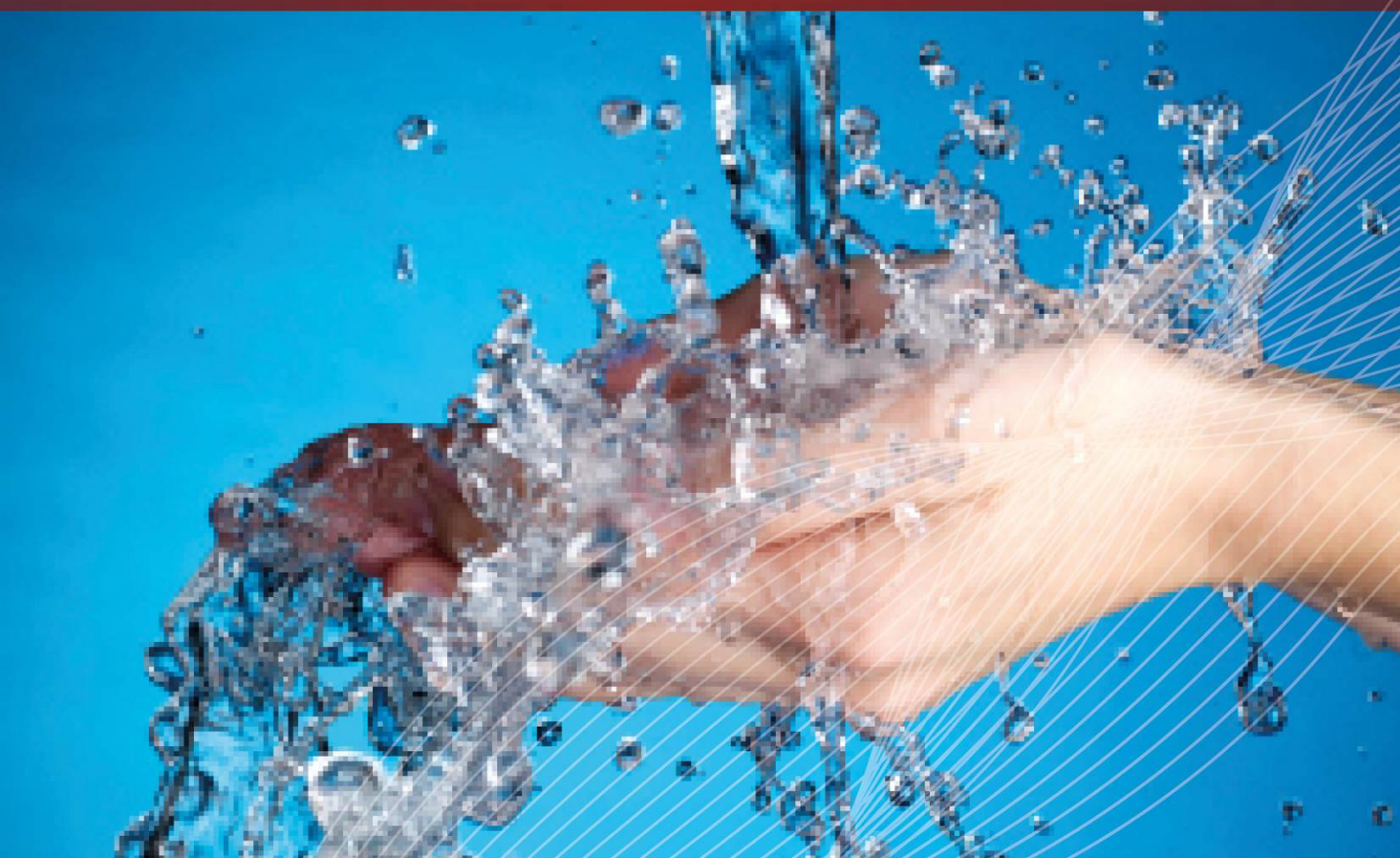
Australian Water Recycling
Centre of Excellence

Project Report

Global Potable Reuse Case Study 6: Western Corridor Recycled Water Scheme

A report of a study funded by the
Australian Water Recycling Centre of Excellence

University of New South Wales, November, 2014



Global Potable Reuse Case Study 6: Western Corridor Recycled Water Scheme

This report has been prepared as part of the National Demonstration Education and Engagement Program (NDEEP). This Program has developed a suite of high quality, evidence-based information, tools and engagement strategies that can be used by the water industry when considering water recycling for drinking purposes. The products are fully integrated and can be used at different phases of project development commencing at "just thinking about water recycling for drinking water purposes as an option" to "nearly implemented". The information contained in this Case Study was first published on the Public Health pages of a University of New South Wales Wiki website in 2012.

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OCWD
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About the Australian Water Recycling Centre of Excellence

The mission of the Australian Water Recycling Centre of Excellence is to enhance management and use of water recycling through industry partnerships, build capacity and capability within the recycled water industry, and promote water recycling as a socially, environmentally and economically sustainable option for future water security.

The Australian Government has provided $20 million to the Centre through its National Urban Water and Desalination Plan to support applied research and development projects which meet water recycling challenges for Australia's irrigation, urban development, food processing, heavy industry and water utility sectors. This funding has levered an additional $40 million investment from more than 80 private and public organisations, in Australia and overseas.

ISBN: 978-1-922202-42-0

Citation:

Onyango, L., Leslie, G. and Wood, J.G. (2014). *Global Potable Reuse Case Study 6: Western Corridor Recycled Water Scheme*, Australian Water Recycling Centre of Excellence, Brisbane, Australia.

Date of publication: November, 2014

Publisher:
Australian Water Recycling Centre of Excellence
Level 5, 200 Creek St, Brisbane, Queensland 4000

www.australianwaterrecycling.com.au

This report was funded by the Australian Water Recycling Centre of Excellence through the Australian Government's National Urban Water and Desalination Plan.

