



Water sensitive urban design

Managed aquifer recharge

Summary

Managed Aquifer Recharge (MAR) is the intentional recharge of an aquifer under controlled conditions for subsequent recovery, environmental benefit, or to mitigate the impacts of abstraction. The managed process assures adequate protection of human health and the environment.

There are a number of methods used to recharge aquifers, including injection wells or infiltration structures such as ponds, basins, galleries and trenches. These methods help to reduce transport and storage costs and water loss through evaporation.

Water from a variety of sources can be used in the recharge process. These include water from subsoil groundwater, stormwater and treated wastewater.

Natural treatment processes in the aquifer can improve water quality. Some pre-treatment of the source water may be required to make sure that the quality of the receiving groundwater is maintained or improved.

The level of treatment needed for the source water generally depends on a risk assessment. (DWER website, 2017)

Main benefits

- Generates additional water supplies from sources not currently being utilised, allowing communities to maintain parks and vegetation and economic activities in a drying climate.
- Stores recharged water to meet need in times of demand in a system with minimum evaporation loss, allowing land to be used for alternative purposes.
- Reduces the potential for salt-water intrusion and protects ecosystems from the impacts of abstraction.
- Opportunity to use a variety of sources, including stormwater runoff, dewatering excess or treated wastewater.
- Increases water availability for commercial and environmental uses and reduces the pressure on other water resources.
- Enhances recharge of aquifers, potentially re-balancing groundwater levels.

- an operating strategy (consistent with DWER Operational policy 5.08), ongoing management and contingency plans;
- a risk assessment (consider *Australian guidelines for water recycling: Managed aquifer recharge*, 2009); and
- the local requirements – e.g. additional information may be required if the proposal is in a public drinking water source area (refer to *Water quality protection note no. 25: Land use compatibility in public drinking water source areas*, 2016), the Pilbara region (refer to *Pilbara water in mining guidelines*, 2009), or if a works approval or licence is required under Part 5 of the *Environmental Protection Act 1986*.

- Recovery volumes are dependent on: recharge volumes; condition of groundwater dependent ecosystems; groundwater migration; differences in existing and recharged groundwater quality. The recovery volume will generally be less than or equal to the recharge volume, based on hydrogeological estimates.
- Water quality treatment is dependent on the quality of the water source and the potential effects on the receiving environment and/or human health from the extracted water. Treatment options include: passive treatment through biofiltration; active filtration using sand or membrane filters; coagulation and flocculation; activated charcoal; UV treatment; chlorination.
- The water quality must be acceptable prior to recharge, consistent with the risk assessment.
- The estimated time between recharge and recovery may vary, depending on a number of factors that may include:

- aquifer characteristics, hydraulic gradients and the distance between recharge and recovery bores or works;
- residence time within the aquifer to meet water quality standards for end use, or to protect environmental values. If the potential exists for human exposure, the Department of Health will require determination of appropriate residence time and validation of water quality;
- a requirement to recharge water for a certain period before recovery. For example, to allow increases in potentiometric levels or water levels to reach the recovery bore;
- if the recharge water is to be banked for a certain period.

Process

The *Australian Guidelines for Water Recycling – MAR* (2009) recommends a four-stage process:

1. Desktop study
2. Investigations and assessment
3. Construction and commissioning
4. Operation

The desktop investigation should determine if the process is suitable for the given location, considering the water demand, sustainable water source and a suitable aquifer for storage.

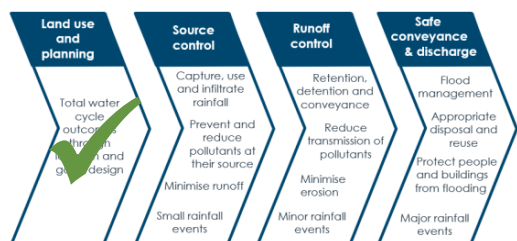
The proposal will need to be supported by:

- a hydrogeological assessment (consistent with DWER Operational policy 5.12, plus information specific to MAR) of potential impacts and feasibility;

Design considerations

- MAR schemes should not adversely affect the environmental values of groundwater or connected surface water systems. Proponents will be required to identify, quantify and manage the risks to these systems to ensure their values are maintained and where possible, enhanced.
- MAR can be achieved through infiltration using ponds and trenches, or through the process of injection using a bore or series of bores.
- Bores are considered to have a smaller storage footprint (less space required) and therefore a lower impact on above-ground land use. Bores are more effective in injecting water for future recovery, experience less evaporation, and are less prone to algal blooms.
- Recharge and recovery operations must occur within the same groundwater system.

Treatment train



Design scale





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- Recharged water is vested in the Crown. Allocation credits are not provided for under the *Rights in Water and Irrigation Act 1914*.
- Banking will be approved if it is demonstrated that the water will be available for use when required and the recovery impacts are acceptable.
- Extensive modelling and investigation is generally required to determine the viability of the MAR proposal.

