Healy S, Howitt J., Kopf R.K., McCasker N., Thiem J. (2017). Long Term Intervention Monitoring project, Edward-Wakool River System Selected Area, Progress Report number 11, March 2017. Charles Sturt University, Institute for Land, Water and Society. Prepared for the Commonwealth Environmental Water Office.



Silver perch (top) and Murray River rainbowfish (bottom) captured during fish recruitment surveys in the Edward-Wakool system in March 2017 (Photos: R. Kopf)

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Summary of progress against monitoring and evaluation activities

This is the eleventh progress report for the Edward-Wakool Long-Term Intervention Monitoring (LTIM) and Evaluation Project. This report contains a summary of work undertaken between January and March 2017 (Table 1). Other reports since the commencement of the project in July 2014 and December 2016 are available on the project website <http://www.csu.edu.au/research/ilws/research/sra-sustainable-water/edward-wakool-research-project>

Table 1. Summary of progress on the Edward-Wakool LTIM Project January to March 2017

Activities	Overview of progress from January to March 2017
Monitoring activities	
Hydraulic modelling	<ul style="list-style-type: none"> 2D hydraulic modelling reported in 2014-15 annual report. No modelling undertaken in 2016
River hydrology	<ul style="list-style-type: none"> Hydrological data from NSW Office of Water gauges regularly downloaded from the web Depth loggers at 7 sites were downloaded monthly The water levels on staff gauges were recorded once per month where possible
Stream metabolism	<ul style="list-style-type: none"> Dissolved oxygen loggers were downloaded monthly and probes are cleaned fortnightly. Monitoring of nutrients and carbon undertaken monthly at sites where loggers installed
Carbon & water quality	<ul style="list-style-type: none"> Routine water monitoring undertaken each month
Riverbank and aquatic vegetation	<ul style="list-style-type: none"> Monitoring of aquatic and riverbank vegetation at fixed transects in four zones was undertaken monthly.
Fish larvae	<ul style="list-style-type: none"> Light trap sampling undertaken fortnightly in January and February, and were completed for 2016-17 watering year on 3 March 2017.
Fish recruitment	<ul style="list-style-type: none"> Sampling of young-of-year fish recruits with backpack electrofisher, set lines and angling was undertaken in February and March 2017 at 16 sites in zones 1 to 4.
Fish community	<ul style="list-style-type: none"> Fish community monitoring for the Category 1 sites will be undertaken in May 2017
Fish movement	<ul style="list-style-type: none"> Receivers for the assessment of fish movement are downloaded four times per year. Next download of data to be undertaken early April 2017.
Evaluation activities	
Annual report	<ul style="list-style-type: none"> The draft 2016-17 Annual report will be submitted by 31 August 2017
Progress reports	<ul style="list-style-type: none"> Progress reports submitted quarterly are available on the project website
Monitoring data	<ul style="list-style-type: none"> The 2016-17 monitoring data will be uploaded into the CEWO Monitoring Data Management System between August and October 2017
Communication and engagement	
Environmental Water Reference Group	<ul style="list-style-type: none"> The third meeting of the EWEWRG was held on 15 March 2017 in Deniliquin. Robyn Watts presented an update on LTIM monitoring and evaluation
E-W Operational Advisory Group	<ul style="list-style-type: none"> The EWOAG met approximately fortnightly between January and March 2017
Other stakeholder engagement	<ul style="list-style-type: none"> Julia Howitt presented water quality results to the Murray and Lower Darling EWAG in Deniliquin on 6 February 2017 Robyn Watts and Julia Howitt gave presentations at the 'Connecting the dots at Koondrook-Perricoota Forest' 2017 Gathering at Moama on 8 February 2017 Nicole McCasker, Julia Howitt, Jason Thiem (NSW Fisheries) and Bruce Campbell (CEWO) gave presentations at the Edward Wakool Fish Forum on 16 February 2017 organised by Murray Local Land Services and the Edward Wakool Stakeholder Committee. A report on Edward-Wakool Aerators by Western Murray Land Improvement group was published in February 2017 Prior to each monitoring trip landholders whose properties are accessed to undertake sampling were contacted

- **Appendix A** provides additional information about the project for the Edward-Wakool system
- **Appendix B** provides a map showing the location of hydrological zones that will be monitored
- **Appendix C** provides a summary of LTIM monitoring to be undertaken from 2014-2019.

