

THE BASIN PLAN

Draft Incident Response Guide

For the Gwydir Alluvium WRP Area (GW15)

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Incident Response Guide for Groundwater Water Resource Plan Areas

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More information

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New South Wales acknowledge and pays its respect to all the Traditional Owners and their Nations of the Murray-Darling Basin.

We acknowledge Aboriginal people as Australia's First Peoples and as the Traditional Owners and Custodians of the land and water on which we rely.

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Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (November 2018). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of the NSW Department of Industry or the user's independent adviser.

Acronyms

A glossary of groundwater terms is provided at Appendix D.

| Abbreviation | Description |
|--------------|--|
| AAL | Aquifer Access Licence |
| ADWG | Australian Drinking Water Guidelines |
| AI | Aquifer Interference |
| AWD | Available Water Determination |
| BLR | Basic Landholder Rights |
| COAG | Council of Australian Governments |
| CWAP | Critical Water Advisory Panel |
| DWMS | Drinking water management system |
| EMPLAN | NSW State Emergency Management Plan |
| EEC | Endangered Ecological Community |
| EPL | Environmental Protection Licence |
| GDE | Groundwater Dependent Ecosystem |
| HPGDE | High priority Groundwater Dependent Ecosystems |
| IRG | Incident Response Guide |
| IWCM | Integrated Water Cycle Management |
| LWU | Local water utility |
| MDBA | Murray-Darling Basin Authority |
| MER | Monitoring, Evaluation and Reporting |
| Minister | NSW Minister responsible for Water Resources (unless otherwise stated) |
| POEO Act | <i>Protection of the Environment Operations Act 1997 (NSW)</i> |
| SAP | Stakeholder Advisory Panel |
| TWS | Town Water Supply |
| WMA | <i>Water Management Act 2000</i> |
| WQMP | Water Quality Management Plan |
| WRP | Water resource plan |
| WRPA | Water resource plan area |
| WSP | Water sharing plan |

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1 Introduction

3.1 Purpose

Incident Response Guides (IRGs) outline the framework for managing extreme events for each major water source in the NSW Murray-Darling Basin based on the principles outlined in the NSW Extreme Events Policy. They provide a progressively expanding toolkit of approaches for water managers to select from as an event becomes more severe. This balances the need to be adaptive in response to changing circumstances, with the need for certainty, to improve longer term planning.

This IRG applies to the NSW groundwater resources of Murray-Darling Basin shown in Figure 1-1 and detailed in columns 1 and 2 of the table in Appendix A.

This IRG has been developed to:

- Meet the requirements under section 10.51 of the *Basin Plan 2012*.
- Support the statutory functions under sections 49A, 49B, 59, 60, 324 and 331 of the *Water Management Act 2000* (WMA 2000).

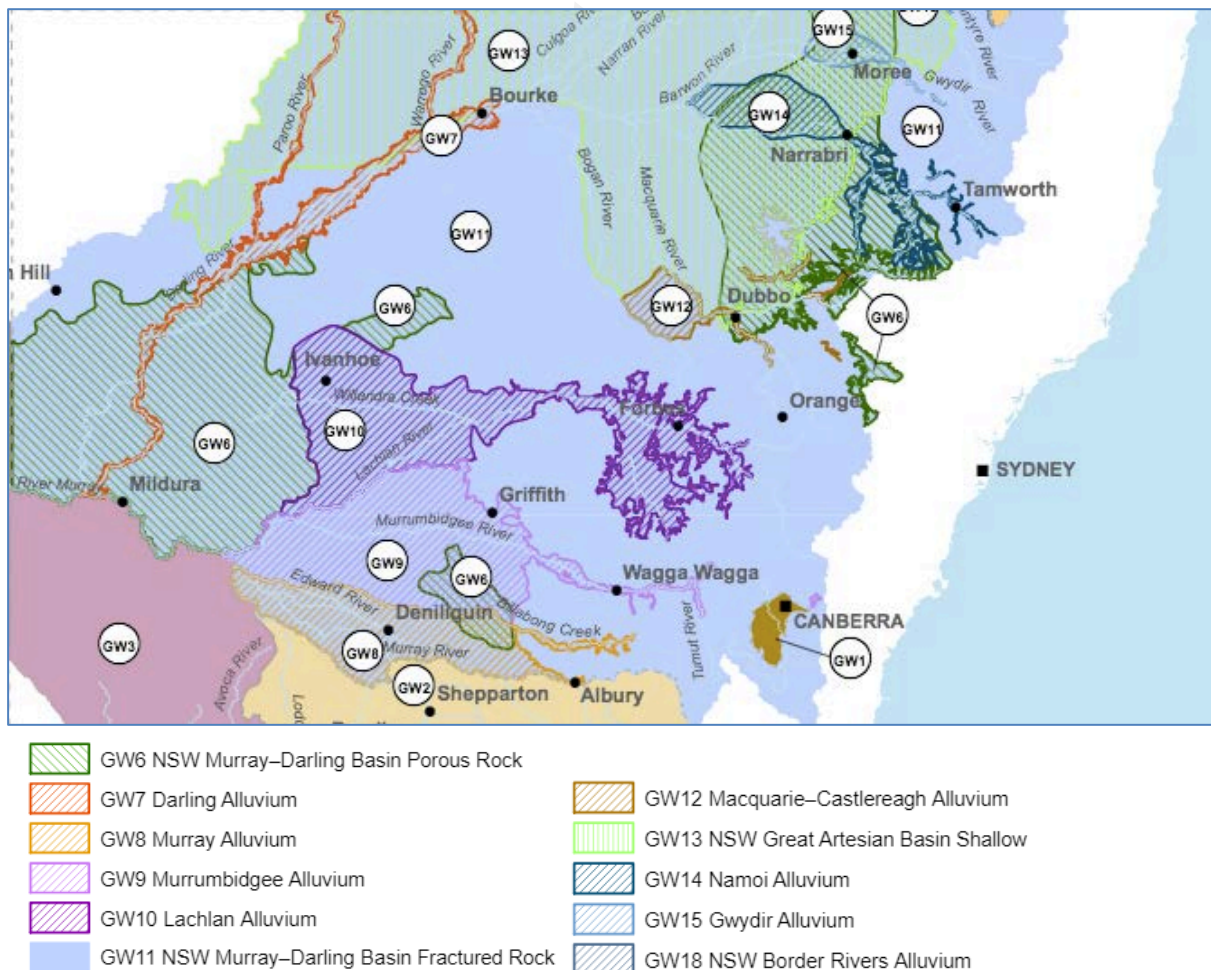


Figure 1-1: Murray-Darling Basin Groundwater Water Resource Plan Areas

An extreme event is defined in section 10.51 of the *Basin Plan 2012*, in the Dictionary of the WMA and in the NSW Extreme Events Policy. It includes extreme dry periods, extreme water quality events, and any other type of event that has led to a management plan previously being suspended in the past 50 years.

An extreme dry period needs to be interpreted liberally for groundwater. A meteorological or hydrologic drought or extreme dry period does not necessarily correlate with reduced groundwater availability or accessibility. Significant recharge to many groundwater systems can be episodic, and largely dependent on flows across the alluvial floodplain.

For the purpose of this Groundwater IRG an extreme dry period will be defined as an extended period during which recharge to the groundwater system from all sources (flood flows, rainfall, river, and through flow) has been below average and is putting at risk the ability to access groundwater of sufficient quantity and/or quality for its intended purpose¹.

An extreme water quality event affecting groundwater may include increased salinity or water pollution.

3.2 Legal and policy context

1.1.1 Statutory management functions

A range of key statutory functions applicable to extreme event management exists within the NSW operating context. These are detailed in the NSW Extreme Events Policy. Any decision made in accordance with this Guide must comply with the provisions of the WMA.

Unless a WSP provides otherwise, the priorities set out in Table 1-1 and Table 1-2 apply to the distribution of groundwater under normal circumstances, and during extreme water shortage or extreme events. The water allocations for higher priority licences are to be diminished at a lesser rate than the water allocations of lower priority licences.

Table 1-1: Normal WMA take priority under ss.5(3), 58 and 60(1)

| Take type/use | Priority |
|--|----------|
| Water source and dependent ecosystems Taking of water by persons exercising BLRs | First |
| LWU access licences Major water utility access licences Domestic and stock access licences | Second |
| All other forms of aquifer access licences | Third |

¹ Water shortage criticality is assessed through analysis by NSW Department of Industry of groundwater level and pressure data from monitoring undertaken by WaterNSW. ² There is no priority given under the Act between different forms of take 'within' a priority.