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1. Scheme overview

Background

The Western Corridor Recycled Water Scheme (WCRWS) was Australia's first potable reuse scheme commissioned to augment drinking water supplies within the South East Queensland (SEQ) water grid through dam supplementation. At the time of commissioning, the region had been experiencing severe drought coupled with the effects of population growth and demand which put a strain on their existing potable sources. In the community of Toowoomba specifically, there was a proposal to introduce potable reuse, to which the community was strongly opposed. In 2007, the Queensland government made the decision to go ahead with potable reuse which would be incorporated into the SEQ drinking supply, Toowoomba included [1]. It was envisioned that the reclaimed water would be used to augment drinking water supplies, as well as for agricultural and industrial use.

Financing the facility cost Water Smart Australia and the Queensland government AU$2.32 billion to build its Advanced Water Treatment Plants (AWTPs) located in Bundamba, Gibson Island, and Luggage Point plus over 200km of large diameter pipeline. The AWTPs receive secondary effluent from six wastewater treatment plants for reclamation. Validation and verification testing were undertaken to ensure consistent achievement of water quality standards at each location, and in 2007 reclamation of 61mgd of wastewater from domestic and commercial sources began. The validation and verification results helped inform the Recycled Water Management Plan (RWMP) - which is their risk based system for management of water quality [2].

Although the purified water was intended for surface water recharge of the Wivenhoe Dam when the combined levels of potable supply fell below 40%, to date, this has not happened. The purified water was only ever supplied to industrial customers (2010-2013) before the plant was decommissioned in 2013. Despite its short lifespan, the scheme has been awarded 13 state, national and international awards.

Figure 1: The Western Corridor Recycled Water Scheme is located at Brisbane, Queensland, Aust.

Further information on Western Corridor Recycled Water Scheme can be found on the Global Connections Map on the *Water360* website.

2. Scheme infrastructure

The WCRWS was operated by Veolia Water Australia. At full capacity, the scheme had 29 operators across the three advanced water treatment plants with Certificate 3 qualifications, which is the minimal requirement for operators. The permit for WCRWS's operational processes was based on the Water Supply (Safety and Reliability) Act 2009 and regulatory guidelines developed under this Act. Their water quality parameters were specified in Schedule 3B of the Public Health Regulation 2005.

The plant was regulated by Queensland Water Supply Regulator (WSR) (in the Department of Energy and Water Supply) and an external audit was performed every 2 years by qualified external auditors according to guidelines issues by Queensland WSR. An internal audit was performed yearly. The scheme was also advised by an independent international panel established by the Queensland Water Commission.

Operational processes were monitored using online Supervisory Control and Data Acquisition (SCADA) systems that provide real-time data. They also performed composite sampling and testing of treated wastewater (source) and purified water. Maintenance was scheduled and performed using a Computerised Maintenance Management System (CMMS).

Multiple Barriers and Treatment

The scheme employs a comprehensive 7-barrier system with each barrier having specifications of water quality (Figure 2).

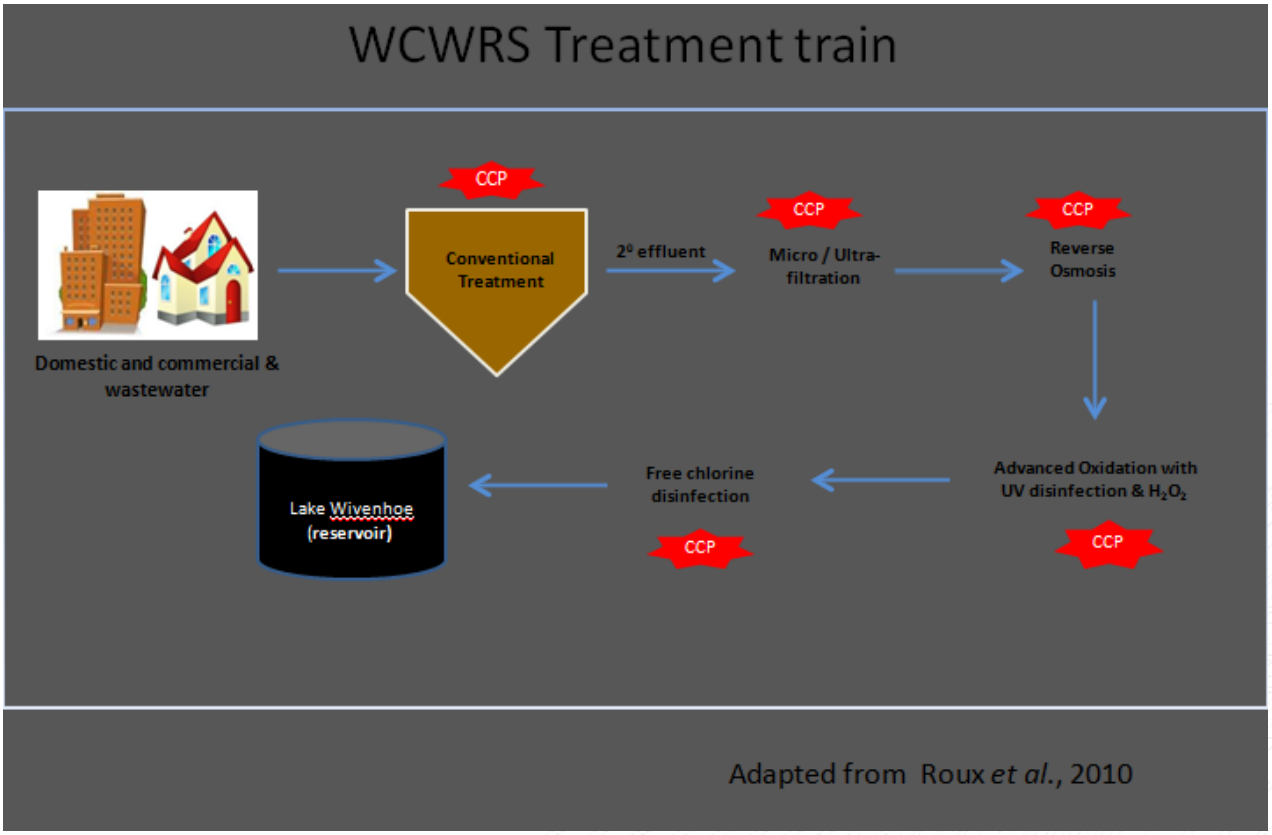

Figure 2: Western Corridor Recycled Water Scheme treatment train.