Commonwealth environmental water use in the Edward-Wakool River system between January and March 2017

Widespread flooding in south-eastern Australia in 2016 resulted in a hypoxic (low dissolved oxygen, DO) blackwater (high dissolved organic carbon) event affecting a large area of the southern Murray-Darling Basin in 2016. Between October and December several Commonwealth environmental watering actions were undertaken to create local refuge areas by releasing environmental flows with higher DO and lower DOC from irrigation canals via regulating structures (known as 'irrigation canal escapes') into rivers in the Edward-Wakool system. Details of the monitoring associated with the hypoxic blackwater and refuge flows were included in progress report number 10. These watering actions were all completed by the end of December 2016.

As the Edward-Wakool system returned to regulated conditions after the 2016 flood, the following environmental watering actions were undertaken in the Edward-Wakool system between January and March 2017:

- **Colligen Creek-Niemur River system and Wakool River-Yallakool Creek system** flows commenced on 01/01/2017 and are planned to continue into winter 2017. These flows are targetting native fish condition, movement, spawning and recruitment in addition to the recovery of instream aquatic native vegetation.
- **Merran Creek system** - A watering action commenced 16/2/2017 and ended 28/3/2017 targetting native fish movement, particularly silver perch, between the Murray River and lower Wakool River systems. This watering action was not monitored as part of LTIM project.



Wakool River near the Wakool-Barham Rd Bridge

Field observations – January to March 2017

Observations from monitoring undertaken between January and March 2017 are provided in this report. Observations prior to January 2017 are in previous progress reports (see Edward-Wakool LTIM website <http://www.csu.edu.au/research/ilws/research/sra-sustainable-water/edward-wakool-research-project>).

1. Water quality

Water quality between January and March 2017 were mostly within the normal range for this system, and were considerably different to results recorded during the hypoxic blackwater event in 2016. The monthly water samples were collected in the week of the 16th of January and the 13th of February 2017 with the final samples of the season scheduled for May 2017.

Dissolved organic carbon (DOC) was in the range of 3.9 to 6.3 mg C/L in January with the highest concentrations found in the Wakool River at Gee Gee Bridge, the most downstream site. DOC was in the range of 2.9 to 4.5 mg/L in February 2017. These results are within the normal range for this system and were considerably lower than the DOC concentrations observed between October and December 2016 (see progress report number 10). Total nitrogen was in the range 0.51 to 0.97 mg N/L in January and 0.69 to 0.82 mg N/L in February, which is above the ANZECC (2000) trigger levels and is slightly elevated for this system, but considerably lower than observations during the 2016 flood event. These results may have been influenced by the presence of blue-green algae in the system (amber alert). Total P was in the range 0.06 to 0.11 mg/L in January and 0.06 to 0.08 mg/L in February which is similar to the normal range of 0.05 mg/L in this system.

Water quality data was presented at the Murray and Lower Darling EWAG meeting in Deniliquin on 06/02/2017 and some LTIM data was used in conjunction with data collected for State Forests NSW for a presentation at 'Connecting the dots at Koondrook-Perricoota Forest' in Moama on 07/02/2017. A public presentation was also given at the 2017 Edward-Wakool Fish Forum in Barham on the 16/02/2017.

2. Fish movement monitoring

The LTIM acoustic receiver array in the Edward-Wakool system monitors fine-scale movements of golden perch and silver perch in Yallakool Creek and the mid-upper reaches of the Wakool River, and is supplemented by a number of acoustic receivers funded by Murray LLS (Figure 1). The Murray LLS receivers enable us to monitor where tagged fish go (and when) throughout the broader Edward-Wakool system, including into the Murray River. A download of acoustic receivers was completed in December 2016.

Tagging of 17 silver perch (Figure 2) was undertaken in February (n=6) and March (n=11) to supplement the 51 golden perch and 11 silver perch that had previously been fitted with acoustic tags during the LTIM project.

