Icon Water

Murrumbidgee Ecological Monitoring Program
Observation Report - Autumn 2019
Impact Monitoring Round 1

August 2019

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1. Introduction

1.1 Background and adaptive management: changes to the MEMP since 2008

The Murrumbidgee Ecological Monitoring Program (MEMP) has been supported by Icon Water to evaluate the potential impacts of water abstraction from the Murrumbidgee River and the influence of increased water volumes in Burra Creek. The MEMP was implemented prior to the commencement of the Murrumbidgee to Googong (M2G) project and has allowed Icon Water to collect pre-abstraction baseline data. This baseline data can be used in comparisons against post-abstraction data to investigate changes to ecological communities due to the M2G project. The monitoring of several components of the aquatic ecosystem has generally occurred in spring and autumn each year between 2008 and 2019.

Over the course of the monitoring program there have been a number of changes and modifications in line with the adaptive management philosophy of the MEMP. Furthermore, during 2014 Icon Water commissioned a full independent review of the MEMP project. This review was completed by Jacobs (2014) and resulted in a number of recommendations to commence in autumn 2015 which are outlined below:

- Sentinel monitoring – completion of autumn and spring monitoring every three years;
- Reduction of sites assessed for macroinvertebrates for each component from six to two sites;
- Reduction from two riffle and two edge samples to one riffle and one edge sample;
- Removal of quantitative periphyton assessment;
- Introduction of photogrammetry monitoring for periphyton, vegetation and geomorphology at relevant locations.

1.2 Project review and requirements

The review by Jacobs (2014), resulted in a number of recommendations to adapt the program so that Icon Water may continue to have a robust monitoring program, capable of detecting potential ecological impacts, while at the same time accounting for the lowered ecological risk during periods of standby and maintenance modes of operation.

Three modes of operation were defined for the M2G and MPS **in the License To Take Water which was current at the time of sampling,** to help target the monitoring program. These are defined for the **M2G** as:

- **Standby (maintenance) –** ready to run, all components in place and being operated routinely for maintenance purposes. Peak pump volumes are typically 49 ML/d and transferring approximately 50 ML in total.
- **Operating (full pump) –** operating in earnest under normal flow conditions with continuous transfer of bulk water to Googong Reservoir for a period of greater than 30 consecutive days.
- **Operating (drought conditions, full pump, drought flows) –** operating in earnest under drought flow conditions with continuous transfer of bulk water to Googong Reservoir for a period of greater than 30 consecutive days.

For the **MPS,** the modes of operation are defined as:

- **Standby –** abstraction from the Murrumbidgee River is not occurring. Ready to run, all components in place and being operated routinely for maintenance purposes.
- **Recirculating Pump Operation -** flow up to 40 ML/d transferred to the base of the Cotter Dam to provide environmental flows to the lower Cotter River. Water to the Cotter River re-enters the Murrumbidgee River just upstream of the MPS.

- **Operating (full pump) –** abstraction of up to 150 ML/d of water for raw water supply to Stromlo Water Treatment Plant for greater than 30 consecutive days. While this is the maximum capacity of the Murrumbidgee Pump Station, this extraction volume rarely occurs due to water quality in the Murrumbidgee River. Hence, smaller volumes are likely to be taken and shandied with cleaner Cotter River water from the Bendora Main.

During periods of standby for M2G and MPS the risks from these projects to the ecological condition of the Murrumbidgee River and Burra Creek is minimal. Alternatively, it is anticipated that any risks to the Murrumbidgee River and Burra Creek are most likely to manifest during periods of full operation.

With this in mind, the revised MEMP will adopt a two-stage approach which incorporates sentinel monitoring during **standby** modes and **impact** monitoring during the various operation modes. These two types of monitoring are described in sections 1.2.1 and 1.2.2 respectively.

The last M2G *Operate To Maintain (O2M)* run was on 4-5 January 2019. These maintenance runs used to be called APPLE runs.

1.2.1 Sentinel monitoring (M2G & MPS)

The purpose of the sentinel monitoring is to understand if major catchment-scale changes to the aquatic ecology are taking place. Sentinel monitoring will occur during standby periods when the risk to the ecosystem due to water transfers is deemed to be very low. Sentinel monitoring will occur in autumn and spring every three years which begun in autumn 2015 with a reduced number of monitoring sites (1 upstream and 1 downstream of Angle crossing (M2G); Burra Creek discharge structure (M2G) and at the Murrumbidgee Pump Station (MPS)). Periphyton sampling is not required in the sentinel monitoring and qualitative methods, such as photogrammetry and AUSRIVAS habitat assessments, are used to track the conditions of these sites on a broad spatial and temporal scale. Under this scenario testing of hypotheses and targeted monitoring are not required.

