Adelaide Plains MAR: essential criteria for risk management and monitoring plans

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This document is intended as a guide to assist Managed Aquifer Recharge (MAR) scheme owners/operators in developing their risk management and monitoring plans for approval by the Minister. It is not intended to replace independent hydrogeological (including but not limited to hydrogeological modelling) or other expert advice. MAR scheme owner/operators are responsible for assessing the accuracy, currency and completeness of the information in the document by independent verification.

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1 Context

Under the <u>Adelaide Plains Water Allocation Plan</u> (the WAP), the owner/operator of a managed aquifer recharge (MAR) scheme within the Adelaide Plains is responsible for preparing and submitting a risk management and monitoring plan (RMMP) to the Department for Environment and Water (DEW) and the Environment Protection Authority of South Australia (EPA). Approval of an RMMP is required prior to a scheme becoming operational. This is to ensure the scheme operates in accordance with the conditions on EPA and DEW licences and to ensure risks involved with the operation of the scheme are managed to the satisfaction of the Minister.

An environmental authorisation, pursuant to section 40(1) of the *Environment Protection Act 1993,* is required when stormwater is drained or discharged to an aquifer within the Greater Adelaide metropolitan area (Schedule 2 Activity 4(2)(c)) or recycled water containing water treatment chemicals throughout the state (Schedule 2 Activity 8(7)). Since 2022, the recharge water licensee (i.e. scheme owner/operator) must operate in accordance with an RMMP (that has been approved by the Minister), in accordance with Principle 42(e) of the WAP. Similarly, Principle 59 of the WAP now requires an RMMP for a drain or discharge permit issued pursuant to section 104(3)(c) of the *Landscape South Australia Act 2019* (the Act). In summary, it is a condition that licensees/permit holders have an approved RMMP under any of these instruments that may be required to inject and extract water in the operation of a MAR scheme.

In accordance with Principle 42(f) of the WAP, the RMMP must be updated as the scheme's operations changes, and as requested from time to time by the Minister. For example, with the adoption of the WAP came new conditions for recharge water licences. One of these conditions therefore requires all owner/operators of MAR schemes within the Adelaide Plains to review existing RMMPs to ensure that they align with the WAP and demonstrate completion of the following, to the satisfaction of the Minister (or Minister's delegate):

- a risk assessment that is consistent with the <u>National Water Quality Management</u> <u>Strategy – Australian Guidelines for Water Recycling: Managing Health & Environmental</u> <u>Risks, Phase 2- Managed Aquifer Recharge</u> (NRMMC-EPHC-NHMRC 2009), as amended from time to time and/or any subsequent guidelines current at the time; and
- an RMMP that is based on the findings of the risk assessment, which demonstrates that the operational procedures and preventive measures in place will minimise the likelihood of negative consequences identified through the risk assessment.

2 Purpose

This document provides the key criteria expected in an RMMP in line with the regulatory requirements of the EPA and DEW, as well as the content DEW and the EPA require when undertaking the review and approval process. The intention of this document is only to provide guidance to scheme operators and to assist with streamlining the technical assessment process. This guide is not prescriptive and should not limit the scheme operator from adding other information as they see fit. It also does not limit the ability of DEW or the EPA to request other information, as appropriate, for the particular scheme if deemed relevant to manage and assess risks.

The RMMP should be developed to suit each MAR scheme and the scheme owner/operator must ensure the RMMP accurately presents the relevant scheme information. If a scheme owner/operator is unsure of the criteria that apply to them, please contact <u>DEW.MAR@sa.gov.au and epa.marart@sa.gov.au</u>.

3 Assessment Process

The draft RMMP can be submitted by the scheme owner/operator to DEW via email at: <u>DEWWaterLicensing@sa.gov.au</u>. Coordinated technical and regulatory assessment of the draft RMMP will occur between DEW and the EPA. Approval is subject to regulators deeming that the scheme complies with relevant legislation and requirements and that risks are suitably prevented, mitigated and/or managed. If necessary, specific comments will be returned to the scheme owner/operator outlining amendments that need to be made). Once these are addressed, the draft RMMP can be resubmitted.

