Planning for the long term with recycled water – the story of Salisbury, South Australia

Dr John C Radcliffe AM FTSE  
Honorary Research Fellow, CSIRO;
“Governments and utilities will need to cater for growth and demand, because of limited potential new reservoir sites and their inability to adapt to climate variability.”

“Infrastructure and services are generally allocated on a sector basis, such as transport, land-use planning and water. The current approach to land-use planning leaves water service provision as an afterthought.”
This is the story of how the City of Salisbury, South Australia, planned ahead over 50 years and developed its own recycled water business.
The Framework governing development

WATER MANAGEMENT IN AUSTRALIA

• Governance
• National Water Quality Management Strategy Guidelines
• Intergovernmental Agreement on the National Water Initiative (NWI)
• Guide - Water Sensitive Urban Design

THE SALISBURY EXPERIENCE

• Urban development – wetlands and MAR
• Creating a commercial water business
• Is treated stormwater a future drinking source?
PREAMBLE

1. Water may be viewed as part of Australia’s natural capital, serving a number of important productive, environmental and social objectives. Australia’s water resources are highly variable, reflecting the range of climatic conditions and terrain nationally. In addition, the level of development in Australia’s water resources ranges from heavily regulated working rivers and groundwater resources, through to rivers and aquifers in almost pristine condition.

2. In Australia, water is vested in governments that allow other parties to access and use water for a variety of purposes – whether irrigation, industrial use, mining, servicing rural and urban communities, or for amenity values. Decisions about water management involve balancing sets of economic, environmental and other interests. The framework within which water is allocated attaches both rights and responsibilities to water users – a right to a share of the water made available for extraction at any particular time, and a responsibility to use this water in accordance with usage conditions set by government. Likewise, governments have a responsibility to ensure that water is allocated and used to achieve socially and economically beneficial outcomes in a manner that is environmentally sustainable.

3. The 1994 Council of Australian Governments’ (COAG) water reform framework and subsequent initiatives recognised that better management of Australia’s water resources is a national issue. As a result of these initiatives, States and Territories have made considerable progress towards more efficient and sustainable water management over regulation, and making explicit provision for environmental water.

4. At the same time, there has been an increase in demand for water, and an increased understanding of the management needs of surface and groundwater systems, including environmental water.
Policies for Progressing Reform:

- Water access entitlements & planning framework
- Water markets and trading
- Best practice water pricing and institutional arrangements
- Integrated Management of Environmental Water
- Water Resource Accounting
- Urban Water Reform
- Community Partnerships and Adjustment
- Knowledge and skills Building
- Temporarily created National Water Commission to drive reform
Water Sensitive Urban Design Guidelines 2009
(but no agreed Statutory Definition)
Australia has agreed national regulatory standards and management tools.

**National Water Quality Management Strategy**

- **Australian Drinking Water Guidelines**
  (endorsed, published 2002-5, revised 2011, updated 2018)

- **Australian Guidelines for Water Recycling**
  - Phase 1 - *Managing Health and Environmental Risks*
    (Ministers approved 2006)

- **Phase 2**
  - *Recycled Water for Drinking* –
    (Ministers approved April 2008)
  - *Stormwater*
  - *Managed Aquifer Recharge*
    (Ministers approved July 2009)

After World War II, Australia had a big increase in population through a post-war “baby boom” and from migration.

New housing was built as the capital cities expanded.

Adelaide expanded north and south including to the Salisbury district.
CITY OF SALISBURY

Bolivar Sewage Treatment Plant

Parafield Airport

ADELAIDE
Central Business District
1946 - Salisbury – a farming village - population 4,160
1960:
Subdivision of farm land for housing starts

A private company develops a new suburb in the Salisbury district

“Para Hills”

State Library of South Australia – Darien Smith
Para Hills 1964

Integrated neighbourhood development

- Houses
- Schools
- Shopping centres
- Community centres
- 15% for recreation
- Drainage lines reserved
Subdivision for housing with a big increase in impermeable surfaces has changed the hydrology of the area from the gentle creeks that ran through the farm land.
Stormwater was collected in a wetland with extensive tree planting, a scenic lake, trails and a popular dog park, the recreation centre being known as “The Paddocks”
“The Paddocks” Wetlands
WETLAND HABITAT AREA
NO PEDESTRIAN ACCESS
PERMITTED

CITY OF SALISBURY
PADDOCKS WETLANDS
THIS AREA IS AN IMPORTANT HABITAT WILDLIFE RESERVE PLEASE ENSURE MINIMUM DISTURBANCE TO WILDLIFE BY REMAINING ON THE PATHS AND KEEP DOGS ON A LEASH AROUND WETLAND AREAS AT ALL TIMES CITY MANAGER

THE PADDOCKS WETLANDS
This Conservation area, is home to a wide range of native animals, birds and reptiles including SNAKES

Please respect their habitat and keep to the formal paths.
Expansion of Wetlands - Greenfields

- Greenfields Wetlands began in 1984, low-lying saline land developed into a stormwater detention basin and wetlands habitat.

