Icon Water Limited

Murrumbidgee Ecological Monitoring Program
Observation Report – Spring 2020
Impact Monitoring Round 4

December 2020

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1. Introduction

1.1 Background

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) and Murrumbidgee Pump Station (MPS) projects and allowed Icon Water to collect pre-abstraction baseline data. This baseline data can be used in comparisons against post-abstraction data to investigate any changes to ecological communities due to the operation of M2G and MPS. The monitoring of several components of the aquatic ecosystem has generally occurred in autumn and spring each year since 2008 through to the most recent monitoring in spring 2020.

1.2 Adaptive management: changes to the MEMP

Over the duration of the monitoring program there have been a number of changes and modifications in line with the adaptive management philosophy of the MEMP. During 2014, Icon Water commissioned a full independent review of the MEMP (see Jacobs 2014). The review resulted in a number of recommendations to modify the program so Icon Water 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. Modifications included changes to the monitoring frequency, the quantity and location of monitoring sites, and a rationalisation of macroinvertebrate and periphyton monitoring methods.

Three modes of operation were defined for the M2G and MPS to help target the monitoring program. These are defined for the M2G as:

- Suspension: parts of the system may be decommissioned requiring lead time before start up. No water can be transferred.
- Standby: ready to run, all components in place and being operated routinely for maintenance purposes.
- Operating: operating and transferring to increase Googong reservoir storage levels.

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/day 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/day 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 Gravity Main.

During periods of standby, the risk from the operation of M2G and MPS 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 adopts 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.

1.2.1 Sentinel monitoring

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 maintenance 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 (one upstream and one 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

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 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 autumn and spring impact monitoring must also be carried out, and should pumping occur across an autumn and/or spring period, sampling will be carried out during those times.

1.3 Recent operation and MEMP program

A summary of the modes of operation for the M2G component of the MEMP are included in Table 1-1. The decision to transition to operation mode in July 2019 initially triggered impact monitoring in autumn and spring 2019 to enable the collection of data prior to the commencement of pumping. The impact monitoring continued in autumn 2020 during the transfer of 4.51 GL to Googong Reservoir. Data was collected as part of the impact monitoring in spring 2020 post pumping cessation in August 2019 and is planned to also occur in autumn 2021.

Table 1-1 M2G modes of operation

Date	M2G Mode	MEMP monitoring
2012 to July 2019	'Standby' mode - regular *Operate to Maintain* runs	Sentinel monitoring spring and autumn every three years Anticipated move to 'Operation' mode in 2019 resulted in Impact monitoring beginning autumn 2019
July 2019	Icon Water decides to move to 'Operational' mode	
July 2019 to August 2020	'Operational' mode but no operational pumping - regular *Operate to Maintain* runs	Impact monitoring spring 2019
February 2020 to August 2020	'Operational' mode - 4.51 GL of water transferred to Googong Reservoir	Impact monitoring autumn 2020
September 2020	Icon Water makes decides to move to 'Standby' mode	
September 2020 to current	'Standby' mode - regular Operate to Maintain runs	Impact monitoring spring 2020 and autumn 2021; then revert to Sentinel monitoring in spring and autumn every three years

1.4 Purpose

The purpose of this report is to:

a. Provide a summary of the monitoring conditions in Burra Creek and Murrumbidgee River during the spring 2020 impact assessment monitoring.

b. Provide an early communication of any potential concerns to Icon Water prior to the completion of the full technical report.

A full technical report covering the findings of the autumn and spring 2020 is in preparation. This report will consolidate results and provide recommendations for future monitoring with consideration given to the historical dataset from sentinel monitoring (2015 to 2018) and pre-operational impact monitoring (autumn and spring 2019).

2. Summary of spring 2020 impact monitoring

Spring impact monitoring was conducted from 25 to 28 November 2020. Over the four days, the weather conditions were variable, with maximum temperatures ranging from 26 to 35°C and 3.4 mm of rainfall on 29 November (Canberra Airport Weather Station: 070351; BoM, 2020).

