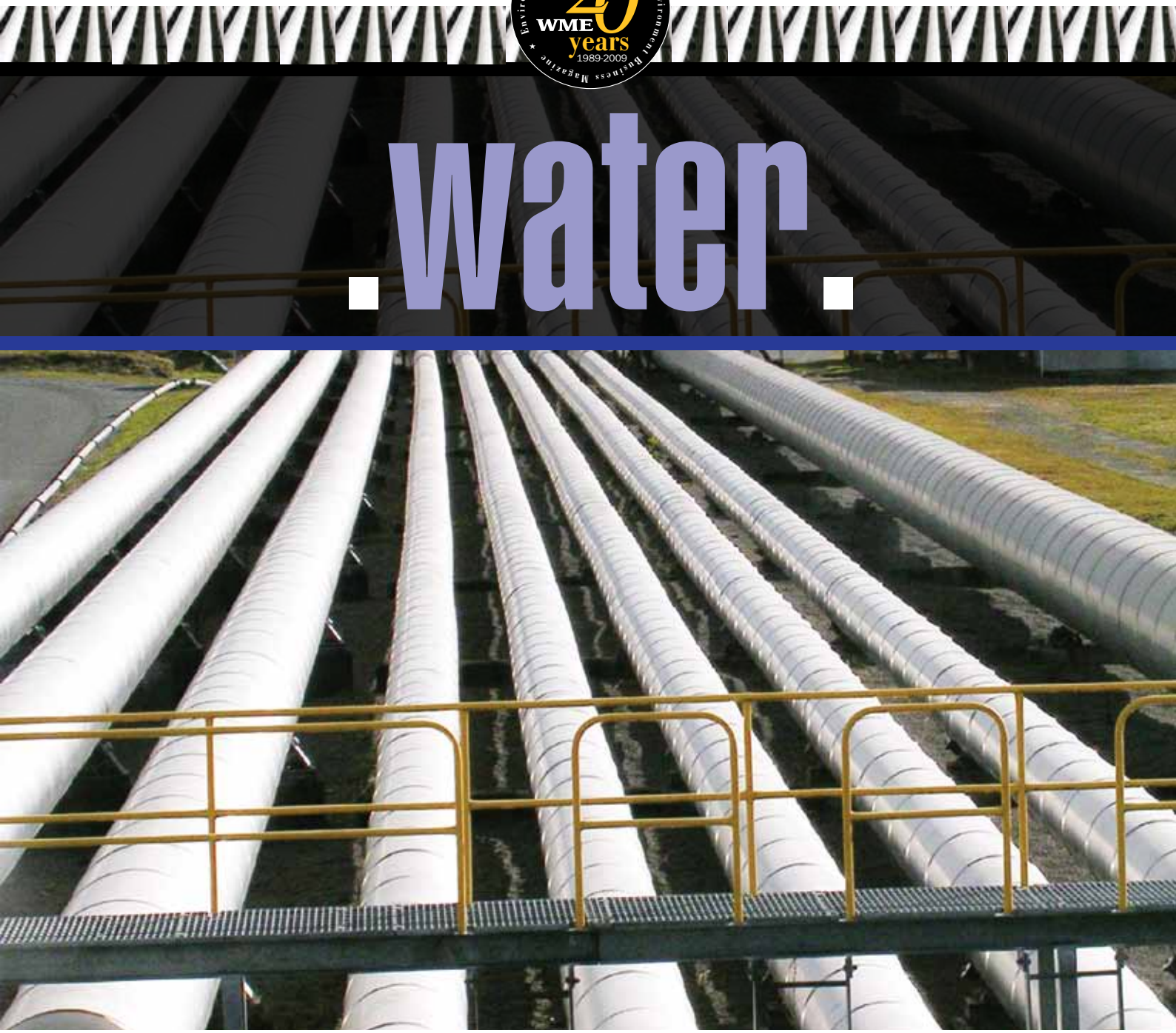

Behind the watersheds

Hydrogen is the most abundant element in the universe, oxygen the third. You'd have thought water would be plentiful, but as we search for life among the stars we know it is not.

