OUTCOMES REPORT 2012

STUDY TOUR
2012 Water Sensitive Cities

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Front Cover Photography by: Tim Buykx - Fountain installation at Western Harbour, Malmo, Sweden.
This page Photography by: Tim Buykx - Foliage close-up from Skogholms ängar, Augustenborg, Sweden.

Foreword

The Water Sensitive Cities Study Tour (WSCST) is a program designed to develop networks of leaders across the water industry, within Australia and internationally, that share a common belief in the principles of integrated water management and sustainability. These direct global links ensure the Australian industry is primed to take on new ideas and innovation and shares its own best practice and innovation with the international community.

This report is the product of the third WSCST, which comprised 18 water professionals representing 14 organisations across five states. It brings together summaries of the projects visited, and distils the group's key reflections around how Integrated Water Cycle Management (IWCM) can be successfully implemented as part of a water sensitive city, and the challenges and successes of this program at fostering leadership.

There was unanimous agreement within the group that the experience was a rare opportunity that yielded invaluable personal and professional learning. The group acknowledges the generous investment and support of all participating organisations and overseas hosts, and applauds their vision in recognising the program's value.

Contents

Photography by: Tim Buykx - Close up of grasses on the green roof in Augustenborg, Sweden.

Photography by: Tim Buykx - Public park in HafenCity, Hamburg, Germany which can be submerged during floods from the River Elbe.

2012 Study Tour Participants

TOP ROW L-R: **SAM INNES, NICK ANDREWES, HANNAH PEXTON, ANGELA GANLEY, JAKE MOORE, TIM BUYKX**

MIDDLE ROW L-R: **NICOLE, SEXTON, CHRISTINE JONES, ZINTA LAZDINS, ELISE PASKETT, SALLY REWELL, DANIEL MUIR**

FRONT ROW L-R: **GREG INGLETON, DJANGO SECCOMBE, RALF PFLEIDERER, BRANT MITCHELL, GUILLIANO ANDY, ROB BELCHER**

Executive summary

STUDY TOUR 2012 WATER SENSITIVE CITIES

The Water Sensitive Cities Study Tour (WSCST) program enables water industry practitioners from a range of professions to undertake an international study tour to visit, investigate and learn from leading integrated water management projects and developments around the world.

The 2012 tour group comprised 18 young water professionals, from 14 organisations across five states. Each participant was funded by their respective organisation. The tour is supported by Clearwater and the Stormwater Industry Association Victoria.

WHY THE NEED FOR A STUDY TOUR?

Since the turn of the century, Australia has experienced significant and widespread drought followed by periods of severe flooding in many parts of the country. Climatic extremes have been felt across the nation and combined with population growth have highlighted serious shortcomings in how we manage the water cycle.

There is widespread recognition of the need to diversify urban water supply portfolios, become more efficient in how we use water, recover more value from wastewater and better plan for the long term impacts of climate change. The study tour program aims to address these issues in two ways:

1. Introducing new ideas and inspiration from leading overseas examples of sustainable cities and IWCM into the Australian practices, and;
2. By developing and empowering a network of young leaders within Australia to drive change within organisations and create better collaborative links across the industry.

United young water leaders come together with a 'can-do' attitude to communicate stories about change, present a blueprint of practical actions for enhancing livability and form a lasting network of leaders and change agents.

WHAT WERE THE TOUR OBJECTIVES?

The key objectives for the 2012 tour were to:

- Understand the drivers for taking an integrated approach to water management;
- Understand the range of tools and mechanisms used to achieve this integrated approach;
- Take the lessons learnt in achieving a more water sensitive city and apply them in our own situation;
- Develop leadership, communication and collaboration skills and;
- Develop a network of enabled industry leaders.

WHERE DID THE TOUR VISIT?

The 2012 study tour commenced in Australia, observing a range of initiatives from small scale stormwater retention and treatment to large scale developments that integrate wastewater and stormwater management and reuse with urban design. The international leg of the tour included Singapore, the United Kingdom (UK), Sweden, Germany and the Netherlands where the study tour visited a diverse range of integrated water management initiatives including:

CITY OF THE SUN/ PARK OF THE MOON, HEERHUGOWAARD, THE NETHERLANDS

This was the first carbon neutral urban development in the world with the implications of carbon neutrality flowing right through the development from housing design to infrastructure choice, integration and energy supply.

HAMBURG WASSER, GERMANY

Hamburg Wasser is leading the design and implementation of integrating wastewater management with power generation and supply via cogeneration and geothermal heat pumps at the Jenfelder Au development. This also includes the implementation of a vacuum wastewater network complete from fixture to treatment plant, which represents some very different products for the customer such as vacuum toilets. More broadly Hamburg Wasser is also leading projects in flood management and sewer heat recovery. HafenCity is another development in Hamburg that is tackling flood mitigation in an innovative fashion.