The barriers include:

- Source control measures - specifications for trade waste discharges to sewer
- Wastewater treatment*
- MF/UF*

- RO*
- AOX (UV/H_2O_2)*
- Free chlorine disinfection*
- Storage in a natural environment (reservoir) before passage through a water treatment plant.

Incorporated within this system are five Critical Control Points (CCPs) (denoted by * in the list above). Each CCP was validated through desktop "pre-commissioning" submission of evidence accompanied by three months of intensive monitoring of source (treated wastewater) and purified water (the final product water). The **Recycled Water Management Plan** (RWMP) also specifies comprehensive response protocols for CCP alarms and purified water quality non-conformance. Each of the CCPs was designed with 3 alarm levels:

- Alert - instigate investigation and operator initiated corrective action;
- Action - automatic shutdown when action alarm levels activated; and
- Critical - alarm if shut-down action or other corrective action not completed.

3. Water Quality & Public Health

As part of their agreement in managing the WCRWS, Seqwater provides an annual report of water quality in accordance with its **RWMP**, a risk-based system that documents recycled water management. The range of water quality assessments and the final product water standards are defined in Schedule 3b of the Public Health Regulation 2005 which were adopted based on the Australian Guidelines for Water Recycling (AGWR).

Purified water from the AWTP had various uses and water quality criteria for each end use were specified in the **Information Notice for the Decision,** along with details of the points where water quality must be monitored for the respective end use. For potable reuse (augmenting drinking water supplies) the **Lake Wivenhoe Point of Supply** was identified and monitored. Although the plant has never supplied water to the dam, performance data was still gathered, but this ceased in December 2012.

The final product water is sampled and tested for compliance according to the monitoring program approved by Queensland WSR. There have been no public health concerns since the reclaimed water was only ever distributed to industrial consumers. Any health-related concerns were dealt with through regular meetings and direct communication with Seqwater. Queensland Health is the body that would have been responsible for undertaking a public health risk assessment when and if the reclaimed water was augmenting drinking supplies.

Assessments of Water Quality

The WCRWS monitors for ~523 parameters. A summary of key parameters for the Lake Wivenhoe Point of Supply is provided in Table 1 for 2011-2013.

Table 1: Summary of key parameters monitored during 2011-2013 at the Lake Wivenhoe Point of Supply for the WCRWS.

Water Quality Category	Parameter
Aesthetic and operational	Turbidity
	Total hardness
Organic chemicals	1,4-Dioxane
	Fluorene
	EDTA
	Octadioxin

Disinfection by products	Chloroform
	Bromate
Pharmaceuticals and personal care products	Warfarin
	Caffeine
Hormones	Estrone
	Testosterone
Pesticides and herbicides	Tetradifon
	Atrazine
Microorganisms	*Escherichia coli*
	Clostridium perfringens spores
	Somatic Coliphages
Nutrients	Nitrite + Nitrate
	Total Organic Carbon

More detailed water quality data for the WCRWS for 2011-2013 is presented in (Table 2).

Table 2: Western Corridor Recycled Water Scheme (WCRWS) water quality data 2011-2013.

Parameter	**Unit**	**Final product water average 2011-2012**	**Final product water average 2012-2013**	**Public Health Regulation Standard**
Microbiological Indicators				
Escherichia coli	cfu/100 mL	ND	ND	0
F-RNA Phages	pfu/100 mL	ND	ND	0
Somatic Coliphages	pfu/100 mL	ND	ND	0
Clostridium perfringens spores	cfu/100 mL	ND	ND	0
Aesthetic Characteristic and Operational Parameters	**Unit**	**Average**	**Average**	**ADWG Guideline**
conductivity	µS/cm	217	225	
pH	unit	8	7.9	6.5 - 8.5
TDS	mg/L	139	141	500
Total Hardness	mg/L ($CaCO_3$)	66	61	
Turbidity	ntu	0.24	0.41	5

Nutrients	Unit	Average	Average	Public Health Regulation Standard
Ammonia	mg(N)/L	0.002	0.0144	0.41*
Nitrate	mg(N)/L	0.55	0.545	11.29*
Nitrite	mg(N)/L	0.001	ND	0.91*
Nitrite + Nitrate	mg(N)/L	0.55	0.514	
Ortho Phosphorus	mg(P)/L	0.005	0.007	
Total Nitrogen	mg(N)/L	0.61	0.568	
Total Organic Carbon	mg/L	0.28	0.315	
Total Phosphorous	mg(P)/L	0.01	0.011	
Inorganic Anionic Compounds	**Unit**	**Average**	**Average**	**Public Health Regulation Standard**
Bicarbonate Alkalinity	mg/L	64	59	
Bromide	mg/L	ND	0.031	7
Carbonate Alkalinity	mg/L ($CaCO_3$)	1	0.8	
Chloride	mg/L	10.4	21.601	
Cyanide Free	mg/L	ND		
Fluoride	mg/L	ND	0.03	1.5
Iodine	mg/L	ND		
Silica (SiO2)	mg/L	1.4	1.2	
Sodium Absorption Ratio	mg/L	0.89	0.96	
Sulphate	mg/L	13	15.3	500
Total Alkalinity	mg/L	65	59.8	
Inorganic Cationic Compounds	**Unit**	**Average**	**Average**	**Public Health Regulation Standard**
Aluminium - total	mg/L	0.033	0.0497	0.2
Antimony - total	mg/L	ND	ND	0.003
Arsenic - total	mg/L	ND	ND	0.007
Barium - total	mg/L	0.0006	0.0028	0.7
Boron - total	mg/L	0.106	0.1107	4
Cadmium - total	mg/L	0.00007	ND	0.002
Calcium - total	mg/L	26	24	
Chromium - total	mg/L	0.0006	ND	0.05
Copper - total	mg/L	0.002	0.0009	2
Iron - total	mg/L	0.011	0.036	0.3
Lead	mg/L		0.0006	0.01
Magnesium - total	mg/L	0.23	0.27	