We are lucky to live on a blue planet. Water is a bringer of life, a giver of health, an economic engine, a playground and a thing of beauty.

For all the water in the world, less than one per cent is accessible freshwater, either on the surface or underground. As the global population grows and as climate change has its unpredictable way with the water cycle, this essential element demands careful stewardship.

Australia is often cited as a world leader in water management, showing the way in areas such as risk management frameworks, water efficiency, source diversification and community engagement. It was not always so.

Water utilities around the country today run programs that would have been unthinkable 20 years ago. Adelaide's new 'Water for Good' strategy is a step change from strategies developed even a decade ago, setting a course to source some 60 per cent of the city's water from recycling, stormwater, desalination and avoided water use by 2050.

Australia has much to teach the rest of the world. Yet there is room to improve. Too quickly do we default to centralised infrastructure. To slowly do we pursue water sensitive urban design. Too little do we seek to capitalise on water's connections to energy and to nutrient cycles.

Challenges remain. But let's not forget the journey that began in 1994 when federal and state governments set the water reform train in motion.

Almost 30 years in Australia

Grundfos was founded in 1945, by Poul Due Jensen, in the basement of his home in Bjerringbro, Denmark. Since then, Grundfos has grown into a truly global company that produces over 16 million pump units each year. In 1965, R G Pank Pty Ltd, based in Adelaide, was awarded the agency agreement as the sole distributor of Grundfos product in Australia, and in 1980, Grundfos Pumps Pty Ltd was established.

Grundfos Australia Local Operations

Grundfos Australia's head office is located in Regency Park, South Australia, where approximately 100 employees are based.

The functions and operations taking place on the Regency Park site span across 3 buildings (17,355 square metres) and include the following business units: Manufacturing, Sales, Marketing, Technical Services, Finance and Administration. A further 50 employees work around Australia in the Sales offices.

Grundfos Australia provides sustainable solutions to customers throughout the country, covering a range of applications across the entire water life cycle, including: facilitation of rainwater reuse in homes; irrigation of parks and sports fields; delivery of water to city hospitals; equipment to facilitate factories producing food and beverage; provision of clean and safe drinking water to towns and cities

Steen Jensen, Managing Direction says "Since its inception in 1980, Grundfos Australia has seen excellent growth, and combined with New Zealand, we currently have $150 million a year turnover." He continues, "Our pumps and pumping systems are world class and provide energy efficient solutions for a diverse range of applications".

A Responsible Company

The Grundfos organisation places great emphasis on quality and considers quality assurance to be a vital consideration in its continual growth.

Managing Director, Steen Jensen says, "In Australia we hold and adhere to both Quality Certification (AS/NZS ISO9001) and Environmental Certification (AS/NZS ISO14001)."

Grundfos Australia recognises that all activities interact with the surrounding environment and they are committed to minimising negative impacts and improving efficiencies. Over the past few years, Grundfos Australia has worked on building its partnerships and associations with organisations that seek to raise the awareness of environmental issues – particularly those of water and energy conservation and efficiency.

The partnership with Keep Australia Beautiful is based on sponsorship of the Water Conservation category of both the Tidy Towns and Sustainable Cities programs at a State/Territory and National level.

Working together, Grundfos, its Dealer network and the Keep Australia Beautiful network can link activities to jointly provide a clear, concise and consistent water conservation message to the community, and help deliver a sustainable Australian environment for generations to come.

Grundfos has also recently committed to becoming the Global Training Partner for GreenPlumbers. GreenPlumbers works with the plumbing industry and Government agencies to implement training and accreditation programs with a focus on changing consumer and plumbing behaviour regarding energy efficient and water saving technologies.

Through this partnership, Grundfos will endeavour to play a part in guiding Plumbers to consider carefully the reliability and sustainability of the products they recommend to consumers.

An Innovative Company

At Grundfos we have an ongoing determination to improve the way things are done - and this does not just apply to setting new precedents in pump technology: we are committed to improving every aspect of our business.

