# M2G Operational Environmental Management Plan (OEMP)

## EN03.01.10

Version 7,  8 December 2021

# Document management

**Document summary**

| | |
|---|---|
| **Title** | M2G Operational Environmental Management Plan (OEMP) |
| **Version** | 7 |
| **Document status** | Draft for regulatory approval |
| **Date of issue** | 8 December 2021 |

**Document development**

| | Name | Position | Date |
|---|---|---|---|
| Prepared by | Michael Harrison | Senior Aquatic Monitoring Officer | 25/01/2021 |
| Reviewed by | Brent Johnson | Senior Land and Bushfire Works Officer | 28/01/2021 |
| | Tim Chaseling | Team Leader Catchment Protection and Land Management | 29/03/2021 |
| | Kyleigh Victory | Senior Process Engineer | 29/03/2021 |
| | Kimberly Lawson | Team Leader Network Operations | 29/03/2021 |
| | Owen Gould | Team Leader Analytical Services | 7/04/2021 |
| | Lara Odell | Team Leader Compliance and Process Operations | 29/03/2021 |
| Endorsed by | Benjamin Bryant | Manager Environment and Sustainability | 22/04/2021 |
| | Cameron Patrick | Manager Operations Services | 22/04/2021 |

**Version control**

| Version | Description | Date |
|---|---|---|
| 1 | Initial version approved by regulators | 03/05/2012 |
| 2 | Revision to reflect new ACTEW Water corporate governance arrangements and Feb 2013 audit findings/recommendations | 28/01/2014 |
| 3 | Update to identify changes to AEMP and SFWQMP | 29/04/2015 |
| 4 | Update to new Icon Water entity and review findings/recommendations | 15/07/2015 |
| 5 | Update following scheduled review of the document. No changes are requiring regulatory approvals. | 01/05/2019 |
| 6 | Consolidation of existing OEMP and sub-plans into single OEMP and Integrated Management System following extended operation and independent audit | 17/06/2021 |

# Contents

**List of Tables and Figures** ..... **5**

**List of Abbreviations** ..... **6**

**Register of changes to the previous version** ..... **7**

**1. Introduction** ..... **8**

1.1. M2G Overview ..... 8

1.2. Statutory context ..... 8

1.3. OEMP structure ..... 8

**2. Site location** ..... **10**

2.1. Location of M2G pipeline and key features ..... 10

2.2. Site Occupancy ..... 10

**3. Activity description and key characteristics** ..... **11**

3.1. M2G Modes ..... 11

3.2. Performance objectives ..... 11

3.3. Adaptive Management ..... 12

3.4. Environmental Monitoring ..... 12

3.4.1. Aquatic ecology ..... 12

3.4.2. Streamflow and water quality ..... 14

**4. Operating Procedures** ..... **15**

**5. Community and stakeholder engagement** ..... **17**

**6. Auditing and Reporting** ..... **18**

**Appendix A - Site Map** ..... **19**

**Appendix B - Aquatic ecology monitoring tools** ..... **20**

**Appendix C - Streamflow and water quality tools** ..... **26**

# List of Tables and Figures

Table 1. Register of changes to previous OEMP version ..... 7
Table 2. Document structure ..... 9
Table 3. Key features of the scheme (see Appendix A for locations). ..... 10
Table 4. Environmental objectives and targets ..... 11
Table 5. Aquatic monitoring content (see Appendix B for datasets) ..... 12
Table 6. Streamflow and water quality content (see Appendix C for datasets) ..... 14
Table 7. Operational checks for pre-start-up, water transfer, and step up and step down. ..... 15
Table 8. Step-up and step down operating procedures ..... 16
Table 9. Community and stakeholder engagement relations network ..... 17
Table 10. Reporting and auditing requirements for the scheme. ..... 18
Table 11. Environmental risk hypotheses ..... 20
Table 12. Risk levels for each monitoring schedule ..... 20
Table 13 Potential environmental risks arising from M2G operations phases ..... 21
Table 14. Environmental Monitoring Parameters ..... 22
Table 15. Standby and operating monitoring scenarios ..... 23
Table 16. Triggers for reactive programs ..... 24
Table 17. Murrumbidgee and Burra Creek AUSRIVERS riffle and edge assessments ..... 25
Table 18. Environmental considerations for streamflow and water quality ..... 26
Table 19. Baseflow protection for Murrumbidgee and Burra creek ..... 27
Table 20. Burra Creek water quality target, action, and critical values ..... 28
Table 21. Limits of operation actions ..... 28

Figure 1. Concept design of M2G monitoring sites ..... 13
Figure 2. M2G Pipeline location of key characteristics ..... 19

Map 1. Murrumbidgee monitoring sites ..... **Error! Bookmark not defined.**
Map 2. Burra Creek monitoring sites ..... **Error! Bookmark not defined.**

# List of Abbreviations

| | |
|---|---|
| **ACT** | Australian Capital Territory |
| **ACTPLA** | ACT Planning & Land Authority |
| **ANZECC** | Australian and New Zealand Conservation Council |
| **Common EMP** | Common Environmental Management Plan |
| **DP&E** | NSW Department of Planning, industry & Environment |
| **DEP** | NSW Department of Environment and Planning |
| **EIS** | Environmental Impact Statement |
| **EMS** | Environmental Management System |
| **EPA** | Environment Protection Authority |
| **EPBC Act** | Environment Protection and Biodiversity Act 1999 (Commonwealth) |
| **ER** | Environmental Representative |
| **ERG** | Environmental Reference Group |
| **EPSDD** | Environment, Planning and Sustainable Development Directorate |
| **HLPS** | High Lift Pump Station |
| **INP** | NSW Industrial Noise Policy |
| **IMS** | Integrated Management System |
| **LLPS** | Low Lift Pump Station |
| **M2G** | Murrumbidgee to Googong Water Transfer |
| **NSW** | New South Wales |
| **OEH** | NSW Office of Environment & Heritage |
| **OEMP** | Operation Environmental Management Plan |
| **PER** | Public Environment Report |
| **PIP** | Property Interaction Plan |
| **SCADA** | Supervisory Control and Data Acquisition System |

# Register of changes to the previous version

**Table 1. Register of changes to previous OEMP version**

| Subject | | Description of change/addition |
|---|---|---|
| **1.** | **General** | • Information streamlined to reflect Icon Water's Integrated Management System and Common EMP approach to simplify management.<br>• Government entity names updated.<br>• Operational tools distributed across three appendices.<br>• Murrumbidgee base flows changed to represent Icon Water's Licence to Take Water (WU67).<br>• An essential maintenance protection flow identified. |
| **2.** | **OEMP sub-plans** | • Streamflow and Water Quality Management Plan and Aquatic Ecology Monitoring Plan incorporated into OEMP<br>• The Landscape Rehabilitation and Terrestrial Ecology Management Plan (sub plan) has been completed<br>• Offsets Delivery Plan remains as sub-plan document. |
| **3.** | **Existing systems and functions** | • Frameworks changed to correspond to objectives<br>• Risk frameworks categorised into adaptive management. |
| **4.** | **Governance** | • Reference 'Governance' has been included as a link only and captured in the Common EMP<br>• A chapter on community engagement was revised to reflect lessons from the recent operational phase |
| **5.** | **Audit and review** | • Application of standard utility complaints handling arrangements.<br>• Independent audit extended to 10-year intervals.<br>• No requirement for ERG. |
| **6.** | **Icon Water Environmental Policy** | • Icon Water Sustainability and Environment Policy was updated to reflect the latest version, which is publicly available on our website. |

# 1. Introduction

## 1.1. M2G Overview

The Murrumbidgee to Googong (M2G) Bulk Water Transfer pipeline (the 'scheme') is a major infrastructure project designed to support the security of water supply for Canberra and the nearby region.