Manganese - total	mg/L	0.003	0.006	0.5
Mercury - total	mg/L	ND		
Molybdenum - total	mg/L	ND	ND	0.05
Nickel - total	mg/L	ND	ND	0.02
Selenium - total	mg/L	0.0002[1]	0.00005	0.01
Strontium - total	mg/L	ND	ND	
Vanadium - total	mg/L	ND	ND	0.05
Zinc-total	mg/L	0.005	0.0022	3
Inorganic Disinfection By-Products (Degradation Products)	**Unit**	**Average**	**Average**	**Public Health Regulation Standard**
Bromate	mg/L	ND	ND	0.02
Chlorate	mg/L	0.18	0.27	
Chlorite	mg/L	ND	ND	0.3
Perchlorate	mg/L	ND	ND	
Carbonaceous Disinfection By-Products	**Unit**	**Average**	**Average**	**Public Health Regulation Standard**
1,1,1-Trichloropropan-2-one	µg/L	ND	ND	
1,1,3-Trichloropropan-2-one	µg/L	ND	ND	
1,1-Dichloropropan-2-one	µg/L	ND	ND	
1,3-Dichloropropan-2-one	µg/L	ND	ND	
Bromochloroacetic Acid	µg/L	ND	2.2	0.014
Bromodichloroacetic acid	µg/L		ND	
Bromodichloromethane	µg/L	4.6	3	6
Bromoform	µg/L	1	1.4	100
Chloral Hydrate	µg/L	0.81	0.7	20
Chlorodibromoacetic acid	µg/L		ND	
Chloroform	µg/L	6.38	3.6	200
Chloropicrin	µg/L	ND	ND	
Dibromoacetic Acid	µg/L	ND	2.21	0.014
DibromochloromethaneL	µg/L	3	2.2	100
Dichloroacetic acid	µg/L	ND	ND	100
Monobromoacetic Acid	µg/L	ND	ND	0.35
Monochloroacetic Acid	µg/L	ND	ND	150
Trichloroacetic acid	µg/L	ND	ND	100

Nitrogenous Disinfection By-Products	Unit	Average	Average	Public Health Regulation Standard
Bromochloroacetonitrile	µg/L	ND	0.42	0.7
Bromodichloroacetonitrile	µg/L		ND	
Dibromoacetonitrile	µg/L	ND	ND	
Dibromonitromethane	µg/L	0.61	ND	
Dichloroacetonitrile	µg/L	ND	ND	2
Nitrilotriacetic Acid	µg/L	ND	ND	
Trichloroacetonitrile	µg/L	ND	ND	
NDBA	ng/L	ND	ND	
NDEA	ng/L	ND	ND	10
NDMA	ng/L	ND	ND	10
Nitroso-morpholine	ng/L	ND	ND	
Nitroso-piperidine	ng/L	ND	ND	
Hormones	**Unit**	**Average**	**Average**	**Public Health Regulation Standard**
17-alpha-Estradiol	ng/L		ND	
17-alpha-ethynylestradiol	ng/L	ND	ND	1.5
17-beta-estradiol	ng/L	ND	ND	175
4-Cumylphenol	ng/L		ND	0.35
Androsterone	ng/L	ND	ND	14000
Equilenin	ng/L		ND	0.03
Equilin	ng/L		ND	0.03
Estriol	ng/L	ND	ND	50
Estrone	ng/L	ND	ND	30
Etiocholanolone	ng/L	ND	ND	
Norethindrone(Norethisterone)	ng/L		ND	0.25
Norgestrel	ng/L	ND	ND	
Predicted Estradiol Equivalent	ng/L	ND	ND	
Progesterone	ng/L		ND	105
Testosterone	ng/L	ND	ND	7000
Other Organic Chemicals (mostly soaps and surfactants)	**Unit**	**Average**	**Average**	**Public Health Regulation Standard**
4-t-Octylphenol	ng/L	ND	ND	50000
Acetaldehyde	µg/L	20.01[2]	ND	
Acrylamide	µg/L	ND	ND	0.2
Bisphenol A	ng/L	ND	5.4	200000

Cholesterol	ng/L	ND	ND	7000
Epichlorohydrin	µg/L	ND	ND	0.5
EDTA Ethylenediamine tetraAAC	µg/L	ND	ND	250
Formaldehyde	µg/L	ND	ND	0.5
Glutaraldehyde	µg/L	ND	ND	
Nonylphenol	ng/L	ND	ND	500000
Phthalic anhydride	µg/L		ND	7000
Tributyltin (Soluble)	µg/L		ND	1
Herbicides and Pesticides	**Unit**	**Average**	**Average**	**Public Health Regulation Standard**
1 H-Benzotriazole	µg/L	ND		
1 H-Benzotriazole, 1-Methyl	µg/L	ND		
1 H-Benzotriazole, 4-Methyl	µg/L	ND		
1 H-Benzotriazole, 5-Methyl	µg/L	ND		
2,2-Dichloropropionic acid (Dalapon)	µg/L		0.09	500
2,4-D Dichlorophenoxy AACL	µg/L	ND	0.005	30
2,4-DB Dichlorophenoxy butyr A	µg/L	ND	ND	
2,4DP Dichlorophenoxypropionic	µg/L	ND	ND	100
2,4-Dichlorophenoxyacetic acid (2,4-D)	µg/L		1.33	500
2,6-Di-t-butyl-p-cresol	µg/L	ND		
2,6-Di-t-butylphenol	µg/L	ND		
3,4 DiCl Aniline	µg/L	ND	ND	0.35
3-hydroxy carbofuran	µg/L	ND	ND	0.5
4-Chloro-3,5-dimethylphenol	µg/L	ND		
Aldicarb	µg/L	ND	ND	1
Aldicarb Sulphone	µg/L	ND	ND	7
Aldicarb Sulphoxide	µg/L	ND	ND	7
Total Aldicarb	µg/L	ND	ND	
Total Aldoxycab	µg/L	ND	ND	
Aldrin	µg/L	ND	ND	0.3
Allethrin	µg/L	ND	ND	
Ametryn	µg/L	ND	ND	50
Aminomethylphosphonic acid	µg/L	ND	ND	1000
Amitaz	µg/L	ND	ND	
Asulam	µg/L		ND	50