1.2.2 Impact monitoring (M2G & MPS)

The trigger for impact monitoring is the decision to operate the M2G or MPS infrastructure. This monitoring scenario requires a before and after approach, and relies on replicated sampling protocols. Under this monitoring protocol several univariate indicators of river health and condition will be compared before and after the operation period at both upstream and downstream locations. Periphyton photogrammetry will be assessed during both time periods and compared between monitoring locations. The key difference between this and the sentinel monitoring is the number of sites, replicates and sampling events (impact monitoring requires at least one before and one after sampling event) and the level of detail used in the analysis.

Following the operation period, consecutive spring and autumn monitoring must also be carried out; and should pumping occur across a spring and/or autumn period, sampling will be carried out during those times.

Since the Jacobs (2014) review, the first round of *impact* monitoring was conducted in autumn 2019. In accordance with the review recommendations GHD surveyed the Murrumbidgee River and Burra Creek for suitable sites located closer to the abstraction and discharge points. Suitable sites have been identified (see Section 2) and sampled in the Murrumbidgee River upstream and downstream of the abstraction point at Angle Crossing.

The identification of new Burra Creek sites was more challenging due to restricted access by landholders and safe access. Furthermore, due to drought conditions the Creek was almost dry which made riffle and / or edge sampling impractical and inconsistent with the AUSRIVAS protocols.

For the autumn 2019 monitoring, the best available second downstream site was located close to Williamsdale Road (known as BUR-2) and the upstream site near the bridge where Burra Road crosses the Creek further south (known as BUR 1d). For reasons stated above, BUR 1c is no longer accessible, so the next best site was located 50 m upstream of the weir and is known as BUR 1d.

GHD sampled these sites as best as practically possible and the relevance of results obtained from the samples in the context of AUSRIVAS will be explained in the discussion section of this report.

1.3 Objectives

Icon Water has made the decision to prepare to move the M2G into operation mode. The Murrumbidgee to Googong (M2G); although at the time of preparing this report, no date for operation had been decided. The decision to operate triggered impact monitoring using the methods and protocols described above in Section 1.2.2.

The objectives of this report are to: a) provide a summary of the sampling conditions in Burra Creek and Murrumbidgee River during the autumn 2019 impact assessment monitoring; and b) provide an early communication of any potential concerns to Icon Water prior to the completion of the full technical report.

Monitoring will be conducted again in spring 2019, followed by an observation report for that round of monitoring and an annual technical report. The annual report will consolidate the results from autumn and spring 2019 and provide recommendations for future monitoring based on those results and consideration of the historical dataset.

2. Summary of autumn 2019 impact monitoring

Autumn monitoring was conducted on the 7th and 8th of May 2019. Over the two days, the weather conditions were generally fine with temperatures ranging from 8 - 16°C.

Sampling during autumn involved the collection of macroinvertebrate samples, water quality grab samples and estimates of the periphyton coverage in the benthic environment. Photogrammetry of vegetation and geomorphological features is also a requirement of the impact assessment and was completed in April 2019. A summary of the sampling conducted in autumn 2019 is shown in Table 2-1.

Changes to the locations of two monitoring sites on the Murrumbidgee River and three sites on Burra Creek were necessary to accommodate access issues and address recommendations made by Jacobs (2014) in their review of the monitoring program. These changes are summarised in Table 2-2 and Table 2-3 and shown in Figure 1 and Figure 2.