The scheme involves pumping raw water from the Murrumbidgee River at Angle Crossing in the ACT and transferring it to Burra Creek (in NSW), where it flows to the Googong Reservoir. The scheme can transfer a nominal 100 ML of water per day. Extensive project and site information can be found in the Environmental Impact Statement (EIS) and Public Environment Report (PER) developed for the scheme available on the Icon Water website.

Icon Water has developed this M2G Operational Environmental Management Plan (OEMP) to be a tool for preparation and response, providing operators with a framework for identifying risks and mitigating environmental impacts. This document sits within the IMS and focuses on environmental controls. The Common Environmental Management Plan (Common EMP) should be referenced for overarching corporate governance arrangements and environmental aspects and impacts common to all EMP's.

## 1.2. Statutory context

Icon Water complies with all environmental legislation, standards, guidelines, and approvals relevant to the management of M2G operations and maintenance located in EMS Legal Register. This register supports compliance with broader environment and planning regulations, codes of practice, and emerging issues.

The M2G is regulated by and operated in compliance with development approvals granted by the Commonwealth, NSW, and ACT governments and the Licence to Take Water (WU67) under the *Water Resources Act 2007 (ACT)*. Planning approvals granted before the construction of the M2G include:

- NSW Department of Planning (now NSW Department of Planning and Environment) the scheme approved under Section 75J of the *Environmental Planning and Assessment Act 1979 (NSW)*, issued 31 March 2010 (Approval number MP08_0160)
- ACT Planning and Land Authority Development Application, May 2010 with approval under the *Planning and Development Act 2007 (ACT)*, issued August 2010 (Application 201017858).
- Commonwealth Department of Environment, Water, Heritage and Arts (now Department of Environment and Energy) approval under the *Environment Protection and Biodiversity Act 1999 (Cth)*, issued 29 October 2010 (EPBC 2009/5124).

Icon Water also complies with a comprehensive list of environmental legislation, standards, guidelines, and approvals specified in the Common EMP.

## 1.3. OEMP structure

In compliance with Commonwealth, ACT NSW development approvals and Environmental Impact Statements and Public Environment Report commitments, Icon Water has developed this OEMP, which includes the Murrumbidgee to Googong Water Transfer Offset Delivery Plan (OPD) as sub plan document. This ODP supports the M2G Operational Environmental Management Plan (OEMP) and has been designed to outline the actions required to deliver the environmental offset located on Tuggeranong Block 1675, ACT, established in 2011.

The structure and content of this OEMP comply with the ACT EPA's *Environmental Guidelines for Preparation of an Environment Management Plan* (2013) and captures the specified information requirements in the document as set out in Table 2.

**Table 2. Document structure**

| Section | Section description | Relevant tables & figures | Further information |
|---|---|---|---|
| **1** | **General information** | • Table 2. Document structure - Key features of the scheme | • Common EMP<br>• Appendix A - Site Map<br>• Offsets Delivery plan |
| **2** | **Activity description** | • Table 3. Key features of the scheme (see Appendix A for locations). Objectives and Targets<br>• Table 4. Environmental objectives and targets- Adaptive management<br>• Figure 1. Concept design of M2G monitoring sites | • Appendix B - Aquatic ecology monitoring tools<br>• Appendix C - Streamflow and water quality tools |
| **4** | **Operating Procedures** | • Table 7. Operational checks for pre-start-up, water transfer, and step up and step down.<br>• Table 8. Step-up and step-down operating procedures | • Appendix B – Aquatic Monitoring Tools<br>• Appendix C – Streamflow and water quality tools |
| **5** | **Community Engagement** | • Table 9. Community and stakeholder engagement relations network | • Common EMP |
| **6** | **Auditing and reporting** | • Table 10. Reporting and auditing requirements for the scheme. | • Common EMP |

# 2. Site location

## 2.1. Location of M2G pipeline and key features

The M2G pipeline crosses rural land in an east/northeast direction, generally located in the vicinity of Angle Crossing, Williamsdale and Burra Roads, within the districts of Williamsdale and Burra. The location of the pipeline is shown in Appendix A - Site Map.

The majority of the 12km M2G pipeline (approximately 9km) is located in NSW, with approximately 3km located in the ACT. The majority of the remaining ACT length is within an environmental offsets area managed by Icon Water. Most land within the easements is mainly cleared land and is actively managed for agricultural purposes.

The M2G pipeline traverses a highly altered landscape of largely cleared agricultural lands within both the ACT and NSW. Within NSW, the pipeline is contained in a combination of crown land and private land. The terrain is undulating to moderately steep, with elevations varying between approximately 590m (Murrumbidgee river) to 870m (Gibraltar Pass). When traversing private land, the pipeline is within easements which vary in width between 15m and 40m. The scheme has an expected design life of 80 years.

**Table 3. Key features of the scheme (see Appendix A for locations**).

| Infrastructure | Description |
|---|---|
| **Ancillary infrastructure** | Includes communications and power cabling, pressure gauges, fire hydrants, carbon dioxide dosing system and power supply facilities. |
| **Discharge structure** | A weir box arrangement located on the bank of Burra Creek where water flows into the weir box from the pipeline and discharges down the creek bank and flows to Googong Reservoir. |
| **Main pump station** | Pumps water through the pipeline to a high point in the Gibraltar Range. From there it runs under gravity to the discharge point. |
| **Mini-hydro and CO2 dosing structure** | Electricity provided by the grid is supplemented by electricity generated by a mini-hydro-electric power facility, constructed as part of the scheme near the outlet structure. The trend is for the system to recover to approximately 20%of the electricity required for pumping activities. A CO2 dosing system allows for pH management of water retained in the pipe for extended periods, which may become alkaline through interaction with the concrete lining of the pipe. |
| **Pipeline** | The pipeline is approximately 12 km long. Air valves and scour valves are located at regular intervals along the pipeline to provide pressure relief and to allow cleaning. |
| **River intake structure** | It consists of a concrete box structure built into the riverbank, including a screen, filtration to prevent fish egg transfer, and pumps and valves. |

## 2.2. Site Occupancy

M2G is designed to be remotely operated and may be utilised for extended periods depending on regional water security. Site attendance is only for routine maintenance, usually during daylight hours by a single operator or small work crew.

