WATERWATCH
Upper Murrumbidgee

Catchment Health Indicator Program

2018

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

Cover photo of Jan sampling at Gibralter Falls by John Corcoran

Contents

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 (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 2018 CHIP report is based upon 2,081 water quality surveys, 192 water bug surveys and 220 riparian condition surveys conducted by over 200 volunteers. The total number of sites surveyed has increased this year from 222 to 232 with a total of 96 reach report cards produced. An important addition is that we have started to include the number of 'dry' surveys conducted in the overall survey tally (ie. when a volunteer has visited their site but it is completely dry). While these do not contribute to the CHIP score, they are an important factor in the condition of the catchment and highlight survey effort. A total of 118 water quality surveys were 'dry' in 2018, taking the number of surveys that contributed to the CHIP score down to 1,963. This is still 100 more surveys with data than in the previous CHIP report. From 2018 onwards, the CHIP report will run to a calendar year. Previous editions have run to the financial year, with the last report covering 2016/17. The last six months of 2017 data was not assessed in order to transiton to the 2018 approach.

There were two new reaches created in this CHIP year. GIN6 includes the Ginninderra Falls area, and splits the GIN5 reach to better represent the lower a rural landscape (GIN5) from a conservation area (GIN6). Likewise, a new site in the Yass township has enabled us to highlight an urban reach (YAS3) and rural country downstream, before the Yass River enters Burrinjuck Dam (YAS4). All these refinements help to ensure that the data collected best represents the condition of a reach. Also. the key reach of CMM11 on the Murrumbidgee River immediately downstream of the Molonglo River confluence, was data deficient last year due to access issues, but is now reinstated and has received a score this year.

Of the 96 reaches presented in this report (Table 1), five were scored as in 'excellent' condition. One reach in the Cooma catchment plus four in Southern ACT. A further 37 reaches were scored as being in 'good' condition, eight less than last year, and 49 reaches were in 'fair' condition, six down on last year. Only three reaches received a 'poor', which is one more than last year. Overall, 55% of reaches fell into the fair/poor range which is a rise from 47%. Two reaches have report cards but didn't receive scores; one was due to their closure for ACT Healthy Waterways construction and the other was data deficient due to being dry for most of the year – despite the volunteer visiting the creek every month.

Table 1: CHIP results for 2018.

CHIP Result	Cooma	Ginninderra	Molonglo	Southern ACT	Yass	Total
Excellent (A)	1	0	0	4	0	5
Good (B)	12	2	8	12	3	37
Fair (C)	10	13	16	7	3	49
Poor (D)	0	0	1	2	0	3
Degraded (E)	0	0	0	0	0	0

The downward trend in scores in 2018 is most likely a result of it being the driest Autumn since 2004 and the driest Winter since 1994 for the ACT region. The three main CHIP parameters were all adversely affected to varying degrees, with water quality showing higher electrical conductivity and lower dissolved oxygen, water bugs being caught in lower numbers and riparian assessments highlighting increases in bare ground. Volunteers, many who have been monitoring for 10+ years, reported their sites ceasing to flow or completely drying up for the first time since they have begun monitoring.

The lower water bug numbers would also support the lower number of Platypus recorded in surveys during 'Platypus Month' in August. Given Platypus feed almost exclusively on water bugs (eating 25% of their body weight daily), it is believed that they may be forced to move further out of their territory in dry times, in order to meet their dietary requirements. A spike in Platypus sightings in Lake Burley Griffin in August, where Platypus are usually only occasionally seen, would also give weight to this theory.

When it did rain, it often came in short sharp storms. A prize example is at the Ginninderra CSIRO rain gauge in February 2018. At the 25 February 2018, the gauge had received only 1.8 mm of rain for the entire month. On 26 February, however, it received 98.2mm in 24 hours. When this kind of rain falls on areas of bare ground, with limited trees, bushes or grasses, there is little opportunity to slow the water down and for infiltration and groundwater recharge to take place. Soil is washed into the waterway, creating high turbidity events and resulting in sediment settling on the bottom of the river and choking habitat for fish, water bugs and aquatic plants.

Forecasts predict that the weather patterns of 2018 will become more frequent as the impacts of climate change take effect. Given the stress the ecosystems have demonstrated during 2018, it is more important than ever for us to build resilience into waterways and their surrounding catchments. Improving the presence and diversity of aquatic plants in our rivers and wetlands will provide more refuge for water bugs and assist in managing oxygen levels and taking up excess nutrients in the system. Improving the native trees, shrubs and grasses along the edges of our waterways (the riparian zone) will help treat and slow water down, before it enters the system, while also shading the water and maintaining more stable, healthy temperatures.

Waterwatch continues to work hard to promote the CHIP to government and community organisations involved in managing our waterways. The success of this, is evident in the increased uptake of the CHIP, with the next State of Environment report due out later in 2019, looking to feature data from the past four CHIP reports. Also, in late 2017, Waterwatch received the ACT Landcare Award for Citizen Science. This is a testament to the thousands of volunteers who have been part of this program for over 20 years. The Waterwatch staff always knew our volunteers were amazing, but it's nice for someone else to acknowledge it too. Pictured below are some of the staff and volunteers holding said award.

The 2018 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 Program and from Icon Water.

Thank you, as always, to the volunteers. This report would not be possible without their continued efforts to collect this important data on the health of our waterways. Particularly in this past year, as volunteers go out to sites that are dry or drying up, their resolve is more important than ever to capture the condition of our waterways and better inform catchment managers. The CHIP continues to rise in profile and be used by more managers and policy makers. The continued collection of large amounts of high quality data is a real credit to the dedication of the volunteers who have demonstrated that with support, they can make a significant contribution to the improvement of our 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, with the exception of the Goodradigbee catchment. The total area monitored by Waterwatch is more than 11,400km^2.

Four Waterwatch coordinators 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, the Yass catchment has increased to six report cards, and continues to be an area of growth for the program.

As at 31 December 2018, Waterwatch had 232 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 initiative 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 houses over 29,000 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 an ongoing 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 coordinators 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 physico-chemical properties of water, in-stream 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 coordinator. This provides further insight into the state of that reach and possible issues influencing the score. Data from another Waterwatch initiative such as Platypus Month and Carp Love 20°C, as well as from our colleagues at Frogwatch, are also used in these report cards to provide greater context.

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
	Nitrate	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 five major sub-catchment areas represented in this report. The Goodradigbee catchment is not included in this report.

2018 CHIP

The 2018 CHIP report is based upon 2,081 water quality surveys, 192 water bug surveys and 220 riparian condition surveys conducted by over 200 volunteers. The total number of sites surveyed has increased this year from 222 to 232 with a total of 96 reach report cards produced. Two of these report cards didn't receive scores; one was due to their closure for ACT Healthy Waterways construction and the other was data deficient due to being dry for most of the year – despite the volunteer visiting the creek every month. We have started to include the number of 'dry' surveys conducted in the overall survey tally. While these do not contribute to the CHIP score, they are an important factor in the condition of the catchment and vital data to collect in an increasingly unpredictable climate. From 2018 onwards, the CHIP report will run to a calendar year. Previous editions have run to the financial year with the last report covering 2016/17. The last six months of 2017 data was not assessed in order to transiton to the 2018 approach.

Thank you, as always, to the volunteers. This report would not be possible without their continued efforts to collect this important data on the health of our waterways. The CHIP continues to rise in profile and be used by more land managers and policy makers. Particularly in this past year, as volunteers go out to sites that are dry or drying up, their resolve is more important than ever to capture the condition of our waterways and better inform catchment managers.

Cooma Region Catchment Facts

The Cooma Region includes the upper Murrumbidgee River mainstem south of the ACT, and the Bredbo, Numeralla, Kybeyan and Badja River sub-catchments. These sub-catchments provide the dominant inflows for the Cooma Region as 99% of the headwaters of the Murrumbidgee River are diverted at Tantangara Dam.

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. The headwaters of catchments are generally less modified and are in better condition. Protection of instream and riparian (riverbank) habitat needs to be prioritised in these areas.

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.

Small yet resilient native fish populations are found in the upper Murrumbidgee River catchment including Murray cod, Trout cod and Macquarie perch. Murray river cray fish, Water rats, Platypus and Eastern long necked turtles are also found. This is due to the high quality aquatic habitat found in our catchment.

The Upper Murrumbidgee Demonstration Reach (UMDR) initiative aims to bring together catchment organisations and the broader community to protect high value aquatic habitats and species of the upper Murrumbidgee catchment via protection of habitat, erosion control works, riparian fencing and planting, woody weed control, returning woody debris for fish habitat, native fish stocking and removing Carp.

Waterwatch volunteers have been monitoring river health in the Cooma Region since 2010. Their work is helping to tracking progress of improvement works across the catchment.

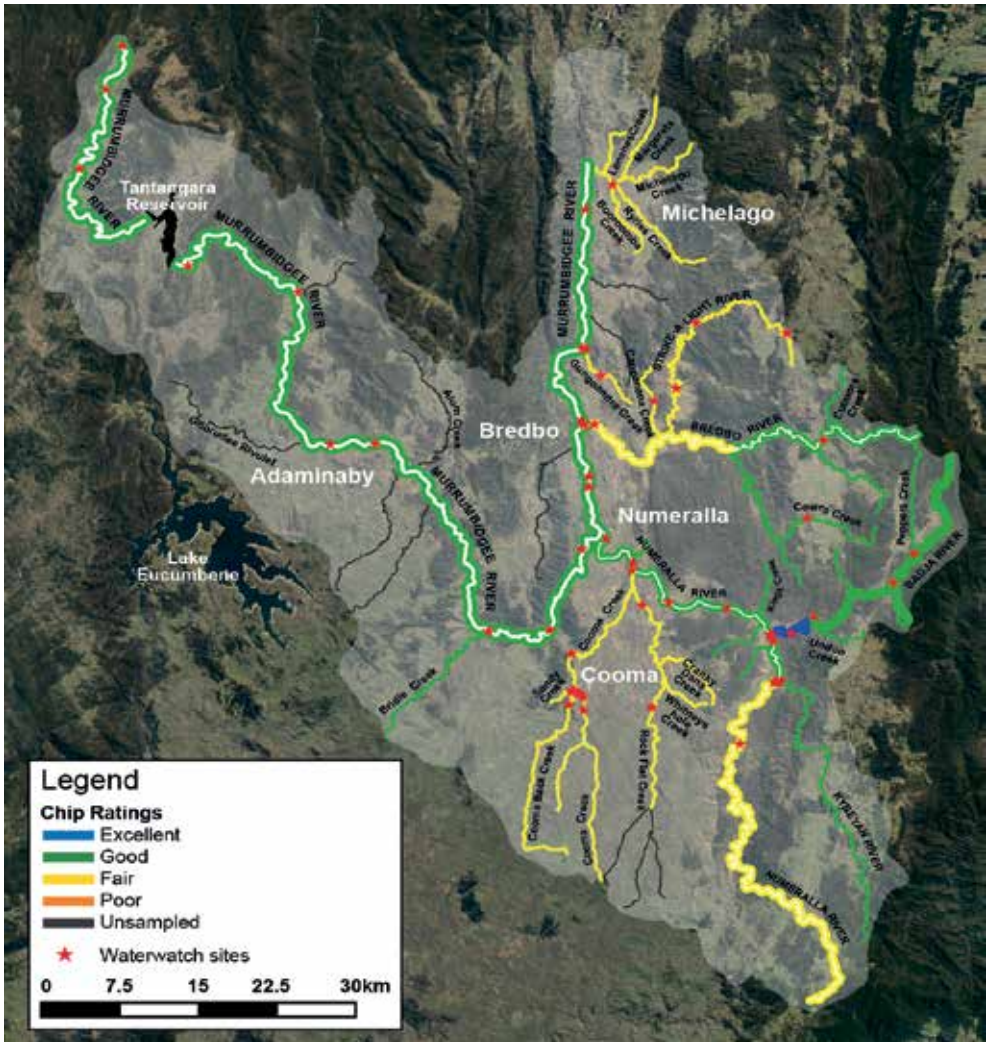
Cooma Catchment Health Summary

2018 in the Cooma Region was notable for its lack of rainfall which impacted heavily on flows. Condition scores for many reaches declined slightly compared to the previous CHIP. In many reaches this was driven by a reduction in water bug scores. This year's Autumn bug surveys also showed that water bugs were in very low numbers at some sites, even despite consistent sampling effort. Interestingly, water quality improved from fair to good, in the urban section of Cooma Creek, during the year. This may seem surprising at first, but makes sense when one considers that a reduction of stormwater inflows also results in a reduction in pollutants entering the Creek which has a positive effect on water quality.

After a very cold, dry and extended Winter and with no significant 'Spring break' rain, our catchment experienced tough conditions which impacted on ground cover levels and food availability for grazing herbivores, both native and introduced. Grazing pressure could be noted in many in-stream and riparian areas, including grazed reeds beds and damage from pigs. The lower Cooma Creek completely dried up several times this year which has not been observed since Waterwatch monitoring began in the Cooma Region in 2010.

Platypus sightings recorded at our Platypus Month surveys were down in 2018, even at Bush Heritage Australia's Scottsdale Reserve, which is a noted Platypus hotspot in the region. Only one Platypus was recorded for the Cooma Creek at one of the four surveys carried out there. Interestingly there were reports of Platypus sightings in other areas of the Cooma Creek during Platypus Month. This supports the finding of the Australian Platypus Conservancy that during drought years sightings are less frequent due to lesser breeding activity as well as the Platypus using a wider area in search of water bugs - their primary food source.

This year Waterwatch has increased its monitoring activity in the headwaters of the upper Murrumbidgee River at Long Plain. Horse impact on in-stream habitat has been increasingly apparent over the last years. After the snowmelt this year extensive pugging (trampling of stream banks) was observed corelating with a rise in turbidity at the worst affected sites.



Badja River BAD1

Headwaters to Undoo Creek

2018 CHIP Result B+ (Good)		
2016/17 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**23**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**1**
Riparian condition	**Good**	**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

This reach includes the headwaters of one of the most healthy streams in the Cooma Region. Factors which contribute to this are the intact in-stream and adjacent habitat found along the river and its tributaries. Water quality readings were found to be excellent overall in 2018 and these are consistent with results throughout years of monitoring in this reach. Although this makes monitoring a bit monotonous for our dedicated Waterwatch volunteer, we are very happy to continue seeing this data as it indicates ongoing stable conditions continue to persist in our best catchment.

Water bug surveys are always interesting for sites in this reach because high numbers and diversity are found, especially within sensitive bug types. This year we observed 'Killer' mayflies (Genus Mirawara) in our bug sample. Mirawara are rare and only found in fast-flowing cobble streams. They are the only predatory mayfly nymph found in Australia.

Peppers Creek at PEP050 (Photo: Jim Wharton).

Badja River BAD2

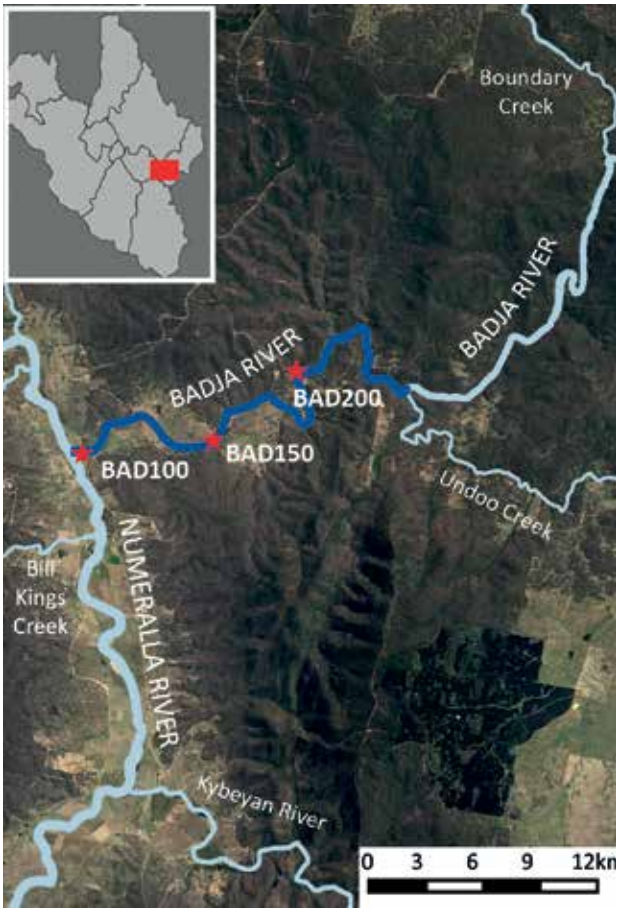
Undoo Creek to Numeralla River confluence

2018 CHIP Result A- (Excellent)		
2016/17 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	Degraded	
Water bug	**Good**	**3**
Riparian condition	**Good**	**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.



Reach Condition

Water levels have been lower in this section of the Badja River throughout 2018, apart from some short sharp flushes generated by storm activity. The River is known to become turbid after such events due partly to the cultivation of the adjoining floodplain. Tributary gully erosion and an increased presence of woody weeds such as Willows are also causing problems, while gold fossicking activities are increasingly impacting the riparian zone near BAD200.

This reach has seen an improvement on the previous CHIP assessment due mainly to a better water bug score. This reach is part of one of the healthiest streams in not just in the Cooma Region, but in the entire upper Murrumbidgee catchment and consequently highlights the importance of continued efforts to protect and improve the reach. This includes work that the Numeralla Landcare Group is doing in partnership with the local landholder, to plant native vegetation at BAD100 and control Blackberry along the entire reach as well as erosion control on tributary gullies.

The Badja River at BAD100.

Bredbo River BRD1

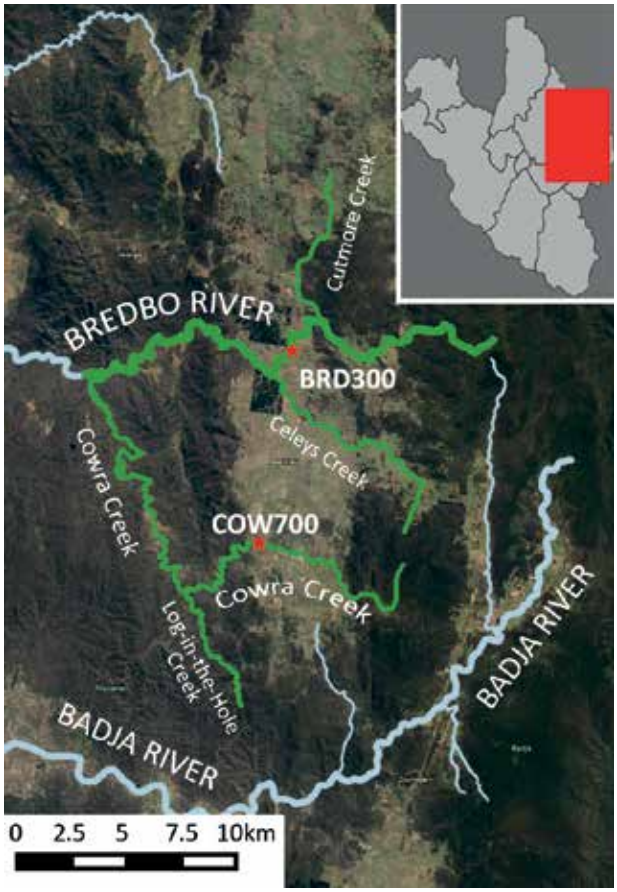
Headwaters to Cowra Creek confluence

2018 CHIP Result B+ (Good)		
2016/17 CHIP Result A- (Excellent)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**18**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Good	
Water bug	**Good**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

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

This reach includes the headwaters of the Bredbo River down to and including Cowra Creek. It runs through a mix of unmodified vegetation and cleared, grazing country. Generally good groundcover levels are retained throughout the catchment which in turn protects water quality, however some gully erosion is found in the middle of the Cowra Creek catchment.



Reach Condition

The sites in this reach are characterised by consistent excellent water quality - even after heavy runoff events. This demonstrates the positive effect of a well vegetated catchment. Water levels became low over the dry Winter and Spring, but streams continued to flow despite this. A site visit to Cowra Creek downstream of our monitoring site (COW700) showed the effects of erosion along the creek. Thus the lower section of the creek will become turbid during runoff events from this point on. Carp are also known to occur there.

Water bug surveys in this reach have always shown an array of water bug types and this year has been no exception. There was good diversity of our three most sensitive water bug types found, including stoneflies, mayflies (three types) and caddis flies (four types). The stoneflies present here, belong to the family Grypopterygidae (commonly known as 'fluffy-bums'). They have a fluffy bunch of gills at their hind end which they can move through the water column, improving their ability to draw in oxygen from the surrounding water.

'Fluffy-bum' stoneflies (Grypopterygidae) from the Bredbo River.

Bredbo River BRD2

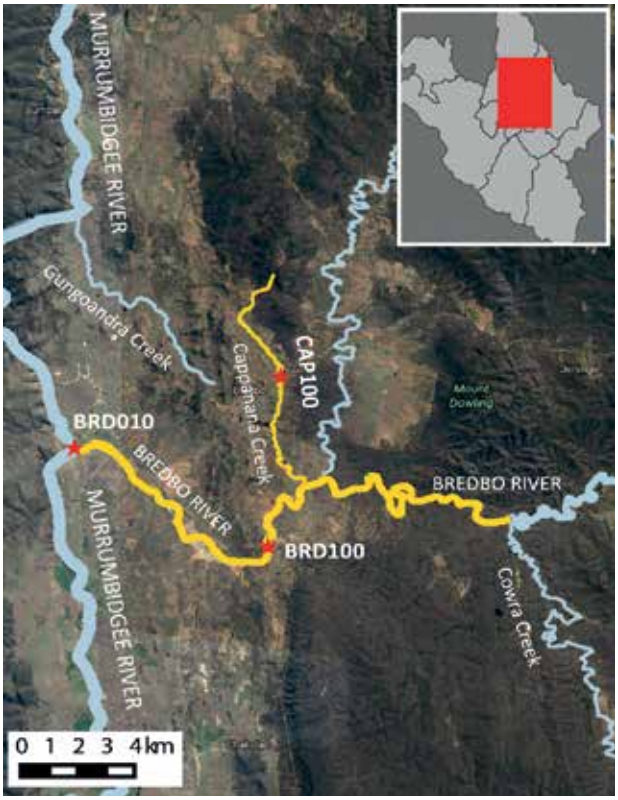
Cowra Creek to Murrumbidgee River confluence

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**23**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**3**

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. This reach is a high priority ACWA catchment with five key erosion sites occuring within it.



Reach Condition

In some areas of this reach, cows are allowed to graze the river corridor and Carp are reported in high numbers. Erosion has caused sand to wash into the river which can smother the river bed and compromise the habitat for water bugs, fish and Platypus. The areas adjacent to the River (the riparian zone) is dominated by exotic vegetation including Blackberry, Willows and Poplars.

That said, towards the end of the reach, native reed beds are establishing and having a stabilising effect which will increase habitat and allow the re-establishment of a river channel through the wide sand bars currently found there. A diversity of in-stream habitat is found in some sections here, which is where the Autumn and Spring water bug surveys were conducted. The two surveys this year highlighted the effects of low flow on water bugs; Autumn was very dry with much of the habitat not available and the survey received a 'degraded' score Spring had good flows and plenty of sensitive water bugs were found such as 70+ stonefly nymphs. The latter survey received an 'excellent' score.

Bredbo Landcare and landholders are improving the Bredbo River through native plantings and woody weed control.

Cooma Creek COO1

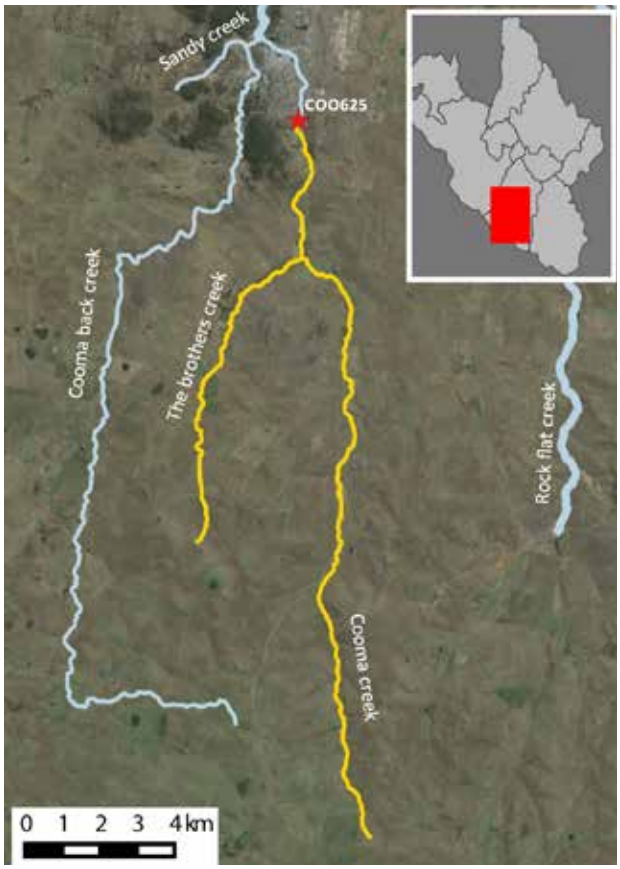
Headwaters to Banksia Lane

2018 CHIP Result C (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**17**
pH	Good	
Turbidity	Excellent	
Phosphorus	Degraded	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**2**

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 in-stream vegetation (reeds/sedges) that are beneficial for stability and nutrient retention, are largely absent in this reach.



Reach Condition

This reach has continued to flow throughout 2018, despite the very dry conditions resulting in low creek levels. During the first half of the year the water appeared clear and fresh, but algal blooms were seen in Spring, likely due to a combination of the low flows, warmer conditions and elevated phosphorus levels.

The upper catchment is used for grazing and cultivation. Much of the creek is unfenced in this reach and stock have access to the vegetation adjacent to the river (the riparian zone) which reduces ground cover and increases erosion. Thus, turbidity can become elevated after rain events. Natural factors such as the geology of the catchment also contribute, in part, to the observed levels of electrical conductivity, pH and phosphorus. These factors combine to influence the overall CHIP score.

Volunteer Emily Griffin sampling Cooma Creek at COO625.

Cooma Creek COO2

Banksia Lane to Cooma Back Creek confluence

2018 CHIP Result C (Fair)		
2016/17 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**16**
pH	Good	
Turbidity	Excellent	
Phosphorus	Degraded	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
Water bug	**Good**	**2**
Riparian condition	**Degraded**	**2**

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 untreated. Litter from stormwater drains is an ongoing problem. There is a popular walking path along the length of this reach.

Reach Condition

Very dry conditions resulted in low in-flows from the upstream catchment areas this year and creek levels were being topped up by inflows from urban run-off. This influenced water quality results especially for high phosphorus and electrical conductivity. Algal blooms were seen throughout this reach in Spring for the first time since Waterwatch volunteers began monitoring. This is likely due to a combination of low flows, warmer conditions and elevated phosphorus levels.

This section of Cooma Creek suffers from gross litter which washes in from around town, through the stormwater system. Each year Cooma Waterwatch runs a community clean up on Clean Up Australia Day, supported by Snowy Monaro Regional Council. This year Monaro High School's Year 7 extension science class also conducted an additional mid-year litter survey and clean up. Analysis of the results found that plastic bags, plastic drink bottles and fast food packaging were the most common items found.

Monaro High School Year 7 Science class hard at work.

Cooma Creek COO3

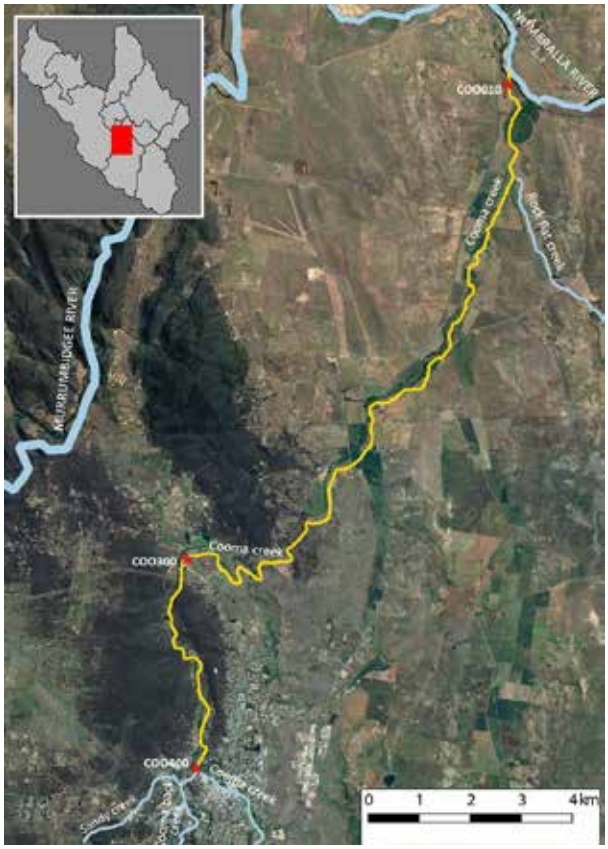
Cooma Back Creek to Numeralla River confluence

2018 CHIP Result C (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**21 (2 dry)**
pH	Good	
Turbidity	Excellent	
Phosphorus	Degraded	
Nitrate	Degraded	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**1**
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 Bunyan and Chakola which is dominated by river flats used for irrigated cropping.



Reach Condition

Dry conditions resulted in low creek levels this year, with the Cooma Creek at COO010 being recorded as dry on several occasions. A freshly killed Water rat was found at this site during one of these dry times. Teeth marks from a dog/fox hinted at the cause of death and highlights the vulnerability of our aquatic fauna during extended periods of drought. This is especially troubling on streams such as the Cooma Creek where there is a general lack of native vegetation to provide protective cover.

The top of this reach is our Platypus Month monitoring site and Platypus continue to be recorded in our surveys. Riparian vegetation is being improved along the creek to help protect Platypus habitat as part of the NSW Environmental Trust funded '*Improving Cooma Creeks*' project. Platypus sightings reported to us this year show they have been moving about more. This is likely due to the drought reducing the amount of water bugs in the system (their main diet) and pushing Platypus out of their usual range, in search of food.

Volunteer Dave Harkins monitoring at COO400.

Cooma Back Creek COB1

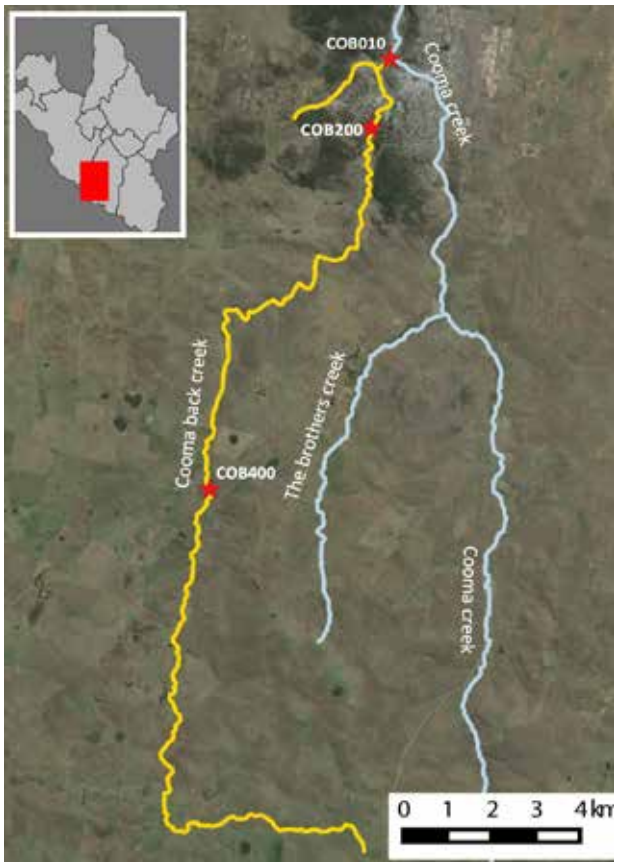
Headwaters to Cooma Creek confluence

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**37**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Fair	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**1**
Riparian condition	**Poor**	**3**

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 the Jillimatong and Sandy Creeks. The upper sections of the reach flows through open, cleared basalt country used for grazing and dryland cropping. The lower, urban section of the reach includes the Lambie Gorge area which is a site of Aboriginal cultural significance.



Reach Condition

This reach had consistently low flows at all sites throughout the year. Observations from our volunteers noted heavy algal growth, in-stream weeds and Azolla growth (a native floating fern that persists in areas of low flow). Heavy grazing by wallabies, kangaroos, wombats and rabbits was also observed.

Electrical conductivity is always high in this reach due to its geology and urban in-flows. The score goes up in dry periods as the salts and minerals become more concentrated in the water column. COB200 was especially problematic this year with six readings of electrical conductivity over 1000µS/cm.

Our Frogwatch surveys found that the bottom end of Lambie Gorge had the highest frog diversity of sites surveyed within the Cooma township, with five species being recorded. Riparian plantings are being carried out below the Gorge as part of the NSW Environmental Trust funded *'Improving Cooma Creeks'* project, to help enhance habitat for frogs. The project has also stabilised an erosion site near the Creek's confluence which will help to improve water quality.