Atrazine	µg/L	ND	ND	40
Azinphos ethyl	µg/L	ND	ND	
Azinphos methyl	µg/L	ND	ND	3
Benalaxyl	µg/L	ND	ND	
Bendiocarb	µg/L	ND	ND	
Bifenthrin	µg/L	ND	ND	
Bioresmethrin	µg/L	ND	ND	100
Bitertinol	µg/L	ND	ND	
Bromacil	µg/L	ND	ND	300
Bromophos ethyl	µg/L	ND	ND	10
Bromoxynil	µg/L		ND	30
Cadusafos	µg/L	ND	ND	
Captan	µg/L	ND	ND	
Carbaryl	µg/L	ND	ND	30
Carbofuran	µg/L	ND	ND	10
Total Carbofuran	µg/L	ND	ND	10
Carbophenothion	µg/L	ND	ND	0.5
Total Chlordane	µg/L	ND	ND	1
Chlordane cis	µg/L	ND	ND	1
Chlordane Trans	µg/L	ND	ND	1
Chlordene	µg/L	ND	ND	
Chlordene Epoxide	µg/L	ND	ND	
Chlordene-1-hydroxy	µg/L	ND	ND	
Chlordene-1-hydroxy-2,3-epoxid	µg/L	ND	ND	
Chlorfenvinphos	µg/L	ND	ND	5
Chlorothalonil	µg/L	ND	ND	30
Chlorpyrifos	µg/L	ND	ND	10
Chlorpyrifos oxon	µg/L	ND	ND	0.35
Chlorpyrifos methyl	µg/L	ND	ND	10
cis-Nonachlor	µg/L	ND		
Coumaphos	µg/L	ND	ND	
Cyfluthrin	µg/L	ND	ND	
Cyhalothrin	µg/L		ND	
Cypermethrin	µg/L	ND	ND	0.5
DDD (op)	µg/L	ND	ND	
DDD (pp)	µg/L	ND	ND	20

DDE (op)	µg/L	ND	ND	
DDE (pp)	µg/L	ND	ND	20
DDT (op)	µg/L	ND	ND	20
DDT (pp)	µg/L	ND	ND	20
DDT Total	µg/L	ND	ND	20
Deltamethrin	µg/L	ND	ND	
Demeton-S	µg/L		ND	0.15
Demeton-S-methyl	µg/L	ND	ND	
Desethyl Atrazine	µg/L	ND	ND	40
Desisopropyl Atrazine	µg/L	ND	ND	40
Diazinon	µg/L	ND	ND	3
Dicamba	µg/L	ND	ND	100
Dichlorvos	µg/L	ND	ND	1
Dichloran	µg/L	ND		
Dichlorfluanid	µg/L	ND		
Diclofol	µg/L	ND	ND	3
Diclofop methyl	µg/L	ND	ND	5
Dieldrin	µg/L	ND	ND	0.3
Dimethoate	µg/L	ND	ND	50
Total Dimethoate	µg/L	ND	ND	50
Dimethomorph	µg/L	ND	ND	
Dioxathion	µg/L	ND	ND	
Disulfoton	µg/L	ND	ND	3
Diuron	µg/L	ND	ND	30
Total Diuron	µg/L	ND	ND	30
Endosulfan alpha	µg/L	ND	ND	30
Endosulfan beta	µg/L	ND	ND	30
Endosulfan Ether	µg/L	ND	ND	
Total Endosulfan	µg/L	ND	ND	30
Endosulfan Lactone	µg/L	ND	ND	
Endosulfan Sulphate	µg/L	ND	ND	30
Endrin aldehyde	µg/L	ND	ND	
Endrin	µg/L	ND	ND	
Ethion	µg/L	ND	ND	3
Ethoprophos	µg/L	ND	ND	1
Etrimphos	µg/L	ND	ND	

Famphur	µg/L	ND	ND	
Fenamiphos	µg/L	ND	ND	0.3
Fenchlorphos	µg/L	ND	ND	30
Fenitrothion	µg/L	ND	ND	10
Fenthion ethyl	µg/L	ND	ND	
Fenthion methyl	µg/L	ND	ND	0.5
Fenvalerate	µg/L	ND	ND	50
Fipronil	µg/L	ND	ND	
Flamprop-methyl	µg/L		ND	3
FLuazifop-Butyl	µg/L	ND	ND	
Fluometuron	µg/L	ND	ND	50
Fluroxypyr	µg/L	ND	ND	700
Fluvalinate	µg/L	ND	ND	
Furalaxyl	µg/L	ND	ND	
Galaxolide	µg/L	ND		
Glufosinate	µg/L	ND	ND	
Glyphosate	µg/L	ND	ND	1000
Total Glyphosate	µg/L	ND	ND	1000
Haloxyfop	µg/L	ND	ND	1.05
Haloxyfop 2-etotyl	µg/L	ND	ND	1.05
Haloxyfop methyl	µg/L	ND	ND	0.175
Haloxyfop Total	µg/L	ND	ND	
HCB	µg/L	ND	ND	
HCH alpha	µg/L	ND	ND	20
HCH beta	µg/L	ND	ND	20
HCH delta	µg/L	ND	ND	
HCH gamma (gamma-Lindane)	µg/L		ND	20
Heptachlor Epoxide	µg/L	ND	ND	0.3
Heptachlor	µg/L	ND	ND	0.3
Heptachlor -Total	µg/L		ND	0.3
Hexazinone	µg/L	ND	ND	300
Isophenphos	µg/L	ND	ND	
lambda-Cyhalothrin	µg/L	ND	ND	900
Lindane	µg/L	ND		
Malathion	µg/L	ND		
MCPA	µg/L	ND	ND	2