The data indicated substantial downstream movements of some golden perch and silver perch fitted with acoustic tags (Figure 3). In the past 6 months 44 golden perch and six silver perch have been detected by the receiver array. High flows in September/October 2016 facilitated the downstream movement of a number of fish out into the wider system, with three golden perch and three silver perch exiting the Edward-Wakool system into the Murray River. One golden perch was detected on another receiver array near Mildura (moved approximately 590 km) and one silver perch was detected in the lower Darling River (moved approximately 760 km). The fate of the remaining individuals during the period of low dissolved oxygen in late 2016 is currently unknown and the next download of acoustic receivers scheduled for April 2017 will provide more information.

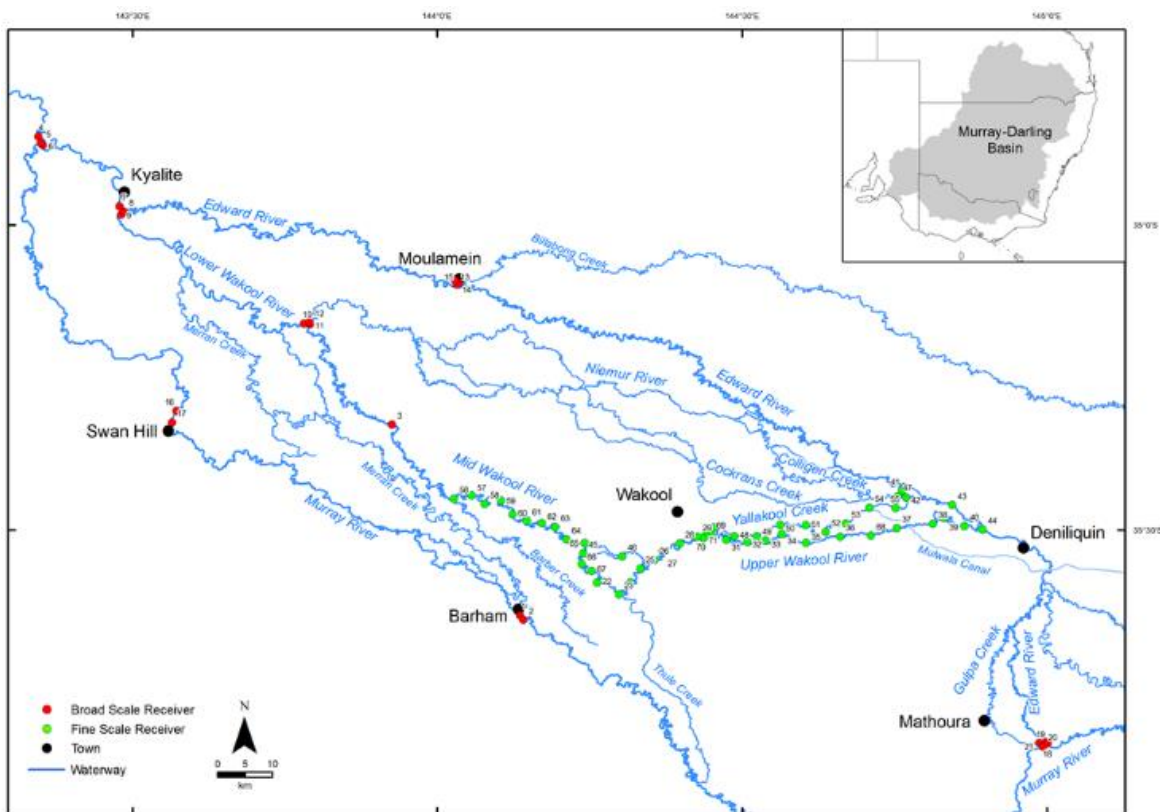


Figure 1. Location of acoustic receivers in the Edward-Wakool system. Installation and maintenance of receivers in zones 1 to 4 (n=51) is funded by the LTIM project and receivers installed at major waterway junctions (n=20) is funded by the Murray Local Land Services.