MILESTONES

1965	First pump imported from Denmark by R G Pank Pty Ltd
1980	Grundfos Pumps Pty Ltd (GPA) Established
1990	10 year Anniversary Celebrations
1991	First Computer Aided Product Selection Program launched (CAPS)
1993	Factory granted AS3901, Quality Assurance
1997	Reach $50 million in sales
1999	Grundfos introduces new 3" SQ submersible
2002	Digital Dosing product range is launched
2004	Australia benefits from new SQFlex Submersible solar pump
2005	25 year Anniversary Celebrations
2006	Integration with Alldos Oceania
2007	Reach $100 million in sales

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A journey by water

As the urban water industry is one of the first industries to be impacted by climate change, the community expects it to be a leader in sustainability, observes Ross Young. So what's been initiated in the past 20 years?

The urban water industry today is a world away from the industry of 20 years ago. We tend to forget and overlook the profound changes that have taken place as the journey has been more evolution than revolution – although the response to climate change is anything but sedate.

For instance, 20 years ago customers paid for their water based on the value of their property, utilities were large monoliths with both service delivery and regulatory functions, and the concept of customer service and stakeholder management were foreign. The industry focus was on resource development and 'drought proofing'.

I intend to pick out a few highlights that have contributed to the Australian urban water industry establishing itself as a leader – both nationally and internationally – in adaptation to the risks associated with climate change.

On the policy front, the 1994 COAG water reforms are without doubt the foundation upon which the urban water industry sits today. Setting up utilities on a commercial basis, separating service delivery from policy, removing the veil of the Crown and charging for water on a volumetric basis were revolutionary at the time.

However, the industry committed itself to deliver the reform package. It is a pity the same appetite for reform was not adopted by the irrigation sector, with virtually all of the 1994 water reforms carried over into the National Water Initiative (NWI) in 2004.

The NWI was the second major policy development for the urban water industry, shifting the focus to water efficiency, customer and stakeholder involvement and sustainability. Most of the urban actions have either been completed or are well underway.

Efficiency and alternatives

The extent to which urban Australia has embraced a water efficiency ethos is one of our great social revolutions. Going back 20 years, watering of nature strips was common, dual flush toilets a rarity and the sprinkler systems were turned on with no thought about the efficiency of application.


The water evolutionary: Ross Young

In both the household and the commercial and industrial sectors, there has been a steady decline in per capita water consumption.

For instance, Sydney now uses the same amount of water as it did in 1974, but there are more than one million additional Sydneysiders.

Water had a very low profile in urban society 20 years ago. It was rarely talked about, apart from the odd drought when water restrictions were applied and the response from governments was to build another dam in the vain hope of 'drought-proofing our cities'.

> **"Sydney now uses the same amount of water as it did in 1974, but there are more than one million additional Sydneysiders"**

Fast forward to 2009 and the world has changed in a miraculous manner. At all levels of government, we have ministers with the word 'water' in their title, reservoir storage levels are on the evening TV news and the front page of the newspapers, and water has developed into a major public policy issue in this country.

In large part, this has been driven by climate change, which, combined with drought, has been the equivalent of a share market crash for the industry. None, or very few, of the historical assumptions upon which water planning was based are relevant today and the entire risk profile of the industry has increased significantly.

Climate change touches every aspect of urban water and is the reason for the unprecedented capital expenditure underway. Between 2006 and 2012, more than $15 billion will have been invested in new water sources.

I don't think anyone in their wildest dreams would have anticipated that by 2012, all mainland coastal capital cities with the exception of Darwin would have operational desalination plants. Once they all come on-stream, they will supply 47 per cent of capital city water needs based on 2007/08 consumption. Rainfall has the 'X factor' and this makes water resource management more of an art than a science.

The sustainability challenge

As the urban water industry is one of the first industries impacted by climate change, the community expects it to be a leader in sustainability.

This not only includes minimising the production of greenhouse gases but also water sensitive urban design, greater use of recycled water, integrated urban water management and a full understanding of the water energy nexus.

These concepts would have been foreign to a water planner 20 years ago but today are well accepted and considered mainstream.

I believe water has such a resonance in our society because it is the quintessential social, political and economic commodity. Whether we like it or not, water is different; it has a spiritual value that other commodities simply do not.