2.1 MEMP sites and monitoring summary

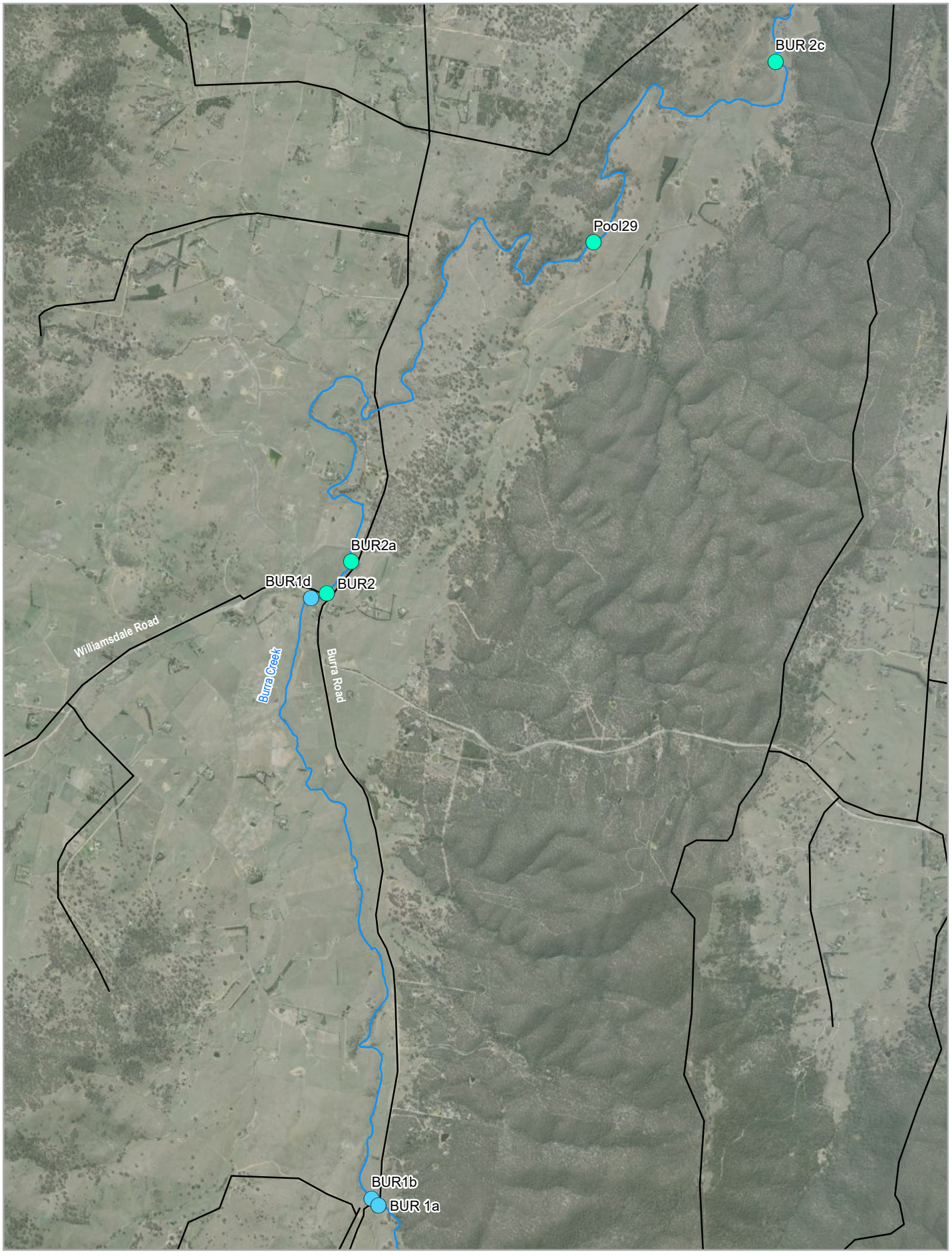
The location of monitoring sites is based on the MEMP review recommendations (see Jacobs, 2014). Details of the site locations are included in Table 2-1 and locations on Burra Creek are shown in Figure 2-1, on the Murrumbidgee River related to the M2G in Figure 2-2 and the MPS in Figure 2-3.

Monitoring during spring 2020 involved the collection of macroinvertebrate samples, *in situ* water quality monitoring, water quality grab samples, estimates of the periphyton coverage in the benthic environment and photogrammetry of vegetation and geomorphological features. A summary of the sampling conducted in spring 2020 is shown in Table 2-1. It should be noted that edge samples were collected from Burra Creek due to low flows and a lack of riffle habitat.