MCPB	µg/L	ND	ND	
Mecoprop	µg/L	ND	ND	10
Metalaxyl	µg/L	ND	ND	
Methidathion	µg/L	ND	ND	30
Methiocarb	µg/L	ND	ND	5
Methomly Oxime	µg/L	ND	ND	30
Methomyl	µg/L	ND	ND	30
Methomyl - Total	µg/L		ND	
Methoprene	µg/L	ND	ND	
Methoxychlor	µg/L	ND	ND	300
Metolachlor	µg/L	ND	ND	300
Metribuzin	µg/L	ND	ND	50
Mevinphos	µg/L	ND	ND	5
Moclobemide	µg/L	ND		
Molinate	µg/L	ND	ND	5
Momocrotophos	µg/L	ND	ND	1
Musk Ketone	ng/L	ND		
Musk Xylene	µg/L	ND		
N-Butyl benzenesulfonamide	µg/L	11.13		
N-Butyltoluenesulfonamide	µg/L	ND		
Nonachlor (cis)	µg/L		ND	
Nonachlor trans	µg/L	ND	ND	
Omethoate	µg/L	ND	ND	50
Oxadiazinon	µg/L	ND	ND	
Oxamyl	µg/L	ND	ND	100
Total Oxamyl	µg/L	ND	ND	
Oxamyl Oxime	µg/L	ND	ND	100
Oxychlordane	µg/L	ND	ND	1
Oxydemetonmethyl	µg/L		ND	
Oxyfluorfen	µg/L	ND	ND	
Parathion ethyl	µg/L	ND	ND	10
Parathion methyl	µg/L	ND	ND	100
Pendimethalin	µg/L	ND	ND	300
Permethrin	µg/L	ND	ND	100
Phenothrin	µg/L	ND	ND	
Phorate	µg/L	ND	ND	

Phosmet	µg/L	ND	ND	
Phosphamidon	µg/L	ND	ND	
Picloram	µg/L	ND	ND	300
Piperonyl Butoxide	µg/L	ND	ND	100
Primicarb	µg/L	ND	ND	5
Primiphos methyl	µg/L	ND	ND	50
Procymidone	µg/L	ND	ND	
Profenofos	µg/L	ND	ND	0.3
Promecarb	µg/L	ND	ND	30
Prometryn	µg/L	ND	ND	105
Propanil	µg/L	ND	ND	500
Propargite	µg/L	ND	ND	50
Propazine	µg/L	ND	ND	50
Propiconazole	µg/L	ND	ND	100
Propoxur	µg/L	ND	ND	70
Prothiophos	µg/L	ND	ND	
Pyrazophos	µg/L	ND	ND	30
Qxydemeton-methyl	µg/L	ND		
Rotenone	µg/L	ND	ND	
Simazine	µg/L	ND	ND	20
Sulprofos	µg/L	ND	ND	10
Tebuconazole	µg/L	ND	ND	
Tebuthiuron	µg/L	ND	ND	
Temephos	µg/L	ND	ND	300
Terbufos	µg/L	ND	ND	0.5
Terbuthylazine	µg/L	ND	ND	
Terbutryn	µg/L	ND	ND	300
Tetrachlorvinphos	µg/L	ND	ND	100
Tetradifon	µg/L	ND	ND	
Tetramethrin	µg/L	ND	ND	
Thiabendazole	µg/L	ND	ND	
Thiodicarb	µg/L	ND	ND	30
Tonalid	ng/L	ND		
Total Aldrin &Dieldrin	µg/L	ND	ND	0.3
Total Heptachlor	µg/L	ND		
Total Methomyl	µg/L	ND		

Total Thiodicard	µg/L	ND	ND	30
Total Triadimefon	µg/L	ND		
Transfluthrin	µg/L	ND	ND	
Triadimefon	µg/L	ND	ND	2
Triadimefon -Total	µg/L		ND	2
Triadimenol	µg/L	ND	ND	
Tri-allate	µg/L	ND	ND	
Triclopyr	µg/L	ND	ND	10
Triclosan methyl ether	µg/L	ND		
Triethylphosphate	µg/L	ND		
Trifuralin	µg/L	ND	ND	50
Tri-n-butyl phosphate	µg/L	ND		
Tris(chloroethyl)Phosphate	µg/L	ND		
Tris(chloropropyl)Phosphate Is	µg/L	ND		
Tris(dichloropropyl)Phosphate	µg/L	ND		
Vinclozolin	µg/L	ND	ND	
Phenols	**Unit**	**Average**	**Average**	**Public Health Regulation Standard**
2,3,4,6-Tetrachlorophenol	µg/L	ND		
2,4,5-Trichlorophenol	µg/L	ND		
2,4,6-Trichlorophenol	µg/L	ND		
2,4-Dichlorophenol	µg/L	ND		
2,4-Dimethylphenol	µg/L	ND		
2,4-Dinitrophenol	µg/L	ND		
2,6-Dichlorophenol	µg/L	ND		
2-Chlorphenol	µg/L	ND		
2-Methyl-4,6-dinitrophenol	µg/L	ND		
2-Methylphenol	µg/L	ND		
2-Nitrophenol	µg/L	ND		
4-Chloro-3-methylphenol	µg/L	ND		
4-Methylphenol	µg/L	ND		
4-Nitrophenol	µg/L	ND		
Pentachlorophenol	µg/L	ND		
Phenol	µg/L	ND		

Pharmaceuticals, Personal Care and Household Products	Unit	Average	Average	Public Health Regulation Standard
Acesulfame	µg/L	0.007	ND	
Acetylsalicylic acid	µg/L	ND	ND	29
Atenolol	µg/L	ND	ND	25
Atorvastatin	µg/L	ND	ND	5
Caffeine	µg/L	0.01	ND	0.35
Carbamazepine	µg/L	ND	ND	100
Cephalaxin	µg/L	ND	ND	35
Chloramphenicol	µg/L	ND	ND	175
Ciprofloxacin	µg/L	ND	ND	250
Citalopram	µg/L	ND	ND	4
Codeine	µg/L	ND	ND	50
Cyclophosamide	µg/L	ND	ND	3.5
Dapsone	µg/L	ND	ND	
DEET	µg/L	ND	ND	2500
Desmethyl Citalopram	µg/L	ND	ND	4
Desmethyl Diazepam	µg/L	ND	ND	3
Diatrizoate sodium	µg/L		ND	0.35
Diazepam (Valium)	µg/L	ND	ND	2.5
Diclofenac	µg/L	ND	ND	1.8
Doxylamine	µg/L	0.01	0.008	
Enrofloxacin	µg/L	ND	ND	22
Erythromycin	µg/L	ND	ND	17.5
Erythromycin Anhydrate	µg/L	ND	ND	17.5
Fluoxetine	µg/L	ND	ND	10
Fluvastatin	µg/L	ND	ND	
Frusemide	µg/L	ND	ND	10
Gabapentin	µg/L	ND	ND	
Gemfibrozol	µg/L	ND	ND	600
Hydrochlorthiazide	µg/L	ND	ND	12.5
Ibuprofen	µg/L	ND	ND	400
Ifosamide	µg/L	ND		
Indomethacin	µg/L	ND	ND	25
Iopromide	µg/L	ND	ND	750
Isophosphamide (Ifosfamide)	µg/L		ND	3.5