- Greenfields Wetlands (114 hectares) is one of the first large, constructed urban wetlands in Australia.

- Home to over 160 species of birds, eight species of fish, four species of frog, yabbies, long-necked tortoises and numerous aquatic invertebrates.

- 25 species of aquatic plants thrive in Greenfields Wetlands.
A development philosophy

• With subdivision of Salisbury for housing and industry, 40 similar recreational wetlands were built into developments.

• The land occupied by wetlands is more than 200 hectares.

• The annual harvest capacity of these wetlands is about 5.8GL.
Adopting Managed Aquifer Recharge

• Salisbury is underlain by aquifers, some used traditionally to support irrigated horticulture – in some areas being overdrawn

• In 1996, the Salisbury Council installed Aquifer Storage and Recovery wells (a form of Managed Aquifer Recharge) at “The Paddocks” to store winter Para Hills stormwater run-off for summer irrigation of local recreation areas.
Aquifer Storage and Recovery (ASR) well

(“The Paddocks” Wetlands at rear)
MANAGED AQUIFER RECHARGE
(Aquifer Storage and Recovery)
Aquifer Storage and Recovery (ASR) wells were then installed on other larger wetlands at Salisbury to irrigate new parks and sports ovals.
## Major water harvesting sites

<table>
<thead>
<tr>
<th>Site name</th>
<th>Year injection commenced</th>
<th>Catchment area (ha)</th>
<th>% Urbanised area</th>
<th>Estimated annual yield (GL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parafield ASR</td>
<td>2003</td>
<td>1,590</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>Cobbler Ck./ Bridgestone Park</td>
<td>2016</td>
<td>1,017</td>
<td>38</td>
<td>1.1</td>
</tr>
<tr>
<td>Unity Park ASR</td>
<td>2006</td>
<td>5,116</td>
<td>77</td>
<td>1.3</td>
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<tr>
<td>Paddocks ASR</td>
<td>2000</td>
<td>456</td>
<td>89</td>
<td>0.1</td>
</tr>
<tr>
<td>Greenfields ASR</td>
<td>2008</td>
<td>11,371</td>
<td>71</td>
<td>0.3</td>
</tr>
<tr>
<td>Edinburgh South ASR</td>
<td>2012</td>
<td>4,417</td>
<td>61</td>
<td>1.2</td>
</tr>
<tr>
<td>Kaurna Park ASR</td>
<td>2005</td>
<td>5,512</td>
<td>64</td>
<td>0.6</td>
</tr>
<tr>
<td>Whites Road ASR</td>
<td>2014</td>
<td>2,628</td>
<td>61</td>
<td>1.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>32,107</strong></td>
<td></td>
<td><strong>5.8</strong></td>
<td></td>
</tr>
</tbody>
</table>
2001: Investment partnership for Industrial use

- Salisbury Council
- G.H. Michell – wool processors
- Australian Government

to build a $4.5 million wetland scheme on Parafield Airport – Adelaide’s secondary airport.

Water was to be used industrially by Michell,
Water used in dual supply system, Mawson Lakes

Supply/demand balanced by Aquifer Storage and Recovery
*Phragmites* spp. under bird netting

PARAFIELD AIRPORT
Two Aquifer Storage Recovery (ASR) Wells

PARAFIELD AIRPORT
Recycled water for Mawson Lakes

• Mawson Lakes - residential suburb on 620-hectares
• 10,000 residents, 10,000 incoming workers, 5,000 students at University of South Australia campus
• First Adelaide community with a ‘purple-pipe’ recycled water system and designed with water sensitive urban design
MAWSON LAKES

• FEATURES

• Recycled water system (purple pipe) using stormwater (Parafield) + effluent (Bolivar STP) through a 2.6ML mixing tank

• Toilet flushing, gardens, car washing

• Swales and other water sensitive urban design

• Energy efficient buildings
For Mawson Lakes

Recycled water from the Bolivar Sewage Treatment Works and ASR Stormwater from Parafield come together in a 2.6 ML Mixing Tank.
MAWSON LAKES
Dual Reticulation
Two water meters
Children should be supervised at all times

- No swimming
- No diving
- No fishing
MAWSON LAKES

OUTCOME

• Reduced usage of drinking water in Mawson Lakes by 50 per cent (compared to Adelaide average) saving 800 Megalitres of drinking water per year.
The City of Salisbury linked its major wetlands / ASR sites with a ring main

Business corporatized, independent Board with expertise in water industry, finance, law

Has a risk-based Management Plan

supplies 5,000 homes, 1,000 external customers, including 32 schools. Michell Wool remains one of the key customers
Planning for the future with recycled water - South Australia's City of Salisbury story