Provided regulatory requirements are met, the draft RMMP can be approved by the Minister (or Minister's delegate), and the approved final document will be returned to the scheme owner/operator in acknowledgement that this licensed condition has been met.

All RMMPs will require updating and resubmission following the statutory review of the WAP (noting that this is currently legislated as being every ten years). However, it is considered best practice to review an RMMP every 5 years.

4 Content

The RMMP should address the licence requirements for the EPA and DEW, and any relevant background information or associated documentation should be clearly referenced if it is not included in the RMMP.

4.1 Administrative information

Please ensure that the RMMP submitted includes the following key details:

- Cover page with the MAR Scheme(s) name and MAR Scheme Licence Holder Name.
- Endorsement page from the licence holder that includes reference to the associated DEW water licence number and EPA licence number, ideally on the first page (copies of the DEW water licence and EPA licence could be included in the appendices).
- The name of the consultant that prepared the RMMP (if relevant).
- The date and document version on the front page and in the footer on each page.
- A version control table that documents the authors, approvals, document version number and date (also include in the footer), as well as reference to the version number and date of this document referred to in the preparation of the RMMP.

See Section 5 for examples of administrative information.

4.2 Introduction

An introduction to the scheme can include:

- why the RMMP has been developed
- what the RMMP will contain, for example:
 - o condition requirements of the EPA and DEW licences
 - \circ other risks relating to the operation of the scheme
 - details of the preventive measures and monitoring strategies for MAR activities at the scheme.
- reference to the RMMP being a 'living' document that is updated regularly as scheme operation and operators change, as per the EPA licence, and as requested from time to time by the Minister
- key historical context of the scheme(s) and reference to previous RMMPs (if applicable).

4.3 12-element framework for management of MAR schemes

As per the EPA licence, the Licensee must prepare and implement an appropriate RMMP that addresses the 12-element risk assessment framework for management of recycled water schemes as outlined in Chapter 3 of the *Australian Guidelines for Water Recycling, Managed Aquifer Recharge* (NRMMC-EPHC-NHMRC, 2009). The risk assessment forms an important part of the document and careful consideration needs to be given to each of the 12 elements to identify risks and consider how these can be prevented, mitigated and/or managed to an acceptable level of risk. If the scheme owner/operator has previously completed the risk

assessment, the RMMP could include a simplified version/summary with more detail included in an appendix or clearly referenced document.

4.4 Scheme details

Important scheme details that should be included in the RMMP are:

- An overview of the scheme design including the maximum annual recovery volume, safe injection pressure, and maximum injection head and/or extraction head.
- A map of the scheme including production and monitoring well locations, relevant third-party wells and significant related infrastructure.
- A list of the locations where irrigation will occur in urban areas.
- A list of key personnel contact details, their roles and responsibilities.
- A summary of water treatment equipment and sensor equipment and who is responsible for scheduled maintenance.
- A table summarising injection and extraction limits for each well, if this varies across the scheme.
- A statement of any native groundwater allocations for the MAR scheme, including which wells and meters the allocation can be taken from.

4.4.1 Licensed injection and extraction volumes

Under the EPA MAR licence conditions, the Licensee must prepare an RMMP that sets the maximum discharge (injection) volumes for the scheme.

As stated on page 50 of the Adelaide Plains WAP:

The volume of water in the Managed Aquifer Recharge Consumptive Pool will change over time in relation to the scheme operator's activities. Individual water access entitlements within this consumptive pool are based on the 'available balance' for the Managed Aquifer Recharge scheme. The 'available balance' takes into account the total volume of water drained or discharged (under a permit issued pursuant to either section 104(3)(c) of the Landscape Act or an environmental authorisation issued under section 40(1) of the Environment Protection Act 1993) throughout the life of the scheme's operation, minus any volume that has subsequently been extracted. The total volume that can be recovered in a single water-use year will be limited to a 'maximum annual recovery volume' as identified in the risk management and monitoring plan for the scheme to ensure no adverse impacts are observed at the site of recovery.