> "The trip allowed us to see a number of projects in a short space of time and allowed us to identify common themes. I felt the key areas that impacted on the success of international and Australian projects were leadership, culture, engagement and innovation."
>
> - Rob Belcher

ACTIVE BEAUTIFUL CLEAN (ABC) WATERS AND OTHER PROGRAMS, SINGAPORE

This is a nation-wide program run by the Public Utilities Board (PUB), with a strong focus on engagement. It aims to shift and harness public behaviour toward better water management. ABC Waters is a key part of the strategy to convert Singapore's urban catchments into water supply catchments and address the implications this brings for urban stormwater quality. The principles of the program have been incorporated into the primary school curriculum. It supports a variety of full scale projects including large scale wastewater recycling, rivers as reservoirs, and landfill leachate treatment. School groups and community members learn about and interact with these ideas and developments through project engagement and education facilities.

ABOVE: Water treatment features integrated into the housing development and accessible to residents in Western Harbour, Malmo, Sweden.

OPPOSITE PAGE: Growing Australian Capital cities.

KEY FINDINGS

All of the projects visited overcame significant challenges to achieve success. The tour group identified four common success factors that consistently emerged, they include:

LEADERSHIP

Demonstrated strong and committed leadership over an extended period of time allowed the community to follow and support concepts, visions and projects. It requires thinking about the long term and what sort of a legacy the project will leave for future generations. With long term drivers in mind, successful projects consider the whole of life cycle impacts of decisions made and approaches taken.

CULTURE

A culture of community acceptance toward making long term infrastructure decisions and taking risk with new innovation. The importance of collaboration between all stakeholders throughout conception, design and delivery is critical to a successful and holistically sustainable project. Strong 'community' culture supported integrated IWCM outcomes and allowed 'big picture' thinking rather than individual thinking.

INNOVATION

Acceptance of risk and willingness to test alternative solutions in order to learn and build knowledge and understanding. Viewing innovation as an opportunity to gain market advantage rather than as a risk. In design and construction, being open to flexibility and learning while doing allows a project to be modified as a result of new information or mistakes made. Successful projects always sought solutions that allowed for multipurpose use of infrastructure.

ENGAGEMENT

The top down – bottom up balance. Both are equally important. Story telling featured in successful projects, allowing different levels of the community to be engaged and participate in projects. An educated, well informed general public is crucial in our transition to a water sensitive future. This means solutions that are well integrated into the urban environment and an emphasis on public education

DEVELOPING LEADERS

Tour participants were exposed to leadership and personal development challenges before, during and after the study tour. Individual skills in communications, planning, decision making, leadership and adaptability were all tested, exposed and developed, resulting in a great learning through doing experience.

TRAVEL ITINERARY FOR THE 2012 TOUR

Where are we?

"For me the study tour reinforced that the approaches Australia is undertaking in water sustainable urban development are up with world's best practise. It also reinforced the need for effective collaboration across organisations, disciplines and jurisdictions to deliver successful projects. The study tour was an inspiration, not so much of the amazing things that we saw, but that what we are doing here is on the right track and we need to do lots more of it."

- Ralf Pfleiderer

Photography by: Tim Buykx - Native waterhen at Cairnlea wetlands, Melbourne.

An Australian perspective

WATER MANAGEMENT IN AUSTRALIA

Since the turn of the century, Australia has experienced significant and widespread drought followed by periods of extreme flooding in many parts of the country. Climatic extremes have been felt right across the nation and combined with ongoing population growth have highlighted serious shortcomings in how we manage the water cycle. Responses to these extremes have involved efforts to transition to a more water sensitive future.

The reliance on centralised surface water storages for urban water supply and adapting to a changing climate have been key focus areas. There has been widespread recognition of the need to diversify urban water supply portfolios, become more efficient in how we use water, recover more value from wastewater and other alternative sources, and improve planning for long term impacts of climate change.

Water management naturally crosses a range of regulatory, social and political boundaries. This makes management in an integrated way complex and difficult. A further challenge lies in the economics of water and wastewater services, which have traditionally been delivered through economies of scale. With the recognition that services need to be diversified many are turning to local 'decentralised' water and wastewater systems, which can carry higher relative costs. Overcoming this barrier is a key and common focus for water service providers in Australia, particularly in relation to who benefits from such integrated and sustainable approaches and subsequently, who should pay.

> "The main difference I found between the Australian and European approach to water sensitive urban design was that we have developed some large scale schemes that incorporate aspects of water sensitive urban design but usually in isolation of other aspects of the urban water cycle, whereas the European approach was more holistic and in a number of cases included the energy and transport sectors in their planning and development."
>
> - Greg Ingleton

URBANISATION AND POPULATION GROWTH

Australia's population continues to grow particularly in the coastal cities. Better planning for these growth areas is required now and will determine how water can be supplied, how it is best managed and how it can assist with the long term resilience and adaptability of these cities. Planning for smart growth and integrating the urban and water planning processes can ensure that growth occurs in the right place, in the right way, for the right reason and with the right solutions. Australia is starting to head down this path, however, there is a long way to go and there is a lot we can learn about how it is best undertaken.