Pam Vipond from Snowy Monaro Regional Council showing off the erosion works near COB010.

Gungoandra Creek GUD1

Headwaters to Murrumbidgee River confluence

2018 CHIP Result C+ (Fair)

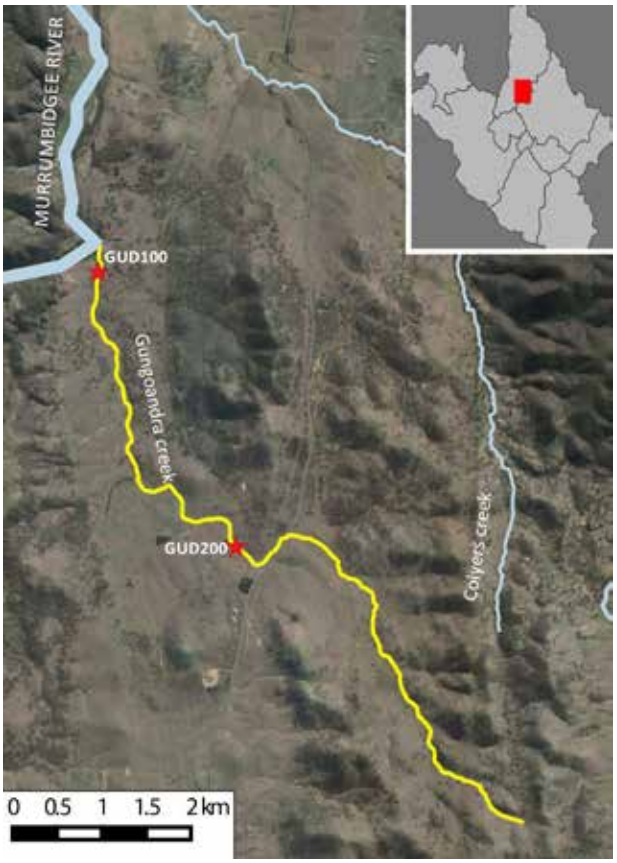
2016/17 CHIP Result B (Good)

Parameter	Rating	No. Survey
Water quality	**Good**	**22**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
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 in-stream macrophytes are continuing to establish.



Reach Condition

The Bush Heritage Australia's Scottsdale Reserve, where the majority of Gungoadra Creek sits within, was previously a 'working' farm used for dryland cropping and grazing. The catchment and the Creek have been transformed significantly since monitoring began here eight years ago. Thick stands of native reeds have been establishing along the length of the Creek at Scottsdale providing positive benefits such filtering, settling sediment, in-stream habitat and stabilising the stream channel. Reed growth will increase rapidly when water levels have been low, such as during this year.

Water bug surveys showed good diversity present, but tolerant species such as snails, beetle larvae, water boatman, springtails and fly larvae were the most abundant.

Bush Heritage is actively restoring the riparian zones along the Creek via plantings of native canopy and shrub layer vegetation. This is supported by funding from Local Land Services and the Rivers of Carbon '*Upper Bidgee'* program which is carrying out riparian restoration actions as part of the Upper Murrumbidgee Demonstration Reach.

Gungoandra Creek at GUD100.

Kybeyan River KYB1

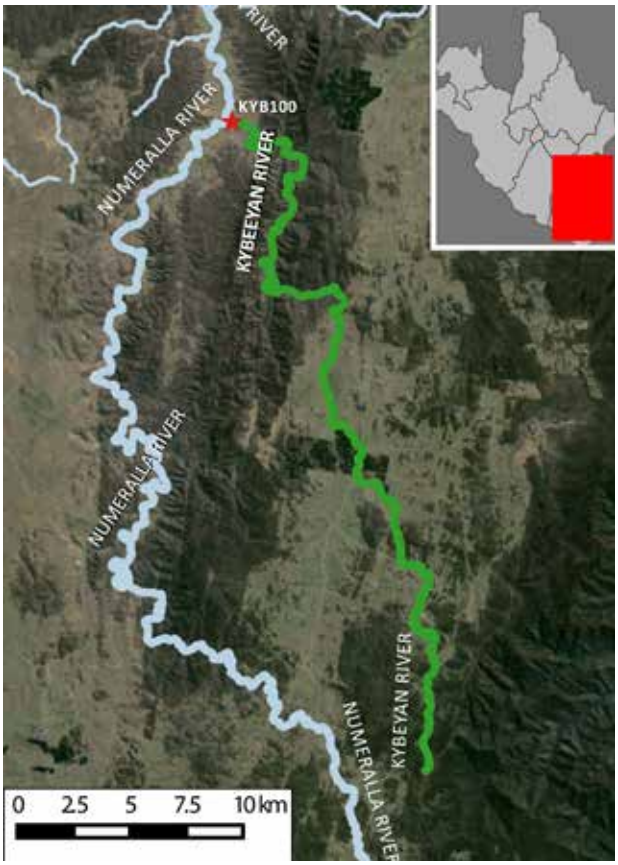
Headwaters to Numeralla River confluence

2018 CHIP Result B- (Good)		
2016/17 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**12**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**2**
Riparian condition	**Poor**	**1**

Reach Facts

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

This reach includes the Cooma Back Creek and tributaries including the Jillimatong and Sandy Creeks. The upper sections of the reach flows through open, cleared basalt country used for grazing and dryland cropping. The lower, urban section of the reach includes the Lambie Gorge area which is a site of Aboriginal cultural significance.



Reach Condition

Water levels were low for this reach throughout 2018, however the adjoining landholder says that he has seen it lower at times. He also noted how much the river has changed over the last 20 years, with Trout once being plentiful and Platypus sightings being assured every time one would visit the River. Now Carp are more often sighted, Eastern gambusia are present in large schools and a Platypus has been sighted only once in recent times.

Working in this reach's favour is the fact that nutrient levels are always very low and the water appears clear most of the time. Water bug surveys showed a reasonable level of diversity although moderately tolerant water bugs such as fly larvae and glass shrimp dominated the survey samples. The latter provides a good food source for Platypus.

Riparian condition is influenced by historical clearing and the planting of long rows of Poplars to stabilise river banks. Native Ti-tree and reeds are colonising the in-stream channel.

The Kybeyan River just above the confluence with the Numeralla River.

Michelago Creek MIC1

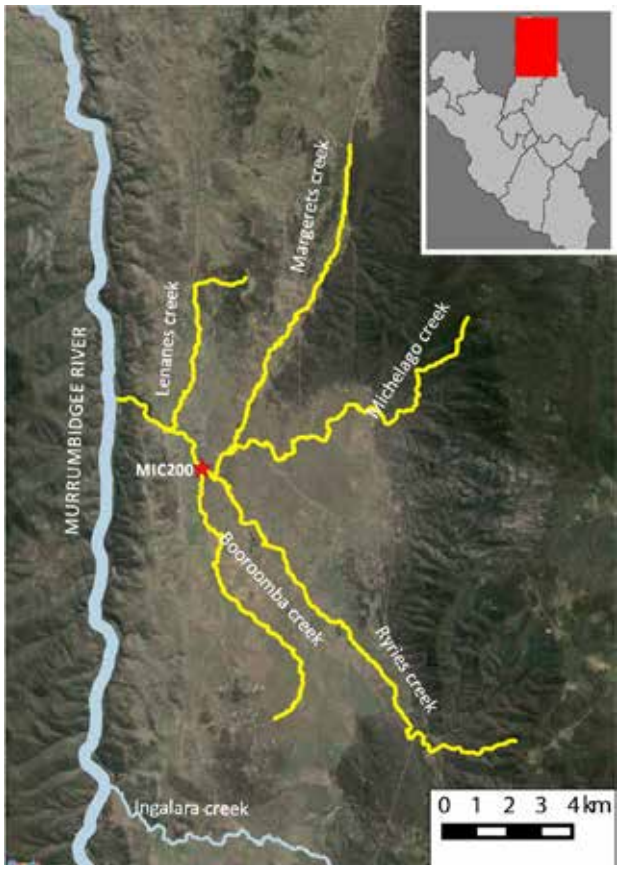
Headwaters to Murrumbidgee River confluence

2018 CHIP Result C (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**12**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**2**
Riparian condition	**Poor**	**1**

Reach Facts

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

This reach includes the entire Michelago Creek catchment including the Margerets 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

Our volunteer Sarah Essex, reports that organic matter build up and heavy algal fringes/rafts were seen at the sample site. The geology of the catchment may be influencing electrical conductivity levels which ranged between 440 and 680ms/cm. Landuse in the catchment has resulted in a 'poor' riparian condition score with very limited native vegetation and a dominance of exotic trees such as Poplars and Willows. Encouragingly large stands of native reeds are establishing in the creek through the Michelago village which is having a stabilising effect.

This year's water bug surveys showed moderate diversity. A standard sample has at least 200 individuals counted, but at our survey site less than that number were found, despite repeated sampling. Water bugs observed included equal numbers of both sensitive types such as caddisflies and water mites as well as tolerant bugs including predatory beetle larvae, fly larvae and glass shrimp. At our Spring survey, a beetle larva was observed catching and killing a small tadpole.

The site is usually teeming with the pest fish Eastern gambusia in the warmer month, though there were notably few of them observed during Spring. This reach is monitored at only one site at its downstream end and another volunteer to monitor an additional site would greatly enhance our knowledge of this catchment.

Michelago Creek - upstream of Michelago village.

Murrumbidgee River CMM1

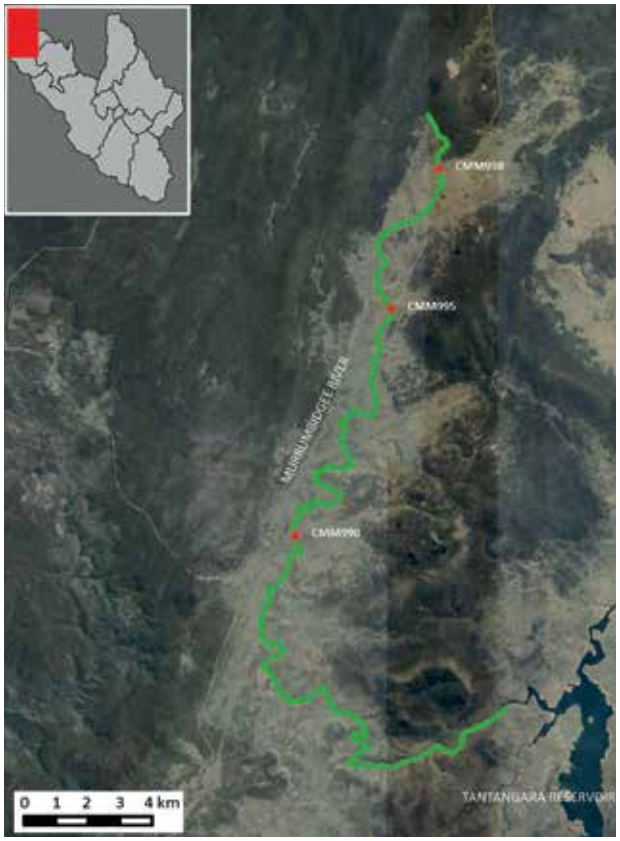
Headwaters to Tantangara Dam

2018 CHIP Result B (Good)		
2016/17 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**21**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Fair	
Water bug	**Good**	**3**
Riparian condition	**Poor**	**3**

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

Taking in the headwaters of the Murrumbidgee River within Kosciuszko National Park, water quality, water bug and riparian condition are expected to be very high for this reach. Expected water quality characteristics include cool temperatures, crystal clear water, no measurable nutrients and very low electrical conductivity.

Sampling after the snowmelt in October revealed that banks were heavily pugged (impact from hard-hoofed animals) and the water appeared turbid. A turbidity of 11 NTU was recorded, which is not high, but unprecedented and unexpected, even after the increased flow of snowmelt. This year nitrates also slipped from being 'excellent' to 'good' for the first time since monitoring began. This is likely associated with the increased numbers of feral horses observed in the catchment.

Water bug surveys still showed high diversity and abundance of the most sensitive species, but changes to water quality observed this year highlight a downward trend in the sensitive aquatic ecosystems in this reach.

Pugged edges seen after snowmelt at CMM998, November 2018.

Murrumbidgee River CMM2

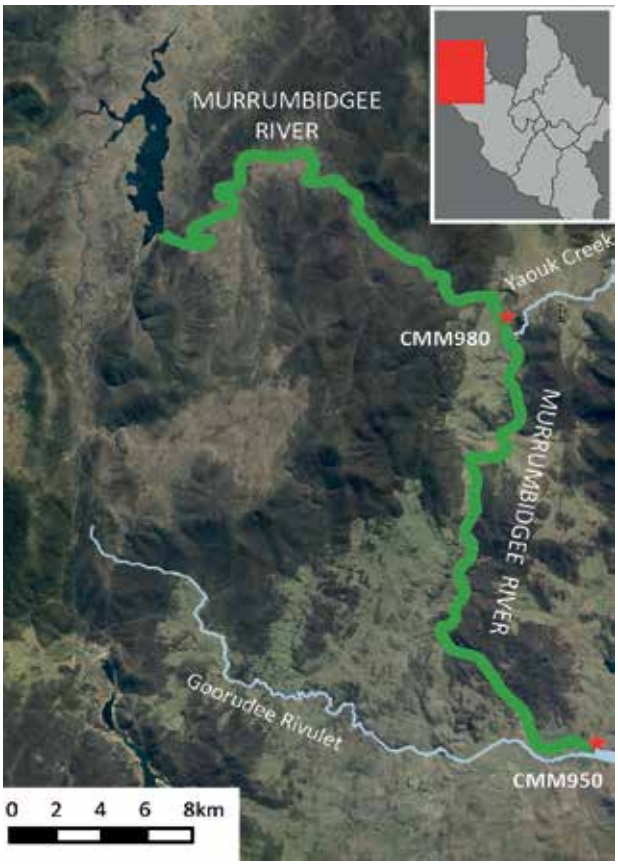
Tantangara Dam to Goorudee Rivulet

2018 CHIP Result B (Good)		
2016/17 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**23**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Fair	
Water bug	**Good**	**2**
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 unmodified country. Valley floors are now utilised predominantly for grazing purposes.



Reach Condition

Excellent water quality scores reflect the high quality water being released from Tantangara Dam which provides the main flow in this reach. However, this flow is greatly reduced by the fact that 99% of the upper Murrumbidgee River's flow is diverted at this point and piped to Eucumbene Dam. The result is that in-stream habitats and aquatic species are exhibiting characteristics of slower flowing ecosystems. This includes the presence of Water lilies, fine sediment build-up and more tolerant water bugs which thrive on higher levels of organic matter. These tolerant bugs include segmented worms and freshwater snails.

The riparian zones in this reach were scored as 'poor' due to a lack of naturally occuring native canopy and understorey. At present this is not taken account by the riparian assessment methodology used by the CHIP. Waterwatch is looking into addressing this issue in future CHIPs. Grazing does occur along the edge of the river in parts of this reach and this also has a negative effect on the quality of vegetation found there.

A water bug workshop on the Murrumbidgee River at Yaouk in November 2018.

Murrumbidgee River CMM3

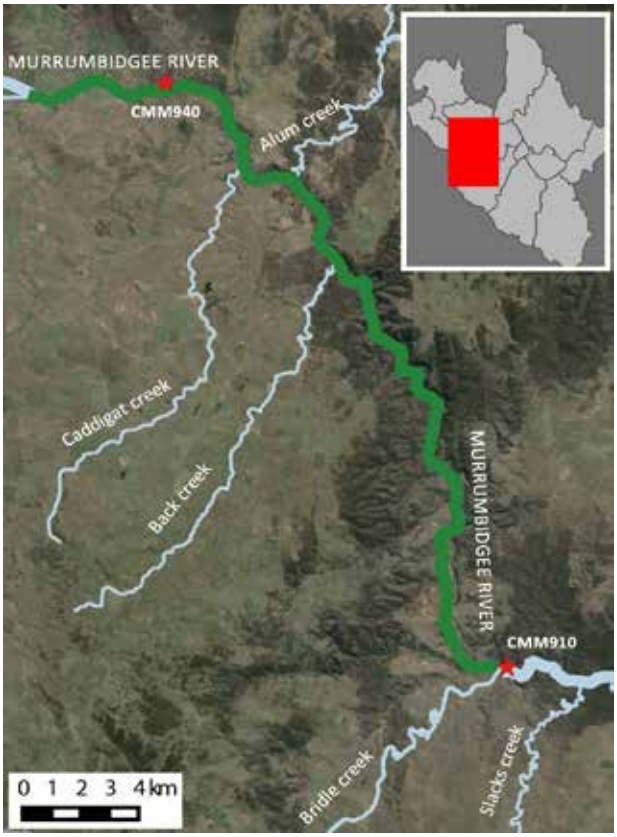
Goorudee Rivulet confluence to Bridle Creek confluence

2018 CHIP Result B+ (Good)		
2016/17 CHIP Result A- (Excellent)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**18**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
Water bug	**Good**	**4**
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

This stretch of the Murrumbidgee River is characterised by remote gorge country which is well vegetated and the river corridor remains largely unmodified. This contributes to the good scores recorded for this reach.

However, despite what the data indicates, there are some concerning issues affecting the health of this section of the river. These issues are observed as one travels downstream. Willows, Box elders and Blackberries are present. The upstream limit to distribution of Carp also occurs in this reach. Tributary gullies are known for their historic erosion both of which contribute to fine sediment which is accumulating on the bottom of the river. Large bands of goats are also contibuting to this problem. This sediment can smother the rocks and plants which are key water bug habitats. This may have contributed to the low abundance of sensitive bug types found in the surveys, when compared to upstream.

A Platypus survey was carried out near the top of this reach for the first time in 2018. One Platypus and one Water rat were seen. The drought may have influenced this result.

Volunteers Kerryn and Mick undertaking bug surveys at CMM940.

Murrumbidgee River CMM4

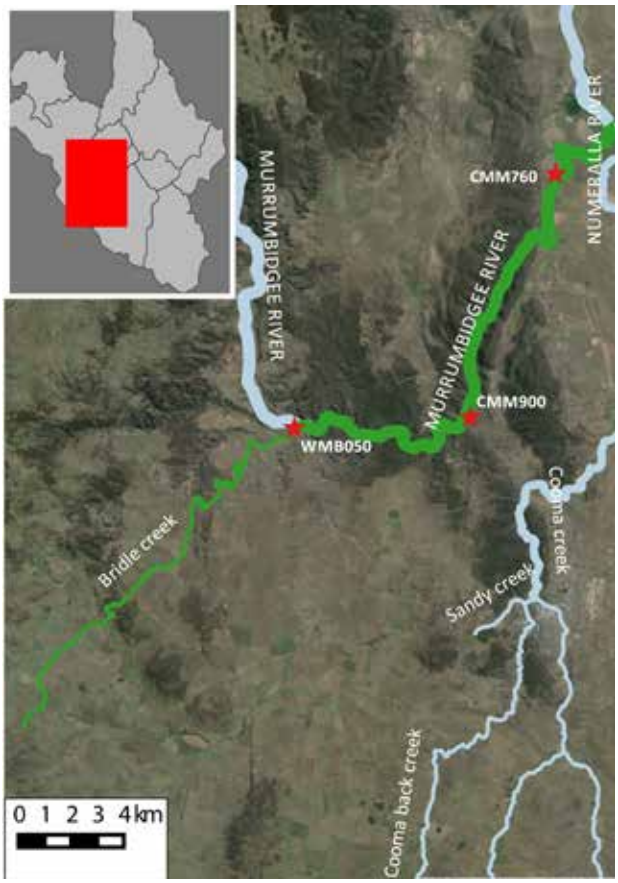
Bridle Creek to Numeralla River confluence

2018 CHIP Result B (Good)		
2016/17 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**21**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
Water bug	**Good**	**3**
Riparian condition	**Poor**	**2**

Reach Facts

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

This reach includes the Murrumbidgee River from the Bridle Creek confluence to the Numeralla River confluence. The lower section has open, cleared country used for predominantly grazing and cropping purposes while 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

Low flows in the Murrumbidgee River throughout the year probably contributed to the growth of thick algae observed in riffle areas (shallow, rocky sections) and Azolla (a native, floating water fern) accumulating at the edges of slower flowing areas.

The lower end of this reach has poorer quality river conditions than the section upstream. It is characterised by wide open floodplains which have been historically cleared and are cultivated from time to time. Heavy Willow infestations occur in this area and little native vegetation is present. This has adversely influenced the riparian condition score.

Poorer water quality can also be observed including elevated electrical conductivity in the lower reach compared to sites upstream. The lower reach also experiences higher turbidity after rain events. Carp and Eastern gambusia are also seen at the lower end of this reach in large numbers.

This stretch of river is the known habitat of Water rats, Platypus and a nationally significant population of Macquarie perch.

Murrumbidgee River looking upstream to the weir at Cooma Pumping Station.

Murrumbidgee River CMM5

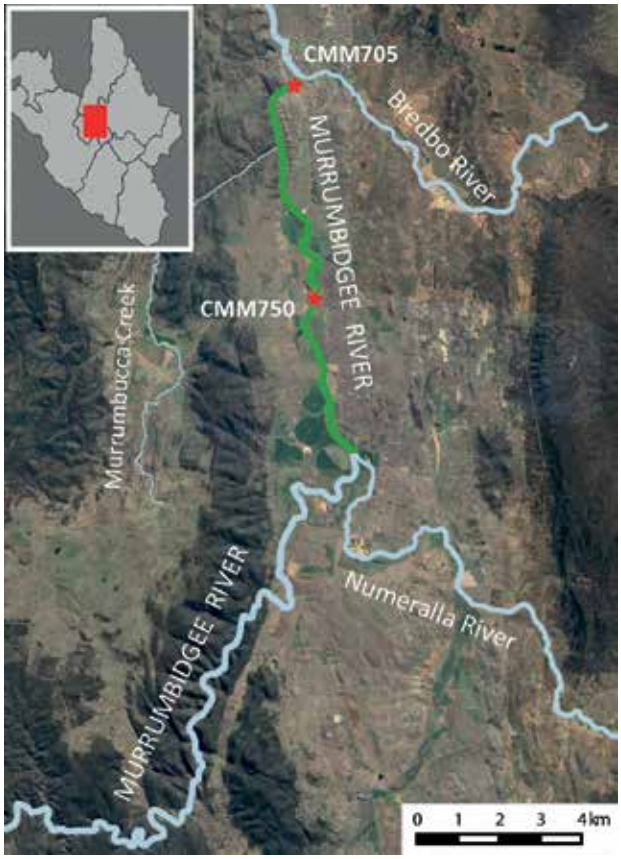
Numeralla River confluence to Bredbo River confluence

2018 CHIP Result B- (Good)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**16**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Water bug	**Good**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

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

This reach includes the Murrumbidgee River from the Numeralla River to the Bredbo River confluence. Very limited native riparian vegetation remains due to historic clearing. This is a priority ACWA catchment with two ACWA sites present. The wide alluvial floodplain areas which flank the river are used for dryland and irrigated cropping as well as grazing.



This reach is slow-flowing through open alluvial floodplains where the river is flanked with dense stands of Willows and exotic groundcovers. Little native vegetation remains and streambanks can be unstable. Large amounts of sand have washed down the Numeralla River from upstream and have smothered in-stream habitats in the Murrumbidgee. Fine silt layers and algae such as diatom fringes were observed on underwater vegetation and the beds of pools. These factors influence the 'poor' riparian condition score and quality of in-stream habitat observed in this reach.

Our water bug survey results did show good diversity, but less sensitive water bug types were present overall, possibly due to the factors mentioned above. A native Galaxias fish was observed in the Autumn survey.

Very low water levels were observed throughout 2018. In the latter half of the year, turbidity of 13-17NTU was consistently measured at sites in the reach. This could have been due to the pest fish Carp, which have been recorded here in high numbers, continually stirring up the sediments at the bottom of the river when they are feeding.

This section of the Murrumbidgee River has a high amount of sand desposition and lots of Willows.

Murrumbidgee River CMM6

Bredbo River confluence to Michelago Creek confluence

2018 CHIP Result B (Good)		
2016/17 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**23**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Water bug	**Good**	**3**
Riparian condition	**Poor**	**1**

Reach Facts

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

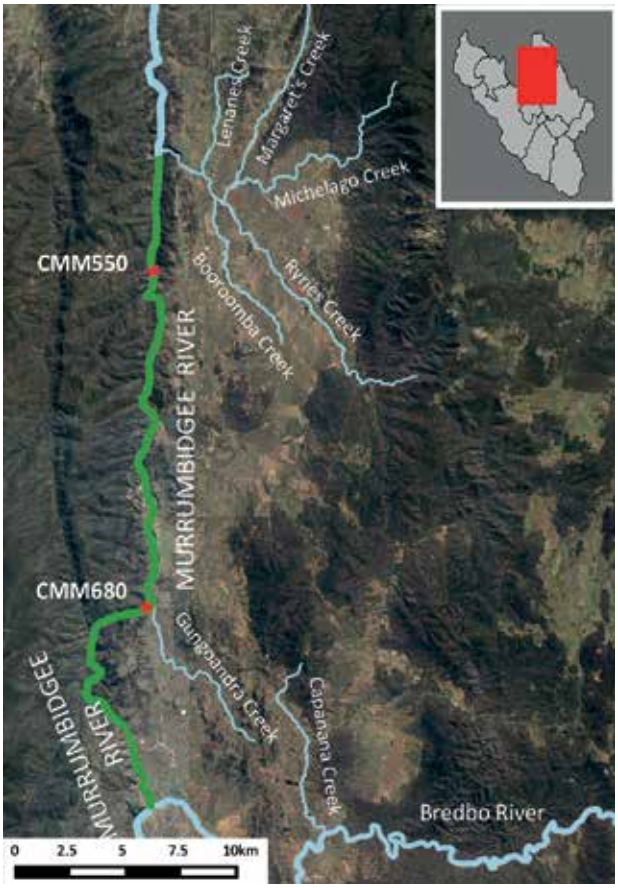
This reach includes the Murrumbidgee River from the Bredbo River to Michelago Creek confluence. It flows through the Bredbo and Colinton Gorges which form the upper and lower sections of the reach and contain good quality riparian and aquatic habitat. The middle section flows through the Bumbalong Valley contains which has more open, cleared country.

Reach Condition

This reach demonstrates the importance of high quality riverine habitats on overall river health, as the CHIP scores here are higher than most of the reaches upstream. Intact riparian and in-stream habitats capture sediments entering the water and absorb nutrients out of the system, resulting in more stable oxygen levels and clearer water. The benefits of intact ecosystems are many and varied.

There is much work occuring on this reach, to protect and improve the River. This includes fencing off the river corridor, off stream watering, improving fish habitat, woody weed control and native plantings. Bredbo and Michelago Landcare and the Upper Murrumbidgee Demonstration Reach project, in conjunction with partners such as Bush Heritage Australia (BHA), Landcare, Local Land Services, NSW DPI-Fisheries and local landholders are among those carrying out projects. Waterwatch is helping to track progress.

Annual Platypus Month surveys carried out at BHA's Scottsdale Reserve have found the top of this reach to be a regional hotspot for Platypus and Water rats.



Murrumbidgee River at Scottsdale Reserve.

Numeralla River NUM1

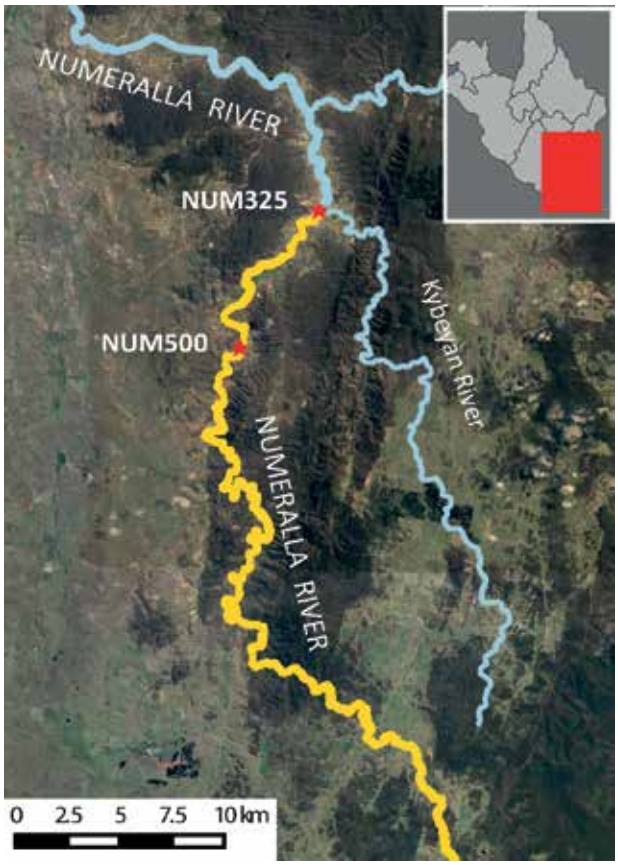
Headwaters to Kybeyan River confluence

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**14**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**2**

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 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

The catchment upstream of the monitoring sites is largely areas of cultivated and grazed agricultural country. This may be influencing electrical conductivity levels observed in this reach with all values being between 230-390ms/cm which fall in the 'fair' and 'poor' ranges.

River levels have been very low throughout the year, with increased abundances of Azolla (a floating, red-coloured, native water fern) seen along the edge of pools at sampling sites. Low flows over the last years have allowed native reed bed and Ti-tree to establish along the river which has improved in-stream habitat and stabilised banks. Despite this, water bug surveys in the Autumn showed low bug numbers overall but nine different types were found which is regarded as a diverse sample.

A young of year Carp (ie. a fish less than one year old) was seen at NUM325 in Autumn. This supports the notion that this site may be a Carp breeding area as spawnings have been recorded here in previous years.

Numeralla River at NUM325 showing low levels and the water fern Azolla growing along the edges.

Numeralla River NUM2

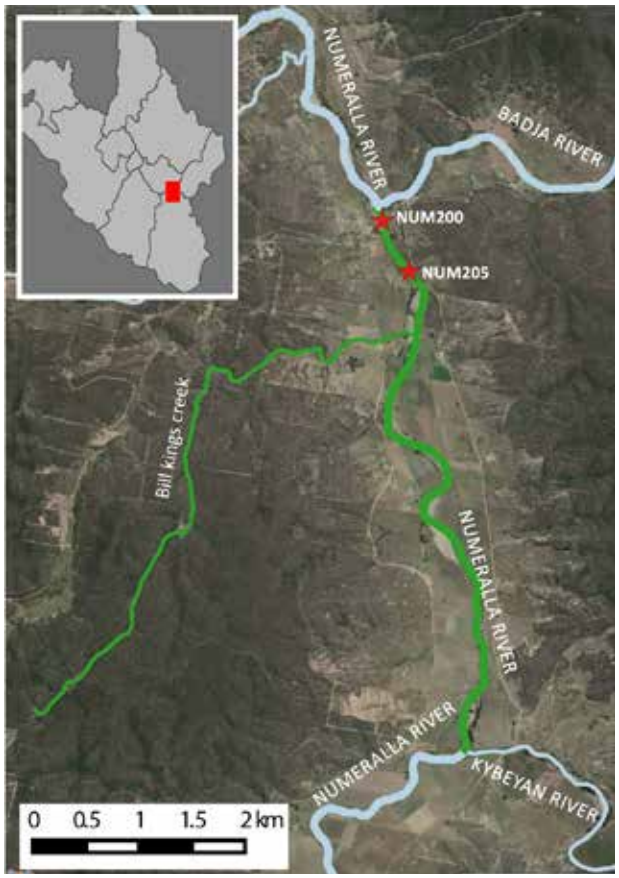
Kybeyan River confluence to Badja River confluence

2018 CHIP Result B- (Good)		
2016/17 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**21**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

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

This reach includes the Numeralla River from the Kybeyan River to the Badja River confluence. It is flanked by wide alluvial floodplains used for dryland cropping and grazing. The Numeralla village adjoins the river at the bottom end of the reach. This reach is in a high priority ACWA catchment where erosion risk was assessed as very high.



Reach Condition

This reach flows through wide alluvial floodplains which are cultivated and grazed. The length of the reach has been fenced to exclude grazing thanks to a decade long focus of Numeralla Landcare and the local community to improve river bank stability. Native plantings have replaced the exotic trees in the riparian zone at various sites. Low flows over the last years have allowed native reed bed and Ti-tree to establish along the river which has further improved in-stream habitat and stabilised banks. The Numeralla Fishing Club and Numeralla Landcare Group have been improving in-stream fish habitat via re-snagging (adding large, woody debris to the river) in this reach.

These factors all contribute to the water quality, water bug and riparian condition scores of this reach, which are overall higher than the reach upstream.

Mark Shubert, our volunteer at NUM205, sighted a Platypus and a Water rat (Rakali) at his site in 2018.

Looking upstream to Numeralla Rd Bridge.