Ross Young is executive director of the Water Services Association of Australia.

Precious water, precious little

It hasn't rained, it's poured when you think of the changes in Australia's water industry. Richard Collins assesses the wash up of the past 20 years.

1. Demanding water efficiency: Believe it or not, the first sizeable scheme to tackle user demand for water was in Kalgoorlie, WA. Ironically, the launch of the $3.5 million program in 1995 was swamped by Cyclone Bobby.

Sydney Water picked up the mantle later that year when a target to reduce per capita use 25 per cent by 2005 was enshrined in its operating licence. It kicked off programs all other utilities followed, including free showerhead exchanges, rebates and home water audits, launched the awarded Every Drop Counts business program and got stuck into pressure and leak reduction in its own system.

"Water efficiency costs a third to a half of supply side options and, in many cases, can provide the most water and is the quickest to bring on board," said Institute of Sustainable Futures head Stuart White.

2. Mitigating and managing risk: Managing a water utility is really about risk management. An area Australia has led the world is in a risk-based approach for managing drinking water quality risks. The concept is enshrined in the Australian Drinking Water Guidelines and has been adopted by the World Health Organisation.

The premise is very simple – you cannot rely on a single barrier, such as a water treatment plant, to manage drinking water quality risks, but must start at the catchment and work your way down through all the elements of a drinking water system to ensure there are appropriate barriers at every point.

3. Climate change catches all: Anyone who attended a water conference in the past decade will have seen the graph showing the step change reduction in Perth's long-run catchment inflows that started in the 1990s.

WSAA's Ross Young describes the south-west as the canary in the coal mine when it comes to climate change.

"Perth led the way. A drying climate hit Perth probably a decade before it hit the east coast. When it starts to dry out over in the east, we all coming running over to Perth to ask how you manage the transition," he said.

It had a portfolio approach, but the centrepiece was the country's first utility-scale desalination plant, opened in 2006.

4. Rain reduces, restrictions ramp up: For industrial water users, the climate change canary sounded the alarm in Queensland's Gladstone Industrial Area. Rainfall records show significant variability over the past century, but an overall drying trend.

With Awoonga Dam levels under 30 per cent in 2001, industry was asked to take a voluntary five per cent water restriction. In April 2002, that became a mandatory 10 per cent cut, followed by 25 per cent just nine months later. A 50 per cent restriction was slated for mid-2003 until Cyclone Benny dropped a welcome five years' supply – but it gave industry a scare.

Just four years later, Queensland authorities again tightened the taps on industry, this time to the Swanbank and Tarong power stations in the state's south-east. National electricity prices soared.

5. The drought hits home: Queensland has plunged billions into water efficiency and diversification since 2006, including the $9 billion, 450km Water Grid in its south-east, the largest urban drought response in Australia (Bundama treatment plant below).

White, however, is a bigger fan of the "hundreds of millions" the state has spent on the water efficiency programs of leakage reduction, business programs, retrofits and so on.

"They started from a relatively low base," he said. "Apart from the Gold Coast, a lot of the councils had not done much in water efficiency; Brisbane was one of the last to do metering and pricing. But, boy, did they make up for it after the drought."

6. Plan to act and save: As the drought worsened and catchment levels in Sydney dropped towards 30 per cent, attention turned to business users there. The NSW Government introduced legislation in May 2005 requiring all councils and any business or public agency using more than 50ML a year at a single site to prepare a Water Savings Action Plan.

Nearly 300 organisations had to determine water use, undertake a management and a technical review, then assess and identify savings measures. Most other states have followed suit.

7. Industry seeks alternative sources: Along with efficiency gains, governments and companies started looking for alternative sources to shore up their supplies at the height of the drought. Qenos leads the pack.

In Sydney, Qenos has since 2006

been using highly treated water from the contaminated Botany aquifer in its demineralisation plant and cooling towers, measures designed to save some 2GL of mains water a year. In Melbourne, it is the foundation customer for the Altona Industrial Region Recycling Project, also expected to save 2GL a year.

However, Australia's single biggest industrial recycling scheme remains BlueScope Steel in Port Kembla, taking 20ML in recycled wastewater a day.