WHAT IS AUSTRALIA DOING?

Across Australia there is good evidence of progression in integrated water cycle management and water sensitive urban design. Initiatives range from small scale stormwater retention and treatment to large scale developments that integrate wastewater and stormwater management and re-use with urban design. However when visiting a number of key projects across Australia, the tour observed an ad-hoc trend from region to region and state to state. Many projects were still at a demonstration scale and tended to be driven by organisations with well-developed strategic vision and an interest in leadership and innovation or a capacity to recover costs through green marketing leverage.

This observation reflects the geographic and socio-political variability in water management challenges. A stormwater treatment project that is viable in Melbourne due to water quality drivers, may struggle to find viability in Sydney where drivers are different. It also highlights the distance we have to go as an industry on the road to achieving water sensitive cities.

Some of the best examples from across Australia include the following:

LOCHIEL PARK, ADELAIDE

Lochiel Park is an 'ecologically sustainable' urban development located 8km from Adelaide central business district (CBD). It is a 15 hectare (ha) site, with 4.25 ha for residential development, and the remaining 10.75ha consisting of open space, wetlands and urban forest. One hundred individual homes located at the site are all equipped with smart metering and each home has a solar hot water system, water and energy efficient appliances, and is rated at a minimum of 7.5 stars.

The development incorporates many water sensitive design features, such as swales instead of drains, rainwater tanks, permeable pavements and rain gardens. The ten megalitre (ML) wetland passively treats stormwater which is then stored in an aquifer storage and recovery (ASR) scheme or directly supplied to customers for toilet flushing, outdoor use and potentially for laundry use. This development is the benchmark for future water sensitive/sustainable development in Adelaide. However, it was delivered by the state owned former Land Management Corporation (now known as Renewal SA) and as such was able to deliver a 70:30 ratio of natural open space to built area. It may be challenging for most developers to achieve this in a financially viable way without the ability to incorporate social and environmental externalities.

CAIRNLEA STORMWATER HARVESTING SCHEME, MELBOURNE

The Cairnlea Stormwater Harvesting Scheme is a partnership between Places Victoria, Melbourne Water and Brimbank City Council. It is a 40ha development with a 700ha catchment. The scheme is designed to supply 160ML per year of treated stormwater to a system of interconnected lakes within the development, where it can be drawn for irrigation of public open space. Treatment is achieved using gross pollutant traps followed by a system of wetlands. The whole system has a storage volume of approximately 40ML. The innovative design aims to keep lakes full while performing multiple functions including non-potable water supply, flood attenuation, recreation, urban aesthetic, and a variety of ecosystem services including enhanced water quality and creation and protection of habitat.

OPPOSITE AND TOP RIGHT: Wetland treatment ponds at Cairnlea, Melbourne.

TOP LEFT: Aerial view of the Lochiel Park development with the treatment wetland in the foreground, Adelaide.

CENTRAL PARK, SYDNEY

Central Park is a new $2 billion redevelopment located on the southern fringe of the CBD, on the old Carlton United Brewery site. It is being delivered by Frasers Property and Sekisui House. Spending over $100 million on green technology, it aims to be the highest environmentally rated mixed use precinct in Australia, comprising 11 buildings, 1,800 apartments, shops, cafes, restaurants, terraces and offices.

The village will feature inter connectivity of buildings and public spaces centred around 6,400m2 of urban park land. Buildings will also feature some of the largest green facades/ roofs in Australia and extensive solar panels. A critical aspect of the sustainability strategy is the on-site water recycling system. An on-site membrane bioreactor (MBR) treats on-site wastewater combined with on-site stormwater and when required, wastewater from a neighbouring sewer main. Approximately 1.5ML of recycled water will be produced for use in cooling towers, toilets, washing machines and for irrigation of open space and green facades. The water and wastewater systems for Central Park are being provided by a new water utility, (Water Factory Company), independently of Sydney Water Corporation. This represents another aspect of innovation

GROUNDWATER REPLENISHMENT, PERTH

Groundwater replenishment is an innovative concept in water conservation where recycled water is treated to drinking water standards and recharged into groundwater supplies. The water can be stored or "banked" in the groundwater and taken out some time later for further treatment and supply to a drinking water system.

The Water Corporation of Western Australia has trialed groundwater replenishment at its Advanced Water Recycling Plant in Craigie, to determine if it can be used to boost drinking water supplies in the future. The requirement to produce recycled water of drinking water standards for addition to groundwater ensures the highest level of protection for water supplies. This means that once the recycled water is added to groundwater, the water will be as safe as the water currently supplied. The treatment process removes chemicals and micro-organisms to levels in accordance with World Health Organisation standards and Australian guidelines for drinking water.