Table 1-2: WMA take priorities for groundwater under ss.60(3) to 60(3C) and s.49A or s.49B order

| Take Type / Use | Priority ² |
|---|-----------------------|
| <ul style="list-style-type: none"> The taking of water for critical human water needs The taking of water for domestic purposes by persons exercising BLRs, and The taking of water for domestic purposes or essential town services authorised by an access licence | First |
| Needs of the environment | Second |
| <ul style="list-style-type: none"> The taking of water for stock purposes by persons exercising BLR, and The taking of water for purposes authorised by a domestic and stock access licence or by persons exercising any other water rights in relation to stock. The taking of water for the purposes of supply of commercial and industrial activities authorised by a LWU access licence, subject to the water made available being in accordance with any drought management strategy established by the Minister for that purpose, and The taking of water for the purposes of electricity generation authorised by a major utility access licence (not applicable in groundwater WRPAs at the commencement of the groundwater WRPAs). | Third |
| Taking of water for purposes authorised by any other category or subcategory of access licence | Fourth |

² There is no priority given under the Act between different forms of take 'within' a priority.

1.1.2 Relationship to other plans and processes

The IRG is a linking document that references other plans and processes relevant to the management of extreme events in NSW groundwater water sources. It must be consistent with NSW and Commonwealth legislation and is informed by a range of other inputs. Figure 1-2 shows the relationship between this IRG and other documents relevant to groundwater WRPA in NSW.

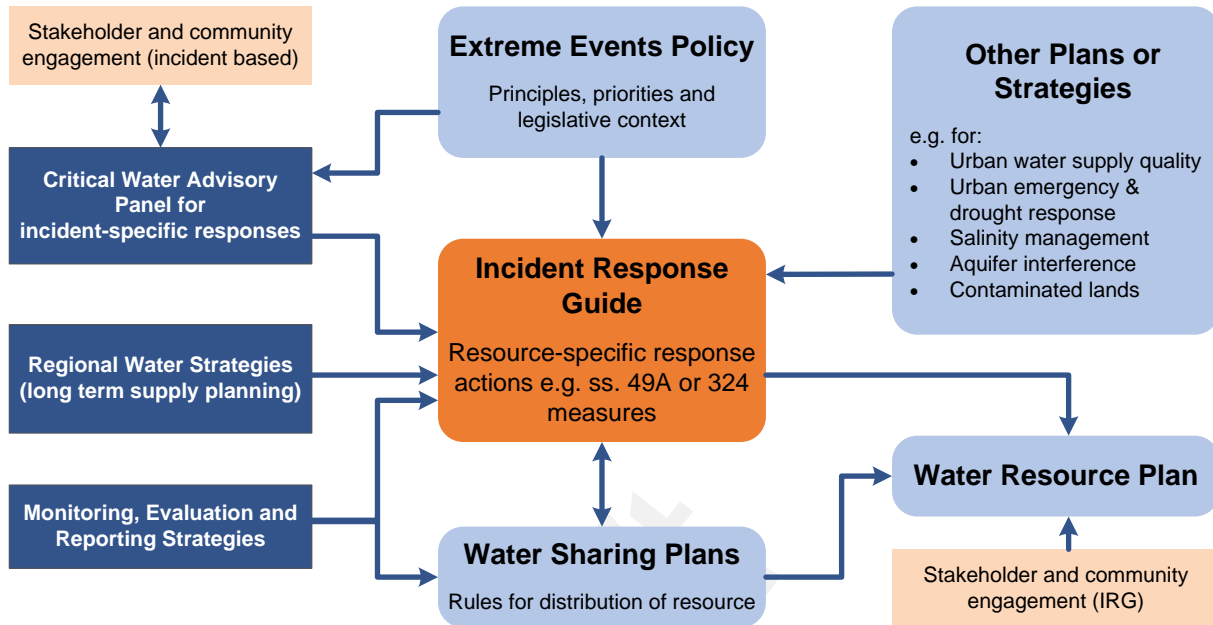


Figure 1-2. Relationship of the IRG to documents relevant to the WRP framework

3.3 Scope

1.1.3 Water sources

This IRG applies to the NSW groundwater resources within WRPA in the Murray-Darling Basin (Appendix A). Surface water is not specifically covered by this IRG, other than where it has a role as a management response (alternative supply) in extreme events. The extreme event management requirements of the Basin Plan (section 10.51) focus on water availability and water quality.

It should be noted that groundwater take frequently increases in response to extreme events in surface water systems, and this increased take is a common contingency measure in NSW surface water IRGs.

1.1.4 Critical human and non-human water requirements

This IRG outlines how groundwater should be managed during extreme events, and in particular how critical human and non-human water requirements can be met during these events (in accordance with principle two of the NSW Extreme Events Policy). Critical human and non-human water requirements are those groundwater uses within WRPA that have been assessed as a core human consumption requirement or non-human consumption requirement that a failure to meet would cause prohibitively high social, economic or national security costs, according to the WMA section 60(3C). These are shown generically for all groundwater WRPA in Table 1-3. The colour coding represents the relative priorities of these critical human and non-human water requirements. There is no particular priority between the uses within each colour priority.

Table 1-3: Critical human and non-human water requirements identified within groundwater WRPA's.

| Use / Value | Description | Type |
|--|--|--|
| Water for towns and essential human needs | Domestic supply and essential town services for LWUs | Human consumption core need (urban) |
| | Domestic supply and essential services for towns under AAL (TWS) licences | |
| | BLRs (domestic and stock and Native Title) domestic uses (see section 1.3.3) | Human consumption core need (rural) |
| | Domestic supply under domestic and stock access licences | Human consumption core need (rural) |
| Environment | Planned environmental water as specified in the applicable water sharing plan (Appendix A) | High economic and social costs associated with long term decline in water levels and water quality, and of rehabilitation (if possible) of groundwater dependent ecosystems |
| Water for stock | Stock supply under domestic and stock access licences | High economic cost of carting water for stock, moving stock, or de-stocking |
| | BLR (stock uses) | High economic cost of carting water for stock, moving stock, or de-stocking |
| Industrial and commercial LWU supplies | Supply of commercial and industrial activities authorised by LWU and AAL (TWS) access licences | High social and economic costs associated with reduction or loss of economic activity and employment in an urban area |
| Inflows associated with aquifer interference (AI) activities | Groundwater associated with AI activities that cannot be 'controlled' | Physical inability to control AI related groundwater inflows to voids and pits (i.e. groundwater take) |
| Other | An aquifer access licence associated with cultural, social justice, public health and safety, and other community and social benefits. | High social costs associated with: <ul style="list-style-type: none"> • Impacted or temporary loss of Aboriginal cultural or community activities • Community amenity and safety |

1.1.5 Bore construction and access to groundwater

Section 52 of the WMA 2000 permits an owner or occupier of a landholding to take water from any aquifer underlying the land to use the water for domestic consumption or stock watering, without the need for an access licence, and subject to approval for construction of a water bore.

Whether or not there is sufficient yield of groundwater available within the groundwater source underlying a particular parcel of land, and the nature of any such groundwater system in terms of its reliability as a water source, may be unknown. Shallow groundwater systems may indeed dry out naturally either seasonally or during drought periods, or more regularly in the absence of sufficient recharge. These groundwater systems are comparable to unregulated ephemeral streams.

The landholder, therefore, takes the risk that a suitable supply will not be found or that the supply is unreliable in nature. The work (bore) approval, per se, is no 'guarantee' of access.

In other, more persistent groundwater systems, water levels or pressures fluctuate naturally in response to recharge, and also in response to nearby groundwater pumping. Some bores are constructed relatively shallow and therefore only access the top portion of water in the aquifer. Due to this, access may be lost as water levels fall. This usually occurs as a result of inadequate infrastructure which precludes access, rather than the availability of groundwater. To guard against such inefficient bore construction, all bore approvals now contain a condition (MW0861-00001) stating that ‘the water supply work must be constructed to a sufficient depth to enable access to the water source for the life of the work’

In 1997, COAG set key principles for States in this regard in its paper *Allocation and Use of Groundwater: A National Framework for Improved Groundwater Management in Australia - Policy Position Paper for Advice to States and Territories*³. In particular, Recommendation 4 in the report stated:

In preparing groundwater management plans, policies and strategies, States should ensure that the efficient utilisation of groundwater resources is not compromised by protection of existing users with inefficiently designed or constructed wells. This particularly applies to domestic and stock wells.

Consistent with the discussion and principles above, priority provision of access for BLRs specified in Table 1-3 will be afforded where the groundwater resource is ‘available’ for take, and if bores are ‘efficiently constructed’ - that is, constructed to such a depth that they can access available water over the full range of climate and pumping conditions.

3.4 Potential extreme events in groundwater WRPAs

1.1.6 Extreme event types, occurrence and risk

Risks to meeting the identified critical human and non-human water requirements are identified in the individual groundwater WRPAs, and their associated Water Quality Management Plan (WQMP). Potential and past extreme events, as defined in section 10.51(1) of the Basin Plan are summarised in Table 1-4.