Figure 2: A silver perch captured from the Wakool River in March 2017 being surgically implanted with an acoustic tag whilst under anaesthesia.

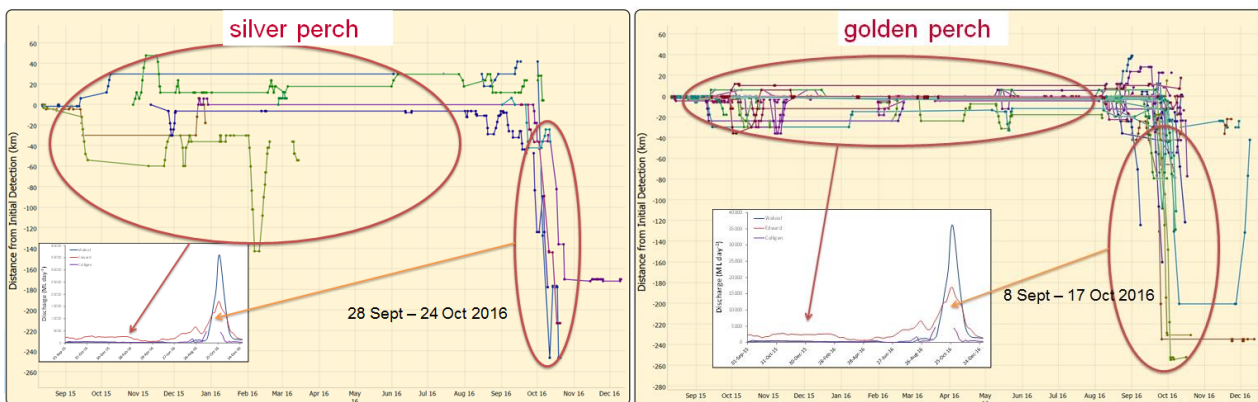


Figure 3: Distances moved by acoustically tagged silver perch (left) and golden perch (right) in the Edward-Wakool system from September 2015 to December 2016.

3. Fish spawning

The fortnightly selected area larval fish sampling at 20 sites across zones 1 to 4 was completed on 3 March 2017. Larvae of seven native fish species and three alien fish species were captured during the 2016-2017 watering year (Table 1). Some notable observations were:

- Strong spawning response carp gudgeon, Murray River rainbow fish and shrimp
- Larvae of bony herring (*Nematolosa erebi*) was caught for the first time in 2016-2017. This species is commonly sampled as adults in the Edward-Wakool system, but to date had not been recorded as larvae. Larval bony herring were collected in zone 1 (Yallakool Creek), zone 2 (Upper Wakool River) and zone 3 (Wakool River upstream of Thule Creek), from late January to early February.
- Very low abundances of Murray cod larvae were detected (n=4) compared with previous years, indicating a poor spawning season for this species. There are two possible explanations for this: i) the hypoxic event killed or stressed spawning adults, and ii) there was large scale movement of Murray cod out of the system during the hypoxic event. The absence of Murray cod larvae is unlikely to be due to a sampling issue because light traps were set during the flood and other species were captured.
- This was the first year of LTIM sampling where we did not find River blackfish larvae in the study area. However, adult river blackfish were caught during the fish recruitment sampling in February/March 2017 (see below) so this species is still present in the upper Wakool River.
- Despite the floods and water flows throughout the system, we did not detect silver perch or golden perch spawning.

Table 1. List of fish species recorded in Edward Wakool River system since 2010. Asterisks highlight if local spawning has been detected, in previous sampling years and in the current 2016-17 spawning season. ¹Indicates species have been recorded in the Edward Wakool system, but outside the LTIM focal study zones.