The comprehensive three-year trial of groundwater replenishment was completed by the Water Corporation on December 31, 2012 with some excellent preliminary results attained. Based on the trial's positive outcomes, the Water Corporation has been given an interim go-ahead by regulators to continue operating and recharging water at the purpose-built recycling facility.

FITZGIBBON CHASE, BRISBANE

Fitzgibbon Chase is a new development approximately 12km north of the Brisbane CBD. The proposed land uses in the Fitzgibbon area include residential areas, mixed use urban areas, commercial precincts, schools and recreational areas. The key goal of development is to provide sustainable and affordable housing that incorporates best practice water sensitive urban design. There are two notable components to this project:

FITZGIBBON STORMWATER HARVESTING (FiSH)

The FiSH project diverts urban stormwater runoff from the Carseldine drain that runs through the development area. The stormwater is used for non-potable purposes, such as garden watering, toilet flushing, car washing and open space irrigation. The scheme will ultimately capture 89 ML per year of stormwater from a 290 ha urban catchment. Flow is pretreated through a 5 ML lagoon before passing through a filtration and disinfection system. The system will reduce the load on the potable water network and remove the need for rainwater tanks at each residential property (a current Government requirement).

POTAROO – POTABLE ROOF WATER HARVESTING

The potable roof water project harvests about 44ML per year of roof water from approximately 11 ha of roof catchment within the Fitzgibbon Chase development. The roof water is connected to a number of tanks located throughout the development and pumped to a central storage and treatment plant. The treatment performance is strictly monitored and includes a three-year validation phase of non-potable use. In addition, the project incorporates a small pilot plant to assess treatment of stormwater for potable use.

> “The Study tour for me was a real life demonstration of how water can best be integrated into our daily lives. When managed sensitively the integration of water can improve both the natural and human environments. The tour allowed me to understand the complexities of the management cycle and appreciate the scale of the issues, but also the rewards that are possible.”
>
> -Tim Buykx

ABOVE L-R: WSUD in Fitzgibbon Chase development, Brisbane,. PotaRoo rainwater treatment facility, Brisbane.

OPPOSITE PAGE TOP-BOTTOM: Central Park location, Sydney. Three dimensional masterplan of Central Park. (Source: Frasers Property).

Summary

The above projects paint an encouraging picture of progress. In a global context, Australia is well advanced and definitely a leader in water management. However, these projects have been cherry-picked from across the country, and for every good example there are typically several poor examples or missed opportunities.

It is clear, based on the observations of the study tour group, that a successful transition to a water sensitive cities future requires political support and leadership. Without it, these types of simple stormwater retention and recycling projects will never have the opportunity to become the benchmark for any new developments in Australia.

What it takes

"The experience of spending two weeks immersed in a diverse melting pot of experience and perspectives was priceless. It has fundamentally opened my perspective to what it takes to deliver positive change."

- Django Seccombe

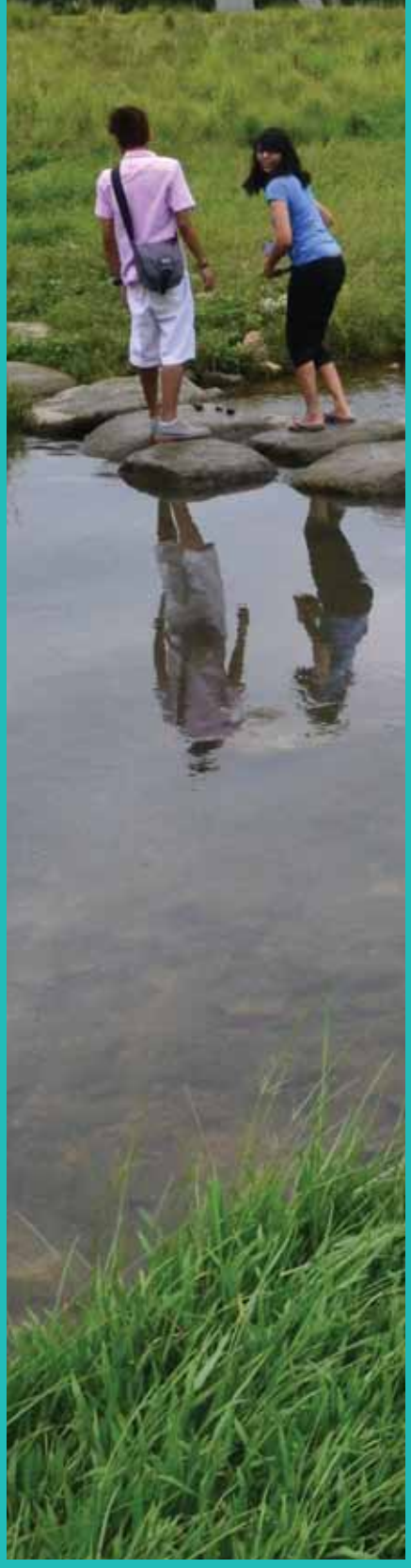
Photography by: Tim Buykx - Publicly accessible green roof, Augustenborg, Malmo, Sweden.