Table 1-4: Section 10.51(1) possible extreme event types

| Event Type | Description | Context - potential or actual past events |
|-----------------------|--|--|
| Severe water shortage | <ul style="list-style-type: none"> Extreme dry period | <ul style="list-style-type: none"> See relevant groundwater IRG Appendix for detail. |
| | <ul style="list-style-type: none"> Unacceptable local water level drawdown or depressurisation | <ul style="list-style-type: none"> Has occurred in the Namoi Alluvium WRPA Potential in the Gwydir Alluvium, Namoi Alluvium and Murrumbidgee Alluvium WRPAs |
| | <ul style="list-style-type: none"> Land subsidence or sediment compaction resulting from groundwater extraction | <ul style="list-style-type: none"> Has occurred in the Namoi Alluvium WRPA. Not identified in other areas. |
| Water quality events | <ul style="list-style-type: none"> Contaminated site threatening groundwater quality | <ul style="list-style-type: none"> As contained on the contaminated land register: http://www.epa.nsw.gov.au/your-environment/contaminated-land/notification-policy/record-of-notices. |
| | <ul style="list-style-type: none"> Induced connection with poor quality (saline) groundwater | <ul style="list-style-type: none"> Has occurred in isolated areas of the Namoi Alluvium and the Murrumbidgee Alluvium WRPAs. |

³ Task Force on COAG Water Reform Sustainable Land Water Resource Management Committee, Occasional Paper Number 2 December 1996, Commonwealth of Australia, 1997

| Event Type | Description | Context - potential or actual past events |
|-------------------|---|--|
| | (as a result of unacceptable depressurisation/drawdown) | <ul style="list-style-type: none"> Potential in the down gradient areas of the Namoi Alluvium, Macquarie–Castlereagh Alluvium, Lachlan Alluvium, Murrumbidgee Alluvium and Murray Alluvium WRPAs. |
| | <ul style="list-style-type: none"> National security event | <ul style="list-style-type: none"> No known groundwater related national security events have occurred in the NSW groundwater WRPAs. |
| Suspension of WSP | <ul style="list-style-type: none"> Event causing suspension of WSP within the WSPA | <ul style="list-style-type: none"> There have been no events causing suspension of a WSP within the groundwater WRPAs in NSW. |

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2 Incident response framework and process

3.5 Criticality Stages

The response framework taken by the IRGs is consistent with the principles introduced in the NSW Extreme Events Policy. Where circumstances put at risk the ability to access groundwater of sufficient **quantity**, the framework involves progressively introducing more stringent measures to support the highest priority needs as the circumstances becomes more critical. This supports principle five in the NSW Extreme Events Policy to maximize certainty in water management. Water quality events may trigger any criticality stage, depending on the nature and severity of the event.

The general management approaches available during each stage are outlined below in Table 2-1, and the criticality stages are defined in Table 3-1 and Table 3-2.

Table 2-1. Stages of the IRG framework.

| Criticality Level | Agency/management Approaches | WSP Approaches | | |
|-------------------|---|------------------------|-------------------------------------|----------------------|
| | | Normal Rules | WSP Local Scale Management Measures | Suspension (in part) |
| Stage 1 | Normal management operations - long term planning, including drought security planning. | In force | | |
| Stage 2 | Local impact management measures implemented as required. Emergency management readiness implemented. Inter-agency groundwater advisory group briefed. Initial communications with potentially affected communities and stakeholders. | In force | Possibly activated | |
| Stage 3 | Adjustments to access management. Emergency management on stand-by. Critical Water Advisory Panel established and operational, with regular Ministerial updates. Communications with affected communities and stakeholders increased. | Possibly also in force | In force | Possibly activated |
| Stage 4 | Normal access management untenable, emergency management activated. State agency/regional response implemented if required/triggered. Critical Water Advisory Panel maintained, with regular Ministerial updates. Regular communications with affected communities and stakeholders increased. | | In force | In force |

Note that the 'stages' outlined in Table 2-1 and section 3 for this IRG are not aligned with or related to local government water restriction 'levels'. The stages refer to increasing criticality of an extreme event in the WRPA as a whole. Measures in this IRG may affect the total amount of water made available to a town or village. However, it is the responsibility of the water service provider (local government or supply authority) to manage access to that available water within the town or village consistent with their established demand and drought management processes.

3.6 Critical Water Advisory Panel and stakeholder input

The information in Table 1-3 is designed to be guiding, not binding, and flexibility in the prioritisation of groundwater access during extreme conditions may be required, as recommended in principle six of the NSW Extreme Events Policy. To deliberate further in specific WRPAs, a Critical Water Advisory Panel (CWAP or the Panel) will be convened at Stage 3 of the criticality levels (section 2.1). The objective of this Panel is to ensure that advice on priorities comes from a local contextual basis, consistent with the requirements of the WMA. Of particular focus for the Panel will be early, appropriate, and broad communications with potentially affected parties, and on bringing local area perspectives to the selection of management response measures (see section 3). This supports principle seven in the NSW Extreme Events Policy to promote equitable management.

The purpose of a CWAP is clearly defined in its Terms of Reference with its key role being to provide advice to the NSW Department of Industry on appropriate response measures and criticality levels. Depending on the event, members of this Panel could include (but not be limited to) representatives from:

- NSW Department of Industry
- WaterNSW
- Environment Protection Authority
- Department of Primary Industries - Agriculture
- Office of Environmental and Heritage
- Department of Primary Industries - Fisheries
- NSW Health – Water Unit
- Department of Premier & Cabinet
- Local Land Services

Other members or observers may be invited as appropriate, and/or expert technical advice sought.

The Department of Industry — Water will consider advice provided by the CWAP and any other relevant inputs. Recommendations will then be developed and presented with evidence for decision by the appropriate decision maker.

A CWAP communications and engagement plan outlines how it will communicate and engage with external stakeholders and affected parties, including local councils and other water supply authorities, Aboriginal communities, environmental groups and other water users. Opportunities to use existing engagement mechanisms, such as WaterNSW Customer Advisory Groups (CAGs) and water user groups will also be evaluated. The plan also describes the approach to information sharing, confidentiality, handling market sensitive information and transparency.

3 Management responses

Details for groundwater WRPAs, in terms of events, their criticality and the management response toolkit, are shown in Table 3-1 (quantity events) and Table 3-2 (quality events). These tables are the key elements of this IRG.

Management responses will be guided by the type of event, particularly for water quality events, which can be varied and which are often managed by parties other than NSW Department of Industry (Appendix B). For example, if a water quality event triggers the *State Emergency & Rescue Management Act 1989*, the processes and responses specified in that Act will prevail.

The management responses in Table 3-1 and Table 3-2 constitute **options for consideration** by the resource managers and the CWAP when convened, and are consistent with the statutory priorities and approaches set out in section 1.2.

Three general principles will apply in relation to drought or water shortage response measures:

- Every attempt will be made to maintain the operation of the statutory water sharing plans (as per principle one of the NSW Extreme Events Policy).
- The Government will expect water access licence holders to use the water market to manage their own supply shortage risks in all but extreme circumstances (evidence of actual or imminent market failure).
- In all but very extreme circumstances, restricted access will apply at the access licence 'category' or 'sub-category' level. Available water determinations for one or more individual access licences (as provided for under s.59(1)(b) of the WMA) will only be used as a last resort.

These response measures aim to maximise certainty provided to water users, whilst balancing the need to implement fit-for-purpose strategies that treat all licence holders within a licence category or sub-category equally in accordance with principles four, five and six in the NSW Extreme Events Policy. The statutory priorities for water access rights outlined in section 1 of this IRG will apply if water access needs to be reduced in response to an extreme event. To be clear, higher priority access rights will be reduced to a lesser extent than lower priority access rights. This does not mean that higher priority rights must be satisfied in full prior to making water available to lower priority rights. It does mean, however, that higher priority rights cannot be reduced to the same extent as, or more than, lower priority access rights.

Connectivity between water sources should be considered by resource managers and the CWAP when convened, to ensure water is available to meet critical human needs in connected systems during an extreme event. This is consistent with principle nine of the NSW Extreme Events Policy.

3.7 Water quantity event management

Table 3-1 outlines the potential measures available if circumstances cause the quantity or accessibility of groundwater in all or part of a WRPA to become insufficient for meeting critical human and non-human water requirements.

Water shortage criticality is assessed through analysis by NSW Department of Industry of groundwater level and pressure data from monitoring undertaken by WaterNSW.

