WATERWATCH
Upper Murrumbidgee

Catchment Health Indicator Program

2015–16

Supported by:

ACT Government

icon WATER

In Partnership with:

Molonglo Catchment Group

Southern ACT Catchment Group

Ginninderra Catchment Group

This report was written using data collected by over 200 Waterwatch volunteers. Many thanks to them.

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For more information on the Upper Murrumbidgee Waterwatch program go to:
http://www.act.waterwatch.org.au

The Atlas of Living Australia provides database support to the Waterwatch program. Find all the local Waterwatch data at: http://root.ala.org.au/bdrs-core/umww/home.htm

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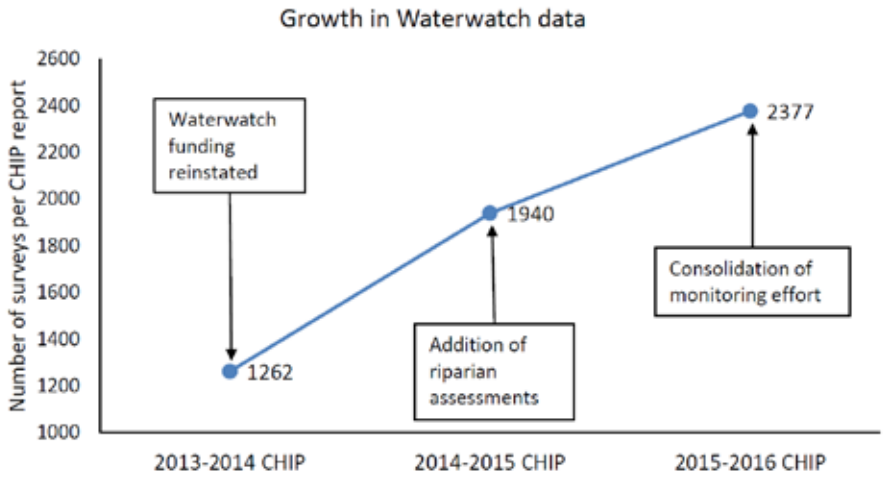
Executive Summary

Upper Murrumbidgee Waterwatch (Waterwatch) works with the community to monitor, raise awareness, educate, restore and protect our local waterways. Waterwatch has been running in the ACT region since 1995 and covers the Murrumbidgee catchment upstream of Burrinjuck Dam near Yass (with the exception of the Goodradigbee catchment). The total area monitored by Waterwatch is more than 11,400km^2.

Two primary functions of the Waterwatch program are to facilitate community engagement through the monitoring and care of local waterways, and to use the data (water quality, macroinvertebrate [water bug] and riparian condition) as an early warning system for aquatic ecosystem health issues. A key output of this program is the annual Catchment Health Indicator Program (CHIP) report, which provides a numerical score of catchment health displayed in individual reach report cards, using data collected by Waterwatch volunteers.

The 2015-2016 CHIP report is based upon 1,973 water quality surveys, 208 water bug surveys and 196 riparian condition surveys conducted by over 200 volunteers! The total number of sites surveyed has increased from 229 to 243 with a total of 96 reach report cards produced. While there was an increase of nearly 500 surveys conducted, there were only 4 new reaches created. The bulk of the new data went into creating a more comprehensive picture of our current reaches which in turn will increase confidence in the CHIP results. **Within our current capacity, it is not anticipated that there will be any considerable growth in the number of surveys conducted or the number of sites sampled in the future** (Figure 1).



Four new reaches have been added to the 2015-2016 CHIP report. A new reach in the headwaters of the Murrumbidgee River upstream of Tantangara Dam (CMM1) will provide further context regarding the health of our catchment. Some species of very sensitive water bugs were found this year in this reach that have not been observed elsewhere by Waterwatch in the upper Murrumbidgee catchment.

Figure 1. Summary of growth in Waterwatch data since 2013

This year, the Yass catchment (comprising the Yass River and the lower reaches of the Murrumbidgee River) has 5 CHIP report cards. The Yass catchment is now an area for growth and its inclusion in the CHIP supports the notion that Waterwatch as a truly regional program.

The 2015-2016 CHIP report sees only a minor change to the handling of water bug data. The SIGNAL 2.0 stream health classification system has been adjusted to include an additional criteria which characterises whether a survey had all three sensitive mayflies, stoneflies and caddisflies. This change now allows for the classification of 'degraded' water bug scores, which previously was not possible.

Every reach report card in the 2015-2016 CHIP report includes where available, the CHIP score from the 2014-2015 CHIP report to show change in reach condition through time. The CHIP scores for each reach from the 2014-2015 CHIP report have been adjusted to reflect the new water bug classification scheme, allowing for direct comparisons between years. It is intended that viewing long term trends will become a key feature of future CHIP reports.

Of the 96 reaches presented in this report, **3 were scored as in 'excellent' condition.** One reach each were in the Cooma, Southern ACT and Molonglo catchments. **39 reaches were scored as being in 'good' condition,** with the majority being found in the Cooma and Southern ACT catchments. **48 reaches were scored to be in 'fair' condition**, the highest of any category, and **6 reaches were scored as 'poor'**, with 2 reaches in Ginninderra, and 1 apiece in Cooma, Molonglo, Southern ACT and Yass catchments. All 6 reaches scored as 'poor' were in urban environments (Table 1). There was little change in results between this year and last year with a slight increase in 'good scores.

Table 1: CHIP results for 2015–2016

CHIP Result	Cooma	Ginninderra	Molonglo	Yass	Southern ACT	Total
Excellent	1	0	1	0	1	3
Good	14	1	8	3	13	39
Fair	7	11	15	1	13	48
Poor	1	2	1	1	1	6
Degraded	0	0	0	0	0	0

Of particular note, 11 out of 15 reaches in the Ginninderra Creek catchment were scored as 'fair'. This is not surprising for this urban catchment with its highly modified riparian zone and high amounts of urban runoff affecting water quality. The new reach this year in Mulligan's Flat (MFL1) at the top of the Ginninderra Creek catchment provides an interesting reference point with water quality scoring 'excellent'.

Overall, the upper Murrumbidgee catchment saw low dissolved oxygen events during a hot dry spell in late Summer and early Autumn. Conversely, when the rains came in June, turbidity became an issue. As with last year's CHIP, there is a clear trend of deterioration in results as you move from the top to the bottom of catchment. Issues such as weeds and the lack of both native riparian and instream vegetation in our downstream rural and urban catchments are a major factor contributing to poorer health. Revegetation of such areas would not only reduce sediments and nutrients entering the system, but provide valuable habitat for water bugs and other aquatic species.

Applying the CHIP

While the CHIP is aimed at communicating general trends in catchment health, there is an incredible amount of data captured that will be further explored in coming months by the Waterwatch team. An example is a study currently underway, identifying underlying causes of high electrical conductivity (EC). Waterwatch has found that while the upper Murrumbidgee River, south of the Numeralla River confluence, is relatively low in EC, readings five times higher are found in smaller tributies such as Bridle Creek (331 µS/cm), which is located in CMM4. Likewise, Cappanana Creek (843 µS/cm) in the Bredbo River catchment (BRD2) has readings four times higher than that in the Bredbo River. If Waterwatch can identify some of these smaller tributaries with high EC inputs, targeted restoration works in these areas may reap larger benefits for water quality within the broader catchment.

Future outputs for Waterwatch will include exploring these data in greater depth to identify and prioritise specific actions to assist catchment managers in improving the health of their waterways.

The 2014-2015 CHIP report would not have been possible without the generous financial support from ACT government, in partnership with the Australian government, through the ACT Healthy Waterways (Basin Project) and from Icon Water.

Thank you as always to the Waterwatch volunteers. This report is a product of your hard work and passion for your local waterways.

Introduction

Upper Murrumbidgee Waterwatch

Upper Murrumbidgee Waterwatch (Waterwatch) engages with the community to monitor, raise awareness, educate, restore and protect our local waterways. Waterwatch has been running in the ACT region since 1995 and covers the Murrumbidgee catchment upstream of Burrinjuck Dam near Yass, with the exception of the Goodradigbee catchment. The total area monitored by Waterwatch is more than 11,400km^2.

Four Waterwatch co-ordinators support volunteers in the major sub-catchments of Cooma, Molonglo, Southern ACT, Ginninderra and Yass (see figure 1). Each of these sub-catchments will make up sections I – V of this report. This year Yass has 5 report cards, and will be an area of growth over the foreseeable future.

As at June 30 2016, Waterwatch had 243 active sites being monitored by over 200 volunteers. Waterwatch thanks the generous funding from the ACT government, in partnership with the Australian government, through the ACT Healthy Waterways (Basin Project) as well as funding for the Cooma region through Icon Water. The Atlas of Living Australia also provides support through the maintenance of the database used by the Waterwatch program. At the time of writing this report, the database housed over 19,000 Waterwatch records.

The purpose of the CHIP

The Waterwatch annual report card is called the Catchment Health Indicator Program (CHIP), based upon the data collected by volunteers throughout the preceding year. The purpose of the report is to give the community a better understanding of water quality and riparian health issues in the catchment as well as providing a baseline assessment of catchment health to assist natural resource managers and policy-makers in addressing some of these issues. The CHIP is recognised in the ACT Water Strategy 2014-44 as a way to '*Enhance knowledge and spatial planning for water and catchment management'*.

How does the CHIP work?

Waterwatch volunteers and co-ordinators collect data relating to water quality, water bugs (macroinvertebrates), and riverbank (riparian) vegetation. The frequency of this data collection is outlined in Table 2. These data sources provide the basis for a composite CHIP score that encompasses physio-chemical properties of water, instream water bug diversity and abundance, and riparian vegetation condition. When combined for an individual stretch of waterway (a reach), the data gives us a score that indicates the overall health of that reach. This CHIP score is linked with a colour to produce maps of reaches at both an individual and sub-catchment scale. Importantly, each individual reach map is accompanied by a report card written by the local co-ordinator. This provides further insight into the state of that reach and possible issues influencing the score.

Technical details regarding the computation of CHIP scores is provided in Appendix II.

Table 2. Summary of data collected to produce the CHIP

	Parameter	Frequency	Number of sites
Water Quality	pH	Monthly	All sites
	Electrical Conductivity	Monthly	All sites
	Turbidity	Monthly	All sites
	Phosphorus	Monthly	All sites
	Nitrates	Monthly	All sites
	Dissolved Oxygen	Monthly	All sites
	Temperature	Monthly	All sites
Macro-invertebrates	SIGNAL 2.0	Biannual (Spring & Autumn)	Key sites (min 1/reach)
Riparian Condition	RARC	Biennial	All sites

Figure 1. Overview of the Upper Murrumbidgee River catchment, outlining the 5 major catchment areas represented in this report. Goodradigbee is not included in this report.

Changes since the 2014–2015 CHIP report

A big thank you to all those people who use the CHIP report and take the time to provide the Waterwatch team with feedback on how to make it a better document.

Changes to the water bug scores

Water bug scores used in the CHIP are based upon the 4 category SIGNAL 2.0 system of stream health classification. For the 2015-2016 CHIP, this 4 category classification system has been increased to 5 categories by including an additional criteria to scores. Now, water bug scores take into account the presence of 3 key sensitive water bug taxa, the Mayflies, Stoneflies and Caddisflies. This change to scores has resulted in some water bug scores being classified as 'degraded', which previously was not possible with the 4 category classification system. Further details can be found in Appendix III.

Comparison to the 2014-2015 CHIP

For the first time, the 2015-2016 CHIP report provides a direct comparison for each reach to the previous year. Each report card now includes the 2015-2016 CHIP score, along with the 2014-2015 CHIP score. This is included to provide information about the change in reach condition through time. The 2014-2015 CHIP scores have been revised to match the 2015-2016 CHIP methodology, namely, the adjustment to the water bug classification system. As such, 2014-2015 CHIP scores reported in this CHIP may differ slightly to the 2014-2015 CHIP report published in 2015.

2015–2016 CHIP

The 2015-2016 CHIP report is based upon 1,973 water quality surveys, 208 water bug surveys and 196 riparian condition surveys. The total number of sites surveyed has increased from 229 to 243. While there was an increase of nearly 500 surveys conducted, there were only 4 new report cards produced. The bulk of the new data went into creating a more comprehensive picture of our current reaches which in turn will increase confidence in the CHIP scores. Within our current capacity, it is not anticipated that there will be any considerable growth in the number of surveys conducted or the number of sites sampled in the future.

Thank you, as always, to the volunteers. This report would not be possible without your continued efforts to collect this important data on the health of our waterways. The increase in data collected this year is a real credit to the dedication of the volunteers who have demonstrated that with support, they are capable of contributing to this impressive resource.

Cooma Region Catchment Facts

The Cooma Region includes the upper Murrumbidgee River south of the ACT, the Bredbo, Numeralla, Kybeyan and Badja River sub catchments. Landuse in the Cooma region includes urban, rural residential, rural (grazing and cropping) and conservation. The lower lying, more fertile areas of the catchment are generally cleared and modified with more intensive landuse and limited native riparian vegetation.

Local landcare and fishing groups are working to restore river health in the Cooma region via erosion control works, riparian planting, returning woody debris for fish habitat, native fish stocking and removing Carp. Groups involved include the Numeralla, Bredbo and Michelago Landcare Groups and the Numeralla and Bredbo Fishing Clubs.

The Actions for Clean Water (ACWA) Plan sets out a strategy for improving water quality (targeting turbidity) in the upper Murrumbidgee catchment. It identifies the Numeralla and Bredbo Rivers as high priority catchments where erosion risk was assessed to be very high. The plan also maps point source erosion sites throughout the catchment.

The Cooma Monaro LGA Comprehensive Koala Plan of Management also identifies the Numeralla/Badja and Bredbo River catchments as significant koala habitat. Riparian connectivity and ribbon gum stands are important elements of this habitat.

Small yet resilient native fish populations are also found in the catchment including Murray cod, Trout cod, Macquarie perch and Mountain galaxias. Macquarie perch are critically endangered yet occur in the Murrumbidgee River, and have been the subject a PhD research project investigating the habitat requirements and environmental cues for spawning in this species. The Upper Murrumbidgee Demonstration Reach (UMDR) initiative supports the recovery of native fish populations in the upper Murrumbidgee River with a focus on the upper Murrumbidgee River between Bredbo in NSW and Casuarina Sands in the ACT.

Waterwatch volunteers have been monitoring river health in the Cooma Waterwatch region since 2010.

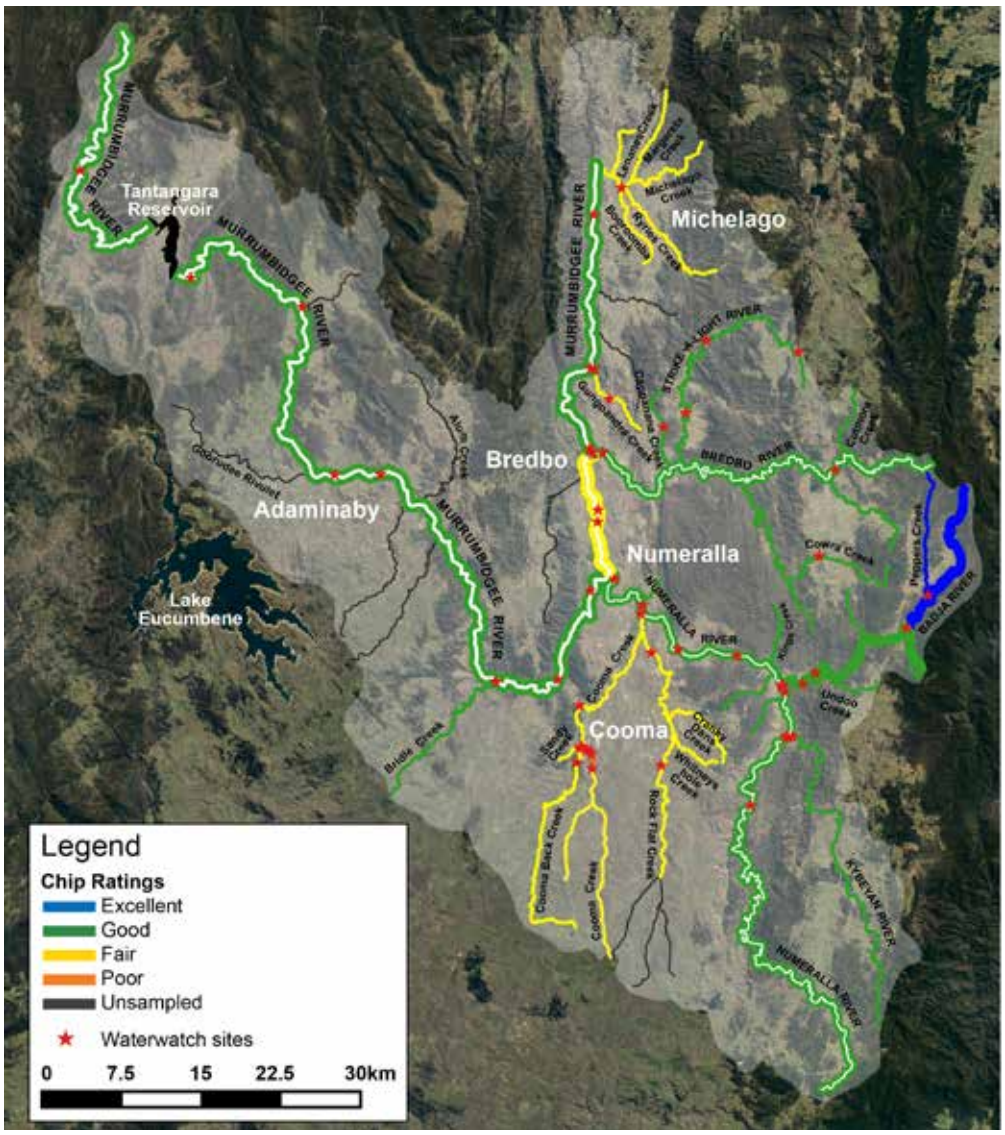
Cooma Catchment Health Summary

CHIP results were the same or slightly improved from last year for most reaches in the Cooma Region. This may be due to above average rainfall and flow levels in Spring, early Summer and late Autumn which generally helps to support aquatic ecosystem processes. However, high rainfall and flow events can also be associated with episodic high turbidity and phosphorous in catchments where intense landuse and limited riparian buffers are found. 'Degraded' dissolved oxygen levels were seen throughout Cooma reaches this year in most reaches. This may have been due to warm temperatures and lower flow levels during late Summer and early Autumn.

A new reach this year in the headwaters of the Murrumbidgee River upstream of Tantangara Dam (CMM1). This reach, which sits entirely in the Kosciuszko National Park will provide further context regarding the health of our catchment. Areas such as these with high groundcover and good native riparian buffer strips have consistently better health scores independent of season and rainfall effects. Water bug surveys in CMM1 this year found some species of very sensitive water bugs such as the rarely-seen alderfly larvae.

Platypus were sighted at all Platypus Month survey sites. Platypus and Water rat sightings are also reported for larger waterways of the Cooma region. Cooma Creek will benefit over the next few years from the Cooma Creek Rehabilitation project, funded by the NSW Environment Trust. This project will control woody weeds, stabilise an erosion site and protect a Platypus breeding site that was first discovered during Platypus Month in 2014.

Carp were recorded for many reaches, with notable exceptions being in headwaters of the upper Murrumbidgee, Badja, Kybeyan and Bredbo Rivers. Records show that Carp started spawning as early as the 2015 October long weekend in the lower Numeralla River.



Badja River BAD1

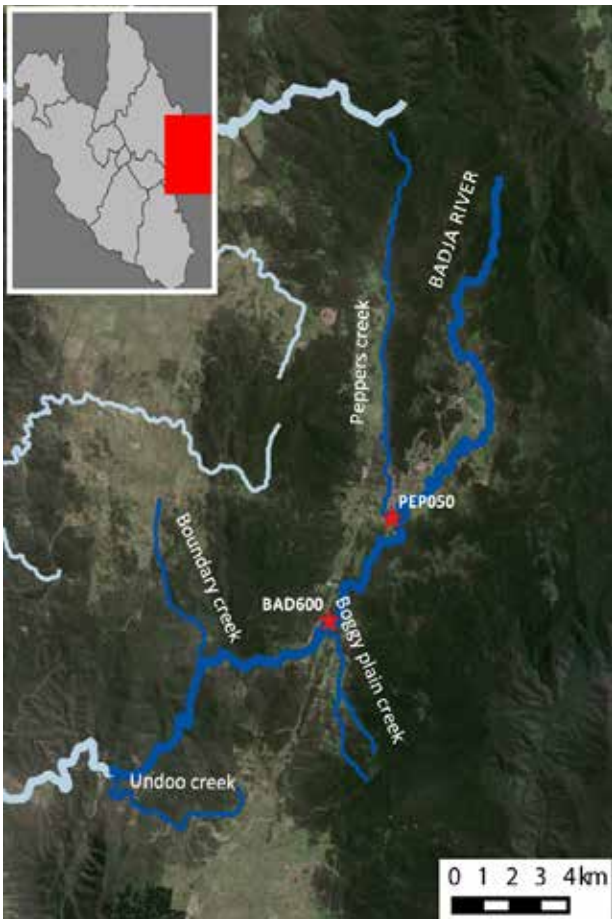
Headwaters to Undoo Creek

2015/16 CHIP Result A (Excellent)		
2014/15 CHIP Result A- (Excellent)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**24**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Excellent**	**4**
Riparian condition	**Excellent**	**2**

Reach Facts

Reach network length: approx. 51km
Dominant land uses: Rural and conservation

This reach includes the headwaters of the Badja River down to and including Undoo Creek. The headwaters of the Badja River rise in the Badja Swamps Nature Reserve which include the nationally-listed Big Badja Swamps. The top of the reach flows through open, historically cleared country then on through steeper, uncleared areas with good native vegetation cover.



Reach Condition

Water quality continues to rate as 'excellent' overall, reflecting the intact instream and riparian habitat which is found in this reach. Dissolved oxygen is the exception and shows levels which were regularly lower than expected. Turbidity is consistently low in this reach, even during high flow events.

Water bug surveys found that three very sensitive water bug types were present. Caddisfly larvae of at least three species are observed in high numbers. Riparian condition was found to be 'good' overall, including native vegetation with intact shrub and canopy layers, high levels of ground cover and habitat features such as native tussocks and logs.

Carp sightings are not recorded in this reach. Trout have been sighted. Broom and scattered Willows occur at the top of this reach and has been the focus of a recent Numeralla Landcare project.

Volunteer Jim Wharton helping out at the Spring bug survey on the Badja River

Badja River BAD2

Undoo Creek to Numeralla River confluence

2015/16 CHIP Result B+ (Good)		
2014/15 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**37**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**5**
Riparian condition	**Fair**	**3**

Reach Facts

Reach network length: approx. 8.6km
Dominant land uses: Rural and rural residential

This reach includes the lower section of the Badja River from Undoo Creek to the Numeralla River confluence. It flows through open, cleared country used predominantly for grazing (sheep and horses) and some dryland cropping.

Continuous native vegetation is found in the riparian zone on both sides of the river along the entire reach, including stands of Ribbon gums.

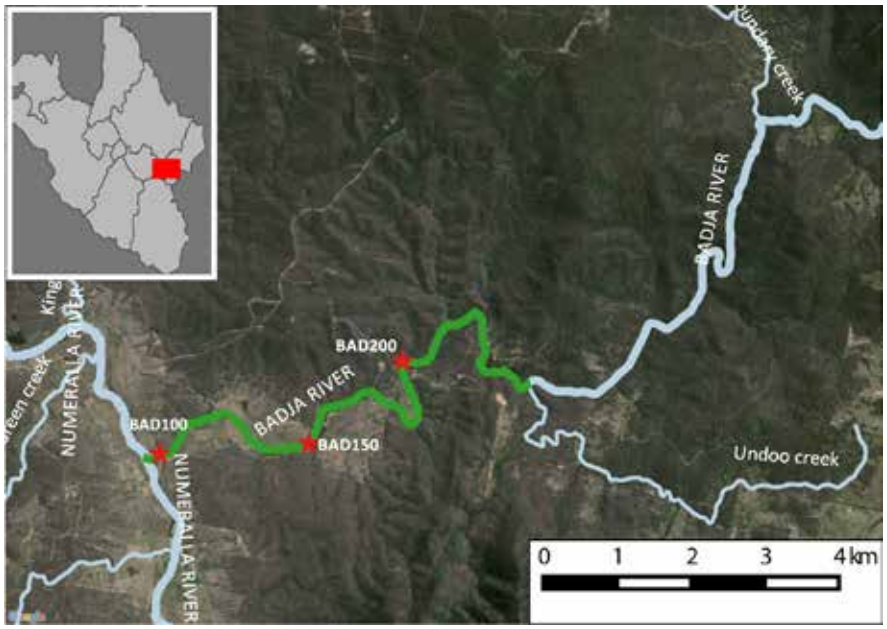
Badja River looking upstream from the Peakview Road bridge

Reach Condition

Water quality continues to be 'excellent' relating to good instream habitat and riparian zones along this reach. However, turbidity levels can be elevated during high flow events, due to gully erosion in the tributaries of this reach. Cultivation of the floodplain may also be a source of fine sediment during Summer storm events.

While native canopy and understorey vegetation is largely continuous along this reach, the overall riparian condition score was only 'fair' due to limited habitat features such as native tussocks, logs and hollow-bearing trees.

Willows and Blackberry have been controlled over the last year as part of a Numeralla Landcare weed control project. Carp sightings are recorded in this reach and Platypus and Water rats are regularly sighted. Trout have also been found.



Bredbo River BRD1

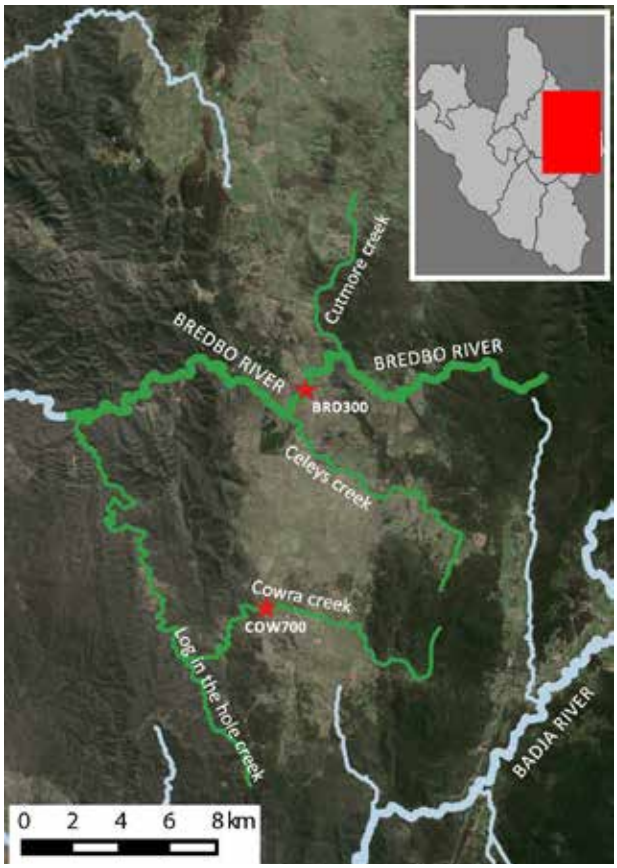
Headwaters to Cowra Creek confluence

2015/16 CHIP Result B+ (Good)		
2014/15 CHIP Result A- (Excellent)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**16**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Poor	
Water bug	**Excellent**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

Reach network length: approx. 33km
Dominant land uses: Rural

This reach includes the Bredbo River catchment down to and including Cowra Creek. This reach runs through a mix of unmodified vegetation and cleared, grazing country. Small areas of pine plantation have also been established in the catchment.



Reach Condition

Water quality continues to be 'excellent' overall for this reach. Turbidity is consistently low including during high rainfall/discharge events. This reflects the quality of the riparian zones and catchment integrity associated with this reach.

The water bug score indicated stream health was 'excellent', but this year scores were slightly lower due to reduced numbers of sensitive water bugs especially stonefly larvae. The 'fair' riparian condition score was partly due to limited canopy and understorey vegetation observed in some transects, associated with naturally occurring pockets of native tussock grassland in the reach. In other transects there was a lack of understorey (possibly due to grazing), fallen logs and hollow bearing trees. Native plant species were dominant at all sites.

Carp are recorded in the Cowra Creek catchment. Platypus have been sighted in the upper Bredbo River.

Bredbo River at Peakview Road

Bredbo River BRD2

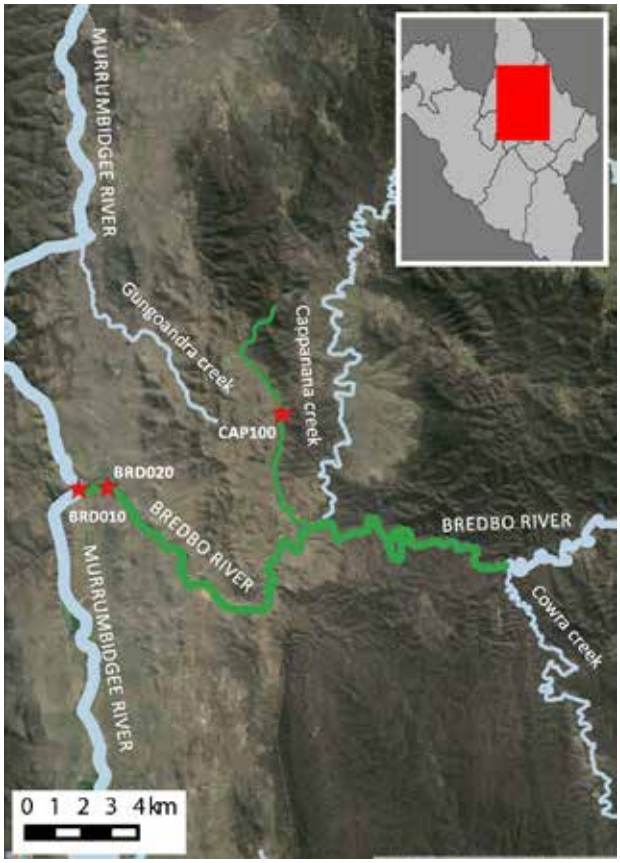
Cowra Creek to Murrumbidgee River confluence

2015/16 CHIP Result B- (Good)		
2014/15 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**19**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 25km
Dominant land uses: Rural including dryland cropping and grazing

This reach includes the Bredbo River from below Cowra Creek to its confluence with the Murrumbidgee River and includes a site on Cappanana Creek. The lower end of this reach has flat, wide floodplains which are used for dryland cropping and grazing. These areas are highly modified and native riparian vegetation is limited. Bredbo Landcare is rehabilitating riparian zones at the bottom of this reach as part of their Two Rivers Wattle Park project. This reach is a high priority ACWA catchment with five key erosion sites occuring in this reach



Reach Condition

Reach condition has improved relative to last year reflecting an improvement in overall water quality results and the water bug score. Water quality results showed an overall improvement in phosphorus results as well as electrical conductivity. Cappanana Creek continues to be an input of concern with electrical conductivity regularly above 900 µS/cm - more than four times the levels found in the Bredbo River.

Riparian condition rated as 'poor' due to high levels of exotic vegetation which is dominated by Poplars, Willows, Blackberry and African lovegrass. Little native understorey or canopy vegetation remains, although native reeds are common.

Carp are reported in high numbers and are the target of 'Carp out' events held by the Bredbo Fishing Club.

Cappanana Creek - May 2016

Murrumbidgee River CMM1

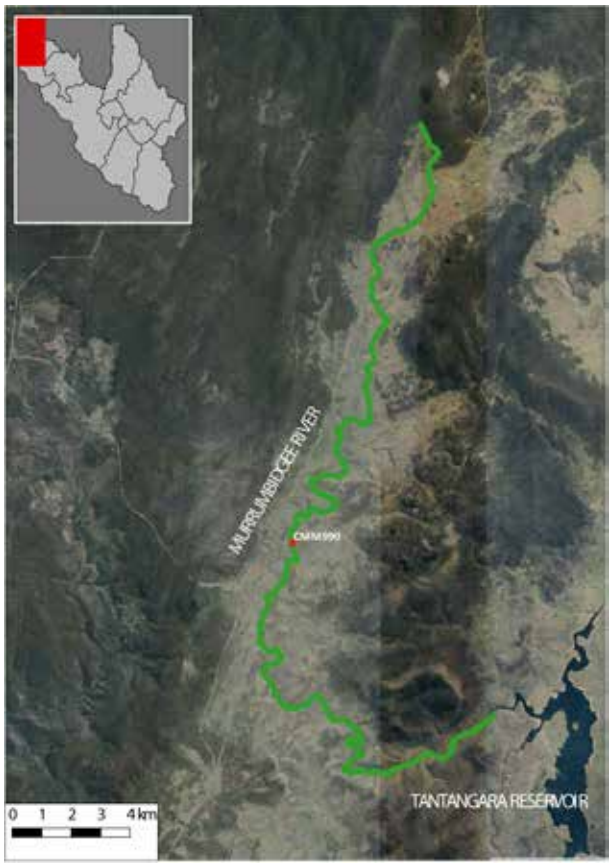
Headwaters to Tantangara Dam

2015/16 CHIP Result B (Good)		
NEW REACH		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**5**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Fair	
Water bug	**Good**	**2**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network length: approx. 53km
Dominant land uses: Conservation

This reach is the Murrumbidgee River from its headwaters to the Tantangara Dam wall and is wholly within Kosciuszko National Park. The reach is in the Australian Alps bioregion which is characterised by heaths, grasslands, bogs and subalpine woodlands. The catchment in this area is used for camping and touring accessed along unsealed fire trails. The area is closed due to snow between the June and October long weekends and is not monitored during this time.



Reach Condition

Water quality was 'excellent' overall, reflecting high catchment integrity in this reach. Dissolved oxygen levels were the exception and may have been lower than expected due to warm water temperatures and low flows during late Summer and Autumn.

The Spring water bug survey found web spinning caddisfly and alderfly larvae present which are rarely found in other parts of the Cooma catchment. The riparian zone is a naturally occurring native tussock grassland, which helps to protect water quality. However, this resulted in a 'poor' riparian condition score as the riparian assessment requires presence of native canopy, understorey and habitat features such as hollow bearing trees and woody debris to achieve a high score.

Trout have been observed at this site. Large numbers of wild horses are often sighted in the catchment.

Murrumbidgee River at Port Phillip Fire Trail

Murrumbidgee River CMM2

Tantangara Dam to Guroodee Rivulet

2015/16 CHIP Result B (Good)

2014/15 CHIP Result C+ (Fair)

Parameter	Rating	No. Survey
Water quality	**Excellent**	**26**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
Water bug	**Good**	**4**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 55km
Dominant land uses: Rural

This reach includes the Murrumbidgee River and its tributaries in the Yaouk area from below the Tantangara Dam wall. The influence of flow regulation is most evident in this reach. The catchment comprises of open valley floors (which would historically have contained tracts of swampy meadows) with a backdrop of steep unimproved country. Valley floors are now utilised predominantly for grazing purposes.

Reach Condition

Excellent water quality scores reflect the high quality of water released from Tantangara Dam which makes up the main flow especially at the upstream sites in this reach. The small and consistent flows released from the dam for most of the year may have influenced the water bug score which was lower than expected considering the excellent water quality scores. The dam does have a 'variable offtake' which reduces cold water pollution.

Riparian zones have naturally occurring native tussock grasslands which results in a low riparian condition score due to lack of native canopy and understorey as required by the riparian assessment. Grasslands were in poor condition where heavy stock grazing was evident.

Trout and Platypus are reported in this reach. No Carp have been reported.

Carol and Manuel Buttigieg sampling at Cazas Bridge on the Murrumbidgee River

Murrumbidgee River CMM3

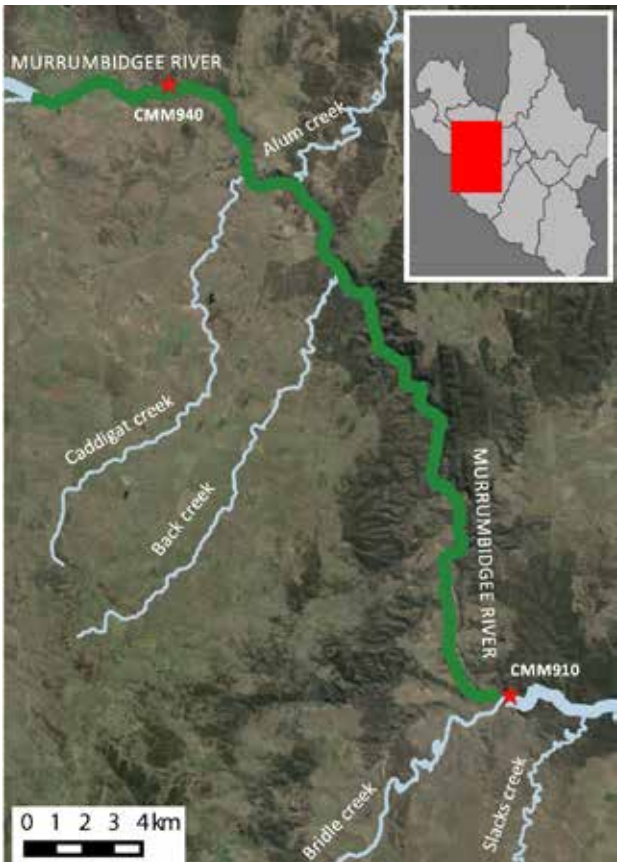
Guroodee Rivulet confluence to Bridle Creek confluence

2015/16 CHIP Result B+ (Good)		
2014/15 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**15**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
Water bug	**Good**	**3**
Riparian condition	**Fair**	**2**

Reach Facts

Reach network length: approx. 43km
Dominant land uses: Rural and conservation

This reach includes the Murrumbidgee River from Goorudee Rivulet down to the area known as 'Dry Plains'. Alum Creek is the major tributary which flows in from the north. Within this reach the river first flows through more open, undulating country which is used predominantly for grazing purposes and then through steeper gorge country dominated by woodland vegetation cover which remains largely unmodified.



Reach Condition

Water quality was 'excellent' for all parameters and reflects the relatively intact nature of the reach which flows through steep, vegetated gorge country. During higher flow events, a decrease in water quality is observed including increased turbidity and nutrient levels. This may be in part due to tributaries which drain from areas dominated by open grassy country used predominantly for grazing.

The 'fair' riparian condition score reflects both 'poor' and 'good' scoring sites on the reach. At 'good' condition sites, good native canopy, understorey and groundcover vegetation were found as well as habitat features such as native tussocks, fallen logs and hollow-bearing trees.

Carp and Eastern gambusia are recorded here. The current upstream limit of Carp distribution in the Murrumbidgee River is thought to occur in this reach.

Murrumbidgee River upstream of Bridle/Wambrook Creek

Murrumbidgee River CMM4

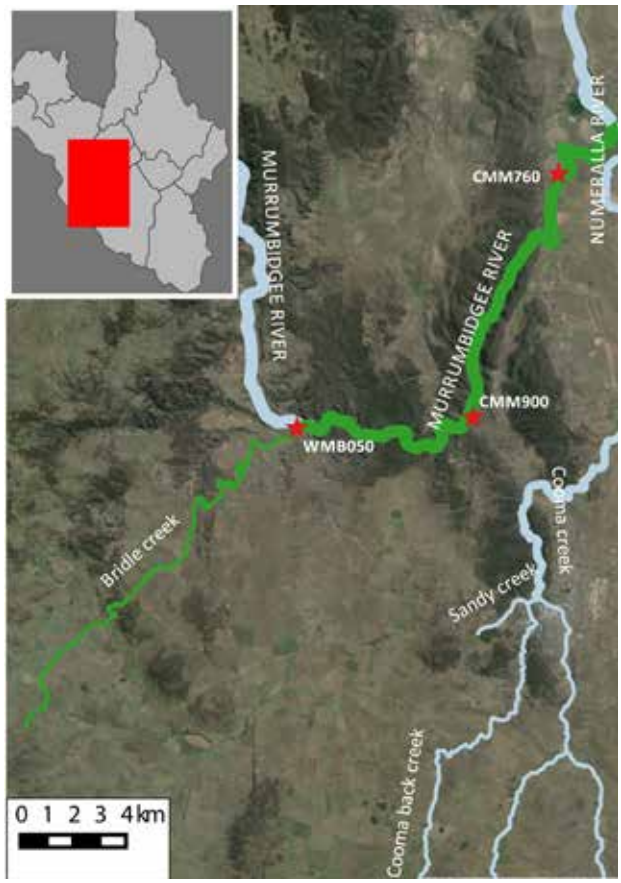
Bridle Creek to Numeralla River confluence

2015/16 CHIP Result B (Good)		
2014/15 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**19**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Fair	
Water bug	**Good**	**4**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 31km
Dominant land uses: Rural and conservation

This reach includes Bridle Creek and the Murrumbidgee River from the Bridle Creek confluence to the Numeralla River confluence. The bottom section of the reach has open, cleared country used for predominantly grazing and cropping purposes. The upper section includes the Binjura Nature Reserve, where the 'Cooma Gorge' is found. Good quality riparian and aquatic habitat are found in this section.



Reach Condition

Water quality in this reach is influenced by inflow from upstream catchments including (naturally) high electrical conductivity found in Wambrook/Bridle creek. Turbidity and nutrient levels can be elevated during high flow events due to gully erosion in tributaries and cultivation of floodplain areas.