# 3. Activity description and key characteristics

## 3.1. M2G Modes

Depending on climatic conditions, rainfall, river flows, and water demand, the M2G can be in one of three modes:

| | |
|---|---|
| Suspension | No water can be transferred as system components may be decommissioned, requiring lead time before start-up. |
| Standby | All components are in place and operated routinely for maintenance purposes. |
| Operating | The operation may be for maintenance or water security purposes when in this mode. |

## 3.2. Performance objectives

Objectives for the performance of the scheme include minimising environmental impacts and maximising the operations. Table 4 documents the environmental objectives that are compulsory to operations.

**Table 4. Environmental objectives and targets**

| # | Objectives | Target |
|---|---|---|
| **1** | **Meet all environmental legislative requirements** | • Ensure Icon water policies, processes, and systems capture all environmental legislative requirements and compliance with all planning approvals.<br>• Maintain and periodically review OEMP.<br>• Report all environmental incidents to the relevant authorities. |
| **2** | **Minimise impacts on aquatic ecology** | • Establish aquatic ecology and water quality baseline data set before operation commences and compare with data after operations<br>• Take all reasonable measures to prevent fish impingement on intake screens at the Murrumbidgee River.<br>• Take all reasonable measures to prevent the translocation of alien fish species from the Murrumbidgee River to Burra Creek.<br>• Adhere to site-specific water quality trigger levels for Burra Creek per ANZECC Guidelines.<br>• Take all reasonable measures to prevent exceedance of site-specific impact thresholds for species in the Murrumbidgee River and Burra Creek. |
| **3** | **Minimise impacts on the waterway geomorphology** | • Continue monitoring programs for detecting bank erosion at Burra Creek Respond within reasonable timeframes with appropriate mitigation measures. |
| **4** | **Minimise impacts on heritage** | • Take all reasonable measures to prevent incidences of erosion that could impact Aboriginal heritage sites. |
| **5** | **Minimise noise and vibration impacts** | • Take all reasonable measures to address noise and vibration complaints associated with operation and maintenance activities. |

| | | |
|---|---|---|
| | | • Maintain noise levels in compliance with relevant legislation endorsed by the ACT and NSW criteria limits.<br>• Take all reasonable measures to prevent structural damage associated with vibration impacts. |
| **6** | **Minimise impact on air quality** | • Take all reasonable measures to prevent visible dust emissions and offensive odours during operation and maintenance. |
| **7** | **Minimise bushfire hazard and manage bushfire risk** | • Take all reasonable measures to prevent bushfires attributable to water transfer operations and maintenance. |

## 3.3. Adaptive Management

Icon Water is committed to continuous improvement of practices to maintain compliance. Existing business systems and functions are used for managing operational environmental management aspects as part of broader water and wastewater utility activities across the region. The most relevant of these are outlined in the Common EMP and delivered through our Integrated Management System (IMS) as the online controlled framework of policies, procedures, work instructions, forms, and enablers maintained consistent with safety, environment, and quality management systems.

## 3.4. Environmental Monitoring

Icon Water has developed a series of plans for environmental monitoring, systematic collection, and interpretation of data to assess performance and compliance with requirements. This section outlines the timing, frequency, methodology, location, and responsibilities for environmental monitoring programs.

All monitoring will be undertaken in accordance with accepted scientific methodology, independently reviewed periodically to ensure efficacy and relevance.

Monitoring is designed to be adaptive and results will be reviewed to identify any significant impacts to the Murrumbidgee River or Burra Creek. If changes are made to the identified risks and corresponding hypotheses, this will require approval from the relevant state and Commonwealth regulators prior to implementation.

### 3.4.1. Aquatic ecology

The aquatic monitoring supplies essential information to Icon Water regarding observed performance compared to environmental and operational standards. The aquatic monitoring objective is to detect whether or not risks are arising from the operation of the M2G and establish review procedures and management actions that should be initiated if triggers are exceeded. The M2G aquatic ecological monitoring tools are located in Appendix B.

**Table 5. Aquatic monitoring content (see Appendix B for datasets)**

| Table | Description | Further information |
|---|---|---|
| **11** | **Environmental risk hypotheses** | • To be tested using the parameters and methodology. |
| **12** | **Monitoring schedules** | • Risk levels were identified for each monitoring mode.<br>• Under a 'suspension' scenario, environmental risks are not listed as these were considered in the process and deemed as nil. |

| | | |
|---|---|---|
| **13** | **Environmental Risks for general monitoring** | • The risks were identified from both a pre-mitigation perspective and against the mitigated scenario.<br>• Under a 'suspension' scenario, environmental risks are not listed as these were considered in the process and deemed as nil.<br>• The risks were agreed upon by a range of Icon Water representatives and external stakeholders, including the Commonwealth Government, ACT Government, and research institutions, in response to the Commonwealth Conditions of Approval. |
| **14** | **Monitoring parameters** | • Sentinel and impact monitoring modes<br>• Includes all monitoring methods and sites to be collected for each parameter |
| **15** | **Monitoring scenarios** | • Sentinel and impact monitoring modes<br>• Examples of when monitoring is implemented across a seven-year period |
| **16** | **Triggers for reactive programs** | • Illustrates the response required should condition assessments show impact from M2G.<br>• The ACT AUSRIVAS assessment tables are used as guidelines to demonstrate river conditions.<br>• The trigger level shall be where there is an observed degraded AUSRIVAS band level downstream of the monitoring sites compared with the upstream sites.<br>• Should the cause be related to natural or upstream changes (unrelated to the M2G), then the monitoring shall continue or be adjusted to obtain better information to see if the results indicate a specific baseline condition change. |
| **17** | **AUSRIVAS assessment** | • The ACT AUSRIVAS assessment has produced condition assessments for various M2G locations upstream and downstream of infrastructure. |

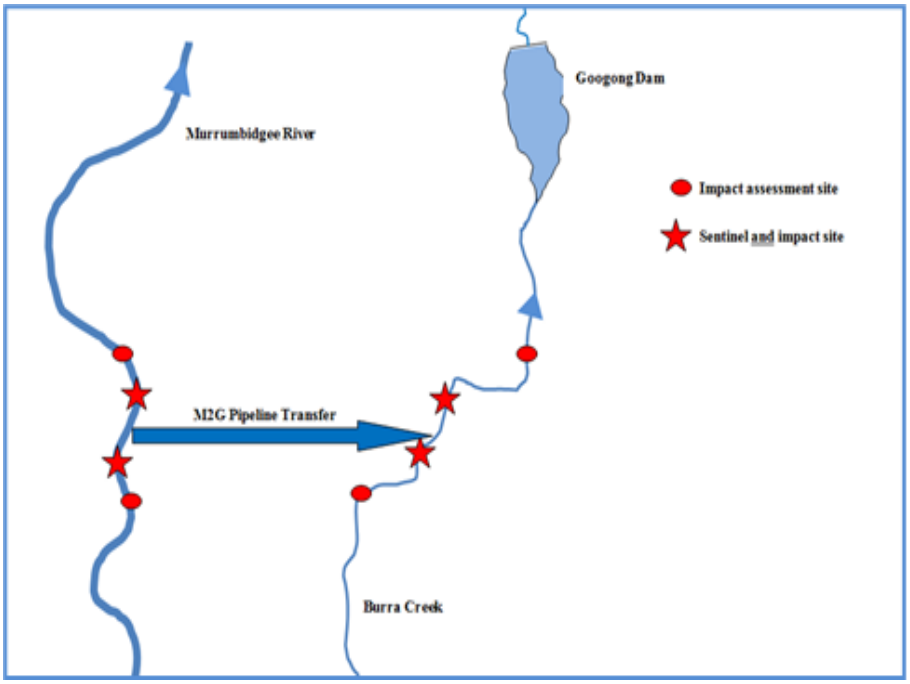



**Figure 1. Concept design of M2G monitoring sites**

### 3.4.2. Streamflow and water quality

Streamflow and water quality monitoring have been developed based on the best available information about native fish and environmental flow requirements as per the Sustainable Diversion Limit Plan 2010 (SDL, 2010) . Operational target values are set to protect the identified aquatic ecology values. Transfer pumping between catchments should not have an unacceptable impact on the extracting environment (Murrumbidgee River) and the receiving environment (Burra Creek).