An international perspective

The international project selection process for the study tour (refer Appendix A – Tour Planning Process), resulted in a diverse mix of ambitious projects designed to integrate water management and urban development solutions. At the tour's conclusion, the group spent a day reflecting and brainstorming to capture each individual's key ideas and learning. The product of this session was a list of observations describing what had made each of the projects successful in achieving positive change.

These observations showed common themes or 'success factors' across many of the projects. Four key success factors (described below), are most representative and encompass what the group observed. This section describes each success factor as demonstrated by project examples. It identifies what is important when attempting to effect positive change. The themes explored are not new to the water industry; however the challenges we face highlight the continued gap between understanding and action.

LEADERSHIP
CULTURE
INNOVATION
ENGAGEMENT



Leadership: strong and committed

> The City of the Sun eco-city residential development in Heerhugowaard, the Netherlands is a good example of how collaboration between the local council and community groups played an important role in lobbying governments, at national and international levels (through the European Union) to financially support the use solar panels at precinct-wide scales.
>
> - Guilliano Andy

Nothing of value ever happens without a champion – this applies at all levels within government, organisations and society. The 'role of champions' was the focus of the 2005 WSCST and it is no surprise that it continues to emerge as a critical factor to successful, positive change. Extraordinary leadership was observed across a variety of projects and there were common traits:

- Unwavering and long term commitment to a vision.
- Willingness and ability to persevere through failure.
- Commitment and ability to influence decision makers at all levels (in the community, other organisations and in government).

The following provides a brief snapshot of notable examples.

THE NETHERLANDS

A striking piece of change leadership, at the government level, was observed in the Netherlands. Legislation requiring land holders to offer first priority of sale to the local municipality was introduced. In addition to other policies, this has given local Government a bigger stake in urban planning, particularly in how services are integrated and in design of public spaces.

The observed result seemed to be better long term decision making. This is logical, given municipalities are left with the legacy of urban planning and design and therefore they have a vested interest in development that is sustainable and that promotes happy and prosperous communities.

CITY OF THE SUN/ PARK OF THE MOON, HEERHUGOWAARD, THE NETHERLANDS

This was the first carbon neutral urban development in the world. Stable local council leadership over a 16 year period provided support for lower level management to develop the project from a concept through design and into full-scale implementation. The implications of carbon neutrality flowed right through the development, from housing design to infrastructure choice, integration and energy supply. This required tight collaboration with the developers, architects, and service providers to identify and work through the shared challenges and benefits.

The project is still being realised 15 years after its conception. While the long term stability of local Government was an obvious factor, the most significant leadership occurred at the project level. Key leaders within council, the associated developers and architects, showed long term commitment and collaboration to overcome challenges over the long time scale required for successful urban development.

MALMO, SWEDEN

Malmo Mayor Ilmar Reepalu was elected in 1994 during a period of economic collapse, and in collaboration with key leaders, developed a new vision for the city. Reepalu held office for over 20 years during which Malmo was transformed from a decaying industrial city with serious social issues and huge unemployment, toward one of the most sustainable cities in the world.

The dramatic changes have largely cascaded from the committed and uncompromising vision that was set when the Mayor first took office and the fact that it was developed in collaboration with all the key stakeholders. Other key success factors include the strong national and European Union (EU) policies supporting sustainable urban development. To capitalise on this, the Mayor set up a small dedicated team for submitting grant applications and lobbying the EU for project support.

Change in urban form and leading sustainability initiatives are demonstrated in the Augustenborg and Western Harbour redevelopments. Specific initiatives include renewable energy generation, resource efficient buildings, green roofs, innovative stormwater management, vacuum waste systems and waste recycling, and a variety of social development programs. While the Mayoral leadership and strong national policy has been important for Malmo, a big part of its transition is the result of individual leadership at multiple lower levels, in government, community and private companies. It is at these lower levels that much of the change action took place and the real battles were fought through difficult economic times.

> The study tour provided a unique opportunity to learn not only from the experiences within the tour group, but also from international project champions and leaders. All the projects visited had passionate professionals with strong leadership skills which ensured the projects progressed from 'visions' to being constructed, as demonstrated by the City of the Sun/Park of the Moon in Heerhugowaard in the Netherlands. This highlighted the importance of leadership excellence across water industry professions and the community, to ensure successful IWCM outcomes.
>
> - Zinta Lazdins

REFLECTION

Stable, long term and visionary leadership at the local government level underpinned several of the large urban developments visited on the tour. It was not clear whether this long term stability was a product of the committed and visionary leadership, or vice versa. Vision and commitment within leadership will generate democratic support within a community and inspire leadership at lower levels.

