Supplementary information: CASE EXAMPLES

Scheme	Description	Developers, owners, operators and retailers	Source
Aurora VIC	Residential greenfield third-pipe	Public utility (Yarra Valley Water)	Sewage
Darling Quarter NSW	Residential & commercial precinct	Private developer (Lend Lease) Private operator and retailer (Veolia)	Sewage
Hervey Bay QLD	Irrigation reuse – crops and plantations; some commercial reuse	Public utility (Wide Bay Water Corp)	Sewage
Gordon Golf Course NSW	Irrigation re-use – golf course	Local government (Ku-ring-Gai Council)	Sewage
Rosehill NSW	Industrial reuse; some irrigation reuse	Private developer, owner and operator (AquaNet consortium) Public utility retailer (Sydney Water)	Sewage

1. **Aurora Scheme** (ISF 2013a)

Drivers: The Urban and Regional Land Corporation (URLC), the Victorian government's development agency, was looking for a site to demonstrate the viability of implementing its strong sustainable development agenda to the commercial development sector. Viability was dependent on scale in order to distribute expenditure over a larger number of households, and low raw land costs so that the final price to market was acceptable and that the government received adequate returns. The fact that Aurora lacked a trunk sewer at the time, and its provision was at least a decade away, provided the opportunity to undertake the development.

Source: Domestic sewage

Uses: The scheme was designed to serve 8,500 homes and currently serves 2,500 homes with recycled water for toilet flushing and garden watering as well as public open space municipal sporting fields irrigation.

Treatment: Class A, including chlorination of the final product. The Victorian Guidelines for Class A require Virus=7 log removal, Protozoa=6 log removal (EPA Victoria 2005)

By the time the treatment development was ready to proceed however, the uptake of lots was significantly slower than anticipated, which meant that the recycling plant was mothballed for 2-3 years after construction because of inadequate flows. Because there was no sewage outlet for Aurora, it had to be trucked to nearby Craigieburn – at a significant cost to developers over 3 years.

Recommended by AGWR: Virus=6.5 log removal, Protozoa=5 log removal. Rolling 6-monthly cross-connection audits with all houses inspected every 5 years.

Discussion: The idea of a third-pipe scheme was deeply challenging to the long-held industry values of providing low-risk services at the lowest cost, so it was received with some anxiety and resistance. The Victorian guidelines for the use of recycled water for indoor use are higher than those suggested by the AGWR.

Further, the Victorian EPA's concern about the ongoing risk of cross-connections, has resulted in all households connected to recycled water having to undergo an inspection audit every 5 years – in line with the AGWR. Under current arrangements, the additional cost ($50/household/year) is borne by Yarra Valley Water and it is spread across the whole customer base.

2. **Darling Quarter** (ISF 2013b)

Drivers: The developers decided to go further than the 5 star Green Star building required by the Sydney Harbour Foreshore Authority, and aimed for a 6-star Green Star building, in order to attract a premium tenant for the building. Each stakeholder had different drivers for this outcome. Lend Lease wanted to use the development as an opportunity to further improve their knowledge and experience with blackwater treatment. For Veolia, this was their first foray into the small scale commercial building market in Australia, so they were focused on ensuring its success. Further concerns were raised during the design phases of the project, such as odour from the plant potentially affecting tenant amenity, residual health risks and long term maintenance and operation. This led to additional plant equipment being installed that effectively increased the planned capital and operating costs.

Source: Draw off from a nearby passing Sydney Water sewer main.

Uses: Wastewater recycled through this scheme is used for toilet flushing, irrigation and cooling towers.

Treatment: In addition to the treatment train (Moving Bed Biofilm Reactor, Membrane Bioreactor and Reverse Osmosis), chlorine dosing and monitoring equipment was added to ensure a greater than 6.5 log removal for viruses, including adenovirus, is achieved in its daily operations. The plant actually achieves approximately 10 log removal of viruses.

Recommended by AGWR: AGWR recommends virus=6.5 log removal for toilet flushing and irrigation.

Discussion: At the time the Darling Quarter plant was built, it was not possible to attain '6 Star Green Star Office As-Built' without a blackwater treatment plant, however, with the recent changes to the rating tool, it is potentially possible that the 6 stars could be achieved through efficiency measures, rather than blackwater recycling.

3. **Hervey Bay Scheme** (ISF 2013c)

Drivers: The rapid urbanisation during the 1980s in the Hervey Bay district, together with the declining health of coastal and riverine waters in urban areas (and the bad press associated frequent incidence of sewage debris and high coliform counts on Bondi Beach in Sydney) were

several factors driving a preference for reuse rather than an ocean outfall. The initial capital cost for the reuse scheme was also estimated at less than the cost of an ocean outfall. Since the commencement of the scheme in 1989, Australian and Queensland government subsidies and rebates have supported the financial viability of scheme expansion.

Source: Sewage

Uses: The reuse scheme initially focussed on providing irrigation water for sugarcane farms. However, reuse was limited by the seasonal nature of cane irrigation and lower than expected uptake. Wide Bay Water Corporation subsequently extended its reuse operations to owning native hardwood plantations to balance demand throughout the year. However, this application was limited overall by naturally high salt levels in local soils and in wet seasons by reduced demand. Reuse water is also used for the irrigation of a golf course and sporting fields, and seasonal drip irrigation at the Airport Industrial Estate.