Common name	Species name	Local spawning recorded 2010-2016	Local spawning recorded 2016-2017
Native species			
Australian smelt	<i>Retropinna semoni</i>	*	*
carp gudgeon	<i>Hypseleotris</i> spp.	*	*
flathead gudgeon	<i>Philypnodon grandiceps</i>	*	*
Murray cod	<i>Maccullochella peelii</i>	*	*
Murray River rainbowfish	<i>Melanotaenia fluviatilis</i>	*	*
unspecked hardyhead	<i>Craterocephalus stercusmuscarum fulvus</i>	*	*
obscure galaxias	<i>Galaxias oliros</i>	*	
river blackfish	<i>Gadopsis marmoratus</i>	*	
silver perch	<i>Bidyanus bidyanus</i>	*	
bony herring	<i>Nematolosa erebi</i>		*
golden perch	<i>Macquaria ambigua</i>		
trout cod ¹	<i>Maccullochella macquariensis</i>		
dwarf flathead gudgeon ¹	<i>Philypnodon macrostomus</i>		
eel-tailed catfish ¹	<i>Tandanus tandanus</i>		
Alien species			
common carp	<i>Cyprinus carpio</i>	*	*
eastern gambusia	<i>Gambusia holbrooki</i>	*	*
oriental weatherloach	<i>Misgurnus anguillicaudatus</i>	*	*
redfin perch	<i>Perca fluviatilis</i>	*	
goldfish	<i>Carrassius auratus</i>		

4. Fish recruitment

Fish recruitment and growth sampling for the 2016-17 year commenced on 6 February 2017 and all 16 sites were sampled successfully by 3 March 2017. Seven native and four invasive fish species were detected. All small-bodied fishes (Figure 4) and river blackfish that were present in the previous two years were detected again in 2016-17. Unlike the previous two years, no Murray cod (recruits, juveniles or adults) were detected at any of the sites (Table 2). Also different to the previous years, juvenile common carp dominated the catch in 2016-17.

Large juvenile and adult silver perch (Figure 5) were consistently present across sites in 2016-17, but fewer recruits were sampled compared to the previous year (Table 2). Consistent catches of large juvenile and adult silver perch provided an opportunity for NSW Fisheries to increase the number of silver perch with acoustic transmitters (see earlier in this report). Otoliths of a sub-sample of silver perch (n = 17) have been processed for age estimation and growth analyses are currently underway. Similar to the previous two years, no golden perch recruitment was detected in 2016-17 (Table 2).

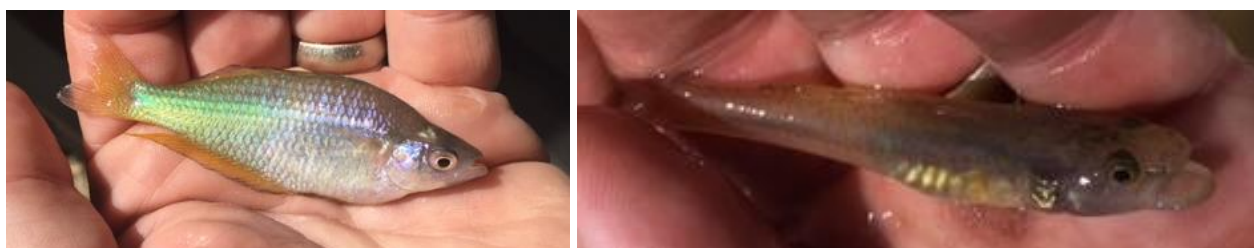


Figure 4: Small native fishes: rainbowfish (left) and flatheaded gudgeon (right) sampled in the Edward-Wakool system March 2017. (Photo: Keller Kopf)



Figure 5: Young silver perch estimated to be 2 years of age sampled in the Wakool River and implanted with an acoustic transmitter by NSW Fisheries. (Photo: Keller Kopf)

Table 2: Number of Murray cod, silver perch and golden perch sampled as part of young-of-year (YOY) and age class 1 recruitment sampling at 16 sites in Yallakool Creek and the Wakool River over the past three years.

Species	2014-15			2015-16			2016-17		
	YOY recruit	1+ recruit	Other Juvenile or Adult	YOY recruit	1+ recruit	Other Juvenile or Adult	YOY recruit	1+ recruit	Other Juvenile or Adult
Murray cod	20	46	55	40	50	56	0	0	0
silver perch	0	3	14	5	20	31	0	3	32
golden perch	0	0	3	0	0	4	0	0	0

5. Riverbank and aquatic vegetation

While the floods interrupted access to survey sites between August and December 2016, the riverbank and aquatic vegetation monitoring was back on track in January 2017. Approximately eighty one plant species have been identified since inception of monitoring up to March 2017.