8. The master approach to water: Nestled at the northern end of the Gold Coast is one of the country's leading examples of integrated water planning, the 7,000 hectare Pimpama Coomera region. Its award-winning Waterfuture Master Plan addresses all elements of the urban water cycle – rainwater, stormwater, drinking water, wastewater and recycled water.

Since 2005, all new homes have been built with purple 'third pipe' reticulation (pictured), which in the next few months will finally see Class A+ recycled water and rainwater supplied to homes and businesses for toilet and outdoor use. It follows pioneering projects in Sydney at Rouse Hill and the former Olympic Village, and Adelaide's Mawson Lakes estate.

9. The rise of local infrastructure: There has been a massive growth in interest in distributed systems, partly due to the rise of green buildings.

The 60L building in Melbourne was one of the early examples of in-building treatment of effluent and rainfall, backed up by point-of-use.

"This has led to a complete questioning of centralised infrastructure and I'd say is the beginning of the end of the way we have done things for 150 years," said White.

Sydney Water's new HQ in Parramatta, the latest example of this growing trend, uses 75 per cent less water than a standard office block and discharges up to 90 per cent less.

10. Water costs carbon: Water is heavy and hard to treat, hot water is energy intensive and wastewater contains all sorts of organic matter that gives off methane as it breaks down. It turns out the water sector is one of the country's biggest greenhouse emitters, prompting its inclusion in the planned Carbon Pollution Reduction Scheme.

But there are options. A report earlier this year by the CSIRO and the WSAA looking at savings in the use-phase of water found a 15 per cent reduction in residential hot water use could offset all the energy used by urban water utilities in 2006/07. The water-energy nexus will be a major driver of future change. WME

Sharing and caring

People have long been tuned in to the need to be water wise and to respect everybody's needs. Utilities have been slow to pick up on it, writes Blair Nancarrow.

Communities are the first to be blamed whenever there is a water crisis. People don't understand; water is scarce! They are not prepared to reduce their use! They're self-interested and think water just falls from the sky!

I have been hearing these statements from water planners and managers for my 20 years as a social scientist in this space. Yet it does not gel with what people in cities and the bush have told us in the course of our research.

It's time water utilities tuned into 'person in the street', because living in the world's driest inhabited continent has seen them grow wise about water.

Water wise: Australians respect water for life.

Myth 1: They just don't understand

Nothing could be further from the truth. While water recycling has only become a serious part of water utilities' source planning in the past decade, the community has been advocating water reuse for more than 20 years.

Speak with any community group on the subject and you'll be told: "It shouldn't be called wastewater because that means that water is a waste product".

The reuse of wastewater for irrigation of public open space, crops and gardens has been highly supported by communities nationally for years, and there are constant calls for the reuse of rain and stormwater. Yet only now, with the lifting of local government restrictions, can people easily install rainwater tanks.

Communities across the country have long advocated taking responsibility for some of their own water supply. Reusing their own wastewater is preferred to reusing their neighbour's or the city's wastewater.

However, they are prepared to consider indirect potable reuse (IPR) of wastewater – returning first to a dam or aquifer – given appropriate treatment standards, safeguards against human error and trusted regulators.

Yet how often do we hear scientists and planners scoff at community reticence on IPR as being due to the 'yuck factor'? The recent situation in south-east Queensland is an interesting case. Close to three-quarters of the community were tolerant of the concept, provided the above criteria could be met.

Yet all they saw in the media was scientists arguing about the safety of the treatment processes and similar political arguments. How should a lay person react when the authorities they needed to trust could not agree.

Myth 2: They're not ready to reduce

Community members are the first to agree their water use behaviours contribute substantially to water scarcity. That's why there is strong support for permanent outdoor water restrictions.

Longitudinal studies from the late 1980s show the more experience of restrictions, the more support for permanent lower-level restrictions. Consumer studies in the major capital cities in recent years add that people have experienced little or no disadvantage from the restrictions.

Unfortunately, the economic principles that have driven utility policies for the past 15 years have not supported water conservation through permanent restrictions. With climate change now on our doorsteps, perhaps community opinion and utility policies will align.