Table 3-1. IRG criticality matrix and management responses for extreme water quantity events within NSW groundwater WRPAs.

| Criticality Level | Management Response Toolkit Options and Responsibility |
|---|---|
| <p>Stage 1</p> <p>Groundwater levels remain within acceptable ranges, with annual recovery as expected given rainfall/recharge events</p> | <p>NSW Department of Industry and WaterNSW:</p> <ul style="list-style-type: none"> • Maintain WSP rules for distribution of access • Ongoing monitoring of groundwater levels and take • Planning/programs for continuity of access for BLR for 'efficiently' constructed works⁴ • Planning under the Regional Water Strategy. <p>LWUs:</p> <ul style="list-style-type: none"> • Long term water security and emergency/drought contingency planning as part of IWCM Strategy. |
| <p>Stage 2</p> <p>Unacceptable groundwater level and or pressure declines potentially or actually impacting on groundwater availability to high priority GDEs, BLRs and/or LWUs</p> <p>Drawdown to levels that could lead to sediment compaction</p> | <p>NSW Department of Industry and WaterNSW:</p> <p>As for green (Stage 1) criticality, and in addition:</p> <ul style="list-style-type: none"> • Assess the extent of the actual or potential impact - the entire water source or a local area. • As and where required, impose extraction restrictions (s.324 WMA) on lower priority AALs within the impacted areas, and/or restrict or deny trades (allocation or share assignments) if that would result in an increase in authorised extraction in the impacted area: <ul style="list-style-type: none"> ○ to maintain or protect water levels/water pressure at key points within the groundwater source (i.e. at key monitoring bores), or ○ to prevent potential subsidence or compaction in a water source, or ○ to protect groundwater-dependent ecosystems. <p>LWUs:</p> <ul style="list-style-type: none"> • Accelerate implementation of the IWCM Strategy measures and commence readiness planning of Emergency/drought contingency response plan measures. • Cl. 136 Water Management (General) Regulation 2011 (WMA regulation) notices as required. |

⁴ See limitations on this protection as set out in section 1.3.2.1

| Criticality Level | Management Response Toolkit Options and Responsibility |
|---|---|
| <p>Stage 3</p> <p>Continuing unacceptable groundwater level or pressure declines</p> <p>Unacceptable drawdown impacts on 'efficiently constructed' BLR bores (i.e. levels below the pump or deeper than the bore)</p> <p>Evidence of aquifer compaction</p> | <p>NSW Department of Industry and WaterNSW:</p> <p>As for yellow (Stage 2) criticality, and in addition:</p> <ul style="list-style-type: none"> • Commence implementation of protection measures for efficiently constructed BLR bores, if required • Possible s.49A or s. 49B WMA suspension of water allocation account clauses in applicable WSP, with temporary arrangements that: <ul style="list-style-type: none"> ○ Amend the take limit specified in the plan (individual account take limits) ○ Limit the AWD for AALs within the impacted area (s.59(1)(b) of the WMA) ○ Limit the AWD for AALs for one or more individual access licences (s.59(1)(b) of the WMA) ○ Limit the AWD for high priority access licences to <100% consistent with the priorities in Table 1-2. <p>LWUs:</p> <ul style="list-style-type: none"> • Continue accelerated implementation of the IWCM Strategy measures, commence implementation of demand-side emergency/drought contingency response plan measures, and continue readiness planning of supply-side emergency measures • Cl. 136 WMA regulation notices as required. |
| <p>Stage 4</p> <p>Water level declines pose a risk to long term availability of the groundwater resources - subsidence, and/or mobilisation and induced flow of poorer water quality</p> <p>Access by 'efficiently constructed' BLR bores significantly impacted</p> | <p>NSW Department of Industry and WaterNSW:</p> <p>As for orange (Stage 3) criticality, and in addition:</p> <ul style="list-style-type: none"> • Potential suspension of all take under AALs, except in accordance with the priorities in Table 1-2 • Further restriction of priority access in Table 1-2 as required • If necessary, S.324 WMA order restricting groundwater take by LWUs and under BLRs • S.331 WMA 2000 restrictions on BLR access, either generally, or in accordance with Reasonable Use Guidelines (s.336 WMA) <p>LWUs:</p> <ul style="list-style-type: none"> • Complete implementation of the IWCM Strategy, review and enhance implementation of demand-side emergency/drought contingency response plan, and commence implementation of supply-side emergency measures • Cl. 136 WMA regulation notices as required. |

3.8 Water quality event management

Table 3-2 outlines the potential measures available if an event causes the groundwater in all or part of a WRPA to be of insufficient quality to meet critical human and non-human water requirements and other established local values and uses.

Water quality event management in NSW is the responsibility of a wide variety of organisations, including NSW State agencies, NSW local government and the Murray Darling Basin Authority (only for those events within the Murray-Darling Basin). The NSW EPA is the primary regulatory authority of water pollution activities. In most other cases, the regulatory authority is the relevant local council. WaterNSW is responsible for implementing management strategies throughout their areas of operation. NSW Department of Industry and the Office of Environment and Heritage contribute to water quality management through the development of Water Quality Management Plans and Long Term Watering Plans respectively, within the Murray-Darling Basin.

Table 3-2 includes only management responses that relate directly to the availability of water for use consistent with the Basin Plan and NSW WSPs, and the impact that water quality events may have on this water availability. It does not include actions undertaken by the EPA under the relevant environmental protection legislation, including pollution control mechanisms and management orders relating to significantly contaminated land. Water quality criticality will typically be evidenced by:

- Water quality 'event' reporting to the EPA
- Declarations of significantly contaminated land under Division 2, Part 3 of the NSW *Contaminated Land Management Act 1997* Exceedance of Australian Drinking Water Guidelines 2011 values as specified in LWUs' Drinking Water Management Systems
- Water quality sampling and analysis that reveals a potential risk to water quality, for example unusual levels of :
 - dissolved oxygen
 - pH
 - salinity
 - heavy metals
 - organic compounds
 - nitrates
 - other known contaminants, etc.

Table 3-2. IRG criticality matrix and management responses for extreme water quality events within NSW groundwater WRPAs.

| Criticality Level | Management Response Toolkit Options and Responsibility |
|---|--|
| <p>Stage 1</p> <p>Raw water able to be treated under normal process conditions</p> <p>Water quality able to meet other established local values and uses</p> | <p>NSW Department of Industry and WaterNSW:</p> <ul style="list-style-type: none"> • Maintain WSP rules for distribution of access • Ongoing monitoring of groundwater quality • Mapping of reports from EPA (below) against groundwater vulnerability. <p>LWUs:</p> |
| <p>Stage 2</p> <p>Raw water able to be treated with some adjustments (minor cost) to process conditions</p> <p>Water quality able to meet other established local values and uses</p> | <ul style="list-style-type: none"> • Implementation of Quality Assurance Program –Drinking Water Management System (DWMS) under the NSW Public Health Act 2010 and Public Health Regulation 2012 • Cl. 136 WMA regulation notices as required. <p>Others:</p> <ul style="list-style-type: none"> • EPA reporting to NSW Department of Industry of any: <ul style="list-style-type: none"> ○ Existing or new declarations of significantly contaminated land under Division 2, Part 3 of the NSW <i>Contaminated Land Management Act 1997</i> ○ Pollution incidents reported under the POEO Act ○ EPLs in the groundwater sources, particularly for underground fuel storage and waste disposal/management. |
| <p>Stage 3</p> <p>Raw water able to be treated with major adjustments (major cost) to process conditions</p> <p>Water quality unable to meet some established local values and uses</p> | <p>As for Stage 1 & 2 criticality, and in addition:</p> <p>NSW Department of Industry and WaterNSW:</p> <ul style="list-style-type: none"> • Apply WMA s.324 and/or s.331 orders restricting or prohibiting groundwater take if necessary in affected areas • Notify groundwater works approval holders in affected areas of potential water quality issues • Apply WMA s.110 order placing an embargo on applications for new bores (water supply works) in specified areas • Broad public communications re: groundwater quality/contamination risks • NSW Department of Industry notification of groundwater quality contamination to EPA, NSW Health and LWU. <p>Others:</p> <ul style="list-style-type: none"> • EPA implementing and reporting to NSW Department of Industry of any incident or contaminated lands management actions triggered under the <i>Contaminated Land Management Act 2007</i> or the POEO Act • EPA notification of groundwater quality contamination to NSW Health, NSW Department of Industry and LWU. |
| <p>Stage 4</p> <p>Raw water:</p> <ul style="list-style-type: none"> • Unable to be treated with current process train, to meet ADWG health-related values • Likely to remain untreatable over the longer term <p>Water quality unable to meet most established local values and uses</p> | <p>As for Stage 3 criticality, and in addition:</p> <ul style="list-style-type: none"> • If required, activate provisions of the <i>Essential Services Act 1988</i> and the <i>State Emergency and Rescue Management Act 1989</i> as required therein. |

3.9 Returning to standard management practices following an extreme event

As conditions improve, a conservative, risk-based approach will be taken when making decisions to conclude measures that were implemented during stages 2 to 4. This is to ensure that de-escalation does not exacerbate conditions and cause a need for the decision to be reversed. Consultation with key stakeholders is expected to occur prior to any decision being made. Providing certainty to the market is also a key consideration.

A decision to recommence any suspended water sharing plan provisions earlier than at the end of the water year will be made by the Minister for Regional Water with the concurrence of the Minister for the Environment. All other decisions may be made by the Executive Director, Water. For water quality, a return to standard operations will occur when raw water is able to be effectively treated under normal process conditions and the water quality is able to meet other established local values and uses.

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4 IRG evaluation and review

The IRG evaluation framework outlined in Figure 4-1 will be used to assess the effectiveness of IRGs and to inform IRG reviews. The evaluation framework follows a program logic approach that is consistent with NSW Government Program Evaluation Guidelines and other NSW Department of Industry MER frameworks. The IRGs will be reviewed every 5 years consistent with review of the NSW Extreme Events Policy, or earlier if specified triggers are reached. IRG evaluation findings are relevant to NSW Department of Industry annual Basin Plan reporting against Schedule 12, Matter 13.