Riparian condition score is 'poor', due to thick exotic (Willow) canopy cover, limited native understorey and a lack of habitat features such as native tussocks and fallen logs. Restoring healthy riparian vegetation zones as filter strips is desirable in this reach especially were floodplain cultivation takes place.

Carp and Eastern gambusia are recorded in this reach. This reach also has a Platypus Month survey site at which Platypus and Water rats have been recorded.

This section of the Murrumbidgee River has recently been the focus of important research on the habitat requirements and environmental cues for spawning in the endangered Macquarie perch.

Murrumbidgee River at Dromore crossing during flood conditions in June 2016

Murrumbidgee River CMM5

Numeralla River confluence to Bredbo River confluence

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**19**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**2**
Riparian condition	**Degraded**	**2**

Reach Facts

Reach network length: approx. 12km
Dominant land uses: Rural

The reach includes the Murrumbidgee River from the Numeralla River confluence to the Bredbo River confluence. Very limited native riparian vegetation remains in this reach. This reach is a priority ACWA catchment. Two ACWA sites occur in this reach. Large alluvial floodplain areas are found in this reach.

Floodplain areas are extensively used for dryland and irrigated cropping (Lucerne) as well as grazing purposes.

Reach Condition

Water quality in this reach is influenced by inflow from upstream catchments including the Numeralla River, which can result in elevated turbidity levels during high flow events. High flood conditions in June 2016 resulted in stream bank slumping along this reach.

Instream and riparian habitat has been highly modified in this reach due to sand slugs clogging up the river channel, historical clearing of vegetation and the spread of exotic species such as Willows and African lovegrass. These factors have influenced the water bug and riparian condition scores for this reach.

Carp and Eastern gambusia sightings are recorded in this reach. Platypus have also been observed. A stabilised ACWA site is being monitored along this reach.

Murrumbidgee River at Billilingra flows through wide alluvial floodplain areas

Murrumbidgee River CMM6

Bredbo River confluence to Michelago Creek confluence

2015/16 CHIP Result B- (Good)		
2014/15 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**22**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Water bug	**Fair**	**1**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 35km
Dominant land uses: Rural and conservation

This reach takes in the upper Murrumbidgee River from the Bredbo River confluence to Michelago Creek. This reach flows through the Bredbo and Colinton Gorges which form the upper and lower sections of the reach, and contains good quality riparian and aquatic habitat.

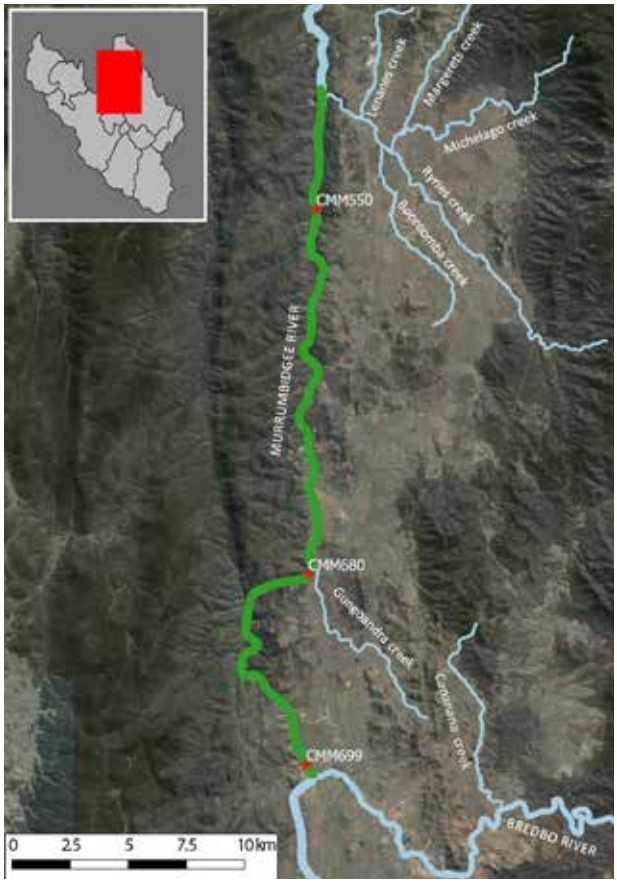
The middle section (Bumbalong Valley) contains more open, cleared country. This reach is the upper section of the Upper Murrumbidgee Demonstration Reach.

Reach Condition

Water quality in this reach is influenced by upstream catchments including the Numeralla and Bredbo Rivers (both priority ACWA catchments). Highly elevated turbidity levels are common during high flow events, especially resulting from Summer storms. High flood conditions in June resulted in stream bank slumping along this reach.

Riparian condition was 'poor' due to limited native canopy and understorey vegetation present at the upstream end of the reach. Riparian condition is being improved as part of the UMDR Rivers of Carbon Upper Murrumbidgee River Rehabilitation project which aims to reconnect the Bredbo and Colinton gorges with riparian plantings.

Carp and native fish are recorded for this reach. Platypus are surveyed at the Bush Heritage Australia Reserve at Scottsdale, and are recorded in this reach. Water rats are also recorded.



Upper Murrumbidgee River at the bottom end of Black Rock Gorge at Scottsdale Reserve

Cooma Creek COO1

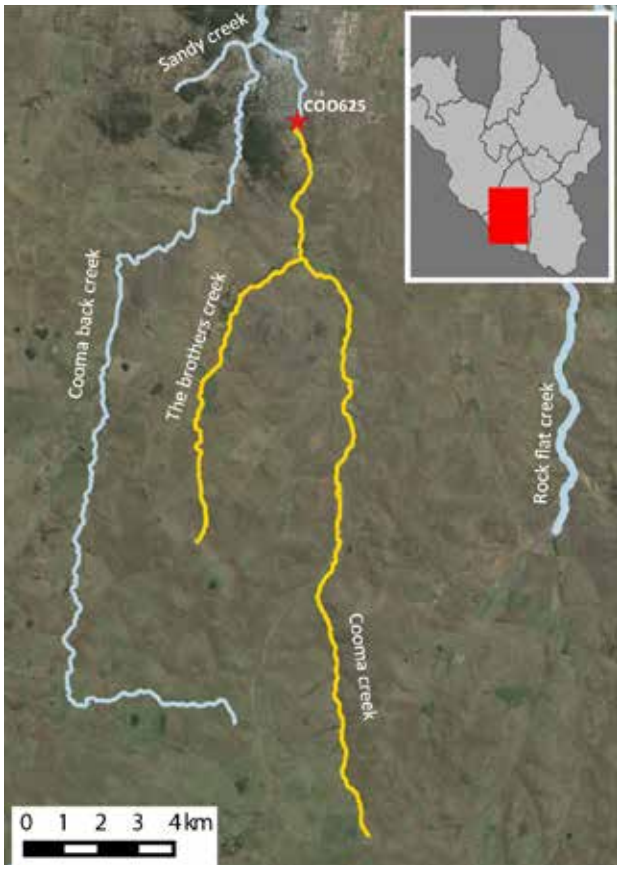
Headwaters to Banksia Lane

2015/16 CHIP Result C (Fair)		
2014/15 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**13**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Fair	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Degraded**	**1**

Reach Facts

Reach network length: approx. 22km
Dominant land uses: Rural and urban

The headwaters of Cooma Creek rise south of Cooma and flow through open, basalt country. The fertile floodplains in this reach are used for dryland cropping and grazing agriculture. Dense and extensive instream vegetation (reeds/sedges) are beneficial for stability and nutrient retention along this creek.



Currently this reach is monitored at only one site at the bottom of this reach. An additional site upstream is desirable to increase data confidence.

Reach Condition

Water quality in the reach is influenced by naturally high electrical conductivity due to the geology of the catchment. Phosphorus becomes very high during high rainfall/flow events. Turbidity can also be very elevated at these times, but up until now creek water was always very clear during periods of base flow. A noticeable change occurred last Summer, when the water took on a 'murky' appearance, but still reading below 10 NTU. This is ongoing and as yet, no point source has been identified.

Riparian condition is degraded due to a lack of native vegetation. Instream habitat is degraded in this reach and is especially apparent in areas where stock has free access to the creek. An infestation of Mintweed occurs in this reach, but monitoring has shown that it has not spread downstream. No Carp have been recorded.

Cooma Creek adjacent to the Myalla Road

Cooma Creek COO2

Banksia Lane to Cooma Back Creek confluence

2015/16 CHIP Result D+ (Poor)		
2014/15 CHIP Result D+ (Poor)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**31**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**2**
Riparian condition	**Degraded**	**4**

Reach Facts

Reach network length: approx. 3km
Dominant land uses: Urban

This reach includes the section of the Cooma Creek that flows through the township of Cooma. Flood mitigation works have been carried out to protect urban assets in times of high flows. Stormwater from the town is discharged into the creek. Litter from stormwater drains is an ongoing problem. There is a popular walking path along the length of this reach.

Reach Condition

Electrical conductivity is high due to combined effects of catchment geology (natural) as well as urban runoff (indicating pollution). Turbidity and phosphorus become very high during high rainfall and flow events.

At base flows, the creek water has always been very clear. A noticeable change occurred last Summer, when the water took on a 'murky' appearance, but turbidity still reading below 10 NTU. This is ongoing and no point source has been identified. The Autumn water bug survey also showed that bug numbers of all types were much reduced compared to the Spring survey.

Gross litter enters the creek from the CBD's stormwater drains and is the focus of the annual Keep Cooma Creek Clean Day. No Carp are recorded in this reach. Water rats and native Mountain galaxias are recorded.

Cooma Creek at the skate park

Cooma Creek COO3

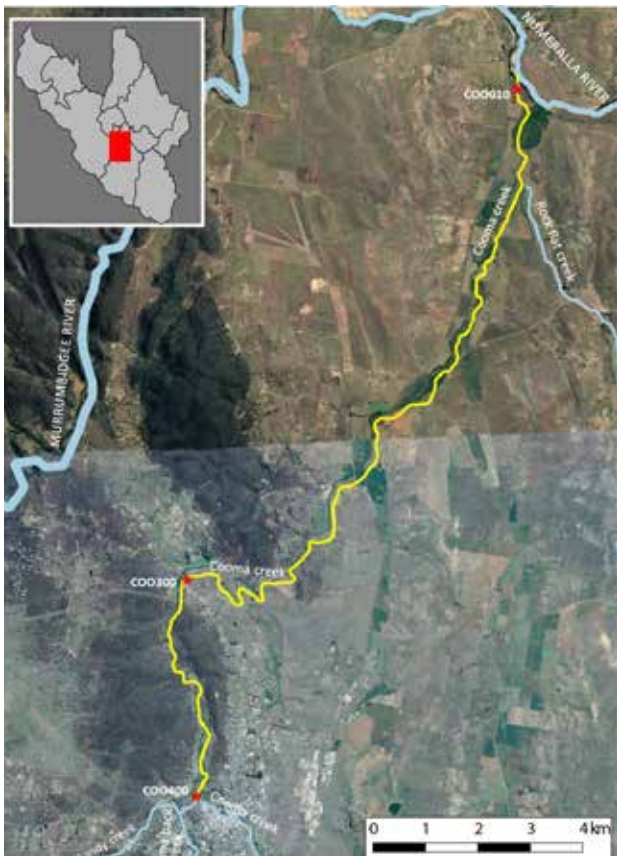
Cooma Back Creek confluence to Numeralla River confluence

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**16**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 18km
Dominant land uses: Conservation, rural residential and rural

This reach includes the Cooma Creek downstream of Cooma to its confluence with the Numeralla River. The reach is flanked by the North Ridge Nature Reserve at its upper end, then flows through more open, rural residential holdings (in the Mittagang Road area) and finally through the open rural area of Bunyan which is dominated by river flats used for irrigated cropping.



Reach Condition

Water quality in this reach is highly influenced by upstream inputs. This includes electrical conductivity which is naturally high due to upstream catchment geology. Turbidity and phosphorous can be very high during high flow events.

Riparian vegetation is highly modified at the top and bottom of the reach and groundcover and instream habitat is reduced where stock have unregulated access to the creek.

A Platypus Month survey site is located at the top of the reach where Platypus and Water Rats have been sighted. This site is the focus of rehabilitation activities as part of the Improving Cooma Creek project, funded by the NSW Environmental Trust.

Litter is a problem in this creek and significant amounts can be found up to 6km downstream of Cooma. Carp, including schools of fingerlings, are also recorded in this reach.

Cooma Creek at Chakola

Cooma Back Creek COB1

Headwaters to Cooma Creek confluence

2015/16 CHIP Result C (Fair)

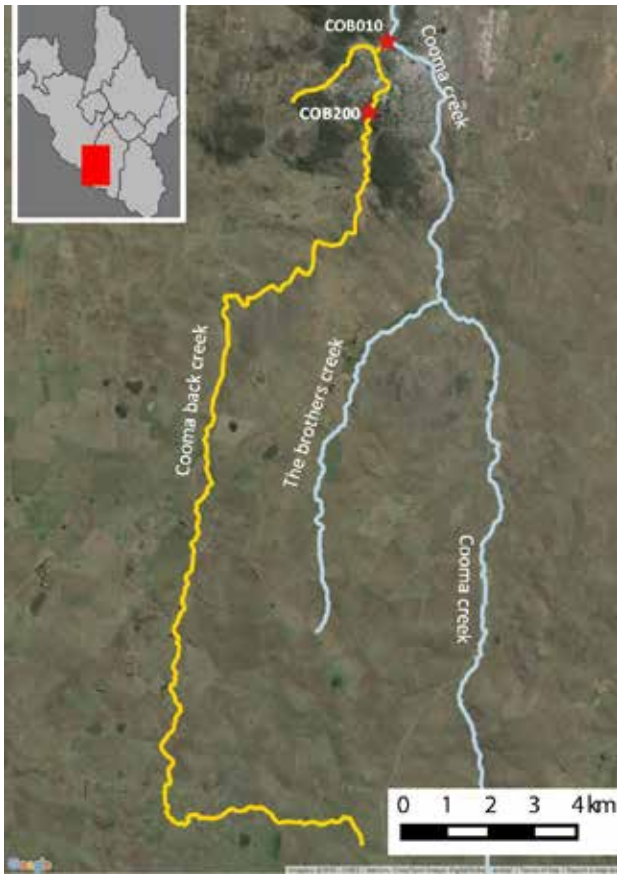
2014/15 CHIP Result D (Poor)

Parameter	Rating	No. Survey
Water quality	**Fair**	**25**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 30km
Dominant land uses: Conservation, urban, rural residential and rural

This reach includes the Cooma Back Creek and tributaries, including Jillimatong and Sandy Creeks. The upper sections of the reach are surrounded by predominantly rural landuse with open cleared country. The urban section of the reach (lower) includes the Lambie Gorge area which is a site of European and Aboriginal cultural significance.



Reach Condition

Water quality testing shows that electrical conductivity and phosphorous are consistently elevated in this reach. Turbidity levels can also be very elevated during high flow events. While electrical conductivity is likely to be naturally high due to catchment geology, phosphorous and turbidity should be low for a healthy upland creek system.

Riparian scores reflect highly modified riparian zones dominated by exotic plant species and lacking native canopy, understorey and habitat features at survey sites. The Improving Cooma Creek project, funded by the NSW Environmental Trust, will carry out Willow control and riparian planting in the lower section of this reach in the coming years, which should improve the riparian assessment score over time.

Carp are not recorded in this reach. Water Rat and Platypus sightings have been reported.

Volunteer Pam Vipond monitoring Cooma Back Creek at Mulach St causeway

Gungoandra Creek GUD1

Headwaters to Murrumbidgee River confluence

2015/16 CHIP Result C+ (Fair)

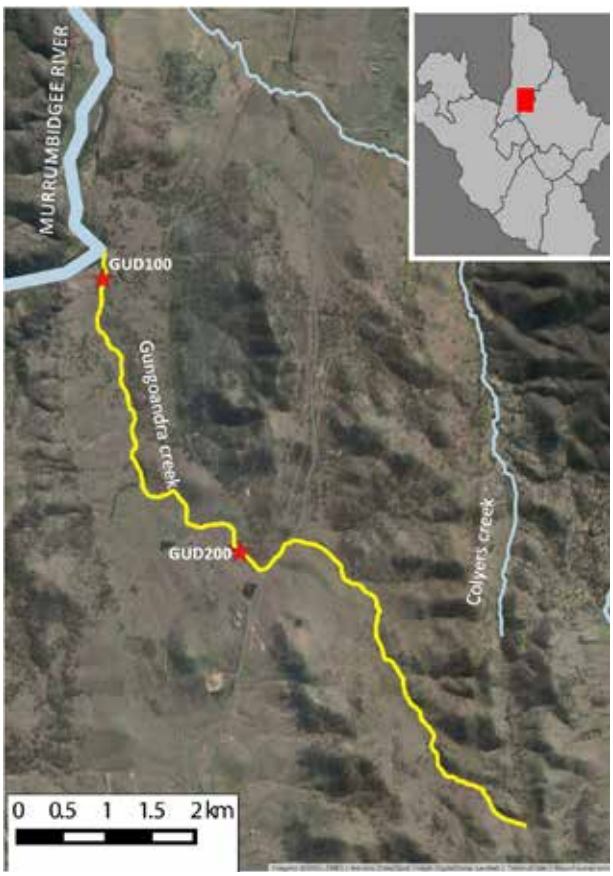
2014/15 CHIP Result C- (Fair)

Parameter	Rating	No. Survey
Water quality	**Good**	**24**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Fair	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 9km
Dominant land uses: Rural and conservation

This reach includes the entire Gungoandra Creek which flows into the Murrumbidgee River downstream of Bredbo Gorge. The upper section of the creek has been cleared and is grazed, while the lower section runs through Bush Heritage Australia's Scottsdale Reserve. Revegetation is occurring on the Reserve in the creek's catchment area and stands of instream macrophytes are continuing to establish.



Reach Condition

Water quality monitoring shows high electrical conductivity which is due to the geology and land use in the catchment. Interestingly, the data shows that electrical conductivity is consistently lower at downstream sample sites, perhaps due to extensive instream reed beds on Scottsdale Reserve providing a filtering effect.

Riparian condition reflects historical landuse from cropping and grazing in the catchment. This is being addressed at Scottsdale Reserve through Willow control, instream erosion works and revegetation. Revegetation activities are part of the Rivers of Carbon Upper Murrumbidgee River Rehabilitation project. ACWA works have been carried out including the stabilisation of an instream head cut which is being photo-monitored.

Carp, Oriental weatherloach and Platypus sightings are recorded in the lower section of this reach.

Volunteers Bob and Jenny Cooper at Gungoandra Creek

Kybean River KYB1

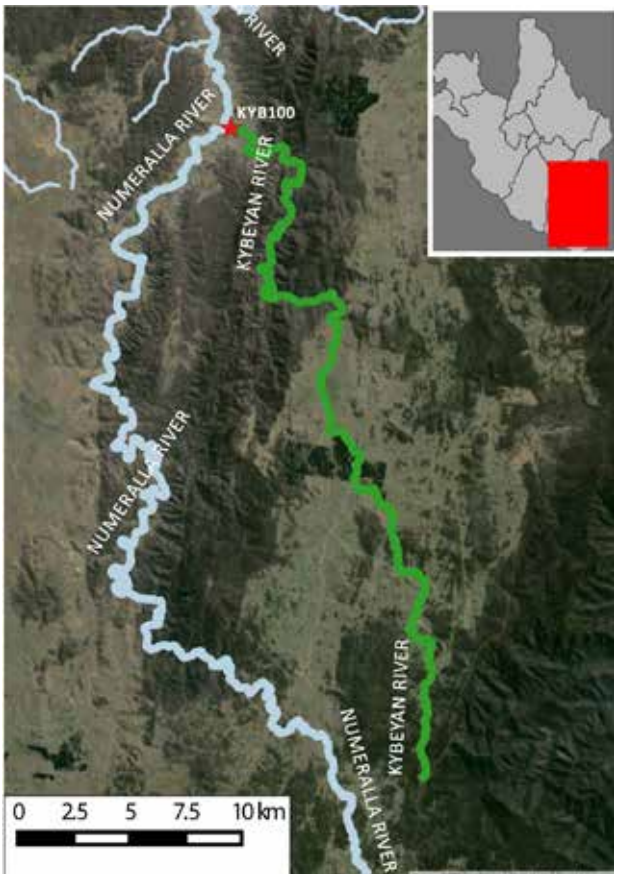
Headwaters to Numeralla River confluence

2015/16 CHIP Result B (Good)		
2014/15 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**11**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

Reach network length: approx. 49km
Dominant land uses: Rural

This reach includes the entire Kybeyan River catchment. This reach is characterised by both rural (grazing) country towards its headwaters, from where it flows through steep, unmodified country (including the Kybeyan State Conservation Area) to join the floodplains of the Numeralla River at its confluence. The lower floodplains of the reach are utilised for both grazing and cropping purposes.



Reach Condition

Dissolved oxygen scores were very low this year and correspond to warm water temperatures and very low flows in early Summer and Autumn.

Riparian condition was assessed in the lower section of this reach, where historical clearing associated with cropping and grazing has reduced native canopy, understorey and ground cover. Native species have been replaced with exotic species including Poplars and Phalaris. Small numbers of native titree are also regenerating instream.

Eastern gambusia, Carp and Platypus are recorded in the lower section of this reach. Large numbers of Carp 10-15cm long were caught at the Warrens Corner Road crossing during the Numeralla Fishing Club 'Carp-out' in Autumn 2016.

Water quality is measured at a site at the bottom of this reach and more sampling sites upstream are desirable.

Kybeyan River - January 2016

Michelago Creek MIC1

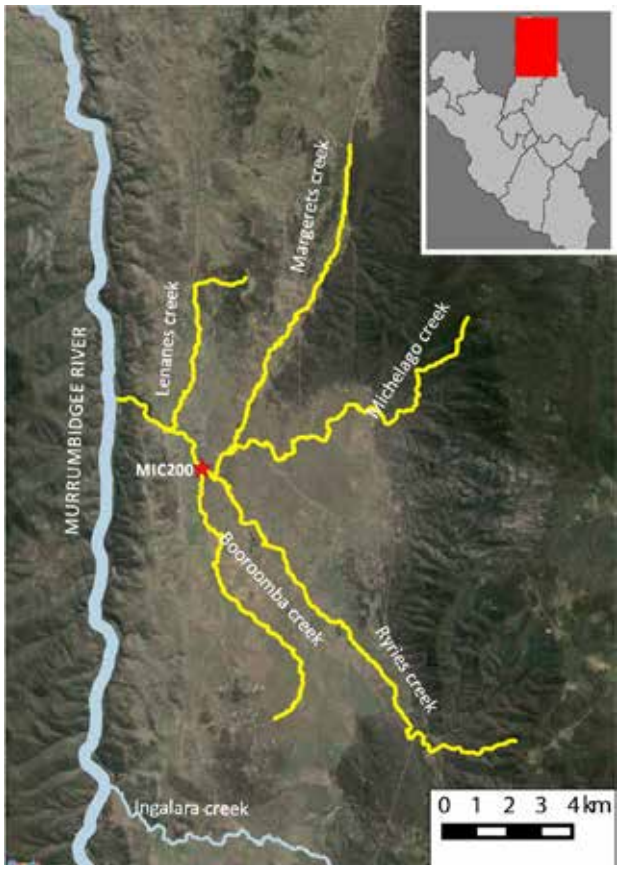
Headwaters to Murrumbidgee River confluence

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**10**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network length: approx. 55km
Dominant land uses: Rural, rural residential and conservation

This reach includes the Michelago Creek catchment including the Margarets and Ryries Creeks. The upper reaches of these creeks retain native, unmodified vegetation. The lower reaches flow through open, historically cleared country predominantly used for grazing and rural residential purposes (in and around the village of Michelago).



Reach Condition

Water quality observations show that electrical conductivity is elevated and is likely to be due to the geology of the catchment as well as land use. Dissolved oxygen levels have been low this year due to warm water temperatures and low water flows in Summer and Autumn.

Riparian condition reflects historical clearing in the lower parts of the reach which has reduced native canopy, understorey and ground cover. Exotic species including Poplars and Phalaris are prevalent. Large beds of native reeds have established instream and provide stabilising and filtering effects.

Willow control, riparian planting and streambank stabilisation has been carried out along the Michelago Creek by the Michelago Landcare Group. This is an ongoing project with further Willow control by the Green Army scheduled in the near future and possible further riparian plantings downstream towards the Monaro Highway.

Eastern gambusia are recorded for this reach. This reach is monitored at only one site and more sampling sites upstream in this catchment would increase data confidence.

Michelago Creek downstream of the Railway bridge near Michelago Road

Numeralla River NUM1

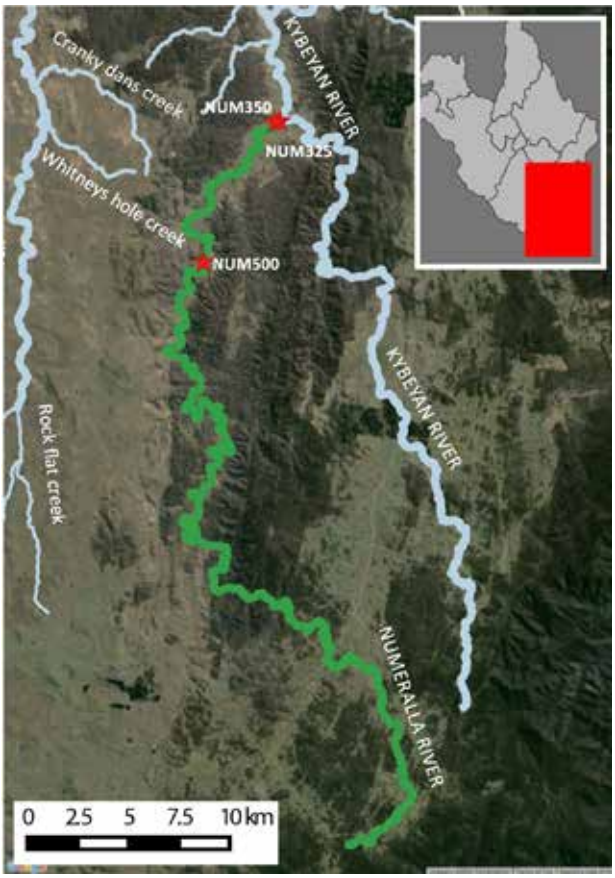
Headwaters to Kybean River confluence

2015/16 CHIP Result B (Good)		
2014/15 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**18**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
Water bug	**Excellent**	**1**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 38km
Dominant land uses: Rural and conservation

This reach includes the Numeralla River upstream of the Kybeyan River confluence. Land use adjoining the reach includes use for dryland cropping and grazing agriculture in the mid to lower sections. Sections of the upper reaches retain native vegetation including the Dangelong Nature Reserve. This reach is a high priority ACWA catchment where erosion risk was assessed as very high.



Reach Condition

Electrical conductivity and phosphorous levels are higher in this reach than those downstream and may reflect cultivation occurring adjacent to survey sites and upstream. Turbidity may be elevated slightly at times when water temperatures are warm and water levels are low. This correlates with times of high Carp activity. Carp sightings are recorded up to the middle of this reach and it would be of interest to assess whether they have spread to the headwaters.

This reach is a high priority ACWA catchment and includes two sites where streambank stabilisation works have been carried out. These are being photo-monitored and remain stable. The Numeralla Fishing Club are working in this reach to restore fish snags, revegetate snag sites and carrying out native fish stocking.

Platypus and Water Rats have been sighted in this reach.

Numeralla River upstream of Kybean River confluence

Numeralla River NUM2

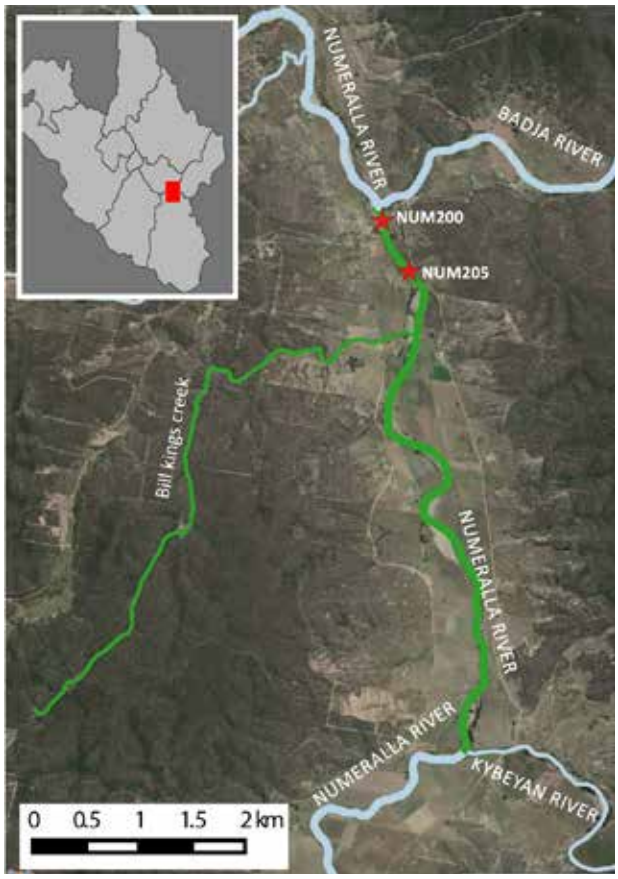
Kybean River confluence to Badja River confluence

2015/16 CHIP Result B- (Good)		
2014/15 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**18**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**3**
Riparian condition	**Fair**	**2**

Reach Facts

Reach network length: approx. 40km
Dominant land uses: Rural and conservation

This reach includes the Numeralla River downstream of the Kybeyan River confluence to the Badja River confluence. The Numeralla River in this reach is flanked by wide floodplains used for agriculture, including dryland cropping and grazing. This reach is a high priority ACWA catchment where erosion risk was assessed as very high.



Reach Condition

Electrical conductivity and phosphorous levels are lower in this reach than in the reach upstream, perhaps due to well vegetated riparian zones and less cultivation near the monitoring sites.

Water bug scores were lower than expected and is perhaps due to the thick cover of Silver poplars at the monitoring site. Silver poplars reduce water quality and reduce instream habitat due to leaf fall and spread of thick root mass which favours more tolerant species such as Water boatmen and Blackfly larvae.

Riparian condition is improving due to riparian revegetation works by the Numeralla Landcare group over the last few years. The Numeralla Fishing Club are also working in this reach to restore snags instream, revegetate banks at snag sites and native fish stocking. Carp and Platypus sightings are recorded.

Numeralla River at "Deepwater" showing fish snags on the far bank

Numeralla River NUM3

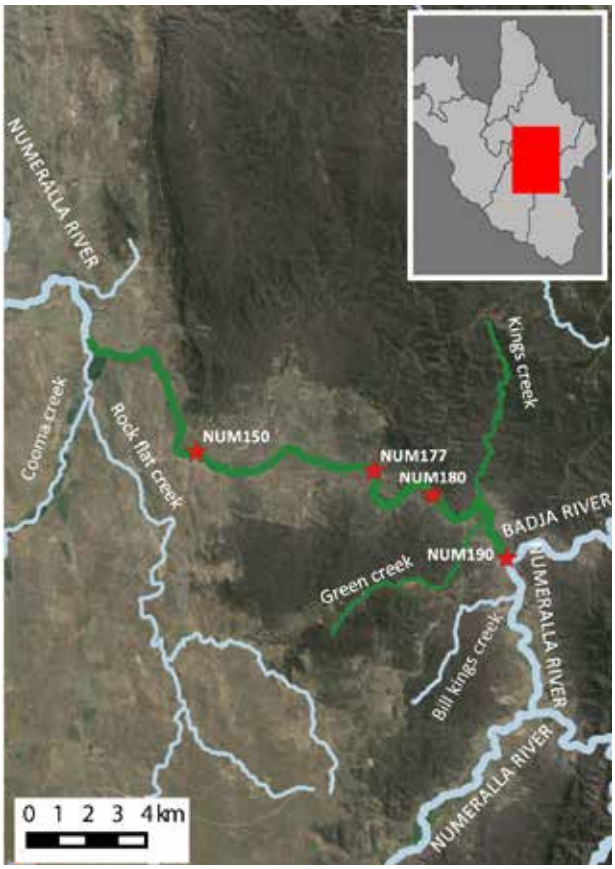
Badja River confluence to Cooma Creek confluence

2015/16 CHIP Result B (Good)		
2014/15 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**30**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**2**
Riparian condition	**Fair**	**3**

Reach Facts

Reach network length: approx. 14km
Dominant land uses: Rural and rural residential

This reach runs from below the Badja River confluence down to the confluence with Cooma Creek. The reach is characterised by floodplain areas used for agriculture including dryland cropping and grazing at various levels. This reach is a high priority ACWA catchment where erosion risk was assessed to be very high. Tributaries feeding into the Numeralla River have retained good native vegetation.



Reach Condition

The overall 'good' water quality results are influenced by inputs from the high quality Badja River and the generally intact catchment and riparian zones in the upper parts of the reach. Dissolved oxygen was the exception with 'degraded' levels possibly due to warm water temperatures and low water flows in Summer and Autumn.

The riparian zones in the upstream section of the reach is flanked by floodplain Ribbon gum woodland vegetation and has good instream habitat. The bottom section adjoins wide floodplains that are historically cleared and are now predominantly used for grazing and dryland cropping purposes. Instream channel depth and habitat is reduced where sand slugs are present.

Large instream reed beds are present in this reach where Carp have been seen in high numbers and displaying spawning behaviour. Platypus have been sighted here and the introduced Eastern gambusia have also been recorded.

Volunteers Edel and Erich Stephans doing riparian assessments with Nicole Clark at 'Eureka"

Numeralla River NUM4

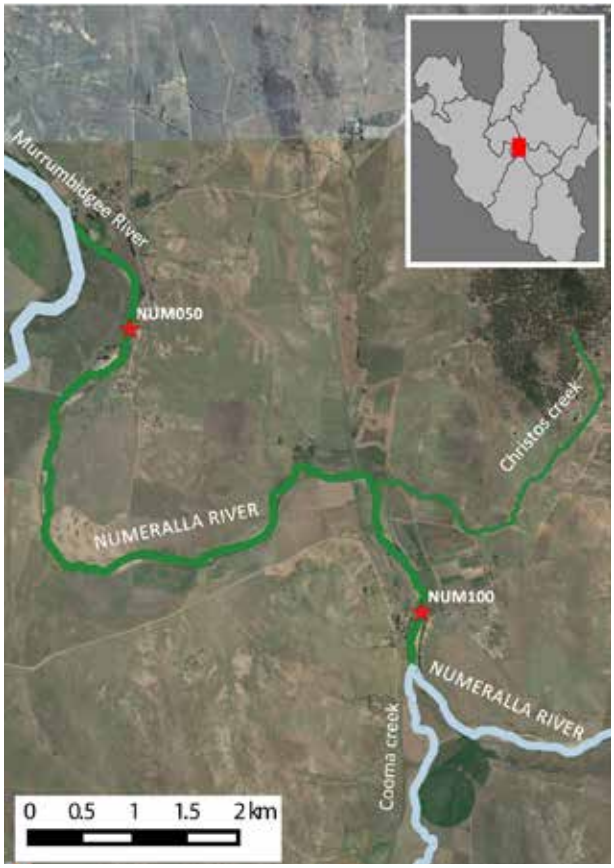
Cooma Creek confluence to Murrumbidgee River confluence

2015/16 CHIP Result B- (Good)		
2014/15 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**18**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 17km
Dominant land uses: Rural

This reach includes the lower section of the Numeralla River from Cooma Creek to its confluence with the Murrumbidgee River. The catchment includes wide floodplain areas on both sides of the Numeralla River which are used for agriculture including grazing, dryland and irrigated cropping. Riparian zones are highly modified and sediment deposition is widespread in the river.



Reach Condition

Water quality shows nutrients are slightly elevated compared to the reach upstream. This is likely due to the absence of well vegetated riparian zones and increased cultivation and grazing of floodplains adjoining the reach. Turbidity can be can be very high during high flow events, which indicates presence of streambank and gully erosion in the reach and upstream.

Riparian zones were found to be poor in this reach due to a lack of native canopy, understorey, groundcover and habitat features. Fencing to exclude stock is desirable. Native reed beds are colonising instream which provides important stabilising and filtering effects.

Large numbers of Carp are reported, including 'spawning runs'. Platypus sightings are reported.

Numeralla River at Chakola

Rock Flat Creek ROC1

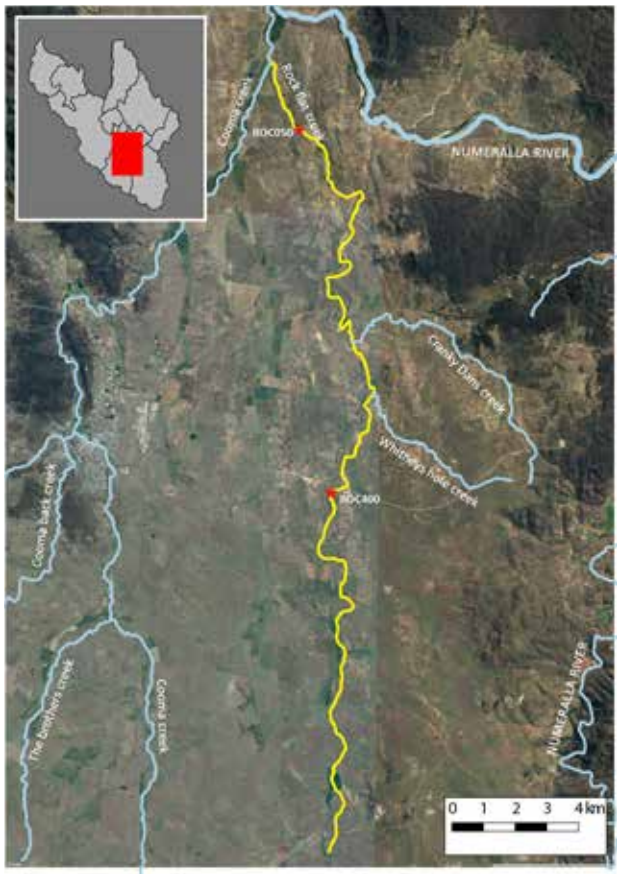
Headwaters to Cottage Hill Road crossing

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**23**
pH	Good	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Poor	
Water bug	**Good**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 42km
Dominant land uses: Rural

This reach includes the entire Rock Flat Creek from the headwaters down to its confluence with the Cooma Creek. The catchment flows through predominantly open basalt country, which is used for grazing and cropping agriculture. Wide floodplains at the bottom end of the reach have been historically prized for cropping and hence riparian zones are highly modified in this catchment.



This reach is an ACWA catchment with moderate erosion risk and includes a high priority ACWA site just downstream of the Cottage Hill crossing.

Reach Condition

Electrical conductivity (350 – 730 µS/cm) and the pH (7 – 8.5) are both high - largely due to the geology of the catchment. The water in the creek is usually very clear during regular flows, but turbidity can become elevated during high flow events. Slightly elevated nutrient levels reflect the grazing and cropping land use in the catchment.

Riparian vegetation is rated as 'poor' and reflects a lack of native species, habitat features and native tussocks in riparian zones. Native tussocks and regeneration of riparian species is limited where stock have access to the creek and riparian fencing is desirable in these areas.

Anecdotal reports indicate Carp are found right to the top of the catchment. Water rats are also recorded.

The ACWA site on Rock Flat Creek

Strike-A-Light River STR1

Headwaters to Bredbo River confluence

2015/16 CHIP Result B- (Good)		
2014/15 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**24**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Fair	
Water bug	**Fair**	**4**
Riparian condition	**Fair**	**2**

Reach Facts

Reach network length: approx. 38km
Dominant land uses: Rural

This reach includes the entire Strike-A-Light River catchment from its headwaters down to its confluence. The catchment includes cleared open country, utilised predominantly for grazing agriculture at the top and bottom ends of the reach. In these areas riparian vegetation has been modified. The middle of the reach is largely native vegetation with intact riparian areas and good instream habitat.

Reach Condition

Water quality scores reflect the vegetated nature of the upper catchment which helps to protect water quality. The lower catchment is utilised for grazing and dryland cropping and event-based monitoring shows that turbidity may be elevated in this part of the reach during high flow events. Riparian buffers and fencing to exclude stock are desirable management options.

The water bug score was lower than expected considering the 'excellent' water quality score. This could have been influenced by the dominance of Poplars at the site. During Autumn the leaf fall from Poplars reduces oxygen levels, increases nutrients and results in a thick muddy substrate in the river that can smother the water bug habitat.

Carp sightings have not reported in this reach. Mountain galaxias and Water rats have been reported.

Volunteers Alan and Marj Jones monitoring at STR500

Ginninderra Catchment Facts

Over 35% of ACT residents live in Ginninderra Creek catchment making it the most urbanised in the ACT. It carries substantial urban water runoff from both established and newly developing suburbs directly into the Murrumbidgee River.

Ginninderra Creek itself begins in the upper reaches of Gungahlin within the Mulligans Flat Nature Reserve and enters the Murrumbidgee after passing through the catchment's most significant and best preserved remnant ecosystem; the Ginninderra Gorge including the spectacular upper and lower falls. Gooromon Ponds Creek joins Ginninderra Creek near Dunlop and captures run off from much of the NSW land around Wallaroo and also includes Hall Creek.

Steady development in Canberra's north has impacted significantly over the past 30 years with sediment from development sites and weeds the two most significant issues. The riparian zone for most of the creek is dominated by exotic grasses with a mix of native and exotic mid-storey and canopy. Some notable exceptions are areas where Landcare groups have been working for many years such as Evatt, Umbagong District Park, Macgregor and Dunlop.