Discuss past injection and extraction volumes, and determination of the maximum annual recovery volume (MARV). Note that it is the lesser of the available balance or the MARV that is issued as the recharge water allocation each year.

The MARV will also be authorised on the water licence, following approval of the RMMP. It is suggested that the MARV included in the RMMP reflects a volume sufficient to meet

requirements in a drier year, and/or to facilitate the transfer of recharge water allocation to third parties (e.g. water licensees or those interested in accessing groundwater). The scheme operator must complete a risk assessment for a larger extraction volume if the requested MARV is larger than that previously authorised. Based on the outcome of the risk assessment, the scheme's monitoring plan and management strategies may need to be augmented to ensure any new or increased risk of negative impacts to the resource and existing users is mitigated such that the level of risk will be considered acceptable. This could include the use of trigger levels. The RMMP must be updated to incorporate any new monitoring and management strategies to ensure the risks are managed effectively.

4.4.2 Safe injection pressure

Under the EPA MAR licence conditions, the Licensee must prepare an RMMP that sets the maximum discharge (injection) pressures for the scheme. There are several different approaches for calculating the safe injection pressure. Please include reference(s) to the method(s) chosen and a clear explanation for the values used in the calculations. The top of the screen or gravel pack (which in most cases is the top of the aquifer) is the appropriate place to determine the safe operating pressure. As the standing water level fluctuates seasonally in all groundwater systems, it is best to convert to a safe injection pressure of metres above ground level (AGL). This also makes it easier for ground staff to monitor.

Table included as an example only.

Produ	iction well	Safe injection pressure according to method used (m AGL)					
Unit number	Top of aquifer (m BGL)	Simple estimate	MAR Guidelines (2009)	Hodgkin (2004)	Driscoll (1986)		
6628-12345							
6628-12346							

Table 1 Calculation of the safe injection pressure for the MAR scheme

4.4.3 Recharge water allocation transfers

If the scheme owner/operator intends to transfer some of the scheme's recharge allocation volume to other licensees, the continued injection without extraction from the same location must be assessed in the RMMP to determine if extra monitoring and risk management strategies are needed to allow for such a volume to be extracted elsewhere during one water-use year. Please refer to Principle 50(g) of the Adelaide Plains WAP for more information.

4.4.4 Overview of scheme's historical performance

A summary of how the scheme has performed to date is to be included, such as historical injection and extraction volumes, and how this has impacted the resource, and any relevant groundwater-dependent ecosystems, on a local and regional scale based on monitoring well data. The RMMP should also include an analysis and list of existing users (may be obtained via online tools such as Groundwater Data on the WaterConnect website) that may be impacted by the operation of the MAR scheme. If relevant, please include details of any existing wells that have reported artesian flow or reduced yield and how the incidents were managed.

Based on the resource response, review the predicted long-term performance of the scheme, and consider if the levels of risk for the relevant hazards and subsequent management strategies are still appropriate. Recognise that if there are any unexpected real-world outcomes then it is likely that a review of the model and the RMMP will be necessary.