Under the Basin Plan and individual WRPs, it is the formal responsibility of NSW Department of Industry to monitor new scientific knowledge relevant to the likelihood of extreme events of a kind referred to in section 10.51(1) of the Basin Plan. It is also NSW Department of Industry's formal responsibility to consider if the water resources in a WRPA should be managed differently as a result of the new information.

To this end, NSW Department of Industry, in consultation with the relevant CWAP will review IRGs after significant incidents or when other improvement opportunities are identified (in accordance with principle eight of the NSW Extreme Events Policy), such as:

- Through any applicable groundwater or surface water monitoring, evaluation and reporting plan or relevant strategy.
- If there are significant changes to water infrastructure or water savings measures.

In addition, NSW Department of Industry will undertake a review of IRGs in concert with any review of the water sharing plans for surface or groundwater sources applicable in the relevant WRPA, or of the relevant WRP. Evaluation findings will be taken into consideration during IRG reviews.

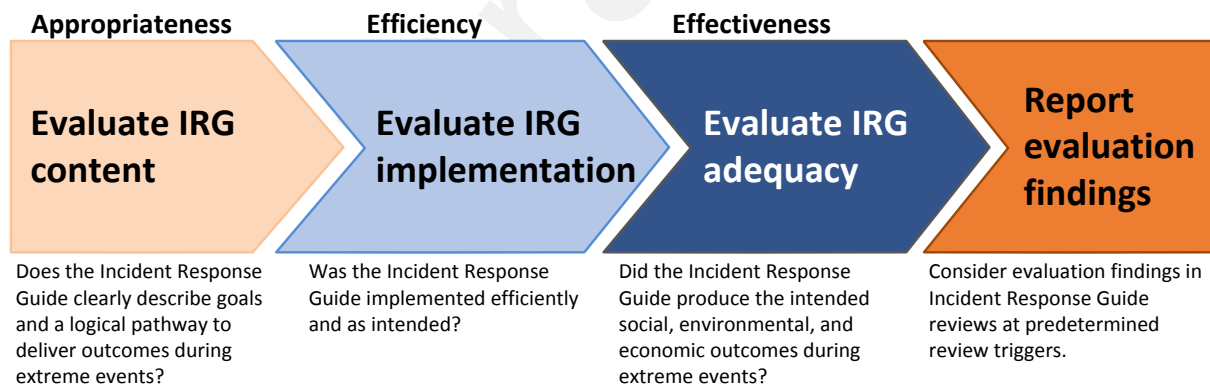


Figure 4-1. IRG evaluation and review framework

A key feature of the evaluation framework is flexibility which allows assessment effort to be varied according to event type and severity. The extent of IRG evaluation will be determined by the occurrence, scale and intensity of extreme events during the review period. Evaluation will only progress through the framework if evidence is available to assess the framework stage. Effectiveness evaluation will only occur if both appropriateness and efficiency stages are completed. This approach avoids unnecessary review of IRG content and ensures findings are only made when adequate evidence is available. For example evaluation will be restricted to assessing IRG appropriateness if no triggers to implement measures under the IRG have occurred during the review period.

Evaluation in this context is a systematic, evidence-based review of IRG success in meeting critical human and non-human water requirements during extreme events. Identification of

factors that enable or restrict the achievement of desired outcomes is also considered. A series of questions are used to evaluate each framework stage; examples are provided in Appendix E. Questions may be restricted or extended according to required evaluation effort.

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Appendix A. WRPs and applicable WSPs

| WRPA GW No. | WRPA and 2019 WSPs | Applicable WSPs pre 2019 |
|-------------|---|--|
| 6 | NSW Murray-Darling Basin Porous Rock | NSW Murray-Darling Basin Porous Rock Groundwater Sources 2012 |
| 7 | Darling Alluvium | Barwon-Darling Unregulated and Alluvial Water Sources 2012 Lower Murray-Darling Unregulated and Alluvial Water Sources 2011 Intersecting Streams Unregulated and Alluvial Water Sources 2011 |
| 8 | Murray Alluvium | Lower Murray Groundwater Source 2006 Murray Unregulated and Alluvial Water Sources 2012 Lower Murray Shallow Groundwater Source 2012 Murrumbidgee Unregulated and Alluvial Water Sources 2012 |
| 9 | Murrumbidgee Alluvium | Lower Murrumbidgee Groundwater Sources 2006 Murrumbidgee Unregulated and Alluvial Water Sources 2012 |
| 10 | Lachlan Alluvium | Lachlan Unregulated and Alluvial Water Sources 2012 Lower Lachlan Groundwater Source 2008 |
| 11 | NSW Murray-Darling Basin Fractured Rock | NSW Murray-Darling Basin Fractured Rock Groundwater Sources 2012 |
| 12 | Macquarie-Castlereagh Alluvium | Lower Macquarie Groundwater Sources 2008 Macquarie Bogan Unregulated and Alluvial Water Sources 2012 Castlereagh River Unregulated and Alluvial Water Source 2011 |
| 13 | NSW Great Artesian Basin Shallow | NSW Great Artesian Basin Shallow Groundwater Sources 2011 |
| 14 | Namoi Alluvium | Peel Valley Regulated, Unregulated, Alluvium and Fractured Rock Water Sources 2010 Upper and Lower Namoi Groundwater Sources 2006 Namoi Unregulated and Alluvial Water Sources 2012 |
| 15 | Gwydir Alluvium | Lower Gwydir Groundwater Source 2006 Gwydir Unregulated and Alluvial Water Sources 2012 |
| 18 | NSW Border Rivers Alluvium | NSW Border Rivers Unregulated and Alluvial Water Sources 2012 |

Appendix B. NSW extreme event operating context and relevant plans

A range of instruments exist within NSW that have relevance for the management of extreme water quantity and quality events. Some of these instruments specify the development and implementation of statutory 'plans' or 'systems'. The information below summarises those instruments of relevance to this IRG.

| Instrument ⁵ | Event Relevance | Summary | 'Plan' or other Obligation | Responsibility ⁶ |
|---|---------------------------------|---|--|--------------------------------|
| Best Practice Management Guidelines (<i>Local Government Act 1993</i> (NSW), S. 409(6)(a)) | Water quantity and quality | Administered by NSW Department of Industry, sets out best practice long-term water security, water quality & emergency response contingency planning and management and expectations of LWUs. Includes: <ul style="list-style-type: none"> • 30-year strategy for supply-demand measures. • Trigger points for drought water restrictions. • Identification of contingencies to ensure water supply system does not run out of water. | Integrated Water Cycle Management Strategy. Drought Management Plan. | LWU |
| <i>Essential Services Act 1988</i> | Water quality Water quantity | Applies to those services classified as essential including: <ul style="list-style-type: none"> • Supply or distribution of water. • Regulation of bulk water supply by the Water Administration Ministerial Corporation in the exercise of its rights to the control, use and flow of water. | Links to EMPLAN. | Depends on event. |
| <i>Protection of the Environment Operations Act 1997</i> | Water quality (environment) | Important for: <ul style="list-style-type: none"> • Licensing and compliance. • Incident response management. | Environment Protection Licence. Pollution Incident Response Management Plans. | Licence Holder (LWU or other). |

⁵ NSW instruments unless otherwise specified. A reference to an Act also implies a reference to a regulation (if not specifically stated).

⁶ For plan implementation and revision.

| Instrument ⁵ | Event Relevance | Summary | 'Plan' or other Obligation | Responsibility ⁶ |
|--|---|--|--|-----------------------------|
| | | <ul style="list-style-type: none"> The requirement to publish and/or make pollution monitoring data available. The requirement for organisations and individuals to report pollution incidents. | | |
| <i>Contaminated Land Management Act 1997</i> and Regulation | Water quality | Declaration and management of contaminated lands, including responsibilities, assessment of contamination and the supervision of the investigation and management of contaminated sites | Plans of Management, management and maintenance orders. | EPA and 'owner' |
| <i>Public Health Act 2010</i> Public Health Regulation 2012 | Water quality (drinking water) | The <i>Public Health Act 2010</i> along with the Public Health Regulation 2012 (Clause 34), require water suppliers to implement and adhere to a 'quality assurance program' consistent with the Framework for Management of Drinking Water Quality in the <i>Australian Drinking Water Guidelines</i> (2011). | Quality Assurance Program – interpreted practically as a Drinking Water Management System (DWMS) | LWU |
| <i>State Emergency and Rescue Management Act 1989</i> | Overarching (general, can include environment, public health) | Management of imminent or actual emergencies. | State-wide Emergency Management Plan or EMPLAN. Subordinate plans: <ul style="list-style-type: none"> Energy and Utilities Services Supporting Plan. Engineering Services Supporting Plan. Environmental Services Supporting Plan. Health Services Supporting Plan. | Depends on event |

Appendix C. Contact details

This appendix provides indicative information for all groundwater WRPA IRGs.