Updates to the flow protection and water quality values are based on an analysis of the latest time-series data by an independent consultant and considering the environmental factors outlined in Table 19 and Table 20.

The M2G streamflow and water quality monitoring tools are located in Appendix B - Aquatic ecology monitoring tools and Appendix C - Streamflow and water quality tools.

Each tool is described below, including the considerations, base flow protections, target values, and response actions.

**Table 6. Streamflow and water quality content (see Appendix C for data sets)**

| Table | Description | Further information |
|---|---|---|
| **18** | **Environmental factors and considerations** | • The considerations are to be incorporated into the parameters and general methods. |
| **19** | **Baseflow protection** | • The protection of environmental flows in the Murrumbidgee River downstream of the abstraction point at Angle Crossing is a key governing factor around the operation of the M2G.<br>• Icon Water's Supervisory Control and Data Acquisition (SCADA) system is the primary operational control system for the scheme. The system includes alarms and automatic shut-off if the water transfer is not being operated under the environmental flow rules or other requirements.<br>• M2G uses the flow measurement stations and SCADA to provide reliable data to inform management and operational decisions |
| **20** | **Target, actions, and critical values** | • Data for water quality values can be found through the water quality monitoring contractor platform ALS Global portal website.<br>• As a check before an operation, the water quality at the Murrumbidgee River abstraction point (MURW2 / 41001701) should be compared to the Burra Creek limits of operation values in Table 20. Water quality should continue to be monitored for the duration of that operational run.<br>• Operational values (limits of operation) used for water quality management are consistent with Codex Alimentarius Hazard Analysis Critical Control Point (HACCP) terminology. |
| **21** | **Actions for Values that fall outside water quality limits** | • Should values fall outside the target range in Table 20, then the recommended actions in Table 21 should be followed.<br>• Burra Creek is periodically exposed to high turbidity following rainfall events. High flow events and increases in turbidity tend to be flashy and do not remain (usually not more than 24 hours). However, high values that stay for several days are considered abnormal and deemed an unacceptable risk to the system's ecology. |

# 4. Operating Procedures

The following rules must be met prior to pump start-up for both standby and operating modes. Allowance is to be made for the validity of the data, and expected trends over the next 24 hours based on predicted rainfall events and flows.

**Table 7. Operational checks for pre-start-up, water transfer, and step up and step down.**

| | # | Operational requirements |
|---|---|---|
| **M2G pre-start up checks**<br><br>**(Standby and Operating modes)** | 1 | Googong Reservoir must be below 80% capacity (for full operation only, not standby), as measured at the dam wall gauge (410748). |
| | 2 | The water transfer must not cause Burra Creek flow to exceed 1,830ML/DAY, measured at the 410774 gauge (see<br>Figure **1** for gauge locations) |
| | 3 | The Murrumbidgee River's environmental flow protection conditions can be met when starting the pumps and for the next 24 hours, as specified in Table 19. Use the mean daily flow for this check. |
| | 4 | The water quality at the Murrumbidgee River abstraction point (MURW2 / 41001701) should be compared to the Burra Creek values in Table 20. If these are within the acceptable ranges, operations can proceed, subject to the limits of operation actions defined in Table 21. |
| | 5 | Fish egg filtration screens for use must be fully functional. |
| | 6 | Actions required to address any incident since the last flow episode are in place. |
| **Requirements during water transfer**<br><br>**(Standby and Operating modes** | 1 | Fish egg filtration screens in use must be fully functional. |
| | 2 | The water transfer must not cause Burra Creek flow to exceed 1,830ML/Day, measured at the 410774 gauge. |
| | 3 | Flow in the Murrumbidgee River must be protected under the rules in Table 19. Use the instantaneous flow values for this check. |
| | 4 | The water quality at the Murrumbidgee River abstraction point (MURW2 / 41001701) should be compared to the Burra Creek values in Table 20. If these are within the acceptable ranges, operations can continue, subject to the limits of operation actions defined in Table 21. |
| | 5 | Where practical to do so, the flow should be varied to mimic natural flows. A constant flow shall not be maintained for a long time, negatively impacting a healthy ecological system. |
| **Pump step-up and step-down checks**<br><br>**(Operating mode only)** | 1 | The step times are designed to mimic natural events. Non-compliance with procedures outlined in Table 8 requires a notification to the appropriate Regulators. |
| | 2 | The timing should provide as smooth a transition as possible, with the switching down of pumps tapering off gradually to simulate the slow tapering off in the tail end of a natural hydrograph. |
| | 3 | Step-up and step-down are not required in Standby mode as these pump runs are generally of short duration and emulate the natural flow events in Burra Creek. |

Notification to the appropriate Environmental Regulator may be required if operational requirements in Table 7 and Table 8 are not met (as per the environmental objectives and targets in Table 4).

**Table 8. Step-up and step-down operating procedures**

| **Peak Pumping rate** | **High Lift Pumps required for peak rate** | **Step-up operating sequence** | **Minimum Step-up time (Hr)** |
|---|---|---|---|
| **21 ML/Day** | 1 small pump | Start anytime | **0** |
| **49 ML/Day** | 1 large pump | • Run Small for 0.5 hr<br>• Start Large and stop Small | **0.5** |
| **68 ML/Day*** | 1 small pump and 1 large pump | • Step-up to 49 ML/Day and run for 0.5 hr<br>• Start Small | **1** |
| **94 ML/Day*** | 2 large pumps | • Step-up to 68 ML/Day and run for 0.5hr<br>• Stop Small, start Large | **1.5** |
| **109 ML/Day*** | 2 large pumps and 1 small pump | • Step up to 94 ML/Day and run for 0.5 hr<br>• Start second Large | **2** |
| **Peak Pumping rate** | **High Lift Pumps required for peak rate** | **Step-down operating sequence** | **Minimum Step-down time (Hr)** |
| **109 ML/Day*** | 2 large pumps and 1 small pump | • Stop small<br>• Run for 1.0 hr @ 94ML/Day | **8** |
| **94 ML/Day*** | 2 large pumps | • Stop Large<br>• Start Small<br>• Run for 2 hrs @ 68 ML/Day | **7** |
| **68 ML/Day*** | 1 small pump and 1 large pump | • Stop small<br>• Run for 2 hrs @ 49 ML/Day | **5** |
| **49 ML/Day** | 1 large pump | • Stop Large<br>• Start Small<br>• Run for 3 hrs @ 21 ML/Day | **3** |
| **21 ML/Day** | 1 small pump | Turn off anytime | **0** |
| **Other information** | | | |
| **Minimum time intervals** | The minimum time interval between a pump stopping and re-starting is 15 minutes. The minimum time interval between stepping up and stepping down the flows is 30 minutes due to transient surges in the pipeline. | | |
| **Pump capacity and use** | Utilising more than the capacity of one large pump is not generally required for a maintenance standby mode run as the large pumps can be run consecutively. Flow rates above 49ML/Day are expected during operating mode water transfer only. | | |