Table 2-1 MEMP sites and monitoring summary

Site	Location	Latitude	Longitude	Macroinvertebrates	Water quality[1]	Periphyton[2]	Geomorphology[3]	Riparian vegetation[4]
Burra Creek (M2G)								
BUR 1b	~ 4 km upstream of Williamsdale Rd bridge	-35.597536	149.227023	2 edge	✓			
BUR 1d	~ 50 m upstream of Williamsdale Rd bridge	-35.555963	149.222150	2 edge	✓			
BUR 2	~ 100 m downstream of Williamsdale Rd bridge	-35.555531	149.223118	2 edge	✓		✓	✓
BUR 2a	~ 400 m downstream of Williamsdale Rd bridge	-35.553320	149.225228	2 edge	✓	✓	✓	
BUR 1a	~ 30 m upstream Burra Road	-35.597819	149.227547				✓	
BUR 2c	~ 200 m downstream London Bridge Arch	-35.518833	149.261250				✓	✓
Pool 29	~ 1.5 km downstream London Bridge Arch	-35.531316	149.245800				✓	✓
Murrumbidgee River (M2G)								
MUR 17	~950 m upstream of Angle Crossing	-35.586453	149.112817	2 riffle	✓	✓		
MUR 18	~600 m upstream of Angle Crossing	-35.587394	149.110067	2 riffle	✓	✓		
MUR 19	Immediately downstream of Angle Crossing	-35.582850	149.109812	2 riffle	✓	✓	✓	
MUR 20	~400 m downstream of Angle Crossing	-35.580979	149.111303	2 riffle	✓	✓		
Murrumbidgee River (MPS)								
MUR 28 up	~300 m upstream of MPS	-35.324699	148.950417	2 riffle	✓	✓		
MUR 28 down	~150 m upstream of MPS	-35.323770	148.950129	2 riffle	✓	✓		
MUR 935	~350 m downstream of MPS	-35.319633	148.951397	2 riffle	✓	✓		
MUR 936	~1200 m downstream of MPS	-35.317535	148.961213	2 riffle	✓	✓		

[1] Water quality included *in situ* recordings of temperature, dissolved oxygen, pH, electrical conductivity, pH, turbidity and alkalinity and water samples submitted to ALS for analysis of total nitrogen, total phosphorus and ammonia
[2] Periphyton included representative photos and qualitative estimates
[3] Geomorphology included photographs from designated points
[4] Riparian vegetation included photographs from designated points



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Kilometers

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

N

GHD

Icon Water
Murrumbidgee Ecological Monitoring Program

Murrumbidgee to Gogong Impact Monitoring Sites

Project No. **2316216**
Revision No. **2**
Date **24/07/2020**

FIGURE 2-1

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Kilometers

Map Projection: Mercator Auxiliary Sphere
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Icon Water
Murrumbidgee Ecological Monitoring Program

Murrumbidgee to Googong Impact Monitoring Sites

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

FIGURE 2-2

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Print date: 15 May 2019 - 12:23

Data source: . Created by: pjtaylor

MUR936

Murrumbidgee River

MUR935

MPS

MUR28down

MUR28up

Cotter River

Paper Size ISO A4

0 0.07 0.14 0.21 0.28

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

Murrumbidgee Pump Station Impact Monitoring Sites

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

FIGURE 2-3

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2.2 Burra Creek

There was no water being discharged from M2G into Burra Creek at the time of monitoring in spring 2020. During monitoring in spring 2020, mean daily flow in Burra Creek measured at Burra Weir gauging station (410774) was 4.75 ML/day (Figure 2-4). This represents a significant increase compared to the spring 2019 monitoring (0.39 ML/day), as well as the autumn 2019 and 2020 monitoring (0.75 and 1.81 ML/day respectively).

The increase in flow is likely due to increased rainfall. Total rainfall during November 2020 was 96.4 mm that exceeded the historical mean of 75.1 mm (BoM Station 70339 at Tuggeranong). Prior to the spring monitoring on 25 November, daily rainfall was 34.0 and 8.2 mm on the 23 and 24 November respectively.

The channel contained dense beds of aquatic macrophytes in the form of reeds (*Typha* spp. and *Phragmites australis*), and sedges (Great Bulrush - *Schoenoplectus validus*). There was no riffle habitat at any of the monitoring sites on Burra Creek during monitoring. There was no noticeable increase in algae growth or periphyton cover in Burra Creek (Plate 2-2).

The *in situ* water quality during spring 2020 was comparable to previous years. However, there was slightly higher temperature and dissolved oxygen compared to spring 2019. Furthermore, there were no obvious differences in the *in situ* water quality upstream and downstream of the discharge point. Turbidity and pH complied with the ANZG (2018) guidelines at all sites while there were some exceedances of electrical conductivity at some sites. Dissolved oxygen was lower than the guidelines at all sites.