| Agency | Contact Details |
|---|--|
| NSW Department of Industry | Ph: 02 9338 6600 Email: complete our online contact us form |
| Natural Resources Access Regulator (NRAR) | Report illegal activities Ph: 1800 633 362 Email: nrar.enquiries@nrar.nsw.gov.au |
| WaterNSW | Ph: 1300 662 077 Email: Customer.Helpdesk@waternsw.com.au Emergency reporting: 1800 061 069 |
| Environment Protection Authority | Ph: 131 555 Email: info@epa.nsw.gov.au |
| Office of Environment and Heritage | Ph: (02) 9995 5000 or 131 555 Email: info@environment.nsw.gov.au |
| Department of Primary Industries - Agriculture | Ph: 1800 808 095 Email: nsw.agriculture@dpi.nsw.gov.au |
| Fire and Rescue NSW and other emergency services including Rural Fire Service, SES and NSW Police | 000 |
| Local Water Utilities | Specific to WRP area. See appendices for details of LWUs |
| Local Land Services | See website for regional contact details |
| NSW Health - Water Unit | Ph: 02 9391 9939 Email: waterqual@doh.health.nsw.gov.au |

Appendix D. Glossary of groundwater terms

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| Alluvial aquifer | A groundwater system whose geological matrix is composed of unconsolidated sediments consisting of gravel, sand, silt and clay transported and deposited by rivers and streams. |
| Alluvium | Unconsolidated sediments deposited by rivers or streams consisting of gravel, sand, silt and clay, and found in terraces, valleys, alluvial fans and floodplains. |
| Aquifer | Under the <i>Water Management Act 2000</i> an aquifer is a geological structure or formation, or an artificial landfill that is permeated with water or is capable of being permeated with water. More generally, the term aquifer is commonly understood to mean a groundwater system that can yield useful volumes of groundwater. For the purposes of groundwater management in NSW the term 'aquifer' has the same meaning as 'groundwater system' and includes low yielding and saline systems. |
| Anabranch | Stable multi-thread channels that are intermediate between single thread and braided channels characterised by vegetation or otherwise stable alluvial islands that divide flows at discharges up to nearly bank-full. |
| Aquitard | A confining low permeability layer that retards but does not completely stop the flow of water to or from an adjacent aquifer, and that can store groundwater but does not readily release it. |
| Artesian | Groundwater which rises above the surface of the ground under its own pressure by way of a spring or when accessed by a bore. |
| Archean | The Archean Era spanned 4.56 to 2.5 billion years ago. |
| Australian Height Datum (AHD) | Elevation in metres above mean sea level. |
| Available water determination | A determination referred to in section 59 of the <i>Water Management Act 2000</i> that defines a volume of water or the proportion of the share component (also known as an 'allocation') that will be credited to respective water accounts under specified categories of water access licence. Initial allocations are made on 1 July each year and, if not already fully allocated, may be incremented during the water year. |
| Baseflow | Discharge of groundwater into a surface water system. |
| Basement (rock) | See Bedrock |
| Basic landholder rights (BLR) | Domestic and stock rights, harvestable rights or native title rights. |
| Bedding | Discrete sedimentary layers that were deposited one on top |

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| | of another. |
| Bedrock | A general term used for solid rock that underlies aquifers, soils or other unconsolidated material. |
| Beneficial use (category) | ⁷ A general categorisation of groundwater uses based on water quality and the presence or absence of contaminants. Beneficial use is the equivalent to the 'environmental value' of water. |
| Bore (or well) | A hole or shaft drilled or dug into the ground... |
| Brackish water | Water with a salinity between 3,000 and 7,000 mg/L total dissolved solids. |
| Cenozoic | The Cenozoic Era spanned from 66 million years ago to present |
| Confined aquifer | An aquifer which is bounded above and below by impermeable layers causing it to be under pressure so that when the aquifer is penetrated by a bore, the groundwater will rise above the top of the aquifer. |
| Connected water sources | Water sources that have some level of hydraulic connection. |
| Development (of a groundwater resource) | The commencement of extraction of significant volumes of water from a water source. |
| Discharge | Flow of groundwater from a groundwater source. |
| Drawdown | The difference between groundwater level/pressure before take and that during take. |
| Dual porosity | Where a groundwater system has two types of porosity; primary porosity resulting from the voids between the constituent particles forming the rock mass, and secondary porosity resulting from dissolution, faulting and jointing of the rock mass. |
| Electrical conductivity (EC) | Ability of a substance to conduct an electrical current. Used as a measure of the concentration of dissolved ions (salts) in water (i.e. water salinity). Measured in micro-Siemens per centimetre ($\mu\text{S}/\text{cm}$) or deci-Siemens per metre (dS/m) at 25° C. 1 dS/m = 1000 $\mu\text{S}/\text{cm}$ |
| Environmental Value | ⁸ Particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health and which require protection from the effects of contamination, waste discharges and deposits. |
| Fractured rock | Rocks with fractures, joints, bedding planes and cavities in the rock mass. |
| Geological sequence | A sequence of rocks or sediments occurring in chronological order. |

⁷ As defined in 'Macro water sharing plans – the approach for groundwater' (NSW Office of Water, 2011)

⁸ As defined in 'Guidelines for Groundwater Quality Protection in Australia 2013' published by the National Water Quality Management Strategy.

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| Groundwater | Water that occurs beneath the ground surface in the saturated zone. |
| Groundwater Dependent Ecosystem (GDE) | ⁹ Ecosystems that require access to groundwater to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services. |
| Geological formation | A fundamental lithostratigraphic unit used in the local classification of strata and classified by the distinctive physical and chemical features of the rocks that distinguish it from other formations. |
| Groundwater equilibrium | A state where the forces driving groundwater flow have reached a balance in a groundwater system, for example where groundwater inflow equals groundwater outflow. |
| Groundwater system | Any type of saturated sequence of rocks or sediments that is in hydraulic connection. The characteristics can range from low yielding and high salinity water to high yielding and low salinity water. |
| Hydraulic conductivity | The capacity of a porous medium to transmit water. Measured in meters/day. |
| Hydraulic connection | A path or conduit allowing fluids to be connected. The degree to which a groundwater system can respond hydraulically to changes in hydraulic head. |
| Hydraulic head | The height of a water column above a defined point, usually expressed in metres. |
| Hydrogeology | The branch of geology that relates to the occurrence, distribution and processes of groundwater. |
| Hydrograph | A plot of water data over time. |
| Kriging | A method of interpolation using a weighted average of neighbouring samples to estimate an 'unknown' value at a given location to create surfaces. |
| Long term average annual extraction limit (LTAAEL) | The long term average volume of water (expressed in megalitres per year) in a water source available to be lawfully extracted or otherwise taken. |
| Igneous rock | Rocks which have solidified from a molten mass. |
| Infiltration | The movement of water from the land surface into the ground. |
| Ion | Mineral species dissolved in groundwater. |
| Make good provisions (in reference to a water | The requirement to ensure third parties have access to an equivalent supply of water through enhanced infrastructure or other means for example deepening an existing bore, funding |

⁹ Kuginis L., Dabovic, J., Byrne, G., Raine, A., and Hemakumara, H. 2016, *Methods for the identification of high probability groundwater dependent vegetation ecosystems*. DPI Water, Sydney, NSW.

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| supply work) | extra pumping costs or constructing a new pipeline or bore. |
| Management zone | A defined area within a water source where a particular set of water sharing rules applies. |
| Mesozoic | The Mesozoic Era spanned 252 to 66 million years ago |
| Metamorphic rock | Rocks that result from partial or complete recrystallisation in the solid state of pre-existing rocks under conditions of temperature and pressure. |
| Minimal impact considerations | Factors that need to be assessed to determine the potential effect of aquifer interference activities on groundwater and its dependent assets. |
| Monitoring bore | A specially constructed bore used to measure groundwater level or pressure and groundwater quality at a specific depth. Not intended to supply water. |
| Ongoing take | The take of groundwater that occurs after part or all of the principal activity has ceased. For example extraction of groundwater (active take) entering completed structures, groundwater filling abandoned underground workings (passive take) or the evaporation of water (passive take) from an abandoned excavation that has filled with groundwater. |
| Outcrop | Rocks which are exposed at the land surface. |
| Piezometric or Potentiometric head | The pressure or hydraulic head of the groundwater at a particular depth in the ground. In unconfined aquifers this is the same as the water table. |
| Palaeozoic | The Palaeozoic Era spanned 541 to 252 million years ago. |
| Perched water table | A local water table of very limited extent which is separated from the underlying groundwater by an unsaturated zone. |
| Permeability | The capacity of earth materials to transmit a fluid. |
| Porous rock | Consolidated sedimentary rock containing voids, pores or other openings in the rock (such as joints, cleats and/or fractures). |
| Pre-development | Prior to development of a groundwater resource. |
| Proterozoic | The Proterozoic Era spanned 2.5 billion to 541 million years ago. |
| Recharge | The addition of water into a groundwater system by infiltration, flow or injection from sources such as rainfall, overland flow, adjacent groundwater sources, irrigation, or surface water sources. |
| Recovery | The rise of groundwater levels or pressures after groundwater take has ceased. Where water is being added, recovery will be a fall. |
| Recovery decline | Where groundwater levels or pressures do not fully return to the previous level after a period of groundwater removal or addition. |