Table 2-1. Sampling overviews

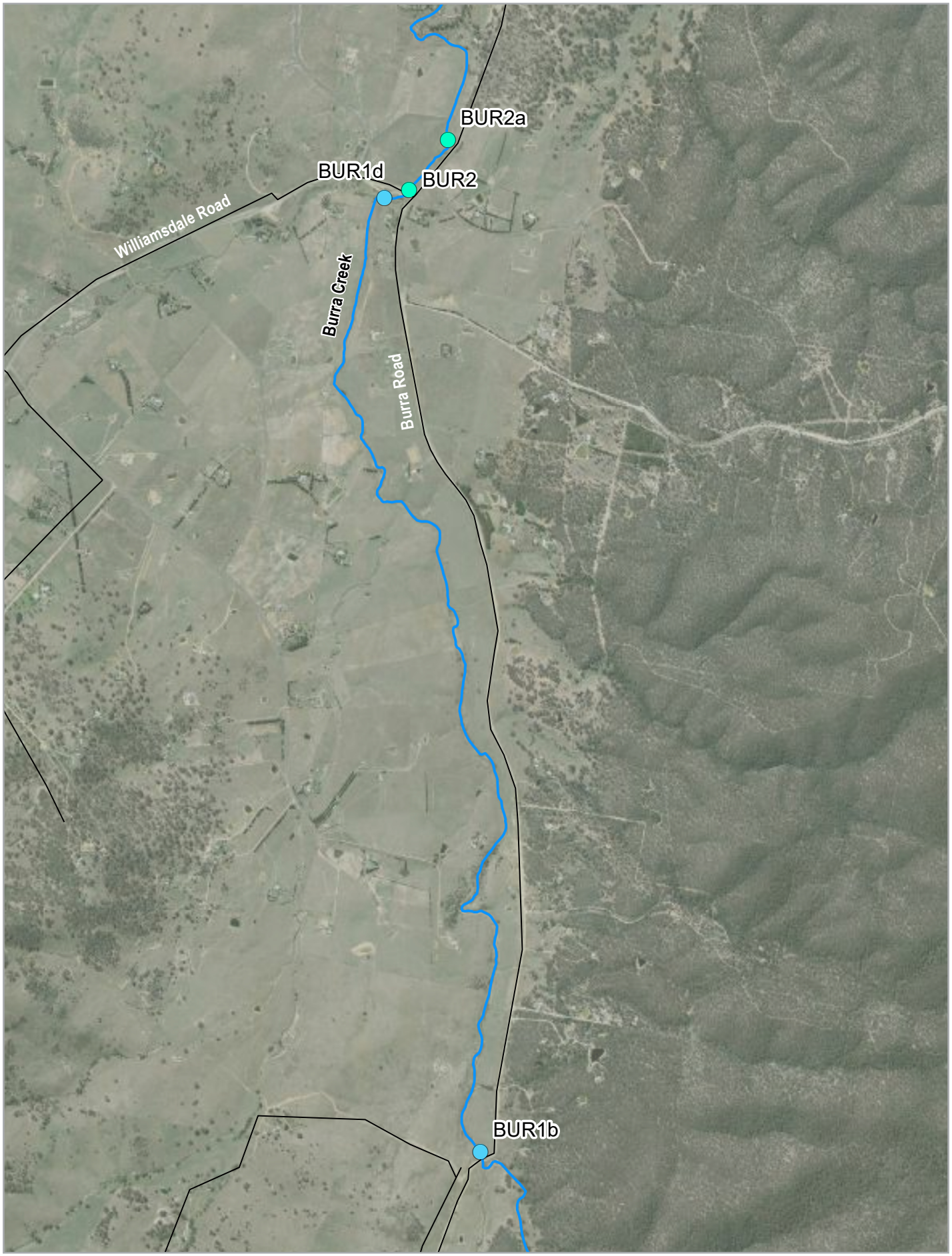
Site	Macroinvertebrates	Water Quality Grab Sample	Periphyton	Geomorphology	Riparian Vegetation
Burra Creek					
BUR 1b	2 replicate edge samples	Collected – submitted to ALS for analysis			-
BUR 1c				1 Photo point	-
BUR 1d	2 replicate edge samples	Collected – submitted to ALS for analysis			-
BUR 2	2 replicate edge samples	Collected – submitted to ALS for analysis			-
BUR 2a	Burra Creek	Collected – submitted to ALS for analysis	Photos taken qualitative estimates	4 Photo points	-
BUR 1a	2 replicate edge samples	-	-	3 Photo Points	-
BUR 2	-	-	-	4 Photo points	4 Photo points
BUR 2c	-	-	-	4 Photo points	4 Photo points
D/S Pool 29	-	-	-	3 Photo points	3 Photo points
Murrumbidgee River					
MUR 17	2 replicate riffle samples	Collected – submitted to ALS for analysis	Photos taken qualitative estimates	-	-
MUR 18	2 replicate riffle samples	Collected – submitted to ALS for analysis	Photos taken qualitative estimates		-
MUR 19	2 replicate riffle samples	Collected – submitted to ALS for analysis	Photos taken qualitative estimates	5 Photo Points	-
MUR 20	2 replicate riffle samples	Collected – submitted to ALS for analysis	Photos taken qualitative estimates	-	-

Table 2-2 Burra Creek monitoring sites

Site	Location	Lat.	Long.	Notes
BUR 1b	~ 4 km upstream of weir	-35.597536	149.227023	Second upstream site added to meet requirements for the impact monitoring
BUR 1d	~ 50 m upstream of weir	-35.555963	149.222150	Replaces BUR 1c as access is no longer available
BUR 2	~ 100 m downstream of weir	-35.555531	149.223118	Second downstream site to meet the requirements for impact monitoring
BUR 2a	~ 400 m downstream of weir	-35.553320	149.225228	Existing site

Table 2-3 Murrumbidgee River (Angle Crossing) monitoring sites

Site	Location	Lat.	Long.	Notes
MUR 17	~950 m upstream of Angle Crossing	-35.586453	149.112817	Second upstream site selected for impact monitoring. Might not be possible to sample this site during higher flow periods.
MUR 18	~600 m upstream of Angle Crossing	-35.587394	149.110067	Same as sentinel monitoring site
MUR 19	Immediately downstream of Angle Crossing	-35.582850	149.109812	Same as sentinel monitoring site
MUR 20	~400 m downstream of Angle Crossing	-35.580979	149.111303	Second downstream site selected for impact monitoring. Might not be possible to sample this site during higher flow periods.



