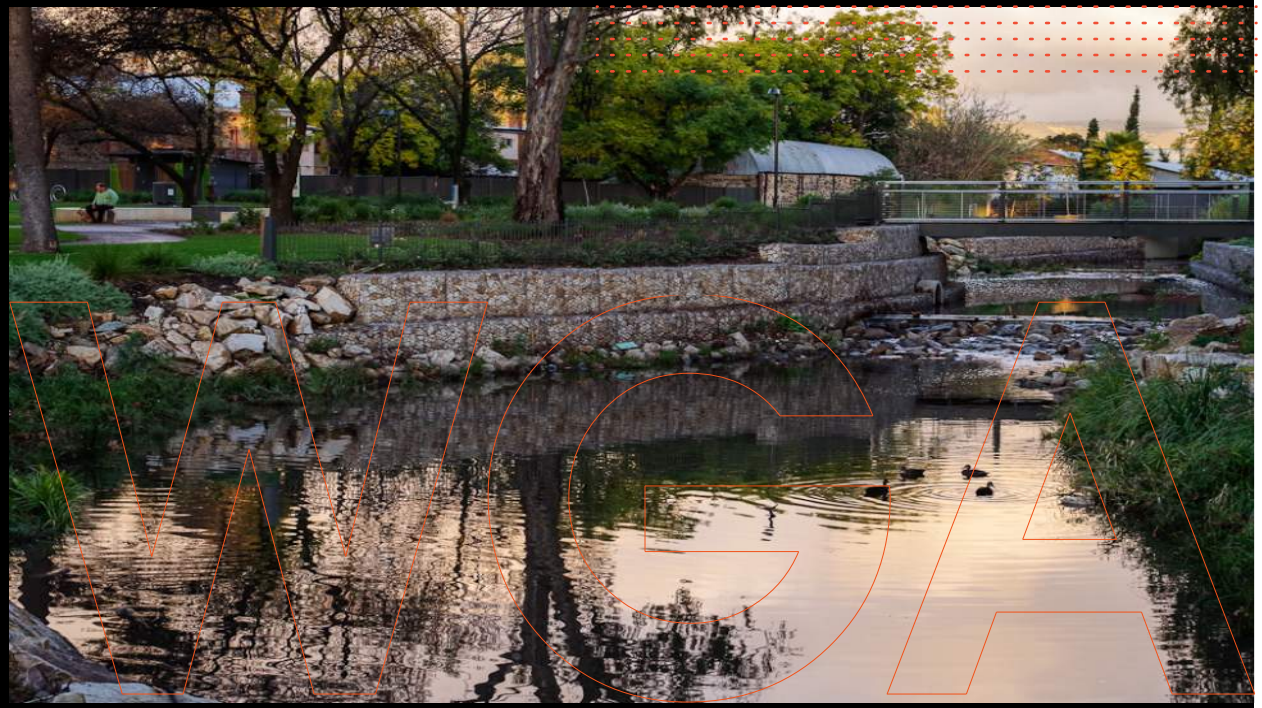
WGA

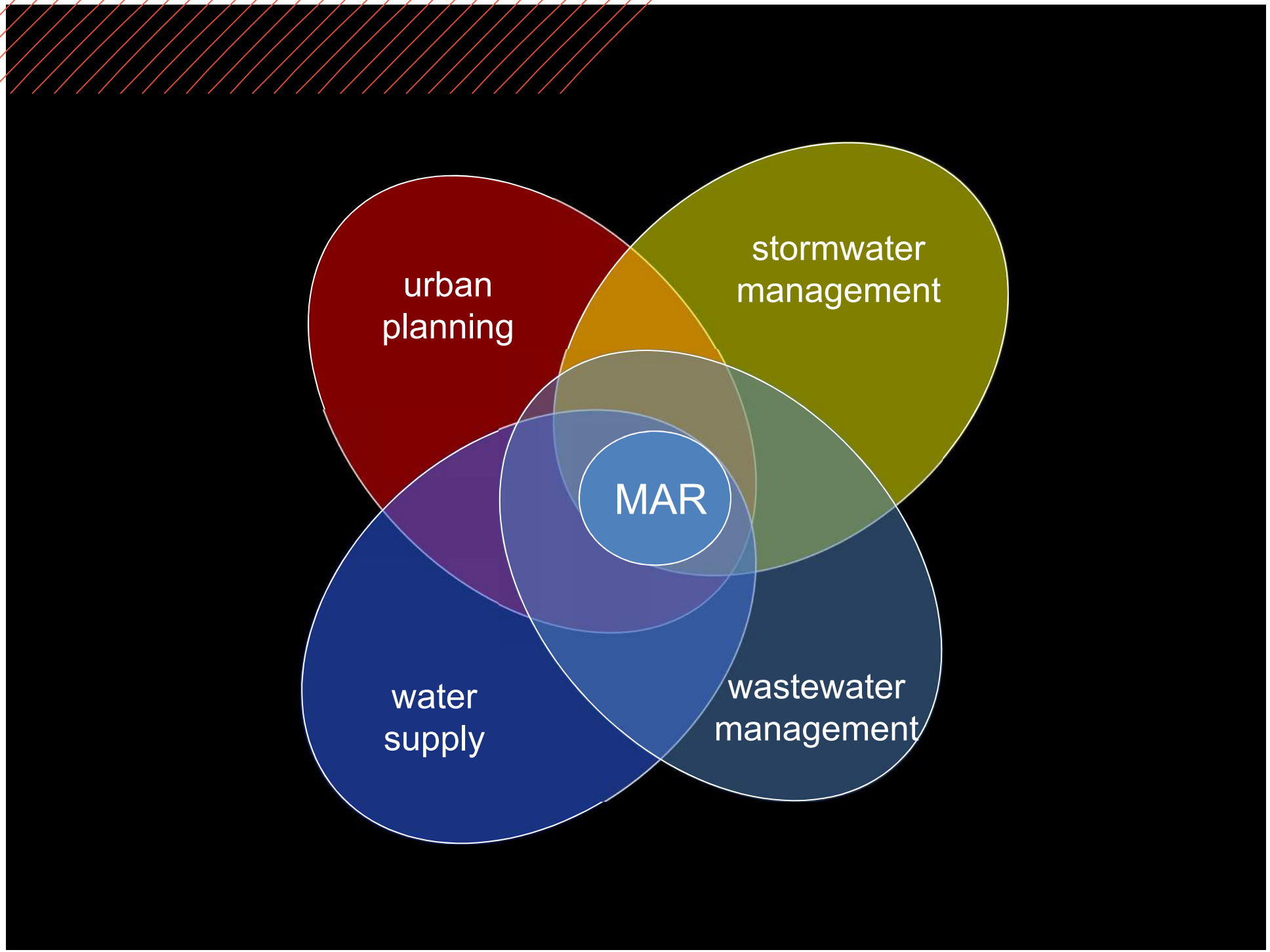
WALLBRIDGE GILBERT AZTEC

Managed Aquifer Recharge (MAR)

Technical Considerations

7 September 2017




urban
planning
stormwater
management
MAR
water
supply
wastewater
management

Several factors have contributed to MAR global uptake

- **Economics**
  - Typically less than half the capital cost of alternative water supplies sources
  - Staged implementation
  - Marginal cost pricing
- **Proven success**
  - Knowledge over past 2 decades has increased tremendously
- **Environmental and Water Quality Benefits**
  - Maintain minimum flows
  - Water security
  - Liveability
  - Small storage footprint compared to surface reservoirs
- **Adaptability to Different situations**
  - Fresh, brackish or saline storage aquifers
  - Drinking water, reclaimed water, stormwater or groundwater storage
  - Over 27 different applications for MAR

Cooke Reserve – Waterproofing the West City of Charles Sturt