Numeralla River NUM3

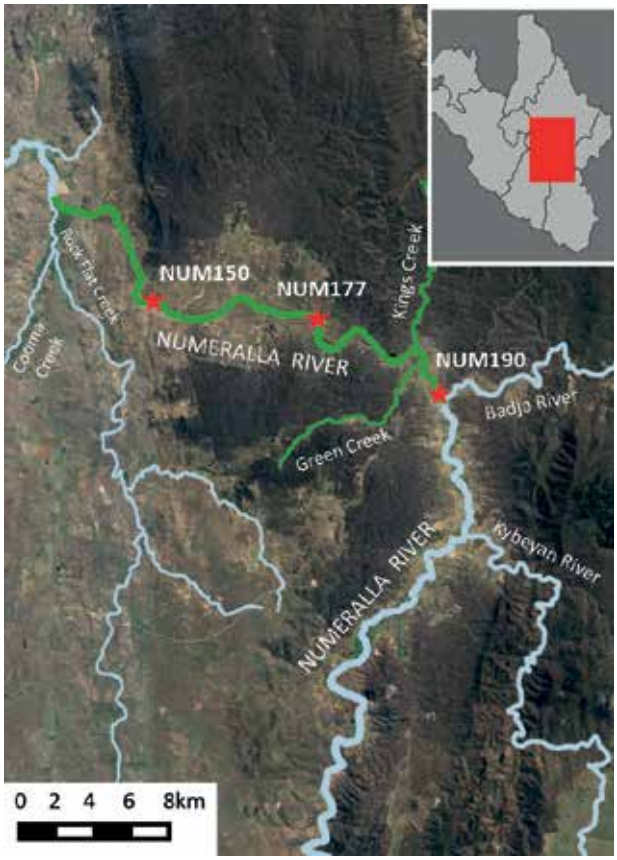
Badja River confluence to Cooma Creek confluence

2018 CHIP Result B (Good)		
2016/17 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**25**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Water bug	**Fair**	**2**
Riparian condition	**Fair**	**3**

Reach Facts

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

This reach includes the Numeralla River from the Badja River to the Cooma Creek confluence. The lower parts of the reach has wide floodplains used for dryland cropping and grazing. The top of the reach and its tributaries retain good native vegetation. This reach is in a high priority ACWA catchment where erosion risk was assessed to be very high.



Reach Condition

The top half of this reach is flanked with good native vegetation including tall stands of Ribbon gums, fringing Ti-tree and Bottlebrushes, beds of in-stream reeds and swathes of Water milfoil submerged in the river. The clear waters of the Badja River also flow in at the top of this reach. These factors contribute to the reach score being slightly better than the score of NUM2 upstream.

The downstream section of NUM3 is a known Carp spawning hot spot, with breeding events observed every Spring as the water warms to around 20°C. This area is characterised by an open river channel with large stands of reeds present where Carp are known to gather during spawning. This year, however, Carp were also seen spawning in a shallow riffle section, which was covered in Water milfoil (a submerged water plant). This highlights our findings that in the upper Murrumbidgee catchment Carp spawn opportunistically in a range of habitats.

Another pest fish, Eastern gambusia, are also seen in high numbers at NUM150.

Good stands of Ribbon gum and Ti-tree are present along this section of the Numeralla River.

Numeralla River NUM4

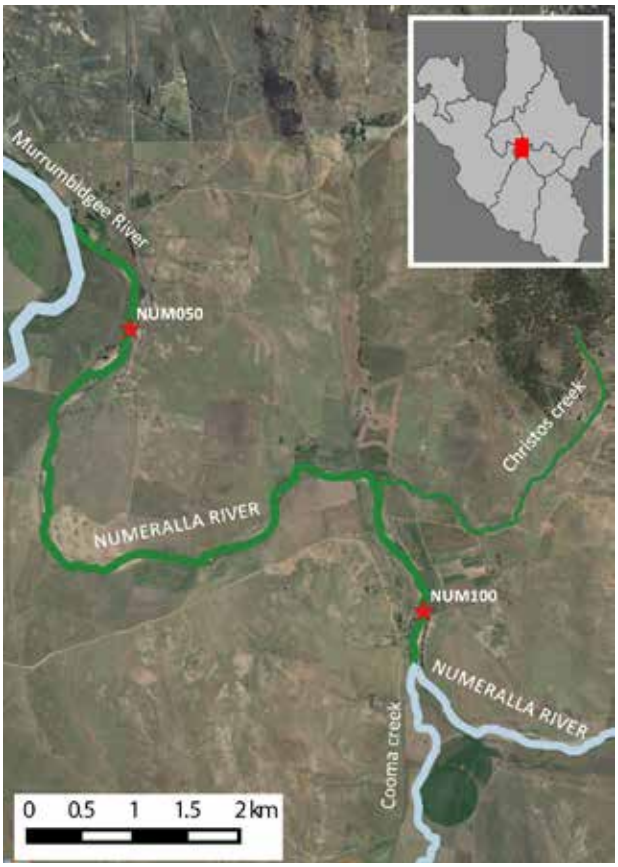
Cooma Creek confluence to Murrumbidgee River confluence

2018 CHIP Result B- (Good)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**16**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Good	
Water bug	**Good**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

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

This reach includes the Numeralla River from the Cooma Creek to its confluence with the Murrumbidgee River. It runs through wide floodplains which are used for grazing and dryland and irrigated cropping. Riparian zones are highly modified and sediment deposition is widespread in the river. This reach is in a high priority ACWA catchment where erosion risk was assessed to be very high.



Reach Condition

There is very little native vegetation remaining along this section of the Numeralla River due to historic clearing and riparian (riverside) vegetation is made up of invasive exotic species such as Willows, Box elder, Poplars and Blackberry. The wide alluvial river flats are used for cultivation and grazing which can result in high run-off events and turbidity, as occurred after a storm in December. Water levels have been very low throughout the year contributing to a build up of diatom algae and fine sediment in-stream with no substantial flow to flush them downstream.

On a positive note, stands of native reeds are establishing in the river which has a stabilising, shading and filtering effect on the water. It is also encouraging to see landholders at Chakola controlling sapling Willows along the river to prevent further increases in woody weed infestations.

A Platypus was seen at NUM050 in October.

Looking upstream of Chakola causeway at NUM100.

Rock Flat Creek ROC1

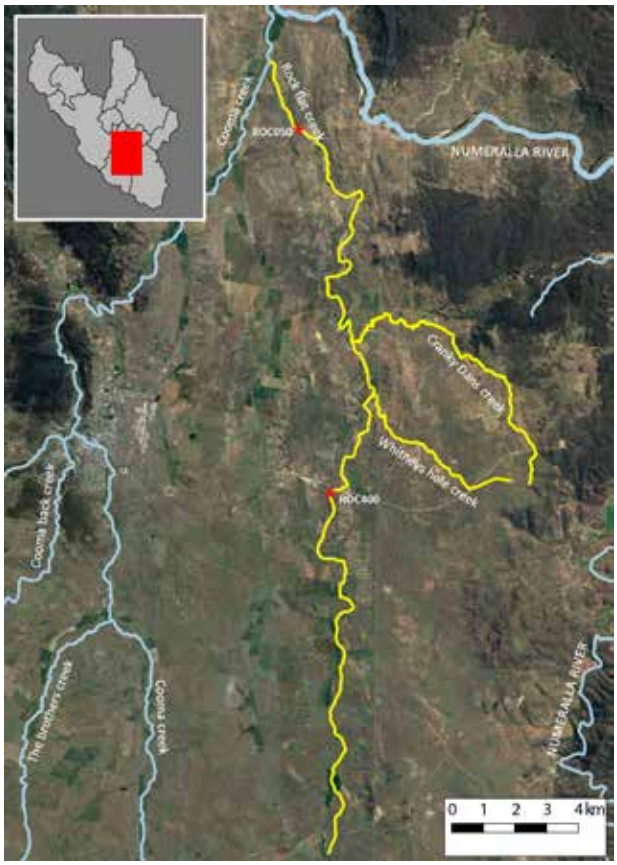
Headwaters to Cottage Hill Road crossing

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**14**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
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 catchment. The creek flows through predominantly open basalt country, which is used for grazing and cropping agriculture. Riparian zones are highly modified in this catchment especially at the bottom end of the reach. This reach includes a high priority ACWA site just downstream of the Cottage Hill Road crossing.



Reach Condition

Water levels were very low throughout the year and the creek was reduced to a series of pools in the latter half of 2018. Carp have often been sighted at ROC050 and when the creek was reduced to a pool at this site, the Carp were trapped there. As the water level in the pool dropped the turbidity also increased, rising to 27NTU. Carp stirring up bottom sediments was the likely cause.

Riparian vegetation along the creek is highly modified with the canopy and shrub layers largely absent, except for scattered Willows. Similarly there is a lack of in-stream vegetation along this reach, especially where it is accessed by stock.

Sections of the Creek have unstable streambanks causing increased turbidity and sediment inputs which smothers available habitat. These factors influence the water bug community. Surveys found high numbers of very tolerant species including segmented worms, flatworms, fly larvae and beetle larvae.

Rock Flat Creek formed a series of pools in 2018 following an extended dry period.

Strike-A-Light River STR1

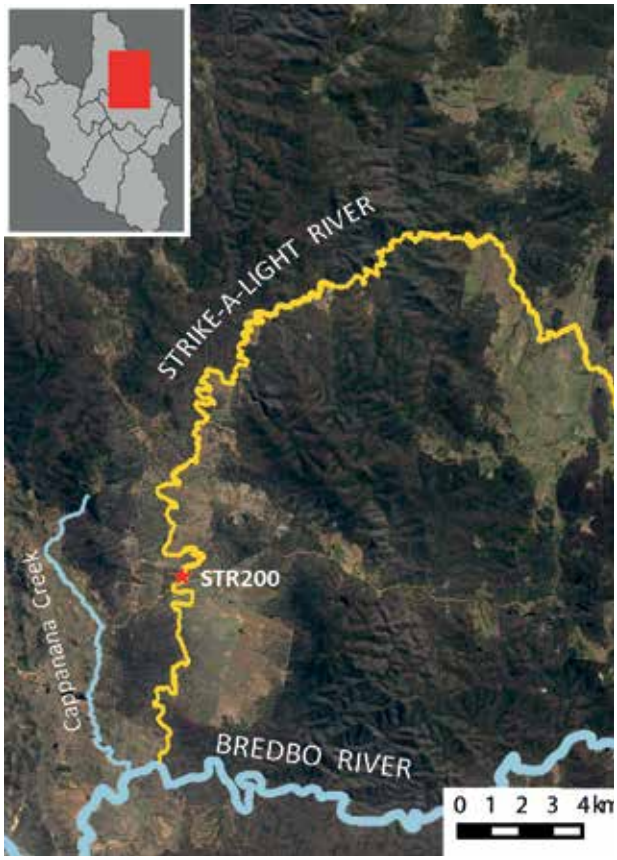
Headwaters to Bredbo River confluence

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**12**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Poor	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**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 in-stream habitat.



Reach Condition

Water levels were very low throughout the year and Strike-A-Light Creek was reduced to a series of pools in the latter half of 2018. Despite this, the water remained clear and free of algae although a thin scum layer was noticed on top. Low water levels no doubt influenced electrical conductivity and dissolved oxygen scores, which declined this year in comparison to previous years.

Water bug surveys show an interesting level of diversity including freshwater sponges, mayflies, damselflies and hydra (a simple polyp related to freshwater jellyfish). Both in Autumn and Spring there was a high number of fly larvae and segmented worms. One of our most sensitive water bug types, the stoneflies, were absent from both the water bug surveys this year.

Carp are noted in the lower sections of this reach, however they have not been seen up as far as STR200. A Water rat (also known as Rakali) as well as an Eastern water dragon were noted swimming in the River near the Waterwatch site. There is currently only one active monitoring site on this reach so extra volunteers are needed to assist in gathering data.

STR1 has seen low water levels during 2018.

Ginninderra Catchment Facts

Over 42% 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. This includes Evatt, Umbagong District Park, Macgregor and Dunlop.

Ginninderra Waterwatch Volunteers have been monitoring this catchment since 1997.

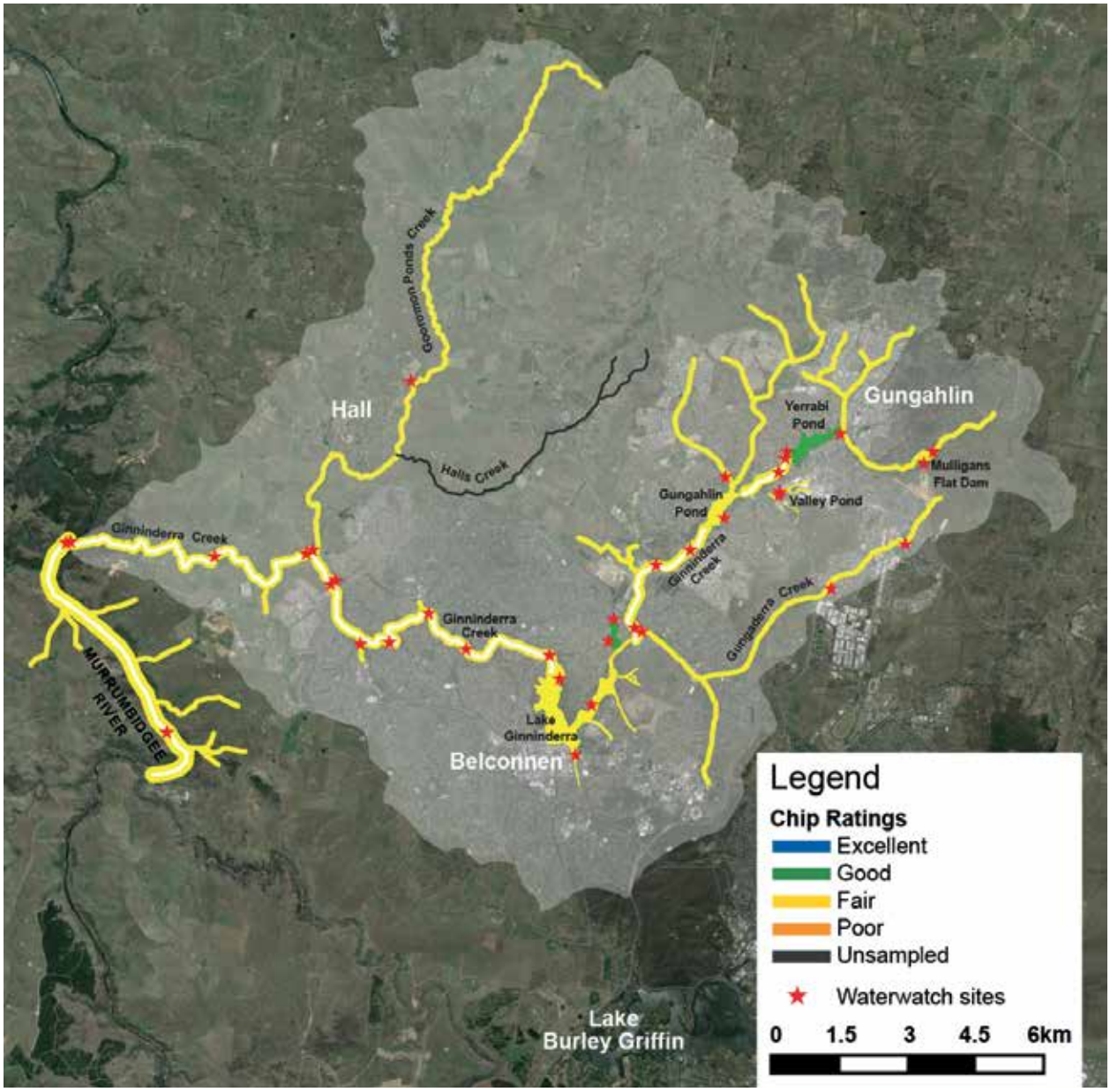
Ginninderra Catchment Health Summary

The dry conditions have taken their toll on the Ginninderra Creek catchment in 2018, with lower than average rainfall, higher temperatures and a consequent reduction in water levels. During the drier periods, the increase in green filamentous algae was evident in several reaches.

Overall, two reaches had 'good' scores and the other 13 reaches scored 'fair'. Compared to last year's CHIP results, scores are not that different, with the vast majority of reaches in this highly urbanised catchment sitting in the 'fair' range. Seven reaches had similar scores to the previous year, while three presented worse scores (GDC1, GIN1 and MFL1), and three improved their result (GIN5, MCW1 and YER1). All three key parameters (water quality, water bugs and riparian condition) contributed in varying degrees to the change of scores with no single parameter being the major influence.

This year, the Valley Ponds in Gungahlin (GUN1), again had water quality data, owing to the great effort of some new volunteers. In addition, a new reach was created (GIN06), which encompasses the Ginninderra Falls area (GIN050). This used to be part of GIN5 reach but this modification better represents the lower section of Ginninderra Creek, thus splitting a rural landscape (GIN5) from a conservation area (GIN6).

Waterwatch has also re-established access to the Ginninderra Falls area, sampling both the bottom of Ginninderra Creek and above and below the confluence on the Murrumbidgee River. This enables valuable data to be collected for three reaches (CMM11, CMM12 and GIN6). By sampling regularly at CMM11 in 2018, it seems plausible that the elevated readings of nitrates (up to 30 mg/L) are a consequence of outputs from the Lower Molonglo Water Quality Control Centre (LMWQCC). Sampling above and below the LMWQCC is now taking place and these measurements support this proposition.



Ginninderra Creek GIN1

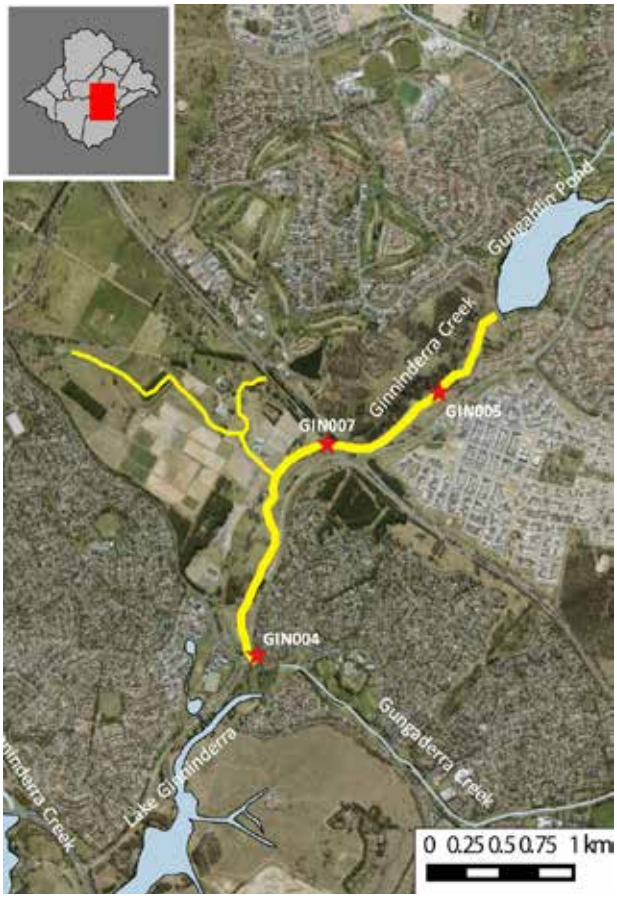
Crace to Giralang Pond

2018 CHIP Result C (Fair)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**26**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**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

Despite 2018 being a dry year, the flooding rains in February and storm days in late Spring gave the system a good flush. Unfortunately, those storm events also brought sediments and increased turbidity levels (35 NTU), in addition to elevated phosphorus readings (0.06 mg/L). Dissolved oxygen records were much lower in 2018 compared to the previous year, possibly as a result of frequent low flows and high temperatures.

During the Autumn water bug survey there were nine orders of water bugs recorded, including sensitive ones such as mayflies, caddisflies and water mites. However, the lower water levels and the presence of filamentous algal mats during the Spring sampling, saw the numbers falling to seven orders with no caddisflies recorded.

While the areas adjacent to Ginninderra Creek in this reach, have good ground cover and little signs of erosion, the absence of large trees and shrubs means the creek can be quite exposed and thus received a poor score for riparian condition.

Birds using the island that appeared in Giralang Pond during the dry of July 2018.

Ginninderra Creek GIN2

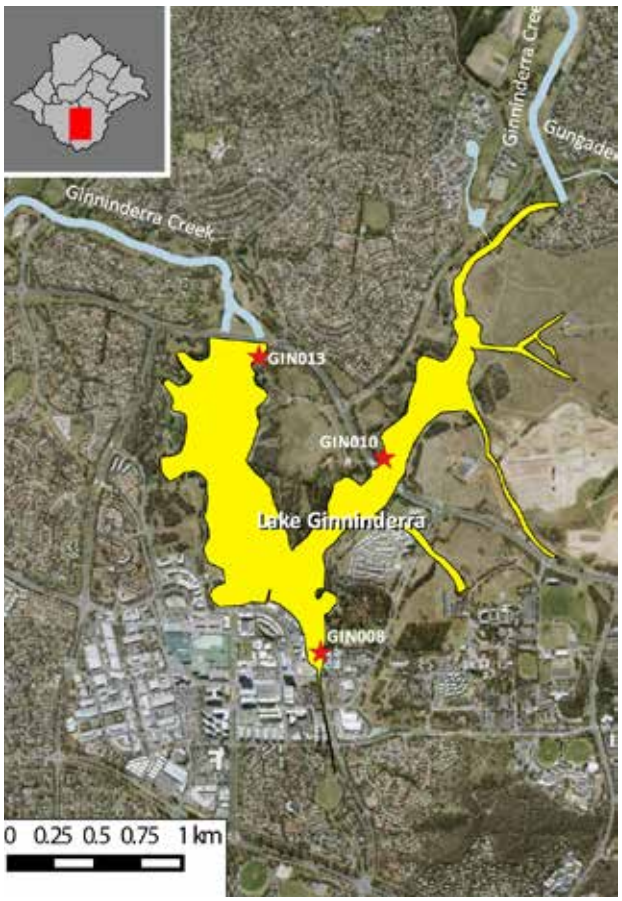
Lake Ginninderra

2018 CHIP Result C+ (Fair)		
2016/17 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**	**2**
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

The dry conditions have been felt in this reach, especially in the Eastern Valley Way wetland (GIN008), where on several occasions, the Lake Ginninderra Sea Scout volunteers reported low water levels, very murky waters, no flow, and the exposure of shopping trolleys from the depths of the Lake. Still, the water quality parameters in this reach were consistent with last year, with the presence of tadpoles and several bird species, such as Dusky moorhens, Purple swamphens and White-faced herons.

The riparian zone is this area of Lake Ginninderra is mainly composed of grasses and shrubs, with many being introduced species. There is little available habitat for wildlife along the edges of the Lake.

Rubbish continues to be a problem throughout the reach, and the volunteer reported two illegal yabbie traps to the Environmental Protection Agency (EPA). These traps were removed.

Lake Ginninderra at GIN013.

Ginninderra Creek GIN3

Dam wall to Ginninderra Drive

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**18**
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

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

Starting below the Lake Ginninderra spillway, this reach sits entirely within established suburbs with high urban stormwater inflow. The 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 observed 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

While the overall water quality score was rated 'good', it is important to note that the majority of electrical conductivity records fell in the 'poor' range (213-404 µS/cm) - 13 out of 18 records. This is most likely a result of drier conditions which tends to make salts and minerals in the water more concentrated. Additionally, dissolved oxygen levels seemed to reflect that as well, with eight records below 40% dissolved oxygen saturation (range: 17-38%). Nonetheless, no fish mortality has been observed.

The abundance of water bugs was much higher in Autumn than Spring sampling, although tolerant bugs, such as fly larvae and segmented worms, still made up the majority of the sample. In Spring, the site was much drier and had a lot of filamentous algae present.

Even though there is a moderate presence of trees along the edge of Ginninderra Creek in this section, the majority are introduced species like Poplars and Willows . Some areas the Creek (GIN009) are choked up with them. They drop large amounts of leaf litter into the waterways in Autumn causing unwanted spikes in nutrients within the system.

Ginninderra Creek at GIN009, directly downstream of Lake Ginninderra.

Ginninderra Creek GIN4

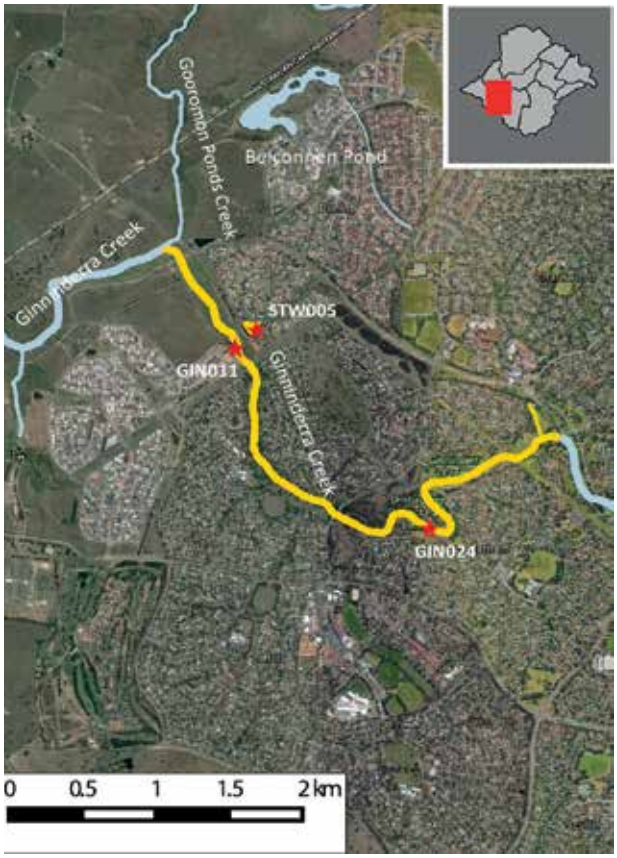
Ginninderra Creek at Umbagong District Park

2018 CHIP Result C (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**34**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**2**
Riparian condition	**Poor**	**3**

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. The reach is well vegetated with a 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

The dry conditions have been felt during late Summer and early Autumn, with consistently low dissolved oxygen levels and high electrical conductivity in Umbagong District Park (GIN024) and further downstream at GIN011. The dry continued into Winter and possibly influenced reduced water bug diversity in the Spring bug survey.

When the rain did come, it was delivered in short, sharp storms. Water samples collected following a 10mm storm in October saw a turbidity spike to 160 NTU at Umbagong. Our Umbagong volunteer has sighted a number bird species during their monitoring including crimson rosellas, kookaburras and king parrots but has also noted that they are removing increased amounts of rubbish from the area.

The ACT Healthy Waterways Project are conducting research at Jarramlee Pond (STW005) looking at how varying the water level in urban wetlands can improve their ability to trap pollutants. The level of Jarramlee Pond was deliberately lowered in March by about 1.5 metres as part of this study.

Research on varying water levels is being conducted at Jaramlee Pond (STW005).

Ginninderra Creek GIN5

Gooromon Ponds Creek confluence to Ginninderra Falls Gorge

2018 CHIP Result C (Fair)		
2016/17 CHIP Result D+ (Poor)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**16**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Excellent	
Water bug	**Poor**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 7km
Dominant land uses: Urban/Rural Fringe

This reach runs from the confluence with Gooromon Ponds Creek to the rural properties in Kilby Homestead region. The upper section has significant bank erosion and the lower section runs through sheep and cattle farms. Ginninderra Catchment Group, Greening Australia and the Riverview group have undertaken Willow removal and native regeneration work in the mid-section.

Reach Condition

There was a slight improvement in the water bug score in 2018 compared to the previous year. This was mainly due to the Autumn water bug survey at Kilby Homestead (GIN040), yielding nine different orders of water bugs. This included some sensitive bugs; mayflies, caddisflies and water mites, although water boatman, a pollution-tolerant bug, made the bulk of the sample (300+ individuals). A water dragon was also sighted at the concrete bridge during the water bug survey.

Erosion continues to be a problem downstream of the confluence of Ginninderra Creek and Gooromon Ponds (GIN030). It's positive to note, however, the regeneration of native shrubs plus some habitat such as fallen logs, along the edge of the creek at Kilby Homestead. This provides essential refuge for small vertebrates such as frogs and lizards.

Surprisingly, this is one of the few sites in Ginninderra Creek drainage, that has an overall 'excellent' dissolved oxygen reading, which was consistent with last year findings. This is despite the more degraded conditions upstream.

Significant erosion is present at GIN030, downstream of the confluence with Gooromon Ponds Creek.

Ginninderra Creek GIN6

Ginninderra Falls Gorge to Murrumbidgee River confluence

2018 CHIP Result C+ (Fair)		
NEW REACH		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**6**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Fair	
Water bug	**Poor**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

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

This reach comprises the high conservation value area of the Ginninderra Falls and Gorge. It is composed of large areas of native woodlands and shrubs. Ginninderra Falls also represents an important Ngunnawal cultural and heritage site, known to host significant indigenous ceremonial and male initiations.

Reach Condition

This last section of Ginninderra Creek is well conserved and has the best vegetation cover in the Ginninderra catchment, supporting a diversity of native plant species. Although the riparian vegetation is well represented by mature casuarinas and gum trees, not much regeneration has been observed along the creek. Despite the good vegetation cover, the upstream stressors such as urbanisation and farming can still be felt downstream, as electrical conductivity ranged in the 'poor' category (230-400 µS/cm) and dissolved oxygen was considered 'fair' (as low as 74% saturation).

Very little aquatic vegetation has been observed in this section of the Creek, which is represented mainly by a rocky bottom. This lack of in-stream habitat is reflective of the lower scores in water bug diversity, with many tolerant species present including snails, fly larvae, glass shrimp, and lots of water boatman (600+ individuals in a single sample).

Eastern water dragons are regularly observed during sampling.

Lower Ginninderra Falls, just above GIN050.

Gooromon Ponds Creek GOO1

Headwaters to confluence with Ginninderra Creek

2018 CHIP Result C (Fair)

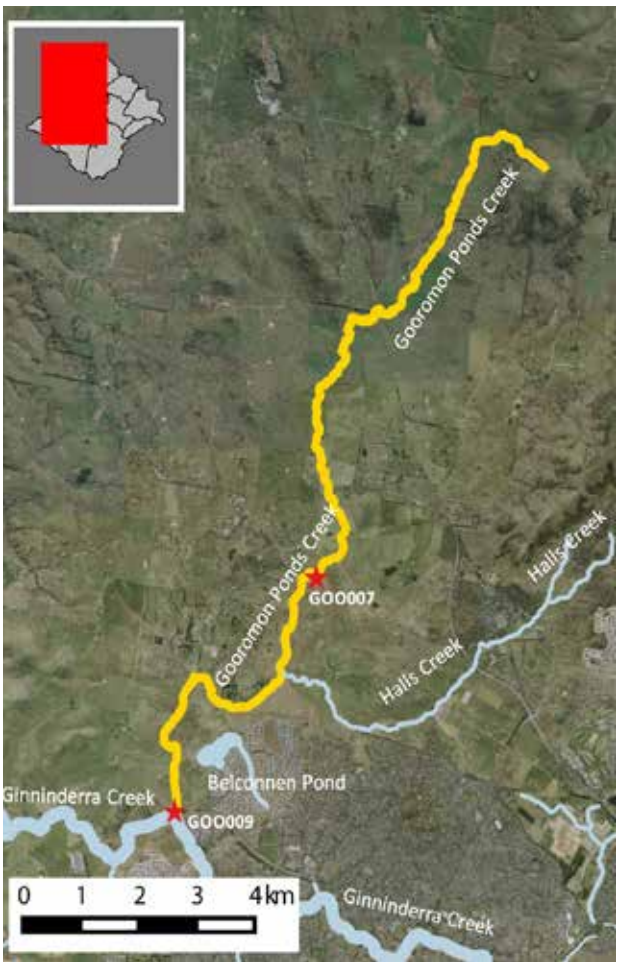
2016/17 CHIP Result C- (Fair)

Parameter	Rating	No. Survey
Water quality	**Good**	**19**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**2**
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 and extensive areas with low habitat value.



Reach Condition

Fluctuations in the water levels were a common feature at the top of the reach (GOO007). On several occasions there was no flow and sampling was done in the isolated pools, where dissolved oxygen showed extremely low levels (22% saturation). It is interesting to note how the upstream section (GOO007) showed high electrical conductivity (EC) values (1620 µS/cm) and lower nitrates (0 -1 mg/L) compared to the downstream area (GOO009; 980 µS/cm and 1-3 mg/L respectively), which seems to ease the influence of geology on EC downstream but increase the run-off of nitrates in this rural landscape.

Although pollution-sensitive water bugs have been found in the surveys, such as caddisflies, mayflies and water mites, the samples had mainly tolerant species, such as fly larvae (180+), snails (25+) and damselfly nymphs (40+).

The volunteer has noted dumping of several garbage bags, shoes and appliances on the bank of the site GOO007, which could potentially leach into the Creek after a storm.

Gooroomon Creek at Jaramlee Crossing (GOO009) with extensive reed coverage (Photo: D.Fitzsimmons).