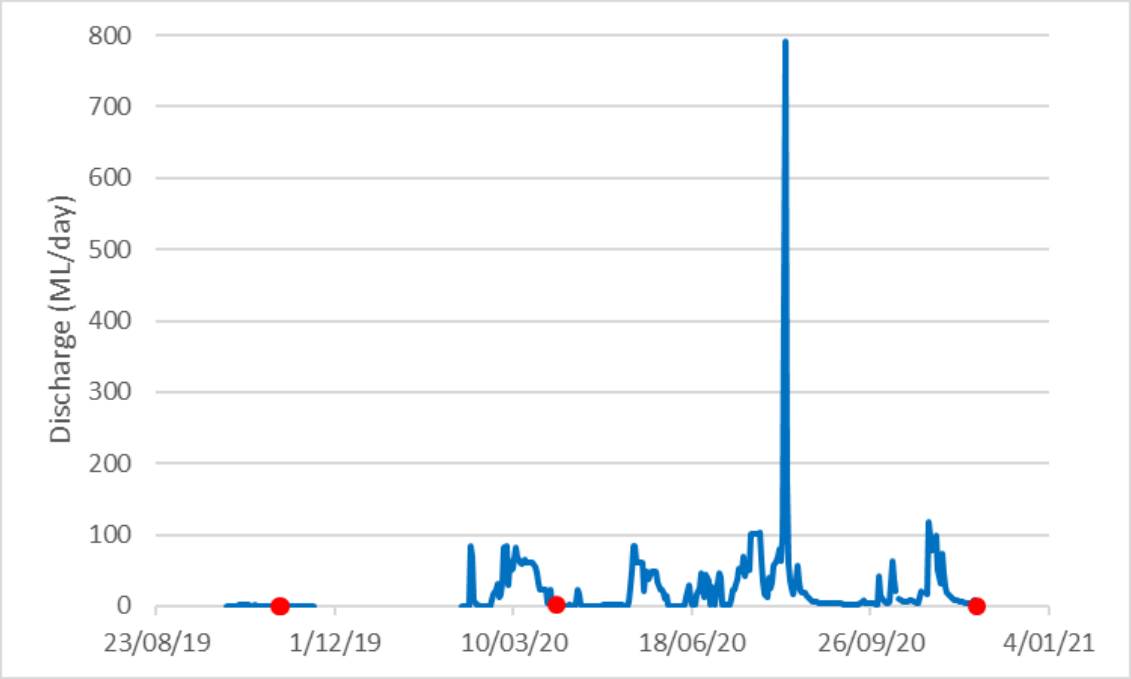

Figure 2-4 Hydrograph for Burra Creek at the Burra Weir (410774) for the past 12 months. Red dots indicate monitoring periods

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

Site	Date	Time	Location	Temp. (°C)	EC (µS/cm)	pH	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Turbidity (NTU)	Alkalinity (mg/l)
BUR 1b	25/11/20	1400	Upstream	28.7	155	7.7	5.2	74.4	7	120
BUR 1d	25/11/20	1000	Upstream	24.1	369	7.3	5.5	71.3	9	180
BUR 2	25/11/20	1030	Downstream	25.2	368	7.5	6.2	82.7	6	180
BUR 2a	25/11/20	1230	Downstream	24.9	369	7.6	6.2	81.9	11	180
ANZG (2018) Guideline					30-350	6.5-8.0		90-110	2-25	

Plate 2-1 Photos of the Burra Creek monitoring sites

Plate 2-2 Photos of quadrat surveys in Burra Creek at Site 2a showing composition of the substrate

2.3 Murrumbidgee River (M2G)

There was no water being abstracted from the Murrumbidgee River by the M2G at the time of monitoring in spring 2020. During monitoring in spring 2020, mean daily flow in the Murrumbidgee River measured at the gauging station upstream of Angle Crossing (41001702) was 512.1 ML/day (Figure 2-5). This represents a significant increase compared to the spring 2019 monitoring (22.6 ML/day), as well as the autumn 2020 monitoring (48.3 ML/day). As for Burra Creek, the increase in flow is likely due to increased rainfall.

As per the requirements of the impact monitoring, two replicate riffle samples were collected from each site. There was no noticeable increase in algae growth or periphyton cover in the Murrumbidgee River.

In situ water quality in the Murrumbidgee River were mostly within the ANZG (2018) guidelines (Table 2-3), except for turbidity at MUR20. Compared to previous monitoring data, the *in situ* water quality was within the range observed in previous monitoring periods. There were no notable differences in water quality parameters between upstream and downstream sites.