Salisbury Council Water Business
- Ring main connecting 9 major MAR sites, serving 1000 customers for ovals, factories, 32 schools and amenity use
- Salinity Water Treatment Plant (WTP)
- Recycled water from Bolivar WWTP DAFF plant
- 3rd pipe system - suburb of Mawson Lakes, 5,000 homes

Managed Aquifer Recharge - 9 sites
- Recovered water irrigates 100 ovals and sports fields
- WSUD subdivisions - stormwater to 40 Wetlands
- Salisbury district - before 1960 traditional farm land Population 4160 (1945)
- Subdivided for housing after 1960 Population now 141,000

Research into Aquifer Storage Transfer and Recovery of Salisbury stormwater and identification of treatments to generate safe drinking water
CITY OF SALISBURY, South Australia

Water courses, wetlands, and MAR sites.
Customer Supply pipes
### Salisbury Water Business

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Cost</td>
<td>$52m</td>
</tr>
<tr>
<td>Annual Operating</td>
<td>$3m</td>
</tr>
<tr>
<td>Sales of water</td>
<td>$5m</td>
</tr>
</tbody>
</table>

Council’s open space irrigation = $1.31/KL
(Mains water equivalent cost = $3.26KL)
(+ greenhouse gas saving not lifting 700m, pumping from R Murray)

**Benefit:Cost ratio** 2.5 : 1
Except for Parafield Airport, Salisbury is now totally urbanised – Population 141,000
The Future - Water for drinking?

• Australia had the Millennium drought – 2000-2010
• Adelaide had severe water restrictions
• Adelaide Hills reservoirs were depleted
• The River Murray (back-up supply) became too salty for drinking
• Will climate change reduce annual catchment of water?
• Could the Salisbury Stormwater be made suitable for drinking?
Could Salisbury ASR be another alternative drinking water source?

12 Experimental Treatments

- 4 for open space irrigation
- 4 for use in “purple pipe” dual reticulation systems
- 4 for indirect potable re-use with and without Managed Aquifer Recharge (Aquifer Storage, Transfer and Recovery-ASTR)
Stormwater quality monitoring, sampling and analysis and a quantitative microbial risk assessment to meet health standards

Open space irrigation requires

• $1.6 \log_{10}$ reduction for viruses,
• $0.5 \log_{10}$ for protozoa and
• $1.2 \log_{10}$ for bacteria.

(These standards have been met for some years)
Dual reticulation system using purple pipes including for toilet flushing and washing machines requires

- $2.7 \log_{10}$ reduction for viruses,
- $1.6 \log_{10}$ for protozoa and
- $2.3 \log_{10}$ for bacteria.

(Aquifer treatment could deliver this treatment if it were validated. Otherwise UV disinfection + chlorination would be required.)
Drinking water requires
• $5.8 \log_{10}$ for viruses,
• $4.6 \log_{10}$ for protozoa and
• $5.3 \log_{10}$ for bacteria

Appropriate post-extraction water treatment would be required, for which several options could be considered.
ASR/ASTR Well, Parafield Gardens Oval
Risks

- **Open Space – Irrigation – Pathogens**
- **Purple Pipe – Pathogens + aesthetics (colour, salinity)**
- **Drinking – Pathogens + aesthetics + inorganic chemicals**
Land use analysis to assess risks
Maps of Risks

Chemicals
- Tannery
- Horticulture
- Plastics
- Cars
- Metal ind.
- Milk Plant
- Wool proc.
- Sports field
- Rail yard
Assessed Risks

After existing and proposed pollutant barriers

• Chemicals, nutrients, turbidity – Low
• Radionuclides – none
• Pathogens in ambient groundwater – none
• Pathogens in managed aquifer recharge – need to be managed
Conclusions

• Aquifer Storage Transfer and Recovery (ASTR) provides pathogen attenuation of $4 \log_{10}$

• Detention time needs validation and management

• Aquifer Storage and Recovery would not guarantee residence time

• For other parameters, Australian Drinking Water Guidelines met

• Some aesthetic targets sometimes exceeded – colour, turbidity, salinity
Conclusions

• Risks acceptable – can meet quality targets with treatments for each end use

• Treatment for pathogens, turbidity and colour required prior to purple pipe and drinking water use

• Risks to environment well managed

• Risk Management Plans, a Water Safety Plan and Economic Assessment needed

• Community and Regulator acceptance required
Conclusions

• Water from Salisbury stormwater wetlands can meet drinking water standards with added end-point water treatment

• Water research and policies have encouraged new food industries to develop in Salisbury

• Salisbury has grown from 5,000 to 141,000 in 50 years while successfully adapting and benefiting from changed hydrology that follows urbanisation
Thank you

Dr John C Radcliffe AM FTSE
Honorary Research Fellow, CSIRO;

t  +61 8 83038580

e  john.radcliffe@csiro.au