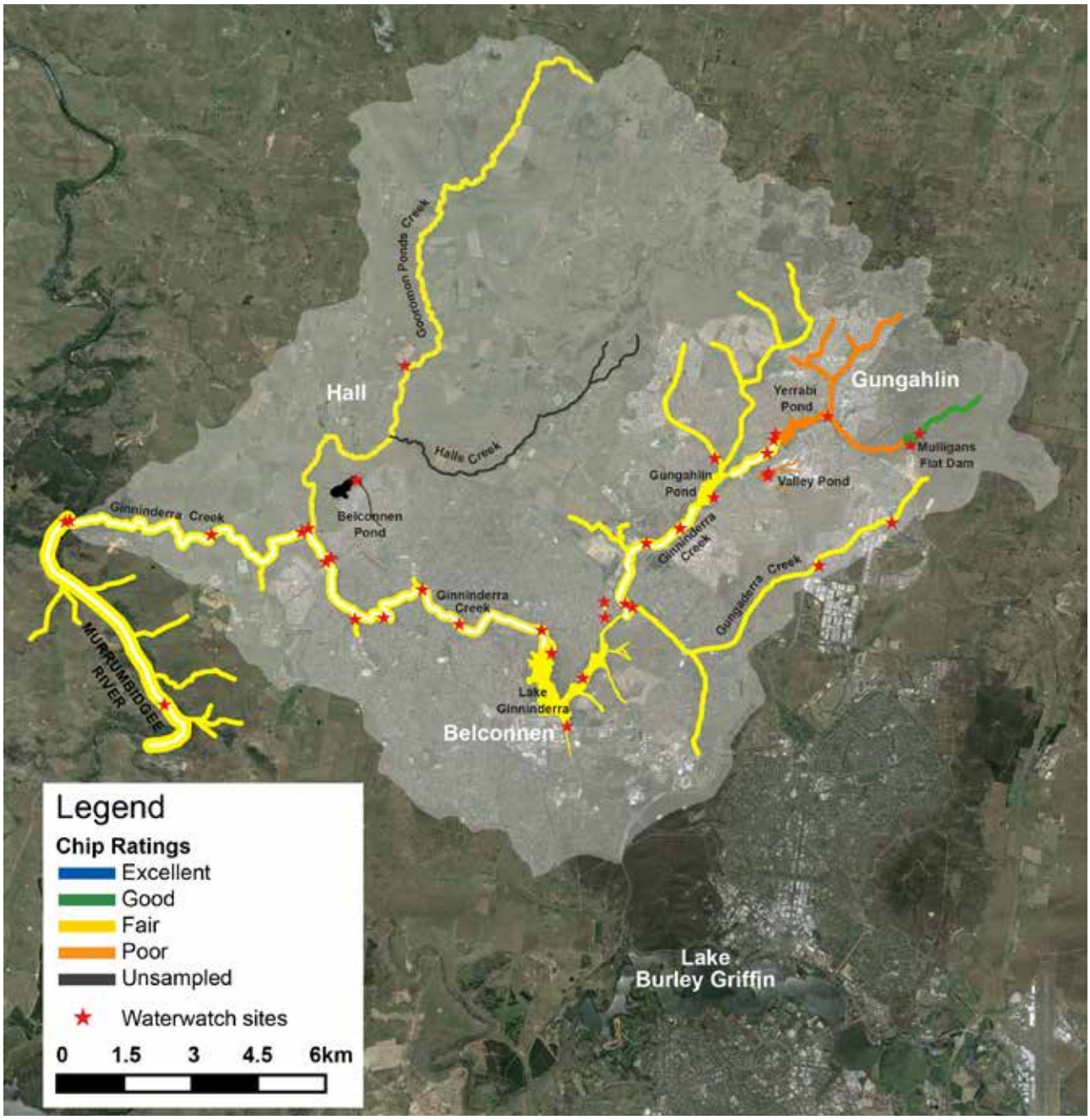
Ginninderra Waterwatch Volunteers have been monitoring this catchment since 1997.

Ginninderra Catchment Health Summary

Most reaches scored in the 'fair' to poor' range with two reaches remaining the same and five reaches slightly declining from last year. Four reaches improved slightly, however two of these show improvements based on the reallocation of reach sites.

To give finer resolution for water quality issues, Kippax creek (KIP1) was split from GIN4 resulting an improvement in the overall result for GIN4. A new reach was also created for the McKellar wetlands to provide an example of a urban wetland designed specifically for habitat (MCW1). Mulligans Flat dam has been added as a reach (MLF1) providing an example of a wetland within a catchment that is not impacted by rural or urban pressures. As expected, given the catchment is entirely within a nature reserve, MLF1 recorded the best CHIP score in Ginninderra catchment and was the only reach assessed as 'good'.

Some minor variation within parameters for reaches could be explained by significant rain events or adjacent works having adverse impacts on water quality. For example the turbidity for the Valley Ponds (GUN1) declined as a result of construction works upstream during this recording season. Storm events have highlighted the level of rubbish within this catchment with an increase in reports of rubbish from monitoring volunteers and the other community members. Plastic bottles were reported as the most significant issue as well as plastic-wrapped newspapers.



Murrumbidgee River CMM11

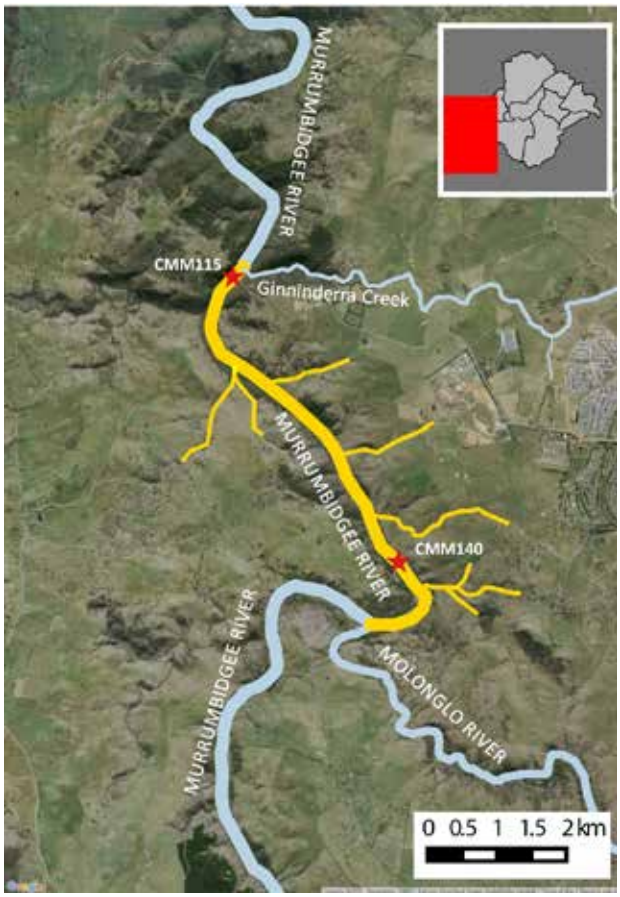
Molonglo River confluence to Ginninderra Creek confluence

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**43**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
Water bug	**Degraded**	**4**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 7.1km
Dominant land uses: Conservation, rural

Starting below the confluence of the Molonglo River this reach includes mostly rural land and Murrumbidgee River Reserve to the confluence with Ginninderra Creek. The reach also includes some sections of gorge country and the upper section of the reach receives the outflow from the Lower Molonglo Water Quality Control Centre.



Reach Condition

A number of high nitrate readings are explained by outflows from Lower Molonglo Water Quality Control Centre, and subsequent recordings show that the nitrate levels drop reasonably quickly as you move downstream. The outlying high turbidity scores are attributable to significant rainfall events, with most turbidity readings returning to a normal range within a month.

Water bug surveys produced both 'poor' and 'degraded' results. The shallow and rocky part of the river has limited potential for macrophytes and other aquatic plants, reducing habitat for certain species of bugs.

The 'fair' score for riparian vegetation was due to limited native canopy species, but a number exotic canopy species. The area is sufficiently covered, with some native understorey species and native tussock grasses.

Pelicans on the Murrumbidgee River just beyond the ACT border

Gungaderra Creek GDC1

Gungahlin to Giralang Pond

2015/16 CHIP Result C- (Fair)

2014/15 CHIP Result D (Poor)

Parameter	Rating	Survey
Water quality	**Good**	**17**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**1**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 10km
Dominant land uses: Urban

This reach starts in the southern suburbs of Gungahlin, flows through the Gungaderra Grassland Reserve and into Ginninderra Creek at Giralang Pond just upstream of Lake Ginninderra. The reach also includes a stormwater channel from the University of Canberra and Canberra Stadium and has moderate urban stormwater inflow.

Reach Condition

Overall water quality was good with 'poor' electrical conductivity results coming from the stormwater arm of Giralang Pond. The 'degraded' dissolved oxygen (DO) results correlated with no flow in both the Giralang Pond and Gungaderra Creek reducing the CHIP score to 'fair'. One volunteer noted a foul odour at Giralang Pond when such low DO scores were recorded.

A lack of native canopy and understorey and a dominant exotic vegetation account for the 'poor' riparian vegetation assessment.

A juvenile Eastern longneck turtle was netted during water bug sampling, which is welcomed given the number of foxes seen in the area. Foxes predate heavily on turtle eggs.

A plan to improve the width of riparian habitat is being worked on with the ACT Government wetland staff. It is hoped that providing a better buffer for frog populations will result in better frog numbers and diversity. Giralang Pond has some rarer bird visitors at times, such as Lathams Snipe, and improving the buffer will also provide better habitat for such species.

Top: Juvenile Eastern longneck turtle
Bottom: Gungaderra grassland reserve pond

Ginninderra Creek GIN1

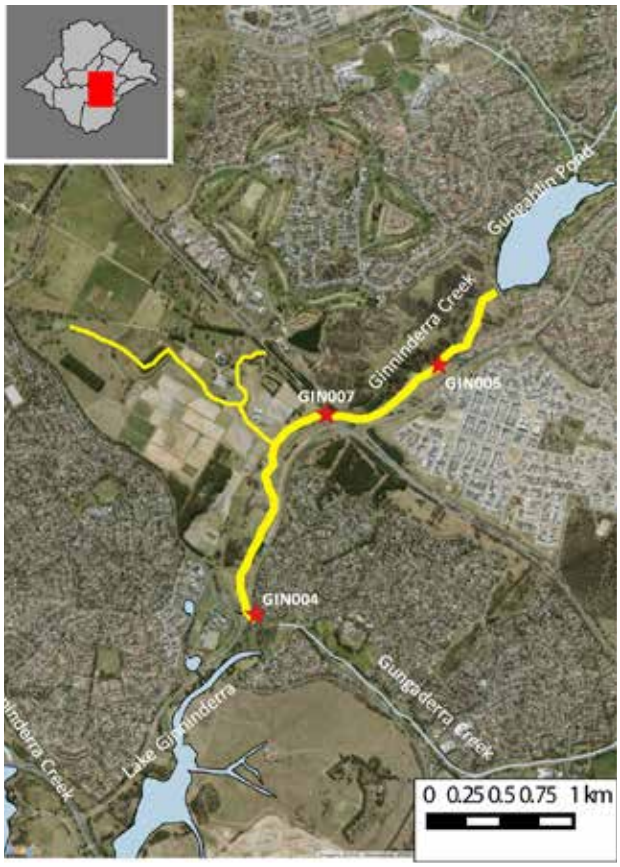
Crace to Giralang Pond

2015/16 CHIP Result C- (Fair)		
2014/15 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**19**
pH	Excellent	
Turbidity	Good	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 5km
Dominant land uses: Urban

Starting at the outflow of Gungahlin Pond this reach includes the stormwater inflow from Nicholls and Crace. The middle of the reach receives runoff from the CSIRO field test facility. The downstream section flows through the Old Palmerville township historic site 12 and Landcare Forest. The end point for this reach is Giralang Pond which is the only small stream pond present on Ginninderra Creek.



Reach Condition

High electrical conductivity (EC) results and low dissolved oxygen (DO) drive down the water quality rating in this reach. The high EC reading (range 170 – 780 µS/cm) is likely due to runoff from a highly urbanised catchment, while the degraded, yet highly variable DO readings (30 – 128% saturation) is likely due to a combination of lowered water levels, elevated nutrients and instream processes that have become simplfied and lack stability.

Overall riparian vegetation assessment showed 'poor' results due to high numbers of exotic species present, minimal understorey plants, and low canopy cover, possibly reducing overall erosion resilience.

Despite collecting 3 mayflies at GIN004 in Spring, the majority of water bugs collected were tolerant taxa, and not in high numbers. Lack of suitable habitat also affects water bug species and although significant reeds are present, there is little diverse instream vegetation.

A baited yabby trap was removed by the volunteer at Giralang Pond. Feral fish such as Eastern gambusia, Redfin perch and Carp are all regularly seen here.

24 bags of rubbish (mostly plastic bottles) were taken out of Giralang Pond on Clean Up Australia Day in March 2016.

Ginninderra Creek GIN2

Lake Ginninderra

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**29**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**4**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 9km
Dominant land uses: Urban

Starting below Giralang Pond and finishing at the Lake Ginninderra Dam wall, this reach covers the main city centre of Belconnen. The main inflow is from Ginninderra Creek from the north-east, which includes the new development suburb of Lawson. The other inflow is at the southern end of the Lake and is mostly urban stormwater that flows into the recently redeveloped Eastern Valley Way wetland.

Reach Condition

Water quality data shows an improvement in the Eastern Valley Way wetland section of the Lake. This is likely due to improved plant growth within the new wetland and the improvement in flow resulting from the introduction of a reticulation pump during no flow periods.

Water bugs found during surveys were mostly in the moderate to very tolerant categories. While some areas of the Lake has good habitat for bugs, the constant water levels result in less variation in wet and dry areas around the Lake's edge which results in a more simplified littoral zone and reduced habitat value.

Riparian condition scores were 'poor' and reflect the parkland nature of this Lake reach. Habitat features are particularly low including debris and native vegetation in many areas. There is scope for improvement in areas that are not required for visitor access and do not need to be maintained in a "neat and tidy" manner.

A rather turbid Lake Ginninderra after rain.

Ginninderra Creek GIN3

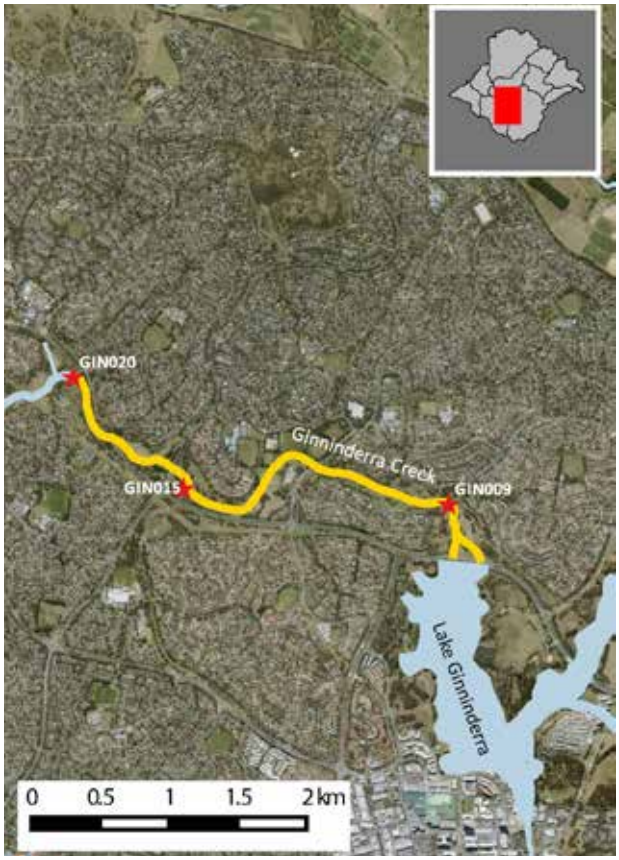
Dam wall to Ginninderra Drive

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**35**
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**4**
Riparian condition	**Fair**	**2**

Reach Facts

Reach network length: approx. 4km
Dominant land uses: Urban

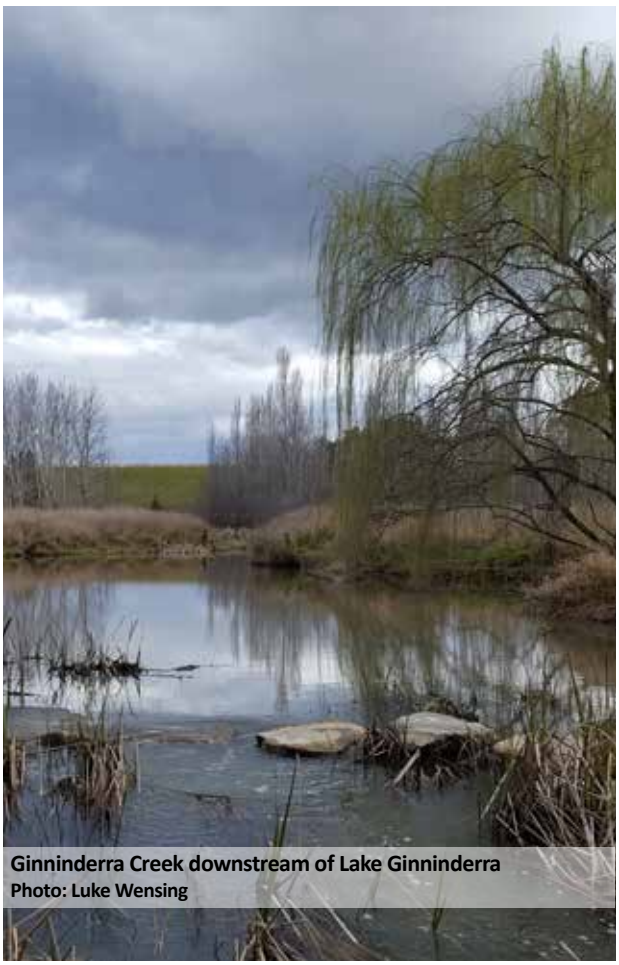
Starting below the Lake Ginninderra spillway this reach sits entirely with in established suburbs with high urban stormwater inflow. This reach has good reed cover and wide, well grassed buffer zones in most areas. During rain events the water in this section runs very clear and turbidity is only seen when overflow from Lake Ginninderra occurs. Two new wetlands are to be built in this reach through the ACT Government Healthy Waterways (Basin Project).



Reach Condition

The data density threshold for water quality was not reached for this reach last year so the CHIP result was based on riparian condition and water bugs. With a new volunteer now active in the lower section, this reach has a good data set for water quality which further confirms the overall score. Poor results for dissolved oxygen (DO) and electrical conductivity (EC) were mostly recorded during the warmer months with low water level and no flow periods that resulted in warmer water (lower DO) and pollutants being more concentrated (higher EC). This reach could benefit from some environmental releases from Lake Ginninderra to reduce the length of no flow periods.

Riparian condition varies greatly through this reach mainly due to changes in the exotic to native plant ratio. In some areas where Landcare groups are active, the riparian zone contains good native structure and habitat features. Ginninderra Catchment Group and ACT Government tree unit have undertaken some poplar replacement works through this reach in previous years with native plants now starting to establish.



Ginninderra Creek downstream of Lake Ginninderra
Photo: Luke Wensing

Ginninderra Creek GIN4

Ginninderra Creek at Umbagong District Park

2015/16 CHIP Result C+(Fair)		
2014/15 CHIP Result D+ (Poor)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**20**
pH	Excellent	
Turbidity	Good	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

Reach network length: approx. 6km
Dominant land uses: Urban

This reach starts downstream of Ginninderra Drive and flows through the Umbagong District Park, ending at the confluence with Gooromon Pond Creek. This reach is well vegetated with good native riparian zone and wide grassland buffers in many sections. Previous creek restoration projects by the Ginninderra Catchment Group and Umbagong and Macgregor Landcare Groups have improved riparian condition and water quality.

Reach Condition

Improvement in reach condition can in part be attributed to separating the low-scoring Kippax Creek section off into a new reach.

A significant increase in phosphorus levels, low dissolved oxygen and high electrical conductivity and were mostly recorded during low and no flow periods. This reach would benefit from some flow management during extended no flow periods.

Water bug scores were varied with the better results recorded in areas with good reed growth. Bugs that prefer areas of good reed habitat such as mayflies and caddisflies were recorded at the better vegetated sites.

This reach contains good sections of native vegetation particularly through Umbagong District Park and Macgregor. Plantings from 2012 through the Macgregor section have become well established and improved habitat value along this section. Instream plantings have stabilised some sections impacted by erosion with more plantings required in other areas.

Results of a rehabilitation project between Macgregor Landcare and Ginninderra Catchment Group

Ginninderra Creek GIN5

Gooromon Ponds Creek confluence to Murrumbidgee River confluence

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**47**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**3**
Riparian condition	**Poor**	**3**

Autumn water bug survey at GIN030 with volunteer David Fitzsimmons

Reach Facts

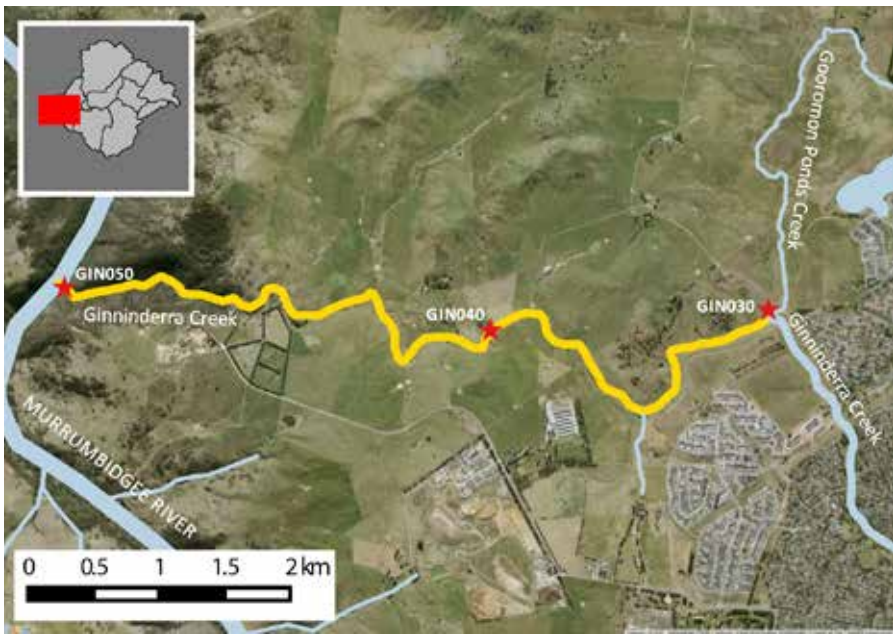
Reach network length: approx. 10km
Dominant land uses: Urban/Rural Fringe

This reach runs from the confluence with Gooromon Ponds Creek to the confluence with the Murrumbidgee River. The upper section has significant bank erosion and the lower section contains the high conservation value area of the Ginninderra Falls and Gorge. Ginninderra Catchment Group, Greening Australia and the Riverview group have undertaken a Willow removal and native regeneration project in the mid-section.

Reach Condition

Both dissolved oxygen and electrical conductivity are rated as 'poor' and 'degraded' respectively – this is likely the result of poor instream vegetation upstream and the influence of Gooromon Ponds Creek, which has much higher salt levels than Ginninderra Creek.

There are extreme examples of riparian health present in this reach. There is severe erosion at the Gooromon Ponds Creek confluence caused by cattle, with no canopy or understorey cover present. In contrast, significant native canopy, understorey and ground cover exist downstream at the Ginninderra Creek confluence with the Murrumbidgee River. The rough terrain and inaccessible nature of the downstream section contributes to its complex structure.



The severe erosion upstream is expected to be addressed through riparian restoration works by the ACT Government in the coming year. This will include extensive erosion control plantings.

Plastic bottles and other debris continue to accumulate at the Ginninderra Creek confluence, numbering in the thousands. Eastern gambusia is also sighted throughout this reach.

Gooromon Ponds Creek GOO1

Umbagong to Dunlop

2015/16 CHIP Result C+ (Fair)

2014/15 CHIP Result D+ (Poor)

Parameter	Rating	No. Survey
Water quality	**Good**	**13**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**1**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 17km
Dominant land uses: Rural

Flowing through the rural land surrounding Hall and Wallaroo, the Gooromon Ponds Creek is a mostly ephemeral creek with intermittent pools. This Creek contains sections of moderate erosion with mostly low habitat value.

Reach Condition

Electrical conductivity is consistently elevated in this reach, which has often been dry or with very little flow during this reporting period. Significant rain events affect the water level quite quickly, which dilute the creek water and lower the electrical conductivity readings. The usually elevated electrical conductivity levels is possibly a combination of naturally occurring geological influences and evidence of low levels of dryland salinity.

Spikes of nitrate and phosphorous readings are possibly due to run-off, as the area is surrounded by long term farming country.

The riparian condition of this reach scored a 'degraded' rating due to an almost complete dominance of exotic species in all layers. Ground cover is relatively complete however exotic pasture grasses dominate, mid-storey and canopy species are scarce and mostly exotic and there is a complete lack of features such as fallen logs and tussock grasses. There is scattered instream vegetation throughout the reach including some sections with good reed growth.

A pool on the Gooromon Ponds Creek just above the confluence with Ginninderra Creek.

The Valley Ponds GUN1

Wetland to Gungahlin Town Centre

2015/16 CHIP Result D+ (Poor)		
2014/15 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**8**
pH	Good	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Poor	
Dissolved Oxygen	Fair	
Water bug	**Degraded**	**1**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network length: approx. 2km
Dominant land uses: Urban

Originally an old farm dam and artificial seepage grassland, this site was a unique habitat for this catchment. The site has since been redeveloped into urban wetland for the Gungahlin town centre and parts of Palmerston. It is now a high quality education and recreation wetland.

Reach Condition

The CHIP score declined due to poorer water quality results which were likely due to the neighbouring construction site that has contributed large amounts of rubbish and sediment. This was most apparent in elevated turbidity and nitrate levels with consistent poor results throughout the year. Reports of large amounts rubbish entering the wetland were forwarded to the ACT Government.

Water bug results also declined with only the 6 bug types recorded. The lack of instream habitat and in particular submergent macrophytes (plants living below the water surface) may also be impacting on bug diversity. As the wetland develops it is expected to improve in habitat value and in turn improve bug diversity. Plantings of submergent macrophytes to provide better instream habitat should improve bug diversity.

Riparian condition is expected to improve as the wetland develops over time. Good initial plantings of canopy, midstorey and ground cover including tussock grasses will ensure a complex structure develops. Good numbers of reeds have already established and provide valuable habitat. Some perching logs have been installed within the wetland but more large woody debris around the wetland would be desired to provide additional habitat.

The Valley Ponds

Gungahlin Pond GUN2

Headwaters of Ginninderra Creek north arm to Gungahlin Ponds

2015/16 CHIP Result C+ (Fair)

2014/15 CHIP Result C (Fair)

Parameter	Rating	No. Survey
Water quality	**Good**	**19**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**4**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 6km
Dominant land uses: Urban/Rural Fringe

The north arm of Ginninderra Creek originates in the rural lands surrounding the northern suburbs of Gungahlin and joins the east arm in Gungahlin Pond. The upper section is mostly ephemeral creeks fragmented by stock dams and flowing into the sediment control pond of Gungahlin. The reach receives a high inflow of urban stormwater from surrounding suburbs and new developing suburbs.

Reach Condition

'Degraded' dissolved oxygen and electrical conductivity levels are likely a continuation from inputs from the Casey developments, although the reach shows an improvement in water quality from the previous year. Five especially high phosphorus readings are possibly to due domestic landscape development in the new suburb.

Some algae was observed upstream at the outflow of Yerrabi Pond in the warmer months and algal blooms were consistently observed at the stormwater drain site. These, combined with low water levels, are a possible explanation for some significantly low dissolved oxygen readings.

Limited sections of the riparian zone scored well for their habitat values, with some significant native canopy evident. Exotic species, however, with limited habitat values, dominate the edge of Gungahlin Ponds. Instream vegetation in the form of reeds are present throughout the reach, and abundant in some areas, providing good habitat value for frogs and water bugs.

An ibis roost at Gungahlin Pond

Kippax Creek KIP1

Headwaters to Ginninderra Creek confluence

2015/16 CHIP Result C- (Fair)		
NEW REACH		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**12**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Fair	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**1**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network length: approx. 2km
Dominant land uses: Urban

Kippax Creek is now mostly a system of stormwater drains and drainage lines. The remaining "natural" creek section is only a 400m stretch from the last gross pollutant trap to the confluence with Ginninderra Creek. This reach does offer a great opportunity to study the impacts of a catchment that is heavily urbanised with limited water quality improvement infrastructure.

The lower section sits within an important native grassland at the Umbagong District Park. Significant erosion is evident towards the confluence.

Reach Condition

The electrical conductivity of this reach was the highest for of the urban reaches of Ginninderra; with half the samples showing above 500 µS/cm. Dissolved oxygen was rated as degraded and is expected within a stormwater system with a mostly low flow cycle. Phosphorus results were the worst for the catchment, consistently measuring 0.05 mg/L. High nitrate levels were recorded following the cleaning of the gross pollutant trap and volunteers have reported plumes of paint or plaster material in this reach.

Given all this, the water bug score was, unsurprisingly degraded with an almost entirely tolerant range of taxa; dominated by water snails and nematodes.

Riparian condition was patchy, overall the reach lacks native ground cover complexity in structure of layers and habitat features.

Significant erosion on Kippax Creek

McKellar Wetlands MCW1

Designed habitat wetland system, McKellar

2015/16 CHIP Result C- (Fair)		
NEW REACH		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**12**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**1**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network length: approx. 500m
Dominant land uses: Urban

The two McKellar wetlands are designed primarily for frog habitat, with humans as secondary users. This is evident in the significant reed growth in both wetlands, and the connecting channel linking the two wetlands, which is heavily vegetated to facilitate frog movement. As it is situated in an established suburb, nutrient inputs are from human activity such as gardening and leaves from deciduous trees.

Reach Condition

This is the first year that this wetland system has be classified as an individual reach. The 'fair' grading is a result of consistently low dissolved oxygen and higher electrical conductivity levels in the upper pond. Very high decomposition and possibly high microbial activity in these wetlands may also be causing low dissolved oxygen levels. Turbidity was higher than expected and is possibly a result of the extremely high numbers of Carp present in the wetlands.

The water bugs (macroinvertebrates) were 'degraded' with only a few tolerant species recorded. Good instream habitat would suggest far higher water bug assemblage so it is likely that poor water quality is influencing the result. The high Carp numbers may also be a contributing factor.

The poor result for riparian vegetation resulted from some areas of very poor habitat with mowed grassland right to the edge of the pond. Other areas provide good habitat with a large vegetation zone. Instream reeds are abundant but submergent macrophytes in many areas are missing and high algae growth is common..

A family of Black Swans at McKellar Wetlands

Mulligan's Flat Dam MFL1

Headwaters of Ginninderra Creek to Mulligan's Flat Dam

2015/16 CHIP Result B+ (Good)		
NEW REACH		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**24**
pH	Good	
Turbidity	Good	
Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
Water bug	**Fair**	**1**
Riparian condition	**Good**	**1**

Reach Facts

Reach network length: approx. 2km
Dominant land uses: Conservation

Mulligan's Flat Dam was originally an old farm dam, now repurposed as an ecological habitat for aquatic life, bird life and native fauna and flora. The Mulligan's Flat Nature Reserve was established in 1995 to protect the box-gum grassy woodlands and fauna situated in the Gungahlin area. The Dam is normally filled with rainwater that is grass-filtered, and is a popular spot for bird watchers. The site play hosts to a number of conservation projects.

Reach Condition

The Mulligan's Flat Dam held a good diversity of water bugs, including dragonfly, damselfly and caddisfly larvae. The site is also notable for water measurers (Hydrometridae) and needle bugs (Nepidae), which are not commonly found in large numbers in this catchment. Hydrometrids in particular are adversely affected by urban runoff as they walk on the water's surface and the presence of sufactants (such as detergents) will decrease the surface tension and cause them to sink.

The riparian vegetation rated an overall 'good' score with good native canopy, understorey and ground cover found throughout. There is also significant instream vegetation, providing a good aquatic habitat.

The water quality in the dam rated overall 'good', but the electrical conductivity levels were notably 'excellent' – which is in sharp contrast to the rest of the catchment. This is largely due to the contained nature of the reach, with no inputs from urban development and an intact riparian zone.

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Large dam at Mulligan's Flat

Yerrabi Pond YER1

Headwaters of Ginninderra Creek to Yerrabi Dam Wall

2015/16 CHIP Result D- (Poor)		
2014/15 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**No Data**	**0**
pH	No Data	
Turbidity	No Data	
Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
Water bug	**Degraded**	**1**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 10km
Dominant land uses: Urban/Rural Fringe

The east arm of Ginninderra Creek originates in the rural lands surrounding the northern suburbs of Gungahlin. It includes the former rural lands, now significant woodland reserve, of Mulligans Flat Sanctuary. The upper section is mostly ephemeral creeks fragmented by stock dams and flows into the sediment control pond of Yerrabi.

The reach receives a moderate inflow of urban stormwater from surrounding suburbs.

Reach Condition

This reach was data deficient for water quality.

Riparian vegetation was rated overall as 'poor', due in large part to the outflow of Yerrabi Pond, which backs on to a concrete channel that connects to a busy road. In areas that did contain riparian vegetation, exotic species made up the majority of canopy, understorey and ground cover.

Some caddisfly and mayfly larvae were observed, however the majority of bugs identified were true bugs (order: Hemiptera) such as water boatman. These true bugs are able to draw their oxygen from the air and can fly between wetlands so have a higher tolerance to pollutants.

Eastern gambusia and Carp are regularly sighted throughout Yerrabi Pond although it is also regularly stocked with Murray cod and Golden perch fingerlings by the ACT Government's Conservation and Research Unit.

Water bug sampling at Yerrabi Pond with volunteer Amuntha and her son Kishen

Molonglo Catchment Facts

The Molonglo catchment extends from the Murrumbidgee River, just downstream of Uriarra Crossing, to the headwaters of Molonglo and Queanbeyan Rivers and Jerrabomberra Creek, an area of about 2,000 km^2

This diverse catchment includes the urban areas of Queanbeyan and inner Canberra, villages such as Captains Flat and rural residential areas and farmland including Burra, Royalla and Carwoola. Non-residential areas include native and pine forests, wetlands, national parks and the foreshores of Googong Dam, which supplies some of Canberra's and Queanbeyan's water.

Lake Burley Griffin is on the Molonglo River and collects stormwater and runoff from Queanbeyan, much of north Canberra and Fyshwick industrial area, as well as treated output from the Queanbeyan sewerage treatment plant. Lake Burley Griffin water quality is monitored by the National Capital Authority and can be found at http://www.nationalcapital.gov.au/WaterQuality/index.php/en/.

The Molonglo catchment has a large population with urban waterways flowing in concrete channels. This is a key issue in urban catchments where there is little riparian vegetation and habitat to slow down flows and capture and absorb nutrients and sediments.

Of the six priority sub-catchments in the ACT Healthy Waterways (Basin Project), four are in the Molonglo catchment. These sub-catchments will be the focus of treatment works such as wetlands and water-sensitive urban design aimed at improving water quality.

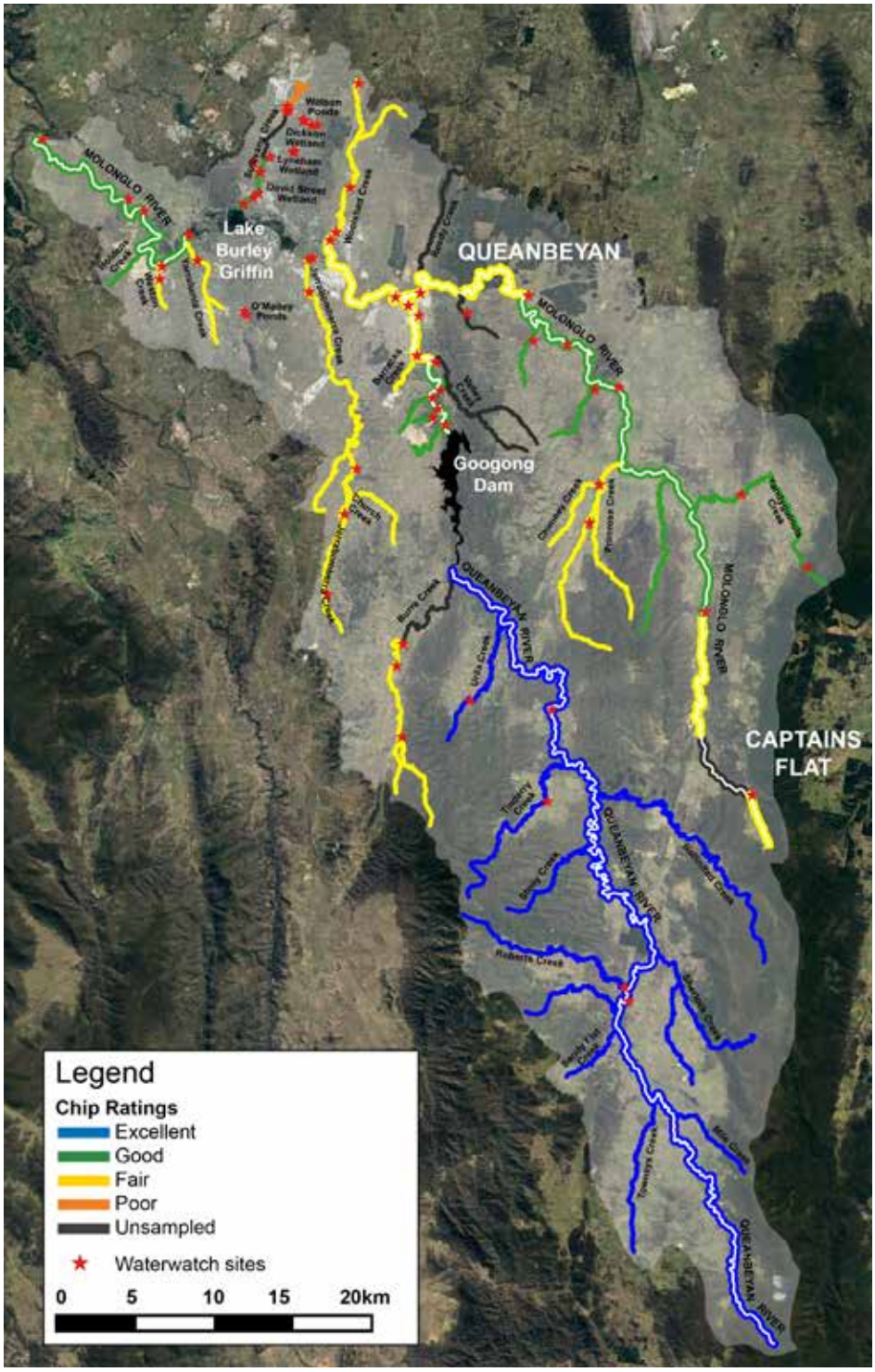
Though water quality across the Molonglo catchment is generally good, upper Sullivan's Creek and Weston Creek have some of the lowest quality. When taking all our catchment health indicators into account (water quality, water bugs and riparian condition), it is the highly urban catchments and rural creeks with largely cleared vegetation that are in the poorest condition.

Molonglo Catchment Health Summary

One third of Molonglo Catchment reaches were in 'good' condition overall, and two-thirds were in 'fair' condition. Only a single reach was rated as 'excellent', the upper Queanbeyan River, and only one was rated as 'poor': upper Sullivan's Creek.

The same five reaches as last year had the highest overall scores (two reaches on the Queanbeyan River plus Yandyguinula Creek, Googong Creek and David St Wetland), though in a slightly different order to last year. All the reaches with the top overall scores have more intact native bush and good riparian vegetation throughout most of their catchment.

There was more variation in reaches with the bottom five scores, with only Weston Creek having the dubious honour of featuring both years. The major driver influencing the lower scoring reaches was changes in available data and/or shifts in the water bug score. This will vary less as we aim for more consistent amounts of data that will even out the seasonal variation in both water bug and water quality surveys.



There was another fuel leak reported this year, this time into Sullivans Creek somewhere around Lyneham or O'Connor, but the source of the leak was not found. There were also sediment pond overflows again from new developments. We are very reliant on members of the public, including Waterwatchers, to notice and act on pollution events, including high turbidity events, as quickly as possible by reporting them to Access Canberra in the ACT, or your local council in NSW.

Burra Creek BUR1

Headwaters to Burra Road

2015/16 CHIP Result C (Fair)		
2014/15 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**26**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 30km
Dominant land uses: Native bush, grazing, rural

Burra Creek arises in the north-western edge of the Tinderry Mountains and flows into the Queanbeyan River just upstream of Googong Dam. This reach comprises the top half of the creek and flows through rural subdivisions and includes the outlet of the pipeline from the Murrumbidgee to Googong water transfer scheme. Riparian vegetation is largely absent or dominated by Willows, but has some extensive reed beds.

Reach Condition

Water quality was very similar to last year. The 'degraded' electrical conductivity was strongly related to low flow periods, indicating geology and hydrogeology as major factors. This is exacerbated by historic land clearing, including extensive removal of riparian vegetation, causing higher water tables and the potential for saline discharge from the landscape.