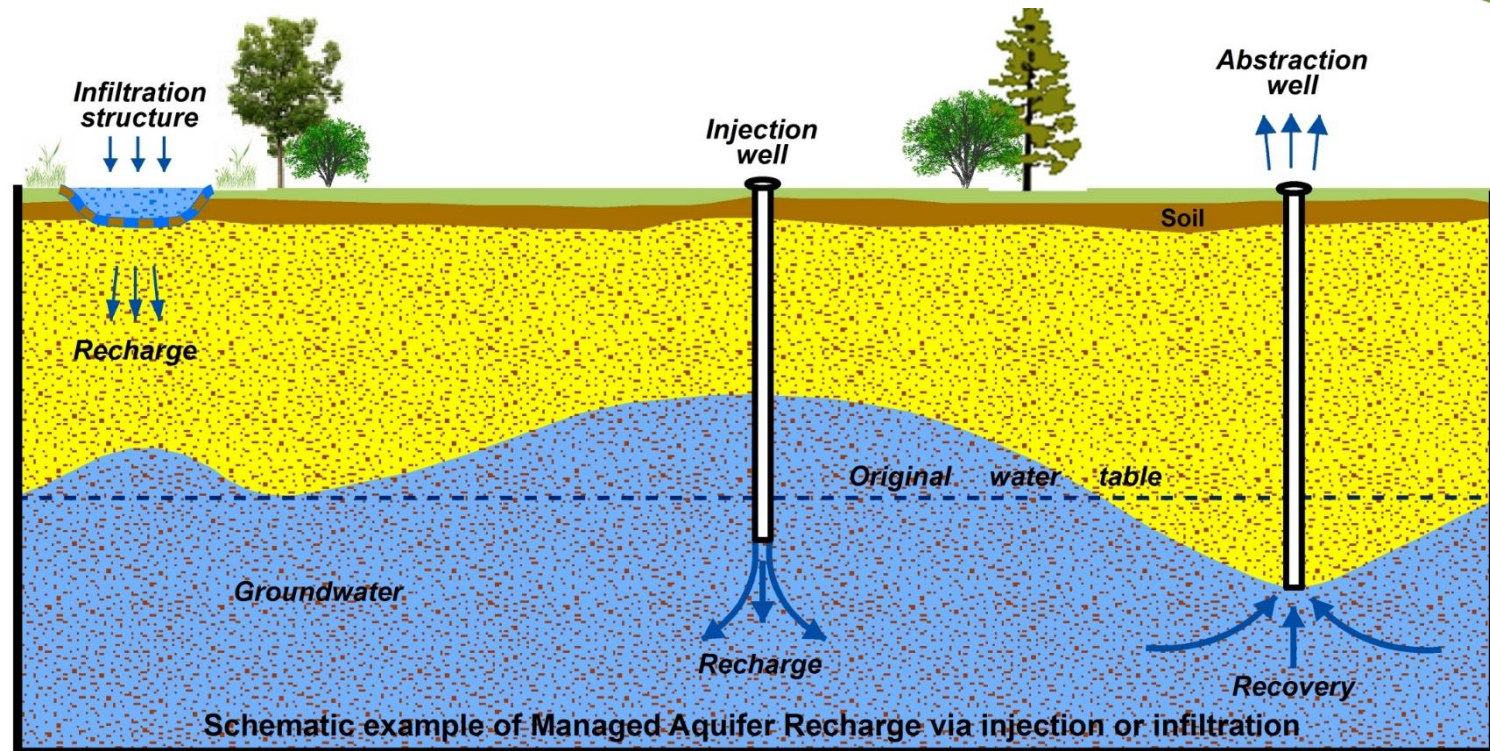
Licensing and consultation requirements

The following licenses may be required:

- Licence to construct or alter a well: section 26D, *Rights in Water and Irrigation Act 1914*.
- Licence to take and use groundwater: section 5C, *Rights in Water and Irrigation Act 1914* - granted to the company undertaking the recharge operations.
- A works approval or licence under Part V of the *Environmental Protection Act 1986*.
- There is no specific licence for injection. This is managed under 26D and 5C licences.
- Existing operations will need to apply for a licence to undertake MAR.

MAR proponents are responsible for contacting relevant Western Australian government agencies for the approval and management of MAR schemes. This may include:

- Department of Water and Environmental Regulation for licensing under the *Rights in Water and Irrigation Act 1914* or for proximity to contaminated sites (*Contaminated Sites Act 2003*);
- Environmental Protection Authority for any significant environmental impacts of a MAR scheme (*Environmental Protection Act 1986*);
- Department of Health, where the end use of extracted water has the potential to affect human health, according to the *Health Act 1911*.



Suggested reading

- Operational policy 5.12- Hydrogeological reporting associated with a groundwater well licence, Department of Water, 2009.
- Operational policy 5.05 – Giving an undertaking to grant a water licence or permit, Department of Water, 2010.
- Operational policy 5.13 – Water entitlement transactions for Western Australia, Department of Water, 2010.
- Operational policy 5.08: Use of operating strategies in the water licensing process, Department of Water, 2011.
- Guideline for the approval of non-drinking water systems in Western Australia, Department of Water, 2013.
- Australian guidelines for water recycling: Managing health and environmental risks (Phase 2), Managed aquifer recharge, Natural Resource Management Ministerial Council, Environment Protection & Heritage Council and the Australian Health Ministers’ Conference, 2009.
- National water quality management strategy, Australian & New Zealand guidelines for fresh and marine water quality 4, Australian Government, National Health and Medical Research Council & Natural Resource Management Ministerial Council, 2004.
- Stormwater Management Manual for Western Australia, Department of Water, 2004-2007.