Paper Size ISO A4

0 0.2 0.4 0.6 0.8

Kilometers

Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxiliary Sphere

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GHD

Icon Water
Murrumbidgee Ecological Monitoring Program

Autumn 2019
Impact Monitoring Sites

Project No. **2316216**
Revision No. 1 **-**
Date **15/05/2019**

FIGURE 1

G:\23\16216\GIS\Maps\Working\Burra Creek.mxd
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Data source: . Created by: pjtaylor

Paper Size ISO A4

0 0.055 0.11 0.165 0.22

Kilometers

Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxiliary Sphere

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Icon Water
Murrumbidgee Ecological Monitoring Program

Autumn 2019 Impact Monitoring Sites

Project No. 2316216
Revision No. **1**
Date **15/05/2019**

FIGURE 2

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2.1 Burra Creek

Flow conditions in Burra Creek were low at the time of monitoring. Mean daily flow at the Burra Weir (410774) was 0.746 ML/d during autumn 2019, which was lower than the same time in autumn 2018 (0.98 ML/d) when sentinel monitoring was conducted.

There was a slight increase in flow (Figure 3) on the 4th and 5th of May following 17.8 mm of rainfall (recorded at Burra Creek: 570951). The maximum flow was 2.3 ML/d on the 4th of May which rapidly decreased to below 1 ML/d. Prior to this increase in flow, the last notable event was on the 31st of March when peak flow was 96.2 ML/d (30.9 ML/d mean daily flow) (Figure 3).

Over the past twelve months there have been few high flow events, although there was one significant event on the 14th of December, which peaked at 832 ML/d resulting in a mean daily flow of 83.1 ML/d (Figure 4).