Myth 3: Self-interested and simplistic

Conflict over water has been building during the past 20 years. Conflict between cities and rural communities, and between consumptive uses and the environment, are becoming increasingly evident. Climate change will likely escalate them.

Currently 'who gets what' is argued from economic perspectives, which always find in favour of cities over rural needs. However, economic bases to water allocation are not supported by communities. A prime example was the WA government opting for the nation's first desalination plant in Perth over piping water from the Margaret River region.

Perth people did not think it was *fair* to take water from another region , with both urban and rural communities keen to ensure south-west towns and rural industries remained viable.

The fairness ethic is alive and well when you talk to Australians about sharing water. Self-interest forms a part of everyone's decision-making, but pro-social perspectives are as important to communities. If economics continues to be the basis of policies, then we can look forward to further conflict over water resources.

Blair Nancarrow recently left CSIRO to set up consultancy, Syme and Nancarrow Water.

How 40,000 Queensland homes rely on Grundfos quality to keep clean recycled water flowing

The Situation

South East Queensland is one of Australia's fastest growing regions. Through the 1970s and 1980s, urban expansion from Redbank Plains to Goodna and from Collingwood Park to Springfield supported a population of about 40,000 householders. As the housing estates expanded, so did the infrastructure, with suburban streets obscuring literally thousands of kilometres of underground water reticulation pipes, and sewage lines flowing back to a wastewater recycling plant nearby.

The construction of the Goodna Wastewater Centre wisely anticipated strong future growth. It has the capacity to handle wastewater from roughly double the existing population – about 85,000 people.

Further, an upgrade in 1996 changed the way the wastewater was treated. In the early years, Goodna's facilities used a conventional activated sludge treatment approach to start the process of purifying the water.

But in 1996 it was changed to embrace a more natural approach, capitalising on the micro-organisms found in sewage sludge to feed on and help remove harmful microflora.

The Grundfos Solution

The fundamental principle involved in this wastewater treatment approach is to be able to return part-treated wastewater to reserves of incoming untreated sewage so that the feeding micro-organisms can continue to satisfy their hunger for more – a genuine and natural recycling process. The key to the 'cycle' is high quality, reliable pumps.

According to Ipswich Water End User Representative, Liam Clarke, the process that turns raw sewage into potable water follows several phases. The first sees the sewage screened of its larger solids and grit. It still contains biological solids, but commences a process of biological nutrient removal in which nitrogen and phosphorous elements are removed. Next, activated sludge is transferred to a biological nutrient removal process. After this, the processed fluid then is clarified in large settlement tanks. Solids settle from the clarified water, another separation follows, and the water is returned to the clarification process.

Resulting effluent water is chlorinated and transferred to a 'reverse osmosis' facility to filter out remaining microflora and chemicals, before being transferred to either industrial consumers or a major Brisbane Valley dam to recommence the water cycle once more.

Where it is intended to be potable quality, the water undergoes more chemical treatment before being reticulated for use in the kitchens and bathrooms of millions of Queensland homes.

The Outcome

The Grundfos outcome was to replace shaft-line-driven, split-case pumps more than 30 years old with new Grundfos submersible pumps, model S2504. The first crucial criterion for these pumps is that they could run 24 hours a day if necessary, without any risk of failure.

As Liam Clarke noted: "If you lose the pumps, the whole process stops." This is because the Goodna treatment process relies on the recycling of micro-organisms from a later phase back to the early incoming phase, in a continual cycle, allowing them to feed on incoming, nutrient-rich sewage. The Grundfos pump solution, therefore, is the key to the success of the process.

Grundfos Queensland representative, Graeme Croker, said that Grundfos product had a strong and well-established reputation for reliability, which had augured well when Ipswich Water was evaluating the pump tenders.

"These pumps have to work hard, and there must be confidence that they can do the job," he said. "The pump units have been tested in accordance with ISO9906 to ensure they will perform correctly, maintaining and achieving the required 125 l/s at 24 mhd in single pump operation up to 200 l/s at 10 mhd in parallel operation, all while being controlled by VSD. The units operate according to the incoming plant flowrate, so the operating times and total flows can vary. They operate about 20 hours per day."