# 5. Community and stakeholder engagement

**Table 9. Community and stakeholder engagement relations network**

| Resources | Systems | Documents |
|---|---|---|
| **Environment representative** | The M2G Environmental Representative (ER) is independent of Icon Water and is suitably qualified with certification through the Director-General of NSW Department of Planning and Environment. The role of the ER is to:<br>• Oversee the implementation of the OEMP and monitoring plans and advise Icon Water on achieving the programs and objectives.<br>• Advise Icon Water on compliance with the approval and the EIS commitments.<br>• Recommend to Icon Water steps to avoid or minimise environmental impact, including any activities that should cease if there is a risk that a significant environmental impact will occur.<br>• Review revisions to the OEMP and sub plans. | Section 6.1 of the NSW Department of Planning and Environment Approval MP08_0160 |
| **Icon Water website** | Provides information / links to environmental planning documents, and other information such as licences, notifications, and our annual report. | www.iconwater.com.au |
| **Notification and work instructions** | Notification is provided to affected landholders | IMS work instruction *WI06.02.01 Customer letter mail out.*<br>The website may also be utilised for these notifications. |
| **Property Interaction Plans (PIPs)** | Individual operational PIPs are in place for all 17 landholders along the M2G easement in NSW. | PIP link |
| **Complaints and inquiries** | Complaints from external stakeholders will be recorded and responded to.<br>Media inquiries will be managed by Icon Water's Communications and Engagement Branch. | Icon Water's Complaints Handling Policy |