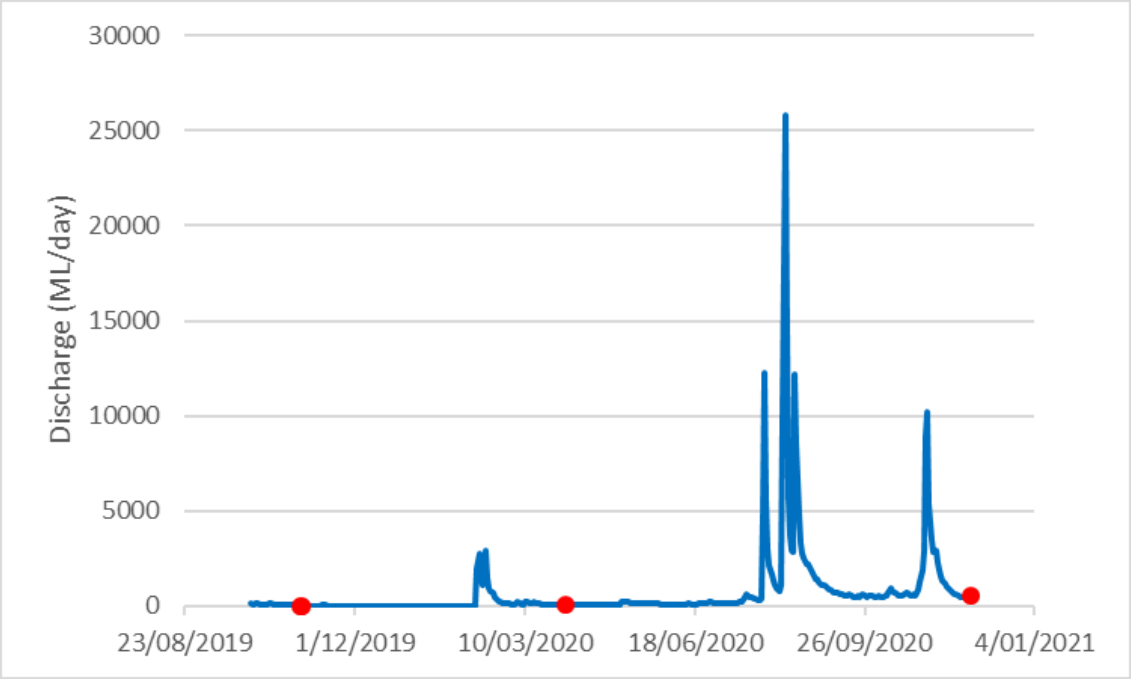

Figure 2-5 Hydrograph for the Murrumbidgee River Upstream of Angle Crossing (41001702) for the past 12 months. Red dots indicate monitoring periods

Table 2-3 *In-situ* water quality parameters in the Murrumbidgee River (M2G)

Site	Date	Time	Location	Temp. (°C)	EC (µS/cm)	pH	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Turbidity (NTU)	Alkalinity (mg/L)
MUR17	27/11/2020	1300	Upstream	24.2	107	7.6	7.4	95.1	18	50
MUR18	27/11/2020	1030	Upstream	22.8	107	6.9	7.4	92.5	12	50
MUR19	27/11/2020	1430	Downstream	27.9	111	7.5	7.2	98.8	24	45
MUR20	27/11/2020	1530	Downstream	26.6	109	7.4	7.4	99.5	29	45
ANZG (2018) Guidelines					30-350	6.5-8.0		90-110	2-25	