A second important aspect was that the pumps should be able to operate under water. "The pump units are in a dry-well pit in the lower area of the plant, about three metres underground. However, there's a chance of rain or groundwater entering it, and because the pit also contains large pipework which also has a risk of failure there's a chance that water could flood the area, so the submersible capability of the Grundfos pumps was important," Graeme said.

While Queenslanders from Redbank Plains, Goodna, Collingwood Park and Springfield go about their business, few understand that the success of their local water recycling plant depends on the efficiency of just two pumps, working day and night, depending on demand, to ensure that Brisbane's regional water recycling needs continue to be met.

The mastery of membranes

By 2010 Australia's desalination capacity will have grown 10-fold in six years, while recycling schemes pop up apace. Greg Leslie explores the technology at their heart.

The march of technology has been one of the defining dynamics of the water industry in recent decades, but none has been as transformative as the advances in reverse osmosis (RO) and microfiltration. Membranes are the core technology underpinning the diversification of water sources in an era of declining surface run-off.

Given that the capacity of membrane-based desalination in Australia will have grown from 45GL a year in 2004 to more than 500GL by 2010, it is worth considering the planning and investment in research and development that started more than 40 years ago.

Many of the advances in seawater desalting (and the allied practices of water reuse and brackish water harvesting) were made possible by a targeted research program initiated by the US Office of Saline Water (OSW), which was established in 1952, around the same time NASA started reaching for space. Presidents Eisenhower, Kennedy and Johnson all cited the goal of producing potable water from seawater as a key to enduring peace in a variety of regions of the world.

For the next 30 years, the US Government ran a grand R&D program that every year invested the equivalent of US$54 million in 2005 dollars. To put it into perspective, that's about US$34 million more than the US Bureau of Reclamations' budget for all water project development and related R&D activities in 2004.

Moreover, a unique partnering arrangement and research structure ensured all intellectual property would be held in trust so the technology could be commercialised to independent companies. This drove the standardisation of membrane equipment (seen in desalination plants from Perth to the Gold Coast), economies of scale of production and decreased costs.

Federal and state governments in Australia, together with the urban water authorities, should consider what investment they can make to equip future generations with technology that allows communities to adapt to the challenges of supplying safe drinking water.

Membranes have become big business in the water industry.

History of desalination research

The key technological advance in membranes has been the dramatic reduction in operating energy requirements, which has slashed the cost and carbon footprint of desalination.

One of the most important developments in the early period was the design and manufacture of the flat sheet, spiral wound membrane element. It was adopted by the four main suppliers of RO membranes affiliated with the OSW program and became a commodity item suited to most plants. Through competitive practice the production techniques and performance properties of the elements (such as flux and rejection) were improved.

Another notable achievement was development of the thin film composite membrane, which removes more salt from seawater than traditional cellulose acetate membranes, while producing an equivalent volume at lower operating pressures.

Today, the thin film composite, spiral wound membrane element is the standard component of municipal wastewater recycling, seawater desalination, brackish water desalting and groundwater softening plants around the world.

It is interesting to note that a hollow fine fibre RO membrane developed and exclusively patented by Du Pont around the same time is today only used in small desalination plants in the Caribbean and by a few industrial customers.

Advances in RO systems can been seen from the records for membrane replacement at Water Factory 21, the 20,000m^3/day RO plant recycling secondary effluent in California. Four sets of spiral wound membranes were purchased between 1976 and 1996, the first at an installed cost of US$1,200 per element and with an energy requirement of 1.5kWh/m^3 of permeate. The fourth set cost US$650 per element and required just 0.25kWh/m^3.

By the time the US Government desalination research program was dissolved in 1982 it had also initiated nascent research on issues such as concentrate disposal, solar driven desalination and alternative desalination processes.

It is a salient lesson in what is required for an innovative research idea to develop to full-scale commercial deployment, and change the face of the water industry.

Greg Leslie is deputy director of the UNESCO Centre for Membrane Science and Technology at the University of NSW.