Patchy emergence of floodplain responders such as common sneezeweed (*Centipeda cunninghamii*), joyweed (*Alternanthera denticulate*) and nutheads (*Epaltes australis*) were observed on the recession of flows (Figure 6). There was mass emergence of common sneezeweed higher up the banks in zones one, two and three following flood recession (Figure 7). Several new species were detected between January and March 2017 including *Dysphania sp*, *Marselia drummondii*, *Chenopodium sp* and *Solanum esuriale*. Male and female Lignum plants in flower and full leaf following heavy rains and flooding, which has also been observed elsewhere in the Murray catchment.

Following the flood there has been little to no aquatic instream vegetation observed, with exception to some Moira Grass in Zone 4. Prior to the 2016 floods instream vegetation including *Chara spp.*, floating pondweed (*Potamogeton tricarlinatus*), swamp lily (*Ottelia ovalifolia*), milfoil (*Myriophyllum spp.*), water primrose (*Ludwegia peploides*) and water fern (*Azolla spp.*) were typically observed across zones (Figure 8).



Figure 6: Patchily emerging herbs at zone four (left) and zone one (right). (Photo: Sascha Healy)



Figure 7: Common sneezeweed *Centipeda cunninghamii* response at zone 2 site 4 between transect 5 and 6 in February 2017 (Photo: Sascha Healy)



Figure 8: Zone 3 site 1 in January 2015 (top left), January 2016 (top right) and January 2017 (bottom), showing the lack of in stream vegetation following the floods in late 2016.

Planned activities – April to June 2017

Between April and June 2017 the LTIM Monitoring and Evaluation Team will complete the monitoring for the 2016-17 water year. Water quality monitoring will be undertaken monthly until May. Fish community monitoring will be undertaken at ten sites within the Wakool River (Wakool Reserve to Bookit Island) in May 2017 using a basin-wide standardised monitoring approach. Aquatic and riverbank vegetation will be monitored once per month. Acoustic data to assess fish movement will be downloaded from loggers every three months. Between April and June the LTIM team will also complete the laboratory processing of larval fish samples and water samples and will commence analysis of data for the 2016-17 annual report.

Farewell and thank you – Mr James (Jim) Abell

In January 2017 the Edward-Wakool LTIM project team sadly said farewell to Mr Jim Abell (Technical Officer) who has been a key member of the Edward-Wakool environmental flows team for 5 years. Jim and his wife Dr Manu Saunders have moved to Armidale, NSW. Jim is a dedicated and hard-working team member and he will be very much missed by the team.



Jim Abell (seated) and Edward-Wakool team members (from left) Sascha Healy, Keller Kopf, Nicole McCasker and Robyn Watts at Jim's farewell in February 2017.

Acknowledgements

We respectfully acknowledge the Traditional Owners, their Elders past and present, their Nations of the Murray–Darling Basin, and their cultural, social, environmental, spiritual and economic connection to their lands and waters. We extend our thanks to the Wakool River Association, the Edward-Wakool Anglers Association and landholders in the Edward-Wakool river system for allowing access to their properties and for their keen interest in this project. This project was funded by the Commonwealth Environmental Water Office and is a collaboration between Charles Sturt University, Murray Local Land Services, NSW Department of Primary Industries, Monash University, NSW Office of Environment and Heritage and Griffith University. Members of the Edward-Wakool Long-term Intervention Monitoring project team are listed on the Edward-Wakool LTIM website <http://www.csu.edu.au/research/ilws/research/sra-sustainable-water/edward-wakool-research-project>.

Appendix A: The Long-Term Intervention Monitoring Project for the Edward-Wakool system and its context in terms of ecological monitoring and evaluation within the Murray-Darling Basin.