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| Reliable water supply | ¹⁰ Rainfall of 350mm or more per annum (9 out of 10 years); or a regulated river, or unregulated rivers where there are flows for at least 95% of the time (i.e. the 95th percentile flow of each month of the year is greater than zero) or 5th order and higher rivers; or groundwater aquifers (excluding miscellaneous alluvial aquifers, also known as small storage aquifers) which have a yield rate greater than 5L/s and total dissolved solids of less than 1,500mg/L. |
| River Condition Index (RCI) | This is a spatial tool used to measure and monitor the long term trend of river condition, but also reports on instream values and risk to instream values from extraction and geomorphic disturbance. |
| Salinity | The concentration of dissolved minerals in water, usually expressed in EC units or milligrams of total dissolved solids per litre. |
| Salt | A mineral which in a liquid will readily dissociate into its component ionic species for example NaCl into Na ⁺ and Cl ⁻ ions. |
| Saturated zone | Area below the water table where all soil spaces, pores, fractures and voids are filled with water. |
| Sedimentary rock | A rock formed by consolidation of sediments deposited in layers, for example sandstone, siltstone and limestone. |
| Share component | An entitlement to water specified on an access licence, expressed as a unit share or for specific purpose licences a volume in megalitres (eg. LWU, major water utility and domestic and stock). |
| Sustainable Diversion Limits | The volume of water that can be taken from a Sustainable Diversion Limit resource unit as defined under the Murray Darling <i>Basin Plan 2012</i> . |
| Unassigned water | Exists where current water requirements (including licensed volumes and water to meet basic landholder rights) are less than the extraction limit for a water source. |
| Unconfined aquifer | A groundwater system usually near the ground surface, which is in connection with atmospheric pressure and whose upper level is represented by the water table. |
| Unconsolidated sediment | Particles of gravel, sand, silt or clay that are not bound or hardened by mineral cement, pressure, or thermal alteration of the grains. |
| Unsaturated zone | Area above the water table where soil spaces, pores, fractures and voids are not completely filled with water. |
| Water balance | A calculation of all water entering and leaving a system. |

¹⁰ As defined by Strategic Regional Land Use Plans

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| Water resource plan | ¹¹ A plan made under the <i>Commonwealth Water Act 2007</i> that outlines how a particular area of the Murray–Darling Basin’s water resources will be managed to be consistent with the Murray–Darling Basin Plan. These plans set out the water sharing rules and arrangements relating to issues such as annual limits on water take, environmental water, managing water during extreme events and strategies to achieve water quality standards and manage risks. |
| Water sharing plan | ¹² A plan made under the <i>Water Management Act 2000</i> which set out the rules for sharing water between the environment and water users within whole or part of a water management area or water source. |
| Water source | Defined under the <i>Water Management Act 2000</i> as ‘The whole or any part of one or more rivers, lakes or estuaries, or one or more places where water occurs naturally on or below the surface of the ground and includes the coastal waters of the State. Individual water sources are more specifically defined in water sharing plans. |
| Water table | Upper surface of groundwater at atmospheric pressure, below which the ground is saturated. |
| Water year | Twelve month period from 1 July to 30 June. |
| Yield | The amount of water that can be supplied over a specific period. |

¹¹ <https://www.mdba.gov.au/basin-plan-roll-out/water-resource-plans> 21/03/17

¹² As defined in ‘*Macro water sharing plans – the approach for groundwater*’ (NSW Office of Water, 2011)

Appendix E. Evaluation questions

In the context of this document evaluation refers to a systematic, evidence-based assessment of IRG success in meeting critical human and non-human water requirements during extreme events. Review refers to the formal revision and updating of IRG documents.

The following questions are a guide to IRG appropriateness, efficiency and effectiveness evaluation. The nature of extreme events may restrict or extend this list. Question scope should be considered prior to commencing any evaluation. Also note evaluation is a staged process progressing only when adequate evidence is available with effectiveness evaluation reliant on completion of appropriateness and effectiveness stages.

Appropriateness example evaluation questions

Does the IRG reflect current policy and legislative instruments such as the NSW Extreme Events Policy, Water Management Act 2000, Basin Plan 2012 and relevant WSPs?

Does the IRG clearly describe critical water needs and how they will be prioritised and met during an extreme event?

Are the described range of measures and triggers appropriate for the WRP area?

Are the governance arrangements for the establishment and operation of CWAPs appropriate and readily available?

(This includes membership, decision documentation, and communications)

Is the decision making process clearly defined, well documented and transparent?

Does the IRG base management of water resources during extreme events on the best available scientific event likelihood information?

(This is a requirement of the BP 10.51(1))

Is the range of instruments and information identified in the IRG and Appendices A, B and C appropriate, relevant and current?

Efficiency example evaluation questions

Was relevant and adequate information readily available throughout the review period to detect an approaching extreme event?

(e.g. water level assessments, salinity and pollution monitoring)

Did an extreme event occur during the review period?

If yes, IRG efficiency and effectiveness can be evaluated and the following questions assessed.

Was a CWAP formed when required?

Was adequate and timely information available to inform CWAP decisions?

Were CWAP decisions made in a timely, transparent manner?

Were CWAP decisions well documented and communicated efficiently and as early as possible to stakeholders?

Were multi-state, multi-agency and issue-specific groups consulted when relevant and in a timely manner?

Efficiency example evaluation questions

Were issue specific management plans utilised when required?

Were the staged responses adequately spaced, realistic, and a relevant guide to CWAP decisions?

Was the IRG reviewed and updated by NSW Department of Industry and the CWAP after significant events and at other identified review trigger points?

Has a list of relevant scientific knowledge and information sources been identified to inform IRG review?

Effectiveness example evaluation questions

Was the IRG effective in delivering outcomes to meet the critical human and non-human needs identified in Table 1-3?

Outcomes should be assessed with regard to: appropriateness and efficiency findings; both intended outcomes and unintended adverse outcomes; WMA 2000 take priority during extreme events; and non-water management contextual information.

Effectiveness assessment is based on economic, social, and environmental outcomes and assessed in the following groups. Performance indicators have not been specified at this stage due to the variable nature, extent and duration of extreme events. Information collected under a variety of monitoring programs and WRP specific MER plans will be considered in IRG evaluation and review.

Appendix F. Gwydir Alluvium WRP

Context

The Gwydir Alluvium WRP (Figure F 1) includes the following SDL resource units, the boundaries of which correspond with groundwater sources managed under the *Water Sharing Plan for the Gwydir Alluvial Groundwater Sources 2019*:

- Lower Gwydir Alluvium (GS24),
- Upper Gwydir Alluvium (GS43).

A fuller description of the WRP can be found in the Gwydir Alluvium Water Resource Plan – Groundwater Resource Description (NSW Department of Industry, 2018).