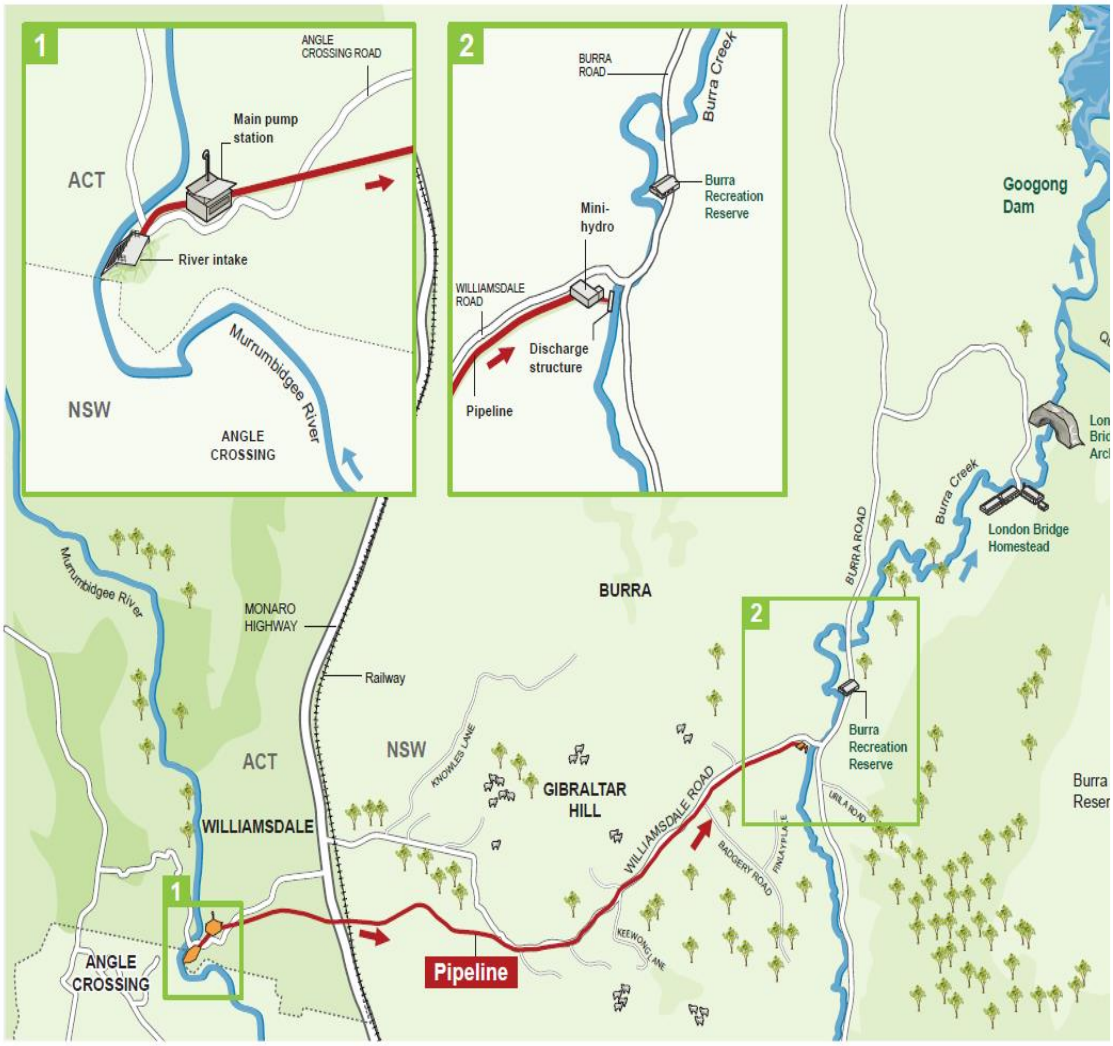
# 6. Auditing and Reporting

**Table 10. Reporting and auditing requirements for the scheme.**

| Processes | Requirements |
|---|---|
| **Reporting** | Icon Water will submit an annual performance report to address the Commonwealth Conditions of Approval No.6 of approval EPBC 2009/5124 for the M2G project under the Environmental Protection and Biodiversity Conservation Act 1999. This performance report will summarise the performance against the objectives in section 3.2 of this OEMP and include details of all non-compliances throughout the reporting period and water extraction data.<br><br>Monitoring Technical Reports are completed for every monitoring event and include any correlated impacts of water abstraction and other catchment conditions. These reports will be available to the public and regulators via the Icon Water website. |
| **Independent audits** | Compliance with the requirements of the NSW Department of Planning and Environment Planning approval number MP08_0160 and the ACT Planning and Land Authority (ACTPLA) Notice of Decision will be assessed. The scope of the independent audits may include any development approval conditions and OEMP documents. Audits will be undertaken at least every ten years following the initial schedule of every two years during project construction until after the first operation run in 2021.<br><br>The findings and recommendations of the audit will be presented to Icon Water. In addition, the audit reports are provided on Icon Water's public website and to the regulators. |
| **Internal audits** | Internal audits will be conducted as required by Icon Water per IMS *PR11.02 Internal audit* procedure to provide a review, continuous improvement, and quality assurance of practices. |
| **Corrective actions** | Corrective actions identified in any audits will be documented according to IMS *PR11.07 Corrective action*s procedure and allocated to Icon Water personnel on the incident, action, and risk management system according to Icon Water's *P07 Risk management* framework. |
| **Data analysis** | The streamflow and continuous water quality data collected shall be QA certified and stored on the HYDSTRA data management system and made available for reporting. This data is also publicly available through NSW water website, Independent audit reports available on Icon website, Burra Rd gauge station (available on Icon website), Annual drinking Water Reports, License notifications, and compliance documentation referenced in the Common EMP. |
| **Review** | Icon Water will review the OEMP every 2 years and according to the following triggers:<br>• A change in the scope of the scheme<br>• A significant environmental incident<br>• New knowledge of environmental risks<br>• Completion of an audit and requirement for improvement<br>• Decommissioning of the scheme. |

# Appendix A - Site Map

**Figure 2. M2G Pipeline location of key characteristics**



# Appendix B - Aquatic ecology monitoring tools

**Table 11. Environmental risk hypotheses**

| # | Hypothesis |
|---|---|
| 1 | Flow abstraction in the Murrumbidgee River will not result in the deterioration of the macroinvertebrate community (measured using biological indices) at sites downstream of the abstraction point (Angle Crossing) relative to sites upstream informed by prevailing conditions in the broader region. |
| 2 | 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 point relative to sites upstream, informed by prevailing conditions in the broader region. |
| 3 | Flow abstraction in the Murrumbidgee River will not result in the development of increased periphyton to the extent it impacts on quality of 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 |
| 4 | Flow discharge to Burra Creek will not result in increased periphyton to the extent it impacts the quality of riffle habitat at the site downstream of the inflow point, compared with sites upstream of the inflow point and informed by prevailing conditions in the broader region |
| 5 | Flow discharge to Burra Creek will not result in bank erosion that is beyond that currently occurring in response to natural high flow events |
| 6 | Flow discharge to Burra Creek will not result in changes in macrophyte or riparian vegetation (including weed species) that is beyond that currently occurring in response to natural high flow events |
| 7 | Flow abstraction in the Murrumbidgee River will not result in an increased threat to threatened cod species due to decreased pool mixing and consequent water quality impacts |
| 8 | Flow discharge to Burra Creek will not result in Carp or Oriental Weatherloach populations (via transfer) in Burra Creek or native fish stranding on drawdown. |

**Table 12. Risk levels for each monitoring schedule**

| M2G Mode | Scheduled program | Risks |
|---|---|---|
| **Suspension** | Monitoring is not required. Sentinel monitoring will be undertaken for two sequential seasons ahead of any planned transition back to Standby or Operating modes. | **Negligible** |
| **Standby** | The sentinel sites will be monitored (both autumn and spring) at least every three years. See Figure 2 for concept design and Table 14 for monitoring parameters. | **Low** |
| **Operating** | Ideally, there will be an adequate lead time for the decision to operate to allow a spring and autumn sample before, during, and following the operation of M2G.<br><br>Requires a combination of sentinel monitoring for the standby periods and impact monitoring (autumn and spring) before, during and after full pumping. Table 8. Step-up and step-down operating procedures). | **Moderate / low** |

**Table 13 Potential environmental risks arising from M2G operations phases**

| Operational component | Potential impact | Unmitigated ecological consequence | Operational mitigation | Residual impact (Mitigation measures designed for 100ML/Day) | | | Monitoring regime / response | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Standby | Full pump | Full pump (drought) | Standby | Full pump | Full pump (drought flows) |
| Transfer of water from Murrumbidgee River to Burra Creek | Transfer of fish eggs to Burra Creek | Potential to transfer non-native fish species to Burra Creek | Install and maintenance of Fine screen (0.5mm) at Angle Crossing Pump station preventing fish egg transfer. | **Very low**<br>Short duration<br>Low volumes. | **Low** | **Low** | Carp egg/larval monitoring at Angle crossing and in the discharge in Burra Creek once every four years during pumping operation (spawning season)<br><br>Angling reports and opportunistic sightings of Carp or other exotic species in the Googong reservoir. | | |
| | Increased sediment transfer (Burra creek/Murrumbidgee) | Potential to reduce habitat quality for fish and macro-invertebrates by smothering physical habitat and transporting contaminants | Turbidity concentration rules controlling transfer.<br><br>Fine screen preventing the transfer of course sediment | **Very low**<br>Short duration,<br>Low volumes.<br>Abstraction unlikely to cause significant sediment transfer | **Low** | **Low – Medium** | Online turbidity concentration measures are taken up and downstream (both rivers) | | |
| | | | | | | | Sentinel site macroinvertebrate monitoring every three years (autumn and spring); including visual habitat monitoring | Macroinvertibrate sampling (preferably for two seasons) before operations commencing. Sampling should also be undertaken following operations for two seasons (Autumn and Spring).<br>Visual habitat assessments as part of and in line with the monitoring schedule. | |

**Table 14. Environmental Monitoring Parameters**

| **Sentinel monitoring** | | |
|---|---|---|
| **Parameter** | **Method** | **Sites** |
| **Water quality (online)** | Online collection of DO, temperature, pH, EC and turbidity. | 2 Murrumbidgee sites (upstream and downstream of discharge)<br>1 'in –system' sensor<br>1 Burra Creek site (downstream of discharge) |
| **Water quality (grab sample)** | Grab sample collection of TDS, Fe, Mn, nutrients (TKN, TN, TP), pathogens (E.coli), and pesticides. | Every 3 months in line with operational monitoring locations. |
| **Macroinvertebrates** | AUSRIVAS assessment techniques.<br>3 within-site replicates where possible (considering site constraints).<br>3 sub-samples per site (considering site constraints). | 2 Murrumbidgee sites (subset of impact monitoring sites)<br>2 Burra Creek sites (subset of impact monitoring sites) |
| **Geomorphology** | Photo points at key hotspot sites every two years. | (same as impact monitoring sites) |
| **Riparian vegetation (including weeds)** | Photo points at key riparian edge movement sites every two years. | (same as impact monitoring sites) |
| **Fish** | As per ACT Government Biennial Fish Surveillance Program. | 9 Murrumbidgee sites |
| **Operational monitoring** | | |
| **Water quality (online)** | Online collection of DO, temperature, pH, EC and turbidity. | 2 Murrumbidgee sites (upstream and downstream of discharge)<br>1 'in –system' sensor<br>1 Burra Creek site (downstream of discharge) |
| **Water quality (grab sample)** | Grab sample collection of TDS, Fe, Mn, nutrients (TKN, TN, TP), pathogens (E.coli) and pesticides. | Every 3 months in line with operational monitoring locations. |
| **Macroinvertebrates** | AUSRIVAS assessment techniques.<br>3 within-site replicates where possible (considering site constraints).<br>3 sub-samples per site (considering site constraints). | 4 Murrumbidgee sites<br>4 Burra Creek sites |
| **Periphyton** | A before and after pumping visual assessment using photo points to compare the extent of periphyton cover as a measure of riffle habitat quality.<br>Every four weeks (approx.) should pumping still be occurring | 4 Murrumbidgee sites<br>4 Burra Creek sites<br>Site locations correspond to AUSRIVAS sites. |
| **Geomorphology** | Before and after pumping visual assessment using photo points to compare the extent of any large-scale channel erosion. | Identified erosion hotspot sites downstream of discharge structure. |