Treatment: Eli Creek, Pulgul and Nikenbah are the three main sewage treatment plants, treating sewage to B, B and A class respectively. Water from Nikenbah is mixed with Eli Creek water, so all reuse water produced from the scheme is classified as B. Nikenbah was deliberately designed with the potential to be upgraded to supply A+ class potable water during drought as this enabled it to attract a substantial reuse subsidy.

Recommended by AGWR: It is difficult to align the Queensland Guidelines with the AGWR, except for Class A+ (V=6.5, P=5, B=5), which is equivalent to the level of treatment recommended by the AGWR for toilet flushing.

The Queensland Guidelines suggest Class C for sugar cane irrigation, Class D for irrigating trees and Class A+ for toilet flushing (EPA Queensland 2005).

Discussion: The now higher cost of land and absence of subsidies going forward are key factors that would influence decisions about whether to extend the land-based reuses of the scheme in future. Without the subsidies from government, it is unlikely these schemes would have gone ahead, or at the very least they would have been designed to meet a specific re-use demand. Also, it would appear that a higher level of treatment has been achieved than is necessary for the application of the recycled water.

4. **Gordon Golf Course** (ISF 2013d)

Drivers: In 2005 the context of the drought and the fear that in future golf courses would not be allowed to irrigate with potable water, were the main drivers for the scheme. The availability of government funding for "green initiatives" and the fact that Ku-ring-gai Council was positioning itself as a pioneer of local government sustainability, where additional drivers.

Source: Sewage

Uses: Golf course irrigation

Treatment: 3-stage treatment process (membrane bio-reactor, ultraviolet disinfection and chlorination). Pathogen log reduction values of 6.0, 4.0 and 8.0 were validated for viruses, protozoa and bacteria, respectively, for the sum of the ultrafiltration and free chlorine disinfection process Insufficient information was provided to assign a pathogen log reduction

value for the UV disinfection system but it is noted that the UV disinfection system will probably be capable of achieving some virus reduction (of the order 0.5 log) and significant protozoan and bacterial pathogen reduction (of the order 4.0 log) (iConneXX & Water Futures 2011), bringing the reduction values to 6.5, 8, 12.

Recommended by AGWR: Filtration and disinfection the Gordon scheme is not a private scheme and therefore the guidelines do not apply. However, the guidelines underpin the risk-based approach to management of recycled water systems. The AGRW recommends 5.2, 3.7 and 4 for viruses, protozoa and bacteria, respectively for unrestricted irrigation. The AGWR does not suggest chlorination in addition to membrane filtration and UV treatment.

Discussion: Based on the treatment validation, it would seem that the scheme meets the requirements of the AGWR. The application of both UV and chlorine way exceeds this recommendation however, but potentially provides an additional margin of safety and meets the "Multiple Barrier Principle" of the AGWR.

5. **Rosehill Industrial Scheme** (ISF 2013e)

Drivers: The scheme emerged in the context of drought in NSW, at a time when pursuing water security was a major driver for both public and private sector agencies. The industrial area around Rosehill and the availability of a disused gas main provided further incentive to pursue the scheme.

Source: Secondary effluent from Sydney Water's Liverpool to Ashfield Pipeline.

Uses: Five major industrial users and one irrigation user.

Treatment: Class A. The treatment involves ultrafiltration and reverse osmosis (RO), and is monitored to meet water quality targets of < 50 mg/L TDS, pH of 6.5–8.5, Chlorine residual of 1 mg/L and turbidity of < 0.5 NTU.1

Recommended by AGWR: The AGWR does not recommend a treatment standard for industrial use, since this would be determined by the requirements of the application. Given the potential for cross-connections, the standard would be Class A equivalent, but does not require RO.

Discussion: At least one prospective customer agreed to be involved only if low TDS water was supplied, and thus RO treatment was considered essential by the developers to secure sufficient demand volumes from foundation customers. In retrospect, not all customers required RO-treated water, and it could have been more cost-effective overall for specific customers to undertake additional treatment as and if required on their own sites. The higher quality water used for cooling towers and boilers has brought customers substantially greater cost savings than they had anticipated.

Industry concerns about community perceptions associated with using recycled water in the manufacture of personal use products for example, have resulted in some manufacturers unwilling to sign up and hence hindered the full utilisation of the Rosehill scheme.

References:

ISF, 2013a. *Aurora Case Study, Building Industry Capability to Make Recycled Water Investment Decisions*, Prepared by the Institute for Sustainable Futures, University of Technology, Sydney for the Australian Water Recycling Centre of Excellence.

ISF, 2013b. *Darling Quarter Case Study, Building Industry Capability to Make Recycled Water Investment Decisions*, Prepared by the Institute for Sustainable Futures, University of Technology, Sydney for the Australian Water Recycling Centre of Excellence.

ISF, 2013c. *Wide Bay Water Case Study, Building Industry Capability to Make Recycled Water Investment Decisions*, Prepared by the Institute for Sustainable Futures, University of Technology, Sydney for the Australian Water Recycling Centre of Excellence.

ISF, 2013d. *Navigating the institutional maze, Building Industry Capability to Make Recycled Water Investment Decisions*, Prepared by the Institute for Sustainable Futures, University of Technology, Sydney for the Australian Water Recycling Centre of Excellence.

ISF, 2013e. *Rosehill Case Study, Building Industry Capability to Make Recycled Water Investment Decisions*, Prepared by the Institute for Sustainable Futures, University of Technology, Sydney for the Australian Water Recycling Centre of Excellence.