Unity Park Wetland – City of Salisbury

Advantages of Aquifers Compared to Storage Reservoirs

Advantages

- Smaller impact on above ground landuse especially in lowlands and built environs.
- Protection against algae blooms, fall out, evaporation loss.
- High natural attenuation (suspended solids, pathogens, TEs, OMPs, Rads, NO).
- Damping quality and temperature fluctuations.
- Lower cost than above ground storage of commensurate size
- Can be scaled up over time therefore capital costs can be spread out over time

Problems

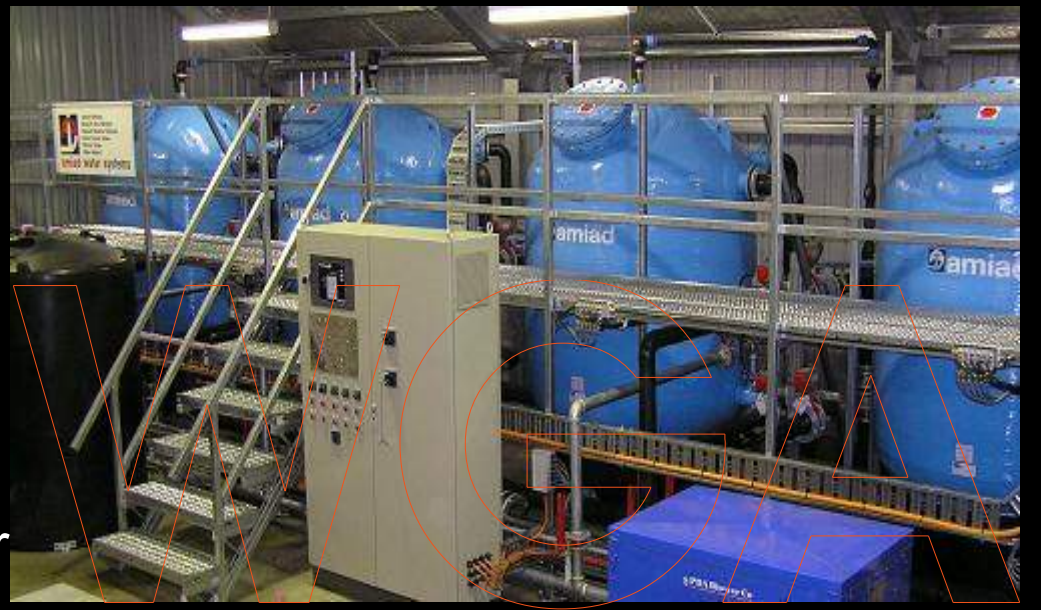
- Aquifers are not water tight (some water is lost Beyond capture zone, vertical leakage
- Surrounding saline groundwater may mix with injected water
- Reactions of water with aquifer matrix (Fe, Mn, NH4, As ,Al ……)
- Infiltration / recovery rates can be limited by clogging of basins / wells / drains
- Need a suitable aquifer system
- Potentially higher level of O&M compared to above ground storage.