| | | |
|---|---|---|
| | These will be captured before and after pumping. Full transect surveys will be undertaken if significant erosion is noted from the visual assessments. | |
| **Riparian vegetation (including weeds)** | Before and after pumping visual assessment using photo points to compare any gross-scale changes in riparian edge vegetation movement.<br>In addition, 100m transect surveys will be undertaken before, and after pumping, to determine if there is evidence of a gross change in extent, composition, or abundance of native and invasive species within the inundation zone. | Key riparian edge movement sites below discharge location. |
| **Fish** | As per ACT Government Biennial Fish Surveillance Program. | 9 Murrumbidgee sites |

**Table 15. Standby and operating monitoring scenarios**

| Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 |
|---|---|---|---|---|---|---|
| **Example of standby mode for 7 years** | | | | | | |
| **Standby** | Standby | Standby | Standby | Standby | Standby | Standby |
| **Autumn & Spring Sentinel monitoring** | No monitoring | No monitoring | Autumn & Spring Sentinel monitoring | No monitoring | No monitoring | Autumn & Spring Sentinel monitoring |
| **Example of operating mode occurring in Year 4.** | | | | | | |
| **Standby** | Standby | Standby (preparing to operate following year) | M2G operates | Standby (year following operation) | Standby | Standby |
| **Autumn & Spring Sentinel monitoring** | No monitoring | Autumn & Spring (pre) Impact monitoring | Autumn & Spring Impact monitoring | Autumn & Spring (post) Impact monitoring | No monitoring | Autumn & Spring Sentinel monitoring |

**Table 16. Triggers for reactive programs**

| Locations | Trigger | Reactive program |
|---|---|---|
| **In-stream** | AUSRIVAS band level scores downstream of pipeline score band C, or are below upstream site levels over two monitoring periods. | Investigation into the cause. Should the cause be related to the M2G, Icon Water will develop appropriate management and mitigation measures. Options for mitigation may be referred to an expert panel. |
| **Geo-morphology** | Any significant geomorphological change occurring (in the photo point comparisons) in Burra creek. | Icon Water will notify the Commonwealth and State regulators and implement and or assist in an erosion control program. |
| **Fish** | Where there is existence of native fish population(s) in Burra creek below the discharge location; and the existence of a developing carp populations.<br>Where there is a significant reduction in fish diversity or habitat as outlined in the SDL plan 2010. | Research into impact to native fish populations. Should native fish be showing impacts from pipeline effect:<br>1. Control program for invasive species<br>2. Implantation of fish habitat |
| **Weed control** | Significant changes to the riverine vegetation composition (e.g. loss of natives / increase in weeds and changes in river channel flora). | Determine and document extent of change. Initiate a more regular monitoring assessment. If change is having a negative impact on riverine health review flow management regime. |
| **All** | If the cause of deviations from the trigger levels cannot be determined. | Referred to an expert panel. |

**Table 17. Murrumbidgee and Burra Creek AUSRIVERS riffle and edge assessments**

| Site | Site code | Location | Autumn 2009 | | Spring 2009 | | Autumn 2010 | | Spring 2010 | | Autumn 2011 | | Spring 2011 | | Autumn 2012 | | Spring 2012 | | Autumn 2013 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Riffle | Edge | Riffle | Edge | Riffle | Edge | Riffle | Edge | Riffle | Edge | Riffle | Edge | Riffle | Edge | Riffle | Edge | Riffle | Edge |
| 1 | BUR1 | Burra Creek U/S of Cassidy Creek confluence | NS | NS | NS | A | C | B | B | B | B | B | A | B | C | B | B | A | NS | NS |
| 2 | BUR1c | Burra Creek ~300m U/S Discharge Point | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | C | A | B | B | B | A | B | B |
| 3 | BUR2a* | Burra Creek D/S Williamsdale Rd | NS | NS | NS | B | NS | B | NS | B | C | B | A | NRA* | B | A | A | A | B | B |
| 4 | BUR2b* | Burra Creek D/S Burra Road bridge | NS | NS | NS | C | NS | B | NS | B | B | B | B | A | C | B | B | B | B | B |
| 5 | BUR2c* | Burra Creek ~100m U/S London Bridge arch | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | B | A | B | B | A | A | A | A |
| 6 | BUR3* | Burra Creek D/S London Bridge arch | NS | NS | B | B | B | B | B | A | NS | B | NS | NS | NS | NS | NS | NS | NS | NS |
| 7 | QBN1 | Queanbeyan River ~ 3km U/S Burra Creek confluence. | B | A | B | A | B | B | B | B | B | B | A | A | B | A | A | X | B | B |
| 8 | QBN2* | Queanbeyan River ~1km D/S Burra Creek confluence. | C | B | B | B | B | B | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| 9 | CAS1 | Cassidy Creek U/S Burra Creek confluence | NS | NS | NS | B | NS | B | NS | B | NS | B | NS | NS | NS | NS | NS | NS | NS | NS |

** Sites impacted by the M2G discharge. Other sites are used as Control sites. QBYN 2 may not be a viable location as Googong Reservoir fills. When Googong exceeds 80% storage the confluence with Burra Creek becomes inundated.*

*NRA* - No Reliable Assessment due to the high variability obtained in the site replicates.*

*NS – Not sampled due to high or no flow.*

*Note: If the AUSRIVAS Band for Riffle and Edge differ then the Band used for the site is taken as the lower assessment of the two.*

| Site | Site code | Location | Spring 2008 | | Autumn 2009 | | Spring 2009 | | Autumn 2010 | | Spring 2010 | | Autumn 2011 | | Spring 2011 | | Autumn 2012 | | Spring 2012 | | Autumn 2013 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Upstream | Riffle | Edge | Riffle | Edge | Riffle | Edge | Riffle | Edge | Riffle | Edge | Riffle | Edge | Riffle | Edge | Riffle | Edge | Riffle | Edge | Riffle | Edge |
| 1 | MUR15 | ~30 km U/S of Angle Crossing near Colinton; | NS | NS | B | B | NRA* | B | B | B | A | NRA* | A | B | A | A | B | B | A | A | A | A |
| 2 | MUR16 | Just U/S Angle Crossing | NS | NS | B | B | B | B | A | B | A | C | A | B | A | A | B | B | B | A | A | B |
| 3 | MUR18 | ~500m above abstraction site | NS | NS | B | B | B | B | B | B | B | NRA* | B | A | B | B | B | B | B | A | B | A |
| 4 | MUR19 | D/S Angle Crossing; directly below causeway | A | A | B | B | B | B | B | B | B | C | A | A | A | A | B | B | B | A | A | A |
| 5 | MUR23 | D/S Angle Crossing; at Point Hut; | A | A | B | C | B | B | B | B | A | B | B | B | A | A | B | B | A | A | A | A |
| 6 | MUR28 | ~33km D/S Angle Crossing; U/S Cotter River confluence; | A | B | B | B | B | B | B | B | NS | NS | A | B | B | B | B | B | B | B | A | A |