Gungaderra Creek GDC1

Gungahlin to Giralang Pond

2018 CHIP Result C+ (Fair)

2016/17 CHIP Result B- (Good)

Parameter	Rating	Survey
Water quality	**Excellent**	**23**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Water bug	**Degraded**	**4**
Riparian condition	**Fair**	**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

This reach displays a marked decrease in water quality parameters from the upstream (GDC010) to the downstream site (STW001), showing the cumulative effects of the water running through the urban landscape, travelling over lots of impermeable surfaces and through concrete drains. For example, electrical conductivity averages 107 µS/cm at the top of the reach, compared to 205 µS/cm at the bottom. Similarly, phosphorus and nitrates (top: 0.007 mg/L and 0.11 mg/L, respectively; bottom:0.06 mg/L and 1.67 mg/L), showing how much nutrients move through the system. Another interesting observation is that the water is always warmer, with lower dissolved oxygen and higher electrical conductivity at STW001 before it flows into Ginninderra Creek.

The effects of drought, with higher than average temperatures and lower rainfall in Autumn and mid-Spring, had an adverse effect on the results of both Autumn and Spring water bug surveys. Both surveys found less bug diversity and mainly tolerant species, including fly larvae, water boatman and yabbies.

The drain at STW001 after 98mm of rain on 26 February - followed by one of the driest Autumns on record.

Gungahlin Pond GUN2

Headwaters of Ginninderra Creek north arm to Gungahlin Ponds

2018 CHIP Result C (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**28**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**2**
Riparian condition	**Poor**	**3**

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 disconnected 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

Water quality was overall 'good' in this reach despite some elevated readings of electrical conductivity in STW006. This was especially the case during the dry spells in July and September, with 780 and 890 µS/cm respectively. Fine brown algae is commonly found here among rocks, reeds and along the substrate (the bottom layer of the Creek). During early Spring, low rainfall and high temperatures probably facilitated algae growth, changing the commonly clear Gungahlin Pond (GUN001) into a green coloured pond, with higher than usual turbidity (30 NTU).

Much of the areas directly adjacent to this section of Ginninderra Creek showed good ground cover which is represented by manicured and exotic grasses, typical of urban ponds. There is also an abundance of reeds, which serve as in-stream habitat for water bugs, fish and turtles.

Despite the bulk of water bugs being of tolerant species, we did record sensitive ones, such as caddisfly, mayflies and water mites in both Autumn and Spring bug surveys.

Reeds (and some rubbish) along the edge of Gungahlin Pond at GUN001.

Kippax Creek KIP1

Headwaters to Ginninderra Creek confluence

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**12**
pH	Excellent	
Turbidity	Good	
Phosphorus	Fair	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
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

This reach showed some contrasting water quality results from early to late 2018. The heatwaves and low rainfall from January to April reflected the dissolved oxygen results, ranging from 15 – 35 %, in addition to the highest electrical conductivity reading in the urbanised section of Ginninderra Creek; 980µS/cm. On the other hand, with around 80 mm of rain during the week preceding the water sampling in December, some parameters skyrocketed, such as nitrates (10mg/L) and phosphorus (0.125 mg/L).

Although the weed, African lovegrass is still very common in the area, it is interesting to note the increasing presence of the native Kangaroo grass. Our volunteer has been carefully noting the erosion issues in this reach and things have worsened over the last few years following a number of flash floods.

Yellow-tailed Black Cockatoos have been sighted several times at this site with a flock of 40 flying over in late May.

Kippax Creek.

McKellar Wetlands MCW1

Designed habitat wetland system, McKellar

2018 CHIP Result B- (Good)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**20**
pH	Excellent	
Turbidity	Poor	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Fair**	**2**

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 McKellar wetlands received the best overall score in the Ginninderra catchment in 2018. It was also the only reach in Ginninderra catchment to have an 'excellent' electrical conductivity score while the other reaches mainly produced 'poor' scores. Perhaps this is due to this section not receiving the high amounts of urban stormwater which can often elevate electrical conductivity scores. Also, given the high amount of edge and in-stream vegetation present in both these wetlands, it's possible that they are just doing a more efficient job of treating the water quality. Nonetheless, the effects of low rainfall have been felt, with reduced water levels, increased turbidity and low dissolved oxygen.

Although not many large native trees are present in the riparian zone, native tussock grasses are quite common in addition to large amounts of reeds in the Dam. Water mites (350+) were the most abundant species of water bugs found, which are pollution-sensitive. Water mites are known to temporarily live on the surface of aquatic insects during their life cycle.

Icon Water worked with Waterwatch on Clean up Australia Day at these sites and removed 20 bags of rubbish plus chairs and election corflute signs!

Icon Water staff with their haul at Clean Up Australia Day, McKellar Wetlands.

Mulligan's Flat Dam MFL1

Headwaters of Ginninderra Creek to Mulligan's Flat Dam

2018 CHIP Result C- (Fair)		
2016/17 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**10**
pH	Excellent	
Turbidity	Poor	
Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

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

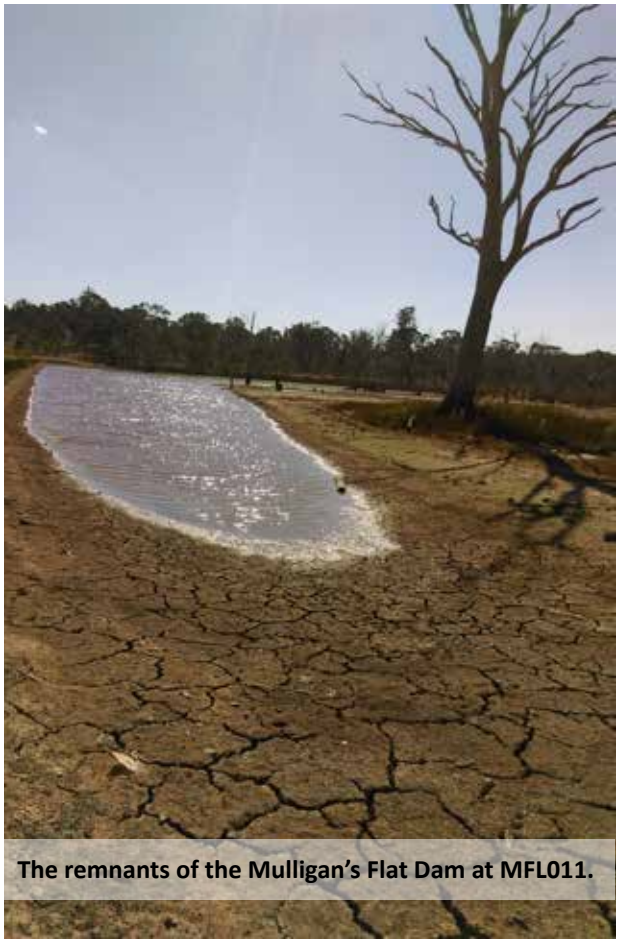
Mulligan's Flat Dam was originally an old farm dam, now repurposed as an ecological habitat for aquatic life, bird life and native fauna and flora. The Mulligan's Flat Nature Reserve was established in 1995 to protect the box-gum grassy woodlands and fauna situated in the Gungahlin area. The Dam is normally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

Reach Condition

This year the overall condition of this reach, which is the headwaters of Ginninderra Creek, has deteriorated and the effects of drought were evident. Our volunteer has mentioned several times about the low water levels of the wetland. Water was also turbid (150 NTU in February), the bottom of the Dam was very muddy and dissolved oxygen also dropped from 'excellent' last year to the lowest category, 'degraded', in 2018.

Water bug scores have gone from a high diversity in the prior year's sample, with ten orders and high abundance of the pollution-sensitive bugs, to low in 2018, with only three order of water bugs being recorded. They were water mites (300+), water boatman (300+) and fly larvae (10+). This was possibly influenced by the complete absence of aquatic vegetation, which serves as habitat for water bugs. This absence occurred because it was either left 'high and dry' or could not persist through the dry times.

A few eastern long-necked turtle heads were spotted in the remaining water along the dam wall.



The remnants of the Mulligan's Flat Dam at MFL011.

Murrumbidgee River CMM11

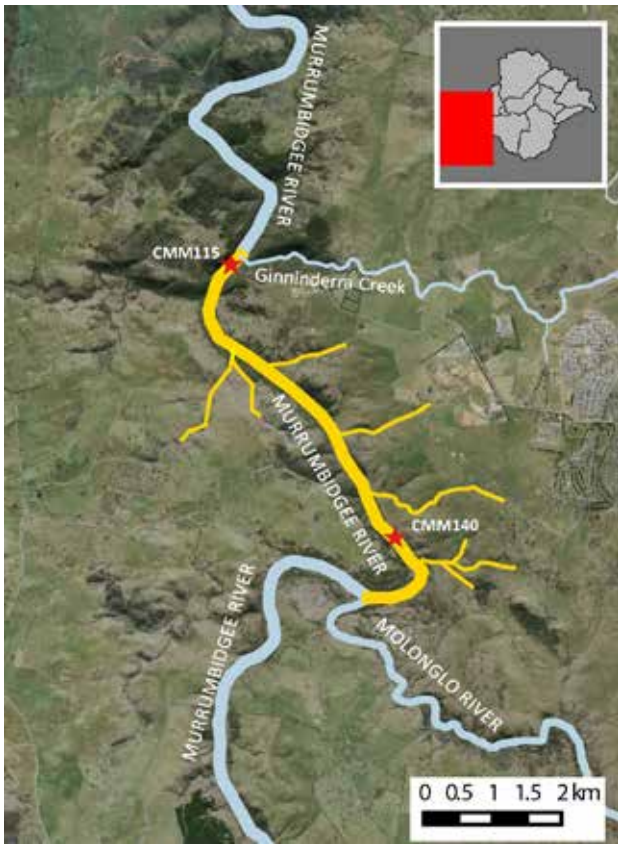
Molonglo River confluence to Ginninderra Creek confluence

2018 CHIP Result C (Fair)		
2016/17 CHIP Result DD (Data Deficient)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**12**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Poor	
Dissolved Oxygen	Excellent	
Water bug	**Degraded**	**3**
Riparian condition	**Fair**	**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

This reach has been reactivated after a few years of no data collection. The most striking water quality result is the nitrate measurements(range: 4 –30 mg/L), the second highest in the ACT region. These results are only less than the Lower Molonglo reach (MOL6) which feeds into the Murrumbidgee River just upstream of this reach. The results are most likely being influenced by the discharges of the Lower Molonglo Water Quality Control Centre(LMWQCC), as indicated by the nitrate results above and below the LMWQCC.

Most of the water bugs found, fell in the tolerant category, with high numbers of yabbies, fly larvae and water boatman. The reduced amount of reeds and aquatic vegetation in this section of the Murrumbidgee River are probably influencing the poor bug results.

Carp are a common sighting in this reach and occasionally Eastern froglets are heard.

Conducting riparian assessments on the Murrumbidgee River (CMM115).

The Valley Ponds GUN1

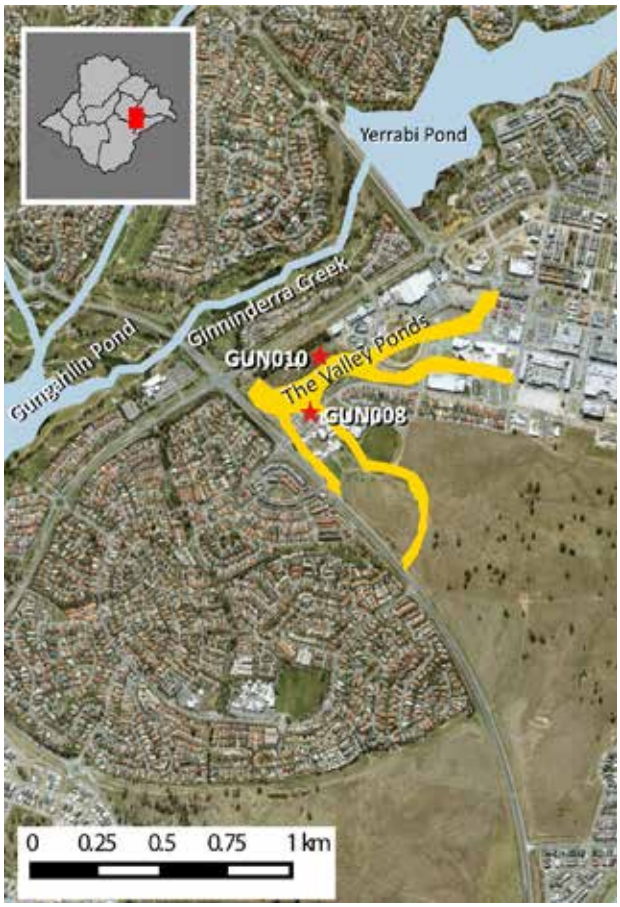
Wetland to Gungahlin Town Centre

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**16**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Fair**	**2**

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

Last year this reach was data deficient for water quality but owing to the great effort of our volunteers, the Birralee Scouts, sampling is back on track.

Despite an overall 'good' result for water quality, electrical conductivity reached one of the highest values (range: 230-770 µS/cm) for the urbanised area of Ginninderra Creek. This could be related to the stormwater it receives and historical land use impacts. It has been noted that elevated amounts of rubbish after rainy days, and turbidity reached the highest level in this drainage (200 NTU) after a 10mm storm in October.

With the help of the Birralee Bunyip Cubs, we conducted both Autumn and Spring bug surveys, recording ten orders of water bugs at each. It was great to see the pollution-sensitive mayflies, caddisflies and water mites, but the majority of the samples were composed of flatworms (80+), fly larvae (70+) and true bugs (300+).

The Valley Ponds.

Yerrabi Pond YER1

Headwaters of Ginninderra Creek to Yerrabi Dam Wall

2018 CHIP Result B- (Good)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**18**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Fair	
Water bug	**Fair**	**2**
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,disconnected by stock dams. It flows into the sediment control pond of Yerrabi.

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

Reach Condition

There were nine orders of water bugs observed in both the Autumn and Spring sampling at Yerrabi Pond, with many tolerant species recorded, such as fly larvae, worms, water boatman and snails. On the other hand, microcaddis, which are sensitive to pollution, were observed during Spring. They are a member of the caddisfly family that builds a small silk case to protect themselves, and because of their small size they can be hard to spot.

Water quality rated better this year, with dissolved oxygen, nitrates and pH records helping to push up the scores.

Much of the riparian zone was composed of exotic grasses, which are typical ground cover plants in the ACT urban park. A few scattered trees, with casuarinas being the most representative native tree, do occur. During dry years, urban ponds can help to buffer the effects of drought and provide refuge habitat for native wildlife. Some more complexity in the riparian zone would positively contribute to this.

Yerrabi Pond at YER001.

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. There is new residential development occurring at Googong, south-east of Queanbeyan, and around the lower Molonglo River. 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 information 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 for 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 project, four are in the Molonglo catchment. These sub-catchments are currently the focus of water quality improvement strategies such as wetlands and water-sensitive urban design.

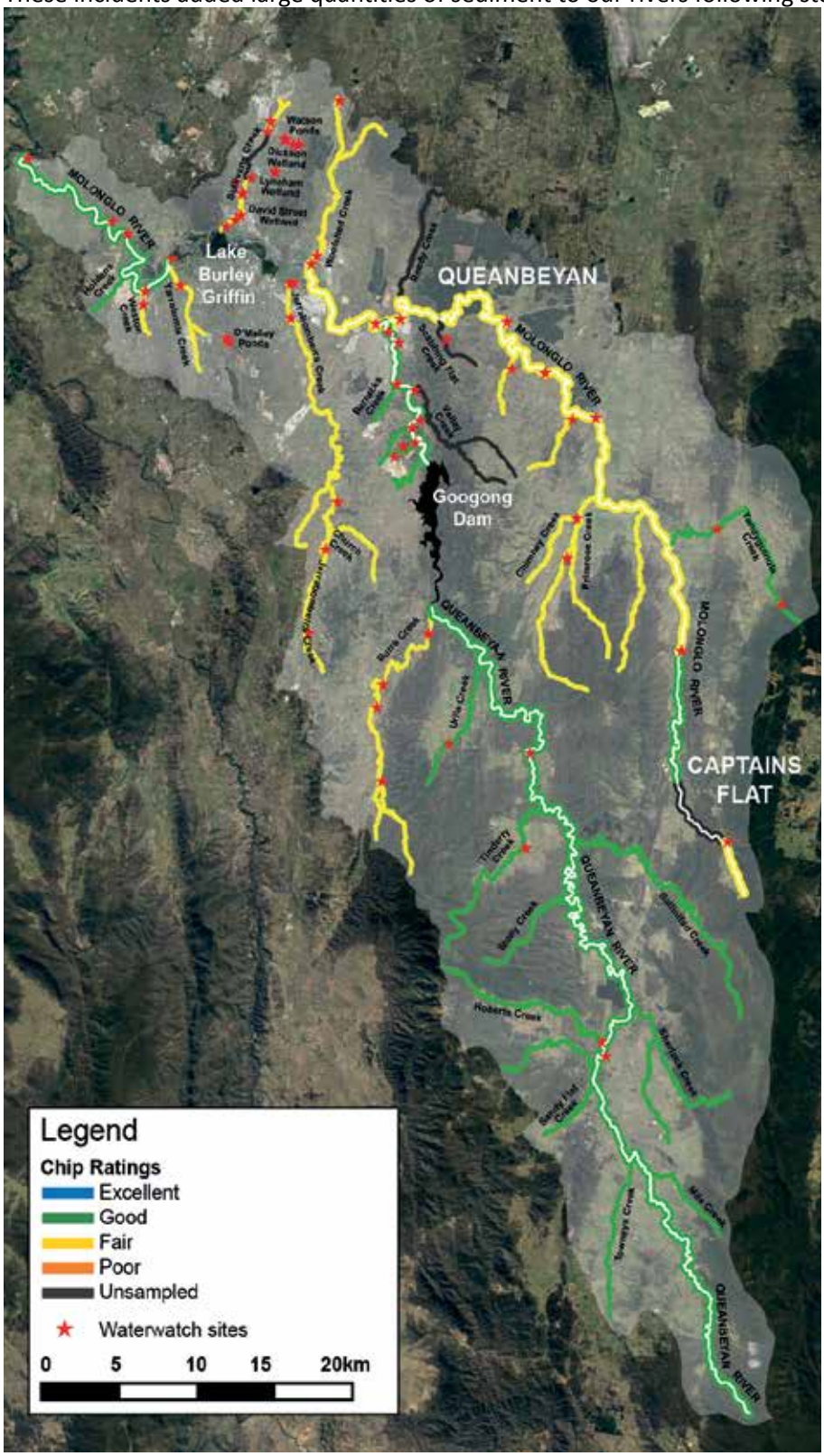
Though water quality across the Molonglo catchment is generally good, when taking account of all our catchment health indicators (water quality, water bugs and riparian condition), it is the highly urbanised catchments and rural creeks with largely cleared vegetation, that are in the poorest condition.

Molonglo Catchment Health Summary

As with other sites around the upper Murrumbidgee, a dry Autumn and Winter in 2018 had a negative impact on overall CHIP scores in the Molonglo catchment.

There were significant periods when smaller creeks were dry, including four creeks which were dry for nine months or more, and much lower flows in most other creeks, as well as in the Molonglo River above Lake Burley Griffin.

The reduced rainfall saw 19 of 24 reaches with 'degraded' dissolved oxygen ratings, up from 16 reaches the previous year (which was also up on the year before that). When it did rain, there were incidents of very high turbidity, likely from urban development, and historical erosion from previously cleared rural land. These incidents added large quantities of sediment to our rivers following storm events which at times were extremely heavy and localised.



With lower flows, many water bug surveys had reduced scores with less diversity and overall numbers of bugs being collected. Every season, however, favours particular water bug species, and we continued to see unusual water bugs here and there (see the 'Toebiter' at QUE1).

The state of riparian vegetation was also impacted by the drier conditions, with many sites having more bare ground adjacent to waterways, and lower planting survival rates. Of the 63 Waterwatch sites assessed for riparian vegetation in the Molonglo catchment, only eight were rated as 'excellent' or 'good' and over half were rated as 'poor' or 'degraded'. As with previous years, it is mostly the upper catchments that have good complexity and diversity of native habitat, with the urban and lower rural sites having barer ground and a dominance of exotic trees. Working to improve the complexity of our riparian corridors is vital not only for the health of our rivers but to provide habitat and refuge for our wildlife.

Banksia Street Wetland SUW2

Sullivans Creek in O'Connor

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result D+ (Poor)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**4**
pH	Good	
Turbidity	Excellent	
Phosphorus	Poor	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

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

Banksia Street is an artificial 'off-line' wetland, constructed in 2010. It includes an ephemeral section (an area that dries out from time to time). Low flows are diverted from the westerly arm of Sullivans Creek concrete channel,to pass through the wetland, then overflow back into the westerly channel when water levels are sufficiently high.

Reach Condition

This Wetland is being sampled once again, with volunteers Louise and Lyn taking on this site along with Lyneham Wetland. Water quality is based on Spring and early Summer only, but the 'excellent' turbidity and electrical conductivity suggested a well-functioning wetland with sediment and plant nutrients being captured instead of flowing into Sullivans Creek.

The ephemeral section of the Wetland provided habitat for frogs, away from the large numbers of feral Eastern gambusia fish, which are voracious feeders, known to eat tadpoles and frog's eggs. The permanent water section supported some diversity of water bugs but they were in low numbers and mostly tolerant types such as snails. In Spring, the water was teeming with tiny crustaceans: mostly seed shrimps (Ostracoda) and some Daphnia (Cladocera).

Despite only a 'fair' vegetation condition rating, this Wetland has very diverse plants around and in the water, as well as other habitat features such as logs, and it rated the best of the urban Wetlands. Only the upstream sections of some creeks and rivers, with good native vegetation, have attracted a better vegetation score.

The permanent water section of Banksia Street Wetland.

Burra Creek BUR1

Headwaters to Googong Foreshores NR

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**38 (4 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**3**
Riparian condition	**Poor**	**4**

Reach Facts

Reach network length: approx. 40km
Dominant land uses: Native bush, grazing, rural, conservation

Burra Creek arises in the north-western edge of the Tinderry Mountains and flowing into the Queanbeyan River just upstream of Googong Dam. It flows through rural subdivisions and includes the outlet of the pipeline from the Murrumbidgee to Googong water transfer scheme, before passing through the southern end of Googong Foreshores nature reserve. Riparian vegetation is absent or dominated by Willows. There are some reed beds.

Reach Condition

For four months of 2018, the most upstream site on Burra Creek was dry. With reduced flows for much of this year, both electrical conductivity and the number of sensitive water bugs were adversely impacted.

Despite the poor streamside vegetation and condition at the main water bug sampling site, there was a good mix of in-stream habitat for the bugs. This included cobbles, pebbles, coarse sand, patches of organic matter, a shallow flowing section, a deeper pool, and other areas of vegetation that resulted in a good diversity of water bugs including some sensitive types.

It is pleasing to include five months of water quality data from a new downstream site close to London Bridge heritage site and the Queanbeyan River confluence. Unfortunately, even though this falls within Googong Foreshores Nature Reserve, riparian vegetation is minimal and there are areas of bare ground.

Whilst erosion and lack of streamside vegetation continue to be an issue, Icon Water is focusing on erosion problems in this catchment and has recently commissioned an ACWA survey. We look forward to more opportunities for landholders to make improvements that will help stabilise erosion and improve vegetation and water quality.

Volunteer Sarah Essex at our new Waterwatch site on Burra Creek (BUR095).

David Street Wetland SUW1

Sullivans Creek catchment in O'Connor

2018 CHIP Result C (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**13**
pH	Good	
Turbidity	Fair	
Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

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

David Street Wetland is the second '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

Water bug sampling was extremely difficult again this year in the thick, soupy water. Woo O'Reilly noted: *"The pond was dark, stagnant with a deep layer of anaerobic sludge on the bottom. The surface was also covered in a heavy layer of pollen/seed. The water was also teeming with Gambusia (a feral fish species)."*

As the oldest and smallest wetland in the inner North, David St Wetland has captured a deep layer of sediment over time, which is a primary part of its intended function. However, the deep sediment, and a dominance of Acacia trees has reduced the growth of water plants, and suggests this wetland is not functioning as well as it could to improve water quality.

With most water quality parameters being worse this year including a 'degraded' dissolved oxygen rating, the overall water quality score has dropped considerably. This makes this wetland equal worst in the Molonglo catchment (along with Lyneham Wetland). The 'degraded' phosphorus status, possibly contributed to the blue-green algae (cyanobacteria) noted at the Wetland in March and April.

A thick layer of seed and pollen made the Spring water bug survey a challenge at David St Wetland.

Dickson Wetland DIC1

Sullivans Creek catchment

2018 CHIP Result B (Good)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**14**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Fair**	**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

With big improvements in nitrate and electrical conductivity this year, this urban wetland had the equal third highest water quality in the Molonglo catchment. When most creeks and some river sites were barely flowing, Dickson Wetland had high water levels and pristine looking water. This has resulted in excellent water quality, which was only equalled or surpassed by the three Queanbeyan River reaches.

A good variety of edge and wetland plants have matured here over the past eight years. They have been well watered and are providing excellent water bug habitat. This has resulted in an overall riparian condition score that was higher than other urban wetlands and most other reaches in the catchment.

Locals report that the feral fish species, redfin perch, are found here. Another unusual find was small freshwater mussels.

This lovely wetland continues to be well looked after by local residents and it is valued by locals and visitors alike.

The good diversity of edge vegetation is starting to mature at Dickson Wetland .

Googong Creek GGG1

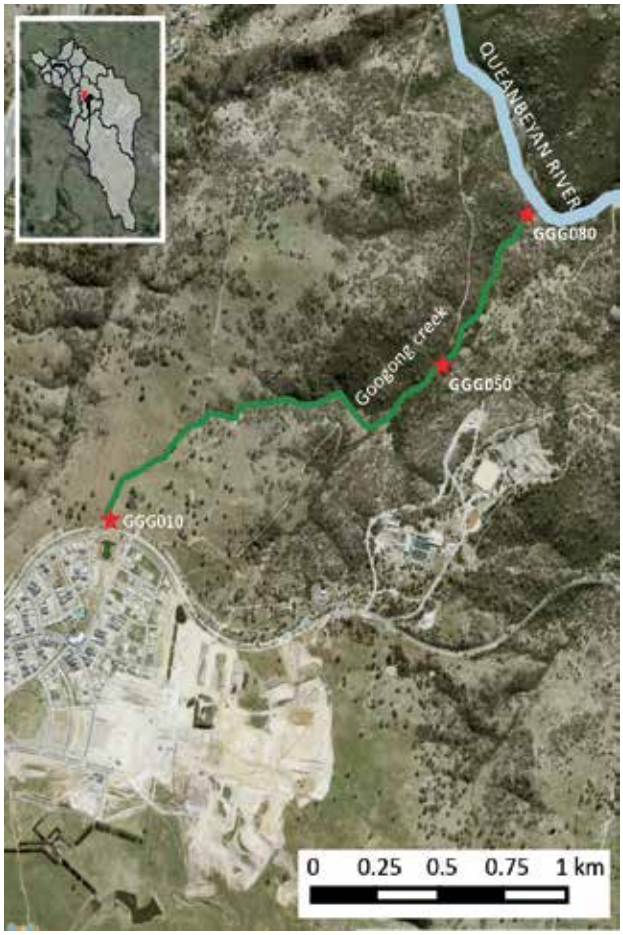
Headwaters to Queanbeyan River confluence

2018 CHIP Result B (Good)		
2016/17 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**17 (3 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
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 rises 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

Water quality overall has reduced slightly since last year. A new site was added at the top of the Creek to monitor water from Googong township. This can then be compared to the sites downstream that are more influenced by spring water. The riparian condition score for the new site has not yet been included in this score.

Our volunteer, Sue, continued to report apparent pig damage to groundcover vegetation around the Creek at the downstream sites, as well as the presence of riparian weed species. There were concerning periods with high nitrogen measurements, as well as spikes of high turbidity following rain, which had a negative impact on this Creek and the Queanbeyan River downstream.

For several months in Autumn the middle site on the reach has no surface water flows and at the site furthest downstream Sue said that “flow was just a trickle - the lowest I have seen it”.

Our champion Waterwatch volunteer, Sue Gibson, at the new site on Googong Creek (GGG010).

Jerrabomberra Creek JER1

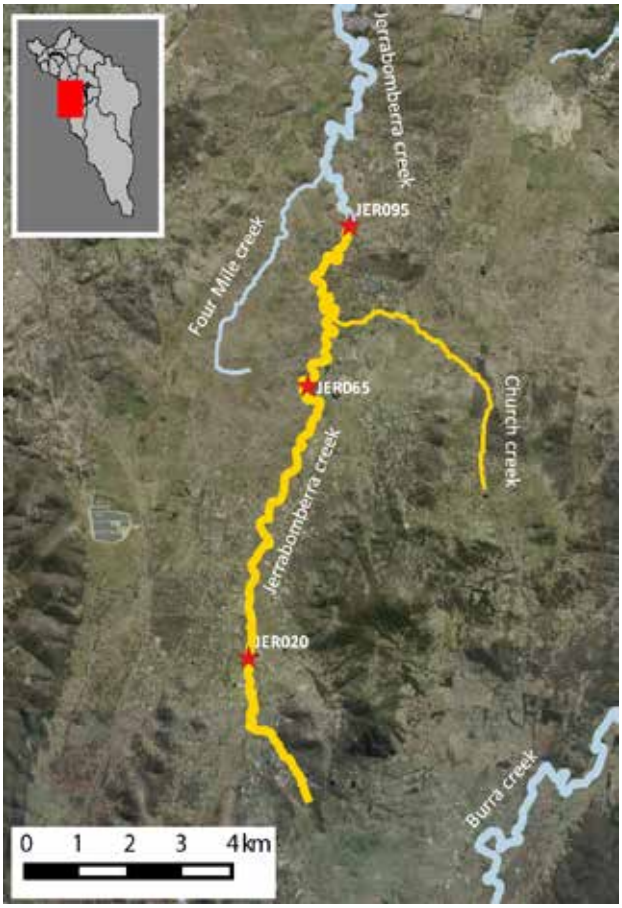
Headwaters to Fernleigh Drive

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**19 (2 dry)**
pH	Excellent	
Turbidity	Good	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**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. The creek channel has some healthy riparian vegetation before flowing into rural subdivisions with very little riparian vegetation.



Reach Condition

Turbidity, electrical conductivity and water bugs all received lower scores this year. This is likely a consequence of reduced flows due to the very dry conditions and reduced data collection. JER065 was dry for most of 2018, while the upstream site did maintain it's water all year. Downstream, although JER095 may not have always been dry, it was not monitored as frequently as past years and lacks data for most of 2018.

Comments from the Waterwatchers testing this section of Jerrabomberra Creek emphasise how vital refuge pools are, as they retain water for many months when surface flows have ceased. Areas with pools and vegetation are vital for wildlife, with regular reports at JER020 of a diversity of bird species, frogs, kangaroos as well as many water creatures. These important habitats enable wildlife to persist and then disperse again once the flows return.

There are two new areas of development on the Church Creek tributary with potential to impact this reach.

Jerrabomberra Creek at JER065 was dry for much of 2018.

Jerrabomberra Creek JER2

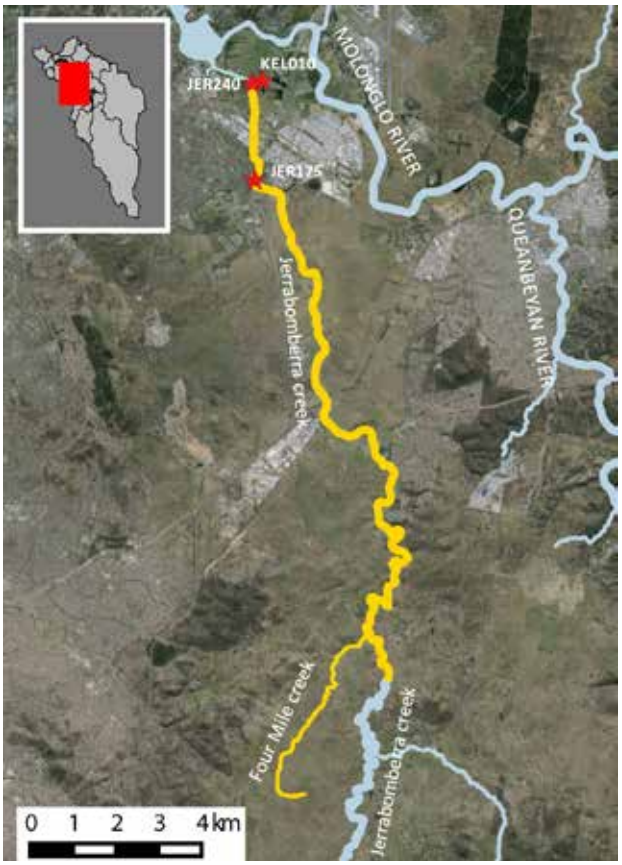
Fernleigh Park to Molonglo River confluence

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**27 (2 dry)**
pH	Excellent	
Turbidity	Good	
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 Nature Reserve.



These largely artificial wetlands capture runoff from the adjoining Fyshwick industrial area. 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

Lower Jerrabomberra Creek improved its water quality score this year, up considerably from the last CHIP report. Phosphorus particularly improved, with turbidity and nitrate readings also better. The relative influence of Kelly's Swamp on the water quality score in the reach was less than in previous years because it was dry for two months.

