Managed Aquifer Recharge Frequently Asked Questions

Water for a Healthy Country Flagship

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Using recycled water is a viable option to reduce water shortages. Recycling water through managed aquifer recharge (MAR) is emerging in Australia and abroad as an innovative and environmentally friendly treatment option.

What is Managed Aquifer Recharge (MAR)?

Managed Aquifer Recharge is the process of adding a water source such as recycled water to aquifers under controlled conditions for withdrawal at a later date, or used as a barrier to prevent saltwater or other contaminants from entering the aquifer. Water can be recharged by a number of methods including infiltration via basins or galleries or by the use of injection wells.

What sort of water can be used for MAR?

Many different water types can be used as a source for MAR. Current successful MAR schemes in Australia have been using drinking water, captured stormwater, and treated wastewater. The water used can depend on what is available, the conditions of the aquifer and the uses of recovered water.

How does MAR work?

In Australia a variety of methods are used for MAR:

Aquifer storage and recovery (ASR): injection of water into a well for storage and recovery from the same well. This is useful in brackish aquifers, where storage is the primary goal and water treatment is a smaller consideration (for example Grange golf course, South Australia).

Aquifer storage, transfer and recovery (ASTR): involves injecting water into a well for storage, and recovery from a different well. This is used to achieve additional water treatment in the aquifer by extending residence time in the aquifer beyond that of a single well (for example Parafield Gardens, SA).

Infiltration ponds: involve diverting surface water into off-stream basins and channels that allow water to soak through an unsaturated zone to the underlying unconfined aquifer (for example Burdekin Delta, Qld).

Infiltration galleries: buried trenches (containing polythene cells or slotted pipes) in permeable soils that allow infiltration through the unsaturated zone to an unconfined aquifer (for example Floreat Park, WA, see figure 1).

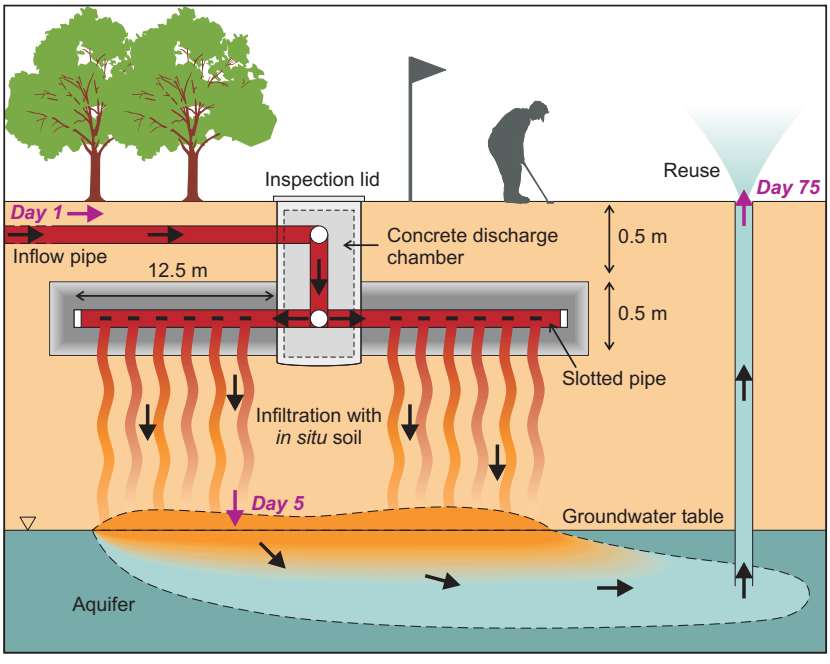
Soil aquifer treatment (SAT): treated sewage effluent is intermittently infiltrated through infiltration ponds to vary the amount of oxygen present and facilitate nutrient and pathogen removal during passage through the unsaturated zone before recovery by wells after residence in the unconfined aquifer (for example Alice Springs, NT).

Percolation tanks or recharge weirs: dams built in ephemeral streams detain water which infiltrates through the bed to enhance storage in unconfined aquifers and is extracted down-valley (for example Callide Valley, Qld).