The lower overall score for the year is linked mainly to water bugs with no sensitive stoneflies being found this year. This may be due to low flows during both water bugs surveys

Although the Murrumbidgee to Googong pipeline is unlikely to be used in the foreseeable future, impacts from changed flow regimes and different source water would be likely, particularly to water bugs suited to the conditions in Burra Creek. Having Waterwatch sites above and below the pipeline site is important to our baseline data, providing more data for future comparisons, as well as picking up more localised effects during the year.

Erosion on Burra Creek

Dickson Wetland DIC1

Sullivans Creek catchment

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**16**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Good	
Water bug	**Poor**	**2**
Riparian condition	**Poor**	**1**

Reach Facts

Reach area: approx. 1Ha
Dominant land uses: Urban

Dickson Wetland was constructed in 2011 and is on the lower western slopes near Mt Majura. A large concrete stormwater channel is fed into the constructed wetland, but during high rainfall events the wetland is bypassed. Water from the wetland flows back into the concrete channel and through to Lyneham Wetland just upstream of the confluence with Sullivans Creek.

Reach Condition

Several water quality parameters have improved considerably this year including turbidity, pH and nitrates. We were informed that there had been either a mains water or reticulated stormwater leak into Dickson Wetland over the past year which resulted in it keeping a good level of water when other urban wetlands were dropping and becoming smelly. Adding a continual inflow of water would be expected to produce very similar impacts on water quality to those seen.

In contrast, the water bug rating dropped from 'fair' to 'poor'. It is not clear why the bug score did this but the Autumn survey was a great improvement on Spring, capturing large numbers of sensitive caddisfly and mayfly nymphs.

Dickson Wetland Carers have been looking after the wetland since it was constructed and it is an important community asset. The group's ongoing work is a large part of why this wetland is so lovely, weed free, well mulched and treasured by the local community!

Maja, Stephanie and Ken water bugging at Dickson Wetland

Googong Creek GGG1

Headwaters to Queanbeyan River confluence

2015/16 CHIP Result B+ (Good)		
2014/15 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**18**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Good	
Water bug	**No Data**	**0**
Riparian condition	**Good**	**2**

Reach Facts

Reach network length: approx. 1km
Dominant land uses: Native bush, grazing, urban, infrastructure, rural residential

Googong Creek arises in the developing township of Googong, and runs into the Queanbeyan River downstream from Googong Dam. It passes through a stormwater holding dam on the edge of Googong township and crosses a pipeline access track.

This creates another dam on the creek before reaching the Queanbeyan River upstream of Wickerslack Lane. Googong Creek flows intermittently but now takes discharge from the Googong water recycling plant.

Reach Condition

Electrical conductivity is typically high in this creek, and is probably related to local geology and the high mineral content of parent rock. Groundwater is also important in the lower part of this reach, as in dry times water in the creek comes from a Spring. The cause of a high spike of nitrates in June has not yet been identified, but is likely to come from development upstream.

It is a good walk in to the sites on this reach, and the volunteer often needs to cut through Blackberry canes to access the lower site on the reach. Volunteers certainly have great commitment!

Googong Creek is too small and ephemeral to sample for water bugs.

Sue taking samples at Googong Creek

Jerrabomberra Creek JER1

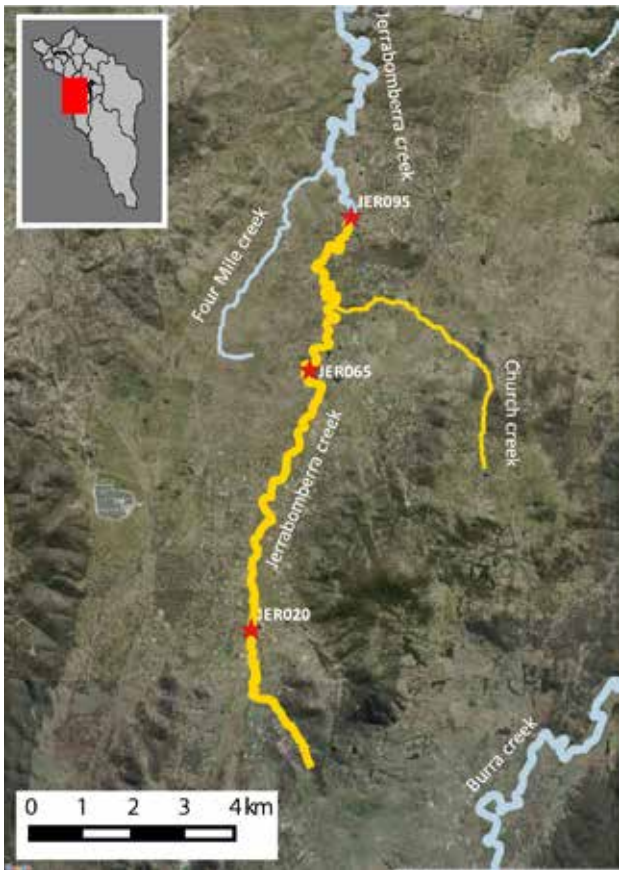
Headwaters to Fernleigh Drive

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**23**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 15km
Dominant land uses: Native bush, Rural residential,

Jerrabomberra Creek arises in the hills surrounding the rural residential area of Royalla along the south-east side of the ACT border. It has a number of small creeks flowing into it along this section of the creek. The creek channel has some healthy riparian vegetation before flowing into rural subdivisions with very little riparian vegetation.



Reach Condition

Dissolved oxygen data was included here for the first time this year and its 'degraded' score has reduced the overall result for this reach. It is notable that flows at the upper site were often high when the middle and lower sites had much lower flows. It would be interesting to know why: is it due to water extraction, stock access, evaporation or some other cause?

Electrical conductivity was concerning, but not surprising given the frequent low flows and extensive vegetation clearing on this mostly rural land. Both parent metamorphic rock and water logged discharge areas contribute to generally high electrical conductivity, and sodic soils make it subject to significant erosion.

There are plantings along some of the creek, but the majority of this reach would benefit from increased planting and fencing off stock so erosion can be reduced.

Jerrabomberra Creek downstream of the Old Cooma Road

Jerrabomberra Creek JER2

Fernleigh Park to Molonglo River confluence

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**34**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 19km
Dominant land uses: Rural residential, light industrial, urban, conservation, recreation

This reach flows from Fernleigh Park rural residential area and runs past the suburb of Jerrabomberra, the Environa development and the Hume industrial estate. It then flows through Jerrabomberra Grassland Reserve, through some rural land with little riparian vegetation, and then through to Jerrabomberra Wetlands.

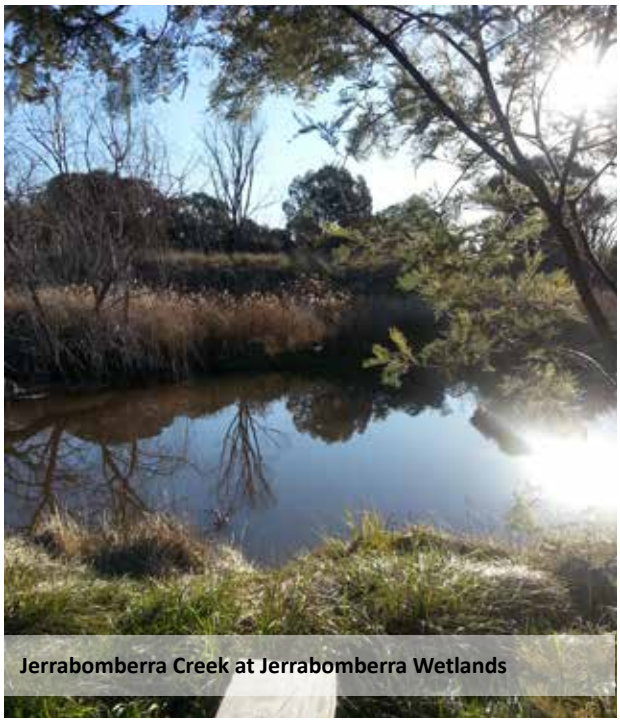
These largely artificial wetlands adjoining the Fyshwick industrial area, capture runoff and stormwater flowing into the creek. The reach also includes the ephemeral Woden Creek and Kelly's Swamp. The water in the bottom part of this reach is backed up and slowed down by Scrivener Dam, which contains the waters of Lake Burley Griffin.

Reach Condition

There were two major changes in water quality in this reach compared to last year: pH improved from 'poor' to 'excellent', and phosphorus from 'degraded' to 'excellent'. The improvement in phosphorus may be explained by the new site on the reach at Narrabundah (JER175), which reduces the skewing influence of Kelly's Swamp. This is a good thing since Kelly's Swamp is not really on the drainage line anyway unless it floods, and as a closed water body with a large population of birds, it accumulates phosphorus. In addition to the new site on Jerrabomberra Creek, the change in how we measure pH (using strips instead of probes) may have improved our confidence in this data.

There is very little riparian vegetation along most of this reach which is reflected in its 'poor' riparian condition rating. There is work continuing in the Reserve on planting and removing woody weeds so this score should improve over time.

The ACT Health Waterways (Basin Project) is planning several works in this reach to improve water quality. Platypus and Water rats are regularly sighted.



Jerrabomberra Creek at Jerrabomberra Wetlands

Lyneham Wetland LYN1

Sullivans Creek catchment off Wattle Street Lyneham

2015/16 CHIP Result C (Fair)		
2014/15 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**6**
pH	Excellent	
Turbidity	Good	
Phosphorus	Degraded	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

Reach area: approx. 1Ha
Dominant land uses: Urban

Lyneham Wetland is a large artificial wetland constructed in 2011–12 and is fed by stormwater from surrounding suburbs, including Dickson, and from the large concrete stormwater channel which flows from Dickson Wetlands. Unlike Dickson Wetlands however this is an 'online' wetland which takes all runoff including high flows following storms. Lyneham Wetland overflows into Sullivans Creek when water levels are sufficiently high.

Reach Condition

While phosphorus (P) and dissolved oxygen indicate a 'degraded' catchment, the majority of these readings were taken during the hot dry Summer/Autumn period. Both parameters improved when the rains came in June.

The water bug results at Lyneham Wetland were affected by a number of management actions during the past year. In Spring the Wetland was drained to address repairs and in Autumn, the water was pumped to Flemington Pond as part of the Inner North Reticulation Network to be used for irrigation. These events unfortunately coincided with the two bug surveys that found the usual water bug habitat of macrophytes were all above the water mark. This resulted in a greatly reduced water bug score with millions of large, orange daphnia being the main component of the Spring haul. Urban wetlands such as Lyneham were built with multiple uses in mind and getting the balance between water recycling, water quality treatment and biodiversity continues to be a challenge for managers.

Lyneham Wetland with the inlet from the Dickson concrete channel

Molonglo River MOL1

Headwaters to Captains Flat

2015/16 CHIP Result C- (Fair)		
2014/15 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**No Data**	**0**
pH	No Data	
Turbidity	No Data	
Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network length: approx. 3.5km
Dominant land uses: Conservation, grazing, rural residential

From its origins in the north western section of Tallaganda National Park in the Great Dividing Range, the Molonglo River flows north through grazing properties to Captains Flat. Apart from the uppermost section of the reach, which is wet sclerophyll forest, it is largely cleared rural land with little or no riparian vegetation.

Reach Condition

As with many reaches, water bug scores were lower this year - particularly in Autumn. This is possibly due to the low rainfall over January to March compared to last year. There was "nice diversity of mayfly, caddisfly and damselfly nymphs, but it lacked in overall diversity" which probably reflects the lack of riparian vegetation, despite some good instream habitat in this reach.

Stock can access the river, potentially damaging riparian vegetation and regrowth, causing erosion and reducing water quality, and feral deer are also frequently sighted in the area.

Pobblebonk tadpoles were observed in this reach during Spring 2015.

Water quality data is not currently collected at MOL030 and a replacement volunteer is needed for this valuable reference reach which is upstream of the Captains Flat mine.

Molonglo coordinator Deb Kellock collecting bugs on the Upper Molonglo River - November 2015

Molonglo River MOL2

Captains Flat to Travelling Stock Reserve

2015/16 CHIP Result C- (Fair)		
2014/15 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**12**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**2**
Riparian condition	**Good**	**1**

Reach Facts

Reach network length: approx. 10km
Dominant land uses: Grazing, rural residential, mining (historical)

The upstream section of this reach of the Molonglo River begins below the Captains Flat Dam. Leachate from a mine closed in the 1960s continues to contaminate the river with acid minewater and potentially with heavy metals. The Molonglo flows through mostly modified rural land and finishes at the Travelling Stock Reserve (TSR) at 'Foxlow'.

Reach Condition

Water bugs are always surprisingly bad on this reach, despite the good habitat at the TSR. We will regularly net large numbers of caddisfly, damselfly and true bugs (Hemiptera) and little of anything else. We assume this is largely because of continual seepage and historical pollution from the Captains Flat mine. It may however, also be influenced by poorer habitat and riparian vegetation in much of the area upstream, which is predominantly rural and largely cleared of vegetation.

With only one site on this reach, the riparian assessment score is not representative of the reach overall. An ongoing weed control program in the TSR and with landholders upstream, has been supported by Captains Flat Landcare.

The Waterwatch volunteers on this reach have surveyed frogs here over many years as part of the Frogwatch program. During late Winter and early Spring for the past 2 years, they have conducted more regular surveys as part of a Frogwatch climate change study to find out if frogs are regularly breeding earlier in the season.

Looking upstream in Travelling Stock Reserve

Molonglo River MOL3

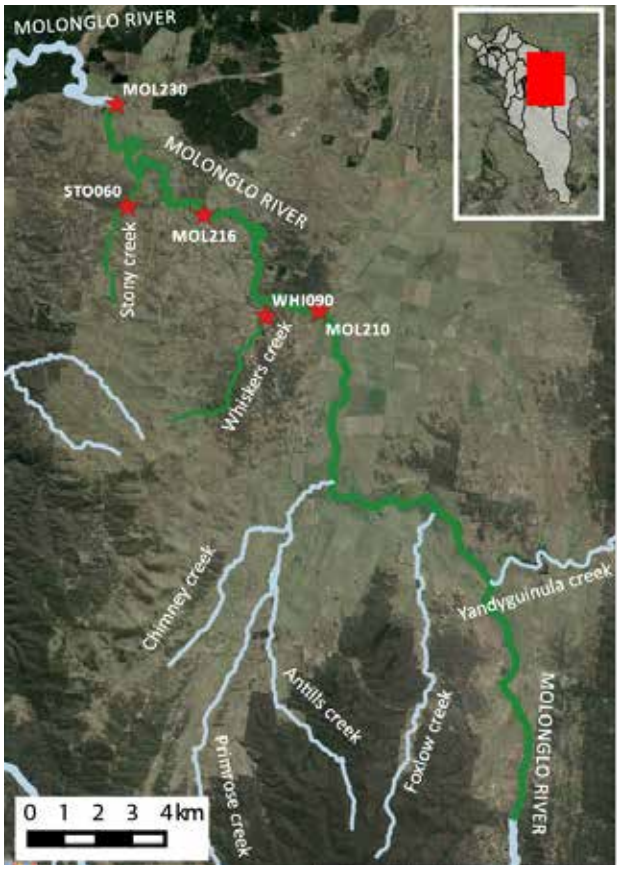
Downstream of Travelling Stock Reserve near 'Foxlow'

2015/16 CHIP Result B- (Good)		
2014/15 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**49**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Fair**	**5**

Reach Facts

Reach network length: approx. 54km
Dominant land uses: Grazing, rural residential

This reach of the Molonglo River extends from below the Travelling Stock Reserve south of 'Foxlow' to Burbong Bridge on the Kings Highway and flows through modified rural land and rural subdivisions. The reach includes Plains Creek, Whiskers Creek and Stony Creek, with runoff from the Hoskinstown Plain, which is largely treeless due to being a frost hollow. Whiskers Creek and Stony Creek are adjacent to small rural subdivisions.



Reach Condition

This year the water bugs in this reach were consistently high in diversity, which improved the overall score. All water quality parameters were the same as the previous year, with electrical conductivity and dissolved oxygen being of continuing concern. This is a long reach and includes data from Whiskers Creek and Stony Creek with their higher electrical conductivity results that are from geology as well as historical land clearing. That said, the influence of these creeks on the overall results for the reach is not large.

Revegetation work by local groups including Hoskinstown Landcare and Carwoola Landcare has been undertaken for many years, but there are still significant lengths of this reach with little vegetation or dominated by exotic vegetation. The Molonglo River Rescue project in 2010–11 focussed on weed control and improving river habitat in a 20km stretch from Briars Sharrow Road to Burbong Bridge.

Eastern gambusia is seen in high numbers throughout this reach.

Molonglo River at Briars Sharrow Rd crossing

Molonglo River MOL4

Downstream of Burbong Bridge to Queanbeyan River confluence

2015/16 CHIP Result C+ (Fair)

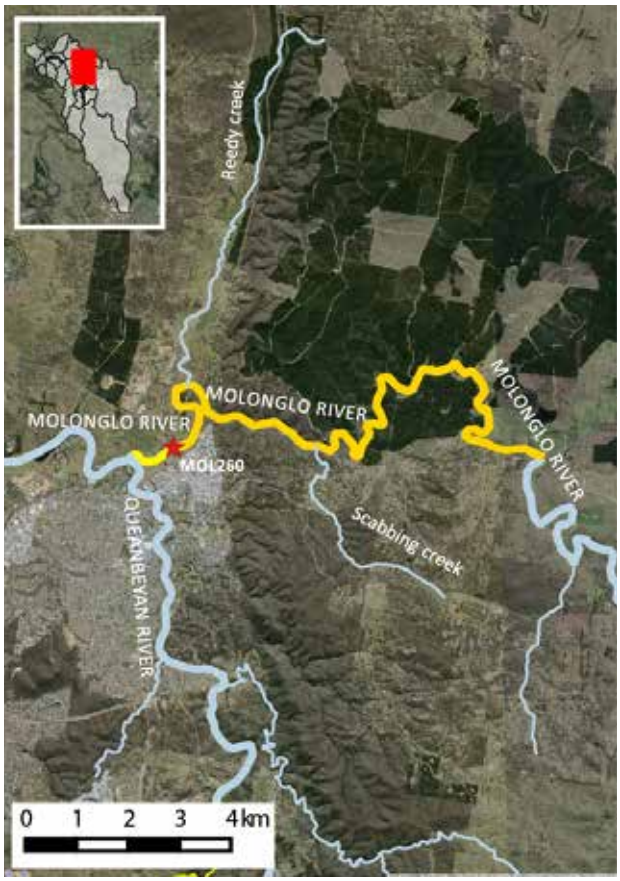
2014/15 CHIP Result C- (Fair)

Parameter	Rating	No. Survey
Water quality	**Good**	**7**
pH	Excellent	
Turbidity	Good	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Fair	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network length: approx. 16km
Dominant land uses: Grazing, rural residential, forestry, conservation, urban

This reach begins downstream of the Kings Highway at Burbong Bridge on the NSW/ACT border, passes through the southern section of Kowen Forest pine plantation, and through Molonglo Gorge with its intact native vegetation, and ends above the Molonglo River's confluence with the Queanbeyan River at Oaks Estate.



Reach Condition

The reach score has water quality data included this year, thanks to an existing volunteer taking on an additional site. The overall water quality score was quite good, although electrical conductivity was poor, as it is down the entire Molonglo River as a result of geology, historical land clearing and current impacts from land use.

The Molonglo Gorge is not far upstream from the water testing site at the bottom of this reach. Dissolved oxygen was far better here than on upstream reaches, reflecting the positive impacts from the intact riverine conditions of the gorge, which is steeper and rockier with generally good riparian vegetation.

The water bug score is in the top 5 for reaches in the greater Molonglo catchment, with the good instream vegetation present at the site assisting greatly. The water bugs, together with water quality, has resulted in a welcomed improvement in the overall score for this reach.

Top: Volunteer John Bisset looking for water bugs
Bottom: Molonglo River upstream of Yass Road bridge

Molonglo River MOL5

Upstream of Lake Burley Griffin

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**22**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Excellent	
Water bug	**Poor**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 10km
Dominant land uses: Urban, industrial, horticulture, grazing

This section of the Molonglo River begins at its confluence with the Queanbeyan River at Oaks Estate, continues on past Fyshwick industrial estate and Pialligo nurseries, close to Canberra airport, then passes an extensive turf growing business. It forms the northern boundary of Jerrabomberra Wetlands Nature Reserve before entering Lake Burley Griffin.

Much of the water in this part of the Molonglo River is backed up and slowed down by the presence of Scrivener Dam at the bottom of Lake Burley Griffin.

Reach Condition

While water quality rated as some of the best in the Molonglo catchment, there were some episodes of low dissolved oxygen during the hot, dry Summer and high turbidity following significant rain events.

Water quality in this reach is also impacted by the backed up water from Lake Burley Griffin which results in reduced flow rates.

Water bugs were better than the previous year, but still rated as 'poor'. There were a dominant number of the tolerant true bugs (order: Hemiptera) observed such as water boatman that can take oxygen from the air and have the advantage of being able to fly to other waterways. The bug results reflect the generally poor riparian and instream vegetation and episodes of poorer water quality.

Small numbers of Platypus and Water rats are seen regularly in this reach.

Molonglo River at Oaks Estate bridge after floods in June 2016

Molonglo River MOL6

Lake Burley Griffin to Murrumbidgee River confluence

2015/16 CHIP Result B- (Good)		
2014/15 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**19**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**3**
Riparian condition	**Fair**	**4**

Reach Facts

Reach network length: approx. 26km
Dominant land uses: Urban, grazing, conservation

This reach on the Molonglo River has been extended this year from directly downstream of Lake Burley Griffin to the Murrumbidgee River confluence. With the addition of three new sites, it includes the new and future Molonglo Valley urban developments, the new Molonglo River Reserve, Coppins Crossing picnic area and the Lower Molonglo Water Quality Control Centre (LMWQCC) just above the confluence.

This reach will be targeted by the ACT Healthy Waterways (Basin Project) with works aimed at improving water quality.

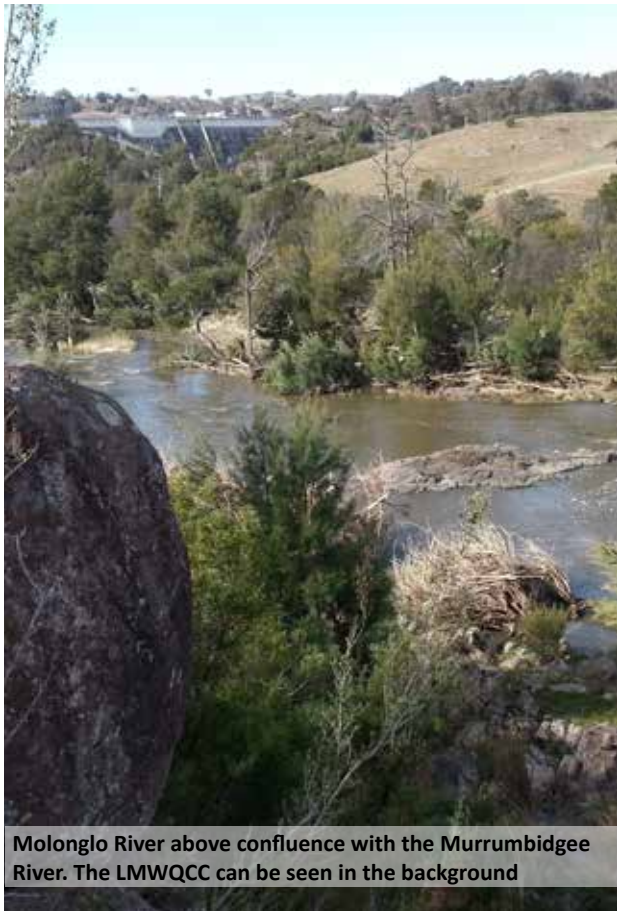
Reach Condition

The extension of this reach has resulted in additional sites pushing the water quality score down and the riparian vegetation score up slightly.

We had discontinuous data for all four sites, with the training of new volunteers. Dissolved oxygen may have been disproportionately affected by seasonal differences in the data collected, resulting in a 'degraded' score. The lowest site, below the LMWQCC, had very high nitrates (23 – 50 mg/L) when compared to the rest of the catchment. This is a management strategy to curb blue green algae growth. This site also contributed the highest electrical conductivity readings.

Monitoring of this reach is very important given the future projected population of 55,000. The planned riparian plantings and involvement of community in looking after the new Molonglo River Reserve will be a vital part of maintaining the condition of this reach.

Platypus have recently been seen in this reach.



Molonglo River above confluence with the Murrumbidgee River. The LMWQCC can be seen in the background

Primrose Creek PRI1

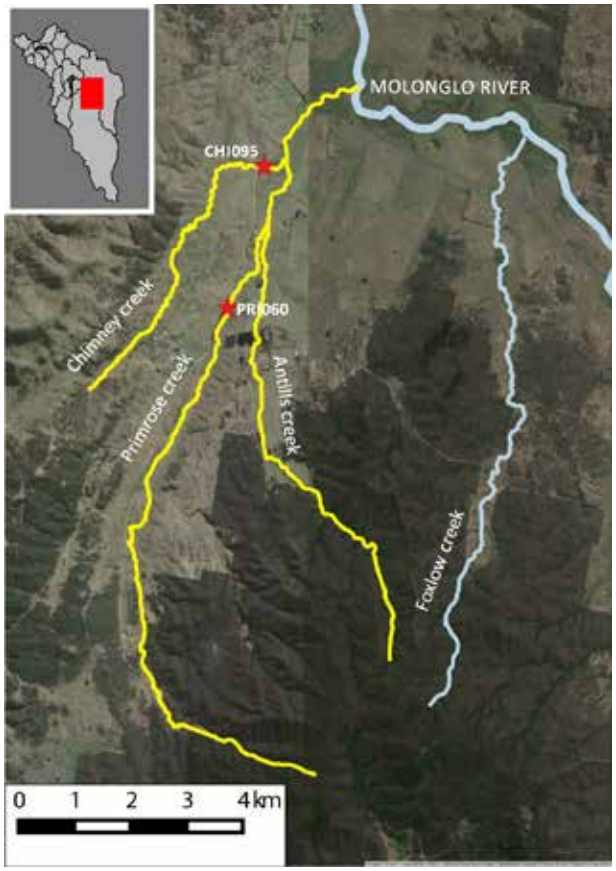
Headwaters to Molonglo River confluence

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**16**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Good	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 34km
Dominant land uses: Conservation, grazing, rural

Primrose Creek is a chain of ponds with headwaters in Yanununbeyan State Conservation Area and Mount Foxlow. It includes Chimney Creek and Antills Creek, and flows into the Molonglo River near Carwoola. The lower section of Primrose Creek is slightly incised. There is little or no riparian vegetation except at the headwaters of Primrose Creek and Antills Creek. The reach flows mostly through rural land.



Reach Condition

There was very little change between last year and this in water quality in this reach except dissolved oxygen, which moved from 'excellent' to 'good'. This is probably because flows were low for the majority of the testing. Electrical conductivity indicated a 'degraded' reach, however this too is likely linked to ongoing low flows, indicating that local geology and hydrology are playing a role here.

We sampled water bugs on this reach for the first time and found a good diversity and surprising numbers of bugs considering the site is a small creek, with the Spring water bug survey being particularly good. We also saw a diversity of other water life including a long necked turtle, and the volunteer here has previously identified Mountain galaxias, a small native fish.

With its generally excellent water quality, this appears to be a small but important piece of biodiversity in the area, despite the very poor riparian vegetation throughout much of the reach.

Chimney Creek - looking upstream

Queanbeyan River QUE1

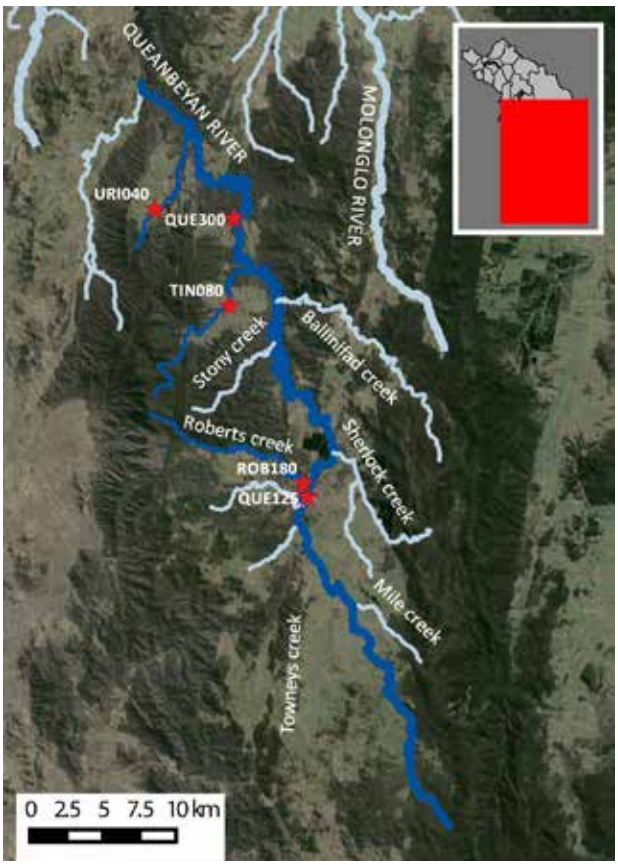
Upstream of Googong Dam

2015/16 CHIP Result A- (Excellent)		
2014/15 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**57**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
Water bug	**Good**	**2**
Riparian condition	**Good**	**4**

Reach Facts

Reach network length: approx. 143km
Dominant land uses: Conservation, grazing, rural residential

The upper section of the Queanbeyan River is a extensive stretch of river that runs from its origins on the southern slopes of the western Tinderry Ranges to Googong Dam. The reach includes Sherlock Creek, Urialla Creek, Tinderry Creek, Roberts Creek and Bradleys Creek.



Reach Condition

The water quality score for the reach was the best in the entire Molonglo catchment. With two sites on the Queanbeyan River and two on ephemeral rural tributaries, overall dissolved oxygen may be disproportionately affected on this reach when flows are low.

With little rain over a hot Summer and Autumn, volunteer Sandy noted: “Despite a long, dry spell, the river is running strongly”. This is characteristic of reaches with well-vegetated upper catchments, where vegetation and soils act as sponges which soak up water and release it gradually. Sandy also said: “[An] abundance of various animal prints in the sand point to a dependence on river as local creeks are dry.”

The Spring water bug survey, conducted on the lower site on this reach, provided the only ‘excellent’ water bug rating in the Molonglo catchment, with good numbers of very sensitive water bugs found. Riparian vegetation is also better on this reach than many other reaches in the catchment, with the most downstream site having one of the highest scores for this type of vegetation - dry eucalypt woodland.

Top: Sandy at her farm ‘Sunnybrae’
Bottom: The Queanbeyan River (QUE300)

Queanbeyan River QUE2

Downstream of Googong Dam to city of Queanbeyan

2015/16 CHIP Result B (Good)		
2014/15 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**30**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Fair	
Water bug	**Good**	**2**
Riparian condition	**Fair**	**4**

Reach Facts

Reach network length: approx. 6.7km
Dominant land uses: Urban, rural residential

This section of the Queanbeyan River extends downstream from Googong Dam to the edge of Queanbeyan city. Googong, Montgomery and Gorge Creeks near the Googong township, feed into this reach as well as Valley Creek flowing out of Cuumbuen Nature Reserve. Googong Creek (GGG1) is treated as a separate reach in this report.

Reach Condition

Although the overall score for this reach hasn't changed from last year, water quality overall has dropped slightly. This is due in part to degraded electrical conductivity (EC) results from the inclusion of sites from Gorge Creek and the more ephemeral Montgomery Creek. Whether the high EC is due to parent rock and minerals or is influenced by the Googong township development upstream is difficult to say. We do not have data prior to the development but EC has been consistently high (≤ 840 µS/cm) on Gorge Creek since monitoring began three years ago.

One volunteer in this reach has recorded several high turbidity events over the last 2 years and has been successful in influencing better sediment management of the ongoing development at Googong township. Problems with sedimentation, however, have continued to occur sporadically. This is of particular concern given the Platypus population living on this reach and their reliance on good water bug habitat to provide sufficient food sources.

Doeberl Reserve

Queanbeyan River QUE3

Queanbeyan city to Molonglo River confluence

2015/16 CHIP Result C (Fair)		
2014/15 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**18**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Degraded	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 9.4km
Dominant land uses: Urban

This section of the Queanbeyan River extends through the city of Queanbeyan to its confluence with the Molonglo River. It takes in runoff from Queanbeyan and its suburbs (including a golf course), the Cuumbuen Nature Reserve and the eastern slopes of Mt Jerrabomberra. The reach includes Barracks Creek and the Queanbeyan Weir.

Reach Condition

pH moved from 'fair' to 'excellent', probably resulting from a change in our testing method (from probes to strips) improving confidence in this data. Electrical conductivity rated as 'degraded' again this year, however all the highest readings are from Barracks Creek with possible causes being local geology and hydrogeology, as well as urban runoff. Likewise, the 'degraded' nitrates (N) is generally attributable to Barracks Creek, although N readings crept upwards on the Queanbeyan River which is something to watch as urbanisation upstream increases.

Dissolved oxygen again rated as 'excellent' this year, which is a pleasing result, with only one other reach in the catchment (also on the Queanbeyan River) matching this.

We plan to recruit a volunteer to sample water quality at the bottom of this reach (only water bug and riparian assessments were conducted at QUE495), so results next year should be less influenced by the small volume of water from Barracks Creek.

Platypus continue to be regularly sighted in good numbers in this reach.

Railway bridge over Queanbeyan River (QUE495)

Scabbing Flat Creek SCA1

Headwaters to Kings Highway

2015/16 CHIP Result DD (Data Deficient)		
2014/15 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**No Data**	**9**
pH	No Data	
Turbidity	No Data	
Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
Water bug	**No Data**	**0**
Riparian condition	**Fair**	**1**

Reach Facts

Reach network length: approx. 5.1km
Dominant land uses: Conservation

Scabbing Flat Creek is an ephemeral creek which arises in Cuumbeun Nature Reserve. Most of the creek catchment is in the Nature Reserve, which is high value Grassy Box Woodland, bisected by Captains Flat Road. The Kings Highway marks the northern edge of the reserve and the creek flows in a concrete culvert under the Kings Highway, where it eventually flows into the Molonglo River beyond this reach.

Reach Condition

There were not enough water quality records this year because seven of the nine survey records report Scabbing Flat Creek as 'dry'. SCA1 will not have a CHIP score because the creek is too ephemeral to sample water bugs.

Riparian condition was assessed as 'fair', being at its worst close to the Kings Highway culvert, and rapidly improving upstream in Cuumbean Nature Reserve.

Scabbing Flat Creek near the Kings Highway

Sullivans Creek SUL1

Headwaters to Randwick and Flemington Road Pond, Mitchell

2015/16 CHIP Result D+ (Poor)

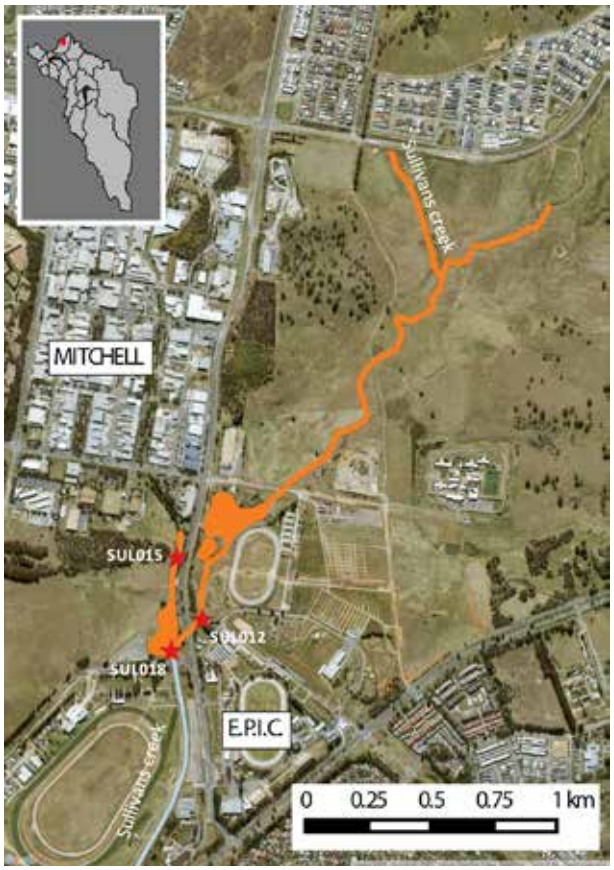
2014/15 CHIP Result C+ (Fair)

Parameter	Rating	No. Survey
Water quality	**Poor**	**16**
pH	Degraded	
Turbidity	Excellent	
Phosphorus	Degraded	
Nitrate	No Data	
Electrical Conductivity	Degraded	
Dissolved Oxygen	No Data	
Water bug	**Degraded**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

Reach network length: approx. 6km
Dominant land uses: Conservation, grazing (historical), industrial

Sullivans Creek originates in Goorooyarroo Nature Reserve, flows through historical grazing land then into a concrete channel. It then flows through the new suburb of Kenny, west of Watson, and adjoins the industrial area of Mitchell where it includes the stormwater channel from Exhibition Park (EPIC) and flows through two constructed wetlands.



Reach Condition

Upper Sullivans Creek received the worst overall score in the Molonglo catchment this year. This resulted in part from a lower water bug score than last year.

Water quality was assessed as the worst in the catchment. While not all parameters were measured, with the low flows over much of the year at the two concrete drain sites, the 'poor' result is not surprising. The site at the constructed wetland generally had better water quality than the 'drain' sites with both high electrical conductivity (≤ 830 µS/cm) and phosphorus (≤ 0.25 mg/L).

Sullivans Creek is an ephemeral creek collecting runoff from a large area, much of it degraded ex-rural land, new development and light industrial. Thus, adverse water quality impacts are to be expected. Extensive plantings planned for Goorooyaroo Nature Reserves (at the top of this catchment) as part of the 20 Million Trees program may play a role in improving this sub-catchment.

Sullivans Creek near Exhibition Park

Sullivans Creek ANU SUL3

Lyneham Wetland to Lake Burley Griffin confluence

2015/16 CHIP Result B- (Good)		
2014/15 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**28**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

Reach network length: approx. 3.7km
Dominant land uses: Urban, recreation

This section of Sullivans Creek flows into a concrete channel through playing fields and parklands in O'Connor and Turner. It crosses under a number of minor roads and through the Barry Drive gross pollution trap before entering ANU campus. It passes Toad Hall pond, before continuing through the campus and flowing into Lake Burley Griffin.

Reach Condition

This is the downstream end of a highly urbanised catchment, so 'degraded' or 'poor' scores for phosphorus, dissolved oxygen and electrical conductivity are not surprising.

Lower Sullivans Creek had identical scores for all water quality parameters and for water bug scores compared to last year. This is perhaps driven by the lowest site on the reach (SUL765) which is heavily influenced by Lake Burley Griffin where water from the Lake backs up into the creek.

Despite some good instream habitat, there was a predominance of pollution tolerant water bugs found in the two surveys. Riparian vegetation is 'fair' for this reach but only one of the three sites has been surveyed, so further assessments are required to give a more complete picture for the next report.

Native Western carp gudgeon were captured in this reach during the Autumn water bug survey. Introduced Carp have also been observed breeding in the lower section of the Creek on the ANU campus.

The ever-reliable Tim Yiu of ANUgreen Sustainability who monitors all 3 sites on SUL3

David Street Wetland SUW1

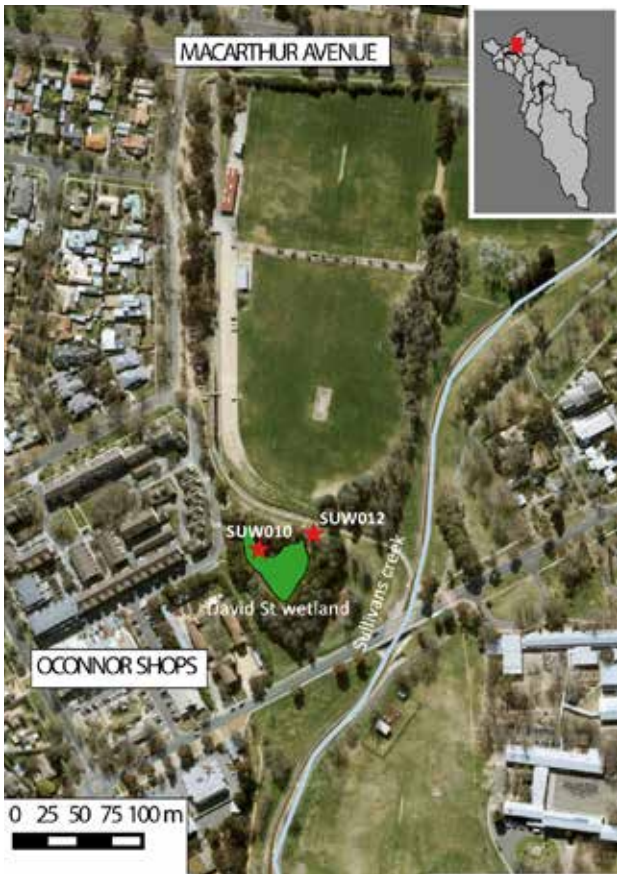
Sullivans Creek catchment in O'Connor

2015/16 CHIP Result B (Good)		
2014/15 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**12**
pH	Good	
Turbidity	Good	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	No Data	
Water bug	**Poor**	**2**
Riparian condition	**Good**	**1**

Reach Facts

Reach network length: approx. 0.21Ha
Dominant land uses: Urban, recreation

David Street Wetland is the 2nd 'offline' wetland along the westerly branch of Sullivans Creek which flows in a concrete stormwater channel. This wetland was constructed in 2001 and takes low flows which pass through the wetland then overflow back into the westerly concrete channel just before it joins the main northern branch.