*NRA* - No Reliable Assessment due to the high variability obtained in the site replicates*

*NS – Not sampled due to high or no flow*

# Appendix C - Streamflow and water quality tools

**Table 18. Environmental considerations for streamflow and water quality**

| # | Environmental factors | Considerations (as described in the SDL Plan 2010) |
|---|---|---|
| **1** | Provide suitable habitat and habitat diversity for native fish species. | Minimum depth and extent of key habitat pools are maintained in low flow conditions.<br>Structural complexity of key reaches is maintained or improved, as measured by the on-going presence of woody debris, riparian vegetation, and in-stream boulders.<br>A range of instream depth and flow velocities are provided. |
| **2** | Provide opportunities for native fish movement, as required. | In-stream barriers are drowned out at key times on moderate to high flows.<br>Minimum depth is maintained in key shallow reaches. |
| **3** | Maintain clean and productive riffle habitats for native fish. | Riffle cleaning flows effectively scour riffles of sediment and algal films. |
| **4** | Maintain and improve water quality and temperature in the river downstream of the abstraction point. | Water retention time in large pools does not result in hostile water quality conditions, particularly at depth. |
| **5** | Avoid ecological and geomorphological impacts associated with the cessation of M2G flows. | Flow step-down avoids fish stranding, vegetation modification, and bank collapse. |
| **6** | Avoid disruption associated with natural flooding events in Burra Creek. | Flow does not contribute to flooding in Burra Creek. |

**Table 19. Baseflow protection for Murrumbidgee and Burra creek**

<table>
<tr><th>Considerations</th><th>Details</th></tr>
<tr><td>Measuring stations</td><td>Upstream Angle Crossing Gauging Stations (MURW2 / 41000270)<br>Lobbs Hole Gauging Station (410761)<br>Burra Creek (410774)</td></tr>
<tr><td>Base flow<br>(Operating / Standby Modes)</td><td>Pumping of the water from the Murrumbidgee must not cause the flow in ML/Day to be less than (with reference to ACT WU67 Licence To Take Water)
<table>
<tr><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>33.7</td><td>22</td><td>16</td><td>35</td><td>55</td><td>65</td><td>79</td><td>99</td><td>169</td><td>128</td><td>130</td><td>53</td></tr>
</table>
Note: Flow is measured at Angle Xing (41001702) by the Pipeline Flow Meter. Murrumbidgee flows may go below these base flow rates intermittently during pipeline maintenance periods; however, daily base flow rules still apply across 24 hours. When Murrumbidgee flows are significantly less than at the base flow protection rules values (above), pumping will either cease or not occur unless where necessary to facilitate maintenance activities. Pumping during maintenance will not cause the river to flow below 20ML/Day.<br><br>(Noting that Commonwealth approval for base flow protection volumes was measured further downstream at Lobbs Hole 410761).</td></tr>
<tr><td>Essential maintenance (maintain to operate)</td><td>Essential maintenance of the M2G infrastructure is required during both Operational and Standby modes to ensure the long-term operability of this critical water supply infrastructure. During essential maintenance a minimum flow rate of 20ML/day in the Murrumbidgee River will be protected. Essential maintenance operations will be reported in the annual performance reports.</td></tr>
<tr><td>Drought</td><td>Protect flows in the Murrumbidgee River when the following ‘drought rule’ is triggered – where average flow is for at least 15 of the 18 (~80%) past dry season months (November to April inclusive), below the base flow values (above). Under these conditions, M2G pumping is required to protect the base flows in the Murrumbidgee River as shown (ML/Day; measured at Lobbs Hole 410761)
<table>
<tr><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>132.2</td><td>107</td><td>118.2</td><td>98.5</td><td>54.1</td><td>66.8</td><td>89.3</td><td>133.6</td><td>200.1</td><td>145.9</td><td>384.9</td><td>207</td></tr>
</table></td></tr>
<tr><td>Riffle maintenance</td><td>During operating mode, protect a minimum of 250 ML/Day of natural flow for riffle maintenance in the Murrumbidgee River, for a period of 24 hours, once every 30 days, measured at Lobbs Hole (410761).</td></tr>
<tr><td>Burra creek</td><td>To avoid contributing to flooding of the causeway over Williamsdale Road, the M2G must not be operated if the natural flow in Burra Creek is greater than 1,830ML/Day recorded at Burra Ck at Burra Rd 410774. To minimise impact on the receiving waters, this rule requires the pumps to be started and stopped in a defined sequence as far as the pump sizing and capacity allows, mimicking natural catchment runoff and flow events occurring</td></tr>
</table>

| | |
|---|---|
| | within Burra Creek when M2G is in operating mode. The pump step-up and step-down procedures are described in Table 8. Step-up and step-down operating procedures. |

**Table 20. Burra Creek water quality target, action and critical values**

| **Variables** | **Burra creek water quality targets** | | | | | |
|---|---|---|---|---|---|---|
| **Season** | Autumn / Winter | | | Spring / Summer | | |
| **Limits of Ops actions** | Target | Action | Critical | Target | Action | Critical |
| **Temp** | > 5 | < 5 | < 2.5 | < 24 | > 24 | > 32 |
| **EC (us/com)** | < 600 | > 600 | > 1400 | < 600 | > 600 | > 1400 |
| **PH (Ph units)** | 6.5 – 8.5 | < 6.5 or > 8.5 | ≤ 6 or ≥ 9 | 6.5 – 8.5 | < 6.5 or > 8.5 | ≤ 6 or ≥ 9 |
| **Turbidity (NTU)** | < 80 | > 80 | 800 NTU for no more than 48 consecutive hours | < 100 | > 100 | 800 NTU for no more than 48 consecutive hours |
| **Dissolved Oxygen (% sat)** | 70 – 110 | <70 or >110 | < 40 or > 140 | 60 - 110 | < 60 or > 110 | < 30 or<br>> 160 |

**Table 21. Limits of operation actions**

| **Term** | **Action for values outside of limit** |
|---|---|
| **Target Values** | • If values are inside range, no action is required. If outside, the target values then refer to Action or Critical values below. |
| **Action Values** | • Continue monitoring. This may include in-situ sampling and/or grab samples to validate online data.<br>• Cross-check data accuracy. Use data from alternative gauges, if available.<br>• Cross-check that M2G pumping meets operational plan requirements.<br>• Check for abnormal catchment-wide activities, e.g. rainfall events. |
| **Critical Values** | • Shut down operation.<br>• Notify the Regulators and key stakeholders.<br>• Conduct further monitoring and a detailed investigation by subject matter experts about the cause of the critical values exceedance. |