4.4.5 Regulatory reporting

To provide evidence that the MAR scheme is operating in accordance with the RMMP, as per the conditions of the EPA MAR licence and the DEW recharge water licence, MAR scheme operators must submit an annual monitoring report. The MAR Annual Report (MARAR) must include, but is not limited to:

- 1. Tabulated water quality analysis for analytes contained in Table 3 of the EPA Licence.
- 2. The volume of water discharged into and extracted from the aquifer for each well, reported in monthly totals.
- 3. The total amount of water drained or discharged into a well, as measured by each meter, in the water-use year, and at any period as determined by the Minister.
- 4. Any deviations from the monitoring requirements as set out in conditions of licence.
- 5. A summary of all exceedances of water quality criteria listed in Tables 2 and 3 of the EPA Licence.
- 6. Proposed actions to reduce the likelihood of future exceedances.
- 7. A summary of any changes to the RMMP.
- 8. Certification that the report is true and accurate.
- 9. The groundwater level/pressure for the relevant aquifer accessed by the well/s through which water was drained or discharged, as measured by wells specified on the permit, at intervals specified on the permit (where applicable).
- 10. The salinity and other specified chemical components of the water drained or discharged into a well, as well as the receiving native groundwater (as determined on a case-by-case basis). The reported values from this monitoring should be at a minimum based on an annual record but may be more frequent if monitoring and adaptive management measures are based on these readings.

NOTE: Further guidance on preparation of monitoring reports is provided within the EPA Guideline for Regulatory Monitoring and Testing - Monitoring report requirements (EPA, 2006).

If an issue arises during the operation of the MAR scheme that is not included in the RMMP, it should be identified in the MARAR and an approach to address the hazard should be included in an updated RMMP (preferably with the changes highlighted/pointed to when it is submitted). This should be submitted along with the MARAR so the annual compliance assessment can be undertaken on both and an approved RMMP can be provided when issuing the annual recharge allocation.

4.5 Monitoring

Monitoring is used to assess whether preventive measures reduce or maintain risks at acceptable levels. As more data is gathered and the effectiveness of the RMMP is evaluated, the RMMP (i.e. the monitoring program) may need to be reviewed and modified. This should be assessed during compilation of the MARAR. In addition, any significant changes to the monitoring program need to be reflected in the RMMP. For example, if a well is no longer being monitored or a new well is added to the scheme's monitoring network, this needs to be reflected in the MARAR and an updated RMMP needs to be submitted at this time.

4.5.1 Operational monitoring

Operational monitoring at the scheme should be conducted in accordance with approval conditions and include critical control points and associated critical limits and target criteria. DEW recharge water licences require the metering of extraction and injection volumes. Under the EPA MAR licence conditions, the RMMP must include a monitoring plan that sets the methods and frequency of monitoring the analytes listed in Tables 2 and 3 of the EPA Licence, with corrective actions to be taken if exceedances occur. Other monitoring requirements of the EPA MAR Licence include:

- Use a flowmeter to measure and record the total volume of water (in megalitres) discharged into and extracted from each approved well.
- Use direct instruments and inline data recorders for measuring the parameters listed in Table 2.
- Use direct instruments and inline data recorders for measuring aquifer pressures.
- Ensure that all instrumentation is operating within the manufacturers specifications and is maintained by a maintenance programme for compliance with these specifications.
- Ensure that any samples are collected and maintained so that the results are representative of the water being discharged or extracted.
- Ensure that all analysis is undertaken by a laboratory accredited by NATA to undertake that analysis.

See Section 5 for an example of an operational monitoring plan.

4.5.2 Groundwater monitoring

A groundwater monitoring plan must be included in the RMMP and is important for assessing local/regional groundwater pressure level response to injection and extraction, development of local/regional artesian conditions, and model validation. The provision and analysis of groundwater pressure level data from any scheme-operated monitoring wells, i.e., wells that are not part of the DEW state monitoring network, should be included in the MARAR.

Table included as an example only.