Plate 2-3 Photos of the Murrumbidgee River (M2G) sampling sites

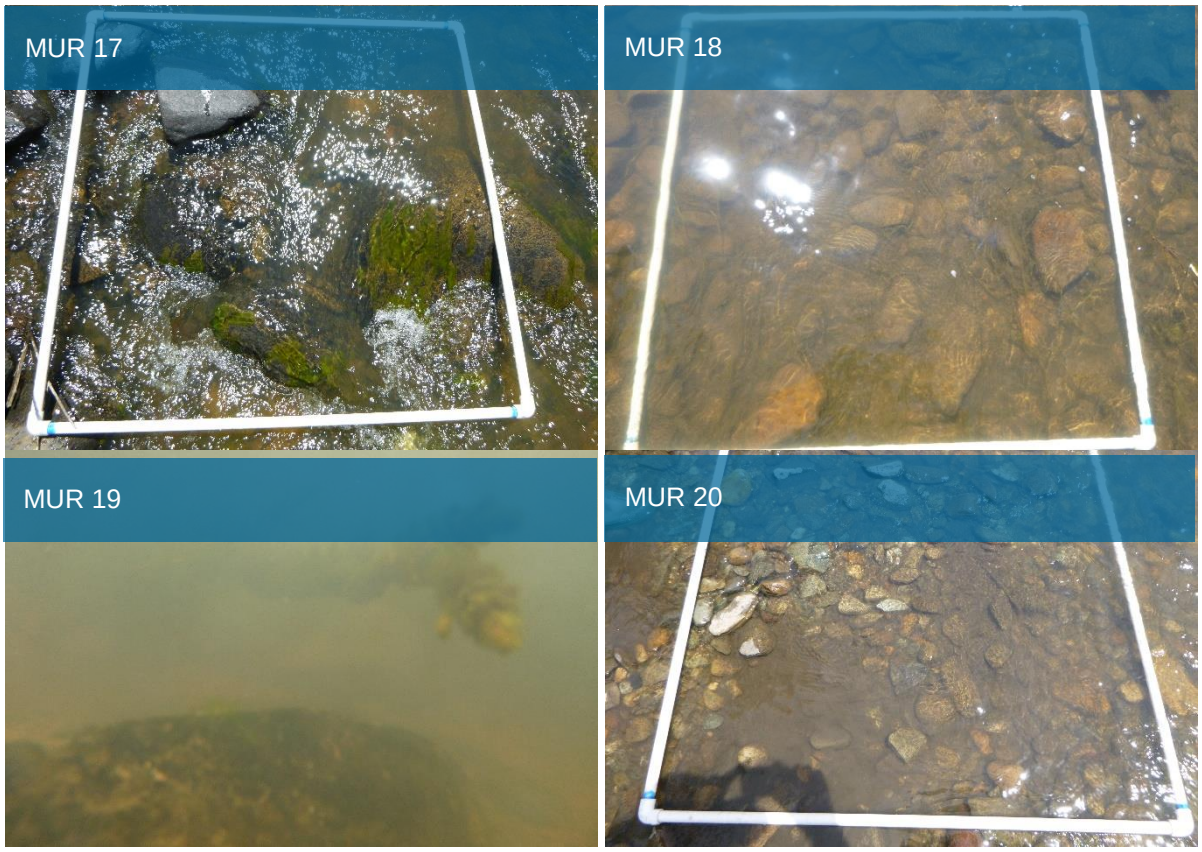

Plate 2-4 Photos of quadrat surveys in the Murrumbidgee River (M2G)

2.4 Murrumbidgee River (MPS)

During monitoring, mean daily flow in the Murrumbidgee River measured at the gauging station below Lobbs Hole Creek (410761) was 393.3 ML/day (Figure 2-6). This represents a significant increase compared to the spring 2019 monitoring (21.2 ML/day), as well as the autumn 2020 monitoring (55.0 ML/day). As for Burra Creek, the increase in flow is likely due to increased rainfall.

As per the requirements of the impact monitoring, two replicate riffle samples were collected from each site. There was no noticeable increase in algae growth or periphyton cover in the Murrumbidgee River.

In situ water quality in the Murrumbidgee River were mostly within the ANZG (2018) guidelines (Table 2-3), except for turbidity at MUR20. Compared to previous monitoring data, the *in situ* water quality was within the range observed in previous monitoring periods. There were no notable differences in water quality parameters between upstream and downstream sites.