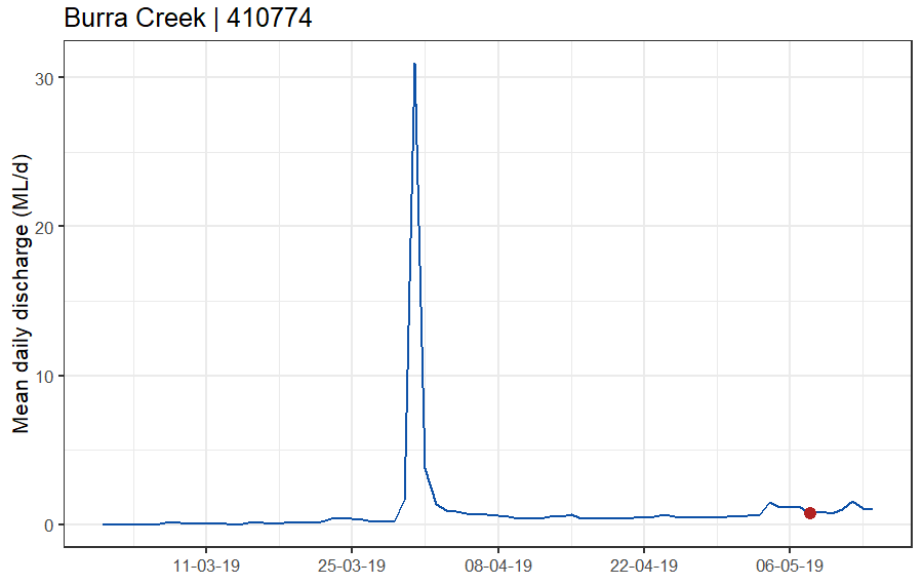

Figure 3. Hydrograph for Burra Creek at the Burra Weir (410774) for autumn 2019

Note: the red point indicates when sampling was conducted

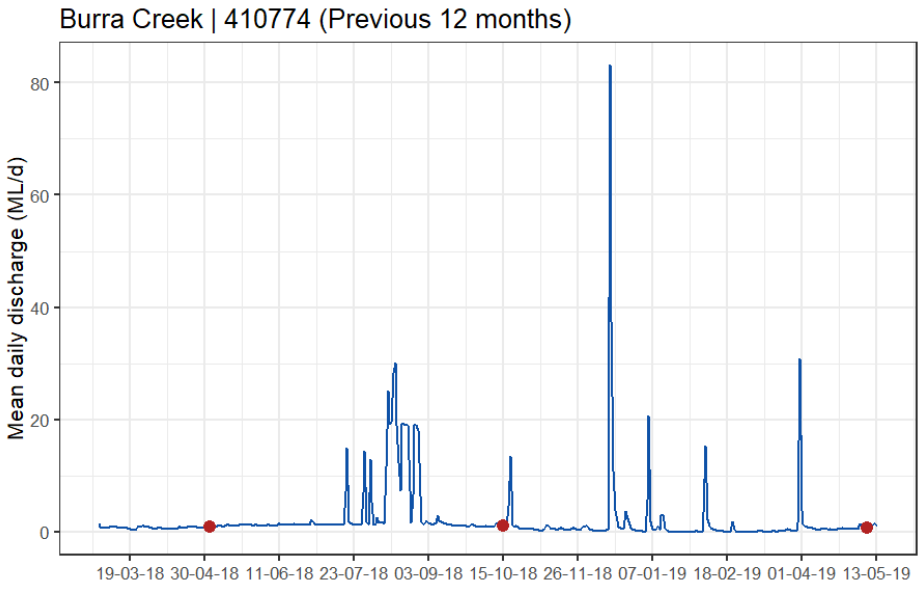

Figure 4. Hydrograph for Burra Creek at the Burra Weir (410774) for the past 12 months

Note: the red point indicates when sampling was conducted

The conditions in Burra Creek were characterised by low flows. There was significant siltation on the Creek bed (see following photo plates), the channel was significantly encroached by macrophyte growth (Plate 2-1) (*Typha* spp., *Phragmites australis,* and Great Bulrush (*Schoenoplectus validus*)) and there was no riffle habitat at any of the monitoring sites, meaning that riffle samples were not collected.

Plate 2-1 Aerial view of macrophyte encroachment in Burra Creek*

The in-situ water quality was indicative of the time of year and low flow conditions. Notably, there was no obvious difference upstream and downstream of the weir, although there were minor increases in temperature, electrical conductivity and dissolved oxygen downstream. Although there were some differences between locations with slightly higher temperature, EC and DO downstream of the weir this is likely due to natural variation rather than any changes related to the discharge weir(Table 2-4).

Table 2-4. *In-situ* water quality parameters in Burra Creek

Site	Date	time	Location	Temp.	EC	pH	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Turbidity	Alkalinity
BUR1b	8/5/2019	1000	Upstream	9.7	261.1	8.17	7.04	61.8	30.7	230
BUR1d	8/5/2019	1130	Upstream	9.7	358.6	8.08	6.83	60.2	13.6	240
BUR2	8/5/2019	1330	downstream	10.5	372.9	8.11	8.08	74.6	8.6	250
BUR2a	8/5/2019	1520	downstream	11.1	388.4	8.21	7.40	67.6	13.1	260