Well	Monitoring objective	Parameter	Frequency
6628-XXXXX 6628-XXXXX	Assess local groundwater level response to injection and extraction	Groundwater pressure level	Continuous logger data
	Assess development		
	of local artesian conditions		
	Model validation		
6628-XXXXX	Assess regional groundwater level response to injection	Groundwater pressure level	Monthly manual measurements
6628-XXXX	and extraction		
6628-XXXXX	Assess development		
	of regional artesian		
6628-XXXXX	conditions		
	Model validation		

 Table 2
 Groundwater monitoring near the MAR scheme

4.6 Risk management strategy

Various literature sources on risk assessments for water safety and quality describe qualitative methods to determine risks from the likelihood of occurrence and severity of potential impacts of a hazard using a matrix-based category approach, e.g., Bartram et al. 2009, NHMRC-NRMMC 2011, NRMMC-EPHC-AHMC 2006. Each potential key operational hazard must be evaluated according to a risk framework and the RMMP identifies management strategies to address the risk. The management strategies are implemented when operational critical limits are exceeded and include a progression of actions or range of options that will be taken to address a particular impact.

See Section 5 for an example of a risk management plan.

5 Examples

EXAMPLE 1 - Endorsement page from licence holder

The below text includes bracketed text [] that indicates where information individual to the relevant MAR Scheme(s) is needed.

[Licence holder name e.g. City of...] has developed this document to support operation of the [Scheme Name] Managed Aquifer Recharge (MAR) Scheme (*please use bullet points if more than one scheme*), and this risk management and monitoring plan (RMMP) is endorsed by the authorised officer below.

It is acknowledged that in order to provide evidence that the scheme is operating in accordance with this RMMP, and as specified in the conditions on recharge water licence [#####] and EPA licence [#####], the [Licence holder name] is responsible for ensuring that a MAR Annual Report (MARAR) is submitted on an annual basis (by 30 November each year) and will include:

- o monthly measurements of injection and extraction volumes in kilolitres (kL)
- [monthly]¹ groundwater pressure or water level data from scheme-operated monitoring wells, i.e., wells that are not part of the DEW state monitoring network
- [twice-yearly]¹ salinity measurements from production wells before injection and before extraction.

Signed for and on behalf of the [Licence holder name e.g. City of...]

Name:

Position: [Licence holder representative with the necessary authority level e.g. Chief Executive Officer]

Signed:

Date:

¹ more frequent monitoring may be required if this is stipulated in the RMMP due to an identified risk.

EXAMPLE 2 - Version control table

Include a version control table that documents the authors, approvals, document version number and date (also include in the footer), as well as reference to the version number and date of this document referred to in the preparation of the RMMP.

Document version control tables

Author(s)		
Version Date		
Version		
Version of Ade monitoring pla	elaide Plains MAR: essential criteria for risk management and cons referred to in preparation of this document	1.0

	Approved By	Date
Name and		
Position		
Final		
Approval		
Date		

EXAMPLE 3 – Operational monitoring and risk management tables

For ease of reference it is recommended that tables similar to those shown below be included in RMMPs. However, these are examples only and it is the scheme licence holder/operator's responsibility to perform an appropriate risk management assessment for the scheme.

Operational monitoring for the MAR scheme

ltem	Critical control point	Monitoring objective	Monitoring type/parameter	Frequency	Critical limit/target criteria	Corrective action
Source water	Wetland	Characterise source water quality Prevent aquifer contamination	Grab samples for laboratory analysis: Analyte suite per Table 3 of EPA licence	Suite A at pre-injection (0 ML); suite B at X ML	Analytes outside of EPA licence values (Table 3 of EPA licence)	Notify EPA. Injection stops if parameters exceed EPA licence values Follow risk management strategy
	Inline sampling (SCADA)	-	EC, pH, turbidity	Continuous via inline SCADA system	pH, EC, turbidity outside of EPA licence values (Table 2 of EPA licence)	Injection stops if parameters exceed EPA licence values Follow risk management strategy
		Remain within safe injection pressures	Groundwater pressure levels	Continuous via inline SCADA system (both injection and	Production well injection pressure X m above ground level	Alarm sent to operating officer
MAR wells	6628-XXXXX 6628-XXXXX			recovery) Captured via pressure transducers	Production well injection pressure >X m above ground level	Alarm sent to operating officer Injection stops—fully automated by SCADA system Investigate as per risk management strategy