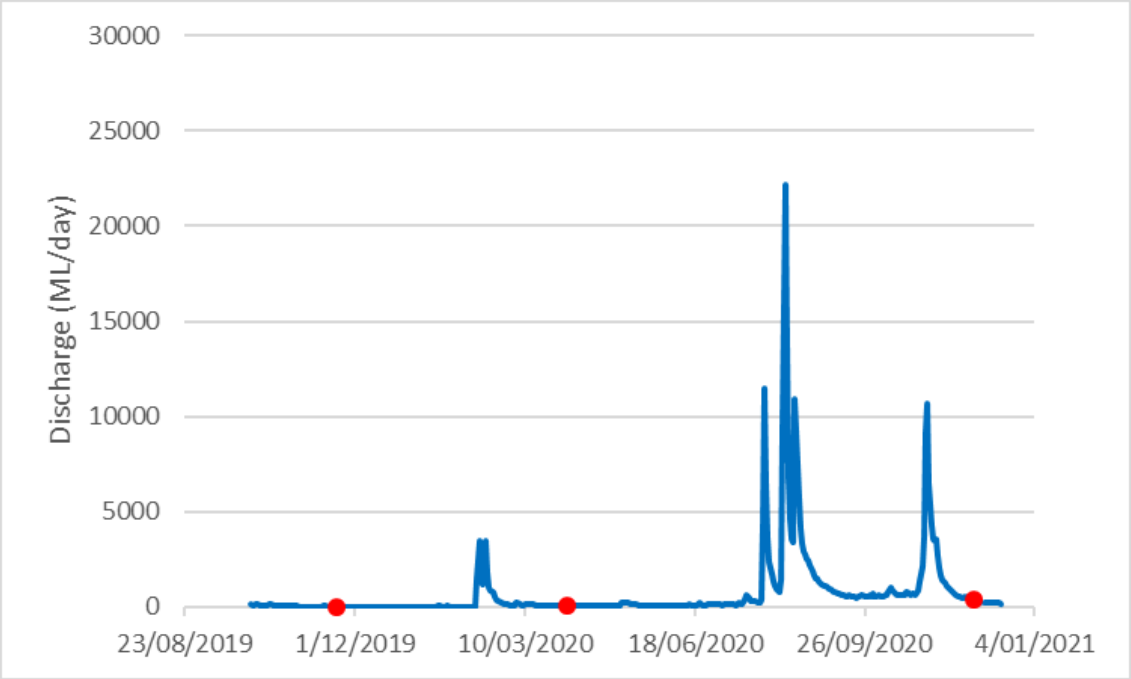

Figure 2-6 Hydrograph for the Murrumbidgee River below of Lobbs Hole Creek (410761) for the past 12 months. Red dots indicate monitoring periods

Table 2-4 *In-situ* water quality parameters in the Murrumbidgee River (MPS)

Site	Date	Time	Location	Temp. (°C)	EC (µS/cm)	pH	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Turbidity (NTU)	Alkalinity (mg/L)
MUR28up	28/11/2020	1030	Upstream	25.5	125	7.2	7.3	94.7	7	55
MUR28down	28/11/2020	1230	Upstream	24.7	57	7.2	7.3	93.5	3	30
MUR935	29/11/2020	1030	Downstream	25.3	125	7.4	6.8	89.0	5	50
MUR936	29/11/2020	1300	Downstream	25.1	94	7.6	7.5	97.1	8	45
ANZG (2018) Guidelines					30-350	6.5-8.0		90-110	2-25	