As an ephemeral wetland, Kelly's Swamp naturally has higher nutrients (like phosphorus), salts (pushing up electrical conductivity) and turbidity. But the cycle of wetting and drying in the Swamp provides rich habitat for many types of water birds, Eastern long-necked turtles and water bugs.

There are major works underway on this reach to improve water quality as part of the ACT Healthy Waterways Program. This includes new ponds in Narrabundah, and works that will connect to an existing channel of Jerrabomberra Creek in the Wetlands, creating a much larger chain of functional wetlands

Water bugging at Jerrabomberra Wetlands.

Lyneham Wetland LYN1

Sullivans Creek catchment off Wattle Street Lyneham

2018 CHIP Result D+ (Poor)		
2016/17 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**7**
pH	Good	
Turbidity	Good	
Phosphorus	Degraded	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**2**
Riparian condition	**Poor**	**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

Volunteers Lyn and Louise adopted Lyneham Wetland in June, so water quality sampling only covers the second half of the year.

This year's score is down on last year. Phosphorus levels have deteriorated significantly with more than half of the measurements falling into the 'degraded' category (>0.08mg/L). It's not clear what the reason for this is, however if the bottom layer of water in the wetland is depleted of oxygen, this can result in a chemical reaction that releases existing phosphorus from the sediments, into the water column.

Water bugs indicate 'degraded' conditions, which is a further decline on last year. Small pollution tolerant crustaceans, particularly Daphnia, continue to dominate this Wetland. Occasional very high flows create challenging conditions with few in-stream plants present to help slow the water down. This Wetland has water pumped from it as part of the Inner North Reticulation Network. This results in the water levels dropping quite suddenly at times which can leave the water edge plants here, high and dry and limiting available habitat for water bugs.

Pleasingly, this Wetland has much less rubbish than we've seen in previous years.

Attracting some curious passers-by during the Spring bug survey at Lyneham Wetland.

Molonglo River MOL1

Headwaters to Captains Flat

2018 CHIP Result C+ (Fair		
2016/17 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**No Data**	**0**
pH	NA	
Turbidity	NA	
Phosphorus	NA	
Nitrate	NA	
Electrical Conductivity	NA	
Dissolved Oxygen	NA	
Water bug	**Good**	**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

This top reach for the Molonglo River continues to lack water quality data due to the absence of a volunteer. If you know anyone who lives around Captains Flat who may be interested, we would love to hear from you! Thus, only water bugs and riparian condition surveys are contributing to the overall CHIP score this year.

With low rainfall, the sensitive water bugs were somewhat reduced in numbers, but over both Autumn and Spring surveys they were still the best in the Molonglo catchment. Considering the small size of the river this far upstream in the catchment, plus its limited habitat types and riverside vegetation, the diversity and number of water bugs suggests water quality is very good. There is also some dense in-stream vegetation, diverse water-edge plants, and faster flowing water upstream.

With no official rainfall data available, anecdotal news from a local landholder saw the lowest flows in 20 years occur in March. Some good rainfall fell in this part of the catchment in October, despite little evidence of increased flows downstream

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

Molonglo River MOL2

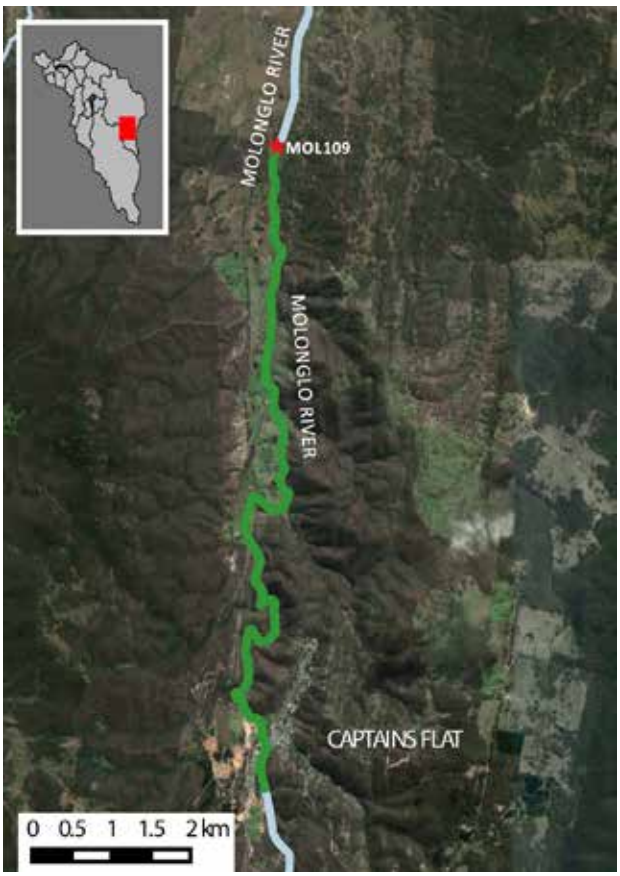
Captains Flat to Travelling Stock Reserve

2018 CHIP Result B (Good)		
2016/17 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**12**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**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 mostly through modified rural land and finishes at the Travelling Stock Reserve (TSR) at 'Foxlow'.



Reach Condition

Long term resident volunteers, Wendy and Steve, remarked, "This is the lowest water level we have ever seen at this site". Electrical conductivity and dissolved oxygen scores were also strongly impacted by little or no river flow for most of the year, but nitrate and phosphorus were improved overall.

This reach had two very contrasting water bug surveys, with the worst in Autumn and one of the best in Spring. Whilst habitat is very good and water quality is 'excellent' for many parameters, water bugs show that not all is well. It may be that low flow conditions concentrate the remnant pollution from the Captains Flat mine but the cause remains unclear.

There were three months when turbidity was very high at the only Waterwatch site on this reach. It possibly related to the resident Carp population stirring up sediment in the pool upstream. This also coincided with the Autumn water bug survey so this may have been a contributing factor to the poor water bug score.

Weed control in this travelling stock reserve is an ongoing issue within this pocket of excellent native bush. It is a rarity in an area where riverside vegetation has been largely removed.

Wendy and Steve helping out with water bug surveys at the Travelling Stock Reserve on the Molonglo River.

Molonglo River MOL3

Downstream of Travelling Stock Reserve near 'Foxlow'

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**50 (1 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**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

Willows continue to re-establish along this reach, and riverside vegetation at many sites is dominated by exotic species. Local landcarers continue to work towards improvements in riparian vegetation, and the smaller creeks do have better vegetation condition. Unfortunately, the large rural properties with highly cleared landscapes dominate the main river channel.

This reach had very similar results to last year, and only poorer electrical conductivity and water bug results, reduced the overall score, both likely due to reduced flows from the dry conditions. There are, however, welcomed stretches of dense aquatic vegetation which, despite lacking in diversity, provide important habitat for water bugs.

With multiple sites in the reach, Whiskers Creek has little impact on overall water quality but it supports a beautiful algae called Nitella, which only grows in clean water and managed to persist despite the low flows.

Molonglo River below Briars Sharrow Road crossing.

Molonglo River MOL4

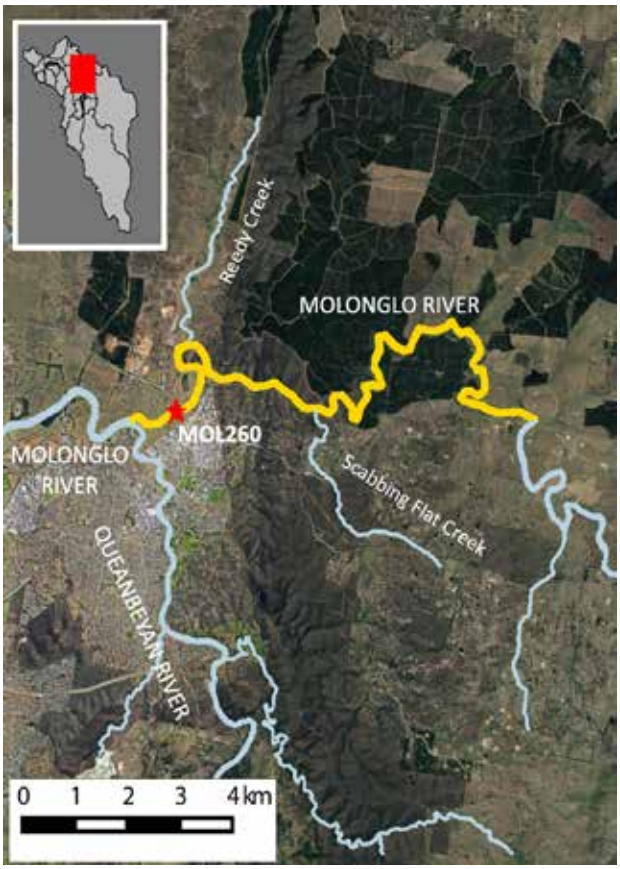
Downstream of Burbong Bridge to Queanbeyan River confluence

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**12**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
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

With small reductions in water quality and water bug scores, the overall score has dropped slightly from last year, with low flow conditions persisting until December. As with many riparian areas, weedy species such as blackberries and Willows are poised to take over this site and ongoing control is important.

The (artificial) rocky river bottom above the weir provided habitat for less commonly seen water bugs such as uncased caddisfly larvae, and may also reflect the positive influence of Molonglo Gorge not far upstream. However, low flows saw the aquatic plant, Water milfoil, coated in algae for an extended period.

Fisherman visiting the site insist on hanging large dead Carp on nearby posts, making water bug surveys rather stinky! But perhaps they also attract water bug types such as the big water scorpion we saw devouring a damselfly nymph.

Molonglo River looking downstream to Yass Road bridge.

Molonglo River MOL5

Upstream of Lake Burley Griffin

2018 CHIP Result C (Fair)		
2016/17 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**17**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**2**
Riparian condition	**Poor**	**1**

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

The most notable thing this year is high nitrate readings at MOL295 which regularly got measurements of around 5mg/L. This resulted in the nitrate score dropping from 'excellent' in the previous year to 'degraded'. The source of this excess nitrate is unknown but the upstream site, MOL270 just below the confluence with the Queanbeyan River, has recorded very low nitrate levels, if any, so the source is somewhere between these two Waterwatch sites.

Small amounts of blue-green algae were noted during the water bug surveys. This did not appear to affect the bugs compared to previous years, which showed an abundance of pollution-tolerant types such as glass shrimp and 'true bugs' (Hemiptera). The limited diversity and numbers of water bugs reflect the lack of diversity in water bug habitat present along this reach. There are many large deciduous trees lining this section of the river and leaves and fluff from white Poplar trees is often evident.

Volunteer Tony Patis knows a thing or two about fish and noted "large numbers of 2cm Carp at edges" during his March sampling at MOL295.

Some blue green algae was noted during Autumn and Spring water bug surveys at MOL295.

Molonglo River MOL6

Lake Burley Griffin to Murrumbidgee River confluence

2018 CHIP Result B- (Good)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**26**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Poor	
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 extends from directly downstream of Lake Burley Griffin to the Murrumbidgee River confluence. 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.

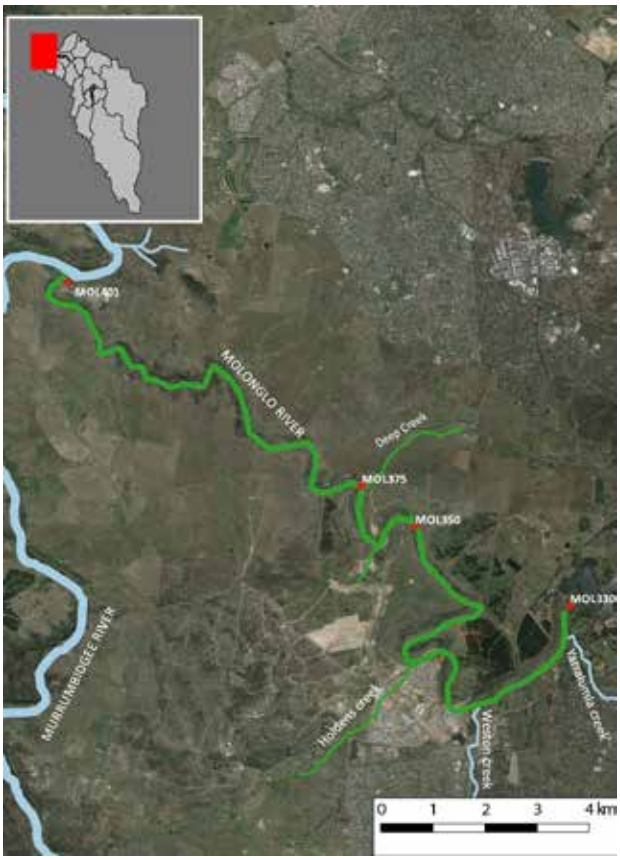
This reach will be targeted by the ACT Healthy Waterways (Basin Project) with works aimed at improving water quality.

Reach Condition

The bottom site on the reach is strongly impacted by outflows from the LMWQCC, with nitrate levels at least ten times higher than upstream and at most other sites in the upper Murrumbidgee catchment. Data from this site has seen the overall nitrate rating drop slightly. However, dissolved oxygen values, dropping considerably this year at all the sites in this reach, has meant a drop in the overall water quality score.

We often find unusual water bugs at the bottom site on the reach, with large black beetle larvae (an unusual species of Elmidae) found in both surveys, less common sack-tailed and split-tailed damselfly larvae (Diphlebiidae & Isostictidae), and net-spinning caddisfly larvae (Hydropsychidae) being some of the standouts. The net-spinners are common in flowing water and spin their nets from silk, similar to a moth.

Riverside vegetation should improve as Molonglo River Reserve has improvements made to fulfil its function as an environmental offset for nearby urban development.



Algae covered rocks in the Molonglo River at MOL401.

Primrose Creek PRI1

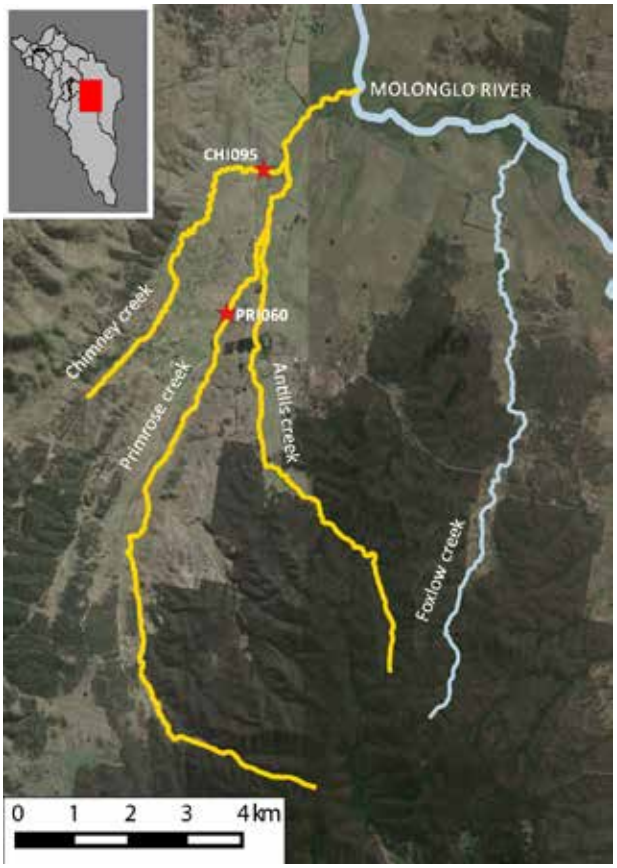
Headwaters to Molonglo River confluence

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**18**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**1**
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 actively eroding. 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

Water quality data is being collected more regularly this year by new volunteers Colleen and Glenn, who say they are enjoying their outings to these sites. There are frequently horses and cows in or near the creeks, and regular visits from wildlife. Primrose Creek particularly is often teeming with water life even though this creek can freeze over in Winter.

Low flows resulted in a significant drop in dissolved oxygen from 'excellent' last year to 'degraded', so the overall water quality has dropped slightly.

Because of the very low flows, only the Autumn water bug survey was done. Although not many sensitive types of water bugs were present, those that were there, were present in large numbers. It is always impressive how many water bugs of diverse types are found in this small but ecologically important creek, which also has diverse aquatic vegetation.

That said, with little or no streamside vegetation to provide shelter and habitat, this reach unfortunately has one of the worst riparian condition scores in the catchment.

Glenn McMahon sampling at Chimney Creek (photo: Colleen McMahon).

Queanbeyan River QUE1

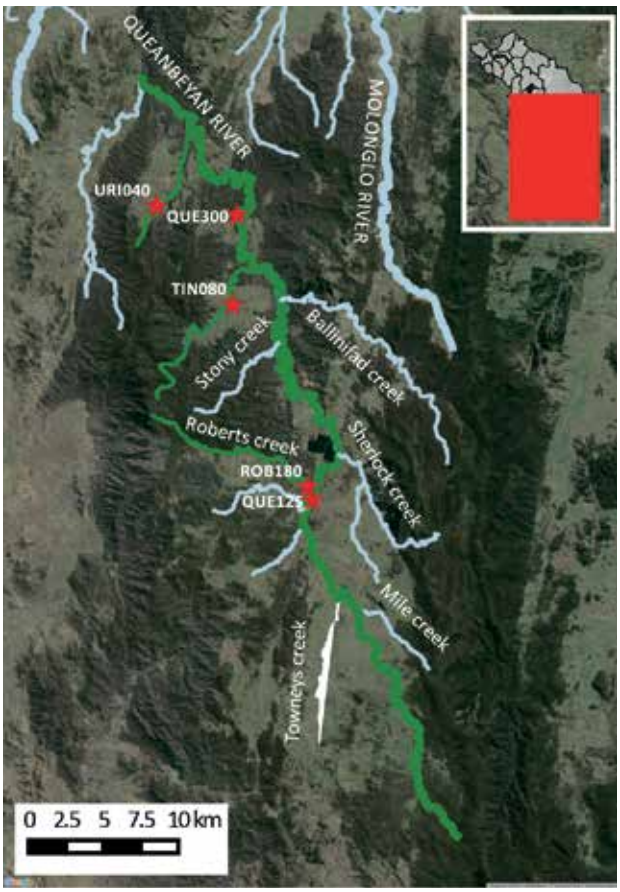
Upstream of Googong Dam

2018 CHIP Result B+ (Good)		
2016/17 CHIP Result A- (Excellent)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**54 (21 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Fair	
Water bug	**Good**	**2**
Riparian condition	**Good**	**5**

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 sites on this reach continued to have some of the best vegetation condition scores in the Molonglo catchment. Despite some areas of cleared rural land, the land surrounding the upper Queanbeyan River has largely intact native vegetation, with trees, understorey and good groundcover vegetation all enhancing its ability to capture and slow down rainfall. This meant the upper Queanbeyan River continued to flow well, despite very low rainfall for many months.

Volunteer John reported active erosion from the *"head of Lyons Creek... [creating a] massive silt load in Lyons Creek and Queanbeyan River"* in January and again in December, following heavy rain. It was captured in the December sampling data when turbidity was much higher than usual (200NTU at Boolboolma Crossing QUE125).

Downstream at QUE300, volunteer Sandy noted patches of ice on the River in July, and in August and September *"the resident Platypus was diving and bobbing - bliss - despite the cold".*

The water bug surveys found sensitive types in lower numbers but greater diversity than in previous years, These included stonefly, five types of mayfly and six types of caddisfly in the Spring sample, as well as a "Toebiter" (Dobsonfly larva) and a pale pink, "long haired" moth larva.

The predatory Dobsonfly larva (called 'Toebiters') was found during the Spring water bug survey.

Queanbeyan River QUE2

Downstream of Googong Dam to city of Queanbeyan

2018 CHIP Result B (Good)		
2016/17 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**35 (2 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
Water bug	**Fair**	**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

Several creeks contribute water to this stretch of the Queanbeyan River but they provide a relatively small amount of the total flow. Reduced flows due to the dry conditions this year contributed to the electrical conductivity being rated as 'degraded' as various salts and minerals became more concentrated by low flows. Montgomery Creek was dry for part of the year but, unexpectedly, Gorge Creek continued flowing well.

Recycled water from the growing Googong township flows into one tributary and contributed to higher nitrate levels but water quality overall is still one of the best in the Molonglo catchment. It is also one of only two reaches to rate as 'excellent' for dissolved oxygen.

Turbidity was generally low, but there were incidents of very high turbidity following heavy rain. Volunteer Sue is particularly concerned about any potential impact on Platypus, which need large numbers of water bugs to thrive. She saw Platypus regularly in the River, including in February when *"we noticed a baby Platypus learning to dive in the pool immediately upstream... We watched it surface and dive dozens of times".*

Sue testing Gorge Creek at GOR090.

Queanbeyan River QUE3

Queanbeyan city to Molonglo River confluence

2018 CHIP Result B- (Good)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**33 (1 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Fair	
Dissolved Oxygen	Fair	
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

There will be a large new road crossing the Queanbeyan River in the upstream section of this reach, with construction beginning in April/May.

River vegetation condition along the reach is variable, and the water bugs at the bottom site (the railway bridge at Oaks Estate) were low in numbers and dominated by more tolerant species. It was noted during the Spring water bug survey that despite available habitat for water bugs, it was adversely impacted, "extensively clogged with algae and sediment [with] lots of algae over submerged and emergent vegetation".

That said, Platypus are seen very regularly in this reach, which supports the highest known population of Platypus in the region.

Queanbeyan River (QUE495) under railway bridge.

Scabbing Flat Creek SCA1

Headwaters to Kings Highway

2018 CHIP Result DD (Data Deficient)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**DD**	**12 (11 dry)**
pH	DD	
Turbidity	DD	
Phosphorus	DD	
Nitrate	DD	
Electrical Conductivity	DD	
Dissolved Oxygen	DD	
Water bug	**No Data**	**0**
Riparian condition	**Good**	**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

The Creek was dry for every month except December, so there was insufficient water quality data to meet the CHIP data threshold. For the one month data was available, results were very similar to the previous year when it was rated as 'good' overall. Such a small ephemeral (intermittently flowing) creek is too small and fragile to sample water bugs.

Our thanks to volunteer John, who visited the site each month in the hope there would be water to test.

Now that access to the downstream end of the site is largely restricted, the dumping problem has been much reduced, and only the rubbish from previous years, and the council roadwork piles remain.

The photo below shows how beautiful the Creek is upstream in Cuumbean Nature Reserve when there is water. The stream forms pools and disappears underground for short distances.

Upstream of SCA080 on Scabbing Flat Creek in Cuumbean Nature Reserve.

Sullivans Creek SUL1

Headwaters to Randwick and Flemington Road Pond, Mitchell

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**18**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**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

Last year this reach was data deficient for water quality due to a lack of a volunteer. With a Waterwatch volunteer sampling at Flemington Pond again, the inclusion of water quality data has lifted the overall score. Dissolved oxygen was notably problematic, although frequent high spikes of phosphorus were also concerning.

Dense, strong dark green algae around water plants made water bug sampling more difficult, and the samples were dominated by tolerant types including segmented worms (closely related to earthworms), flatworms (in Autumn), leeches (in Spring) and a few moderately sensitive types such as water mites.

The Pond usually supports a good range of water birds, but volunteer Michael thought numbers may have been affected over some months by the light-rail construction in close proximity, which produced noise, dust and rubbish.

Michael noted large influxes of rubbish after rain, but the construction of a new gross pollution trap should help reduce this.

View across Flemington Pond towards SUL018 (Photo: Michael Burton).

Sullivans Creek ANU SUL3

Lyneham Wetland to Lake Burley Griffin confluence

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**27**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**3**

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

Despite lower rainfall, Sullivans Creek at the ANU had very similar results to the previous year. Consistently high phosphorus is a continuing problem, increasing the potential for algal blooms in Lake Burley Griffin. The 'poor' electrical conductivity score is typical of a large urban catchment with an extensive network of concrete channels. This could be improved if more sections of creek, supported vegetation or were filtered through functioning wetlands.

There is good vegetation along the edges of the creek at the water bug site (SUL765), but overall, vegetation condition along the reach is 'poor'. Water bugs were found in good numbers and diversity, although they were mainly pollution-tolerant types. One highlight was finding two species of leech.

At Toad Hall Pond in January, volunteer Tim noticed pondweed (Potamogeton sp.), *"forming dense patches along the pond edge and supporting an active water bug community"*.

Feral fish species Carp and Eastern gambusia were seen at the downstream site just above Lake Burley Griffin, as well as native Western Carp gudgeon. Carp were again observed spawning along the edges of the Creek in early Summer.

Water levels in Lake Burley Griffin influence the lower sites on Sullivans Creek.

Watson Wetlands and Ponds WAT1

Justice Robert Hope Park to Aspinall Street

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**20 (1 dry)**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**4**

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

This variable 'reach' achieved an overall water quality score which was just shy of 'excellent'. Surprisingly, given the low rainfall, only one dam was dry during the year when WAT030 dried out in February.

This year, the highest turbidity readings were in WAT020, the dam towards the top end of Justice Robert Hope Park. Readings of 300 and 400 NTU in October/November were likely to be caused by high levels of algae or bacteria resulting in an *"awful pea green-brown colour"* as the water level dropped.

Water bug types found in the Autumn and Spring surveys were almost identical, which is unusual. The main difference was that numbers were lower in Spring. We found reasonably diverse water bugs but pollution tolerant types such as snails, segmented worms and flatworms dominated and no sensitive water bugs were found.

Our long-term volunteer Richard is moving away and we will miss his contributions greatly, including his help doing water bug surveys.

Volunteer Richard Larson helps Ben out with the water bug surveys at WAT040.

Weston Creek WES1

Headwaters to Molonglo River confluence

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**24**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Poor	
Nitrate	Good	
Electrical Conductivity	Good	
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. It then passes close to the new Molonglo development's eastern side and on to the confluence with the Molonglo River.

Reach Condition

During drier times, most water at the downstream site (WES450) comes from underground storage. This flows out into a small pool and on through a dense reed bed before flowing down a more natural, narrow channel to the Molonglo River. Upstream of the pool, a concrete channel carries any overflow water from the large connected ponds beside Cotter Road.

Though water quality improved slightly this year, high phosphorus readings continued to be a concern. The reed bed did, however, appear to have a positive impact on the phosphorus and electrical conductivity.

Water bug surveys saw good diversity but few sensitive types, and there were very large numbers of fly larvae (both surveys) and true bugs (Hemiptera, particularly in Spring). We also caught a baby Eastern long-necked turtle.

Volunteer, Gail noted the introduced pest plants - Blackberry, Privet and Willows - "doing particularly well along this reach".

Conducting water bug surveys above WES450 with the underground storage inlet in the background.

Woolshed Creek WOO1

Headwaters to Molonglo River confluence

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**22**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**2**

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

Improved scores in water quality and vegetation condition are mostly attributable to the middle site no longer being sampled. Because of the Majura Valley's hydrogeology and extensive historical land clearing, the defunct middle site had very high electrical conductivity, which adversely affected the overall rating in previous years.

A very busy road system adjacent to the lower site presents challenges for this small but ecologically important creek. Rubbish washes in from road drains and there is considerable dust and fumes with the high volume of traffic.

Despite the noise and smell, Mel, our volunteer on Woolshed Creek, heard several types of frogs and saw tadpoles and water dragons in Spring. She also noted up to six turtles in the dam upstream, which did not dry up completely despite low rainfall.

Mel often noted how clear the water was downstream, even after heavy rain.

Volunteer Mel McRoberts at WOO090 under Fairbairn Avenue bridge.

Yandyguinula Creek YAN1

Headwaters to Molonglo River confluence

2018 CHIP Result B (Good)		
2016/17 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**24 (13 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**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

Volunteer John, who samples a range of sites around the catchment, continued to visit the remote upstream site (YAN020) despite little rainfall and it being dry for nine months in 2018. He remarked about the downstream site that this was "The first time a dry creek bed was found below the causeway after almost seven years of monitoring". When water was present again, in April, he noted the frog calls and turtles basking beside the Creek, with up to four species of frogs calling whenever there was water.

Thirteen taxonomic orders of water bugs were found in both Autumn and Spring surveys. "Scuds" (Amphipoda, small crustaceans) were present in large numbers amongst the dense Water milfoil, and there were large numbers of various insect larvae including hundreds of mayflies and damselflies. One highlight was an enormous 60mm+ "taper-tailed tiger" predatory beetle larva (Dytiscidae) which grabbed a large damselfly larva during the survey!

Yandyguinula Creek near the Tallanganda National Park.

Yarralumla Creek YAR1

Headwaters to Molonglo River confluence

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**35**
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
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.

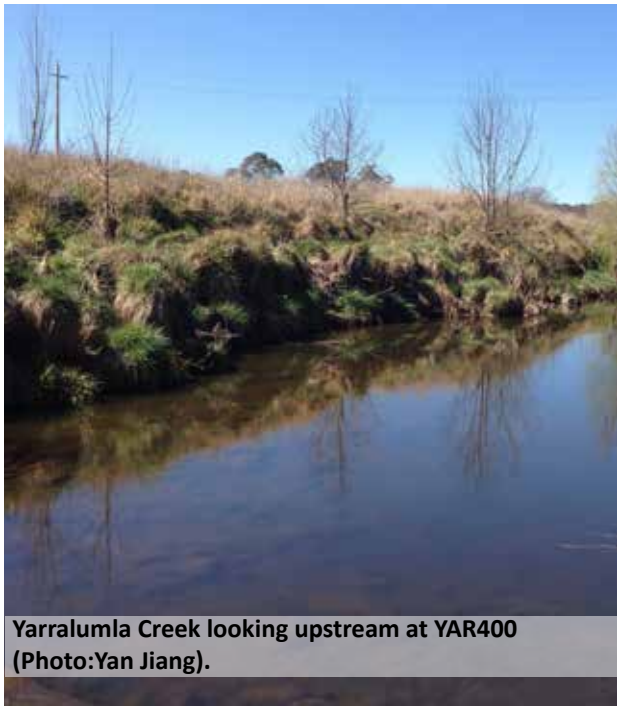
Yarralumla Creek then runs parallel with Curtin in a concrete stormwater channel then down through a deeply incised channel to the Molonglo River, immediately below Scrivener Dam. The reach includes East O'Malley Pond.

Reach Condition

Diversity and numbers of water bugs are generally low in the downstream site (YAR400) on Yarralumla Creek, and pollution tolerant types dominate, such as leeches, snails, and larger numbers of fly larvae.

Apart from the highly variable flows, other varying parameters at YAR400 included electrical conductivity which ranged from 80-1110µS/cm from September to November. In October, sampling coincided with a 10mm rainfall event which saw a turbidity spike of 200NTU and phosphorus shoot up to 0.25mg/L which is as high as the low range phosphorus kits will go. The bulk of phosphorus will move through a system during a rainfall event so it's not surprising to get a result like this in a reach where nutrients are known to be a problem.

Various ACT Healthy Waterways projects are being undertaken upstream on the network of concrete channels which form much of this creek. This will help to reduce the high flows, and provide better filtration of sediment, unwanted nutrients and pollutants. These projects, once completed in 2019, will take several years to be fully functional, as plants grow and establish.



Yarralumla Creek looking upstream at YAR400 (Photo:Yan Jiang).

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.

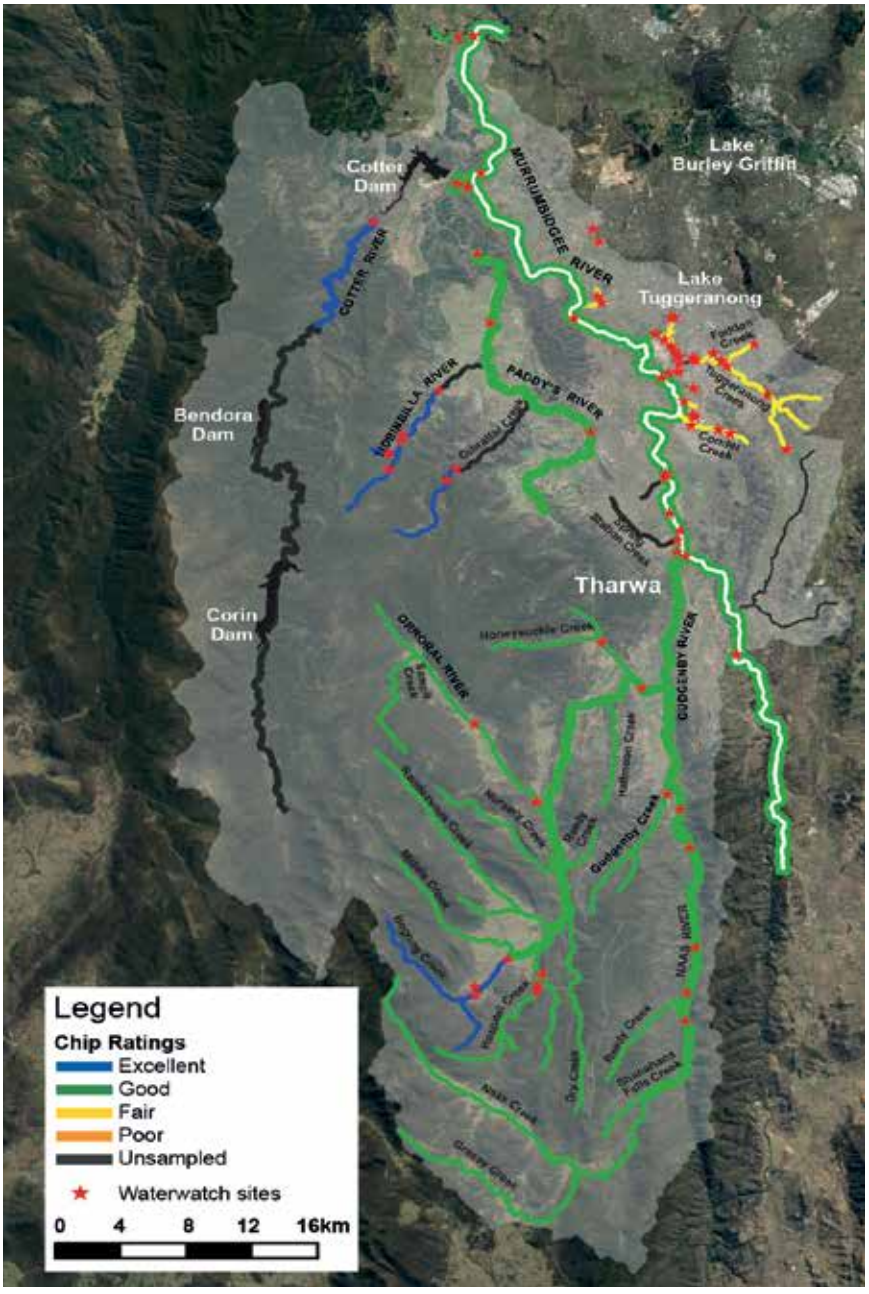
All of these waterways join the Murrumbidgee River in the ACT, which flows north from Angle Crossing, near Tharwa, to Uriarra Crossing, just before the Molonglo River confluence in the north west corner of the ACT. The Murrumbidgee River from Angle Crossing to Casuarina Sands is part of the Upper Murrumbidgee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

Southern ACT Catchment Health Summary

For most months of 2018, the Southern ACT catchment received half of its average rainfall. In July, a mere 7.8mm fell which is one-fifth of the average and the lowest on record for that month. A record number of seven Waterwatch sites have remained either completely dry or were reduced to pools for most of this year. All farm and reserve dams reported being at their lowest levels since many volunteers began monitoring.