ltem	Critical control point	Monitoring objective	Monitoring type/parameter	Frequency	Critical limit/target criteria	Corrective action
		Recovered water meets requirements	EC, pH		>X μS/cm pH <6.5 or >8.5	Alarm sent to operating officer Identify cause as per risk management strategy
		Quantify injection/extraction volumes Prevent injection or extraction beyond licensed limits	Flow rate, total volume	Continuous via inline SCADA system Monthly checks of totalisers to confirm seasonal usage	Volume within 20 ML of licence conditions	Reduce injection/extraction rate Assess whether additional water required to meet demand.

Risk management strategy for the MAR scheme

Hazard	Outcome	Management strategies	Measurement criteria	Likelihood	Consequence	Residual risk
Source water quality unsuitable for	Reduction in recharge volumes	Regular water quality sampling to ensure injectant remains within EPA licence values.	Injected water quality within EPA licence values for MAR	Possible	Minor	Medium
recharge		If analytes above trigger levels (but below cease discharge criteria) notify EPA, continue injecting and resample.	scheme—see Table 3 of EPA licence (Appendix X).			
		If analytes exceed the cease discharge criteria, STOP injecting. Do not resume discharge of water to the aquifer until the injection water meets the criteria. Notify EPA. Investigate site and surrounding area for contamination source. In consultation with the EPA, sample groundwater to determine if aquifer contamination has occurred. Assess wetland plant health. Limit inflow from creek until problem resolved.				
		and assess catchment conditions. Further assessment/actions to be done with EPA consultation.				
Contamination of groundwater during						
recharge						

Hazard	Outcome	Management strategies	Measurement criteria	Likelihood	Consequence	Residual risk
Emerging contaminants identified in catchment			-			
Well clogging e.g., physical, chemical, biological, air entrainment.						
Recovered water unsuitable for intended use						
Failure of confining bed through aquitard collapse, injection pressure exceeding fracture pressure limits or matrix dissolution						
Failure of injection well casing						
Infrastructure or delivery pipeline failure						
Monitoring instrument failure						
Generation of artesian conditions						
Excessive drawdown at third-party wells						
Competing water users reduces available stormwater						
Contaminants enter wetland destroying established						

Hazard	Outcome	Management strategies	Measurement criteria	Likelihood	Consequence	Residual risk
ecosystems; damage						
to wetland plants						
Pest flora and fauna						
inhabit wetland and						
impact function (e.g.,						
турпа)						

6 Glossary

Act (the) — In this document, refers to the Landscape South Australia Act 2019, which supersedes the Natural Resources Management (SA) Act 2004.

Adaptive management — A management approach often used in natural resource management where there is little information and/or a lot of complexity, and there is a need to implement some management changes sooner rather than later. The approach is to use the best available information for the first actions, implement the changes, monitor the outcomes, investigate the assumptions, and regularly evaluate and review the actions required. Consideration must be given to the temporal and spatial scale of monitoring and the evaluation processes appropriate to the ecosystem being managed.

Aquifer — A geological formation or group of formations capable of receiving, storing and transmitting significant quantities of water. Aquifer types include confined, unconfined and artesian.

Aquitard — A geological layer that has low permeability and confines or separates aquifers.

Artesian — When the piezometric surface (hydraulic head) of a confined aquifer is above the ground surface. An uncontrolled artesian well will spurt water out of the ground.

Available balance — The total volume of water drained or discharged throughout the life of the MAR scheme's operation, minus any volume that has subsequently been extracted.

Catchment — Area of land that collects rainfall and contributes to surface water (e.g. streams, rivers, wetlands) or to groundwater.

Confined aquifer — A type of aquifer with a low permeability formation as its upper boundary; its storage is increased by raising the pore pressure in the aquifer, causing elastic compression of aquifer materials and water.