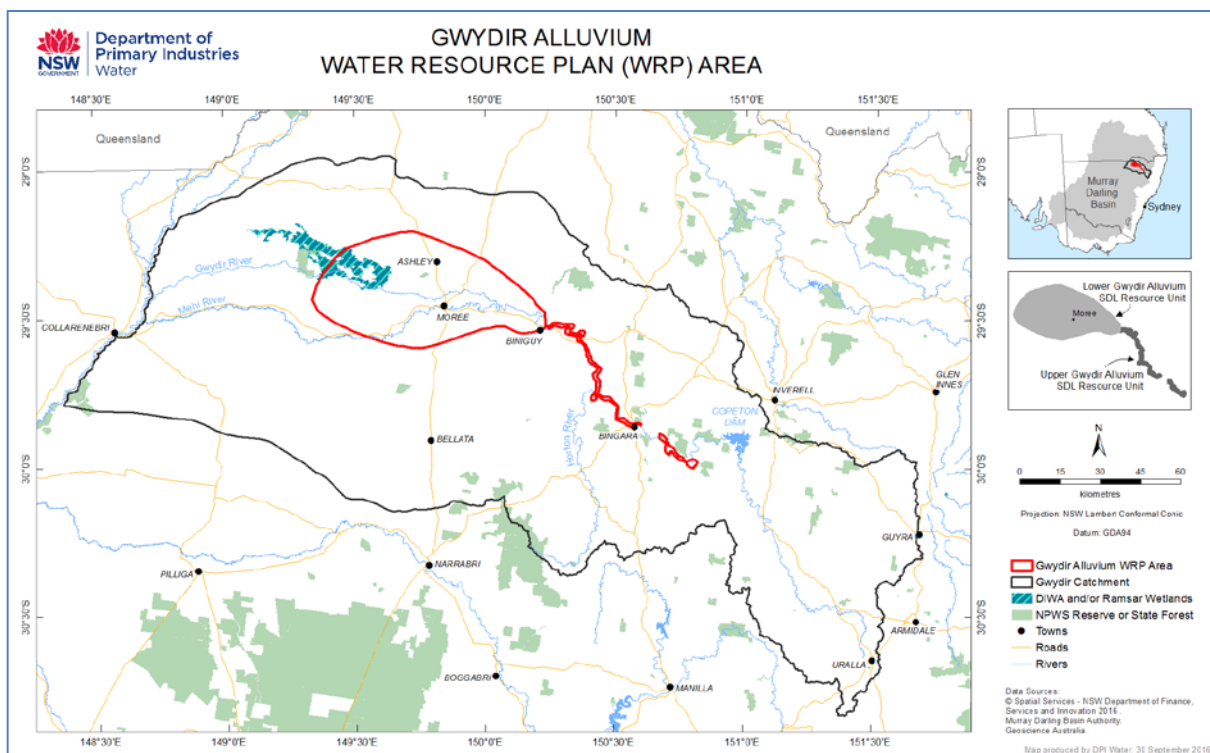


Figure F 1: Gwydir Alluvium WRP

Critical human and non-human water requirements

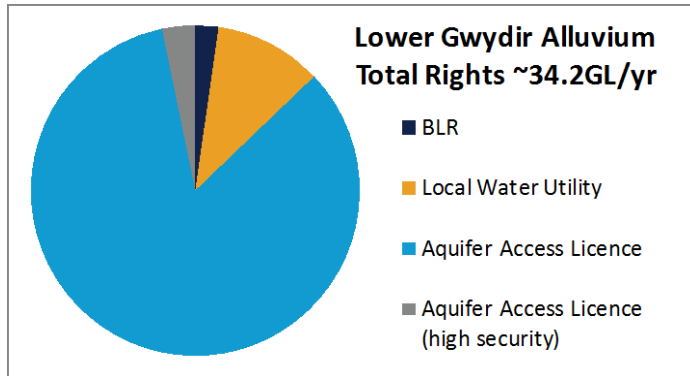
Overview

The Basin Plan establishes the following sustainable diversion limits from the Gwydir Alluvium WRP:

- 32.9 GL/yr from the Lower Gwydir Alluvium, consisting of 32.3GL/yr issued as access licences and 0.6 GL/yr for Basic Landholder Rights
- 0.72 GL/yr from the Upper Gwydir Alluvium, consisting of 0.64GL/yr issued as access licences and 0.08GL/yr for Basic Landholder Rights.

The distribution of water access rights in the Gwydir Alluvium WRPA is shown in Figure F 2. The majority is issued in the Lower Gwydir Alluvium with greater than 96% of these rights in the Lower Gwydir Alluvium.

In the Lower Gwydir Alluvium and Upper Gwydir Alluvium the total volume of water access rights is approximately equivalent to the Basin Plan SDL.



4.1.1 Figure F 2: Rights to access groundwater in the Gwydir Alluvium WRPA

requirements

There are three towns solely dependent on groundwater within the WRPA.

Moree Plains Shire Council holds an entitlement of 3,500ML/yr from the Lower Gwydir for Moree and 72ML/yr for Pallamallawa.

Gwydir Shire Council has a 60ML/yr entitlement in the Upper Gwydir for Gravesend.

The commercial spa operators in Moree are supplied by water from the Great Artesian Basin and not the Gwydir Alluvium.

Non-human water requirements

The groundwater sources of the Gwydir Alluvium WRPA store large volumes of water. The amount of annual recharge¹³ to each is small compared to this stored volume. In this WRPA, the 'stored' groundwater is reserved as environmental water. In addition, in the Upper Gwydir Alluvium and the Lower Gwydir Alluvium the average annual volume of water permitted to be extracted under the rules of the *draft Water Sharing Plan for the Gwydir Alluvial Groundwater Sources 2019* is less than the average annual rainfall recharge to the groundwater source over the long term. This means that in this SDL resource unit, this recharge in excess of the extraction limit is also reserved as environmental water.

River red gum, river coolibah, coolibah-river coolibah – lignum communities dominate both upper and lower Gwydir alluvium in the riparian corridor and on the floodplain. There is a high number of recorded threatened bird and flora species.

Very high and high ecological value vegetation GDEs and associated Ramsar/DIWA wetlands considered as key environmental assets have been scheduled in the *draft Water Sharing Plan for the Gwydir Alluvial Groundwater Sources 2019* as high priority GDEs for management purposes.

Water shortage and quality risks

Change in recovered groundwater levels between 2005-2006 and 2015-16 for the non-pumping period (ie. recovered water levels) in the deep aquifer systems of the Lower Gwydir Alluvium is shown in Figure F 3.

As a result of the continuing groundwater decline in this area, a restricted trading zone has been placed around the area north of Moree to beyond Ashby, limiting transfer of additional entitlements or allocations into these more stressed zones.

Conceptually the dominant recharge process (in terms of total volume) for the Gwydir alluvium is leakage from the overlying rivers and watercourses. In average years, the greatest proportion of recharge is expected to come from direct vertical infiltration from the regulated Gwydir River. Recharge pulses occur after major flood events when large volumes of water, and overbank flooding, results in a higher than average annual recharge to the groundwater system. Some additional recharge is also expected from rainfall, on-farm storages, irrigation losses and groundwater through-flow from the surrounding fractured and porous rock groundwater systems.

The hydrographs also indicate that leakage from the upper groundwater system to the lower groundwater system is occurring in the Lower Gwydir. Extraction from the deeper alluvium will generally result in induced leakage from the shallower alluvium, in some cases resulting in depressurisation and drawdown of the shallow groundwater system.

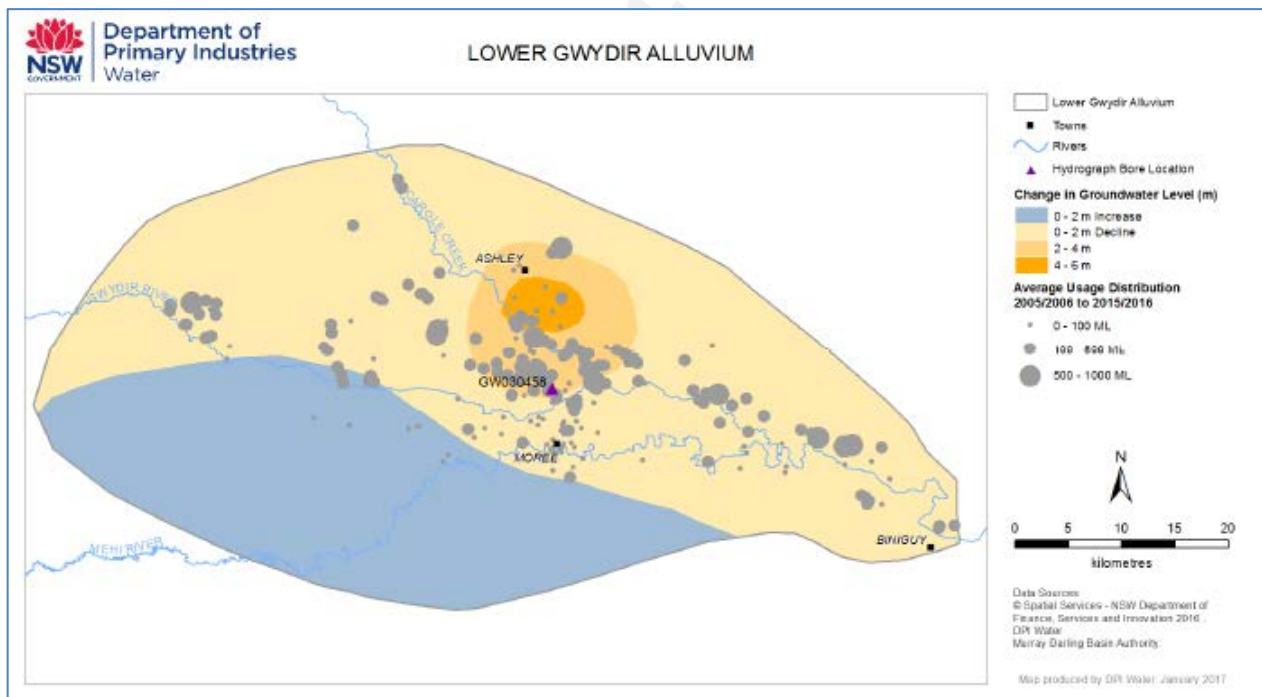


Figure F 3: Change in groundwater levels in the Lower Gwydir deep groundwater system 2005/06 to 2015/16

More detail about specific risks in the Gwydir Alluvium WRPA relating to water quality and quantity can be found in Schedule F of the Gwydir Alluvium Water Quality Management Plan.

References

- Jacobs 2017, *Risk Assessment for the Gwydir Alluvium Water Resource Plan Area (GW15)*
 DPI Water 2017, *Gwydir Alluvium Water Resource Plan (GW15) Water Resource Plan, Status and Issues Paper*

NSW Department of Industry, 2018, *Gwydir Alluvium Water Resource Plan, Groundwater Resource Description*

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