That said, while much of the upper Murrumbidgee catchment has shown a decline in condition in 2018, this catchment has bucked the trend by actually showing a slight improvement in scores. Four reaches scored 'Excellent' up from two last year. Not surprisingly, these were all in the upper, protected areas of the catchment in Namadgi and the Cotter Reserve. Given a large chunk of the Southern ACT catchment falls in reserves, this may explain how it's come out of a significant dry period not looking too bad. Areas with intact riparian zones will provide shading in hot weather, better filter the runoff when it does rain and will hold groundwater for longer. In a world of increasing dry times, this will become even more important.

Nine reaches scored 'fair' or 'poor', down from twelve in 2016/17, although two were 'poor' this year and no reaches received that last year. All nine reaches were either rural or farm dams and urban creeks and ponds. The dams on Cooleman Ridge became completely dry for the first time in ten years. The streams and ponds of the Tuggeranong Creek catchment fared the worst from a combination of construction works causing higher than average turbidity, poor riparian cover means water bodies are more exposed and dry up more quickly and high nutrient scores from its heavily urbanised surrounds being all too common.



Barney's Gully MMB1

Woodcock Drive, Gordon to confluence with Murrumbidgee River

2018 CHIP Result C (Fair)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**10 (4 dry)**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**1**
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 near 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

Barney's was reduced to a chain of drying pools for all but two months of 2018 as the drought pushed this little creek to its limits. On four occasions the trusty volunteer, Deb Kellock, could not sample at all due to the creek being completely dry. When water was there, it was described as "murky/milky" or "blue-green" in appearence. The absence of high nutrient loads compared to some other dried or urban sites may in part be due to the continued growth of planted grasses, shrubs and trees in the heavily restored riparian zone.

Only an Autumn water bug survey was conducted where a small variety of very hardy bugs were found. The largest number of creatures found were water-boatmen, who carry their own oxygen from the air, like scuba divers, and yabbies, Cherax destructor, who burrow deep into the mud to prevent their gills drying out, and go into 'aestivation' (like hibernation) to survive drought.

Barney's Gully - reduced to pools in March 2018.

Bogong Creek Catchment CGB1

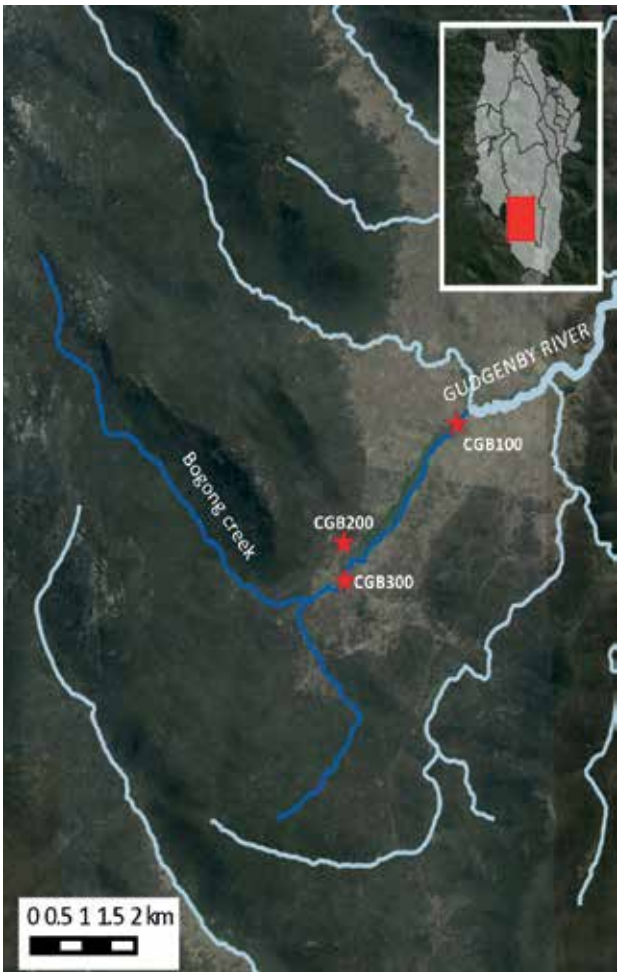
Headwaters to Yankee Hat trail bridge

2018 CHIP Result A- (Excellent)		
2016/17 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**33 (3 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**2**
Riparian condition	**Good**	**1**

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

Bogong Creek is a natural upland waterway continuing to show signs of recovery post the 2003 fires. This is thanks in no small part to the efforts of the Gudgenby Bush Regenerators. Long-time volunteer Martin Chalk did however make some worrying notes this year at the most downstream site, CGB200. In February he says "The EC [electrical conductivity] was the highest since recording started in May 2003" at 140µs/cm, and in June, "turbidity is the highest I have recorded at this site at 50NTU". It's possible that the turbidity event coincided with some culvert work being conducted in the area mid year. The high EC may be result of higher concentrations in the Creek by the end of a long, dry Summer with depleting groundwater inputs not providing much-needed recharge and dilution.

In spite of the dry conditions, sensitive water bugs such as stonefly, mayfly and caddisfly larvae were found in abundance. Many of the water bugs found in this year's surveys feed on detritus including Calocidae caddisfly larvae, known as 'shingle' caddis who often display shiny flakes of mica in their cases, commonly found among the granite deposits in the high country.

Bogong Creek, April 2018.

Cooleman Ridge Dams RAN1

Two dams on Cooleman Ridge

2018 CHIP Result D+ (Poor)		
2016/17 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**20 (1 dry)**
pH	Good	
Turbidity	Degraded	
Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
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

These two dams received one of the worst scores in this year's CHIP report. Cattle and feral pig activity continue to cause issues with both dams recording turbidity as high as 400NTU. The combination of sediment in the water and animals in close proximity have also meant that phosphorus levels were at 'degraded' levels with 0.2mg/L measured on several occasions.

A water bug survey was conducted at the 'old dam' (CMC100) in difficult circumstances, as any access was through deep sticky mud. What water was left in the dam was a sickly green colour. Only water mites and fly larvae were found in any numbers.

European wasps were recorded in February and were noted again in April. An illegal yabby trap was fished out of Kathner Street Dam in March. In November Kathner St Dam (MBK100) went dry for the first time in ten years.

Volunteer Colin Carpenter with the 'Old Dam' water bug sample.

Cotter River MCC1

Cotter Dam to Murrumbidgee River confluence

2018 CHIP Result B+ (Good)		
2016/17 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**12**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
Water bug	**Good**	**2**
Riparian condition	**Fair**	**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

This was our only reach to have excellent scores across all water quality parameters, a first for this reach since CHIP reporting began. Environmental release flows from the main Cotter Dam at low but steady rates all year have no doubt helped. When there wasn't enough water available from the Dam, water was pumped from the Murrumbidgee River back into this reach. This was needed over the dry Winter and early Spring. In December, this was the only source of flow through the lower Cotter.

Volunteers Fleur and Maree found diatom algae on the submerged rocks all year, a clear indicator of low flows and a regular feature of the Cotter Campground.

Water bugs that need diatom-free rocks as well as excellent water quality such as stonefly and net weaving caddisfly larvae were found in abundance in the faster flowing riffle sections upstream from the campground

This was the last year Fleur Horan contributed to this Waterwatch group. Her commitment to this program for 14 years has been tireless.

The Cotter River at the campground (Photo:M.Blume).

Cotter River MCC2

Pipeline Road Crossing to Vanity's Crossing

2018 CHIP Result A- (Excellent)		
2016/17 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**10**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Excellent**	**2**
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

This section of the Cotter River continues to show mostly excellent water quality results. Even when sampling took place the day after heavy rainfall in late February, the River still ran clear, highlighting the importance of a well-vegetated catchment. That said, the volunteer noted "low" river levels for half of the year with observations including "more exposed rocks" and the presence of diatom algae which is usually a sign of reduced flow. Dissolved oxygen was the only water parameter to not receive an 'excellent' score. The eflow data highlights releases as low as 10 ML/day in Autumn, with low observations seeming to align with low dissolved oxygen.

In November, however, there was an 'excellent' diversity of water bugs after a threefold increase in dam releases over early Spring to coincide with Macquarie Perch breeding season. This included highly sensitive stonefly and hundreds of mayfly and caddisfly larvae, mostly in the riffles. In the pool above the crossing, large numbers of fly larvae were in the sediment, but these were the 'toughest' bugs found.

Looking upstream at Vanity's Crossing, November 2018.

Gibraltar Creek GIB1

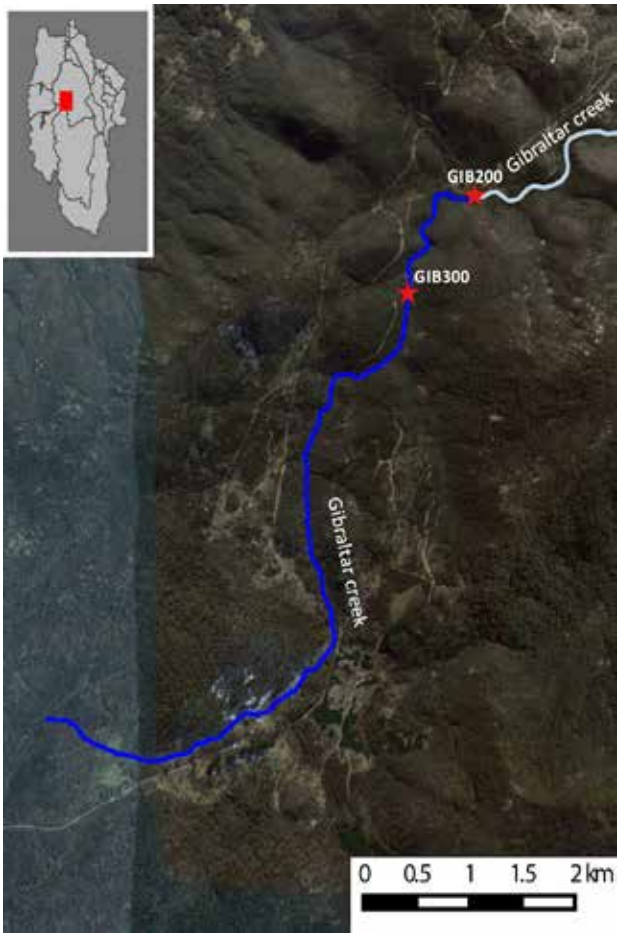
Headwaters to Woods Reserve

2018 CHIP Result A+ (Excellent)		
2016/17 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	Fair	
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

Gibraltar Creek was able to maintain clear, cool water all year despite the water level being recorded as 'low' for most months. This emphasises the crucial role that healthy riparian vegetation has in supporting the overall condition of a waterway, with this creek continuing to achieve a near perfect score for catchment health. However, ongoing low dissolved oxygen levels, in this creek resulted in a score that's the lowest it's seen since the CHIP program began and highlights how stressed our local ecosystems became in this dry period.

Water bug surveys conducted at Woods Reserves in Autumn and Spring produced pleasing results. A team of A.N.U. Intrepid Landcarers found ten types of bugs including hundreds of mayfly larvae, especially 'stream horses' (Coloburiscidae) so called for their 'galloping' movement.

During the Spring water bug survey at GIB200, volunteer Tom Tyrell and the Waterwatch Coordinator found an Alpine Spiny crayfish Euastacus crassus. It was covered with over 20 temnocephalans, a flatworm with tentacles that lives exclusively on crayfish. They apparently do no harm to their host.

An Alpine Spiny crayfish found in Spring at GIB200.

Goodwin Village Pond RAN2

Small Pond at Goodwin Village Monash

2018 CHIP Result C- (Fair)		
2016/17 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**12**
pH	Excellent	
Turbidity	Good	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Degraded**	**1**
Riparian condition	**Degraded**	**1**

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. Its primary purpose is to provide recreational space and visual amenity for the residents of Goodwin Village retirement home.

Reach Condition

Goodwin Village Pond had a drop in water levels well below the edge water plants for most of the year. By September this had the same effect as it did on other still bodies of water, increasing turbidity (50NTU) and lowering dissolved oxygen (58% saturation).

The small floating wetland in this Pond continued to look healthy. Its overall effect on water quality, though, is difficult to assess. Nutrient levels here were certainly healthier than other small ponds in the Southern ACT catchment.

Only one water bug survey was conducted this year, in October, assisted by the enthusiastic students of Caroline Chisholm High School and Bruno Ferronato from Ginninderra Catchment Group. They netted only six types of bugs and most of these were fly larvae (maggots) living in the mud and water boatmen floating in the still water. Lots of Carp were also spotted splashing and getting frisky in the warm, shallow water.

Bruno and the Caroline Chisholm School students studying water bugs at Goodwin Village Pond.

Gudgenby River Catchment CGG1

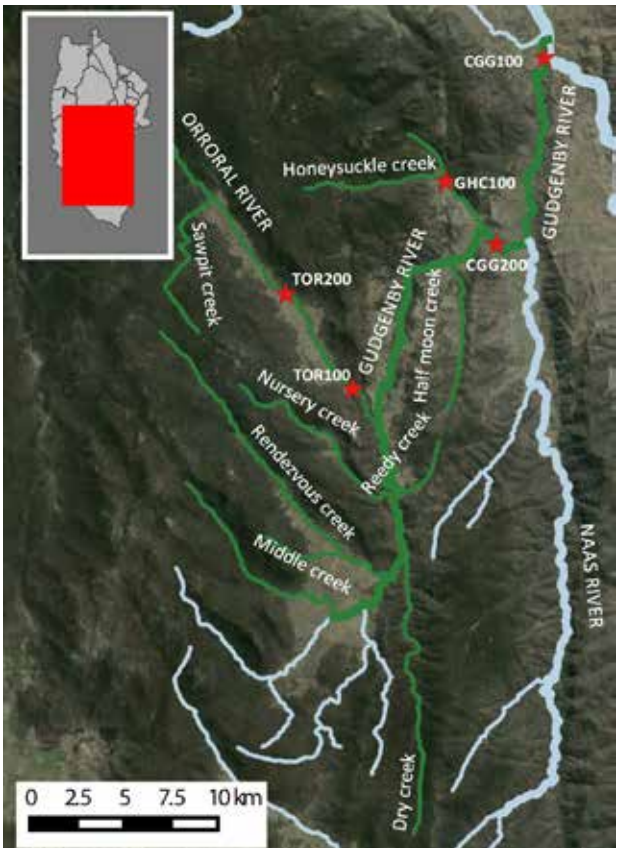
Headwaters of small creeks and Orroral River to the Murrumbidgee River confluence

2018 CHIP Result B (Good)		
2016/17 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**41**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Fair	
Water bug	**Good**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx 120km
Dominant land uses: Conservation and rural grazing

This reach includes five branches off the Gudgenby River; the Orroral River as well as Nursery, Rendezous, Middle and Dry Creeks, in the Namadji National Park. The main arm is the lower stretch of the Gudgenby River, running mostly through mixed grazing properties. The Orroral River section largely comprises upland wetland bogs.



Reach Condition

Volunteer Deb Kellock, who has monitored the mouth of this reach (CGG100) for eight years, noted at the start of 2018 "creek bed is the best it has looked with a mix of rock, cobble...with different depths and flow areas in the creek". Deb also noted the presence of Water milfoil – a submerged, aquatic plant that provide excellent refuge for water bugs and fish. The previous year the riverbed at her site was almost exclusively covered in sand.

The water bug survey at CGG100 in March, found the pest fish Eastern gambusia, as well as the native Australian smelt. The Spring water bug survey was conducted at the Orroral River campsite (TOR100). A healthy selection of bug types were collected in spite of the low water flows, reinforcing the importance of available in-stream habitat. 'Shingle' (Calocidae) and 'Stick' (Leptoceridae) caddisfly larvae were found in abundance. 'Stream horse' (Coloburiscidae) mayfly larvae were also prevalent, all feeding on the decaying woody debris that is in good supply at this site. Corduliid dragonfly larvae, which are quite fuzzy and spider-like, were also numerous and hiding in the rotting plant matter.

Excellent in-stream habitat provides refuge for the water bugs on the Orroral River (TOR100).

Hospital Creek Catchment CGH1

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

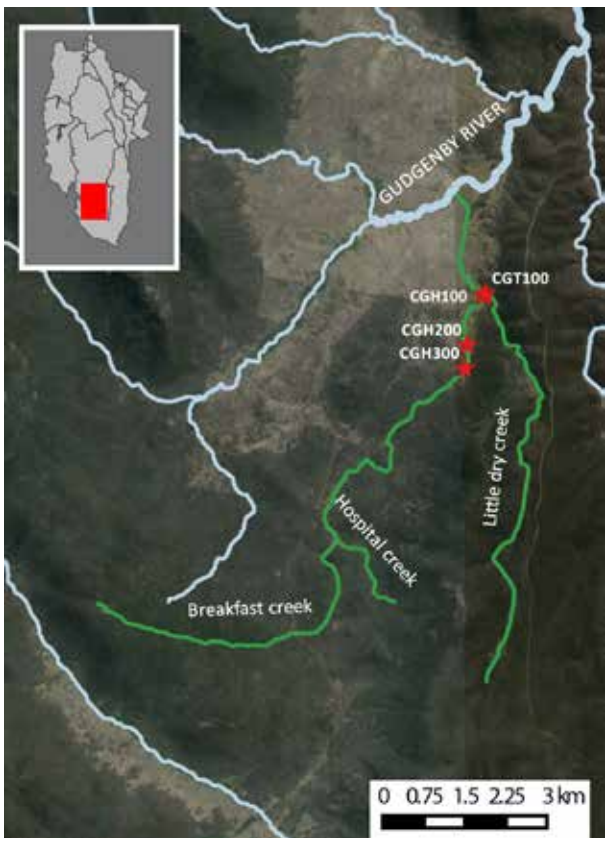
2018 CHIP Result B+ (Good)		
2016/17 CHIP Result A- (Excellent)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**44 (19 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**2**
Riparian condition	**Good**	**2**

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

The drought conditions affected this reach more than other upland bogs in Namadji National Park. Little Dry Creek (CGT100), that usually has winter flows, remained dry all year, even after snow melt.

Hospital Creek also had periods at CGH200 where it was completely dry, and on many other occasions throughout the year, the entire creek was reported as 'low'. At these times, high turbidity, low oxygen and high phosphorus concentrations were evident. Evidence also, of feral pig activity was frequently recorded and was possibly contributing to the turbidity issues. Reports of the pigs were sent to the Parks and Conservation rangers. It is pleasing to note that, despite the dry conditions, water temperatures remained below 17oC all year.

Numerous reports were also made by the two Waterwatch teams, of Blackberry infestations. Some more welcomed sightings were also recorded; the volunteer 'Southwell Venturers' reported a Wedge-tailed eagle fledgling flapping its wings at its nest at Little Dry Creek and a "white dingo" was seen around Hospital Creek.

Volunteers Michaela, Sam and Stefan sampling Hospital Creek in November 2018.

Isabella Pond TIP1

Large pond south of Monash

2018 CHIP Result DD (Data Deficient)		
2016/17 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**No Data**	**14**
pH	DD	
Turbidity	DD	
Phosphorus	DD	
Nitrate	DD	
Electrical Conductivity	DD	
Dissolved Oxygen	DD	
Water bug	**No Data**	**0**
Riparian condition	**Fair**	**2**

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 flows over a high weir at its western end into Lake Tuggeranong (TLT1).

Reach Condition

Isabella Pond has undergone an extensive facelift in the last 18 months as part of the ACT Healthy Waterways initiative, aiming to build infrastructure to improve water quality.

It was the largest refurbishment undertaken in Southern ACT catchment with several hectares of 'wetland' vegetation plantings. There was also a restructure of the Pond's bed to capture and hold urban stormwater runoff before it flows into Lake Tuggeranong.

The aim is to remove nutrients that would, if carried into the main Lake, contribute significantly to toxic blue-green algal blooms. The wetland construction was also timed to coincide with enlargement of the Drakeford Drive weir. This has meant the Pond has been off limits to the public as well as drained of water. Thus, it was unable to be assessed for this year's CHIP report.

Last December, Caroline Chisholm School students recommenced monitoring of three sites in the Pond, so it will be interesting to see how it changes in the next twelve months.

A drained Isabella Pond facing south, September 2018.

Lake Tuggeranong Wetlands TLT1

Drakeford Drive weir to South Quay foot-bridge weir

2018 CHIP Result D+ (Poor)		
2016/17 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**20 (3 dry)**
pH	Good	
Turbidity	Degraded	
Phosphorus	Degraded	
Nitrate	Good	
Electrical Conductivity	Poor	
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

The southern 'wetland' end of Lake Tuggeranong, directly downstream of the Isabella Pond works (see TIP1) suffered temporary, adverse impacts during 2018. It had concerning levels of turbidity all year as construction upstream continued and post February, turbidity never dropped below 100 NTU. Other water quality issues included an 'oily film' on the water in January, alarmingly low dissolved oxygen levels in April and a big spike in nutrient loads in October (0.15mg/L phosphorus).

Part of the function of this body of water is to treat water quality before it enters Lake Tuggeranong proper. Results in TLT2 will attest that the water quality there is better for it. The scores for this reach will most likely improve again next year as the upstream plantings take hold, however we are left with the legacy of the sediments and nutrients captured in TLT1.

To add to the pressures, at least 50 Carp were seen spawning in the extremely low muddy water and no doubt stirring the sediment up even more. In better news, there was also a confirmed sighting (with photos) of a Platypus in this section by construction workers in December.

Looking upstream at TLT300, August 2018.

Lake Tuggeranong TLT2

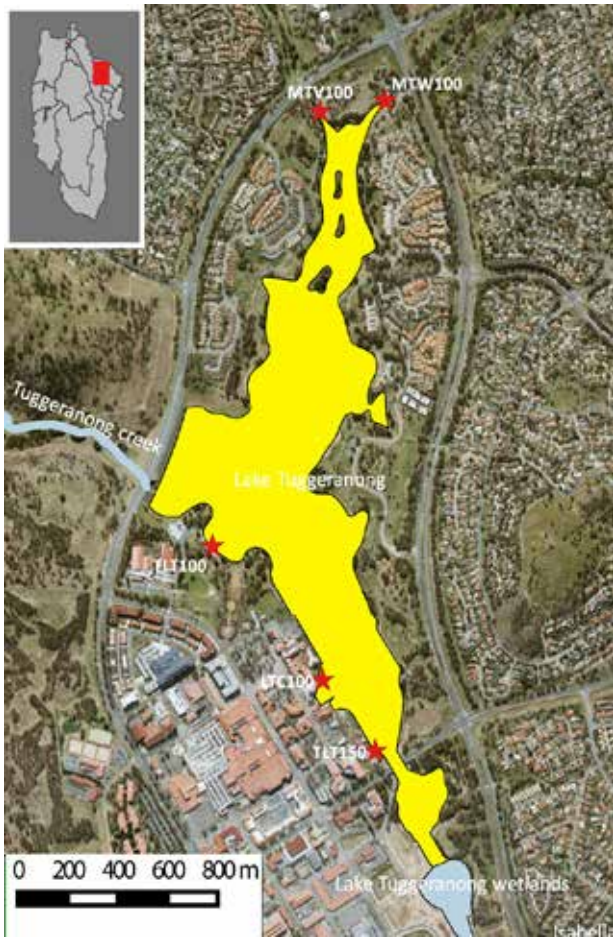
Main lake body

2018 CHIP Result C (Fair)		
2016/17 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**33**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Degraded	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**2**
Riparian condition	**Poor**	**5**

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

The main part of Lake Tuggeranong, in contrast to its upstream wetland (TLT1), remained clear for most of the year. Flows from the northern stormwater system remained very low and clear, but also carried lots of rubbish which clogged the gross pollution traps. Reports of this by Waterwatcher Ben Bryant were quickly acted on by the ACT Government.

An Autumn water bug survey was conducted at the Town Park beach (TLT100) with students from Namadji School's 'Learning Centre'. The enthusiastic team found hundreds of water-boatmen, lots of the pest fish, Eastern gambusia as well as glass shrimp. Another survey in Spring at the northern inlet of Wanniassa Creek (MTW100) was a little better, though still only received a 'fair' result. The survey was comprised of mainly tolerant species such as snails, worms and fly larvae. Spotted marsh frogs *Limnodynastes tasmaniensis* were also heard calling from the reeds.

Wanniassa Creek (MTW100), December 2018 (Photo: P.Horniak).

Murrumbidgee River CMM7

Michelago Creek confluence to Tharwa Sandwash

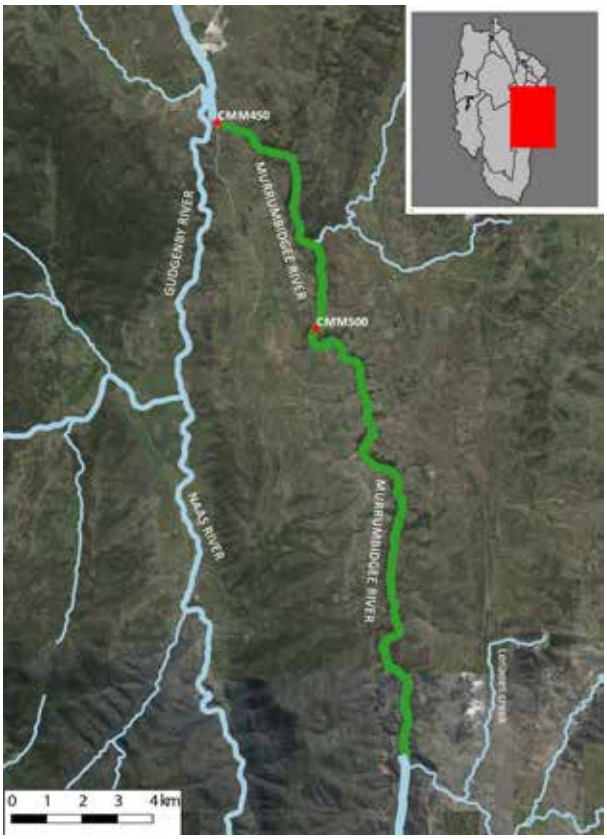
2018 CHIP Result B+ (Good)		
2016/17 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**23**
pH	Excellent	
Turbidity	Good	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Water bug	**Good**	**2**
Riparian condition	**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 the ACT section and the riparian vegetation is significantly healthier than downstream around the Tharwa township.



Reach Condition

The Murrumbidgee River enters the ACT at Angle Crossing from the Monaro region in the south and it can at times show evidence of the erosion issues upstream. Turbidity at Angle Crossing was higher than at other ACT Murrumbidgee River sites in 2018 as it appears that the sediment drops out of the water column as you move downstream.

In October, Waterwatch Facitiator, Woo O'Reilly noted "decent rainfall last weekend after a long, dry spell" while conducting the Spring Bug Blitz. Angle Crossing supported a huge number of stonefly larvae and a good diversity of other sensitive bug species with four types of mayfly and five types of caddisfly larvae found.

Downstream at the Tharwa Sandwash, volunteer Deb Kellock noted that diatom crusts, evidence of a significant lack of flushing flows, were present almost all year, along with exposure of mid-stream sandbars. The water bug survey there in March, assisted by Waterwatcher Wendy Warren along with Max and Hugo from the A.N.U, found a dominance of more tolerant water bug types such as shrimp and 'true bugs' (Hemiptera) such as water boatmen.

The Murrumbidgee River at Tharwa Sandwash.

Murrumbidgee River CMM8

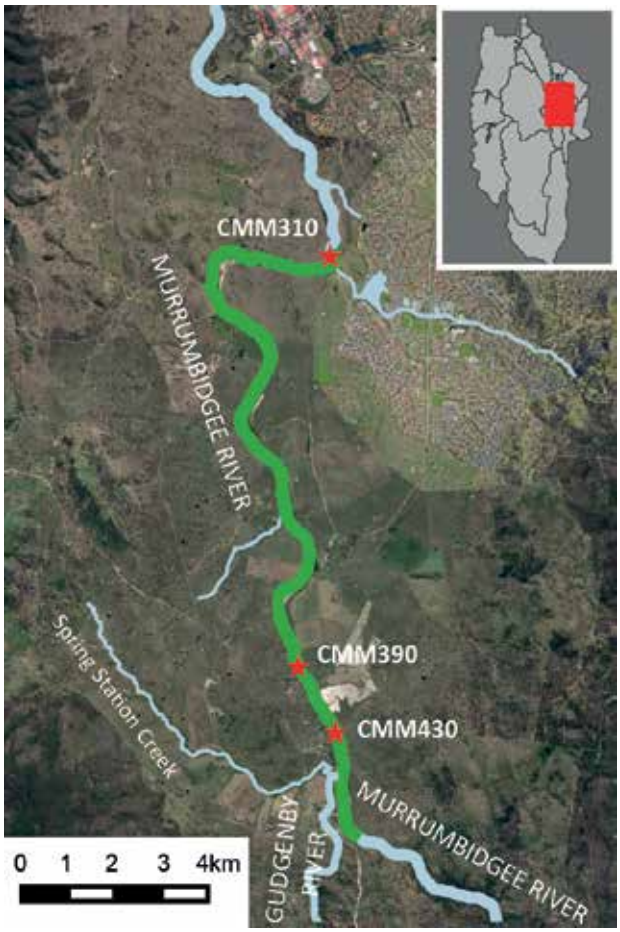
Tharwa sandwash to Point Hut Crossing

2018 CHIP Result B- (Good)		
2016/17 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**27**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Fair	
Dissolved Oxygen	Excellent	
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

The extremely low flows through this relatively flat section of the Murrumbidgee River, gave sediment from upstream time to settle out of the water column. The low levels, however, also allowed salts and minerals to become more concentrated, thus the electrical conductivity increases.

The August 'Platypus Month' surveys were moved to Point Hut Crossing this year. Over 20 community volunteers and Lake Tuggeranong College students assisted in surveying two mornings and two evenings, along a one kilometre stretch of the River. A total of three individual Platypus and a single Rakali (aka Water rat) were sighted over the month.

Water bug surveys were conducted at both the 'Engineered Log Jam'(ELJ) site in Tharwa (CMM390) and at Point Hut Crossing (CMM310). The Autumn survey at Point Hut Crossing produced an impressive fresh water shrimp called a macrobrachium (meaning 'large arms') that was over 10cm long. While a greater diversity of bugs were found at the ELJ, Point Hut Crossing produced healthy numbers of sensitive bugs with over 300 mayfly and five types of caddisfly larvae detected at that survey.

A large Macrobrachium found at Point Hut Crossing.

Murrumbidgee River CMM9

Point Hut Crossing to Kambah Pool

2018 CHIP Result B- (Good)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**17**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Fair	
Dissolved Oxygen	Fair	
Water bug	**Poor**	**2**
Riparian condition	**Fair**	**2**

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

In March, volunteer Bill Kerrigan noted "*Very low flow and probably lowest water level I've seen*" at Pine Island, with low levels persisting through much of 2018. In May, Bill noted unusually high electrical conductivity levels compared to his other site at upstream at Point Hut Crossing. Both sites usually get similar readings.