Confining layer — A rock unit impervious to water; forms the upper bound of a confined aquifer.

Consumptive pool — The water that will from time to time be taken to constitute the resource within a particular part of a prescribed water resource for the purposes of Part 8 of the Act, as determined by the WAP.

Contaminant — Biological or chemical substance or entity not normally present in a system, or any unusually high concentration of a naturally occurring substance, capable of producing an adverse effect in a biological system, seriously injuring structure or function.

Corrective action — Procedures to be followed when monitoring results indicate that a deviation occurs from acceptable criteria.

Critical control point — A step or procedure at which controls can be applied and a hazard can be prevented, eliminated or reduced to acceptable (critical) levels.

Critical limit — A prescribed tolerance that must be met to ensure that a critical control point effectively controls a potential health hazard; a criterion that separates acceptability from unacceptability. The critical limit is the maximum (or minimum) value to which a hazard must be controlled at a critical control point to reduce its risk to an acceptable (low or high) level.

DEW — Department for Environment and Water

Drain or discharge — The emptying of collected waters into an aquifer by either gravity (drain) or under pressure (discharge).

Drinking water — Water intended primarily for human consumption (for the purposes of these guidelines, excludes bottled water).

EC — Electrical conductivity; 1 EC unit = 1 micro-Siemen per centimetre (μ S/cm) measured at 25°C; commonly used as a measure of water salinity as it is quicker and easier than measurement by TDS

EPA — Environment Protection Authority (Government of South Australia)

Existing user — A person who held a water licence under the previous Northern Adelaide Plains Prescribed Wells Area Water Allocation Plan or was considered an existing user of the resource under section 155 of the Landscape Act or holds a water licence in relation to the Dry Creek or Central Adelaide Prescribed Wells Areas.

Grab sample — Single sample collected at a particular time and place that represents the composition of the water only at that time and place.

Groundwater — Water contained in rocks or subsoil.

Groundwater-dependant ecosystem (GDE) — A diverse and important component of biological diversity; considers ecosystems that use groundwater as part of survival. GDEs can potentially include wetlands, vegetation, mound springs, river baseflows, cave ecosystems, playa lakes and saline discharges, springs, mangroves, river pools, billabongs and hanging swamps.

Hazard — A biological, chemical, physical or radiological agent that has the potential to cause harm.

Impact — Having an effect on endpoints such as people, plants, soil, biota, water or a part of the environment.

Injectant — The water injected (pumped or fed by gravity) into a MAR injection well.

Injection well — A well that admits water into an aquifer, by pumping or under gravity.

Irrigation — Provision of sufficient water for the growth of crops, lawns, parks and gardens; can be by flood, furrow, drip, sprinkler or subsurface water application to soil.

Licence — A licence to take water in accordance with the Act; see also 'water licence'

Licensee — A person who holds a water licence

MAR — Managed aquifer recharge (MAR) is a process where water is intentionally placed and stored in an aquifer for later human use, or to benefit the environment.

MARAR — Managed aquifer recharge annual report (MARAR) is an annual monitoring report to be submitted by MAR licensees by 30 November each year, in a form approved by the Minister.

MARV — The maximum annual recovery volume is the total volume of injected water that can be recovered in a single water-use year.

Minister — The Minister for Climate, Environment and Water

Model — A conceptual or mathematical means of understanding elements of the real world that allows for predictions of outcomes given certain conditions. Examples include estimating storm runoff, assessing the impacts of dams or predicting ecological response to environmental change

Monitoring — (1) The repeated measurement of parameters to assess the status and changes over time of the parameters measured (2) Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, animals, and other living things

Monitoring well — A narrow bore, well or piezometer; its sole function is to permit measurement of water level and water quality.

NATA - National Association of Testing Authorities.

Native groundwater — Groundwater that was present before recharge operations.