Plate 2-5 Photos of the Murrumbidgee River (MPS) sampling sites

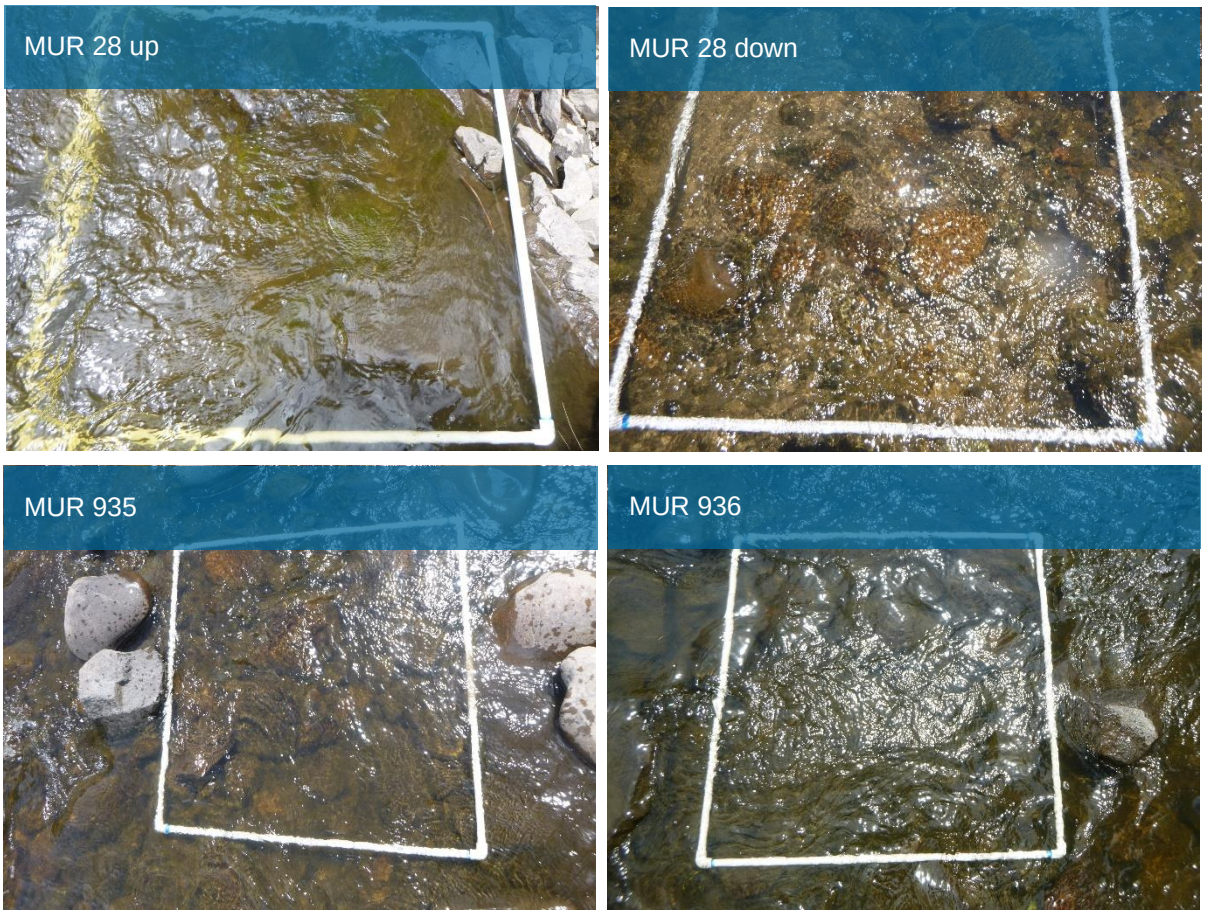

Plate 2-6 Photos of quadrat surveys in the Murrumbidgee River (MPS)

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:

H1a. *Flow abstraction will not result in the deterioration of the macroinvertebrate community (measured using biological indices) at sites downstream of the abstraction point (Angle Crossing for M2G and downstream of MPS) relative to sites upstream, informed by prevailing conditions in the broader region*

H1b: *Flow discharge to Burra Creek will not result in the deterioration of the macroinvertebrate community (measured using biological indices) at sites downstream of the inflow relative to sites upstream of the abstraction point, and informed by prevailing conditions in the broader region.*

H2a: *Flow abstraction in the Murrumbidgee River will not result in the development of increased periphyton to the extent that it impacts on the quality of the riffle habitat at sites downstream of the abstraction point (Angle Crossing for M2G and downstream of MPS) compared to sites upstream of the abstraction point, and informed by prevailing conditions in the broader region*

H2b: *Flow discharge into Burra Creek will not result in the development of increased periphyton to the extent that it impacts on the quality of the riffle habitat at sites downstream of the abstraction point (Angle Crossing) compared to sites upstream of the abstraction point, and informed by prevailing conditions in the broader region.*

H3a: *Flow transfer to Burra Creek will not result in bank erosion that is beyond that currently occurring in response to natural high flow events.*

H3b: *Flow discharge to Burra Creek will not result in changes in macrophyte or riparian vegetation that is beyond that currently occurring in response to natural high flow events.*

The operation of M2G and MPS triggers impact monitoring in which GHD will provide an impact report following the spring (2020) monitoring period, where these hypotheses will be addressed using biological data and suitable metrics. Of note, this period of monitoring represents the second operational condition, so the focus will be on describing and comparing the condition to baseline data (autumn/spring 2019). The impact report will analyse and present the results of AUSRIVAS and other biological indices, including periphyton and water quality.

3.1 Overview of observed condition

In most aspects of river condition observed, the physical and ecological condition of the sites observed in autumn 2020 was similar to previous monitoring events. Importantly, there were no obvious differences in the water quality, substrate composition or flows between upstream and downstream locations during this round of impact monitoring, noting that water was not observed to be flowing from the discharge point at the time of monitoring.

3.2 Potential concerns for Icon Water

The results from the spring 2020 monitoring and preliminary comparisons to previous sampling events suggests the following:

- There were no notable impacts observed during the spring 2020 field sampling, which suggested that there were no major impacts from M2G or MPS operation.
- The field assessment found no obvious bank instability or erosion in Burra Creek associated with the M2G or MPS operation beyond which was observed prior to operation. However, further assessment will be made in the subsequent technical report.

- There were no obvious impacts on riparian or instream vegetation in Burra Creek associated with the M2G or MPS operation.
- There were no major impacts on waterway condition or periphyton in riffle habitat in the Murrumbidgee River associated with the M2G or MPS operation.
- Preliminary analysis of *in situ* water quality reveals only minor differences from previous monitoring results, apart from the water clarity and siltation attributable to bushfire runoff noted previously.

4. References

ANZG. (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

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

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Document Status

Revision	Author	Reviewer		Approved for Issue		
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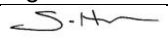
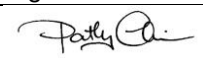
0	A Edmond P Lind	S Harrow		P Chier		18/12/2020

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