Lincomycin	µg/L	ND	ND	3500
Metoprolol	µg/L	ND	ND	25
Naproxen	µg/L	ND	ND	220
Norfloxacin	µg/L	ND	ND	400
Oxazepam	µg/L	ND	ND	15
Oxycodone	µg/L	ND	ND	10
Paracetamol	µg/L	ND	ND	175
Phenytoin	µg/L	ND	ND	
Praziquantel	µg/L	ND	ND	70
Primidone	µg/L	ND	ND	
Propranolol	µg/L	ND	ND	40
Ranitidine	µg/L	ND	ND	26
Roxithromycin	µg/L	ND	ND	150
Salicylic Acid	µg/L	0.12	0.09	105
Sertraline	µg/L	ND	ND	
Sulfsalazine	µg/L	ND	ND	500
Sulphadiazine	µg/L	ND	ND	35
Sulphamethoxazole	µg/L	ND	ND	35
Sulphathiazole	µg/L	ND	ND	35
Temazepam	µg/L	ND	ND	5
Tramadol	µg/L	ND	ND	
Triclosan	µg/L	ND	ND	0.35
Trimethoprim	µg/L	ND	ND	70
Tylosin	µg/L	ND	ND	1050
Venlafaxine	µg/L	ND	ND	75
Warfarin	µg/L	ND	ND	1.5
Dioxins and Furans	**Unit**	**Average**	**Average**	**Public Health Regulation Standard**
OCDD Octachlorodibenzo-p-dioxi	pg/L	ND		
1234678-HpCDD	pg/L	ND		
1234678-HpCDF	pg/L	ND		
1234789-HpCDF	pg/L	ND		
123478-HxCDD	pg/L	ND		
123478-HxCDF	pg/L	ND		
123678-HxCDD	pg/L	ND		
123678-HxCDF	pg/L	ND		
123789-HxCDD	pg/L	ND		

12378-PeCDD	pg/L	ND		
12378-PeCDF	pg/L	ND		
234678-HxCDF	pg/L	ND		
23478-PeCDF	pg/L	ND		
2378-TCDD	pg/L	ND		
2378-TCDF	pg/L	ND		
Hepta Dioxins	pg/L	ND		
Hepta Furans	pg/L	ND		
Hexa Dioxins	pg/L	ND		
Hexa Furans	pg/L	ND		
OCDF	pg/L	ND		
Penta Dioxins	pg/L	ND		
Penta Furans	pg/L	ND		
Tetra Dioxins	pg/L	ND		
Tetra Furans	pg/L	ND		
Polychlorinated Biphenyls (PCBs)	**Unit**	**Average**	**Average**	**Public Health Regulation Standard**
2,3,3 ,4,4 .5.5 -heptachlorobi	pg/L	ND		
2,3,3 ,4.4 ,5-hexachlorobiphe	pg/L	ND		
2,3,4,4 ,5-pentachlorobiphenyl	pg/L	ND		
2,3,4,4,5-pentachlorobipheny	pg/L	ND		
3,3 ,4,4 5-pentachlorobipheny	pg/L	ND		
3,4,4.5-tetrachlorobiphenyl	pg/L	ND		
PCB 105 23344Pentachlorobiphen	pg/L	ND		
PCB 118 23445 pentachlorobiphe	pg/L	ND		
PCB 156 233445Hexachlorobiphen	pg/L	ND		
PCB 167 23445Hexachlorobiphen	pg/L	ND		
PCB 169 345345Hexachlorobiphen	pg/L	ND		
PCB 77	pg/L	ND		
Polycyclic Aromatic Hydrocarbons (PAHs)	**Unit**	**Average**	**Average**	**Public Health Regulation Standard**
1,2-Dimethylnaphthalene	µg/L		ND	
1,4-Dimethylnaphthalene	µg/L		ND	
1,7-Dimethylnaphthalene	µg/L		ND	
1,8-Dimethylnaphthalene	µg/L		ND	
1-Methylfluorene	µg/L		ND	
2,2-Dimethylbiphenyl	µg/L		ND	

2,6-Dimethylnaphthalene	µg/L		ND	
2-Ethylnaphthalene	µg/L		ND	
2-Methoxynaphthalene	µg/L		ND	
2-Methylanthracene	µg/L		ND	
3,3-Dimethylbiphenyl	µg/L		ND	
4,4-Dimethylbiphenyl	µg/L		ND	
9-Methylanthracene	µg/L		ND	
Acenaphtene	µg/L	ND	ND	
Acenaphthylene	µg/L	ND	ND	0.014
Anthracene	µg/L	ND	ND	150
Benz[a]anthracene	µg/L	ND	ND	
Benzo(a)pyrene	µg/L	ND	ND	0.01
Benzo[b+k]fluoranthene	µg/L	ND	ND	
Benzo[ghi]perylene	µg/L	ND	ND	
Biphenyl	µg/L		ND	
Chrysene	µg/L	ND	ND	
Dibenz[a,h]anthracene	µg/L	ND	ND	
Fluoranthene	µg/L	ND	ND	
Fluorene	µg/L	ND	ND	
Indeno[1,2,3-cd] pyrene	µg/L	ND	ND	
Naththalene	µg/L	ND	ND	70
Phenathrene	µg/L	ND	ND	150
Pyrene	µg/L	ND	ND	150
Radionuclides	**Unit**	**Average**	**Average**	**Public Health Regulation Standard**
Americium-241	Bq/L	ND	ND	
Berrylium - 7	Bq/L	ND	ND	
Caesium-137	Bq/L	ND	ND	
Cobalt-57	Bq/L	ND	ND	
Cobalt-60	Bq/L	ND	ND	
Gallium-67	Bq/L	ND	ND	
Indium-111	Bq/L	ND	ND	
Iodine 123	Bq/L	ND	ND	
Iodine-125	Bq/L	ND	ND	
Iodine-131	Bq/L	ND	ND	
Lead-210	Bq/L	ND	ND	
Lutetium-177	Bq/L	ND	ND	