Committed leadership (champions), at the project level was also a common theme observed across many projects, but it was generally not evident what had enabled this leadership. In some cases it may have simply been chance and in others it was possibly the product of deliberate actions of high level leadership to foster growth and leadership, in a similar fashion to the WSCST program.

AUSTRALIAN CONTEXT

The successes of these and similar projects in Europe was not only due to leadership stability; they were also supported by other social, environmental and or economic drivers. The true success was in having a champion in the right place (or position) at the right time, to take advantage of a changing landscape. This would suggest that in Australia, where stability in government is rare, government and infrastructure providers should invest in leadership development. The likelihood of having leadership in the right place at the right time is far greater if there are more potential leaders at grass roots and project levels.

ABOVE: Stormwater fed water treatment features in pocket park provide play elements, Western Harbour, Malmo, Sweden.

OPPOSITE PAGE:
Living sustainably surrounded by the water, City of the Sun, Heerhugowaard, Netherlands.

Culture: collaborative and forward looking

The culture of communities, organisations, governments and nations as a whole, can be the product of a multitude of factors, each occurring over different time scales. Shock events such as economic collapse can change a culture over a short time span, whereas other cultural trends can take longer to develop. For example, efficient water use emerges in response to long term drought.

The sheer multitude and geographical variability of factors that influence a community's culture toward change make it difficult to analyse. While identifying the cause of cultural trends can be challenging, we can identify which trends contribute to positive change. The tour observed a number of recurring trends across different projects, discussed below, which may provide some direction and focus for those trying to drive change here in Australia. These recurring trends included:

- Open and committed to collaboration.
- Forward looking.
- Accepting trade-offs for long term decisions.
- Embracing innovation and seeing value in market leadership.
- Less risk-averse; more pragmatic approach including greater personal responsibility.

The following project examples stood out:

> "While visiting an urban development in Malmo Sweden we were taken to a school with a storm water infiltration basin that doubled as an outdoor classroom. Its value as an educational tool and power as an agent for cultural change was immense, something our guide succinctly pointed out when she said: 'If you want to change a culture, start with the primary school.'"
>
> - Nick Andrewes

AMERSFOORT, THE NETHERLANDS: VATHORST, KATTENBROEK AND NIEWLAND ECO-DEVELOPMENTS

Amersfoort City Council displayed a strong, forward looking and collaborative culture in servicing population growth under the VINEX Program. The municipality developed three new suburbs (Vathorst, Kattenbroek, and Niewland) and set objectives to exceed policy requirements for sustainability and liveability in all circumstances.

To do this they formed a joint venture with private companies. This ensured diverse skills, ideas and perspectives were available in the master planning and construction stages. The development's public/private partnership also ensured financial sustainability by helping to balance ecological and social initiatives with affordability.

Specific initiatives included:

- Use of eight different builders and 50 architects to ensure architectural diversity.
- Precinct-wide solar energy.
- Use of sustainable materials.
- Integration of housing types to promote social integration and cohesion and to help cross-subsidise social housing costs.
- Fast tracking transport links and other services to ensure livability for the first residents.
- Design of canals throughout the development to maintain the water connection for people.
- Adaptation of housing design to meet changing market demands, i.e. - modular architecture to allow easy expansion.

HAMBURG WATER, GERMANY

Hamburg Water demonstrated a collaborative and forward looking culture, through their Hamburg Water Cycle initiative for the Jenfelder development, and through the variety of commercially focussed projects that have required innovation and collaboration with private companies.

The Hamburg Water Cycle project in the Jenfelder development represents a broad range of challenges, mostly associated with cultural change and collaboration. The project integrates wastewater management with power generation and supply via cogeneration and geothermal heat pumps. A vacuum wastewater network, complete from bathroom fixtures to the treatment plant, introduces some very different products for the customer, such as vacuum toilets. It also represents new plumbing standards and maintenance expectations.

This project required ongoing engagement and collaboration with the local government, developers and other service providers over 10 years. Hamburg Water managers have committed resources to this project because they see it as a leading solution of the future, and plan to be a market leader, capable of selling their expertise. Other examples of this culture of collaboration and forward thinking include their project to lay electricity supply services and optic fibre communications through the sewer network, and extraction of heat energy from sewage for domestic heating systems. Hamburg Water represented the best example of achieving the benefits available from the water and energy nexus.

Hamburg Water have developed cultural trends focussed on creating a commercially competitive and innovative business.

AUSTRALIAN CONTEXT

By world standards Australia has a high standard of living. In recent decades however, good forward planning and inter-agency/government collaboration often appear to have been replaced by oversimplified and short term cost-based decision making.

This seems to be supported or possibly propagated by a culture of fear of taking risks and trying new things, particularly by leaders. With the recent economic downturn and continued pressure on infrastructure and services, providing new and progressive approaches to infrastructure are made more difficult. Greater collaboration between government agencies and with the private sector is needed to develop a new and different culture regarding risk and innovation.