The Long Term Intervention Monitoring (LTIM) Project for the Edward-Wakool river system Selected Area is funded by the Commonwealth Environmental Water Office. The project is being delivered by a consortium of service providers lead by Charles Sturt University (Institute for Land, Water and Society) and includes, NSW Department of Primary Industries (Fisheries), Monash University (Water Studies Centre), Griffith University, NSW Office of Environment and Heritage, and Murray Local Land Services.

The LTIM project is based on a clear and robust program logic, as detailed in the Long-Term Intervention Monitoring Project Logic and Rationale Document. That document sets out the scientific and technical foundations of long-term intervention monitoring and is being applied to areas where LTIM projects are being undertaken. It also provides links between Basin Plan objectives and targets to the monitoring of outcomes from Commonwealth environmental watering actions. For more information, see Monitoring and evaluation for the use of Commonwealth environmental water.

Many different agencies play a role in the reporting on environmental outcomes, consistent with the Basin Plan (see Figure A1 below). The Murray Darling Basin Authority is responsible for reporting on achievements against the environmental objectives of the Basin Plan at a basin-scale, which are broadly focussed on flows and water quality, fish, vegetation and birds across the whole of the Basin. State Governments are responsible for reporting on achievements against the environmental objectives of the Basin Plan at an asset-scale i.e. rivers, wetlands, floodplains. The Commonwealth Environmental Water Holder is responsible for reporting on the contribution of Commonwealth environmental water to the environmental objectives of the Basin Plan (at multiple-scales).

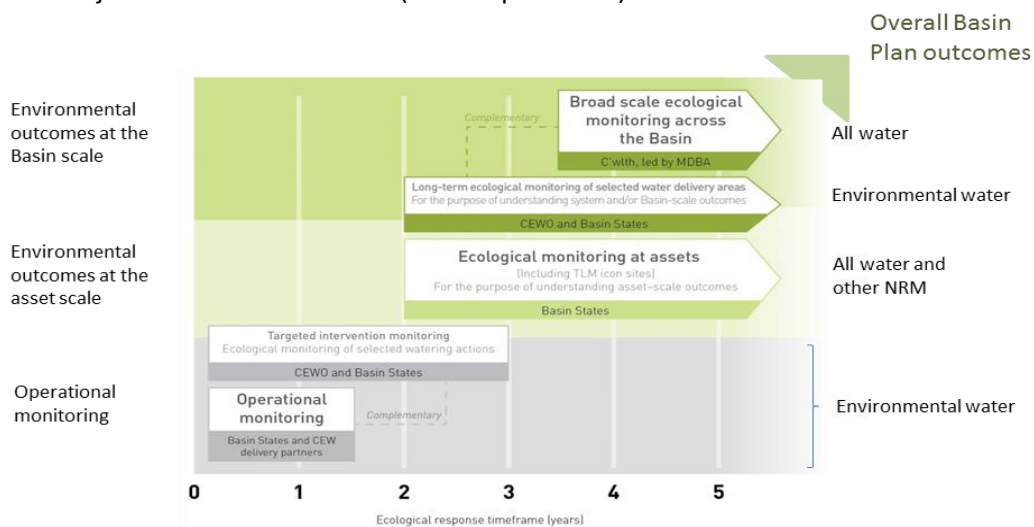


Figure A1. A summary of roles various agencies play in the reporting on environmental outcomes, consistent with the Basin Plan.

Appendix B: Map showing location of sample sites monitored in the Edward-Wakool Selected Area for the Long-Term Intervention Monitoring Project.

The monitoring for the Edward-Wakool LTIM Selected Area Evaluation is focussed on Yallakool Creek (zone 1), the upper Wakool River (zone 2) and mid reaches of the Wakool River (zones 3 and 4)(Figure B1). Fish population surveys are undertaken annually in the focal zone, and a further 20 sites throughout the Edward-Wakool system will be surveyed for fish populations in years 1 and 5. In addition to water quality sampling in the focal area, water quality is also monitored in Stevens Weir and the Mulwala canal as these sites are the potential source of Commonwealth environmental water in this system.