Plate 2-2. Photos of the Burra Creek macroinvertebrate sampling sites

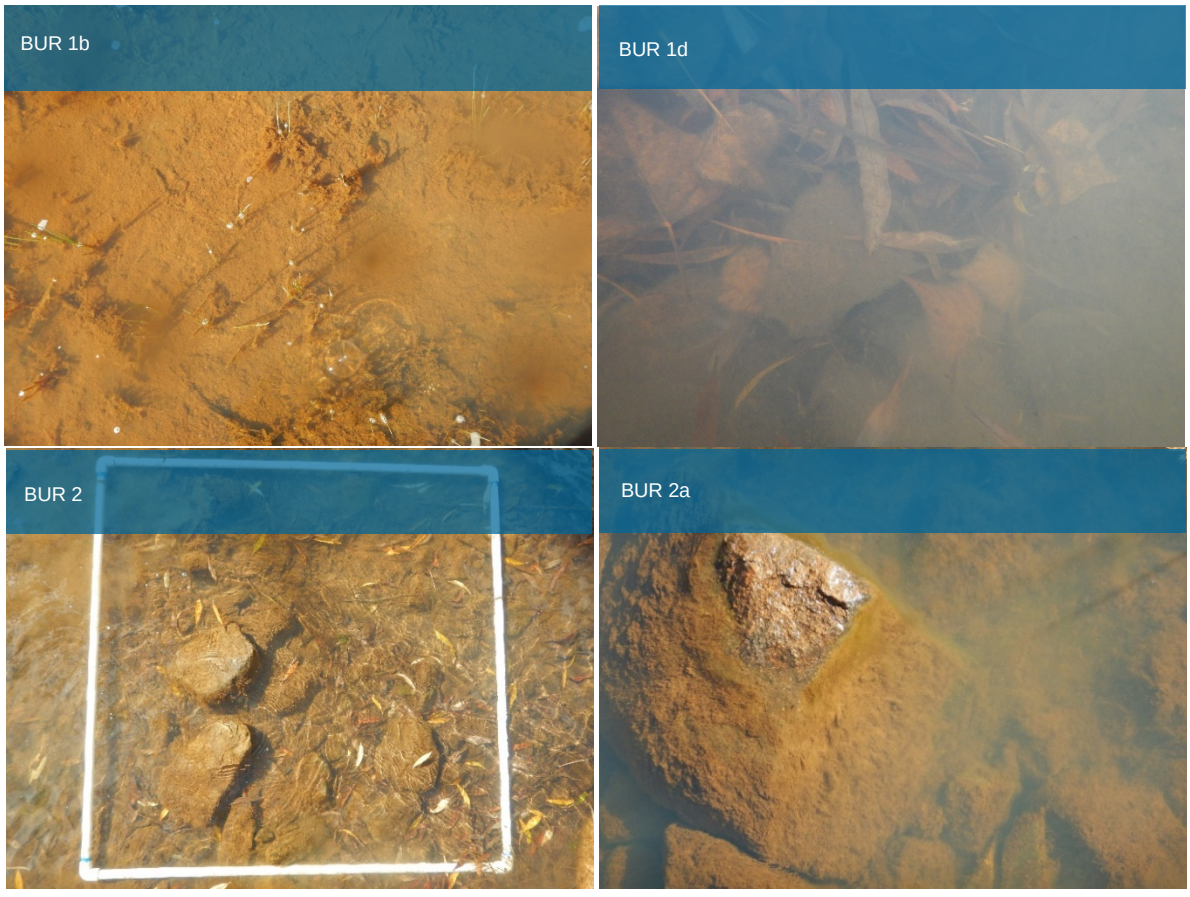

Plate 2-3 Photos of quadrat surveys in Burra Creek showing composition of the substrate

2.2 Murrumbidgee River

The Murrumbidgee River, like Burra Creek, had been experiencing a significant period of low flow over the autumn period (Figure 5 and Figure 6). Average flow in the Murrumbidgee River in autumn 2019 was 97.2 ML/d, which was marginally higher than for autumn 2018 when the average daily flow was 68.2 ML/d

As per the requirements of the impact monitoring, two replicate riffle samples were collected from each site.

Algae growth and periphyton cover were classified as 35-65% cover at all sites. The dominant macrophyte species was *Myriophyllum* spp. which was highest at MUR 19 where it covered 65-90% of the channel (Plate 2-4).

Overall, there are no other significant features or observations of notable difference from previous monitoring rounds for the Murrumbidgee River sites.

In situ water quality in the Murrumbidgee River were mostly within the ANZECC & ARMCANZ (2000) guidelines (Table 2-5). The exception was dissolved oxygen which was outside the 90-100% saturation range at all sites. As with Burra Creek, there were no notable differences in water quality parameters between upstream and downstream sites[1].

Table 2-5 *In-situ* water quality parameters in the Murrumbidgee River

Site	Date	time	Location	Temp.	EC	pH	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Turbidity	Alkalinity
MUR17	7/5/2019	0900	Upstream	12.8	97.2	8.17	8.29	78.4	8.6	78
MUR18	7/5/2019	1130	Upstream	13.9	126.5	8.62	8.72	84.6	20.5	80
MUR19	7/5/2019	1330	downstream	13.4	98.1	7.88	8.84	84.6	17.6	90
MUR20	7/5/2019	1600	downstream	13.7	122.3	8.01	9.12	88.0	17.0	90

[1] However at the time of writing we are still waiting on nutrient analysis from the laboratory

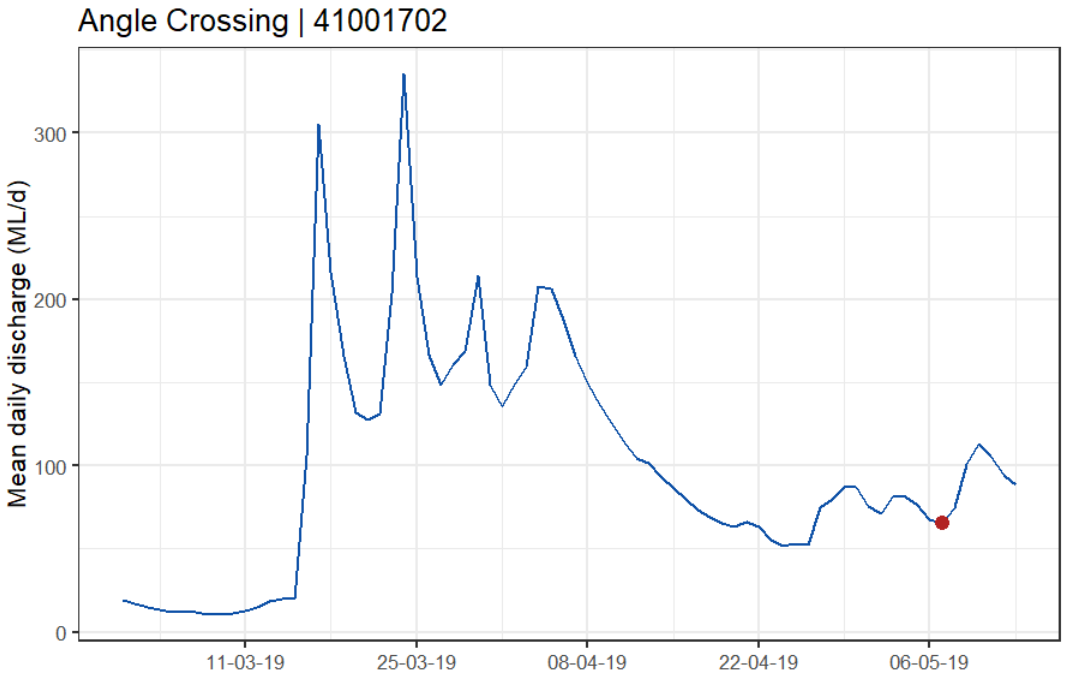

Figure 5 Hydrograph for the Murrumbidgee River - Upstream of Angle Crossing (41001702) for spring 2018, highlighting when sampling was conducted