Excellent but isolated examples of cultural change exist within the Australian water industry. However, it is important for the industry to draw inspiration and learning from international examples. Learning can also be drawn from other industries, as the challenges are not unique to sustainable water management.

ABOVE: Heat exchangers retrofit into sewer pipe, Hamburg, Germany. (Source: Hamburg Wasser)

OPPOSITE PAGE: Water front development, Amersfoort, Netherlands.

Innovation: accepting the risk

Innovation is the process of applying a new idea or concept into a real life situation. Innovation is not confined to technology and applies equally to policy, planning processes, urban design, or indeed anything that represents an improved alternative to what currently exists. Innovation is the process of continuous improvement, and as the study tour was focussed on improving current thinking, attitudes and applications of IWCM, innovation was quickly identified as a key success factor.

Innovation presents challenges in managing inherent risks that come with new approaches, whether that is political risk attached to a new policy, or financial risk attached to a new technology. The following examples successfully managed risk to achieve innovation.

> “I was really impressed that in nearly all of the projects we saw, there were elements of risk taking, where the risks were considered and built into the project.
> The idea of undertaking pilot or ‘trial’ projects was a key learning for me; start small, and then build on the successes of these, or adapt them to improve them for the next time they are implemented.”
>
> - Hannah Pexton

NEREDA™ WASTEWATER TREATMENT PROCESS – EPE WASTEWATER TREATMENT PLANT, THE NETHERLANDS

The Nereda wastewater treatment process is an innovative biological process that centres on dense granules of bacteria, which are grown under specific conditions. The granules form a biomass that treats wastewater in tanks, in similar fashion to conventional biological treatment processes. The key difference comes from the high density of the biomass, which results in sludge settling rates ten times that of conventional processes. This translates to a much smaller footprint and lower construction and operational costs. In addition, the bacterial mix in the granules comprises both aerobic (on the surface) and anaerobic (below the granule surface) species and so can effectively remove both nitrogen and phosphorous in the same process stage.

The process was first developed by Delft University, before being picked up by the Dutch consultancy Royal HaskoningDHV and further developed to a commercial stage.

Royal HaskoningDHV spent ten years developing the process both in the lab and in a pilot plant in collaboration with Delft, before securing a contract to build a full-scale plant at Epe Waste Water Treatment Plant (WWTP). Royal HaskoningDHV recognised the potential of the new process and gave long term commitments of time and resources. The Vallei and Veluwe Water Board took the risk on a new innovation, unproven at a full scale. They managed this risk in a number of ways; they tested the process in a pilot at the existing plant, they built the new plant in parallel to the existing infrastructure and they specified process contingencies to be included in the design, such as additional mechanical mixers and chemical phosphorous removal. At the time of visiting (about three years into operation) neither of these contingencies had been used.

FLOOD PROTECTION - HAFEN CITY, GERMANY

Hafen City is a 157 ha waterfront redevelopment within the original port area of Hamburg. A unique aspect of this project is that the site lies outside the protection of the existing Hamburg dike. This presented major financial and urban design challenges resulting in innovative flood management and design solutions.

The flood management strategy focussed on raising the buildings onto compacted earthen plinths to eight metres above sea level. The public open spaces and some road ways were designed to submerge during flood conditions. This has delayed major investment into expensive flood levees far into the future and allowed development to progress. Buildings are linked with bridge footways and raised roadways above the flood zone so that the development can function normally during floods. Underground car parks have been built within the earthen plinths. Facilities located below flood level are fitted with drop down steel covers to seal off flood water.

Implementing this variety of cost effective flood management approaches has increased the inner city area by 40 per cent, creating 22ha of new public space and parks, 50,000m² of new retail and restaurant areas, 12,000 new residences, and 45,000 new jobs. It demonstrates how innovation in design and planning can help us adapt to changing climate and environmental conditions and at the same time boost livability by providing an interface with water in a highly urbanised environment.

These two examples describe innovation in design and technology and there were several other notable examples (See Case studies). Innovation was also observed in other forms, including policy development and in approaches to social engagement. These forms of innovation often went hand in hand with the technical aspects of the projects. A common theme was not the innovation itself, but an attitude of accepting, and sometimes embracing, the risk that comes with trying something new. Innovation is seen as an opportunity to differentiate, and gain competitive advantage, in an ever more competitive market.

AUSTRALIAN CONTEXT

Australia has long been a global leader in research, however it does not have a good track record in supporting research into innovation, particularly in recent decades. The water industry is no exception in this respect, and typically avoids risk. This risk-averse culture has served the industry well in the past however as competition increases along with financial, environmental and social pressures, there is a need to be more adaptable and agile in responding to change. This requires innovation and more specifically, a different approach to managing the associated risks that come with innovation.

