CRC for
Water Sensitive Cities

Kalamunda Managed Aquifer Recharge Project

Location:
Kalamunda, WA

Case Study — Prepared by Cooperative Research Centre for Water Sensitive Cities, September 2018

Australian Government
Department of Industry, Innovation and Science
Business Cooperative Research Centres Programme

Insight

Water proofing urban parklands using managed aquifer recharge (MAR)

Project description

The Hartfield Park managed aquifer recharge (MAR) project in the Shire of Kalamunda involves recharging an aquifer under controlled conditions to store water for later abstraction for irrigation use. The scheme harvests approximately 30% of high flows (25–50kL/yr) from an existing urban drain, which is then filtered and stored in Leederville aquifer. Water is then available for extraction in the dry season to irrigate the nearby sport and recreation reserve.

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Existing urban drain from which flows are harvested and injected into the underground aquifer

What does this case study demonstrate?

Each case study has been selected to demonstrate specific solutions, benefits or enabling structures that support the creation of water sensitive cities. This case study focuses on:

- **Managed aquifer recharge**
- **Water sensitive parks and open spaces**
- **Alternative water supplies**

The drivers

Demonstration that MAR can be successfully used at a local scale

- **Capped groundwater allocations** – Perth's drying climate means that groundwater levels are in decline, and water allocation limits have been imposed. The fundamental objective of this project is to provide the shire with an alternative and sustainable water source for irrigation purposes into the future. The Hartfield Park Reserve is the largest sport and recreation reserve within the City of Kalamunda, and as such is a high priority site for irrigation.
- **Dry climate** – Annual rainfall is less than evaporation and has resulted in a substantial reduction in streamflow and groundwater levels.

The innovations

Harvesting stormwater from an urban drain to replenish local groundwater using MAR for parkland irrigation

- **Hydrological investigations** – Stormwater is harvested from Woodlupine main drain which conveys water from the Kalamunda Hills into Perth's urban drainage system. This drain is located alongside Hartfield Park. A detailed MAR feasibly investigation was undertaken for Woodlupine Brook to ensure the volume of water harvested could meet the irrigation needs of the park without impacting the downstream waterway environments.
- **Aquifer investigations** – Aquifer investigations were undertaken on the capacity and permeability of the shallow superficial aquifer and deeper Leederville aquifer to ensure stormwater could be stored and recovered without impacting other irrigators and nearby wetlands. While there is still some uncertainty on the properties of the shallow superficial aquifer, it is likely recovery should be close to 1:1 because water will be recovered after six months of injection.
- **MAR solution** – The water is harvested and injected into the Leederville aquifer in the winter months via injection bores, and extracted in the summer months when irrigation is required. The use of infiltration ponds was initially proposed as the injection method, however investigations showed an impermeable layer of clay extending over most of the site, making this infeasible. Prior to injection, stormwater is filtered to prevent bore and aquifer clogging. A low maintenance, self-backwashing AMIAD multi-stage filter package is used which can filter water to 2 micron.
- **2015 trial project** – A trial project was undertaken to test the feasibility of the MAR scheme using the superficial aquifer. Water was extracted intermittently from the drain from late July to August 2015. An existing production bore at the park was retrofitted to inject filtered water into the aquifer. The water level response and water quality were monitored in the aquifer through the trial. The initial results showed less than expected flows (only 4,400kL of filtered stormwater was recharged during the initial trial period), which led to an extension of the trial. Despite the small volume of water recharged, the trial showed the stormwater quality was of a high standard and that the aquifer storage was greater than previously estimated.
- **2017 trial project** – The trial continued into 2017 due to the high risk of biological fouling that was observed in the 2015 trial. An activated carbon filtration unit was installed in 2016 to control biological fouling and the bore was pressurised to allow higher recharge rates to be achieved. Over the 2017 winter, 10,670kL of stormwater was recharged to the Leederville aquifer at a flow rate of 5.75L/s. There was limited biological fouling observed in this trial.
- **Successful trial project likely to lead to further applications** – The positive results show the solution is technically viable and is likely to lead to the scheme becoming fully operational with a dedicated injection bore designed to receive up to 230,000kL. The project has also provided a template and acts as a demonstration site for other future proponents of MAR projects.

The outcomes

Cities providing ecosystem services	Cities as water supply catchments	Cities comprising water sensitive communities
• **Balancing harvesting and environmental flows** – Monitoring and modelling was used to determine a suitable harvesting volume that would only remove approximately 30% of the flows in the high flow period (June to October).	• **Sustainable irrigation supply** – 25-50kL/year can be harvested from the drain and stored in the aquifer for later irrigation use.	• **Building confidence** – This trial project has built confidence that MAR projects are feasible in the Perth region.

Business case

Costs	Benefits
• **Payback period** – The payback period for using MAR as a water supply scheme will be ~7 years, if compared with the cost of drinking water.	• **Use of existing assets** – Using an aquifer as storage and filter does not require construction of stormwater harvesting storage or treatment infrastructure. • **Cheaper than alternatives** – Sewer mining and treatment was first considered as an alternate source but this would have cost $18/kL.

The lessons

- **Multiple asset owners** – Early engagement was required for all of the different asset owners and stakeholders to define the ownership of the MAR infrastructure because the elements were all managed under separate entities.

- **Uncertainty** – There was uncertainty about the feasibility of applying MAR at this scale. A trial was developed to ensure the system will work as designed and to understand the maintenance requirements of the project, which showed great success after two years.

- **Time required for assessments and approvals** – Time needs to be set aside for feasibility assessments and also the approvals process. Approvals were required from multiple agencies including the Water Corporation, Department of Water and Environmental Regulation. A Water Resource Management Operating Strategy was developed for the Stormwater Harvesting and Managed Aquifer Recharge Trial, which includes operating rules and contingency plans and was used to obtain the necessary water licences to commence the trial project. Several engineering challenges in the design, construction and commissioning of the infrastructure were required to meet the requirements outlined in this document and water licence conditions.

- **Climatic variability needs to be considered** – Low levels of winter rainfall during the trial period resulted in low flow volumes in the drain and significantly lower recharge volumes than expected, highlighting the requirement for extreme climate conditions to be included in risk modelling.

- **Additional timing required when using specialised equipment** – Technical difficulties associated with commissioning the specialised equipment for the trial resulted in intermittent injection. This outcome reduced recharge volume and highlighted that additional time is required during the scheduling and planning phases when commissioning specialised equipment.

Transferability

MAR projects are limited to locations that have aquifers available that can be used for storage and recovery without impacting other groundwater dependant uses. The harvesting of water from urban drains and waterways also needs to ensure that a sustainable balance can be achieved between the harvested demand volume and downstream water requirements (such as environmental flows).

Project collaborators

- City of Kalamunda Project Manager
- Water Corporation
- Rockwater Pty Ltd and Managed Recharge
- WA Department of Water and Environmental Regulation
- EPA WA
- WA Department of Health

Awards

- 2018 – Winner IPEWA Awards of Excellence for Excellence in a Water Project
- 2017 – Winner AWA WA, Innovating for Sustainability Award
- 2015 – Finalist AWA WA Grahame Heal Water Sensitive Urban Design Award
- 2015 – Finalist AWA WA Resource Management Award
- Finalists, Government Stewardship, Healthy Land and Water Awards
- Finalist, River Basin Management Society – Involving Community in Waterway Management
- Commendation, Minister's Urban Design Awards

Additional information

More information on the MAR scheme can be found at:

- The Essential Current news article
- City of Kalamunda
- Foothills Water Proofing Strategy, technical paper (Nelson, D)

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