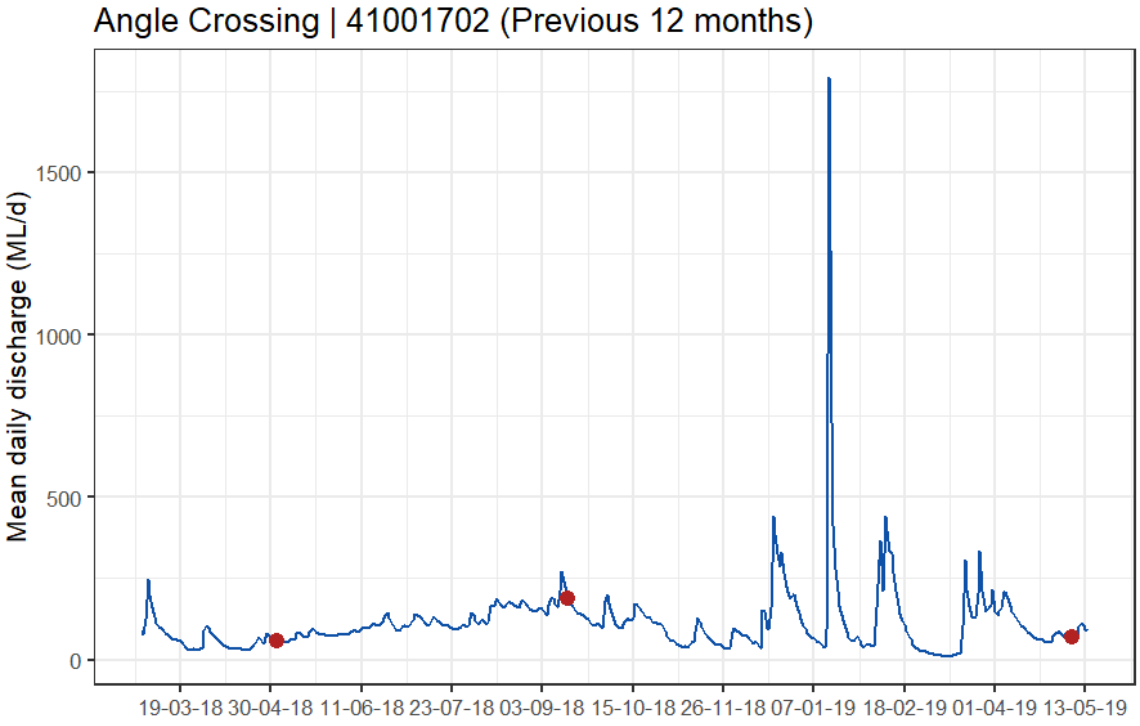

Figure 6. Hydrograph for the Murrumbidgee River Upstream of Angle Crossing (41001702) for the past 12 months