Reach Condition

As the oldest of the inner urban wetlands, this lovely looking wetland is surrounded by trees which are out-shading the water plants and edge vegetation, and this may be impairing wetland function. One passerby also explained during a water bug survey that the same variety of water birds no longer frequent the wetland because they can't land through the trees.

Very low flows over a hot Summer and dense algal growth made it extremely difficult to sample for water bugs, so the Autumn survey was not representative of the usual high diversity of water bugs at this wetland.

Water quality may sometimes be affected by the popularity of this wetland, with the volunteers Vidya and Amar observing that there was "a big dog swimming in the wetland" at the time of sampling.

Vidya and Amar at David Street wetland in O'Connor

Banksia Street Wetland SUW2

Sullivans Creek in O'Connor

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**No Data**	**0**
pH	No Data	
Turbidity	No Data	
Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
Water bug	**Fair**	**1**
Riparian condition	**Fair**	**1**

Reach Facts

Reach network length: approx. 0.2Ha
Dominant land uses: Urban, recreation

Banksia St is an artificial 'off-line' wetland constructed in 2010 which includes an ephemeral section. Low flows are diverted from the westerly arm of Sullivans Creek concrete channel, pass through the wetland, then overflow back into the westerly channel when water levels are sufficiently high.

Reach Condition

The single water bug survey, conducted in Spring 2015, indicated reasonable diversity of water bugs, with the majority being pollution tolerant. High algae growth was also noted.

This attractive wetland has a great selection of riparian, edge and submergent plant species that was initially planted by the Banksia Street Wetland Carer Group. It was designed with an ephemeral zone which dries out when flow and rainfall are low. Small native fish including Western Carp gudgeon were also introduced to improve biodiversity and enhance wetland functioning, and six different species of frogs have been recorded at the wetland by Frogwatch volunteers since 2010, as well as sightings of yabbies and various water birds.

Waterwatch is keen to recruit volunteers to sample water quality at this wetland, which has not been tested this year.

Banksia Street wetland in O'Connor

Watson Wetlands and Ponds WAT1

Justice Robert Hope Park to Aspinall Street

2015/16 CHIP Result B- (Good)		
2014/15 CHIP Result D (Poor)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**29**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**3**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network length: approx. 1.4km
Dominant land uses: Conservation, urban

Watson Wetlands and ponds on the lower western slopes of Mt Majura comprise a drainage line, with two dams in remnant yellow box/red gum grassy woodland which overflow during high rainfall. Further down, a small constructed wetland receives runoff from the adjacent suburb, and a small wetland "soak" takes overflows at the bottom of the reach, with water then flowing via pipes into Sullivans Creek.

Reach Condition

The overall score for Watson Wetlands and ponds has improved considerably. Last year there was insufficient water quality data to provide a score, but this year's score makes it one of the best 5 reaches in the Molonglo catchment. Dissolved oxygen was the exception and was very low but this is generally the case when there is limited flowing water.

Water bugs were sampled at three sites and were much improved on last year with high bug numbers and taxa richness.

The sites in this reach are fairly disparate with only some of them connecting even when flows are high and ponds are overflowing. Thus, sampling water quality and water bugs at multiple sites on the reach provides a more accurate picture. The lowest site, WAT040, is the only one with a riparian assessment completed so conducting these at the other sites would also improve our understanding.

Volunteer Richard Larson at WAT040 near Aspinall Street

Weston Creek WES1

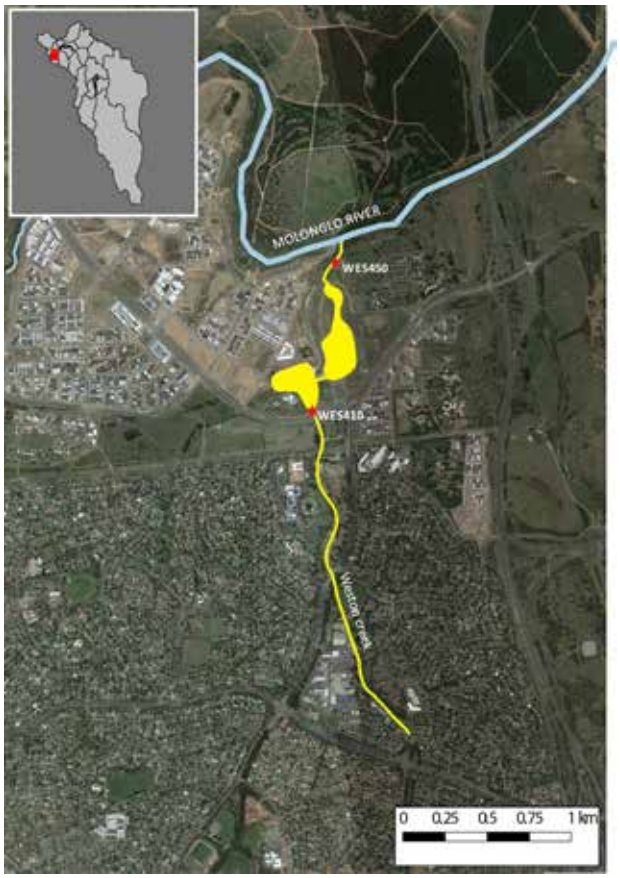
Headwaters to Molonglo River confluence

2015/16 CHIP Result C (Fair)		
2014/15 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**13**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Degraded	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 6.7km
Dominant land uses: Urban

Weston Creek reach includes drainage from the western side of Mt Taylor, and Stirling Ridge. It flows in a concrete stormwater channel through the Canberra suburban area of Weston Creek before entering ponds south-east of the new Molonglo development. Some Weston Creek water flows into underwater storage. It then passes close to the new Molonglo development's eastern side and on to the confluence with the Molonglo River.



Reach Condition

Although most of this reach flows through concrete stormwater drains, the lower section has some rock armouring to reduce erosion, is partially planted, and has a small reed patch as well as exotic trees. A new site above the Molonglo River confluence has improved the riparian assessment score slightly this year.

Water quality in this reach is extremely variable, particularly phosphorus and electrical conductivity. The North Weston Pond site has experienced eutrophication where you get a combination of high nutrient levels from urban runoff and warm temperatures lead to high levels of algae and bacteria (a 'bloom'). The 'bloom' then uses up all the nutrients, resulting in a mass die off of algae/ bacteria. Their decomposition resulted in extremely low dissolved oxygen and high phosphorus at this site, and made the water noticeably smelly.

As with similar urban catchments, flows can vary considerably, with evidence of short term and very high flows after heavy rain.

North Weston Pond in the new Molonglo development

Woolshed Creek WOO1

Headwaters to Molonglo River confluence

2015/16 CHIP Result C (Fair)		
2014/15 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**36**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 19km
Dominant land uses: Rural, urban, site of Majura Parkway

Woolshed Creek originates at a farm dam situated over a Spring at the top of the catchment. It flows through highly modified rural land with some native riparian vegetation in the higher section and some significant waterholes. Two short sections of the creek were moved to make way for Majura Parkway.

The creek joins the Molonglo River near Fairbairn Avenue, just upstream of Lake Burley Griffin. Lower Woolshed Creek has an important fossil site.

Reach Condition

The lowest site on this reach was in the immediate vicinity of the extensive road and bridgeworks from the Majura Parkway and the area was exposed to fumes and dust. Although the water bugs at this site include high numbers of pollution tolerant taxa such as true bugs (Hemiptera) and freshwater snails, it lacks overall diversity with an absence of sensitive species. This resulted in a 'poor' water bug rating this year, dropping the overall score.

Water quality in the reach was very similar to last year, and electrical conductivity continues to be concerning, with minor seasonal saline outbreaks in land adjacent to the drainage line. This is an ephemeral creek, however, and low flows have a big impact on measured water quality and groundwater plays an important role. The waterholes along the creek provide important habitat, retaining water when the creek ceases to flow.

The feral fish Eastern gambusia and Redfin perch were both caught during water bug surveys.

Woolshed Creek looking upstream

Yandyguinula Creek YAN1

Headwaters to Molonglo River confluence

2015/16 CHIP Result B (Good)		
2014/15 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**18**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**2**
Riparian condition	**Good**	**2**

Reach Facts

Reach network length: approx. 18km
Dominant land uses: Conservation, grazing, wetlands

Yandyguinula Creek is an ephemeral tributary of the Molonglo River, with the confluence on 'Foxlow' near Hoskinstown. It arises in Tallaganda National Park on the western side of the Great Dividing Range, and flows into modified rural land with little or no riparian vegetation other than Willows. Near its confluence with the Molonglo River, it passes through an extensive wetland area which supports a significant bird population.

Reach Condition

This creek has one pristine forest site upstream and one in rural land which is largely cleared of vegetation. The upper site had the highest riparian condition score in the Molonglo catchment, being a great example of intact wet Eucalypt forest.

Water quality is one of the best in the Molonglo catchment, with only dissolved oxygen being of concern, though this was mainly during warmer, low flow periods. Water bugs improved slightly this year. There was good diversity and 100+ damselflies in both surveys but not large numbers of bugs overall. The substrate was heavily silted during the Autumn survey making it difficult to catch bugs without the net clogging up. Brown trout fingerlings and Eastern gambusia were caught during these surveys.

The volunteer on this reach went out with a Green Army team to tackle the Blackberry which was beginning to invade the lovely upper site.

Yandyguinula Creek near the Tallanganda National Park

Yarralumla Creek YAR1

Headwaters to Molonglo River confluence

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**33**
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**2**
Riparian condition	**Fair**	**3**

Reach Facts

Reach network length: approx. 9km
Dominant land uses: Conservation, urban

This is one of two main creek systems draining into the Molonglo River below Scrivener Dam. Yarralumla Creek includes three drain lines, one along the west side of Mt Mugga Mugga, one from Farrer to Phillip, and one from Long Gully to Garran. These drain lines run largely in concrete channels.

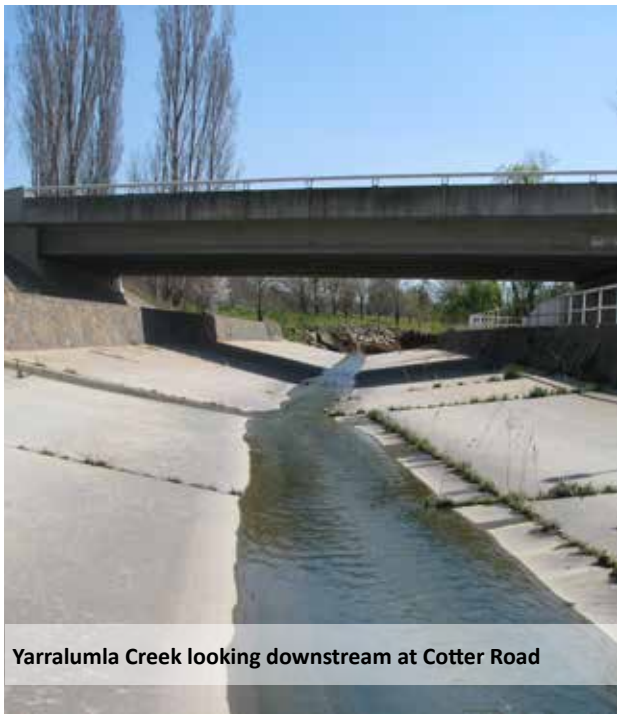
Yarralumla Creek then runs parallel with Curtin in a concrete stormwater channel then down through a deeply incised channel to the Molonglo River immediately below Scrivener Dam. The reach includes East O'Malley Pond. Yarralumla Creek is a priority catchment for the ACT Healthy Waterways (Basin Project) with works aimed at improving water quality.

Reach Condition

Water quality in this highly urbanised catchment was almost identical to last year, with electrical conductivity and dissolved oxygen of concern. With so much urban runoff in the reach flowing through concrete drains, this is not surprising.

Water bugs surveys were typical of a polluted site with pollution-tolerant snails and fly larvae present in dominant numbers. The Autumn survey was slightly better with some mayflies and caddisflies observed but overall numbers were low.

The gross pollution trap is just above the bottom site on this reach and it regularly overflows and washes rubbish downstream. This occurs with rapid changes in water flow which happens even after quite modest rainfall events. This is fairly typical of an urban catchment with many impervious surfaces. Erosion at the bottom of the reach continues to be a serious issue and improvements scheduled through Basin Project works will be welcomed.



Yarralumla Creek looking downstream at Cotter Road

Southern ACT Catchment Facts

For this CHIP report, the Southern ACT area is divided into subcatchments based around 7 main rivers/lake systems in the region which are Murrumbidgee River, Naas River, Gudgenby River, Cotter River, Paddy's River, Lake Tuggeranong and Point Hut Ponds.

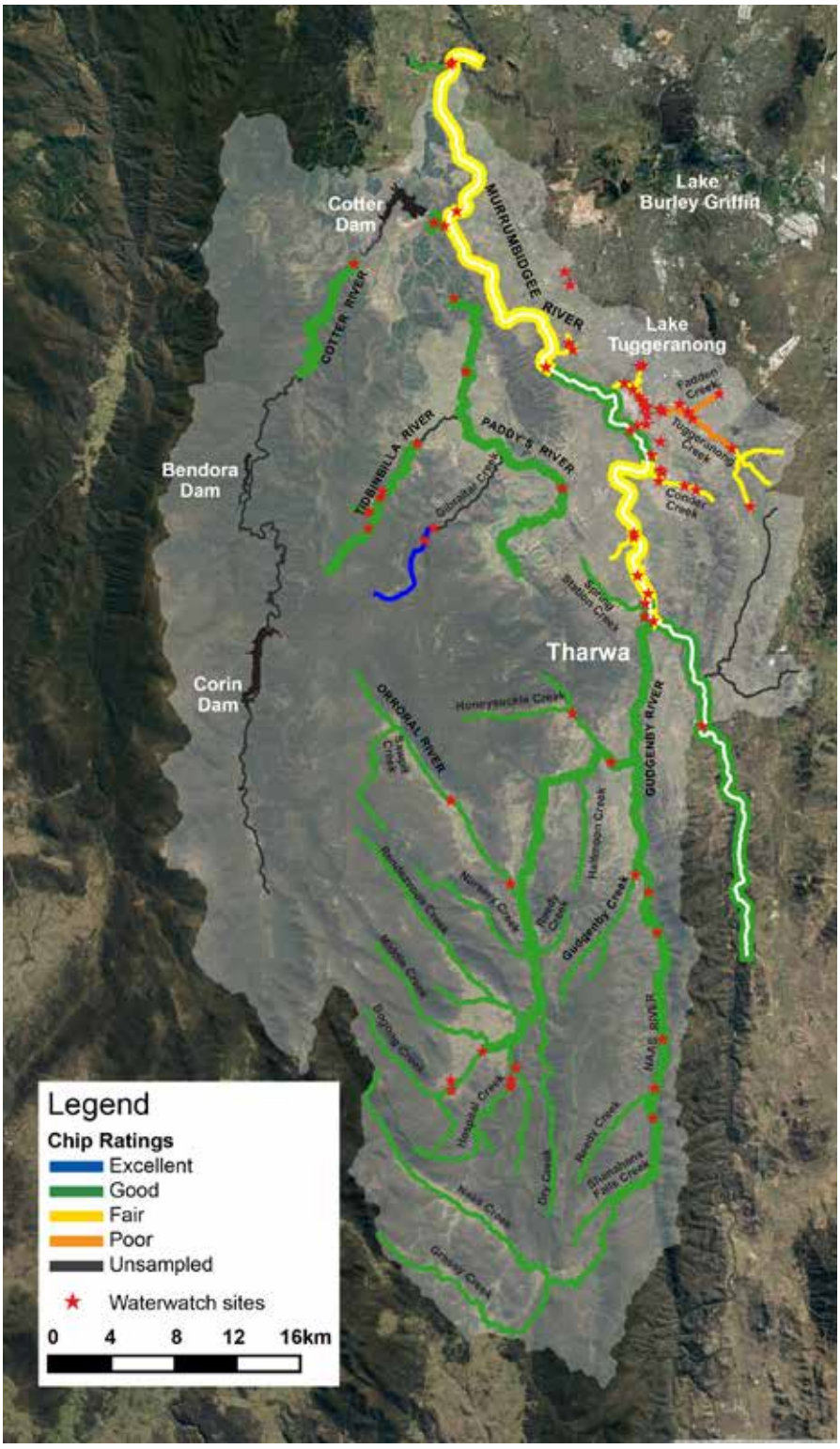
The Naas and the Gudgenby River systems are the highest in the ACT and originate in the mountains of the Namadji National Park. The Cotter River provides our main drinking supply and flows north adjacent to the Brindabella Ranges. Paddy's River is a smaller rural water way flowing to the west of the Bullen Range past forestry land and grazing properties to the immediate west of Canberra. The Lake Tuggeranong and Point Hut Ponds systems comprise predominately urban waterways flowing from the east of the ACT into the two lakes at their western ends. The Lake Tuggeranong inflows are extensively engineered with pipes and concrete channels. The Point Hut Ponds inflows are younger and feature upstream wetlands and terraced, vegetated stormwater channels.

All of these waterways join the Murrumbidgee River in the ACT, which flows north from Angle Crossing near Tharwa to Uriarra Crossing just before the Molonglo River confluence in the north west corner of the ACT. The Murrumbidgee River from Angle Crossing to Casuarina Sands is part of the Upper Murrumbidgee Demonstration Reach (UMDR)

Southern ACT Catchment Health Summary

This year the long, dry Summer encroached well into March. While this might have been great for extending the barbeque season, many of our water ways were beginning to starve of oxygen as their temperatures stayed high and cooling rainfall was in short supply. An El Niño event stretching from early last year was the major culprit. Autumn saw the climate pattern shift into a possible La Nina event giving more rain which in turn improved water quality, but led to higher turbidity levels in many waterways. The water bug sampling in Spring 2015 was more fruitful than Autumn 2016 at sites in the conservation managed areas, but little variation between seasons in urban environments.

There was heavy flooding in June. A month's worth of rain fell in one weekend. Level crossings were closed, as was access to most nature parks. A sad reminder of how dangerous these flooding episodes can be in our catchment was the tragic death of a man trying to cross the Paddy's River. Three others had to be rescued by police in the same location.



Three of the best five reaches in the Southern ACT Catchment exist in conservation managed areas. Two (Paddys River and Gudgenby River) have varying degrees of rural land use – primarily grazing. Gibraltar Creek was again the best scoring reach, and the only reach to be given an overall 'excellent' rating. Conversely, four of the worst five reaches in Southern ACT Catchment exist in heavily urban areas. These reaches in 'fair' to 'poor' condition have a range of problems with respect to water quality. Elevated turbidity and phosphorus levels occur, as well as high electrical conductivity. Dissolved oxygen saturation levels can be both low and high, which is typical of heavily impacted waterways in urban environments. In addition, a lack of instream habitat for water bugs and poor riparian condition all contribute to the poor health scores these reaches have received.

Bogong Creek Catchment CGB1

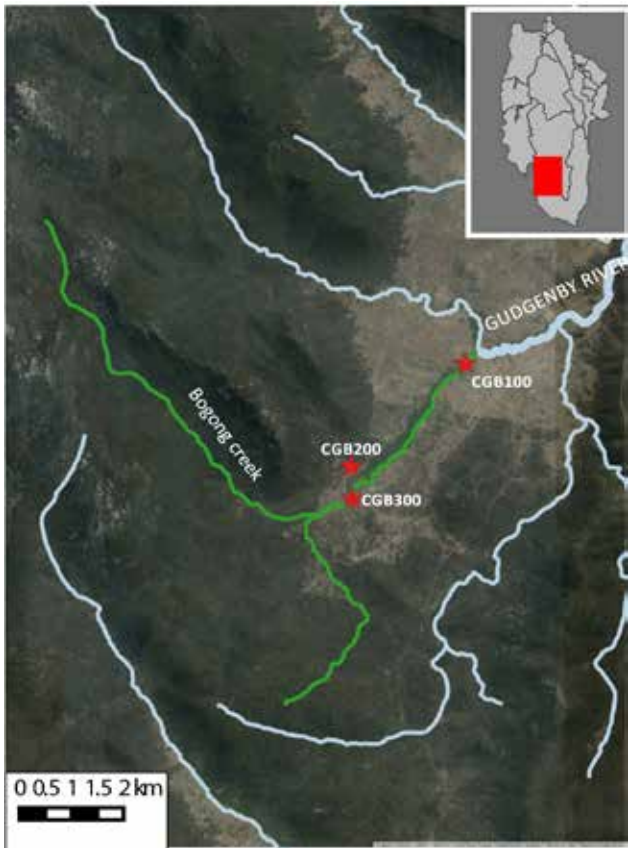
Headwaters to Yankee Hat trail bridge

2015/16 CHIP Result B (Good)		
2014/15 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**16**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Excellent**	**2**
Riparian condition	**Fair**	**3**

Reach Facts

Reach network length: approx 13km
Dominant land uses: Conservation

Part of the Gudgenby River catchment. At its downstream end Bogong Creek is a wide and mostly treeless upland creek/bog flowing north-east in the middle of Namadji National Park.



Reach Condition

Dissolved oxygen in this upland bog/creek system of Namadji National Park dropped to low levels, especially over the warmer months when low flows were experienced. Nutrient levels also have had a mild adverse effect. Overall, however, the water quality was very good and slightly better than last year.

Improvement was also seen in the water bug survey in Autumn at the Yankee Hat trail bridge site. However, while nine different bug types, including several sensitive taxa, the number of bugs detected was low, keeping the overall score at 'good'.

The riparian condition score reflects the sparse canopy vegetation which is to be expected in upland wetlands. The riparian surveys for this reach are completed annually by the growing Waterwatch team from the 'Gudgenby Bush Regenerators' Parkcare group.

Regional facilitator Woo O'Reilly on a frozen Bogong Creek (CBG100), July 2015 (Photo: G.Howard).

Gudgenby River Catchment CGG1

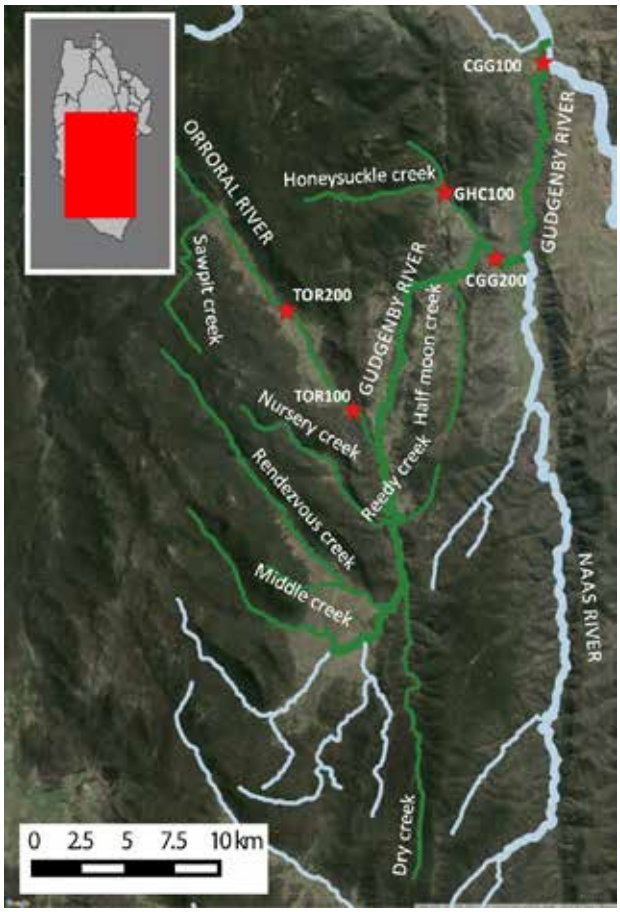
Headwaters of small creeks and Orroral River to the Murrumbidgee River confluence

2015/16 CHIP Result B+ (Good)		
2014/15 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**33**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
Water bug	**Good**	**2**
Riparian condition	**Fair**	**4**

Reach Facts

Reach network length: 22.7km
Dominant land uses: Conservation and rural grazing

This reach includes 3 branches. The main arm is the lower stretch of Gudgenby River, running mostly through rural cattle grazing properties. The Honeysuckle Creek arm runs adjacent to Apollo Road which heads up to the old Honey Suckle Creek Tracking Station site next to Namadji National Park.



Honeysuckle Creek is mostly surrounded by healthy wooded vegetation. The Orroral River section largely comprises upland bogs.

Reach Condition

The water quality readings for this reach were outstanding for the last 12 month period. Improvements were recorded in both increased dissolved oxygen and lower nitrate levels. The monitoring of the Orroral River and Honeysuckle Creek arms of this network has benefitted by the adoption of more comprehensive testing by the Outward Bound Australia program as part of their school camps program. The inclusion of additional regular monitoring at the public campsite on the Orroral River by the Green Army has improved our confidence in this data.

The water bug scores were an improvement on last year with an increased number of sensitive stoneflies detected during Spring.

There was concern raised by volunteer Deb Kellock at CGG100 over increasing erosion occurring where the Smith's Road Bridge crosses the mouth of the Gudgenby River in Tharwa. This was resolved in February through reportings to the relevant ACT Government agencies.

'Gudgenby Canyon' at Smith's Rd Bridge near Tharwa (Photo: D.Kellock)

Hospital Creek Catchment CGH1

Headwaters of Hospital, Breakfast and Little Dry Creeks to the confluence with the Gudgenby River

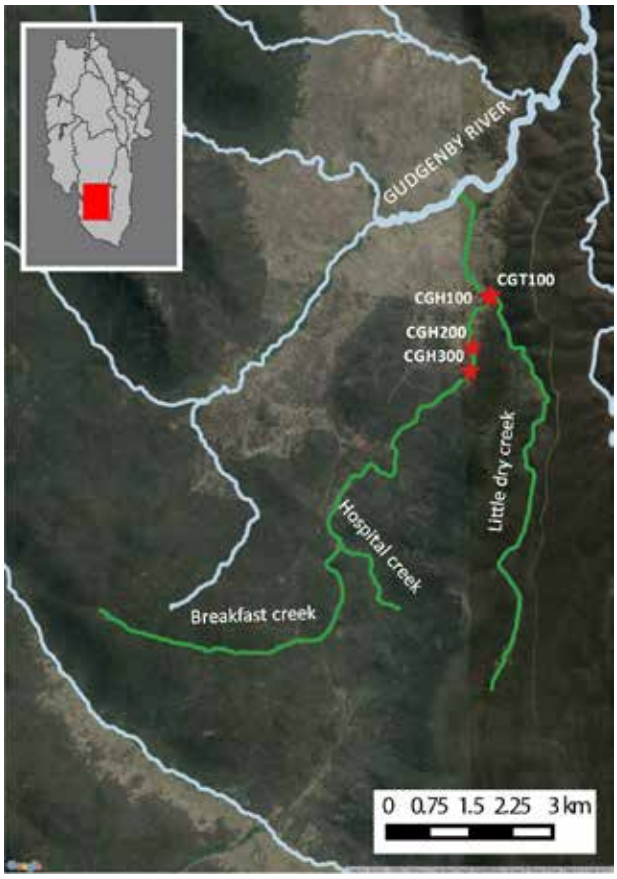
2015/16 CHIP Result B+ (Good)		
2014/15 CHIP Result A- (Excellent)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**24**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**2**
Riparian condition	**Good**	**4**

Reach Facts

Reach network length: Hospital Creek arm (on the left) 12km, Little Dry Creek arm (on right) 7km
Dominant land uses: Conservation

Hospital Creek is mostly a forested gully situated south south east of Bogong Creek. It runs north forming an upland bog before joining the Gudgenby River near its headwaters.

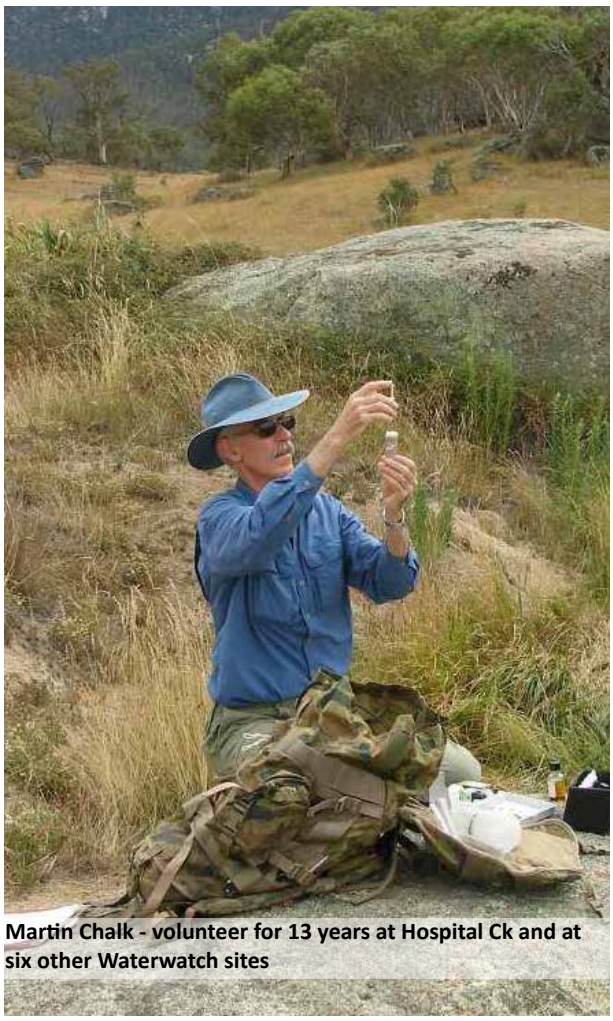
Little Dry Creek is an ephemeral arm to the east of Hospital Creek.



Reach Condition

Hospital Creek had a similar score for water quality to the last report. Oxygen levels were extremely low on a few occasions. The boggy section in the middle of Hospital Creek had a stagnant dissolved oxygen reading of 2.3 mg/L in April. This only the third time in 13 years of monitoring that Waterwatcher Martin Chalk has seen this happen. The long dry Summer which caused this also led to Little Dry Creek drying up for the first time in a few years and the rest of the reach running quite low. The higher creeks in our catchment are more susceptible to the impacts of reduced rainfall and higher temperatures than the larger rivers lower down. These areas could be viewed as the 'canaries in the coalmine' for waterway condition.

The macroinvertebrate (water bug) survey in Autumn revealed a lower diversity than in the previous year. This too could have been a result of the dry, hot Summer.



Martin Chalk - volunteer for 13 years at Hospital Ck and at six other Waterwatch sites

Murrumbidgee River CMM7

Michelago Creek confluence to Tharwa Sandwash

2015/16 CHIP Result B+ (Good)

2014/15 CHIP Result C+ (Fair)

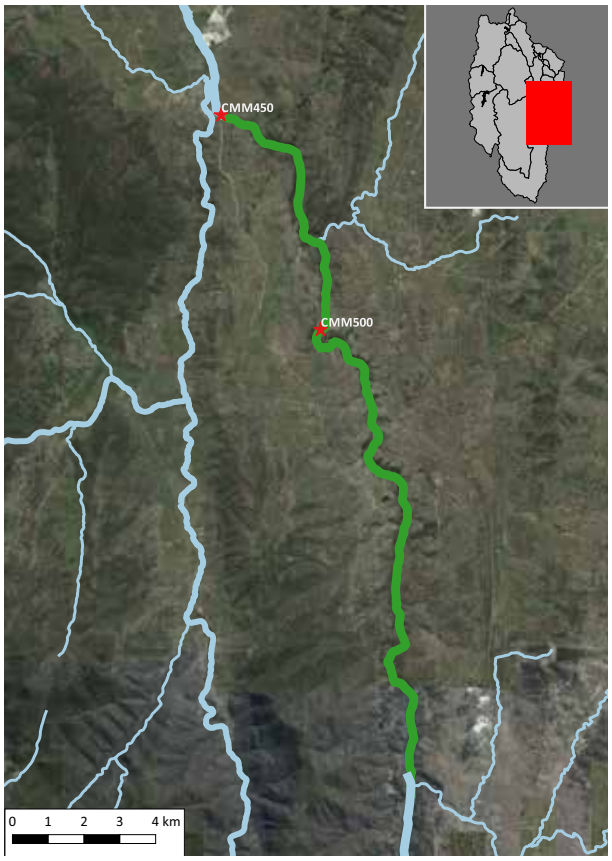
Parameter	Rating	No. Survey
Water quality	**Excellent**	**19**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Fair	
Dissolved Oxygen	Fair	
Water bug	**Good**	**3**
Riparian condition	**Fair**	**2**

Reach Facts

Reach network length: approx. 24km
Dominant land uses: Rural grazing and conservation

This stretch of the Murrumbidgee River begins at Willows Road in NSW, includes Angle Crossing on the ACT/NSW border and runs through the Gigerline Gorge Reserve in the ACT. It ends at Tharwa 'Sandwash'.

Recreational fishing is banned in ACT section and the riparian vegetation is significantly healthier than downstream around the Tharwa township.

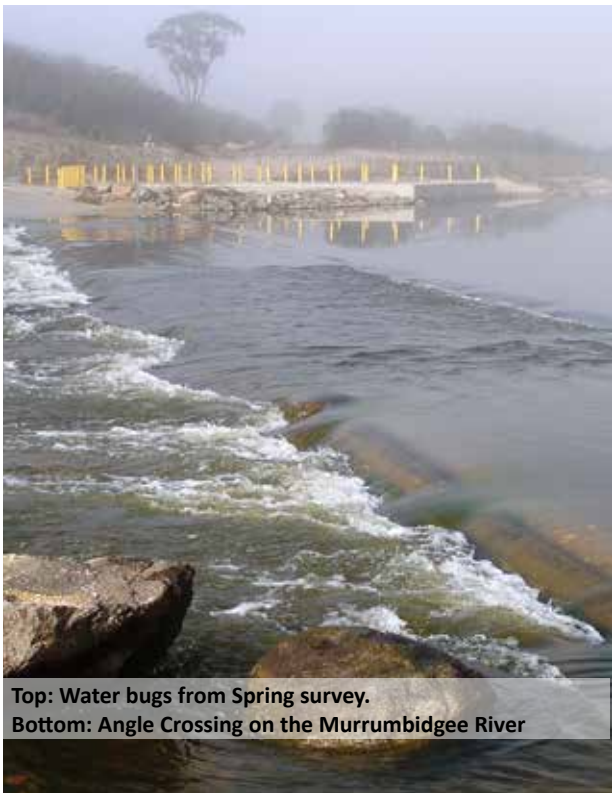


Reach Condition

The section of the Murrumbidgee entering the ACT appeared in better overall condition this year, with an improved water bug result driving up the CHIP score.

ACT Parks & Conservation Service Rangers recorded a low levels of dissolved oxygen in January.

This section of the Murrumbidgee was looking good throughout Spring with a good flush from rain in the high country experienced a month before water bugs surveys were conducted. The Spring survey received an 'excellent' result with large number of sensitive stoneflies, caddisflies and mayflies as well as freshwater mussels which hadn't been recorded in the Murrumbidgee for some years. The Autumn water bug survey was also 'good' as the river picked up from a hot dry Summer.



Top: Water bugs from Spring survey.
Bottom: Angle Crossing on the Murrumbidgee River

Murrumbidgee River CMM8

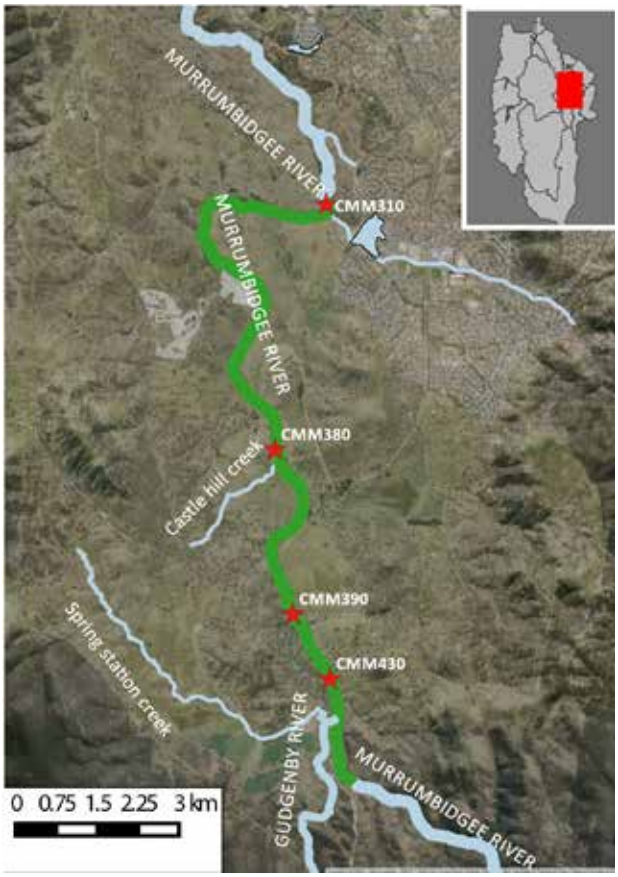
Tharwa sandwash to Point Hut Crossing

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**28**
pH	Excellent	
Turbidity	Good	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**3**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 10km
Dominant land uses: Rural grazing

This reach covers the stretch of Murrumbidgee River from Tharwa Sandwash to Point Hut Crossing. Most of the eastern bank of this reach borders Lanyon Homestead. The western bank flows past a number of properties including Castle Hill and Lambrigg Homesteads among others in the Tharwa district.



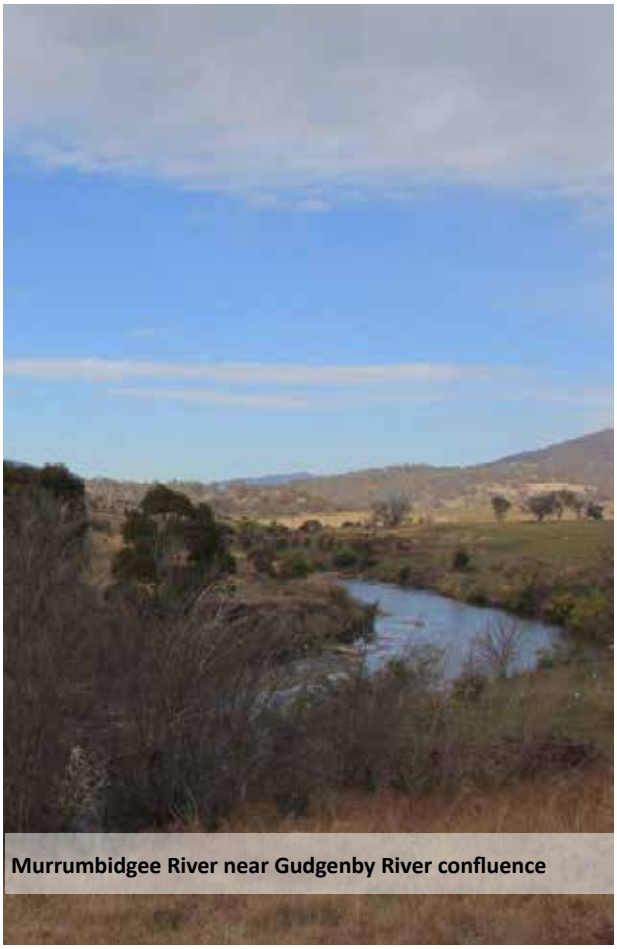
Reach Condition

In July 2015 a turbidity readings of 50 NTU were seen at Point Hut Crossing at the lower end of this reach, but there seems to be only a tenuous link between the water flow rates at the sites and the associated turbidity readings. Medium and low flows did not necessarily mean that the turbidity readings were also low. High flows records, however, usually were coupled with high turbidity readings.

Water bug surveys in Spring recorded the key sensitive taxa (stoneflies, mayflies and caddisflies) at both the Tharwa log jam and Point Hut crossing. In Autumn. however, the Point Hut crossing survey was dominated by over 250 true bugs (Hemiptera) - which are more tolerant taxa.

A single Platypus survey conducted at Tharwa in August 2015 failed to detect any Platypus or Water rats, but may be have inhibited by relatively high flows at that time.

Recent surveys by the ACT Government's Conservation and Research Unit around the Tharwa log jams have detected juvenile and adult Murray cod, suggesting that the log jams are functioning as habitat for this species.