Key considerations for successful implementation

- Identify and prioritise objectives for each MAR system.
- Conduct a MAR feasibility assessment tailored to meet project needs.
  - Water supply trends and variability
  - Hydrogeology and geochemistry
  - Selection of recharge method
  - If adopted method is ASR
    - Consider drilling method
    - Consider materials selection
    - Proper completion & development
  - Planned cycle testing program
  - Economic viability
  - Environmental considerations
  - Public perception
  - Legal, regulatory and water rights issues
- Integration of Hydrogeology and Engineering. - Auditing

Treatment methods

- Various methods of mechanical pre-treatment can be applied:
  - Passive (wetlands, biofiltration)
  - Filtration ranging from simple sand filters to membrane filters
  - Coagulation and flocculation
  - Activated charcoal
  - UV treatment
  - Chlorination
- Water sourced from RO may require additional buffering before recharge.
- Water sourced from wastewater treatment also may require additional treatment prior to recharge (e.g. algae management chlorination – THM?).



Design Considerations

- Experience in the design and construction of these complex systems.
- Understanding of the whole system not the individual parts.
- Consider access for maintenance.
- Safety in Design.
- Materials consideration (plastic vs steel).
- Mechanical & Electrical.
- Operation and maintenance – clogging.
- Management of artesian pressures or waterlogging.

Lessons Learned

- Prioritise the objective(s) of the MAR system upfront.
- Correct aquifer characterisation is critical to informing design.
- Economics - Cost Benefit analysis – early!
- Correct Bore construction critical to success if ASR is the adopted method.
  - MAR bores are not conventional production bores
- Design and treatment should be fit for purpose.
- Each system must be tailored to suit the operating parameters
- Design must suit local conditions.
- Must include ability to carry out maintenance effectively.
- Don’t under-estimate the time it takes to get required approvals.

Lessons Learned – Construction

- Allow adequate time for proper commissioning and testing of systems.
- Allow for Audits by experienced professionals at critical points in the construction stage.
- Do not compromise on the quality of construction materials to be used

Installation of down hole flow control valve – Source R Tribble Cactus Controls

Lessons Learned – Community Consultation

- Don’t forget it.
- Construction activities will inconvenience residents
  - Dust
  - Noise
  - Parks shut down

Lessons Learned- Operations

- Training for operators is vital (early engagement and involvement in system design important)
- Develop detailed monitoring and management plans for the system
- Maintenance plans for the plant and equipment are critical
- Allow for on-going improvement in system as new technologies become available

Call for Abstracts

Groundwater Resources Association of California and the Arizona Hydrological Society Present:

16th Biennial Symposium on Managed Aquifer Recharge

Recharge to the Rescue! Managed Aquifer Recharge as a Water Management Tool

March 6 to 7, 2018
March 5, Optional Workshops

Herman Bouwer Award
March 6, 2018

The Dana on Mission Bay

San Diego, California, USA

MAR Testing, Design and Construction

- Advanced methods for selection of aquifers, sites and methods
- Designing for storm water capture
- Predicting sediment loading/clogging
- Alternative recharge systems
- Innovation in harvesting and storing flood waters
- Overcoming the hydrogeology/engineering disconnect

MAR Operations and Maintenance

- Monitoring and modeling
- Tracer testing
- Clogging management
- Fate of pathogens and pollutants
- Geochemistry and hydrogeology
- Groundwater hydraulics and storage recovery
- Training for MAR operators
- Long-term maintenance requirements/budgeting
- Modifying operations for long-term sustainability

MAR Governance

- Integrated water resources management
- Recharge policies, standards and regulations
- Community engagement and MAR awareness
- MAR to complement groundwater demand management
- Legal issues related to storm water capture by MAR systems

MAR and Water Resources Management

- Reclaimed water reuse via MAR
- Storm water harvesting via MAR (MS4 permitting, etc.)
- Quantification of benefits and costs of MAR
- MAR for drinking water quality improvement
- MAR with desalinated water
- Mining and industrial applications of MAR
- MAR to source heat pumps and geothermal injection
- Mitigating geological problems using MAR - land subsidence, seawater intrusion, etc.
- MAR for rural and irrigation water supplies
- MAR in conjunctive use of surface water and groundwater

MAR Case Studies

- Success factors for projects that worked
- Lessons learned from projects that did not work

Other Issues related to MAR

- MAR and climate change
- MAR in urban areas
- Greenhouse gas considerations in MAR operations

Abstracts deadline: November 1, 2017.

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