Plate 2-4 Photos of the Murrumbidgee River sampling sites

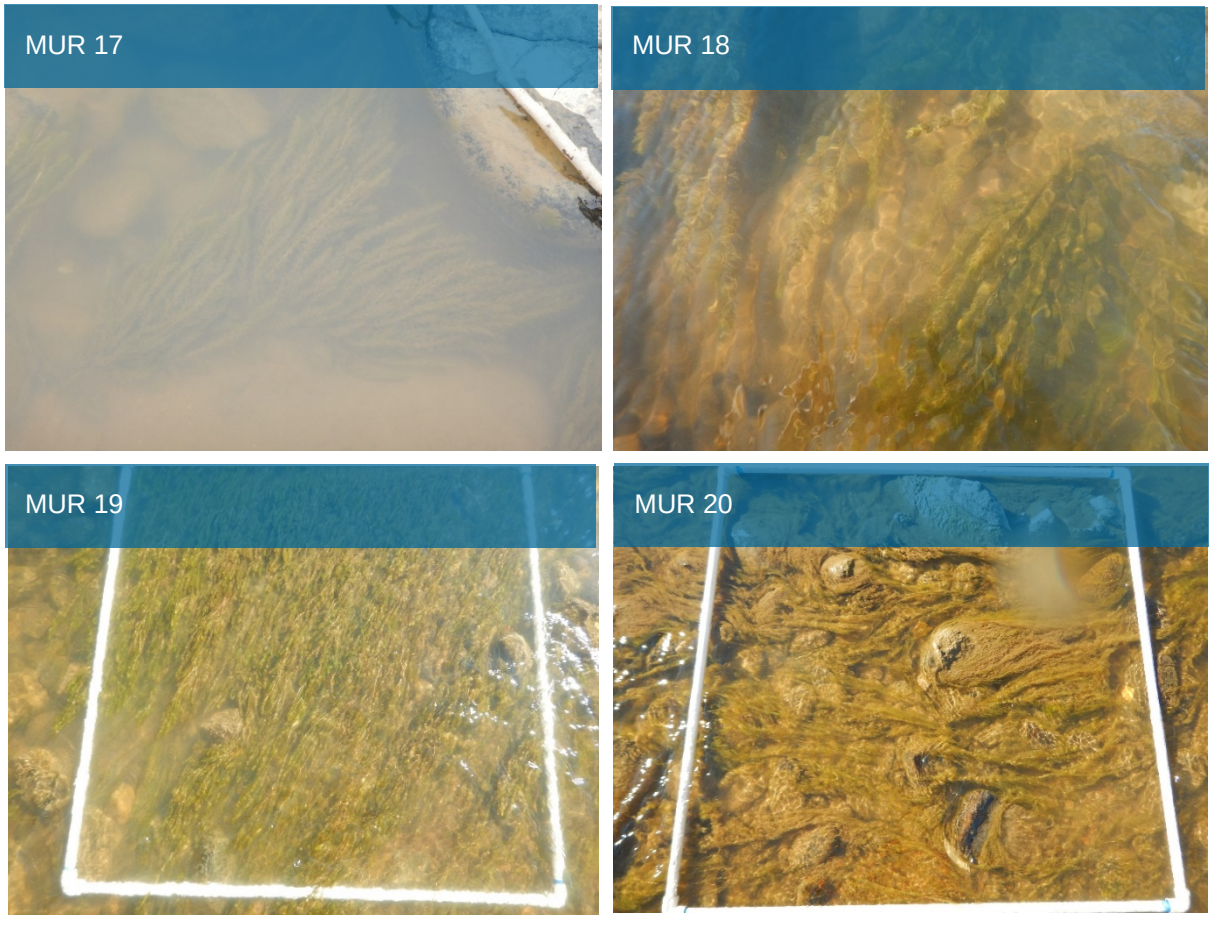

Plate 2-5 Photos of quadrat surveys in the Murrumbidgee River

3. Summary

The objectives of the impact monitoring are to "*demonstrate whether current operational mitigation rules are effective in not degrading river health".* To this end hypotheses have been developed and will be tested using this modified monitoring program design. These hypotheses are:

H_{o1}: (Murrumbidgee River): *Flow abstraction will not result in the deterioration of the macroinvertebrate community at sites downstream of the abstraction point at Angle Crossing relative to sites upstream.*

H_{o2} (**Burra Creek**): *Flow abstraction will not result in the deterioration of the macroinvertebrate community at sites downstream of the inflow point relative to sites upstream.*

As there is not a set date for the "operation" of M2G, it has been agreed to provide a technical report at the conclusion of the next round of sampling, which is likely to be spring 2019, where these hypotheses will be addressed using biological data and suitable metrics.

Despite the low flows prevailing in both systems, there is nothing unusual in the condition of the sites or water quality relative to what has been seen under similar conditions. Importantly, there were no obvious differences in the water quality, substrate composition or flows between upstream and downstream locations during this initial round of impact monitoring, noting that M2G has not been operated in this period.

3.1 Monitoring sites

The monitoring sites for this survey were selected based on aerial photography and on ground surveys. The Murrumbidgee River and Burra Creek have both provided challenges in terms of site selection due to access and finding sites in close enough proximity to the inflow and abstraction points to provide a meaningful ecological assessment of potential point source impacts.

The sites included in this assessment are considered to be suitable to address the hypotheses stated above, but with the following acknowledgements:

- BUR 1b is located approximately 4 km upstream of the discharge weir. It is potentially too far upstream to provide meaningful replication to the study design. Once the macroinvertebrate data has been received from the laboratory and assessed, the suitability of this will be made and recommendations communicated to Icon Water as soon as possible;
- MUR 17 and MUR 20 are new sites to the Angle Crossing Component. At low flows bedrock dominated riffles provide adequate habitat for sampling. However, it is unclear if they can be sampled under higher flow conditions (i.e. spring). This will be continually assessed and any difficulties will be reported back to Icon Water as soon as possible.

4. References

ANZECC & ARMCANZ (2000) National water quality management strategy: Paper No. 4. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volume 1. The Guidelines. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

Jacobs (2014) Review of the Murrumbidgee Environmental Monitoring Program. Report to ACTEW Water. VW07641.

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		Name	Signature	Name	Signature	Date
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