Murrumbidgee River near Gudgenby River confluence

Murrumbidgee River CMM9

Point Hut Crossing to Kambah Pool

2015/16 CHIP Result B (Good)		
2014/15 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**21**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Fair	
Dissolved Oxygen	Fair	
Water bug	**Good**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

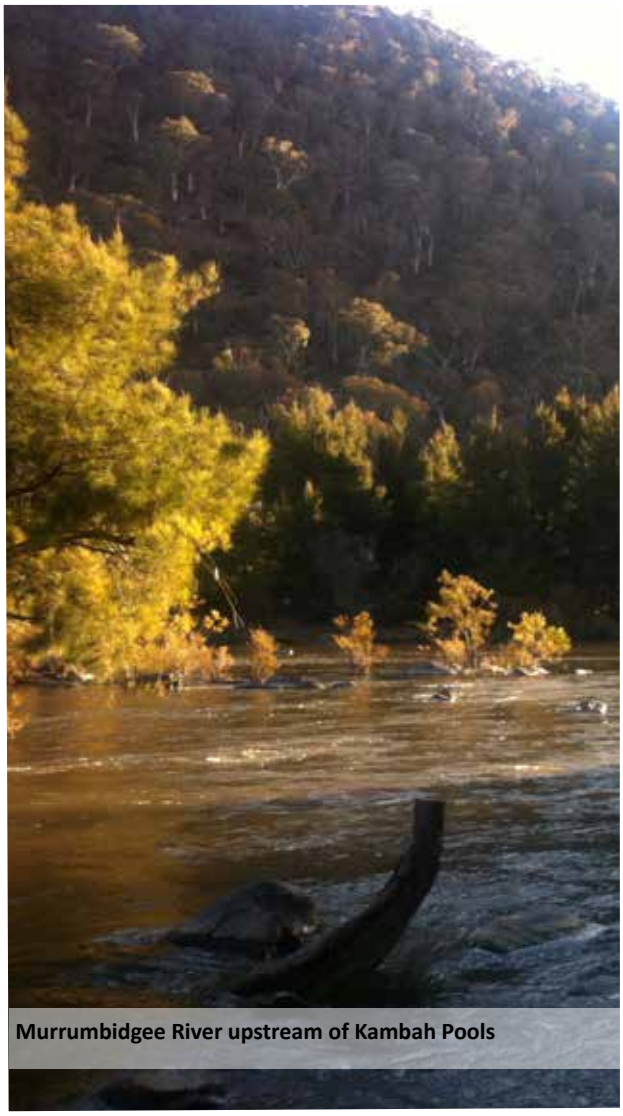
Reach network length: approx. 6.7km
Dominant land uses: Urban, conservation and recreation

This reach covers the section of Murrumbidgee River from Point Hut Crossing to Kambah Pool. Both spots are popular recreational sites. Red Rock Gorge and the confluence with Tuggeranong Creek are also within this reach.

Reach Condition

This section of the Murrumbidgee River in the ACT has the added influence of water from the Lake Tuggeranong and Point Hut Ponds catchments. In July 2015 Pine Island recorded turbidity of 50 NTU. By December, Kambah Pool was crystal clear, but experienced a turbidity spike (90 NTU) in early January. In June this year high rainfall experienced around the region drove the turbidity levels so high at Kambah Pool (400 NTU), the Green Army could not conduct the water tests that require colour comparisons. The turbidity recorded is a rare event only seen before in the Lake Tuggeranong catchment by this coordinator.

A water bug survey conducted in Spring at Kambah Pool picked up low numbers of three sensitive taxa (stoneflies, mayflies and caddisflies) while a late Summer survey at Pine Island was dominated by tolerant species..



Murrumbidgee River upstream of Kambah Pools

Murrumbidgee River CMM10

Kambah Pool to Uriarra Crossing

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**25**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Water bug	**Degraded**	**3**
Riparian condition	**Fair**	**2**

Reach Facts

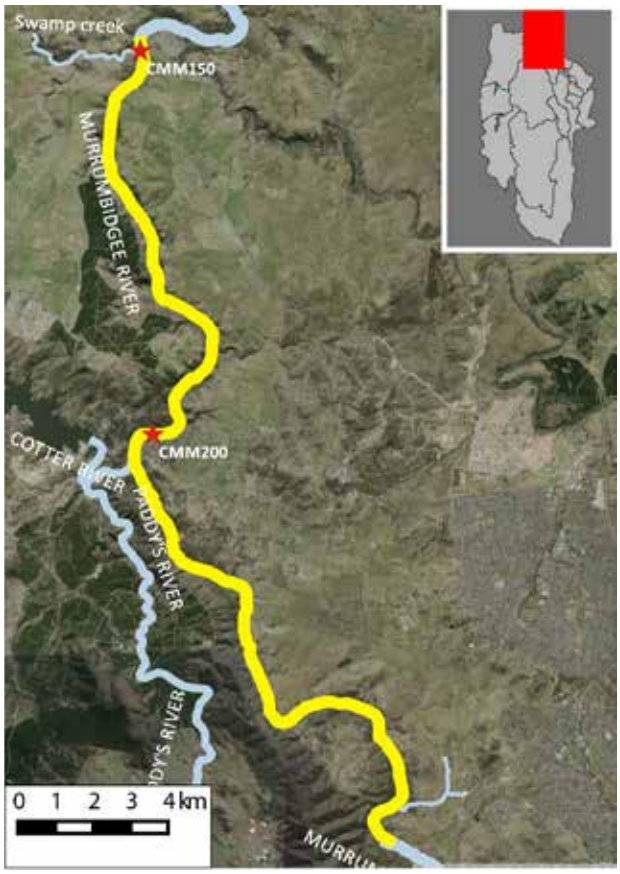
Reach network length: approx. 11km
Dominant land uses: Rural grazing, forestry, recreation and conservation

This reach covers the section of Murrumbidgee River from Kambah Pool to Uriarra Crossing. Much of this reach flows past old pine forest plantations and areas still used for grazing and farming.

Reach Condition

This section of the Murrumbidgee River experiences turbidity events and other water quality anomalies generally later than the river's higher reaches. This reach also receives inputs from both the Paddy's and Cotter Rivers entering just upstream of Casuarina Sands. The turbidity event (38 NTU) in July 2015 was the highest recorded for this reach. In May, volunteer Barbara Mackin encountered a drop in dissolved oxygen at Uriarra Crossing (3 mg/L), possibly as a result of persistently cloudy water. This was gone by June when heavy rains caused major flood damage at Casuarina Sands, and resulting increase in turbidity (30 NTU).

Wendy Rainbird of the 'Sands' group writes; "After good Winter rains, the Murrumbidgee is flowing fully. It is good to see!" Wendy also noted that some native trees had been chopped, and sand had been spread across the riparian zone, but a quick response from ACT Parks and Conservation Service' Shelley Swain provided a detailed picture of on-ground restoration works following the flood. This included smothering of lovegrass to control its spread, pruning of the Casuarinas to ensure good growth and longevity and planned replanting of the riparian zone this coming Spring.



Murrumbidgee River at Casuarina Sands (Photo: A. I'ons)

Spring Station Creek CMS1

Headwaters to Murrumbidgee River confluence

2015/16 CHIP Result B- (Good)

2014/15 CHIP Result C (Fair)

Parameter	Rating	No. Survey
Water quality	**Excellent**	**6**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Fair	
Dissolved Oxygen	Fair	
Water bug	**Fair**	**1**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network length: approx. 4km
Dominant land uses: Rural grazing

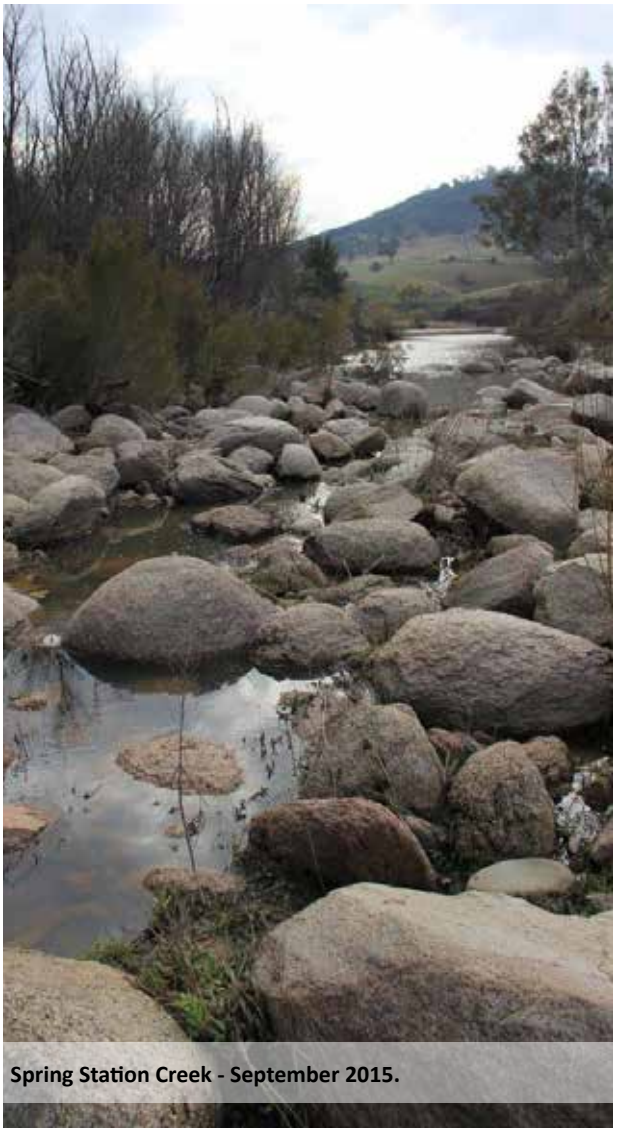
This reach covers most of this small rural creek separating a grazing property to its south and a property with high conservation value woodland to its north. This creek is immediately adjacent to the township of Tharwa. During high rain fall events it is subject to severe flooding at its lowest end where it crosses the Naas Road.

Reach Condition

This creek running under the small bridge just south of Tharwa was very clear over Summer (≤ 10 NTU) and slightly lower electrical conductivity (120 – 250µS/cm) than the previous year (≤ 400 µS/cm), possibly due to higher rainfall this CHIP period.

The macroinvertebrate (water bug) survey by students from Caroline Chisholm School in Spring collected some sensitive types including a single stonefly and caddisfly along with 40 mayflies.

The riparian condition in this reach is poor, with a narrow riparian zone with limited groundcover and canopy cover. This will remain so until significant revegetation occurs, through either natural regrowth or through planned plantings. This is not an isolated issue for a number of small, rural creeks in southern ACT.



Spring Station Creek - September 2015.

Paddy's River Catchment CTP1

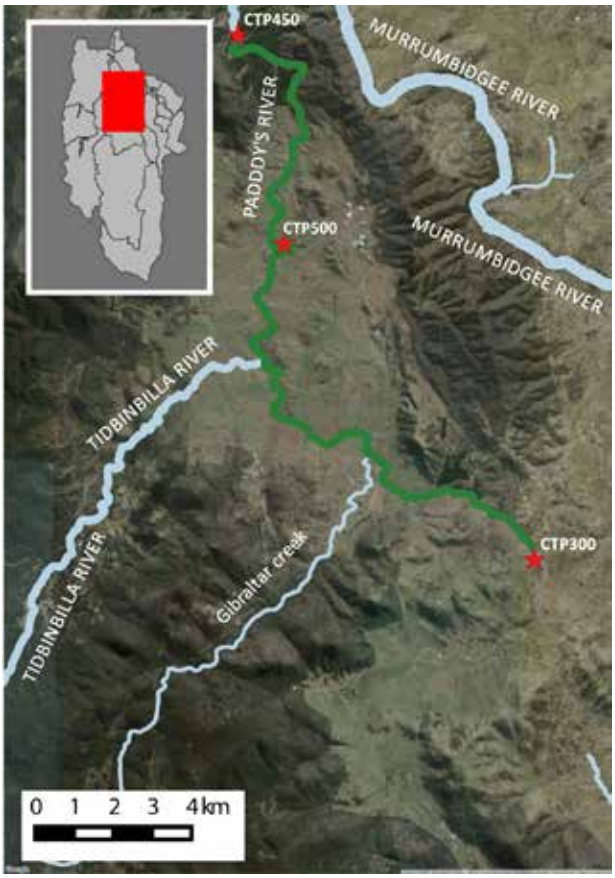
Tidbinbilla Road bridge to Murray's Corner

2015/16 CHIP Result B+ (Good)		
2014/15 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**32**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Fair	
Water bug	**Good**	**3**
Riparian condition	**Fair**	**2**

Reach Facts

Reach network length: approx. 24km
Dominant land uses: Rural grazing

Paddy's River runs mostly through active grazing properties and softwood plantations. This reach covers the section below the headwaters high up on Mt Tennant in the Namadji National Park. The river has been subject to massive erosion through large flooding events in recent years. The consequences of this soil disturbance is still significant.



Reach Condition

Paddy's River was clear with low flow volumes in early Summer. Heavy showers in later December moved a lot of sediment that was detected by PCS Ranger Bernie at Flint's Crossing in January (100 NTU). Fleur and Maree (Paddy's Waterwatch team) noted very little increase in water levels, just lots of gravel and weeds. Turbidity events from along much of the upper stretches of this River are a constant issue when there is decent rainfall. Steep unstable soils in the headwaters of the Booroomba Homestead region are a key contributor.

Water bug surveys at Murrays' Corner in Spring detected all three key sensitive taxa (stoneflies, mayflies and caddisflies), while an Autumn survey at Flint's Crossing collected large numbers of moderately tolerant beetle and fly larvae.

Paddy's River at Murray's Corner April 2016 (Photo: F.Horan)

Tidbinbilla River CTT1

Headwaters of Tidbinbilla River and Ashbrook Creek to Gilmores Road crossing

2015/16 CHIP Result B (Good)		
2014/15 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**49**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**6**
Riparian condition	**Good**	**5**

Reach Facts

Reach network length: approx. 8.5km
Dominant land uses: Conservation, tourism and rural grazing

This reach covers most of the Tidbinbilla River and the adjacent artificial wetlands (the Sanctuary). Most of the river is in the Tidbinbilla Nature Reserve and has significantly recovered from a catastrophic bush fire 11 years ago. Ashbrook Creek is a small upland creek running from the top of the reserve past the Hanging Rock Aboriginal shelter site.

Reach Condition

The CHIP score reflects a trade-off between the good water quality of the upper creeks and lower river and the often poor water quality of the Sanctuary, where water is diverted to fill the pond system.

Tidbinbilla River was recorded as mostly low and clear last Summer by the Friends of Tidbinbilla Parkcare team. Although there had been a lot of brief rain high up in the reserve in late December, the lower parts of the river remained dry. Both the upper creeks and the Sanctuary remained low in Summer too

The readings of concern for Tidbinbilla Nature Reserve this year all came from within the Sanctuary that showed signs of not getting a decent flush. In March this year, the monitored pond at the end of the system, recorded slightly acidic, turbid water with elevated levels of phosphorus. The monitoring point at the middle of Tidbinbilla River also had twice the acceptable level of phosphorus during the same month.

Gary from Friends of Tidbinbilla monitoring Tidbinbilla River. (Photo: F.Spier)

Gibraltar Creek GIB1

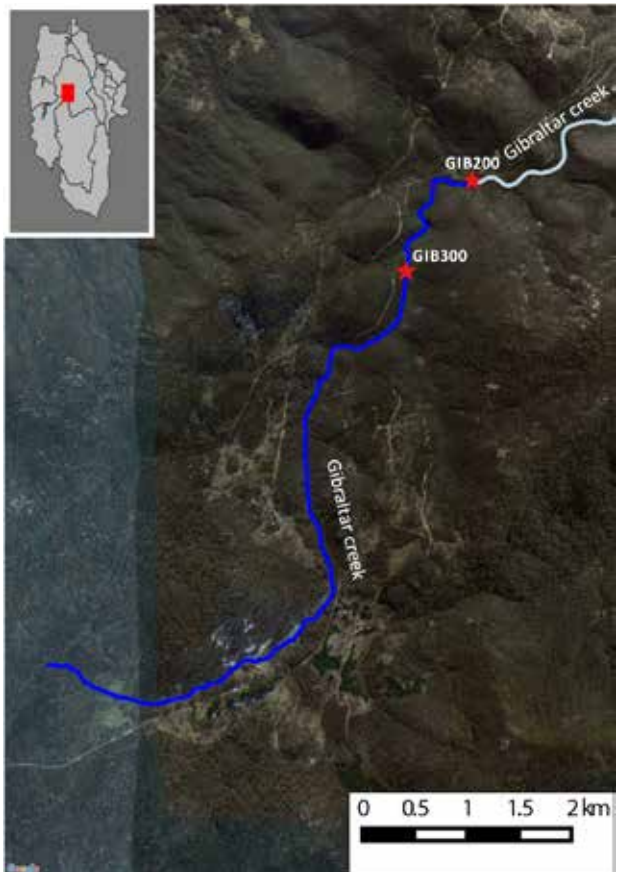
Headwaters to Woods Reserve

2015/16 CHIP Result A+ (Excellent)		
2014/15 CHIP Result A- (Excellent)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**21**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
Water bug	**Excellent**	**2**
Riparian condition	**Excellent**	**2**

Reach Facts

Reach network length: approx. 8.5km
Dominant land uses: Recreation and forestry.

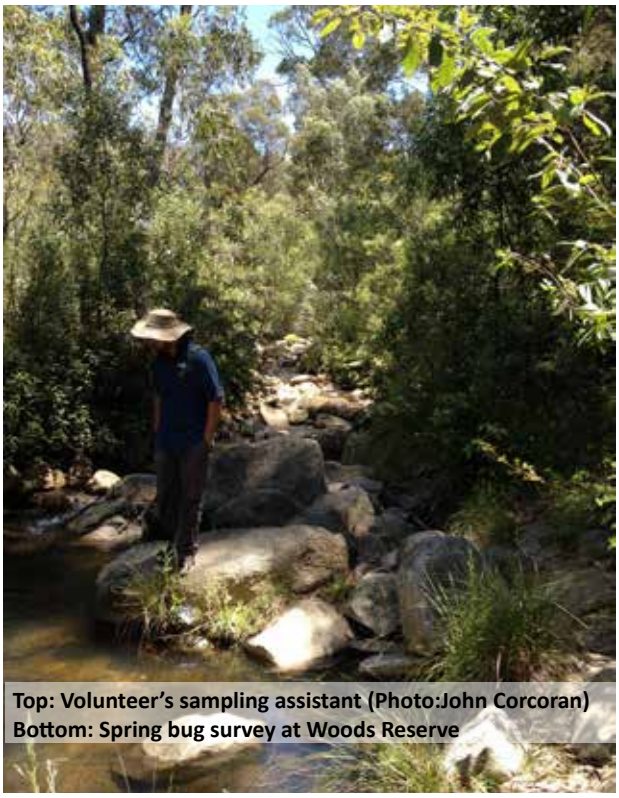
Gibraltar Creek is a small stream running from near Corin Dam and flowing east to Paddy's River. The upper sections have stretches of upland bog habitat. Most of the surrounding land was used for softwood plantations up until the 2003 bushfires.



Reach Condition

'Practically perfect in every way', to quote Mary Poppins. Scoring 'excellent' last year, this reach has managed to appear even better in the last 12 months and is the standout or 'reference' reach for the Southern ACT Catchment. All measures show a creek that continues to benefit from reduced pubic access to much of its surrounding land by the construction of locked gates or by blocking with boulders, at the entrance to many of the old forestry roads. This has reduced or stopped 'recreational' driving through the upland bogs and illegal dumping in the many out of sight side nooks.

The Corin Forest area still has a major overnight campsite at Woods Reserve, a public access waterfall reserve and a popular commercial recreation facility that surround the top of Gibraltar Creek. That this catchment continues to remain in such good health is heartening evidence that recreation and suitable access can be compatible with ecological wellbeing.



Top: Volunteer's sampling assistant (Photo:John Corcoran)
Bottom: Spring bug survey at Woods Reserve

Swamp Creek LMS1

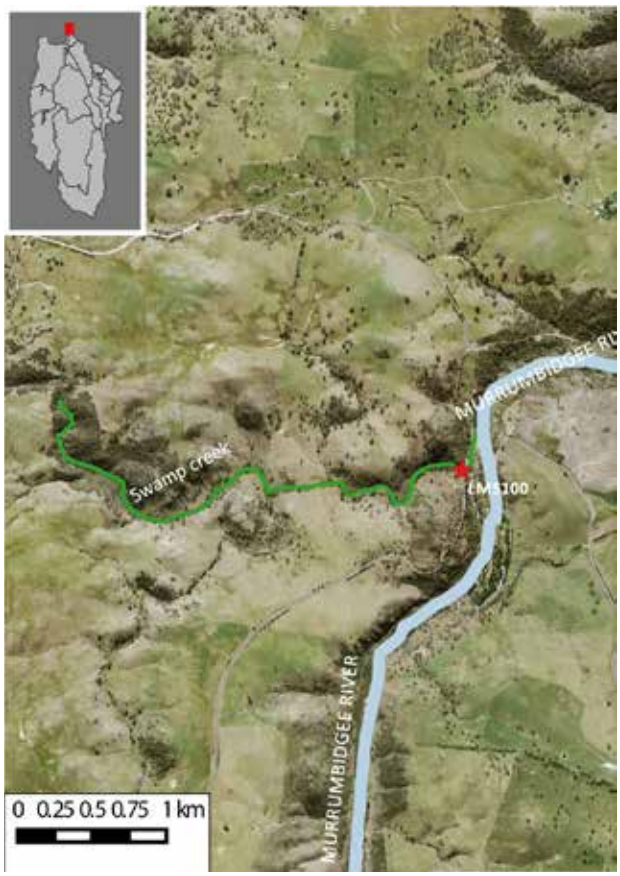
Uriarra Creek confluence to Murrumbidgee River Confluence

2015/16 CHIP Result B (Good)		
2014/15 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**10**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**1**
Riparian condition	**Fair**	**1**

Reach Facts

Reach network length: approx. 1.5km
Dominant land uses: Rural grazing.

Swamp Creek is an ephemeral creek running through Uriarra Homestead. It intersects with Uriarra Creek 1km upstream to the west and flows under the Fairlight Road into the Murrumbidgee River next to Uriarra Crossing. Old maps name the stretch of creek to Murrumbidgee 'Uriarra Creek'. Signage at the reserve refer to it as Swamp Creek. We have opted for the latter.



Reach Condition

Barbara Mackin, from Uriarra Parkcare, found this little creek running crystal clear again this year, with the exception of a single survey of 20 NTU, which she described beautifully: "First time I hadn't seen the bottom of the turbidity tube".

Both nitrates (0 – 1 mg/L) and phosphorus (0 – 0.03 mg/L) levels were very low and dissolved oxygen levels fell to low levels in Summer and Autumn (54 – 74 % saturation). This can be attributed to a longer, warmer Summer season than last year that extended well into March and increased the temperatures of many waterways. No reprieve was given as flow ceased from March to May in response to the brief El Nino weather event.

Members of University of Canberra's Environmental Science Society conducted a bug count last Autumn finding 8 water bug types. While they found over 100 water mites, the overall diversity and abundance was low.

Swamp Creek (Photo: Barbara Mackin)

Cotter River MCC1

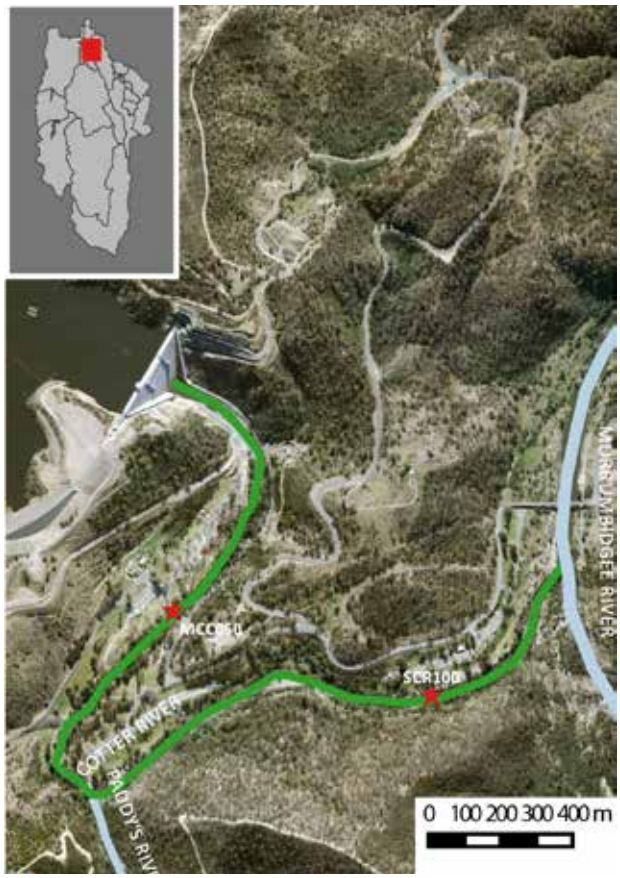
Cotter Dam to Murrumbidgee River confluence

2015/16 CHIP Result B (Good)		
2014/15 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**13**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
Water bug	**Fair**	**2**
Riparian condition	**Good**	**2**

Reach Facts

Reach network length: approx. 2.5km
Dominant land uses: Recreation

This reach covers the relatively short stretch of the Cotter River below the Enlarged Cotter Dam. It includes the confluence with the Paddy's River at Blundell's Flat and terminates at the confluence with the Murrumbidgee River. Water flowing through this reach is heavily influenced by water from the Murrumbidgee River that is regularly pumped from the Cotter Pumphouse to the base of the dam wall.



Reach Condition

The bed of the lower Cotter River downstream of the Cotter Dam is usually coated with a dull brown diatom silt resulting from constant low flows. Last year's CHIP report describes the effect this has on the aquatic environment for water bugs and this problem is not isolated to this reach. This was the case in this reach for most of the last 12 months as low flows from the Cotter Dam are maintained under licence agreements.

The difference in water bug ratings this year reveals some quite interesting connections. From late last Winter to early Summer, water was being released at a higher rate than normal from the Cotter Dam for fish spawning requirements. When volunteers did their monitoring they naturally noted the higher flows. They also recorded a dramatic change in the algae present, from diatoms to 'blanket weed'. The water bug survey in October then found stonefly larvae for the first time in many seasons. So the removal of the diatom crust which makes the river bed uninhabitable for the very sensitive stoneflies saw their welcomed return in Spring.

Cotter River at the Cotter Campground. (Photo F Horan)

Cotter River MCC2

Pipeline Road Crossing to Vanity's Crossing

2015/16 CHIP Result B- (Good)		
2014/15 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**9**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**1**
Riparian condition	**Fair**	**1**

Reach Facts

Reach network length: approx. 11km
Dominant land uses: Drinking water catchment, Conservation

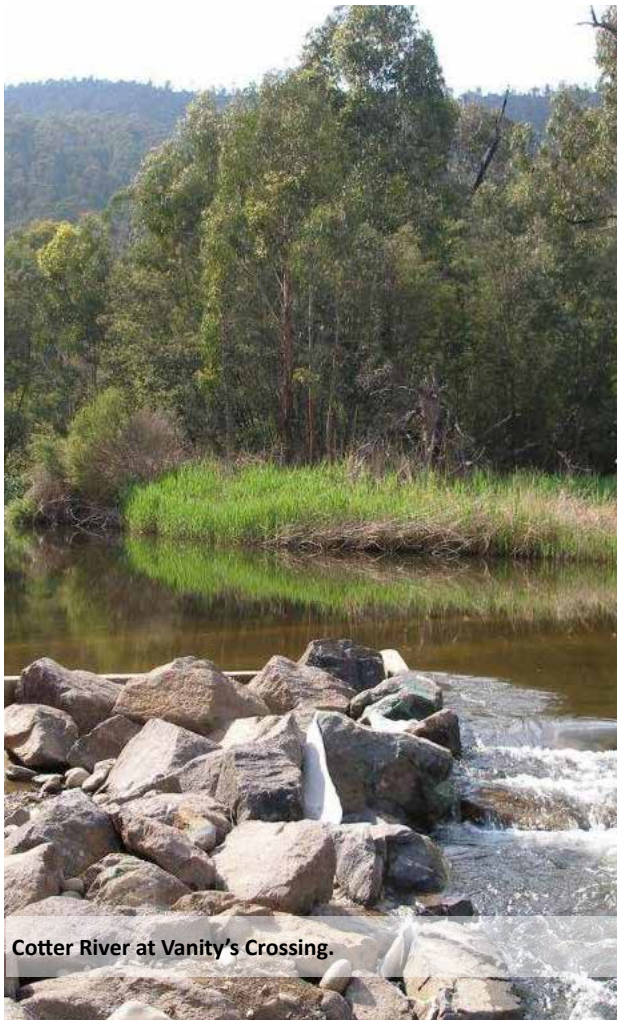
This reach runs along the stretch of the Cotter River between the Cotter and Bendora Dams. Vanity's Crossing is the only current Waterwatch site and sits just upstream of the tail of the Enlarged Cotter Dam. This section of the Cotter has restricted access for vehicles and is heavily monitored and managed by Icon Water and the ACT Government.

This is due to this area being a significant part of the ACT's water utility as well as having a remnant population of the endangered Macquarie perch.

Reach Condition

ACT Parks and Conservation Service Rangers reinstated monthly monitoring at this important sight last Spring at Vanity's Crossing. Turbidity in this flow-regulated reach was generally low (≤ 10 NTU), however, a single survey reported turbidity of 100 NTU immediately following of 52 mm rain falling in the preceding 24 hours.

Long periods of low and moderate flows (< 50ML/day) allow algae and sediment to appear in this reach, which in turn may impair the water bug diversity and abundance. Approximately 300 caddisfly larvae and 50 mayfly nymphs were collected in the Autumn bug survey, but no stoneflies were present. Sedimentation in particular may be a continuing effect of the 2003 bushfires that completely burnt this reach.



Cotter River at Vanity's Crossing.

Barney's Gully MMB1

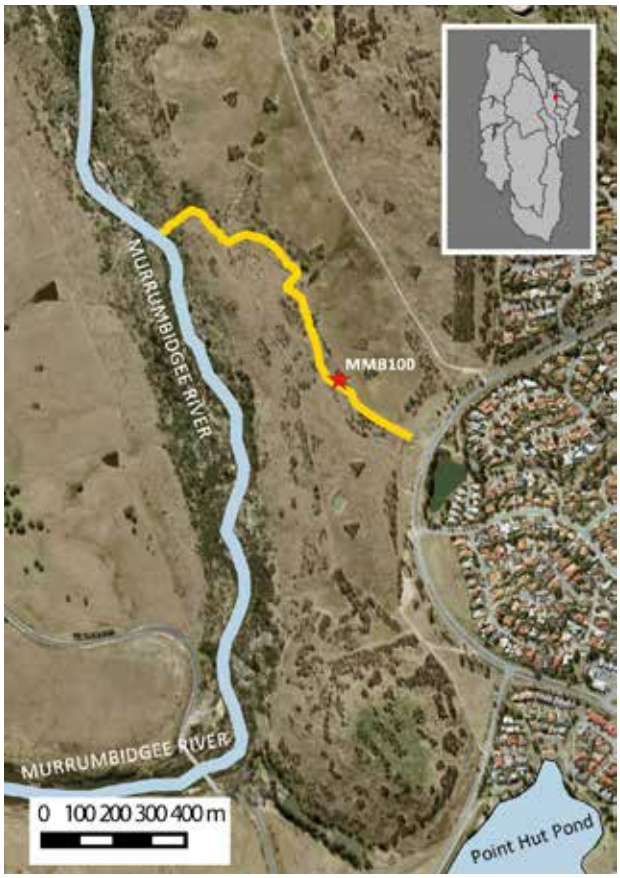
Woodcock Drive, Gordon to confluence with Murrumbidgee River

2015/16 CHIP Result C (Fair)		
2014/15 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**8**
pH	Excellent	
Turbidity	Good	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

Reach network length: approx. 1km
Dominant land uses: Peri urban, conservation and recreation

Barney's Gully is an ephemeral creek off Woodcock Drive, Gordon. This natural creek is connected to the suburban stormwater system of the suburb of Gordon and flows into the Murrumbidgee just over a kilometre downstream of Point Hut Crossing.



Reach Condition

This natural creek line provides a good comparison to other 'creeks' in the suburban Tuggeranong region that have been engineered into stormwater channels that terminate in artificial ponds and lakes. Low flows and stagnant water conditions were reported which is typical for this ephemeral creek. Of concern was the reporting by volunteer Deb Kellock, from the Parkcarers of Southern Murrumbidgee (P.O.S.M) group, of an oily brown gunk on the water's surface, and milky brown water of 35 NTU of unknown origin.

Remedial work by P.O.S.M have had an enormous postive impact. High turbidity after heavy rain used to be an issue with the fragility and exposure of much of the surrounding soil but this is less the case now. Abundant reeds and groundcover support multiple species of frogs that are regularly reported calling in this reach.

Barney's Gully - October 2015 (Photo: D. Kellock).

Point Hut Ponds MPG1

Headwaters of Conder Creek to Murrumbidgee River confluence

2015/16 CHIP Result C- (Fair)		
2014/15 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**55**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**3**
Riparian condition	**Poor**	**4**

Reach Facts

Reach network length: approx. 2.5km
Dominant land uses: Urban

Conder Creek arises in the Rob Roy Nature Reserve and flows into Point Hut Pond. Point Hut Pond is a sediment control pond in the suburb of Gordon. Together they make up a stormwater system that has been engineered with flow reduction and verge vegetation to reduce negative impacts from suburban runoff.

The water from this system then flows into the Murrumbidgee River just downstream of Point Hut Crossing.

Reach Condition

Overall water quality and CHIP scores for this reach are identical to last year. Continuing issues exist with persistent elevated turbidity levels (up to 160 NTU), some of which may be caused by wind action. Nitrate levels are also problematic at times (≤ 10 mg/L).

Other issues identified over the last 12 months include strange smells in December, high phosphorus levels from January to March, clogged drains in January, and a stagnant gross pollutant trap (GPT). Steve from 'Carers of Point Hut Pond' Waterwatch noted the continued garnish of a submerged motorcycle at the southern end of the lake while Vera Kutz found the GPT under Box Hill Avenue very stagnant.

A single mayfly was sampled during the water bug survey in Spring; otherwise water bug samples consisted of low numbers of tolerant taxa, congruent with the water quality issues observed.

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Conder Creek off Tom Roberts Drive, Conder. (Photo V Kurz/J Marriott)

Stranger Pond MSP1

Stranger Pond in North Bonython

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result D+ (Poor)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**14**
pH	Good	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**No Data**	**0**

Reach Facts

Reach network area: approx. 4Ha
Dominant land uses: Urban.

Stranger Pond is the small lake to the south of Lake Tuggeranong providing similar stormwater treatment for the suburb of Bonython. Overflow enters the Murrumbidgee River at Pine Island Reserve.

Reach Condition

An additional site at the main inlet into Stranger Pond is producing some interesting contrasts between incoming and outgoing water quality and the effects this small urban lake has on water quality.

The Green Army have recently adopted this 'reach'. They discovered that the small suburban lake is very effective at trapping sediment as turbidity readings were generally higher going into the pond than going out. Phosphorus levels, however, were generally low at both the inlet and outlet and nitrate levels were higher at the outlet! Dissolved oxygen levels varied greatly (63 – 119% saturation) which is typical of an impaired urban waterway.

Erindale College assisted again by conducting the bug survey for this pond as part of their ecology class. Mayflies were detected in both Spring and late Summer, as were water mites. Caddisflies were detected in the late Summer survey - a good sign for this urban pond.

There was an improvement in overall water quality this year, but identifying why things such as phosphorus and pH made such a dramatic turnaround is extremely difficult.

Stranger Pond - Spring 2015

Naas River NNN1

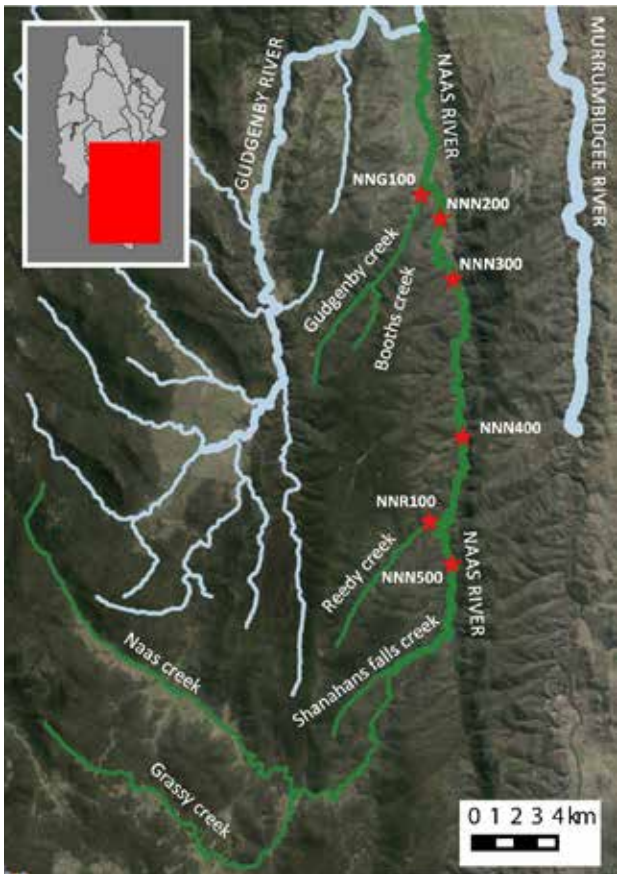
Headwaters to Gudgenby River confluence

2015/16 CHIP Result B+ (Good)		
2014/15 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**31**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Fair	
Water bug	**Fair**	**2**
Riparian condition	**Good**	**3**

Reach Facts

Reach network length: approx. 40km
Dominant land uses: Rural residential, grazing, conservation

The Naas River runs south then hooks east then flows north running through the southern tip of the ACT in Namadji National Park. The lower part of the river runs past grazing properties before joining the Gudgenby River 10 km south of Tharwa. This reach also includes a site on the bottom of the Gudgenby Creek.



Reach Condition

Volunteers Danica Tagaza found the Naas River dry at Caloola Farm for most of Summer. Gudgenby Creek still had water, but it was salty (high electrical conductivity), high in phosphorus and full of cows.

An interesting diversity of water bugs were collected in the Naas River. A water bug survey in Spring 2015 included the Water penny (a family of water beetle) and a predatory Needle bug. Burning in the Naas River catchment in Autumn led a major turbidity event during water bug sampling. Despite this, a Toad bug, Water penny and Freshwater mussels were sampled at this time.

In their travels to the upper parts of the Naas River catchment, the volunteering Marsham family have encountered feral pigs, a European wasp infestation as well as a Rosenberg's monitor. The new site they are monitoring is within 12 kms of the Mt Clear headwaters providinging valuable reference data.

Naas River at Caloola Farm - Spring 2015.

Cooleman Ridge dams RAN1

Two dams on Cooleman Ridge

2015/16 CHIP Result C- (Fair)		
2014/15 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**13**
pH	Excellent	
Turbidity	Poor	
Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Fair	
Water bug	**Degraded**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network area: approx. Kathner Street Dam 0.05Ha, Old Dam 0.15Ha
Dominant land uses: Suburban reserve

Kathner Street Dam is a small dam in Cooleman Ridge Nature Park. It was built to provide water for horses as part of the bicentennial horse trail. The 'Old Dam' is on the eastern slopes of Cooleman Ridge.

Reach Condition

The Cooleman Ridge Parkcarers found the usual high phosphorus (0.1 – 0.2 mg/L) and turbidity (30 – 100 NTU) in both dams. Cattle have regular access to one of the dams but the persistently high phosphorus readings in the other is a continuing mystery. It's could possibly be blamed on historic use of super-phosphate on the ridge in its past, or potentially high use by waterbirds. Nitrates were not detected during any survey, while dissolved oxygen levels (3.8 – 10 mg/L) were respectable for these dams with their considerable water quality issues.

An impressive array of bird life is regularly seen at the dams, including wood ducks (and ducklings), Black ducks and Australasian grebes. Evidence of feral animals (foxes, rabbits and Indian mynas) was also observed as well as invasive plants in the surrounding area (Blackberry, Privet, and African lovegrass).

Cooleman Ridge 'Old Dam' (CMC100)

Goodwin Village Pond RAN2

Small Pond at Goodwin Village Monash

2015/16 CHIP Result C (Fair)		
2014/15 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**13**
pH	Excellent	
Turbidity	Good	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**1**
Riparian condition	**No Data**	**0**

Reach Facts

Reach network area: approx. 0.4Ha
Dominant land uses: Recreation

Goodwin Village Pond is a small pond built into a natural drainage line at the southern end of the suburb of Monash. It's primary purpose is to provide recreational space and visual amenity for the residents of Goodwin Village retirement home.

Reach Condition

Very little variation on last year was seen from this little pond. It is off line from the concrete storm waterways that feed Lake Tuggeranong, so does not suffer the incursion of upstream electrical conductivity, nutrients or sediment. Electrical conductivity in Goodwin Village pond (≤ 210 µS/cm) is substantially lower than in nearby Isabella Pond (≤ 785 µS/cm). Likewise for phosphorus (≤ 0.03 mg/L compared to ≤ 0.07 mg/L).

Dissolved oxygen levels (as low as 62% saturation) reflect the lack of flow and lack of any mature vegetation around the pond to provide any shade in hot months. The pond is fed mostly from run off from the surrounding village.

A water bug survey conducted by Caroline Chisolm School revealed a single caddisfly, along with large numbers of water mites and other more tolerant taxa.

Goodwin Village Pond looking East

Isabella Pond TIP1

Large pond south of Monash

2015/16 CHIP Result B- (Good)		
2014/15 CHIP Result D (Poor)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**19**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Excellent	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network area: approx. 5.8Ha
Dominant land uses: Suburban

This reach is the main settlement pond for stormwater entering Lake Tuggeranong from the south western Tuggeranong suburbs. Water pours over a high weir at its western end into Lake Tuggeranong (TLT1).

Reach Condition

The reintroduction of water quality monitoring this year has revealed surprisingly good long term values. Increased rainfall has probably helped improve conditions for water bugs too lifting the overall health assessment. Despite this, electrical conductivity climbs during periods of low flow (785 uS/cm in January 2016).

With increased rain in a concrete drain, however, come other problems. Volunteers Walt Daly, Eileen Becker and Stuart Young have been sharing Isabella Pond. The southern storm water entry experienced unusual rubbish (including a lawn mower), strange smells and extreme turbidity after heavy rain in February (82 NTU).