Recharge releases: dams on ephemeral streams are used to detain flood water and uses may include slow release of water into the streambed downstream to match the capacity for infiltration into underlying aquifers, thereby significantly enhancing recharge (for example Little Para River, SA).

What effect does the MAR process have on the water?

As the treated water infiltrates the soil and aquifer natural biological, chemical and physical processes occur to remove pathogens, chemicals and nutrients from the water. This 'filtering' process continues while the water infiltrates and resides in the aquifer.



> Figure 1: Cross-section of an infiltration gallery. This is compatible with recreational land uses.

The following water quality improvements occur during the process:

- Attenuation of nutrients such as inorganic phosphates and nitrogen as well as most organic compounds
- Degradation of trace chemicals such as disinfection by-products
- Pathogen die-off

The majority of this treatment occurs through the activity of naturally occurring micro-organisms in the aquifer. As long as these micro-organisms remain active the process remains sustainable. The ability to remove contaminants from the water significantly reduces the health and environmental risks that may be associated with secondary treated wastewater, leaving the reclaimed water in similar quality to that of the surrounding groundwater.

How will we be using the MAR water?

The main purpose of aquifer recharge is to store excess water for later use, while improving water quality by recharging the aquifer with high quality water. If the groundwater is too salty for use then recharge with fresher water will displace the saltier groundwater.

MAR increases water storage in the aquifer which can make more water available for irrigation and other uses and also to preserve water levels in wetlands that are maintained by groundwater. Groundwater recharge may also be used to mitigate or control saltwater intrusion into coastal aquifers.

The water withdrawn from the aquifer can be used to irrigate green open spaces, namely parks, ovals and golf courses, which generally use large quantities of water.

How much water can be supplied through MAR?

Various States are aiming to supply additional water through MAR. The South Australian Government, through its Water for Good Plan, calls for 60GL stormwater harvesting via MAR in Adelaide by 2050 and a further 15 GL/yr in regional SA. (SA Government 2009). In addition, MAR planning and pilot projects are underway in three states (SA, WA, Vic) for subsurface storage of treated water derived from sewage treatment plants, with a combined capacity of more than 30GL/yr.

> One of two water recovery wells at the ASTR well field at Parafield Gardens, South Australia. One of the four stormwater injection wells is 50 m further on behind the trees.

How long will it be before Australia can reliably call on MAR water as a source?

MAR is already in use at various sites in Australia. CSIRO scientists have led research at demonstration projects across the country. They had a major role in the development of the national guidelines for MAR. These guidelines follow a risk management framework and give specific guidance on managing the health risks and the environmental risks associated with recharging aquifers with all sources of water including recycled water for a range of uses.

The guidelines were endorsed by three Ministerial Councils of the Council of Australian Governments and released in August 2009. They are now part of the Australian Recycled Water Guidelines and will help to facilitate wider uptake of this innovative approach.

What are the health risks associated with using MAR?

Wherever recycled water is used, strict Health Department guidelines for water quality and management including watering times must be met.

Extensive work is carried out to ensure that recycled water schemes are designed and monitored to minimise any environmental impact. Each scheme must be individually approved by the State/Territory Health Departments on a 'fit for purpose' basis, depending on the extent of human exposure.

All major schemes require evaluation for chemicals, radiation, pathogens and heavy metals.

How does the cost of supplying water through MAR compare to desalination?

It costs much less to treat and use stormwater or reclaimed water using MAR than seawater desalination; however should high quality water be required the reclaimed water may still need to be desalinated. As there is much less salt in reclaimed water than seawater, significantly less energy is required to desalinate reclaimed water.

Do other countries use MAR?

MAR is actively and successfully used in the USA, Europe, South Africa, India, China and the Middle East. Unesco and the International Association of Hydrogeologists. (IAH) have established the MAR-NET network to help inform and build capacity on MAR for drinking water supplies.

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International Association of Hydrogeologists Commission on MAR (incl. MAR-NET)
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VRU 2010 • WfHC_MAR-FAQfactsheet.indd