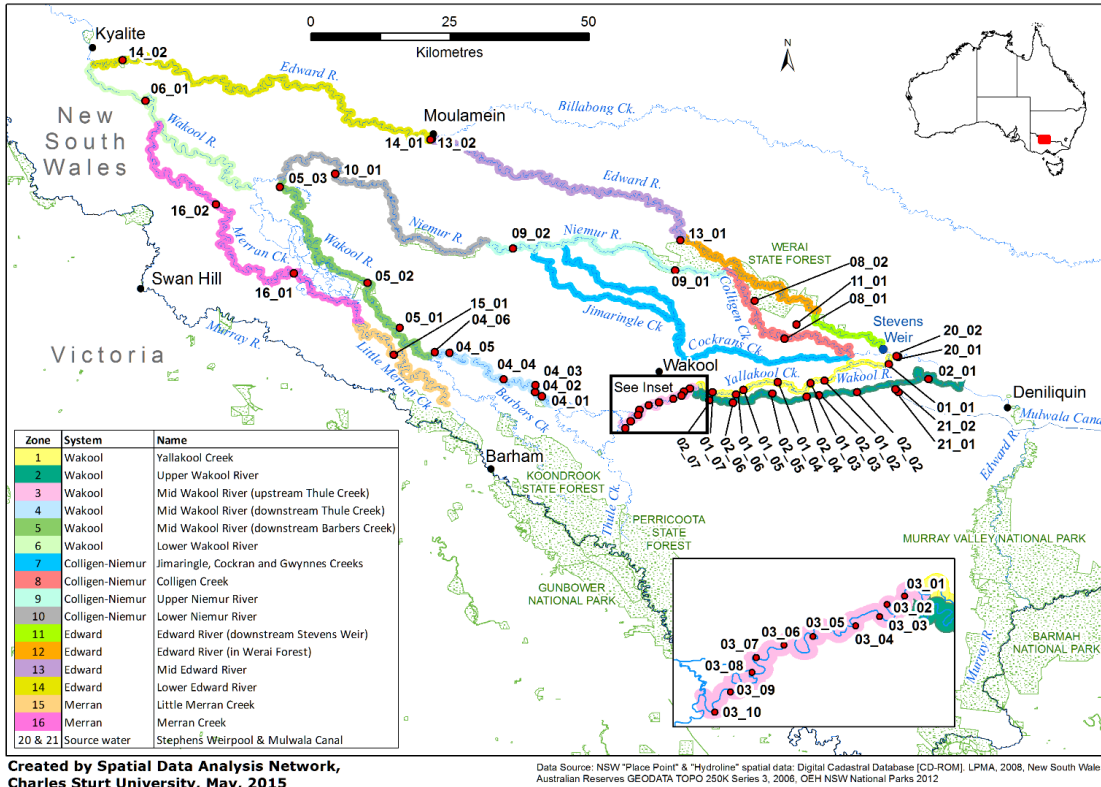


Figure B1. Monitoring sites for the Edward-Wakool Selected Area for the Long-Term Intervention Monitoring (LTIM) Project.

Appendix C: Summary of monitoring undertaken in the Edward-Wakool system for the Long Term Intervention Monitoring Project from 2014-2019.

Indicator	Cat	Zones	Schedule of activities											
			J	A	S	O	N	D	J	F	M	A	M	J
River hydrology	1	1,2,3,4	Continuous data from automated gauging stations											
Hydraulic modelling	3	1,2,3,4	Modelling undertaken in 2014-15											
Stream metabolism and primary productivity	1	1,2,3,4	Continuous data from loggers											
Nutrients and carbon	1	1,2,3,4	Monthly sampling											
Carbon characterisation	3	1,2,3,4	Monthly sampling											
Riverbank and aquatic vegetation	3	1,2,3,4	Monthly monitoring											
Fish reproduction (larvae)	1	3						Fortnightly						
Fish reproduction (larvae)	3	1,2,3,4	Fortnightly sampling											
Fish recruitment	3	1,2,3,4												
Fish community (Cat 1)	1	3												
Fish community survey	3	20 sites	Undertaken in 2014-15 and 2018-19 only											
Fish movement	2	1,2,3,4 (plus sites funded Murray LLS)	Continuous data from acoustic receivers											