A water bug survey by Canberra University's Environmental Science Society in March found 8 taxa, including a single mayfly and caddisfly, however the remaining bugs were all pollution hardy.

Tuggeranong College students sampling bugs at Isabella Pond

Lake Tuggeranong Wetlands TLT1

Drakeford Drive weir to South Quay foot-bridge weir

2015/16 CHIP Result C (Fair)

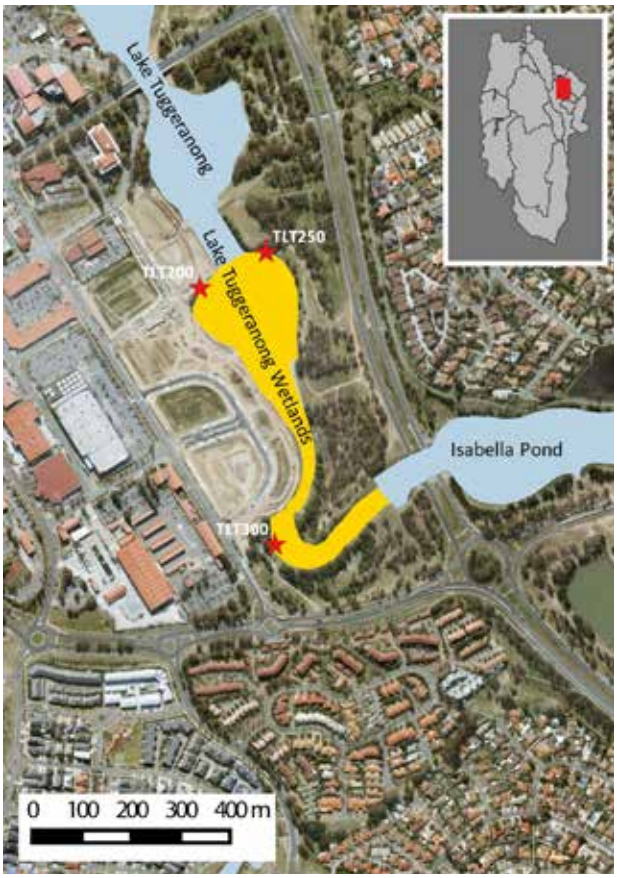
2014/15 CHIP Result C- (Fair)

Parameter	Rating	No. Survey
Water quality	**Good**	**25**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Degraded	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

Reach network length: approx. 4.3Ha
Dominant land uses: Urban

This is the southern section of Lake Tuggeranong upstream of the weir that runs under a pedestrian walkway near the new South Quay Development. It forms a narrow neck at the southern end which is fed by a large zigzag dam wall which overflows from Isabella Ponds.



Reach Condition

Water quality improved as predicted after the 'wetland' area refilled in the wake of the South Quay promenade construction. Turbidity returned to acceptable levels (10 – 15 NTU) and phosphorus decreased significantly (≤ 0.02 mg/L). This supports the notion that ponds can benefit from a good draining just as a fish tank does.

Volunteer Walt Daly did record elevated phosphorus levels (0.05 mg/L) in the southern section of the lake January as temperatures rose and rain was in short supply. This decreased slowly over the rest of Summer as it was gobbled up by blue green algae.

South Quay and the wetlands upstream recorded turbidity of 30 NTU in March after heavy rain and the wetlands had a low dissolved oxygen reading of 3.8 mg/L, possibly due to oxygen-deplete water from Isabella Pond being flushed over the Drakeford Drive wall.

The Green Army at South Quay.

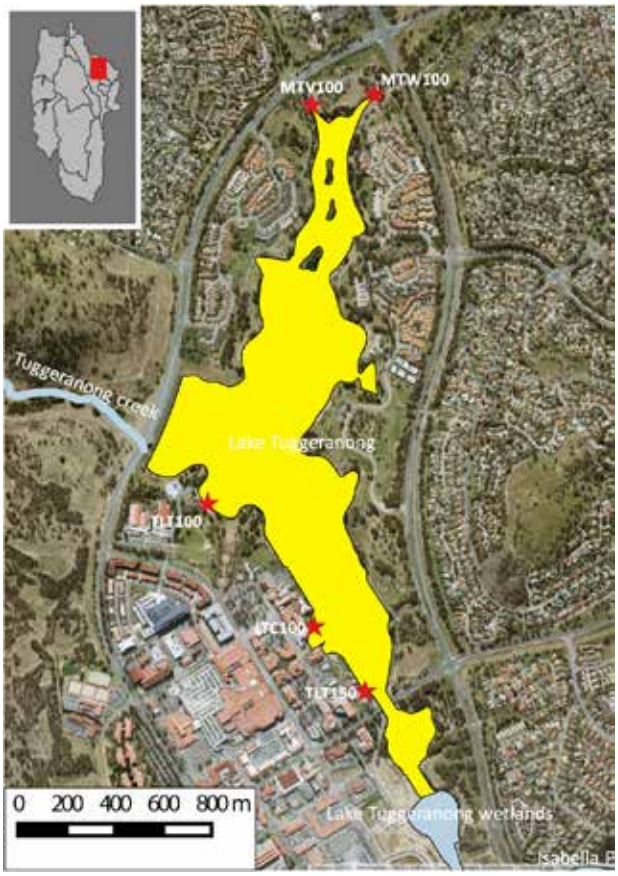
Lake Tuggeranong TLT2
Main lake body

2015/16 CHIP Result C- (Fair)		
2014/15 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**35**
pH	Good	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**6**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network area: approx. 56Ha
Dominant land uses: Urban and recreation

This is the main body of Lake Tuggeranong, which is fed by the stormwater systems of 13 southern suburbs. Two major gross pollutant traps are at the northern end of this reach. Lake Tuggeranong wetlands (TLT1) are immediately upstream of this reach.



Reach Condition

Surveys continued to show consistently elevated phosphorus levels (0.01 – 0.1 mg/L) in the lake. Likewise high levels of nitrates were also recorded (≤ 5 mg/L). Dissolved oxygen levels were also highly variable (69 – 114 % saturation), indicative of an impaired urban waterway that lacks complexity.

High sediment built up in one of the northern gross pollutant traps (GPT) for the Lake was reported by volunteer Ben Bryant in Summer and Territory and City Services responded to get it cleaned.

The Lake Tuggeranong College were back on board in 2016 and recorded that the mud from the southern inflows in March were present in the main body of the Lake with a turbidity score of 30 NTU at both sites near the town centre.

Water bug surveys conducted by the students at the College tended to show relatively low diversity, and predominantly tolerant taxa. The exception being both mayflies and caddisflies there were detected at the Town Park Beach. The majority of water bugs surveyed, however, were the tolerant water boatman.

The Village Creek GPT (Photo: Ben Bryant).

Westwood Farm TMM1

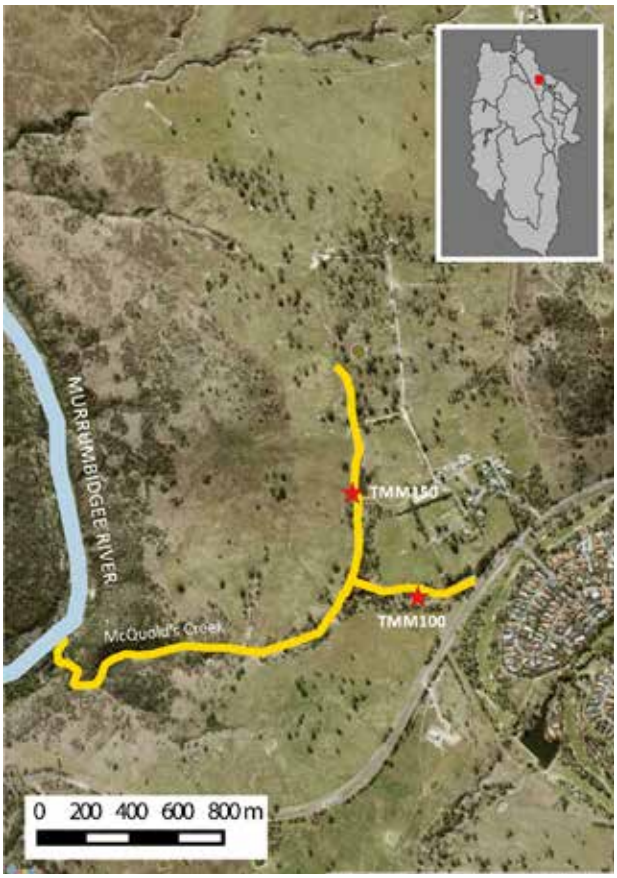
McQuoid's Hill to Murrumbidgee River

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**19**
pH	Excellent	
Turbidity	Fair	
Total Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**3**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 2.5km
Dominant land uses: Rural grazing and recreation

This reach covers McQuoid's Creek and the associated dam on Westwood Farm, Kambah. A tributary of the creek runs past the Murrumbidgee Golf Club. McQuoid's Creek flows into the Murrumbidgee River near Kambah Pool. The upstream sections are predominantly cleared land, while the downstream section is still well vegetated.



Reach Condition

The Green Army found the waterways here to be quite stagnant in December and the small creek considerably higher in electrical conductivity (210 – 840 µS/cm) than the nearby dam (80 –130 µS/cm). Phosphorus levels were elevated (0.01 – 0.2 mg/L) whereas nitrates were generally negligible with the exception of a few 'spikes' upwards of 5 mg/L.

Water bug surveys revealed a diverse array of taxa, including the sensitive stoneflies, mayflies and caddisflies. However, the generally tolerant fly larva and water boatman tended to dominate the samples.

The riparian zone in this reach is generally low in understorey and canopy species, and very poor with regards to the lack of reeds, tussocks, dead trees and fallen logs that contribute greatly to the overall habitat and health of our waterways.

McQuoid's Creek - Spring 2015

Upper Tuggeranong Creek TUG1

Headwaters of Tuggeranong Creek catchment to Theodore

2015/16 CHIP Result C (Fair)		
2014/15 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**8**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Good	
Water bug	**Degraded**	**1**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network length: Monks Creek (upper arm 3.2km), Tuggeranong Creek (lower arm) 4km
Dominant land uses: Rural grazing

The monitoring site is near the Monaro Highway at the eastern border with NSW and is fed from Monks Creek to the east and Tuggeranong Creek to the south. The Tuggeranong Creek arm runs adjacent to the Monaro Highway in NSW.

Reach Condition

Volunteers Eileen Becker and Stuart Young found the top of Tuggeranong Creek with low water levels, high in turbidity (≤ 50 NTU) , high in electrical conductivity (≤ 418 µS/cm) and full of rubbish in January. The Summer and school holidays are never kind to this little part of the creek.

A water bug survey conducted in Autumn by Caroline Chisholm School found some sensitive mayflies, but fly larva and water boatman dominated. No yabbies were captured during this survey despite this usually being a popular place for catching yabbies.

A second site for this reach has recently been established at the headwaters of Tuggeranong Creek along the Monaro Highway and will provide valuable reference data for Tuggeranong Creek in future reports.

Tuggeranong Creek 50m upstream of concrete channel.

Middle Tuggeranong Creek TUG2

Concrete drain system upstream of Isabella Pond

2015/16 CHIP Result D+ (Poor)		
2014/15 CHIP Result D (Poor)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**49**
pH	Degraded	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
Water bug	**Degraded**	**1**
Riparian condition	**Degraded**	**3**

Reach Facts

Reach network length: approx. 8km
Dominant land uses: Urban.

This reach consist of a Y shaped network of 2 concrete stormwater channels. The main arm runs north west from under Leinhop Street in Theodore. This joins another channel following south west from Fadden near Isabella Drive where the channel then flows into Isabella Pond.

Reach Condition

This concrete lined reach can only ever achieve reasonable CHIP values for water quality when rain sends fresh water flowing down the channel. Electrical conductivity is the highest in the southern ACT catchments (33 – 1030 µS/cm), while turbidity was generally low, reaching a peak of 43 NTU in July 2015. Both phosphorus (0 – 0.8mg/L) and nitrates (0 – 10 mg/L) intermittently reach very high levels. In Summer, unusually high pH levels (7 – 10) were recorded in the drain under Ashley Drive.

Water bugs and riparian vegetation are all but non-existent. Difficult bug surveys were again conducted by the terrific students from Caroline Chisholm School. To find any living animals in this concrete drain involves crawling along the concrete with a spoon or pipette, as it is insufficient water to run a net. Just a single lonely yabby was sampled in this section of Tuggeranong Creek.

Tuggeranong Creek (on right) joining channel from Fadden (on left).

Tuggeranong Creek TUG3

Tuggeranong Creek to Murrumbidgee River confluence

2015/16 CHIP Result C+ (Fair)		
2014/15 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**7**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

Reach network length: approx. 1.8km
Dominant land uses: Suburban reserve

This reach includes the natural stretch of Tuggeranong Creek line fed by the overflow from Lake Tuggeranong. This creek enters the Murrumbidgee River 2kms downstream of Pine Island Reserve.

Reach Condition

Below Lake Tuggeranong Dam, the Green Army reported high electrical conductivity (100 – 400 µS/cm), high nitrate levels (0 – 5 mg/L) and low flows in this little creek in early Summer. A water bug survey in Autumn contained 8 taxa including mayfly and caddisfly larvae in low numbers. This contrasts with the Spring survey which reported only 4 water bug taxa. This rapid reestablishment of sensitive species in this reach by Autumn is interesting to note.

Contrasting results between Tuggeranong Creek and upstream in Lake Tuggeranong shows that turbidity (≤ 10 – 35 NTU) is the only parameter that continues to be addressed by the Lake. No other improvements in water quality were noted.

Tuggeranong Creek at the low level crossing below Lake Tuggeranong.

Castle Hill Creek UMC1

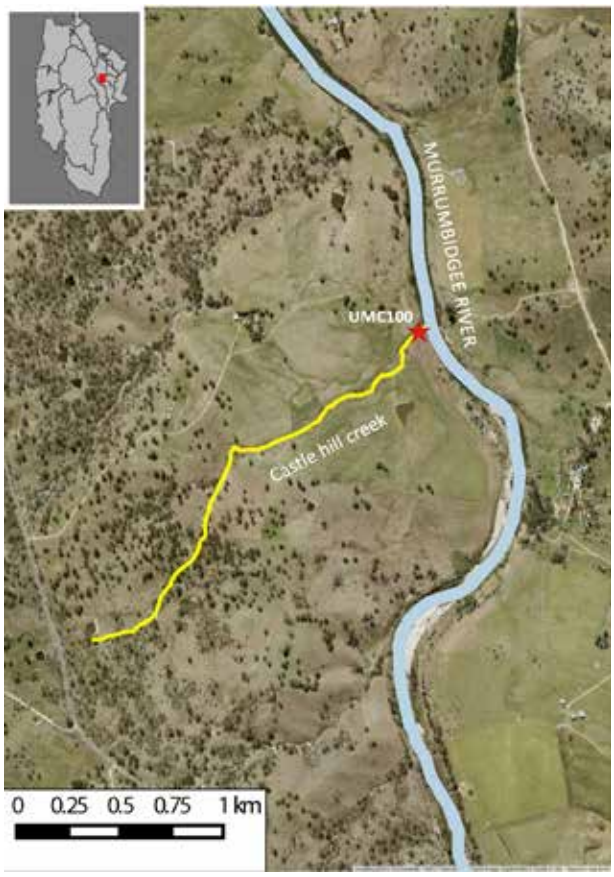
Creek on Castle Hill Homestead

2015/16 CHIP Result C (Fair)		
2014/15 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**3**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**No Data**	**0**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network length: approx. 1km
Dominant land uses: Private land. Rural cattle grazing and free range chicken farming.

This reach is the lower half of an ephemeral creek that runs west to east to the Murrumbidgee River through the southern part of Castle Hill Homestead near Tharwa. Forming isolated pools for most of the year much of the creek line has steep banks, with some evidence of erosion. The banks are , however, fenced off from stock and with some revegetation work along most of its length.



Reach Condition

Three water quality surveys make up this assessment and a planned water bug survey in Autumn by Kacey-Lee Fairall and Alison McKinlay from the Green Army was foiled by persistent rain. Data therefore only covers Winter 2015 and one survey in Spring. No data is available for 2016. The creek on Castle Hill Homestead was a little healthier this year with turbidity levels being much lower (≤ 12 NTU). Electrical conductivity was high (290 – 640 µS/cm) and dissolved oxygen levels remain a concern (34 – 59 % saturation), especially given that surveys were only conducted in Winter and Spring.

A riparian vegetation survey conducted last year showed a lack of canopy or understory, and no groundcover features such as fallen logs or leaf litter. This is a significant contributor to the 'fair' health assessment this creek has received.

Castle Hill Creek - September 2015.

Yass Catchment Facts

Yass catchment is approximately 2,800km^2, and is situated to the north of the ACT. The Yass catchment is made up of two major rivers. The first is the Yass River that has its headwaters approximately 100kms to the south east around Wamboin. The River flows north west past Sutton and downstream to the township of Yass and then through steep gorge country until it flows into Burrinjuck Dam from the east. The major tributaries of the Yass River include Brooks Creek, Gundaroo Creek, Murrumbateman Creek, Dicks Creek and Manton Creek The second major river is the Murrumbidgee River that becomes part of the Yass catchment (in terms of the CHIP report) at the confluence with Ginninderra Creek just after both waterways exit the ACT. The Murrumbidgee runs north through Wallaroo and Cavan, to the west of Murrumbateman, before entering Burrinjuck Dam from the south. This lower section of the Murrumbidgee has large sand slugs resulting from reduced flows, and the impounded waters of Lake Burrinjuck. The natural river bed is swamped by the sand deposits creating wide shallow sections with little or no instream structure.

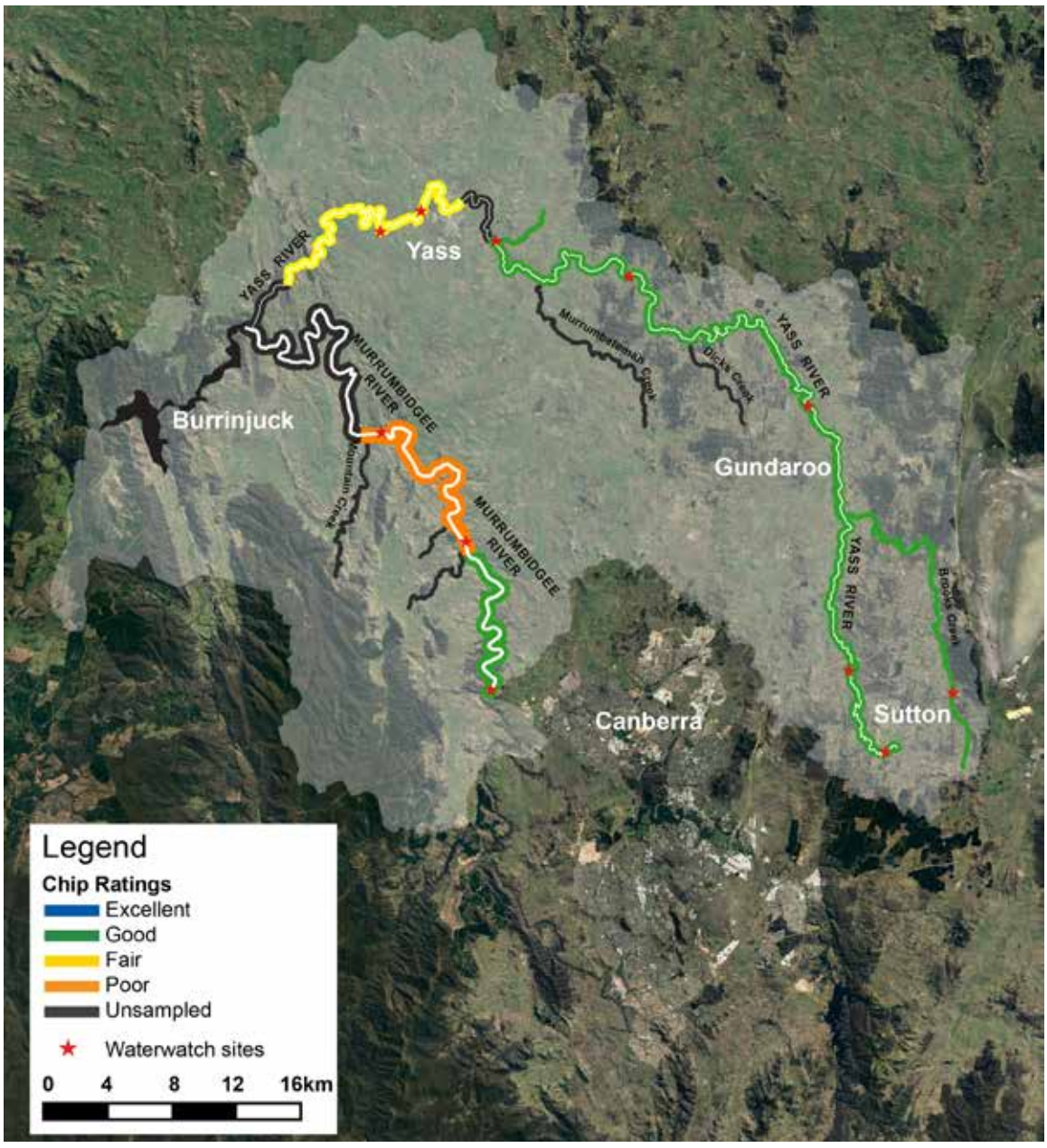
A large proportion of this catchment is cleared grazing land and as a result, major issues in this catchment include dryland salinity and erosion. Many of these issues could be ameliorated through stock exclusion and the regeneration of the riparian zone. This is occurring on a number of fronts throughout the catchment with the Yass Area Network of Landcare Groups (YAN) playing a major part.

Yass Catchment Health Summary

This year's CHIP continues to build a picture of condition in the Yass catchment with some additional volunteers monitoring identified priority sites. The Yass catchment, however, is still in need of more volunteers for a more complete data set. The response from the Yass Council and the community has been great with more support being offered as the program gains more exposure. The community have shown a strong interest in the 'Carp love 20°C' program and as local Landcare groups and individual property owners are undertaking projects to improve riparian condition, there is more interest in monitoring the water quality of the catchment.

Three of the five reaches were recorded as 'good' although they all just scrapped into this category. It is likely YAS1, which lacked a riparian assessment, would have been reduced to a 'fair' score had that been undertaken. Conversely the 'degraded' result for CMM13 would probably improve if the water quality data component was not absent. The two remaining measures (water bugs and riparian assessments) tend to drag overall scores down as they are less transient than water quality.

The two parameters that are of greatest concern are electrical conductivity (EC) and dissolved oxygen. Elevated EC has been an issue in the Yass River for many years with increasingly high levels as you move down the River (as high as 1420 µS/cm at the most downstream site in January). The highest EC scores and the lowest dissolved oxygen levels both correlated with a hot Summer and early Autumn period that experienced extremely low flows.



Murrumbidgee River CMM12

Ginninderra Creek confluence to above Mullion Creek confluence

2015/16 CHIP Result B (Good)		
2014/15 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**20**
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Fair	
Dissolved Oxygen	Excellent	
Water bug	**Fair**	**1**
Riparian condition	**Fair**	**1**

Reach Facts

Reach network length: approx. 18Km
Dominant land uses: Grazing, conservation

This Murrumbidgee River reach starts at the confluence with Ginninderra Creek, and ends above confluence with Mullion Creek in Wallaroo. Much of this reach is surrounded by cleared grazing lands, and a very narrow riparian zone. In a few notable places, private landowners are undertaking riparian vegetation replantings to improve river condition.

Reach Condition

Water quality was mostly 'excellent' although there were two high readings for turbidity (100 and 150 NTU) during flooding events. Higher nitrate levels resulting from the Lower Molonglo Water Quality Control Centre (LMWQCC) are reduced (1 – 7mg/L) by the time the River reaches this section which is approximately 8km downstream. Higher electrical conductivity levels are also possibly related to the LMWQCC with releases containing higher levels of salts than the normal inflows.

The riparian condition varies considerably through this reach. The upper section contains some of the most intact remnant patches in the area with steep rough terrain protecting the native species in the riparian zone. In contrast the lower section has many areas dominated by exotic weed species. The inaccessibility of the upper section means that this is a good place to see Platypus with kayakers reporting regular sightings.

Murrumbidgee River near the Ginninderra Creek confluence

Murrumbidgee River CMM13

Mullion Creek confluence to Taemus Bridge above Burrinjuck Dam

2015/16 CHIP Result D (Poor)		
2014/15 CHIP Result DD (Data Deficient)		
Parameter	**Rating**	**No. Survey**
Water quality	**No Data**	**2**
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
Water bug	**Degraded**	**2**
Riparian condition	**Poor**	**1**

Reach Facts

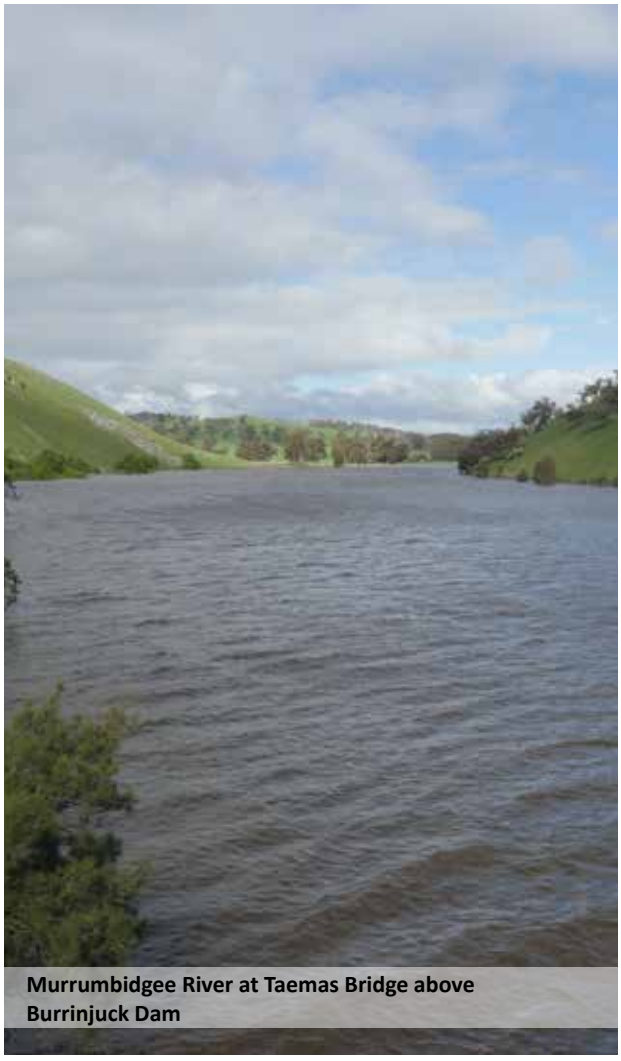
Reach network length: approx. 20Km
Dominant land uses: Rural

This reach of the Murrumbidgee River is the most downstream of 13 reaches on the Murrumbidgee River. The downstream end at Taemus bridge is immediately upstream of the impounded water of Lake Burrinjuck. Much of this catchment is cleared grazing land, with poor instream habitat and a narrow and at times, heavily degraded riparian zone.

Reach condition:

This is the first year of sampling for this reach with only 1 water quality record for each site, both showing good results for most parameters with only a poor result for turbidity of 60 NTU.

The water bug and riparian condition scores were poor, reflecting the very low habitat value through much of this reach. The lower section of the reach has large sand slugs resulting from damming of the river at the Burrinjuck dam. The natural river bed is swamped by the sand deposits creating wide shallow sections with little or no instream structure. The upper section of the reach does have some more natural pools and some riffle sections. The combination of poor riparian structure and almost no instream structure resulted in poor water bug scores. Only bugs that were well adapted to open water or the rocky banks were found in this reach. Large numbers of Carp have been sighted through this reach.



Murrumbidgee River at Taemas Bridge above Burrinjuck Dam

Yass River YAS1

Headwaters to Brooks Creek confluence, including Brooks Creek

2015/16 CHIP Result B- (Good)		
2014/15 CHIP Result DD (Data Deficient)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**19**
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**1**
Riparian condition	**No Data**	**0**

Reach Facts

Reach length: approx. 60km
Dominant land uses: Rural, rural residential

The upper Yass River and Brooks Creek represent the top of the Yass River catchment. This reach is likely to represent the reference condition for this catchment. Improving condition in this reach will have benefits for the Yass River downstream.

Reach condition.

Water quality was mostly good with degraded results for electrical conductivity and dissolved oxygen reducing the overall score. Low dissolved oxygen was most evident during Summer and early Autumn when low and no flow periods were experienced. Brooks Creek showed better results for dissolved oxygen than the Yass River. High electrical conductivity is an issue in the Yass River catchment and this reach recorded up to 780 µS/cm in late Summer although this was heavily diluted (140 µS/cm) when the rains came in June.

Volunteers recorded good numbers of frogs with four species recorded at one sampling event and pobblebonk tadpoles were caught during the Spring bug survey. The riparian condition has not been assessed for this reach however the volunteer notes mention good reed cover in areas where frogs were recorded.

Sampling was not undertaken on the YAS010 site in December or January due to the river being dry in this period.

Brooks Creek (Photo: Paul Churcher)

Yass River YAS2

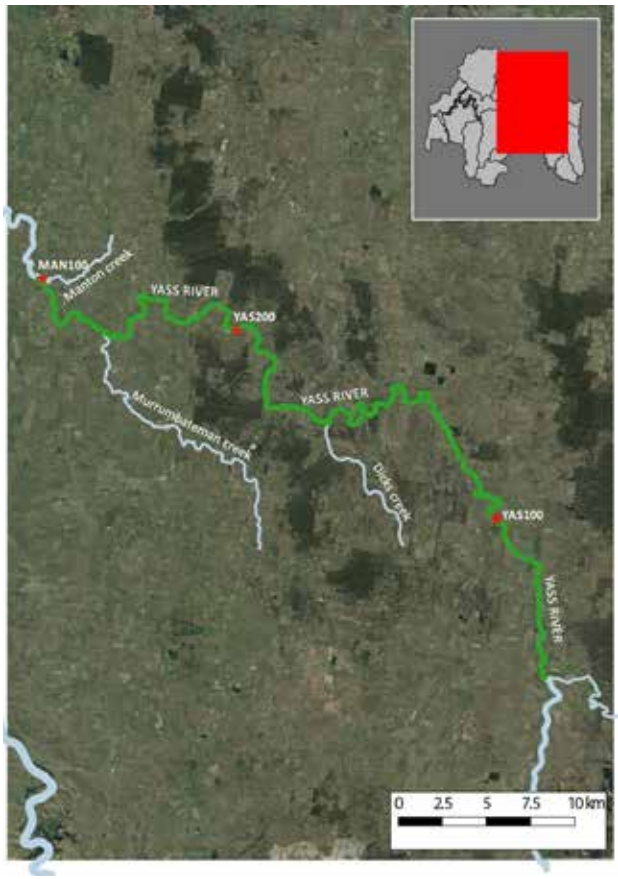
Dicks Creek confluence to Manton Creek confluence

2015/16 CHIP Result B- (Good)		
2014/15 CHIP Result DD (Data Deficient)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**10**
pH	Excellent	
Turbidity	Fair	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**3**
Riparian condition	**Fair**	**2**

Reach Facts

Reach length: approx. 30km
Dominant land uses: rural

This mid-section of the Yass River contains the major tributaries of Murrumbateman and Manton Creek. The catchment is largely cleared and used for grazing. Riparian condition is generally poor, with pasture improvement right up to the river bank and stock access to the river, evident. Likely issues in this reach include high sedimentation leading to reduced instream habitat and high electrical conductivity due to historical land use.



Reach condition:

Water quality was good overall, with the expected issues for the Yass River catchment. Electrical conductivity was high (≤ 890 µS/cm) while dissolved oxygen tended to be low, which may be explained by the hot, dry spell over Summer and early Autumn.

In June 2016 heavy rainful induced flood conditions, with associated high turbidity (80 NTU) and flooding across the causeway at Booths Crossing, which led to a car being washed into the river.

Water bug surveys in Autumn revealed good diversity of water bugs, including the sensitive mayflies and caddisflies. Water bug surveys, however, tended to be dominated by tolerant taxa such as water boatman, fly larvae and water snails.

Riparian condition surveys portray contrasitng results. Good riparian condition can be found at 'Goldenholm' with good native canopy cover, midstorey and groundcover, supporting a highly functional riparian zone. Conversely Booth's Crossing has minimal canopy cover and depauparate groundcover, which gives this reach its 'fair' rating.

Volunteers noted large numbers of Carp during October and November which coincides with the breeding season.

Yass River at 'Goldenholm'

Yass River YAS3

Yass township to Lake Burrinjuck

2015/16 CHIP Result C (Fair)		
2014/15 CHIP Result DD (Data Deficient)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**11**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**3**
Riparian condition	**Fair**	**1**

Reach Facts

Reach length: approx. 33km
Dominant land uses: urban, rural

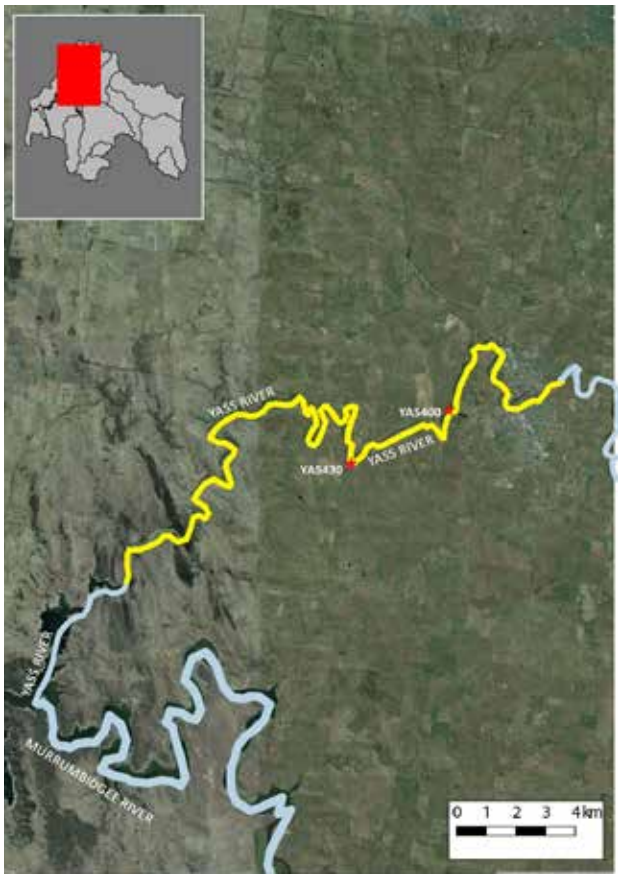
This downstream section of the Yass River includes the township of Yass and runs through extensive gorge country before running into Lake Burrinjuck. Flow is heavily influenced by Yass Dam and urban inputs from the town are also likely to influence water quality in this reach. There is ongoing habitat rehabilitation occurring both in the Yass Gorge at the top of the reach and in downstream rural properties.

Reach condition:

Water quality sampling was initiated in November 2015. High electrical conductivity was recorded for most of the year (680 – 920 µS/cm) which is expected as concentrations build up in the bottom end of this catchment. It then drops considerably in June (210 µS/cm) following a flood event. Turbidity was excellent during the low flow conditions however a spike of 75 NTU was observed on the back of a high flow event in June. Fallen trees were noted at this time, which will contribute to instream habitat for native fish in the future. Large flow events are likely to dispatch much of this large woody debris into Lake Burrinjuck.

Water bug scores were 'degraded' and are a likely combination of poorer water quality and reduced habitat value for instream and fringing vegetation with only scattered reeds and few native tussocks. Landowners below the township are undertaking habitat restoration projects so habitat values should improve in the coming years.

A pair of Peregrine falcons were observed nesting in Spring 2015 at YAS400. High cliff faces in the gorge regions of this catchment make excellent breeding habitat for this species.



Yass River near 'Hatton's Corner ' downstream of Yass

Additional Waterwatch Data

While the CHIP exclusively uses data on water quality, water bug surveys and riparian condition, a range of other data sources collected by Upper Murrumbidgee Waterwatch provide additional information and important context to the CHIP.

Platypus Month

Upper Murrumbidgee Waterwatch runs a series of surveys for Platypus and Water rats (Rakali) every August throughout the catchment. Surveys are conducted by enthusiastic volunteers in the cold mornings along a pre-defined reach of river. Surveys run for one hour and are conducted twice during the month. The overall goal is to develop an understanding of Platypus abundance and population trends over time. Surveys are conducted on the Molonglo River upstream of Lake Burley Griffin (MOL5), Jerrabomberra Wetlands (JER2), Murrumbidgee River near Tharwa (CMM8), Murrumbidgee River at Scottsdale (CMM6), Murrumbidgee River near Cooma (CMM4), Cooma Creek (COO2) and Numeralla River (NUM2).

Survey results from August 2015 show that both Platypus and Water rats are readily observed in the Molonglo River and Jerrabomberra wetlands, with up to 3 unique individuals of both species being observed in a single survey. Conversely, neither species were seen at Tharwa, where there are known habitat issues due to instream sedimentation which is being addressed in part with engineered log jams designed to help scour out the sediment. Upstream in NSW, Platypus were observed at all 4 survey locations, with up to 3 unique individuals observed in each survey. Surprisingly, not a single water rat was seen.

Both species are charismatic and well known within the community. Both are useful for communicating messages regarding catchment health and water quality as they are both dependant on the health of the waterways. For example, the Platypus surveys on Cooma Creek in August 2015 identified major habitat and pollution issues on teh reach. With the now identified presence of Platypus in this reach, major investment in the form of a restoration and rehabilitation grant of $99K from the NSW Environmental Trust Grant has been awarded to undertake weed control and replanting of the riparian zone to improve stream health. Monitoring long-term trends in their abundance will provide much needed information on their status within our waterways. Water rats are already believed to be in decline, however the extent and severity is poorly understood due to a lack of data. Ongoing monitoring such as this is vital to understanding why this is happening.

Further information regarding Platypus month, including a short report on the findings of the August 2015 surveys can be found at www.act.waterwatch.org.au/Platypus.html.

Carp Love 20˚C

European carp (Carp) were introduced into Australia (Victoria) almost 100 years ago. After a slow start, it wasn't until the 1970s when their numbers grew rapidly and they spread throughout the Murray-Darling basin. In the mid-1970s, Carp were introduced into Lake Burley Griffin (accidently) and now make up ~75% of the fish biomass in the upper Murrumbidgee River catchment. They have many detrimental impacts on water quality and instream native flora and fauna.

Efforts to control Carp will include targeted removal, improving natural ecosystem resilience, and potential releases of control agents such as a genetic modification termed 'daughterless Carp technology' and the Koi Herpes Virus. However, any intervention requires information on the biology and ecology of the species in order to be effective. At the present time, we know very little about the breeding biology and movement patterns of Carp in the upper Murrumbidgee River catchment.

Carp Love 20˚C is a citizen science campaign initiated by Waterwatch in Spring 2015. With the assistance of the Invasive Animals CRC FeralScan portal (www.feralscan.org.au), the public can report sightings of Carp in the local waterways. In Spring when water temperatures reach ~20˚C, Carp start to spawn, often in a spectacular fashion, with large numbers of individuals aggregating in shallow water where vigorous chasing and splashing takes place.

Last Spring over 100 records or Carp were made to the FeralScan portal, while 19 were specifically of Carp spawning behaviour. Sightings were made in the urban lakes (Lake Burley Griffin, Lake Tuggeranong and McKellar Wetlands), along with riverine spawning events in Yass River, Murrumbidgee River, Numeralla River and Yarralumla Creek. It is hoped more information will be captured Spring 2016 to help provide a fuller picture of Carp breeding locations within the catchment.

This information will assist in managing future interventions to control Carp, as well as in building a model of Carp breeding, recruitment and movement within our catchment. More information can be found at http://www.act.waterwatch.org.au/Feral%20Fish.html.