Potassium-40	Bq/L	ND	ND	
Radium-224	Bq/L	ND	ND	
Radium-226	Bq/L	ND	ND	
Radium-228	Bq/L	ND	ND	
Samarium-153	Bq/L	ND	ND	
Technetium-99m	Bq/L	ND	ND	
Thallium-201	Bq/L	ND	ND	
Thallium-208	Bq/L	ND	ND	
Uranium-238	Bq/L	ND		
Volatile Organic Compounds (VOCs)	**Unit**	**Average**	**Average**	**Public Health Regulation Standard**
1,1,1,2-Tetrachloroethane	µg/L	ND	ND	
1,1,1-Trichloroethane	µg/L	ND	ND	
1,1,2,2-Tetrachloroethane	µg/L	ND	ND	
1,1,2-Trichloroethane	µg/L	ND	ND	
1,1-Dichloroethane	µg/L	ND	ND	
1,1-Dichloroethene	µg/L	ND	ND	30
1,1-Dichloropropene	µg/L	ND	ND	
1,2,3-Trichlorobenzene	µg/L	ND	ND	
1,2,3-Trichloropropane	µg/L	ND	ND	
1,2,4-Trichlorobenzene	µg/L	ND	ND	
1,2,4-Trimethylbenzene	µg/L	ND	ND	
1,2-Dibromo-3-chloropropane-ug	µg/L	ND	ND	
1,2-Dibromoethane (EDB)	µg/L	ND	ND	1
1,2-Dichlorobenzene	µg/L	ND	ND	1500
1,2-Dichloroethane	µg/L	ND	ND	3
1,2-Dichloroethene (cis)	µg/L	ND	ND	60
1,2-Dichloroethene (trans)	µg/L		ND	60
1,2-Dichloropropane	µg/L	ND	ND	
1,3,5-Trimethylbenzene	µg/L	ND	ND	
1,3-Dichlorobenzene	µg/L	ND	ND	
1,3-Dichloropropane	µg/L	ND	ND	
1,3-Dichloropropene (cis)	µg/L		ND	
1,3-Dichloropropene (trans)	µg/L		ND	
1,4-Dichloro-2-butene (trans)	µg/L		ND	
1,4-Dichlorobenzene	µg/L	ND	ND	40
1-Chlorobutane	µg/L	ND	ND	

2,2-Dichloropropane	µg/L	ND	ND	
2-Butanone (MEK)	µg/L	ND	ND	
2-Chlorotoluene	µg/L	ND	ND	
2-Hexanone (MBK)	µg/L	ND	ND	
4-Chlorotoluene	µg/L	ND	ND	
4-Isopropyltoluene	µg/L		ND	
4-Methyl-2-pentanone (MIBK) ug	µg/L	ND	ND	
Acetone	µg/L	ND	4	
Allyl Chloride	µg/L	ND	ND	
Benzene	µg/L	ND	ND	1
Bromobenzene	µg/L	ND	ND	
Bromochloromethane	µg/L	ND	ND	40
Carbon disulphide	µg/L	ND	ND	
Carbon tetrachloride	µg/L	ND	ND	3
Chlorobenzene	µg/L	ND	ND	300
cis-1,3-Dichloropropene	µg/L	ND		
Dibromomethane	µg/L	ND	ND	
Dichlorodifluoromethane	µg/L	ND	ND	
Dichloromethane (Methylenechloride)	µg/L		ND	4
Ethyl Methacrylate	µg/L	ND	ND	
Ethylbenzene	µg/L	ND	ND	300
Hexachlorobutadiene	µg/L	ND	ND	0.7
Hexachloroethane	µg/L	ND	ND	
Iodomethane	µg/L	ND	ND	
Isopropylbenzene	µg/L	ND	ND	
Meta Para Xylenes	µg/L	ND	ND	600
Methyl Methacrylate	µg/L	ND	ND	
Methyl t-Butyl Ether	µg/L	ND	ND	
Methylene chloride	µg/L	ND		
Napthalene	µg/L	ND		
n-Butylbenzene	µg/L	ND	ND	
n-Propylbenzene	µg/L	ND	ND	
Ortho-Xylene	µg/L	ND	ND	600
Pentachloroethane	µg/L		ND	
sec-Butylbenzene	µg/L		ND	
Styrene (Vinylbenzene)	µg/L		ND	30

tert-Butylbenzene	µg/L		ND	
Tetrachloroethene	µg/L		ND	50
Toluene	µg/L		ND	800
Trichloroethene	µg/L		ND	
Trichlorofluoromethane	µg/L		ND	
Vinyl Acetate	µg/L		ND	
Vinyl Chloride	µg/L		ND	0.3

Notes:

ND – Not Detected

* The analytical laboratory reports the nutrients as the equivalent weight of nitrogen or phosphorous. The PHR standards reported here are the standard as equivalent weight of nitrogen, to enable direct comparison between test results and the standard.

[1] The limit of reporting for selenium varied between 0.001 and 0.0001 during the year. Due to the methodology applied this has resulted in the reported average being above the maximum quantified result and the 95th and 99th LN percentile.

[2] the limit of reporting for acetaldehyde changed from 100 µg/L to 2 µg/L to 0.05 µg/L during the year. The reported average result is greater than the maximum quantified result due to the change in limit of reporting and the methodology applied for calculating the average.

4. Public Education & Engagement

- No coordinated campaign to educate public on potable reuse was undertaken
- Stakeholder engagement based on construction issues alone
- Information provided via fact sheets, web-based tours and water island game; general information on the website about the scheme and potable reuse is on the Seqwater website
- Educational site tours (schools, university and industry) offered on request.

5. References

1. Miller, E. and Buys, L. 2008 **Water recycling in South-East Queensland, Australia: What do men and women think?**Rural Society 18(3)220-229:
2. ↑ Roux, A., Robillot, C., Walker, T. and Hester, B. 2010 **The Western Corridor Recycled Water Project – Challenges in Ensuring Water Quality on a large Indirect Potable Reuse Scheme.**