Operational monitoring — The planned sequence of measurements and observations used to assess and confirm that individual barriers and preventive strategies for controlling hazards are functioning properly and effectively.

pH — Value representing acidity or alkalinity of an aqueous solution; expressed as the logarithm of the reciprocal of the hydrogen ion activity in moles per litre at a given temperature.

Potentiometric head — The potentiometric head or surface is the level to which water rises in a well due to water pressure in the aquifer, measured in metres (m); also known as piezometric surface

Preventive measure — Any planned action, activity or process that is used to prevent hazards from occurring or reduce them to acceptable levels.

Quality — The totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs; the term 'quality' should not be used to express a degree of excellence.

Recharge water access entitlement — A water access entitlement issued in relation to the Managed Aquifer Recharge Consumptive Pool based on the 'available balance', where the 'available balance' takes into account the total volume of water drained or discharged under a permit issued pursuant to either section 104(3)(c) of the Landscape Act or an

environmental authorisation issued under section 40(1) of the Environment Protection Act 1993 throughout the life of the schemes operation, minus any volume that has subsequently been extracted. Also known as the available balance.

Recharge water allocation — A water allocation obtained on account of a recharge water access entitlement. The volume of water allocated in any given water use year shall be the lesser of a) the 'available balance' or b) the 'maximum annual recovery volume' of water authorised to be taken per water use year as a condition on the water licence.

Recovery — the extraction of water previously injected into an aquifer.

Recycled water — Water generated from sewage, grey water or stormwater systems and treated to a standard that is appropriate for its intended use.

Residual risk — The risk remaining after consideration of existing preventive measures.

Risk — The likelihood of a hazard causing harm to exposed populations in a specified period; includes the magnitude of that harm.

Risk assessment — The overall process of using available information to predict how often (likelihood) hazards or specified events may occur and the magnitude of their consequences.

Risk assessment framework — describes a generic process for developing and implementing preventive risk management systems for recycled water use. The aim is to provide a measurable and ongoing assurance that performance requirements are met and that, as far as possible, faults are detected before recycled water is supplied, discharged or applied, so that corrective actions can be implemented.

Risk management — The systematic evaluation of the water supply system, the identification of hazards and hazardous events, the assessment of risks, and the development and implementation of preventive strategies to manage the risks.

RMMP — A risk management and monitoring plan describes the nature of a recycled water system and how it should be operated and managed.

Safe injection pressure — the maximum pressure water will be injected into the receiving aquifer to prevent aquitard, aquifer matrix, and grout failure, and assist with well design and the selection of casing materials and pumps.

Salinity — The presence of soluble salts in soil or water. Electrical conductivity and total dissolved salts are measures of salinity.

Screen — Slotted tube or wire-wound tubular frame in a well; permits the flow of groundwater to the well while maintaining the well's integrity.

Source water — Water as harvested, before any treatment and before recharge.

Standing water level — The distance from the ground surface to the water surface in a well.

Stormwater — Rainwater that runs off all urban surfaces such as roofs, pavements, car parks, roads, gardens and vegetated open space.

Target criteria — Quantitative or qualitative parameters established for preventive measures to indicate performance; performance goals.

Third party — In this document, this refers to other groundwater users.

Turbidity — The cloudiness of water caused by the presence of fine suspended matter.

WAP — Water Allocation Plan; a plan prepared by a water resources planning committee and adopted by the Minister in accordance with the Act

Water recycling — A generic term for water reclamation and reuse. Can also describe a specific type of reuse where water is recycled and used again for the same purpose (e.g., recirculating systems for washing and cooling), with or without treatment in between.

Water-use year — The period between 1 July in any given calendar year and 30 June the following calendar year; also called a licensing year

Well — (1) An opening in the ground excavated for the purpose of obtaining access to underground water. (2) An opening in the ground excavated for some other purpose but that gives access to underground water. (3) A natural opening in the ground that gives access to underground water.

Yield (well) — The amount of water that can be pumped from a given well per unit of time.

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