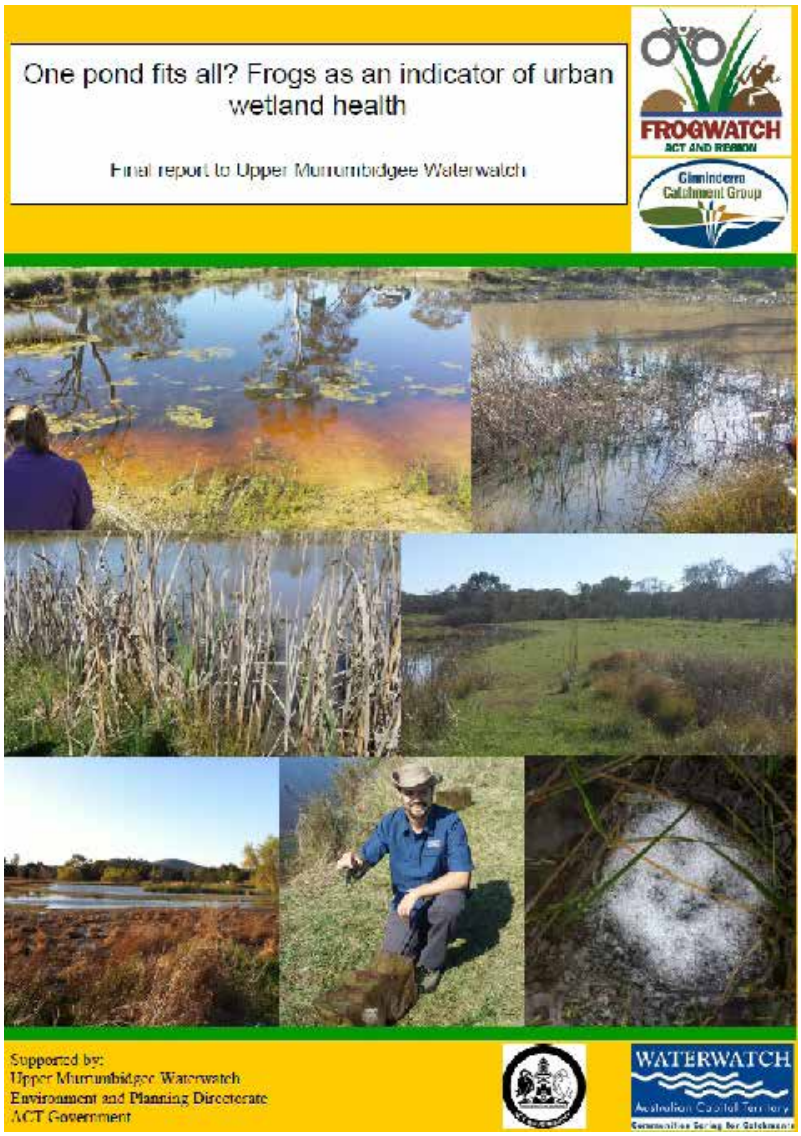
Frogs as a indicator for wetlands

ACT and region Frogwatch is a well-known citizen science program run by Ginninderra Catchment Group (www.ginninderralandcare.org.au/Frogwatch.html). In Spring 2015, Waterwatch and Frogwatch partnered up to explore the what attributes around urban wetlands support healthy populations of frogs, and what management actions can be undertaken to improve urban wetlands as frog habitats in the ACT region.

By combining the Frogwatch census data with information on riparian and in-water condition, water quality, connectivity and the presence of the invasive fish, Eastern gambusia Gambusia holbrooki, we were able to determine the attributes that differ between wetlands that support up to 8 species of frogs from those that support very few (0-2 species).

We found that a range of factors are important, and they differ between species. Notably, connectivity to remnant patches of forest (both native and introduced), riparian condition, presence of Gambusia and water quality all have impacts on frogs. Also of note, wetlands that are regularly mown around their margins support fewer frog species, while those wetlands with abundant fallen logs and groundcover support more frog species. Conversely, this report identifies 5 frog species that can be informative as general indicators of catchment health, due to the strong preferences for high quality instream and riparian condition and water quality, as well as habitat connectivity and aversion to Gambusia.

Recommendations from this report (funded by Upper Murrumbidgee Waterwatch and can be found at www.act.waterwatch.org.au/Frogs.html will be implemented in revised mowing guidelines for the ACT, while also being considered in the future wetland designs in the ACT. This is an excellent example of where citizen science can produce high quality information to support the management of our natural resources.



Volunteer list

Cooma

Ivan Bec
Morgan Blaschke-Broad
Caroline Blyton
Rita Brademann
Remi and Raen Brademanne
John Britton
Neil Brown
Carol and Manuel Buttigieg
John Chapman
Nicole Clark
Max and Julie Clark
Sue Connolly
Jenny and Bob Cooper
Jerangle Public School
Justin Kell
Matt Kent
Laurene Lewis
Jackson Lewis
Kerryn Milligan
Louise and Leo Narusevich
Fran Robertson
Regina Roach
Gill and Tony Robinson
Tim Scrace
Thoe and Vicki Schoo
Mark Shubert
Edel and Eric Stephans
Nicole Szyfko
Anne Henkel
Noel and Diane Thomas
Lauren Van Dyke
Pam Vipond
Dani Wadland
Jim Wharton

Ginninderra

Lyndsay Britt
Lesley Harland
David Fitzsimmons
Luke Wensing
Jake Lennon
Luke Hulbert
Gregg Berry
Johanna Wallner
Amy McLachlan
Nathanael Coyne
Zhou Zhou
Hannah Selmes
Brendan Eyers
Lynette
CIT Students
Margaryta Fedianina

Molonglo

Peter Abbott & Fraser Argue
ANUgreen Sustainability Office
Kate Badek & Xinkai Xue
John Bissett
Tanya Boston
Robyn Briese
Ange Calliess
Des & Jenan Cannon
Captains Flat Landcare Group
Tim Carroll
Eva Culek & Maja Arsic
Bruce Davies
Anna van Dugteren & Sapna Dutta
Ema Falez
Chloe & Stewart Foster
Miranda Gardner
Sue Gibson
Penny Godwin
Hilary Gunn & Christine Bond
Andrew Kaye
Bernard Kertesz
Sandy Lloyd
John Moore
Gail & Darryl Neumann
Tony Patis
Ros Peacock
Stuart Pearson
Peter Robertson & Deb Shaw
Royalla Landcare Group
Phil Sahlqvist
Mike Sim
Amar & Vidya Singh
Kristy Sullivan
Jo Thompson
Watson Woodlands Working Group
Water buggers: John, Michaela, Stephanie, Maja, Ken, Hélène, Bec, Julia, Richard, Robyn, Gail, Krish, Carmen, Sophie, Martin, Sandy.
Riparian assessments: Ryl Parker

Southern

'Bidgee Blue' Waterwatch
'Conder Wetlands' Waterwatch Group
'Cuppacumbalong' Waterwatch Group
'Sands' Waterwatch Group
Stromlo High School
Able Australia
ACT Home School Association
ACT Parks and Conservation Service
Arrawang Girl Guides
Calwell High School
Carers of Point Hut Pond
Caroline Chisholm School
Conder Wetlands' Waterwatch Group
Cooleman Ridge Parkcare Group
Cooleman Ridge Parkcare Group
Erindale College
Friends of Tidbinbilla
Green Army
Gudgenby Bush Regenerators Waterwatch Group
Lake Tuggeranong College: Sustainability Unit
Lake Tuggeraong Rowing Club
Lions Youth Haven Schools Program
Melrose High School Year 8 ACE Team
Monash Primary School
Outward Bound Australia
Paddys River' Waterwatch Group
Park Carers of Southern Murrumbidgee(P.O.S.M)
SACTCG Waterwatch
U.C. Environmental Science Society
Uriarra Parkcare Group
Weston Joey Scouts
Alan Parker
Alex Spoor
Alison McKinlay
Anne & Bill Kerrigan
Ashlee Kirkland
Ashley Cooper
Ben Bryant
Brooke Harder
Connor Mann
Danica Tagaza
Eileen Becker
Eve Davis
Eve Gaunt
Georgie Anderson
Isabella Bateup
Izaak Brooks-Johnson
Jason MacKenzie
Jenara Harrison
John Corcoran
Kacey-Lee Fairall
Keely Monty
Krish Sanghvi
Lisa Evans
Madison Cheng
Martin Chalk
Michaela Popham
Monica Jiang
Nathan Foley
Nic & Kerry Marsham
Paige Edwards
Riley Roberts
Rose Monkivitch
Samantha Donohoe
Stuart Young
Walt Daly
Wendy Rainbird
Woo OReilly & family
Zac Green
Zander Blount

Yass

Carol Boughton
Kate Wilson
Ginny Edwards
Kym Nixon
Paul Churcher
Murray Goodridge
Cathy Campbell

Glossary

Baseline monitoring:
The collection of data prior to a planned intervention/project

Biennial:
Occuring once every 2 years

Confluence:
The intersection of two waterways

Cyanobacteria:
Photosynthesizing bacteria often responsible for blue-green algae blooms

Data deficient:
Being either unsampled or having insufficient information to provide a confident assess-ment

Dissolved oxygen:
The amount of oxygen present within water, either presented as an absolute amount (mg/L) or as a percentage of the total oxygen saturation at a given temperature

Eastern gambusia: A small invasive pest fish introduced from central America

Electrical conductivity:
A measurement of the total combined salts/minerals within water and used as a proxy for salinity

Ephemeral:
Contains water intermittently, as opposed to permanent

Erosion:
The loss of soil from the land into waterways

Eutrophication:
The rapid blooming of algae and cyanobacteria in nutrient-rich water, which can lead to depletion of dissolved oxygen

Fish kill:
A natural or artificially induced mass die-off of fish occurring in a small space of time, often re-lated to rapid depletion of dissolved oxygen

Flashy:
A term used to describe the temporal response of river discharge following rain

Fragmented:
Areas of habitat that have become disconnected due to habitat change

Frost hollow:
An area of land that is subject to severe frosts. Often occurs near waterways

Galaxias:
A small species of native freshwater fish

Gorge: A narrow, steep-sided, often rocky area immediately adjacent to a waterway

Groundwater: Water that is sourced from deep within the soil

Hydrograph: The relationship between river discharge and time

Leachate: Liquid effluent containing harmful substances

Metamorphic: A type of rock, related to its process of formation

Macrophytes: Aquatic plants

Nitrate: A naturally occurring form of Nitrogen. High levels can indicate excessive nutrient inputs into waterways

pH: A measure of the acidity or basicity (alkalinity) of a solution

Phosphorus: A naturally occurring element essential to life. High levels are often implicated in algal blooms in waterways

Reach: A length of waterway defined by hydrological, environmental, landuse and social attributes for the purpose of reporting on ecosystem health

Riparian: The zone immediately adjacent to a waterway, which both directly receives and contributes to the aquatic ecosystem

Runoff: Water that flows into a waterway after rain

Sand slug: A large intrusion of sand within a river channel

Sediment: Soil that has become washed into a waterway

Stormwater: Same as runoff

Stressors:
Natural and man-made processes that can negatively affect natural ecosystem function

Turbidity:
The degree of suspended solids in water that gives it a muddy colour

Willows: an introduced riparian tree species

Abbreviations

ACWA: Actions for Clean Water Plan (an initiative to reduce turbidity in the upper Murrumbidgee)

DO: Dissolved Oxygen

EC: Electrical Conductivity

mg/L: Milligrams per Litre

µS: MicroSiemens

NTU: Nephelometric Turbidity Units

N: Nitrogen

QAQC: Quality Assurance, Quality Control

TP: Total Phosphorus

RARC: Rapid Appraisal of Riparian Condition

TSR: Travelling Stock Reserve

UMDR: Upper Murrumbidgee Demonstration Reach

Appendix I

Cooma region CHIP scores by parameter

Reach	pH	EC	Turbidity	P	DO	Nitrate	WQ Score	WB Score	RARC Score	CHIP Score	Letter
BAD1	1	1	1	1	5	1	1.67	1	1.5	1.39	A
BAD2	1	1	1	1	5	1	1.67	2	3	2.22	B+
BRD1	1	2	1	1	4	1	1.67	1.5	3	2.06	B+
BRD2	1	4	1	1	5	1.5	2.25	2.5	4	2.92	B-
CMM1	1	1	1	1	3	1	1.33	2.5	4	2.61	B
CMM2	1	1	1	1	1	1	1.00	2	4	2.33	B
CMM3	1	1	1	1	1	1	1.00	2	3	2.00	B+
CMM4	1	2	1	2	3	1	1.67	2	4	2.56	B
CMM5	1	3	1	1	5	1	2.00	2.5	5	3.17	C+
CMM6	1	2	1	1	1	1	1.17	3	4	2.72	B-
COO1	1	5	1	3	5	1	2.67	3	5	3.56	C
COO2	1	5	1	5	5	1	3.00	4	5	4.00	D+
COO3	1	5	1	5	5	1	3.00	2.5	4	3.17	C+
COB1	1	5	1	5	5	1	3.00	3	4	3.33	C
GUD1	2	5	1	1	3	2	2.33	3	4	3.11	C+
KYB1	1	2	1	1	5	2	2.00	2.5	3	2.50	B
MIC1	1	5	1	1.5	5	1	2.42	3	4	3.14	C+
NUM1	1	3	1	2	5	2	2.33	1	4	2.44	B
NUM2	1	2	1	1	5	2	2.00	3	3	2.67	B-
NUM3	1	2	1	1	5	2	2.00	2	3	2.33	B
NUM4	1	2	1	2	5	2	2.17	2	4.5	2.89	B-
ROC1	2	5	1	2	4	2	2.67	2.5	4.5	3.22	C+
STR1	1	2	1	2	3	2	1.83	3	3.5	2.78	B-

1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = degraded

Molonglo region CHIP scores by parameter

Reach	pH	EC	Turbidity	P	DO	Nitrate	WQ Score	WB Score	RARC Score	CHIP Score	Letter
BUR1	1	5	1	1	5	1	2.33	4	4	3.44	C
DIC1	1	2	1	1	2	1	1.33	4	4	3.11	C+
GGG1	1	5	1	1	2	2	2.00	DD	2.5	2.25	B+
JER1	1	4	1	1	5	1	2.17	3	4	3.06	C+
JER2	1	5	3	1	5	1	2.67	3	4	3.22	C+
LYN1	1	2	2	5	5	2	2.83	5	3	3.61	C
MOL1	DD	DD	DD	DD	DD	DD	DD	3.5	4	3.75	C-
MOL2	2	4	1	1.5	5	2	2.58	5	2	3.19	C+
MOL3	1	5	1	1	5	2	2.50	3	3	2.83	B-
MOL4	1	4	2	2	3	2	2.33	3	4	3.11	C+
MOL5	1	4	1	1	1	1	1.50	4	4	3.17	C+
MOL6	1	4	1	1	5	2	2.33	3	3.5	2.94	B-
PRI1	1	5	1	1	2	1	1.83	3	4.5	3.11	C+
QUE1	2	1	1	1	1	1	1.17	2	2.5	1.89	A-
QUE2	1	5	1	1	3	2	2.17	2.5	3	2.56	B
QUE3	1	5	1	2	1	5	2.50	3.5	4	3.33	C
SCA1	DD	DD	DD	DD	DD	DD	DD	DD	3	3.00	C+
SUL1	5	5	1	5	DD	DD	4.00	5	3.5	4.17	D+
SUL3	1	4	1	5	5	1	2.83	3	3	2.94	B-
SUW1	2	1	2	1	DD	2	1.60	4	2	2.53	B
SUW2	DD	DD	DD	DD	DD	DD	DD	3	3	3.00	C+
WAT1	1	1	1	1	5	2	1.83	3	4	2.94	B-
WES1	1	4	1	5	5	2	3.00	3	4.5	3.50	C
WOO1	1	5	1	1	5	1	2.33	4	4	3.44	C
YAN1	1	2.5	1	1	5	2	2.08	2.5	2.5	2.36	B
YAR1	1	5	1	1	5	2	2.50	4	3	3.17	C+

1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = degraded

Ginninderra region CHIP scores by parameter

Reach	pH	EC	Turbidity	P	DO	Nitrate	WQ Score	WB Score	RARC Score	CHIP Score	Letter
CMM11	1	3	1	1	1	2	1.50	5	3	3.17	C+
GDC1	1	4	1	1	5	1	2.17	5	4	3.72	C-
GIN1	1	4	2	1	5	2	2.50	5	4	3.83	C-
GIN2	1	4	1	1	5	1	2.17	3	4	3.06	C+
GIN3	1	4	1	1	5	2	2.33	4	3.5	3.28	C+
GIN4	1	4	2	2	5	2	2.67	4	3	3.22	C+
GIN5	1	4	1	1	5	2	2.33	3	4	3.11	C+
GOO1	1	5	1	2	5	1	2.50	3	4.5	3.33	C+
GUN1	2	4	3	1	3	5	3.00	5	4	4.00	D+
GUN2	1	5	1	1	5	1	2.33	3	4	3.11	C+
KIP1	1	5	1	3	5	2	2.83	5	4	3.94	C-
MCW1	1	4	3	1	5	1	2.50	5	4	3.83	C-
MFL1	2	1	2	2	1	1	1.50	3	2	2.17	B+
YER1	DD	DD	DD	DD	DD	DD	DD	5	4.5	4.75	D-

1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = degraded

Southern region CHIP scores by parameter

Reach	pH	EC	Turbidity	P	DO	Nitrate	WQ Score	WB Score	ARC Score	CHIP Score	Letter
CGB1	2	1	1	1	5	2	2.00	2	3	2.33	B
CGG1	1	1	1	1	1	1	1.00	2	3	2.00	B+
CGH1	2	1	1	1	5	2	2.00	2.5	2	2.17	B+
CMM7	1	3	1	1	3	2	1.83	2	3	2.28	B+
CMM8	1	3	2	1	5	2	2.33	3	4	3.11	C+
CMM9	1	3	1	1	3	2	1.83	2.5	3	2.44	B
CMM1	1	2	1	1	1	1	1.17	5	3.5	3.22	C+
CMS1	2	3	1	1	3	1	1.83	3	4	2.94	B-
CTP1	1	1	1	1	3	2	1.50	2	3	2.17	B+
CTT1	2	1	1	1	5	1	1.83	3.5	2	2.44	B
GIB1	1	1	1	1	1	1	1.00	1	1.5	1.17	A+
LMS1	1	2	1	1	5	1	1.83	3	3	2.61	B
MCC1	2	1	1	1	1	2	1.33	3.5	2.5	2.44	B
MCC2	2	1	1	1	5	2	2.00	3	3	2.67	B-
MMB1	1	3	2	1	5	2	2.33	5	3	3.44	C
MPG1	1	3	3	2	5	2	2.67	5	4	3.89	C-
MSP1	2	2	3	1	5	5	3.00	3	DD	3.00	C+
NNN1	1	2	1	1	3	1	1.50	3	2	2.17	B+
RAN1	1	2	4	5	3	1	2.67	5	4	3.89	C-
RAN2	1	1	2	1	5	2	2.00	5	DD	3.50	C
TIP1	1	4	1	1	1	2	1.67	3	4	2.89	B-
TLT1	1	2	1	2	5	5	2.67	5	3	3.56	C
TLT2	2	3	3	1	5	2	2.67	5	4	3.89	C-
TMM1	1	2	3	2	5	1	2.33	3	4.5	3.28	C+
TUG1	1	4	1	1	2.5	1	1.75	5	4	3.58	C
TUG2	5	5	1	1	1	2	2.50	5	5	4.17	D+
TUG3	1	4	1	1	5	5	2.83	4	3	3.28	C+
UMC1	1	5	1	2	5	2	2.67	DD	4	3.33	C

1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = degraded

Yass region CHIP scores by parameter

Reach	pH	EC	Turbidity	P	DO	Nitrate	WQ Score	WB Score	ARC Score	CHIP Score	Letter
CMM1	1	3	1	1	1	2	1.50	3	3	2.50	B
CMM1	DD	DD	DD	DD	DD	DD	DD	5	4	4.50	D
YAS1	1	5	1	1	5	2	2.50	3	DD	2.75	B-
YAS2	1	5	3	1	5	1	2.66	3	3	2.88	B-
YAS3	2	5	1	1	5	2	2.67	5	3	3.56	C

1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = degraded

Appendix II

CHIP Methodology

Upper Murrumbidgee Waterwatch (Waterwatch) produces an annual catchment health report called the Catchment Health Indicator Program (CHIP), based upon the data collected by volunteers throughout the preceding year. This report is a key output of this program, and is used as both a communication tool and to inform management and policy regarding water resource use and protection. However, multiple complex calculations are involved in producing the CHIP, and numerous catchment groups around Australia produce similar (albeit slightly different) CHIPs. Conversely, specific details regarding these CHIPs are not generally forthcoming. This document aims to clearly outline the underlying philosophy and methodology regarding the Waterwatch 2015–2016 CHIP.

Multiple Types of Data

Waterwatch volunteers and co-ordinators collect data relating to water quality, macro-invertebrate abundance and diversity, and riparian condition. Each of these data sources are 'indices' or 'parameters', which, when combined, form an 'indicator'. Currently, the goal for volunteers is to collect water quality data every month, at every site. Volunteers and co-ordinators also collect aquatic macro-invertebrate data twice a year, in Spring and Autumn at key sites within each reach, generally near the bottom of each reach (to provide an indication of the entire reach). Finally, Rapid Appraisal of Riparian Condition (RARC; Jansen et al. 2005) assessments are conducted by volunteers and co-ordinators at each site once every 2 years (biennially). RARCs are conducted at lower frequency, as riparian condition changes at a slower rate than macro-invertebrate assemblages, and water quality. All these data are combined into the CHIP. Finally, additional data regarding algae abundance and diversity, frog abundance and diversity, and platypus abundance are used to provide context regarding catchment health, but are not formally included in the CHIP calculations (Table 1). More details regarding these additional data sources can be found in the section "Additional Data"

Water Quality Parameters

Currently, volunteers strive to collect water quality data for multiple parameters every month (Table 1). These parameters have been widely established as the best indicators of water quality while being relatively easy to measure and have been discussed in detail previously (eg. Waterwatch Victoria 1999). While there are known (and unknown) site-specific variations in these parameters, it is generally accepted for a majority of these that a specific range of values indicate good catchment health (eg. ANZECC 2000). Deviations away from these ideal values indicate declining health of the waterway. It is this philosophy that underpins the computations of the CHIP, and the grading of catchment health (see Appendix III).

Table 1. Summary of waterway health parameters collected by volunteers and co-ordinators, that are included in the CHI. These values here reflect current goals, but are not always achieved in all instances.

	Parameter	Frequency	Number of sites
Water Quality	pH	Monthly	All sites
	Electrical Conductivity	Monthly	All sites
	Turbidity	Monthly	All sites
	Total Phosphorus	Monthly	All sites
	Nitrates	Monthly	All sites
	Dissolved oxygen	Monthly	All sites
	Temperature	Monthly	All sites
Macro-invertebrates	SIGNAL 2.0	Biannual (Spring & Autumn)	Key sites (min 1/reach)
Riparian Condition	RARC	Biennial	All sites

Macro-invertebrates

Aquatic fauna (and flora) are ideal indicators of catchment health, as they are entirely dependent on the waterway for their existence. Aquatic macro-invertebrates differ greatly in their requirements, and their tolerances to changes in their aquatic environment. Numerous programs exist to assess waterway health based upon abundance and diversity of macro-invertebrate assemblages (eg. AUSRIVAS, SIGNAL, ALT) and are similar in many respects. Waterwatch use SIGNAL 2.0, with macro-invertebrate identification to the order level (not family as with AUSRIVAS). Specific details of the sampling methodology are outlined in the SIGNAL 2.0 user manual (Chessman 2001; Chessman 2003).

The SIGNAL 2.0 score obtained at each site receives an additional calculation to produce a modified stream pollution index. This helps to control for the diversity of macro-invertebrates found at a site. We have included an additional criteria this year, that examines whether the three key sensitive orders of Ephemeroptera (Mayflies), Plecoptera (Stoneflies) and Trichoptera (Caddisflies) are present, to aid with standardising scoring across the three data sources (WQ, Waterbugs and RARC). This number is transformed (similar to the water quality parameters, above), and the median value of all the sampling periods within the reach (including Spring and Autumn surveys), before being included in the CHIP (Table 2). Further details are present in Appendix III.

Table 2. Summary of SIGNAL 2.0 scores, and thresholds between the CHIP score categories.

# Taxa	SIGNAL Score	EPT Present	EPT Absent
>7	>5.5	Excellent	Good
>7	>5.5	Good	Fair
≤ 7	≤ 5.5	Fair	Poor
≤ 7	≤ 5.5	Poor	Degraded

Riparian Condition

The riparian zone along a waterway is integral to waterway health. The riparian zone performs several important functions, including acting as a buffer and filter to incoming runoff, and extracting nutrients from the waterway itself. Currently, RARC assessments are conducted biennially at all sites. A substantial number of surveys were conducted in Summer and Autumn 2015. This data has been incorporated for the first time into the CHIP in 2014–2015.

RARC was developed for use along the Murrumbidgee River in open floodplains dominated by a River Red Gum overstorey. As such, its applicability to the upper Murrumbidgee River catchment, urban environments and non-riverine habitats is questionable. However, it is still likely to be an effective tool for recording changes in riparian composition over time, irrespective of the score. The thresholds applied in the 2015-2016 CHIP are as follows (Table 3). These thresholds may be revised in the future, to better reflect the actual distribution of RARC scores present in the Upper Murrumbidgee River catchment.

Table 3. Summary of RARC scores, and thresholds between CHIP score categories.

RARC Score	CHIP Parameter
41–50	Excellent = 1
31–40	Good = 2
21–30	Fair = 3
11–20	Poor = 4
0–10	Degraded = 5

Combining Water Quality, Macro-invertebrate and RARC Data

Using the scores calculated for water quality, macro-invertebrates and RARC assessments, these values are averaged for each site. Currently, water quality, macro-invertebrates and RARCs are equally weighted in the CHIP. However, in the event that one of these is missing, a CHIP score is still produced. If two of the three assessments are missing for a reach, no CHIP score is produced.

Data Density

A potential source of bias can arise from insufficient data collection at sites within reaches. In order to overcome some of these issues, a rule has been applied to the water quality data to ensure a minimum amount of data is present, before a CHIP score is produced. Currently, a minimum of 25% of total potential water quality data must be present for a CHIP score to be produced. This is calculated by dividing the total number of sampling events available for analysis in the preceding year, by the number of sites within a reach, multiplied the number of total sampling events that should have occurred (12). This provides a proportional measure of the amount of sampling that has taken place within a reach in the preceding 12 months. In the event that <25% of data was collected, the water quality data is not included in the computation of a CHIP score.

The CHIP Score

The resulting CHIP score for each reach provides an indication of the overall health of that particular reach. While specific site-level variations (eg. some sites have naturally high electrical conductivity, low pH etc) may receive lower scores, it therefore requires that careful interpretation of these CHIP values be undertaken prior to making inferences of catchment health. In addition, the application of SIGNAL 2.0 in non-flowing aquatic habitats and RARC assessments in heavily urbanised environments may produce unusually low scores. In these instances, comparing within reaches, between years will be more appropriate than comparing between reaches, within years. These considerations must be taken into account when using and interpreting the CHIP. Finally, vitally important context is provided by the Waterwatch coordinators, who know the underlying geology, hydrology, landuse and history of the catchments. Their expert knowledge is critical to valid interpretations of the CHIP scores.

References

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Appendix III

Refining macroinvertebrate scores for the 2015–2016 CHIP

Background:

As part of the continual process of improving the rigour and transparency behind the calculation of CHIP scores, this year we have re-evaluated the process regarding how macro-invertebrate survey data contributes to producing final reach scores.

Throughout the 2013-2014 and 2014-2015 CHIP reports, macro-invertebrate scores have been based upon the divisions defined in the SIGNAL 2.0 manual (Chessman 2003; Table 1).

Table 1. Previous approach to computing CHIP scores based on macro-invertebrate sensitivities and and abundance, as defined by SIGNAL 2.0 (Chessman 2003).

SIGNAL SCORE	# macroinvertebrate orders 0 - 7	>7
>5.5	Fair	Excellent
≤ 5.5	Poor	Good

Macro-invertebrate surveys are categorised into 1 of 4 categories based on the number of taxonomic groups (Orders) and the weighted sensitivity of those orders collected (Chessman 2003). For example, where the weighted sensitivity is >5.5 and the number of taxa >7, will result in a CHIP score of "Excellent". Conversely, a weighted sensitivity of ≤ 5.5 and ≤ 7 taxa would result in a CHIP score of "Poor".

Unfortunately, this does not fit well with our 5 category ranking of catchment health. Indeed, under the previous scheme, it would be impossible to score a reach as "Degraded", as there is no "Degraded" category for macro-invertebrates.

Adjusting the score to 5 levels

TTo make the adjustment to a 5-level scoring system for macro-invertebrates, we have incorporated an additional criteria to the computation of the CHIP score for each macro-invertebrate survey (Table 2). This additional criteria examines whether all three EPTs (Ephemeroptera, Plecoptera and Trichoptera) are present. If 2 or less are present (eg. any one or more of these taxonomic groups are missing), then scores are penalised (Table 2).

Table 2. New macroinvertebrate scoring system for the 2015-16 CHIP.

# Taxa	SIGNAL Score	EPT Present	EPT Absent
>7	>5.5	Excellent	Good
>7	>5.5	Good	Fair
≤ 7	≤ 5.5	Fair	Poor
≤ 7	≤ 5.5	Poor	Degraded

Why EPTs?

The "EPTs" (Ephemeroptera, Plecoptera and Trichoptera) are the three orders of highly sensitive waterbugs – The Mayflies, Stoneflies and Caddisflies. These three orders are generally present where both water quality and aquatic habitat are in excellent condition. Indeed, in all surveys undertaken in the Upper Murrumbidgee catchment by waterwatch in the last two years, all surveys listed as "Excellent" contained these three orders. Both nationally and internationally, there is a strong focus on the EPTs as they are universally considered to be good indicators of good catchment health (eg. Marchant et al. 1995).

What do these changes mean for the CHIP?'

The main effect this change will have on the CHIP report is providing greater differentiation between Good, Fair and Poor reaches. Furthermore, it will now be mathematically plausible to score a reach as "Degraded". All previous sites scored as Excellent are unlikely to change, however reaches scored as Good, Fair and Poor have greater scope to shift downwards, if these three important taxa are missing from their macro-invertebrate surveys.

How does this change the previous CHIP?

By way of examination of these changes on the CHIP result, here we present a comparison of CHIP scores from the 2014–2015 CHIP report, with the old CHIP scores, and the new (Table 3).

Table 3. Summary of changes to the reach scores from the 2014-15 CHIP with the update in macroinvertebrate scoring

SCORE	OLD	NEW
Excellent	4	4
Good	45	34
Fair	36	42
Poor	5	10
Degraded	0	0

In the 2015-2016 CHIP, we present the 2014-2015 CHIP results with the updated macro-invertebrate scoring system, to facilitate direct comparison between the two reports.

Chessman, B (2003) New sensitivity grades for Australian river macroinvertebrates. *Marine and Freshwater Research* **54:** 95-103

Marchant, R., Barmuta, LA., and BC Chessman (1995) Influence of sample quantification and taxonomic resolution on the ordination of macroinvertebrate communities from running waters in Victoria, Australia. Marine and Freshwater Research **46:** 501-506

Appendix IV

Refining water quality thresholds for the CHIP

Background:

In developing the 2013–2014 CHIP, a set of thresholds had to be applied to the water quality parameters in order to produce water quality scores. These are summarised in Table A2 of Appendix III of the 2013–2014 CHIP report (Figure 1).

Figure 1. Summary of 2013–2014 water quality thresholds from CHIP report.

Indicator Rating	Excellent 1	Good 2	Fair 3	Poor 4	Degraded 5	Comment
pH	6 – 7	5.5 – 6 or 7 – 8	8 – 8.5	5 - 5.5 or 8.5 - 9	<5 or >9	
EC (µS)	<=65	<=200	<=350	<=400	>400	
Turbidity (NTU)	<=10	<=12.5	<=15	<=20	>20	
Dissolved oxygen (mg/L)						Not included in CHIP
DO saturation (%)	95 – 105	85 – 95 or 105 – 110	75 – 85	65 – 75 or 115 – 120	<65 or >120	
Total Phosphorus (mg/L)	<0.01	0.01 – 0.02	0.02 – 0.05	0.05 – 0.09	>0.09	
Nitrate (mg/L)	<1.0	1 – 4.9	5 – 9.9	10 – 15	>15	

These thresholds are based largely on those developed by the Molonglo CHIP report (M-CHIP). The M-CHIP values were developed in 2 parts – an urban and rural scale. The rural-scale values were used for the 2013–2014 CHIP report, with a few minor tweaks (mostly to dissolved oxygen) before being implemented. Unfortunately, there is no clear evidence trail of how these thresholds were developed, and so we treated them as based upon expert knowledge.

For the 2014–2015 CHIP report, we aimed to develop a new set of thresholds based upon water quality data collected in the ACT region. The key issues in developing these new thresholds will be outlined here.

Identifying a data set: independence, data quality and reference sites

Numerous sources (ANZECC, ACT Water Regulations, other catchment report cards) promote the development of meaningful thresholds based upon a 'training dataset'. A training dataset is a relevant water quality dataset used to determine thresholds which can be applied to data collected throughout the catchment for the purposes of reporting. The strengths of this approach are that thresholds are locally relevant, are developed in a transparent manner and are updateable and repeatable.

Ideally, an independent dataset would be used to redefine thresholds. This has two major benefits.

Firstly, an independent dataset would not be burdened with any real or perceived data quality issues that volunteer collected data may have. Key issues regarding sampling bias, accuracy and precision of equipment and reporting of data can be eliminated. Secondly, thresholds developed from an independent dataset may be retrospectively applied to all Waterwatch data. The use of Waterwatch data would prevent the application of thresholds to data used to define the thresholds (a problem of circularity).

There are limited sources of data available in the ACT region which may be used to develop thresholds. The most obvious data sources are those collected and maintained by the ACT Government, Icon Water and University of Canberra.

In examining the external water quality to develop thresholds, a key consideration is the choice of sites with which to use to create new thresholds. Obviously, the choice of sites will have a major impact on the threshold values produced. Sites that are considered to represent 'reference condition' are preferred over all others. Reference condition is defined, for the purposes of the CHIP, as sites that represent minimally impacted areas in the ACT region. Ideally, these sites will exist in minimally impacted agricultural or conservation managed lands, without significant impacts from urban centres or major developments.

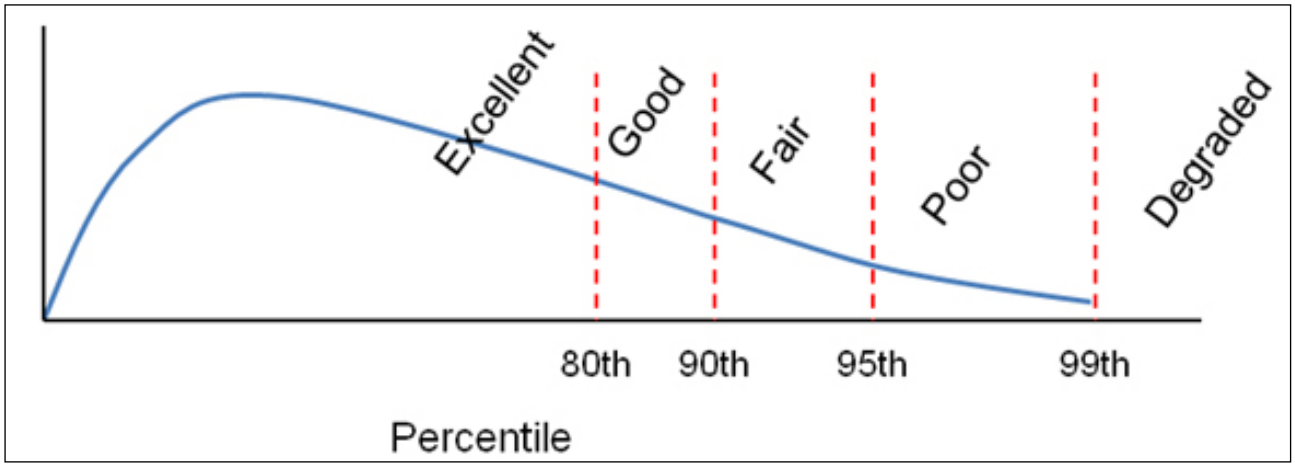
A second key issue is the amount of data available. This is further complicated by the impact that the millennium drought had on reference site condition. For example, data from reference sites of the AUSRIVAS macro-invertebrate monitoring program showed major declines in the relative health of some reference sites during the millennium drought. This is not surprising, but including data that shows negative impacts of drought would influence the discriminatory power that the reference condition approach could provide. These impacts are likely to be present in water quality data that exists from the same time period.

Defining the thresholds

There are numerous ways water quality data could be categorised to produce a score, but we have chosen to use percentiles derived from a frequency histogram of water quality data taken from reference sites to define the thresholds for the CHIP.

Our approach is outlined in figure 2. After creating a frequency histogram from reference condition data, the threshold values for each parameter are defined using the 80th (Excellent), 90th (Good), 95th (Fair), 99th (Poor) and >99th (Degraded) percentiles. The implicit assumption is that parameter values that occur in excess of 80% of the time in the reference sites reflect excellent quality, with rarer occurring events being of lower quality. Finally, it is assumed that 'degraded' water quality would only be observed <1% of the time in a reference condition site.

Figure 2. Depiction of defining thresholds based upon a frequency distribution of data.



Identification of 'reference sites'

The selection of sites from which to produce thresholds will have a major impact on final scores produced in the CHIP report. Site selection is critical to how scores are interpreted. While arguably the score is irrelevant, and rather the change in any site/reach through time is more important, the reality is that scores will be interpreted directly without appropriate thought to how they were derived.

Preference will be to select sites that exhibit minimal levels of agricultural and urban impacts. Avoiding urban influences should be relatively straightforward, however agriculture is widespread throughout the upper Murrumbidgee catchment, hence obtaining sites without agricultural impacts will be difficult. Furthermore, historical impacts from agriculture, mining and land clearing may still be having pervasive impacts on water quality, which may be hard to identify in the first instance, and may not be readily avoidable, in any case. As such, 'reference condition' must not be interpreted as 'pristine'. Rather, it reflects the condition of minimally impacts sites within the catchment. As such, long-term goals aspiring towards water quality in sites equivalent to that of reference condition is a worthy goal, yet by no means suggests a return to pristine or non-impacted conditions.

There are limited sites in the Upper Murrumbidgee River catchment that have long-term data records from which to derive frequency distributions. Data available from Icon water for the Upper Cotter River catchment (above, and including Corin reservoir) and water quality collected from the Goodradigbee River catchment represent the most practical 'reference condition' datasets for the CHIP.

The catchments to the east of the Murrumbidgee River have a different underlying geology compared to the catchments west of the Murrumbidgee River (eg. The Cotter River, and Goodradigbee River.) Likewise, the Ginninderra and Yass catchments may tend to exhibit high electrical conductivity compared to other catchments. With additional data, electrical conductivity thresholds would be developed for the Molonglo, Ginninderra and Yass catchments, provided suitable data from 'reference condition' sites could be found. This is highly unlikely to occur.

Data availability

Icon Water generously provided water quality data for 2 riverine sites upstream of Corin reservoir, three sites within the upstream-most section of Corin reservoir, and data from 3 sites on the Goodradigbee River, and 3 sites on tributaries of the Goodradigbee River, collected by University of Canberra (Table 1).

Table 1. Summary of sites used to define reference condition for CHIP thresholds

Site Name	Years of data	Parameters
Cotter Hut	2007-2014	pH, turbidity, EC, DO
Gingera	2003-2015	pH, turbidity, EC, DO
Corin Reservior site 7	1994-2015	TN, TP
Corin Reservior site 8	1993-2015	TN, TP
Kangaroo Ck	2003-2015	TN, TP
Goodradigbee River site 1	2006-2015	pH, Turbidity, EC, TN, TP
Goodradigbee River site 2	2006-2015	pH, Turbidity, EC, TN, TP
Goodradigbee River site 3	2006-2015	pH, Turbidity, EC, TN, TP
Goodradigbee Tributary 1	2006-2015	pH, Turbidity, EC, TN, TP
Goodradigbee Tributary 2	2006-2015	pH, Turbidity, EC, TN, TP
Goodradigbee Tributary 3	2006-2015	pH, Turbidity, EC, TN, TP

Data analysis

Data analysis involved producing frequency histograms of each of the water quality parameters at each site. Firstly, the impact of the millennium drought was explored by comparing histograms for data collected 2010-current, against pre-2010 data. If no observable difference in distributions was present, data was combined. If significant differences were present, only data post-2010 was considered for threshold production.

After identifying non-drought impacted data, sites were combined and examined. If substantial differences in distributions were evident across sites, they were not combined. Conversely, if no major discrepancies were present, data across sites was combined. The exception to this rule was made for electrical conductivity –the upper Cotter River is very low in electrical conductivity, compared to the Goodradigbee catchment. We chose to combine data from the Cotter River and Goodradigbee River to produce EC thresholds for the CHIP as this will better reflect the apparent naturally higher EC readings from other areas in the catchment such as the Molonglo and Ginninderra.

New thresholds

Table 2 presents the new threshold values applied in the current CHIP. Thresholds were developed based upon the 80th (excellent), 90th (Good), 95th (Fair), 99th (Poor) and > 99th (Degraded) percentiles, for each parameter. For pH and dissolved oxygen, the 10th and 90th (Excellent), 5th and 95th (Good), 2.5th and 97.5th (Fair), 0.5th and 99.5th (Poor) and <0.5th and >99.5th (Degraded) percentiles were used to define thresholds.

Table 2: New water quality CHIP thresholds for 2014-2015 CHIP.

Parameter	Excellent	Good	Fair	Poor	Degraded
pH	6.6 – 7.8	6.1 – 6.5, 7.9 – 8.0	5.7 – 6.0, 8.1 – 8.2	5.4 – 5.6, 8.3 – 8.6	< 5.4, > 8.6
EC (uS)	≤ 98	99 – 156	157 – 212	213 – 404	> 404
Turbidity (NTU)	≤ 10	11 – 16	17 – 36	37 – 90	> 90
DO (mg/L)	Not included in CHiP				
DO Sat. (%)	88 – 99	84 – 87, 100	81 – 83, 101 – 106	78 – 80, 107 – 115	< 78, > 115
TP (mg/L)	< 0.02	0.02 – 0.03	0.04 – 0.05	0.06 – 0.08	> 0.08
Nitrates (mg/L)	< 1.0	1.0 – 1.3	1.4 – 1.7	1.8 – 2.6	> 2.6

Going forward: interpreting the CHIP

Interpreting CHIP scores must explicitly consider how the scores were derived. The data used to derive the water quality thresholds come from water quality monitoring sites in the upper Cotter River catchment and the Goodradigbee River catchment.

As such, all WQ CHIP scores are to be considered in relation to the 'reference condition'.