Overall, the water bugs in this reach didn't fare too well. While a good diversity of ten different types were detected in the faster-flowing riffle zone at Pine Island in October, they were only found in low numbers. That said, Education Officer, Ben Huttner-Koros and the Caroline Chisholm ecology class found plenty of net spinning caddisfly larvae. These require clean rocky river beds to build their homes. The survey downstream at Kambah Pool in May, received a 'degraded' score with hundreds of tolerant 'true bugs' such as water boatmen making up a large portion of the catch.

There was the possible sighting of a Platypus by Bill at Pine Island in March along with two foxes and some swamp wallabies "*seemingly playing a game of follow the leader*".

Caroline Chisholm ecology class assisting with the Spring water bug surveys at Pine Island.

Murrumbidgee River CMM10

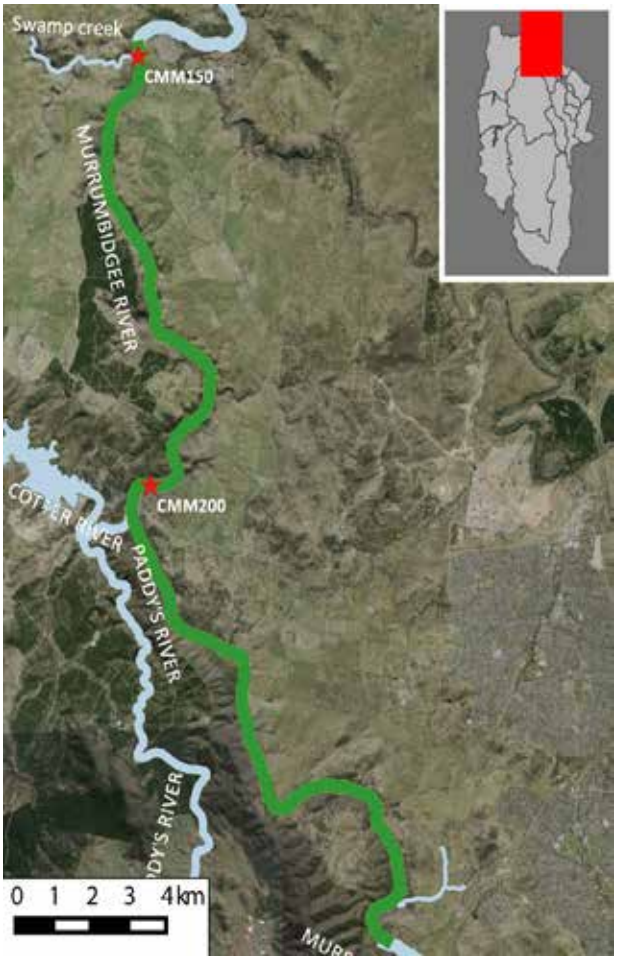
Kambah Pool to Uriarra Crossing

2018 CHIP Result B+ (Good)		
2016/17 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**24**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Water bug	**Good**	**2**
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

The last twelve months has seen both Uriarra Crossing and Casuarina Sands at their lowest levels in over ten years. Barbara, who monitors Uriarra Crossing, noted in March, "*Very low water level, I could walk out to the middle!*" and the 'Sands' Waterwatch team, who have monitored Casuarina Sands since 2003, noted in May that the River was the "*lowest level we can recall*".

Water temperature at Uriarra Crossing began the year at 30°C. Water in the Murrumbidgee River 15 kms upstream at Casuarina Sands was recorded at around 10°C cooler on that same weekend in January. A lack of mature riparian canopy species with significant continuity or width to provide protection from the sun may contribute to this. It's also important to highlight the importance of deep, refuge pools such as those at Casuarina Sands, for maintaining optimum water temperatures.

At Uriarra Crossing, 13 types of water bugs were caught in Spring including many sensitive stonefly, caddisfly and mayfly larvae. The Endangered Murray River crayfish *Euastacus armatus* were spotted at both sites for the first time by the Waterwatch Coordinator.

Murrumbidgee River at Uriarra Crossing.

Naas River NNN1

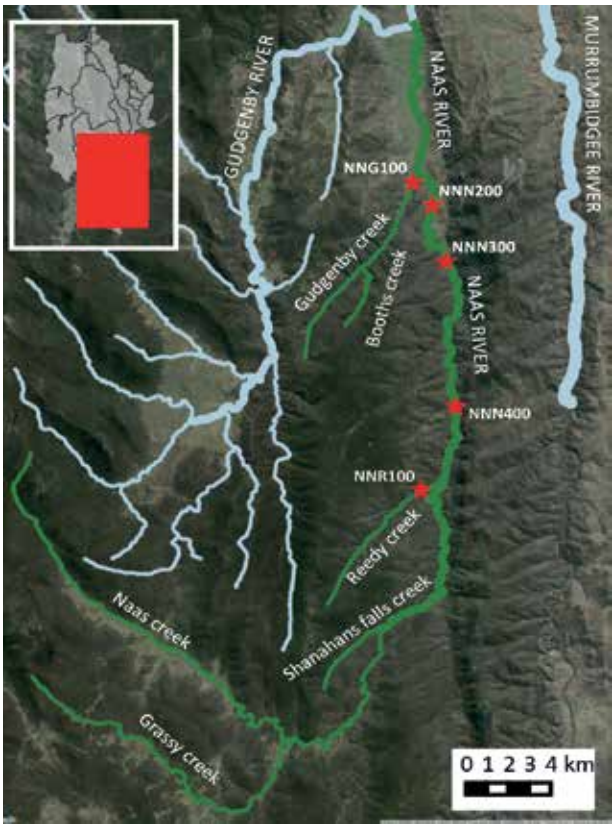
Headwaters to Gudgenby River confluence

2018 CHIP Result B+ (Good)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**29 (4 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Good**	**5**

Reach Facts

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

The Naas River runs south then hooks east and 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

A new volunteer this year, Rodney Yeo, found the only flowing water in the Naas River was at the top sites in Namadji National Park (NNN300 and 400). Access was restricted over Winter months due to the construction of a new river crossing at Caloola Farm. Corin Pennock, another new volunteer, saw no flowing water at her two sites lower down in this sub-catchment. Water was scooped out of small pools, or frozen puddles in Winter.

Bug surveys at Caloola Farm in April and December were conducted in deep residual pools. A surprising diversity was found, but species requiring good-flowing water, such as stonefly larvae, were absent this year. 'Stick' caddisfly (Leptoceridae) were found, which tolerate low to no flow environments. They build a range of cases from neatly rolled up plant matter to hollowed out sticks. They are omnivorous and would find plenty of live and dead plant material to shread in those Naas pools. Of course. water boatmen were found in their hundreds along with many snails and aquatic worms, which also enjoy these conditions.

There were only remnant pools to sample during the Autumn water bug survey at Caloola Farm, NNN200.

Paddy's River Catchment CTP1

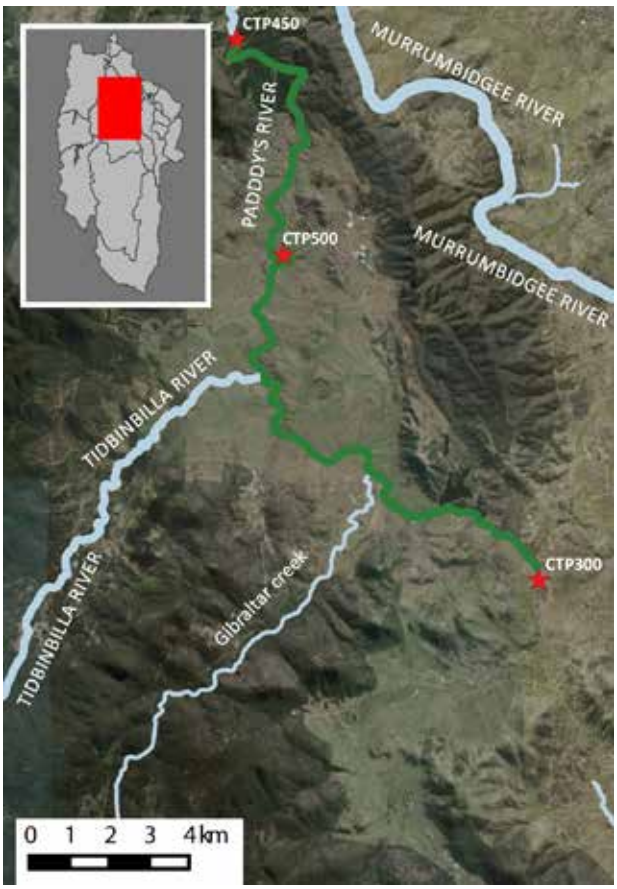
Tidbinbilla Road bridge to Murray's Corner

2018 CHIP Result B (Good)		
2016/17 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**35**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**2**
Riparian condition	**Fair**	**3**

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 had low clear water levels for almost 12 months. Volunteer Maree Blume finally noted at Murray's Corner (CTP450) in December that "The water level is higher than in recent months because of substantial rains over the past week". Unfortunately this rain also brought with it, an increase in turbidity at the top site just above the Tidbinbilla Road bridge, (CTP300) with 120NTU being recorded.

This reach had some interesting incidents this year, with volunteers John and Jan reporting illegal camping for two months near the Tidbinbilla Road bridge. This was dealt with by the rural police following the report which was gratefully used as an official notification.

Water bug surveys found hundreds of 'Baetid' mayfly larvae living in the sandy low flow conditions at the top and bottom Waterwatch sites on this reach. 'Calocid' caddisfly larvae were also in good numbers making use of the sand to build their tubular cases. The Autumn bug survey was assisted by the enthusiastic A.N.U 'Intrepid Landcare' group.

A very low flowing Paddy's River at Tidbinbilla Road Bridge in April 2018.

Point Hut Ponds MPG1

Headwaters of Conder Creek to Murrumbidgee River confluence

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**48**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
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

Point Hut Ponds and Conder Wetlands were both clear, with low water levels for most of the year and the only decent flows occuring last December. This drying out led to the predictable exposure of 'mud flats' in the northern end of the Pond and assorted large masses of algal growth. The upstream wetland (MMW150) had notable 'blanket weed'(Cladophora) all year. The northern end of Point Hut Pond had smelly blue green algal blooms last Summer and the southern section saw the appearance of large amounts of 'bright green floating filaments' (probably Spirogyra).

There was a return of a diverse population of water birds to the Point Hut Ponds as the urban lake system became a refuge in the wake of a prolonged dry period. Volunteer Vera Kurz even saw a pelican up in the top of the Conder Wetlands, which she said was unusual. Alan Parker regularly spotted pelicans, herons, cormorants, ibis and swans joining the usual swamp hens, ducks and cootes downstream at MPG100.

Pest fish Carp and Eastern gambusia were also seen becoming very active in large numbers when the waters warmed up.

Point Hut Ponds - October 2018.

Stranger Pond MSP1

Stranger Pond in North Bonython

2018 CHIP Result B- (Good)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**14**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Fair**	**2**

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

A new urban Landcare group 'Friends of Stranger Pond' have taken on the Waterwatch duties.

Extremely low dissolved oxygen levels at both ends of the Pond were reported twice this year with the lowest being 13% saturation in January at MSP200. Turbid water also appeared after high rain events. Strong odours were also reported again during periods of no flow over the weir, though at these times the water gained some clarity.

Many Carp were spotted displaying breeding behaviour in October when the water was only 17°C. Like our other urban lakes, bird populations increased along with other wildlife, including a Red-bellied black snake. White-plumed honeyeaters were also spotted in the riparian bushes.

Water bug surveys found mostly water mites in both seasons and many damselfly larvae living among the dense stands of bull rushes at the lake edge. Spring rain saw an increase in mayfly and caddisfly larvae which is an improvement on previous years.

New volunteers Colin and Nev during training at Stranger Pond.

Swamp Creek LMS1

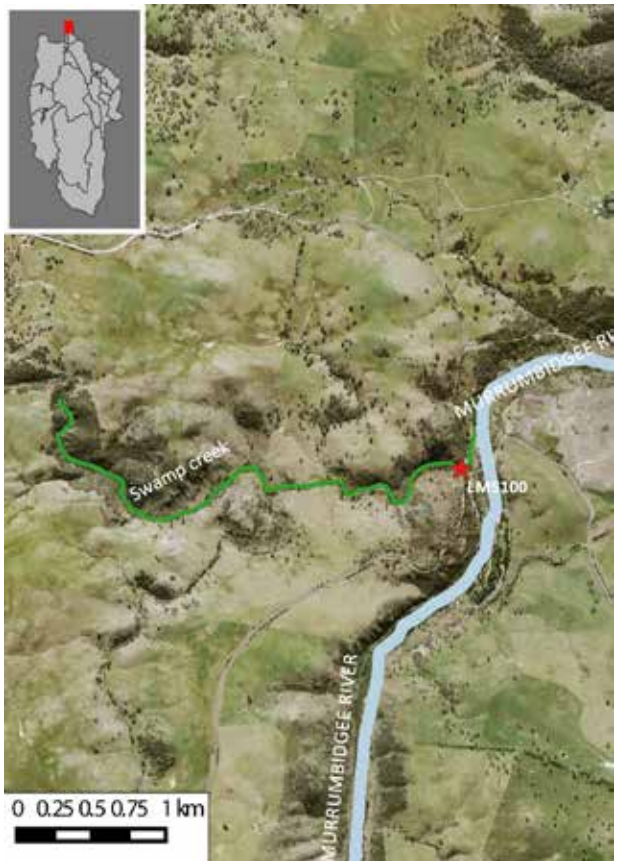
Uriarra Creek confluence to Murrumbidgee River Confluence

2018 CHIP Result B- (Good)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**12**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Fair	
Dissolved Oxygen	Poor	
Water bug	**Poor**	**2**
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

Swamp Creek only had running water during three non-consecutive months this year. One of those months, August, saw a large spike in turbidity, leading to an investigation by the Environment Protection Authority. The possible cause was roadside disturbance near the Yass Valley Council border, but controls were found to be in place and the issue quickly subsided as the Creek returned to the chain of isolated pools it has been for most of this year.

The clear pools played host to large population of whirligig beetles (Family: Dytiscidae) in Autumn and masses of diving beetles (Family: Gyrinidae) in Spring. Some 'true bugs' were also abundant including water striders along with a few water boatman and backswimmers. Many of the adult stages of these insects breathe air that they collect when they break the surface and carry an air bubble underwater with them. This enables them to survive in the poorly oxygenated pools during dry conditions, when other less-tolerant water bugs would be absent.

Swamp Creek, May 2018.

Tidbinbilla River CTT1

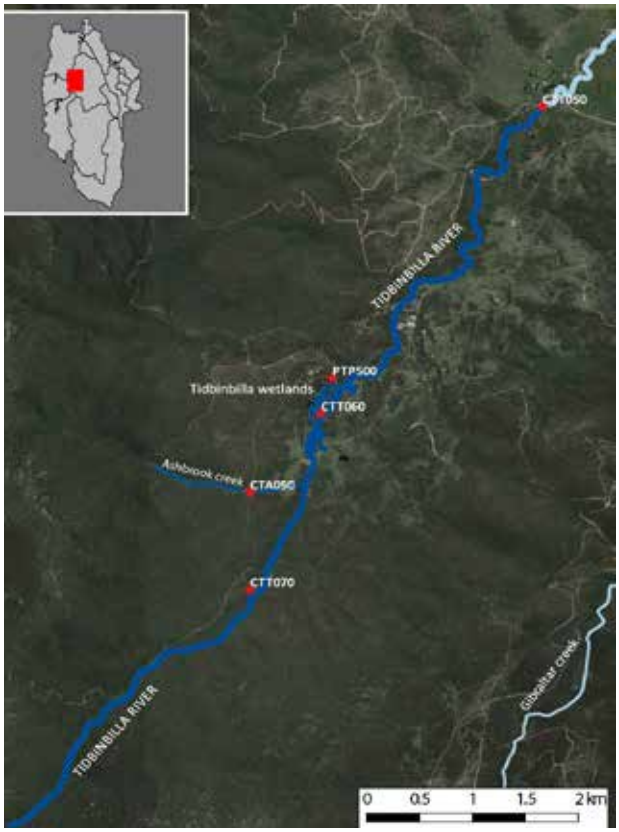
Headwaters of Tidbinbilla River and Ashbrook Creek to Gilmores Road crossing

2018 CHIP Result A- (Excellent)		
2016/17 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**51 (6 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Water bug	**Good**	**2**
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 in 2003. Ashbrook Creek is a small upland creek running from the top of the reserve past the Hanging Rock Aboriginal shelter site.



Reach Condition

By Autumn, both the River and 'Sanctuary' wetlands at the Tidbinbilla Nature Reserve were showing signs of stress from lack of rain, with a serious drop in dissolved oxygen levels at the Sanctuary by March (30% saturation). The Tidbinbilla River was dry at the most downstream site (CTT050) by the start of Winter and volunteer Fiona Spier noted in July that it was the "*first time there has been water to test in seven months*". The upper, well-vegetated sections of the River and its tributaries, had low flows for most of the year and the water continued to run clear even after rainfall.

The Friends of Tidbinbilla Parkcare group found reasonable numbers of pollution sensitive water bugs at the upper section of Tidbinbilla River (CTT070) in Autumn, but there was a lack of overall diversity. In contrast, some rain in Spring helped produce an excellent result with healthy numbers of sensitive water bugs including the high scoring scorpionfly larvae. Scorpionfly larvae live in the silty deposits of small, cool, well-vegetated streams, so are well suited to the upper sections of this reach.

Ashbrook Creek (CTA050) in the upper sections of this reach, continued to flow all year despite dry conditions.

Tuggeranong Creek, Upper TUG1

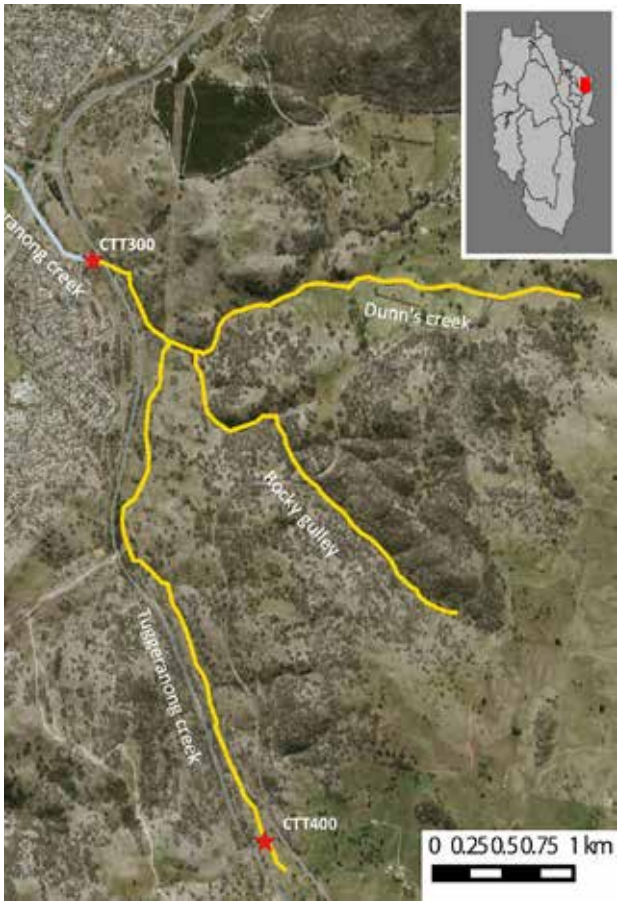
Headwaters of Tuggeranong Creek catchment to Theodore

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**22 (9 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Poor**	**2**

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

The head of Tuggeranong Creek only had flowing water during three months; January, October and December. The section under the Monaro Highway was dry over January and February. As a 'base flow' creek fed by groundwater, this is a serious indication of how dry the year has been. The creek remained clear, but always has slightly higher electrical conductivity than similar creeks elsewhere in our catchment.

Bridgeworks over the creek, along with associated sediment traps, were noted in March, when the Autumn water bug survey was conducted. In Spring, a greater diversity was found with a big increase in water beetle larvae, all hiding under the masses of leaves from the Poplar trees that comprise much of the riparian canopy along the creek, before it becomes a concrete drain. This site is also a great one for yabbies with every bug survey in the past four years noting their presence.

Again, this year there were many reports of assorted discarded items dumped at this site, including the usual car tyres.

Spring water bug survey at CTT300 (Photo:M.Gardner).

Tuggeranong Creek, Middle TUG2

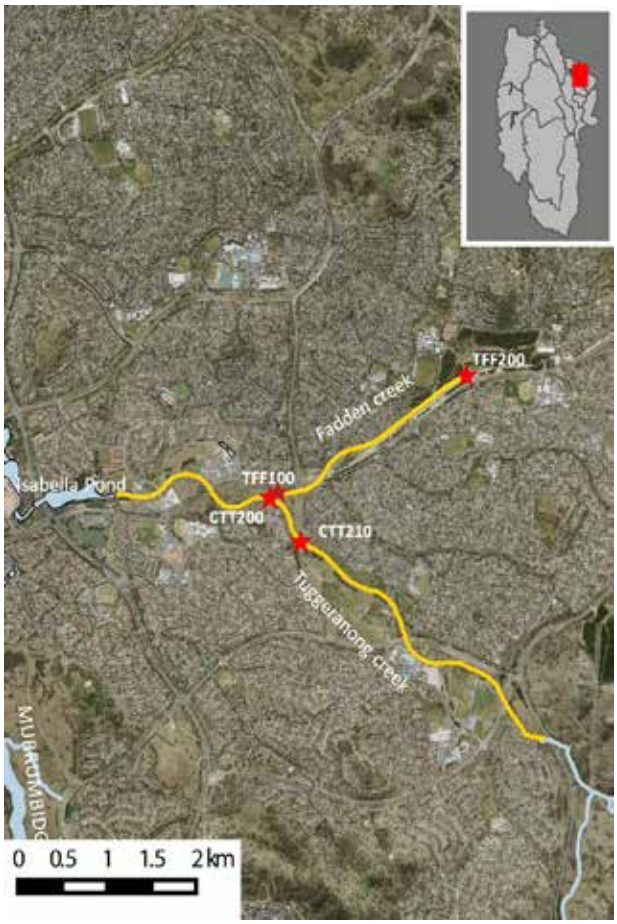
Concrete drain system upstream of Isabella Pond

2018 CHIP Result C- (Fair)		
2016/17 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**47**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Water bug	**Degraded**	**2**
Riparian condition	**Degraded**	**4**

Reach Facts

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

This reach consists of a Y shaped network of two 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.

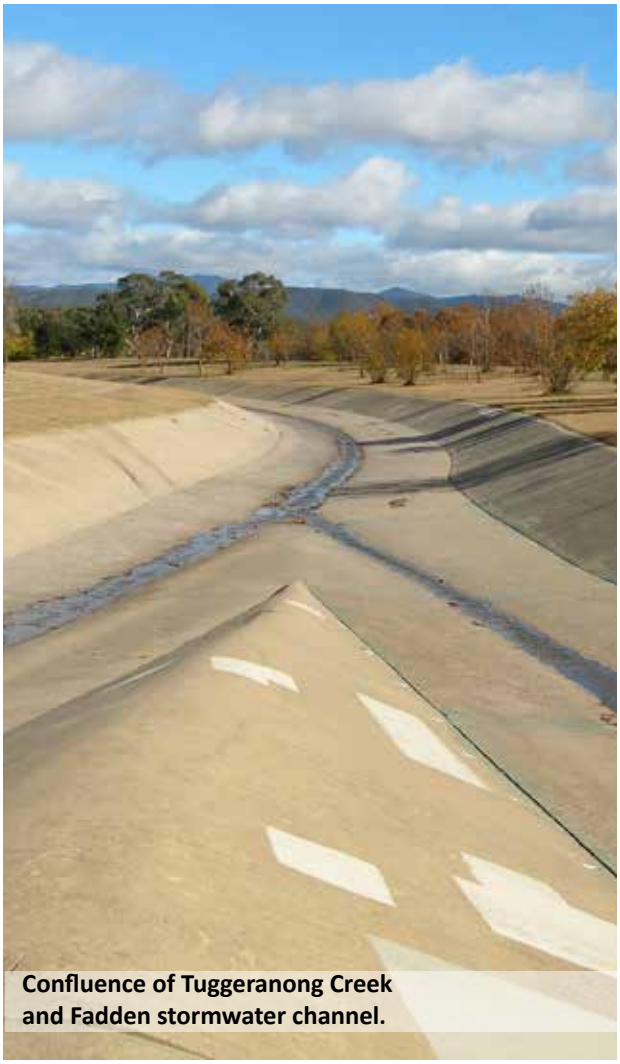


Reach Condition

Flows were low all year. 'Medium' flows only occurred three times in the Tuggeranong Creek branch. This section also had higher electrical conductivity levels with readings ranging between 400 and 600µs/cm all year. A new volunteer, Tom Nilsen, took over from Eileen and Stuart in May to cover this branch.

The Fadden side of this reach had a persistent algal fringe but when checked for water bugs in May, only supported a few species of fly larvae. A pocket of water in the drain under the Ashley Drive bridge revealed the biggest catch of water bugs seen so far in this reach. Lots of aquatic worms, fly larvae, two water beetles and a water mite. This, unsurprisingly, still produced a 'degraded' score.

Tom photographed an Eastern long-necked turtle making its way along the drain at this site in December. A nice surprise for an otherwise featureless waterway.



Confluence of Tuggeranong Creek and Fadden stormwater channel.

Tuggeranong Creek, Lower TUG3

Tuggeranong Creek to Murrumbidgee River confluence

2018 CHIP Result B- (Good)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**8**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Fair	
Nitrate	Poor	
Electrical Conductivity	Good	
Dissolved Oxygen	Fair	
Water bug	**Fair**	**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 fed by the overflow from Lake Tuggeranong. This creek enters the Murrumbidgee River 2kms downstream of Pine Island Reserve.

Reach Condition

Lake Tuggeranong College's 'Sustainability Unit' took on this reach below the lake in earnest this year. The creek remained clear with low to medium flows but the lake's ability to absorb nutrients this year appeared to be limited. Nitrates and phosphorus levels were consistent within the lake, with highs of 3 and 0.08mg/L respectively. The last time levels were up like that was in 2016.

Water bug surveys conducted with the students, revealed good diversity. Lots of net weaving caddisfly larvae (some are filter feeders- and probably made up the bulk of those caught) were found along with many water boatmen (a type of 'true bug') and fly larvae. Pest fish, Eastern gambusia, were also found in abundance in Autumn but not in Spring when common Eastern froglets *Crinia signifera* were heard, calling close to the site, a rarity for this creek.

A member of the public also reported seeing a Platypus in October.

Lake Tuggeranong College students conducting water testing at CTT100 - September 2018.

Westwood Farm TMM1

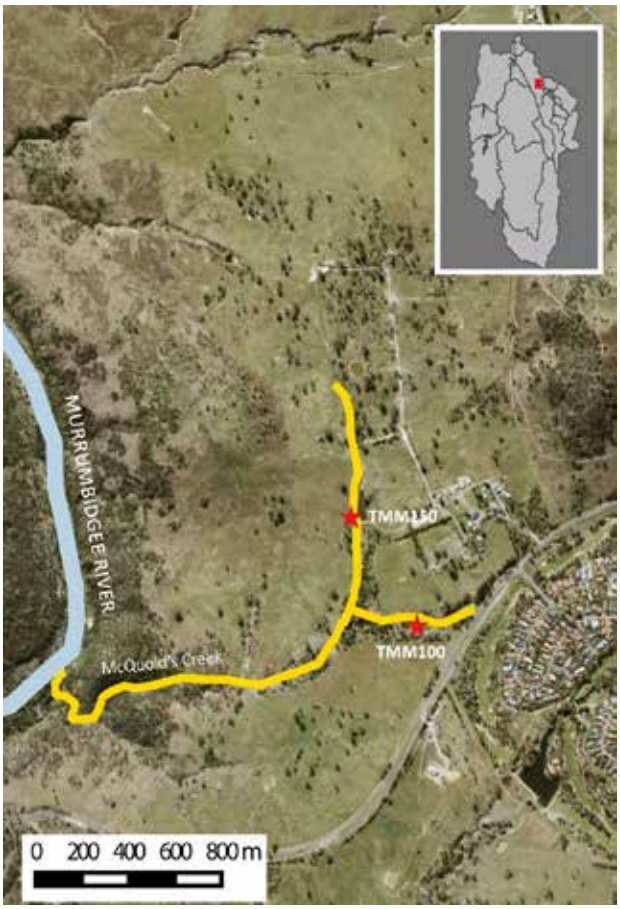
McQuoid's Hill to Murrumbidgee River

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**24 (3 dry)**
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Water bug	**Poor**	**2**
Riparian condition	**Fair**	**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

This year the main dam got to the "lowest level seen by current staff" and McQuoid's Creek was dry from February to May. The dam hosted quite a variety of water birds in the first half of the year, including a white faced heron and a pair of Spurred-wing plovers.

The water bug survey assisted by students from Namadji Highschool at McQuoid's Creek Dam (TMM150), found little else other than hundreds of water boatmen – a type of 'true bug' (Hemiptera). By September the dam was so dry you could walk across it, and by November turtles were noted huddled in the remaining shallows.

The water bug survey in the tiny creek (TMM100) in October found ten types of bugs including pollution sensitive stonefly larvae. Ian Crabb, teacher of the 'Ed Shed' program at Lions Youth Haven, gave a clue revealing that run off from the neighbouring golf course over Winter months may have contributed to its healthy state.

McQuoid's Creek Dam TMM150, November 2018.

Yass Catchment Facts

The Yass catchment is approximately 2,800km^2, and is situated to the north of the ACT. It 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) below 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 deposits resulting from reduced flows and the impounded waters of Lake Burrinjuck. The natural river bed is smothered by the sand creating wide shallow sections with little or no in-stream structure.

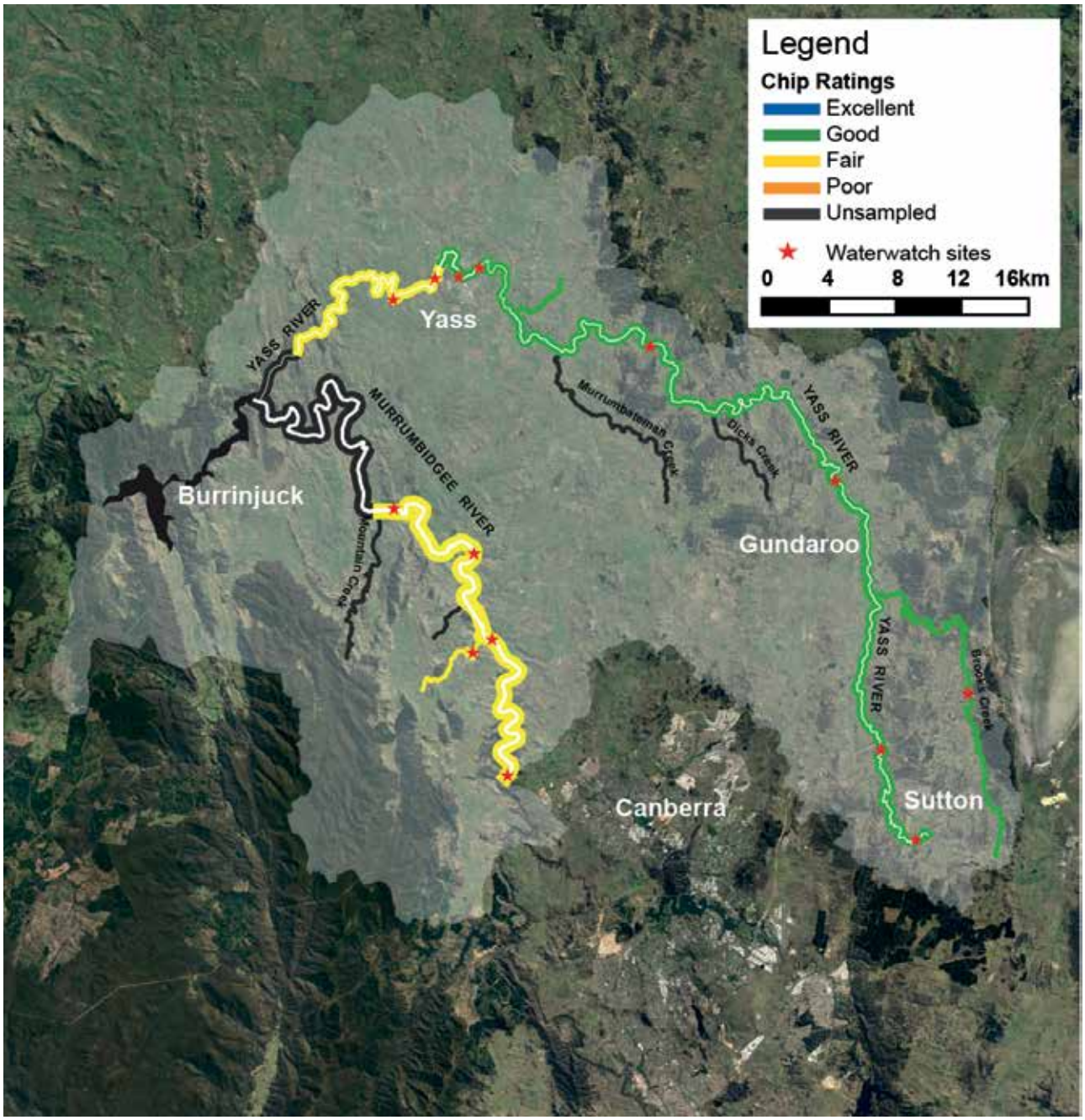
A large portion of this catchment is cleared grazing land and, as a result, major issues include dryland salinity and erosion. Many of these issues could be ameliorated through stock exclusion and the regeneration of the riparian zone. This is occurring on a number of fronts throughout the region with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

Yass Catchment Health Summary

This is the fourth year that data has been collected in the Yass catchment thanks to all the volunteer efforts. With a new sampling site at the Yass Gorge (YAS350), the reach of YAS3 now represents the urbanised section of the Yass River. The section of the river, downstream of the town is now included in YAS4.

Other differences from the last CHIP report include: a new sampling site in Brooks Creek (BRO015) in YAS1 reach and one in the Murrumbidgee River (CMM050) in CMM13 reach, to increase coverage in the upper sections of Yass River and coverage of the flow and nitrate records in the Murrumbidgee, respectively. A site in Mullion Creek (MUL005) was also included in CMM13, and CMM110 site was reactivated.

In 2018, three reaches were rated 'good' and three were 'fair'. The reaches in the Murrumbidgee River (CMM12 and CMM13) remained similar to last year with a 'fair' score and the reaches in the upper- and mid-section of Yass River (YAS1 and YAS2) remained 'good'. YAS3 improved from 'fair' to 'good' due to a better water bug score, potentially improved by the elevated presence of reeds along the Yass River in the township, serving as good habitat. High nitrate readings continue to be detected in the Murrumbidgee River with up to 30mg/L recorded. The Lower Molonglo Water Quality Control Centre (LMWQCC) could be influencing this elevation. The lower Yass River (YAS4) is also getting elevated nitrate results of up to 5mg/L below the township, while the above town reaches have received 'excellent' scores.



Murrumbidgee River CMM12

Ginninderra Creek confluence to above Mullion Creek confluence

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**11**
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Poor	
Dissolved Oxygen	Excellent	
Water bug	**Poor**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

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

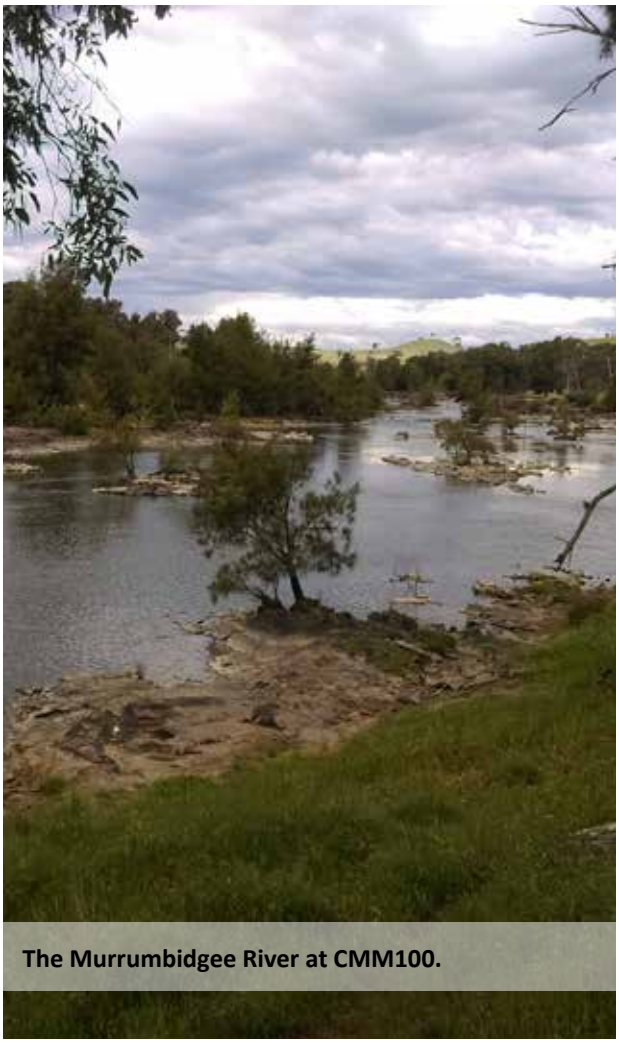
This Murrumbidgee River reach starts at the confluence with Ginninderra Creek, and ends above confluence with Mullion Creek in Wallaroo. Much of this reach is surrounded by cleared grazing lands, and a very narrow riparian zone. In a few notable places, private landowners are undertaking riparian vegetation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

Reach Condition

Perhaps because of the size and volume of Murrumbidgee River, parameters that are readily affected by drought conditions, such as dissolved oxygen and electrical conductivity (EC), have not been as pronounced in this reach (although EC was still a bit elevated). The parameter that continues to show concern is nitrates, with concentrations reaching 30 mg/L in February and May. The source of this is most likely the Lower Molonglo Water Quality Control Centre (see also reach CMM11).

The riparian condition in the upstream site (CMM110), which is located in the conserved Ginninderra Falls region, shows more native vegetation with shrubs and canopy layers than downstream (CMM100), which is surrounded by sheep farms.

Wedge-tailed eagle, flocks of cockatoos, ravens and frogs have been recorded. Unfortunately Carp are still commonly sighted in the River.



The Murrumbidgee River at CMM100.

Murrumbidgee River CMM13

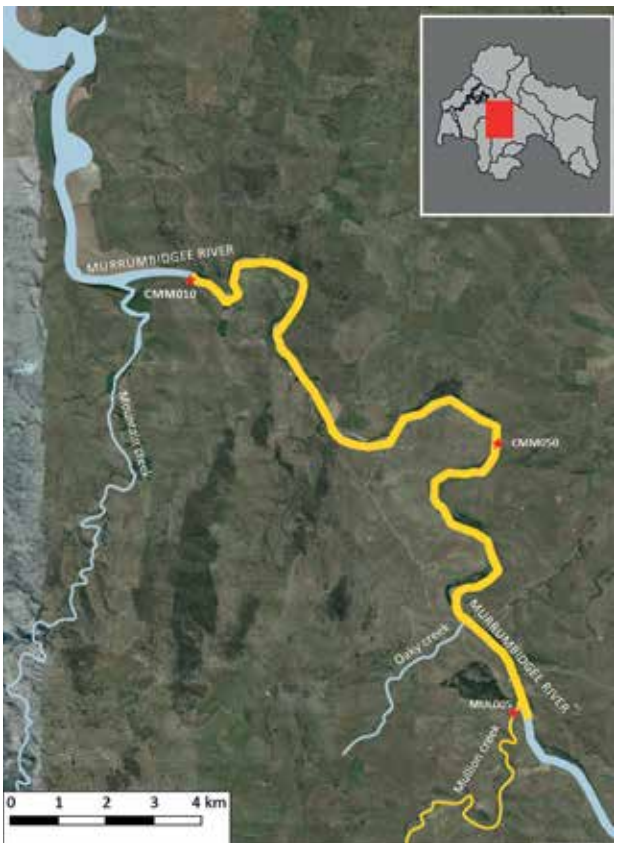
Mullion Creek confluence to Taemas Bridge above Burrinjuck Dam

2018 CHIP Result C (Fair)		
2016/17 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**20**
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Poor	
Dissolved Oxygen	Excellent	
Water bug	**Poor**	**2**
Riparian condition	**Poor**	**3**

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 Taemas bridge is immediately upstream of the impounded waters of Lake Burrinjuck. Much of this catchment is cleared grazing land, with poor in-stream habitat and a narrow and at times, heavily degraded riparian zone.



Reach condition:

Low water levels are common in this reach, and this is particularly evident in CMM010, where the Murrumbidgee River is shallow, has a sandy bottom and little in-stream habitat. This is reflected in the low water bug scores, with high abundance of tolerant species, especially water boatman (350+). Owing to their large numbers in some water bodies, water boatman are considered a good food source for turtles and fish.

Although this reach has good ground cover on the surrounding land, it is mainly composed of exotic grasses, with very few reeds along the river bank. Also, the limited presence of native trees in the riparian zone helped to drag the riparian condition scores down.

Nitrates have shown high levels, but lower than upstream reaches. The influence of the Lower Molonglo Water Quality Control Centre (the likely source) appears to ease the further downstream you go (see also reach CMM11).

The shallow, sandy Murrumbidgee River at Taemas Bridge CMM010.

Yass River YAS1

Headwaters to Brooks Creek confluence, including Brooks Creek

2018 CHIP Result B- (Good)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**21 (2 dry)**
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
Riparian condition	**Fair**	**2**

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.

This reach showed 'excellent' results for most water quality parameters, With the exceptions being dissolved oxygen and electrical conductivity. These may have been influenced by the dry conditions where low water levels would increase the concentration of salts and reduce oxygen saturation. Substantial tannin has been observed in Brooks Creek (BRO015).

Mayflies, caddisflies and water mites, which are pollution-sensitive, were a common finding in this reach. During the Spring sampling in YAS005, mayflies were the most abundant bug (180+), being mainly represented by the Family Leptophlebidae, noted for their prominent gills to absorb oxygen. Despite the dry conditions, the sampled pool had a good amount of aquatic plants and water, helped by the shade provided by gum trees planted by our volunteer along the riparian zone. Native tussock grasses were also present and it is pleasing to see the regeneration of native shrubs and gum trees.

The upper reaches of the Yass River at YAS005.

Yass River YAS2

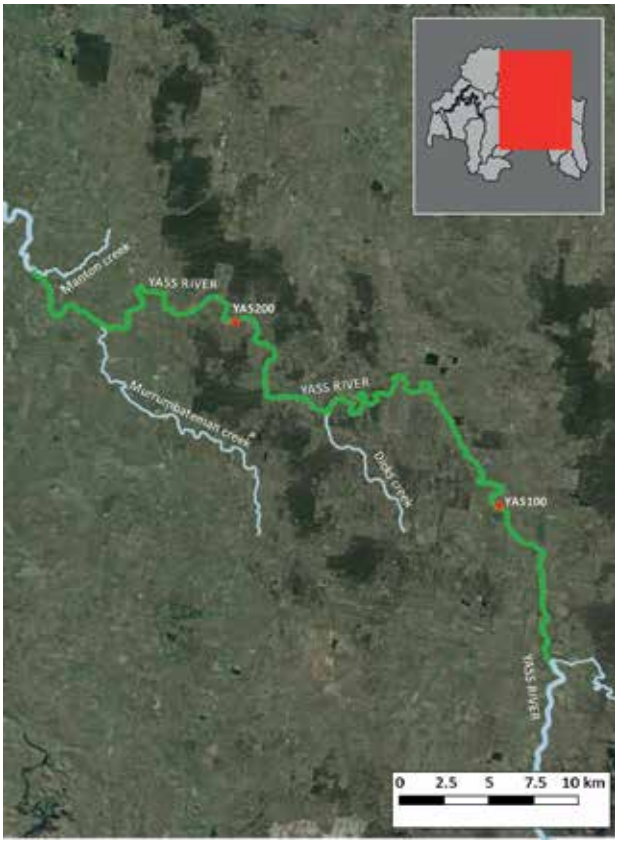
Dicks Creek confluence to Manton Creek confluence

2018 CHIP Result B- (Good)		
2016/17 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**16**
pH	Excellent	
Turbidity	Good	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Water bug	**Fair**	**2**
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, being evident. Likely issues in this reach include high sedimentation leading to reduced in-stream habitat and high electrical conductivity due to historical land use.



Reach condition:

The dry conditions during Summer and Autumn have been felt in this reach, with higher temperatures and reduced flow. This has contributed to the low dissolved oxygen results, which measured 44% saturation in April. This region tends to have elevated electrical conductivity (EC) readings, which are influenced by the geology (natural) and historical land use. It's interesting to note that after storm events, the typical EC range (670 – 1060 µS/cm), dilutes and drops. 240 µS/cm was observed at YAS100 in December after 50 ml of rain, although a spike in turbidity was also noted (30 NTU).

A good amount of in-stream habitat has positively influenced the diversity of water bugs sampled in both Spring and Autumn. Ten orders of bugs were found at each, with water mites, a pollution-sensitive species, being the most common bug during Autumn sampling (380+).

A pair of wedge-tailed eagle were observed in YAS100 and Carp leaping and flapping above the water was common in Spring at YAS200.

Kate Wilson sampling at 'Goldenholm'.

Yass River YAS3

Yass township

2018 CHIP Result B- (Good)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**15**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
Water bug	**Fair**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

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

This section of the Yass River includes the township of Yass. 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 in the Yass Gorge at the top of the reach. The township of Yass was named after Yarrh or Yharr, the word for running water in the Ngunnawal language.

Reach condition:

The large presence of in-stream vegetation in YAS370, such as ribbon weed, serves as habitat for water bugs, fish and turtles. There were nine species of water bugs recorded in both Autumn and Spring sampling, with good numbers of the pollution-sensitive mayflies, caddisflies and water mites. However, the majority were water boatman, yabbies and bloodworms, which are considered tolerant. As their common name indicates, bloodworms are a type of fly larvae that contain the red blood pigment haemoglobin, which enables them to absorb oxygen from the water more readily.

The Yass Gorge (YAS350) is a heritage site and one of the most conserved sections of Yass River, with a large presence of large, native trees, shrubs and lomandra plants. The Friends of Yass Gorge have been instrumental in restoring this landscape and controlling weed species.

Wood ducks, Coots and Dusky moorhens are commonly observed and Pobblebonks *Limnodynastes dumerilii* are heard calling. Carp have also been sighted in this reach.

The well-vegetated Yass Gorge at new site YAS350.

Yass River YAS4

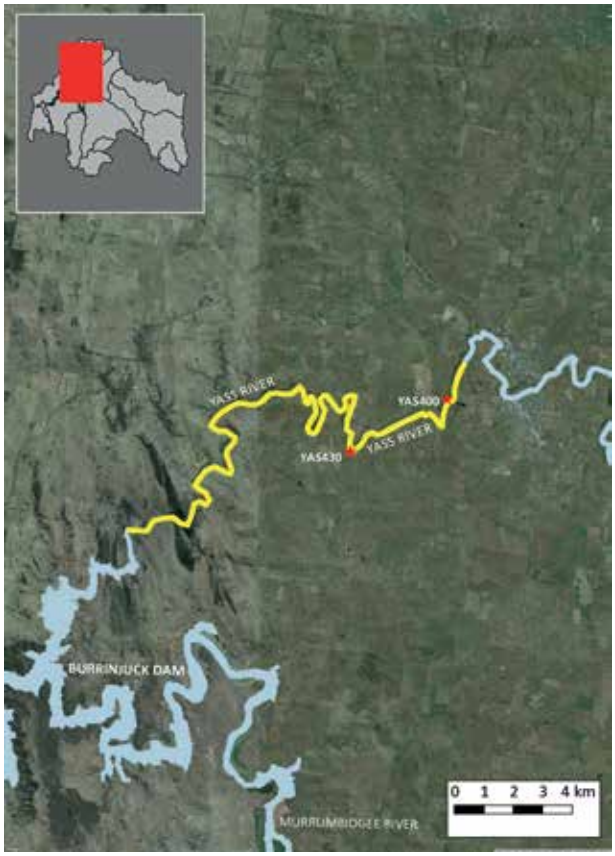
Hattons Corner to Burrinjuck Dam

2018 CHIP Result C+ (Fair)		
2016/17 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**21**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
Water bug	**Fair**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

Reach network length: approx. 23km
Dominant land uses: Rural Fringe

This downstream section of the Yass River runs through gorge country and farmlands before running into Lake Burrinjuck. This reach is marked by its scenic beauty and significant geological history. The Hume Limestone, which caps the escarpment above the river at Hatton's Corner, is particularly rich in fossils. Rehabilitation work by landholders has been happening at the bottom of this reach.



Despite the presence of reeds along the River and some patches of native tree regeneration, most of the riparian zone is lacking good canopy cover and shrubs, which are necessary to provide shade, erosion control, and habitat for birds and mammals.

Nitrate levels continue to be a problem in this reach, especially at Hattons Corner (YAS400). It is possible that this is coming from Yass township upstream and the levels are still measurable a few kilometres downstream.

Water bugs were abundant, especially tolerant species such as fly larvae (600+), but it was positive to also see increasing numbers of the pollution-sensitive mayflies (140+) and water mites (270+).

Eastern long-necked turtles have been sighted in both sites in this reach. This species of turtle is a carnivore, and its diet is mainly composed of water bugs and small fish. It will, however, also scavenge on dead Carp, and they are considered the 'vacuum cleaners of the rivers'.

Jan and John helping out with water bug surveys at YAS400.

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 2018

The 2018 Platypus Month census in August consisted of 24 surveys conducted by over 100 enthusiastic volunteers at six 'river reach' sites across the ACT region. Waterwatch conducted more Platypus Month surveys this year than ever before, with most sites having at least four surveys conducted, rather than the two typically undertaken in previous years. This was in an effort to improve detectability rates and increase confidence in the data. The six survey sites (each averaging one kilometre in length) were on Cooma Creek, Jerrabomberra Creek, the Molonglo River below Coppins Crossing, and three on the Murrumbidgee River; Adaminaby, Bush Heritage Australia's Scottsdale Reserve near Bredbo and Point Hut Crossing in southern Canberra.

Despite the increased survey effort in 2018, numbers were consistently down over all sites compared with previous years. A total of 11 individual Platypus were sighted over the six reaches with last year's count producing 16 individuals. Likewise, Rakali (Water rat) numbers, which are also counted during the survey, totalled six individuals in 2018 down from 11 in 2017.

While it's hard to know what's causing this result, the Australian Platypus Conservancy has done some recent work linking dry Autumn and Winter conditions with fewer Platypus sightings in the following breeding season. Such dry conditions could reduce productivity in streams which may force Platypus (and rakali) to branch out from their usual territories in order to find food (water bugs). This could be even more likely during August as the end of Winter is when food supply is at its lowest. During the very dry Autumn and Winter in the ACT region this year, we detected lower numbers of Platypus in the surveys, plus we had a record number of sightings in Lake Burley Griffin over August! It's possible that this was all linked and Platypus were moving out from their core habitat and showing up in places where they're not regularly seen.

Continuing with a higher number of surveys in future, Platypus Months will help us further test the above possibility and gain a better understanding of our local Platypus populations and how they change over time. Many thanks to all the volunteers who braved the winter conditions and took part in this year's surveys. Also thanks to the team at the Bush Heritage Scottsdale reserve who conducted six surveys for the third year in a row, providing us with a valuable reference point for this initiative. Nationally, our understanding of Platypus numbers and population dynamics is quite limited and that is certainly the case here in the ACT region. So every survey conducted adds to the picture and better enables us to manage these marvellous monotremes. Thank you for contributing to this work.

Platypus seen in Lake Burley Griffin, August 2018. (Photo: Shinji Horiuchi)

Volunteer list

Cooma

Mick Castles
Kerryn Milligan
Phil Irons
David Harkins
Alison Howell
Maria Linkenbagh
Emily Griffin-Morton
Laurene Lewis
Jim Wharton
Mark Shubert
Alistair Bestow
Gill Robinson
Sarah Essex
Edel Stephans
Rita Brademann
Ed & Sue Dawson
Matt Kent
Mark & Melinda Kent
Theo Schoo
Tim Scrace
Ingrid Hagstrom
Julee Harden
Catherine Dodd
Alison Dooley
John Booker
Robert & Rowena Evans
Taylor Beggs
Lavinia Petrescu
Mary Ziesak
Fiona Currie and family
Samantha Donohoe
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Mike Bassanelli
Bruce Cowell
James Cumming
Clarissa Barbosa
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Molonglo Water buggers

John, Yan, Friends of Jerrabomberra Wetlands, Wendy & Steve, Richard, Michael, Tim, Sherri, Jacob, Sarah, Ben, Martin, Mel, Sue G, Lucy, Sue P, and Kate.

Southern

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'Sands' Waterwatch Group (Wendy Rainbird, Anne l'Ons & Tom Tyrrell)

Cooleman Ridge Parkcare Group (Pat Ryan)

Lions Youth Haven 'Ed Shed' Program

Park Carers of Southern Murrumbidgee (P.O.S.M) (Deb Kellock)

Outward Bound Australia

ACT Parks and Conservation Service (Ranger Bernadette Brown)

Australian National University 'Intrepid Landcare' group

Friends of Stranger Pond (Nev Sheather & Colin Carpenter)

Caroline Chisholm School

Namadji High School

Lake Tuggeranong College: 'Sustainability Unit'

Carers of Point Hut Pond (Alan Parker, Laureen Harrison & Stephen Dellar)

Conder Wetlands Waterwatch (Vera Kurz & Mark Kerwin)

'Paddy's River' Waterwatch Group (Fleur Horan & Maree Blume)

Friends of Tidbinbilla Parkcare group

Tidbinbilla Sanctuary Volunteer Assist Program

Gudgenby Bush Regenerators Waterwatch Group (Martin Chalk, Michaela Popham & Samantha Donohoe & Stefan)

Southwell Scout Group Venturers

Yass

Richard Bland

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Jane Major

Fiona Hamer

Rebecca Widdows

Carol Boughton

Paul Churcher

Janette Ryan

Iain Fyfe

Jill McGovern

Richard Miller

Ben Serafin

Glossary

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

Biennial:
Occurring 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 assessment

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 related 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. Measured as Orthophosphate on CHIP

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

P: 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	DOSat	TP	NO3	WQscore	WBscore	RARCscore	CHIPscore	Letter
BAD1	1	1	1	5	1	1	1.67	2	2.5	2.06	B+
BAD2	1	1	1	5	1	1	1.67	2	2	1.89	A-
BRD1	1	2	1	2	1	1	1.33	2	3	2.11	B+
BRD2	1	4	1	5	1	2	2.33	3	4	3.11	C+
CMM1	1	1	1	3	1	2	1.5	2	4	2.5	B
CMM2	1	1	1	3	1	1	1.33	2	4	2.44	B
CMM3	1	1	1	1	1	1	1	2.5	3	2.17	B+
CMM4	1	1	1	1	1	2	1.17	2	4.5	2.56	B
CMM5	1	2	1	1	1	2	1.33	2.5	4.5	2.78	B-
CMM6	1	2	1	1	1	1	1.17	2	4	2.39	B
COB1	1	5	1	5	3	1	2.67	3	4	3.22	C+
COO1	2	5	1	5	5	2	3.33	3	4	3.44	C
COO2	2	5	1	1	5	2	2.67	2.5	5	3.39	C
COO3	2	5	1	5	5	5	3.83	3	4	3.61	C
GUD1	1	5	1	3	1	1	2	3	4	3	C+
KYB1	2	3	1	5	1	1	2.17	2.5	4	2.89	B-
MIC1	1	5	1	5	1	1	2.33	4	4	3.44	C
NUM1	1	4	1	5	1	2	2.33	3	4	3.11	C+
NUM2	1	4	1	5	1	1	2.17	2.5	3.5	2.72	B-
NUM3	1	2	1	1	2	2	1.5	3	3	2.5	B
NUM4	1	4	1	2	1	2	1.83	2.5	4	2.78	B-
ROC1	2	5	1	1	1	2	2	2.5	4.5	3	C+
STR1	1	5	1	4	1	2	2.33	3	4	3.11	C+

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

Molonglo region CHIP scores by parameter

Reach	pH	EC	Turbidity	DOSat	TP	NO3	WQscore	WBscore	RARCscore	CHIPscore	Letter
BUR1	1	5	1	5	1	1	2.33	3	4	3.11	C+
DIC1	1	2	1	5	1	1	1.83	3	3	2.61	B
GGG1	1	5	1	1	1	5	2.33	NA	2.5	2.42	B
JER1	1	5	2	5	1	1	2.5	2.5	4	3	C+
JER2	1	5	2	5	1	1	2.5	3	4	3.17	C+
LYN1	2	2	2	5	5	2	3	5	4	4	D+
MOL1	NA	NA	NA	NA	NA	NA	NA	2	4	3	C+
MOL2	1	5	1	5	1	1	2.33	3	2	2.44	B
MOL3	1	5	1	5	1	2	2.5	3	4	3.17	C+
MOL4	1	5	1	5	2	1	2.5	3	4	3.17	C+
MOL5	1	4	1	5	1	5	2.83	4	4	3.61	C
MOL6	1	4	1	4	1	2	2.17	3	3.5	2.89	B-
PRI1	1	5	1	5	1	1	2.33	3	4.5	3.28	C+
QUE1	1	2	1	3	1	1	1.5	2.5	2	2	B+
QUE2	1	5	1	1	1	2	1.83	3	3	2.61	B
QUE3	1	3	1	3	1	1	1.67	3	4	2.89	B-
SCA1	DD	DD	DD	DD	DD	DD	NA	NA	2	2	B+
SUL1	1	3	1	5	2	2	2.33	3	4	3.11	C+
SUL3	1	4	1	5	5	1	2.83	3	4	3.28	C+
SUW1	2	2	3	5	5	1	3	5	3	3.67	C
SUW2	2	1	1	5	4	1.5	2.42	4	3	3.14	C+
WAT1	1	1	3	5	1	1	2	3	4	3	C+
WES1	1	2	1	5	4	2	2.5	3	4.5	3.33	C+
WOO1	1	3.5	1	5	1	1	2.08	3	4.5	3.19	C+
YAN1	1	5	1	5	1	1	2.33	3	2.5	2.61	B
YAR1	1	4	1	5	1	1	2.17	4	3	3.06	C+

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

Ginninderra region CHIP scores by parameter

Reach	pH	EC	Turbidity	DOSat	TP	NO3	WQscore	WBscore	RARCscore	CHIPscore	Letter
CMM11	1	4	1	1	1	5	2.17	5	3.5	3.56	C
GDC1	1	2	3	1	1	1	1.5	5	3	3.17	C+
GIN1	1	4	1	5	1	2	2.33	4	4	3.44	C
GIN2	1	4	1	5	1	1	2.17	3	4	3.06	C+
GIN3	1	4	1	5	2	2	2.5	3	4	3.17	C+
GIN4	1	4	1	5	1	2	2.33	4	4	3.44	C
GIN5	1	4	3	1	1.5	2	2.08	4	4.5	3.53	C
GIN6	1	4	1	3.5	1	2	2.08	4	3	3.03	C+
GOO1	1	5	1	5	1	2	2.5	4	4.5	3.67	C
GUN1	1	5	3	5	2	1	2.83	3	3.5	3.11	C+
GUN2	1	4	1	5	1	1	2.17	4	4	3.39	C
KIP1	1	4	2	5	3	2	2.83	3	4	3.28	C+
MCW1	1	1	4	5	1	1	2.17	3	3.5	2.89	B-
MFL1	1	3	4	5	2	1	2.67	5	3.5	3.72	C-
YER1	1	4	1	3	1	1	1.83	3	4	2.94	B-

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

Southern region CHIP scores by parameter

Reach	pH	EC	Turbidity	DOSat	TP	NO3	WQscore	WBscore	RARCscore	CHIPscore	Letter
CGB1	1	1	1	5	1	2	1.83	2	2	1.94	A-
CGG1	1	2	1	3	1	1.5	1.58	2	4	2.53	B
CGH1	1	2	1	5	2	2	2.17	2	2.5	2.22	B+
CMM10	1	2	1	1	1	1	1.17	2	3.5	2.22	B+
CMM7	1	2	2	1	1	1	1.33	2	3.5	2.28	B+
CMM8	1	3	1	1	1	1	1.33	3	4	2.78	B-
CMM9	1	3	1	3	1	2	1.83	4	3	2.94	B-
CTP1	1	2	1	5	1	1	1.83	2.5	3	2.44	B
CTT1	1	1	1	5	1	1	1.67	2	2	1.89	A-
GIB1	1	1	1	3	1	1	1.33	1	1.5	1.28	A+
LMS1	1	3	1	4	1	1.5	1.92	4	3	2.97	B-
MCC1	1	1	1	1	1	1	1	2	3	2	B+
MCC2	1	1	1	5	1	1	1.67	1	3	1.89	A-
MMB1	1	4	3	5	1	1.5	2.58	5	3	3.53	C
MPG1	1	3	1	5	1	1	2	3	4	3	C+
MSP1	1	2	3	5	1	2	2.33	3	3.5	2.94	B-
NNN1	1	3	1	5	1	1	2	3	2	2.33	B+
RAN1	2	4	5	5	5	1	3.67	5	4	4.22	D+
RAN2	1	1.5	2	5	1	1	1.92	5	5	3.97	C-
TIP1	DD	DD	DD	DD	DD	DD	NA	NA	3	3	C+
TLT1	2	4	5	5	5	2	3.83	5	3.5	4.11	D+
TLT2	1	2	1	5	2	5	2.67	4	4	3.56	C
TMM1	1	4	1	5	1	2	2.33	4	3.5	3.28	C+
TUG1	1	5	1	5	1	1	2.33	3	4.5	3.28	C+
TUG2	1	2	1	1	1	1	1.17	5	5	3.72	C-
TUG3	1	2.5	1	3.5	3.5	4	2.58	3	3	2.86	B-

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

Yass region CHIP scores by parameter

Reach	pH	EC	Turbidity	DOSat	TP	NO3	WQscore	WBscore	RARCscore	CHIPscore	Letter
CMM12	1	4	1	1	1	5	2.17	4	3.5	3.22	C+
CMM13	1	4	1	1	1	5	2.17	4.5	4	3.56	C
YAS1	1	5	1	5	1	1	2.33	3	3.5	2.94	B-
YAS2	1	5	2	5	1	1.5	2.58	3	3	2.86	B-
YAS3	1	5	1	1	1	5	2.33	3	3.5	2.94	B-
YAS4	2	5	1	1	1	5	2.5	3	3.5	3	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 coordinators 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 coordinators 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 coordinators 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 coordinators, that are included in the CHIP. The 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
	Phosphorus	Monthly	All sites
	Nitrate	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, Water bugs 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.

Number of 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.

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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).

	Number of macroinvertebrate orders	
SIGNAL SCORE	**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.

Number of 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 water bugs – 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 (Table 1).

Table 1. Summary of 2013–2014 water quality thresholds for the CHIP report.

Indicator Rating	Excellent - 1	Good - 2	Fair - 3	Poor - 4	Degraded - 5
pH	6.0 – 6.9	5.5 – 5.9 or 7.0 – 7.9	8.0 – 8.5	5 – 5.5 or 8.5 – 8.9	<5 or >9
EC (mS)	<= 65	<= 200	<= 350	<= 400	> 400
Turbidity (NTU)	<= 10	<= 12.5	<= 15	<= 20	> 20
Dissolved oxygen (mg/L)	*(Not included in CHIP)*				
Dissolved oxygen saturation (%)	95 – 105	85 – 95 or 105 – 110	75 – 85	65 – 75 or 115 – 120	< 65 or > 120
Phosphorus	< 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.

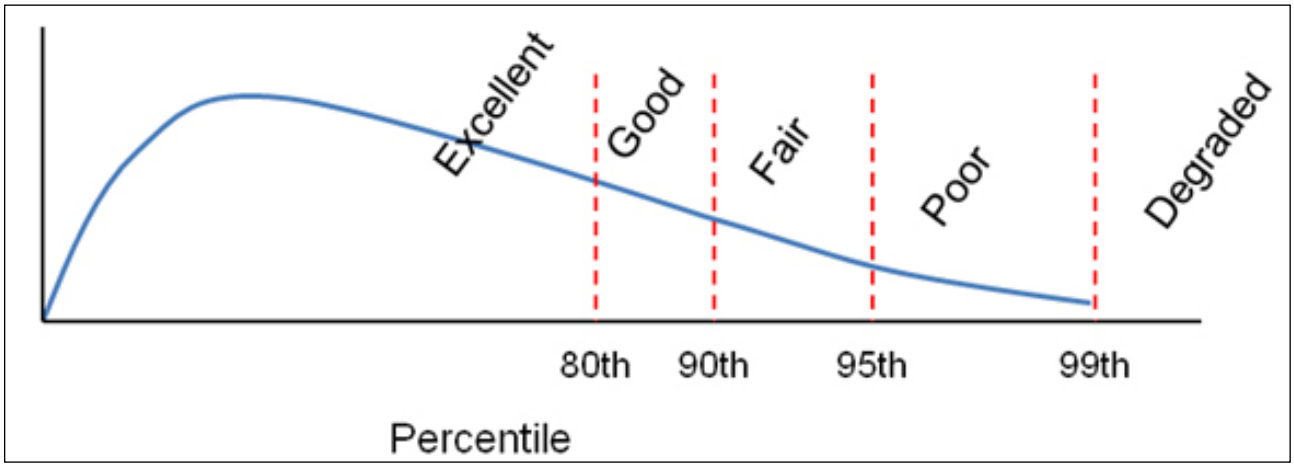
A second key issue is the amount of data available. This is further complicated by the impact that the millennium drought had on reference site condition. For example, data from reference sites of the AUSRIVAS macro-invertebrate monitoring program showed major declines in the relative health of some 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.

Current thresholds

Table 2 presents the 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. These thresholds were redefined for the 2014-15 CHIP report onwards.

Table 2: Water quality CHIP thresholds.

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
Phosphorus (mg/L)	< 0.02	0.02 – 0.03	0.04 – 0.05	0.06 – 0.08	> 0.08
Nitrate (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'.