> “Something I found very interesting on tour was that Europe has a different set of drivers for IWCM. You would think that combined sewers, groundwater dominated supply, different water quality issues and a vastly different climate would lead to a level of incompatibility of approaches between Australia and Europe. This was certainly not the case and European approaches to IWCM have direct application in Australia. I was inspired by the approaches taken to flood management, whole of water cycle planning at large spatial scales, planning for a changing climate and connecting water with energy and resource recovery.”
>
> - Sam Innes

ABOVE: Flood protection measures including reinforced window shutters with raised walkway above, HafenCity, Hamburg, Germany.

OPPOSITE PAGE: Wastewater treatment plant at EPE, Netherlands, including the Nereda bioreactor.

Engagement: balancing top down with bottom up

The water industry has engaged people at the community level as a matter of course rather than as a means to shape the fundamental direction of a project. This is not unique to the water industry, or to Australia. Many of the organisations visited across Europe were trying new approaches to harness community interests to deliver water management and sustainability objectives. Delivering sustainable water solutions in new and existing developments generally comes at a financial premium, particularly when using conventional methods for economic assessment.

Some organisations, like the large monopoly water utilities in Australia, have to date used their scale to cross-subsidise new and more sustainable servicing approaches against the broader customer base. Where services are proposed that go beyond minimum licence requirements, government and pricing regulators in particular demand evidence of customers' willingness to pay.

This dynamic is a driving force behind the interest in using 'bottom up' engagement as a means to drive change toward more sustainable water management. There are other benefits to good grass roots engagement; such as improved public understanding, better public perception of the service provider, and a long term sense of ownership by the community, which can lead to fewer ongoing management challenges for the provider.

Most projects visited on the 2012 study tour showed strong aspects of community engagement. However some showed fundamental shifts toward an almost equal balance between 'top down' policy-based drivers and bottom up community engagement. The following projects demonstrated this approach.

> "A common theme was how early engagement with communities can result in greater ownership of a project and its outcomes. The power of storytelling was a key tool used in many of these projects in gaining momentum to change people's perceptions and attitudes."
>
> - Jake Moore

AUGUSTENBORG, SWEDEN

At the commencement of the reinvigoration of the Augustenborg precinct in Malmo, Sweden, it was recognised that significant community engagement would be required to achieve cultural and behavioural change. The level of engagement in this marginalised public housing community was the highest of all projects.

One of the main objectives of Ekostaden Augustenborg was to enable residents to play a significant role in the planning and implementation. The Augustenborg project incorporated extensive public consultation, regular meetings, community workshops, and informal gatherings at sports and cultural events. The approach became increasingly open and consultative. Although some claim that involvement of local residents was low for a variety of reasons ranging from apathy to language barriers, approximately one-fifth of the tenants in the area have participated in dialogue meetings about the project, and some have become very active in the development of the area. Residents and people working in Augustenborg were involved in the design of the outdoor environment. A special needs advisor and local access and mobility group worked with the design team throughout the

project. Constant communication and in-depth community involvement enabled the project to accommodate residents' concerns and preferences regarding the design of the stormwater system. Consequently, the project encountered little opposition.

Augustenborg school pupils were involved in a number of local developments, such as planning for a new community/ school garden, rainwater collection pond/ice rink, a musical playground, and sustainable building projects incorporating green roofs and solar energy panels.

The greatest challenge with involving the public was maintaining continuity to focus on environmental awareness of the residents and to inform newcomers to the area about what had been done. In order for people to become involved they needed to have control over project outcomes, and the authorities therefore had to accept that things would not always happen exactly as planned.

ABOVE L-R: Stormwater infiltration basin doubling as outdoor classroom and play feature in the school yard, Augustenborg, Malmo, Sweden. Naturalisation of concrete channel into a waterway at Bishan Park in close proximity to high rise housing, Singapore.

OPPOSITE PAGE: Stormwater treatment swale included as feature of car park and building frontage, Augustenborg, Malmo, Sweden.

ACTIVE BEAUTIFUL CLEAN (ABC) WATERS PROGRAM AND BISHAN PARK, SINGAPORE

The ABC Waters program is a nation-wide program run by the Public Utilities Board (PUB). It has a strong engagement focus and aims to shift and harness public behaviour toward better water management. Some of the program's roots lie in the strategy to convert Singapore's urban catchments into water supply catchments and the implications this brings for urban stormwater quality. But it also has roots in enhancing the natural amenity of a highly urbanised and densely populated city. The PUB has introduced the ABC Waters principles into the primary school curriculum and combines this with a variety of full-scale education projects for school groups and community members.

The tour observed this engagement while visiting projects including Bishan Park and Lorong Halus Wetlands. Both projects had comprehensive story boards describing the purpose and function of each aspect of the project. They also incorporated facilities for group activities.

The Bishan Park project showed effective engagement at a number of levels. The project naturalised a large stretch of concrete stormwater channel back to a vegetated sinuous stream. The banks and flood plain area were

RIVER ISAR NATURALISATION – MUNICH, GERMANY

also rehabilitated to merge with adjacent parkland and create a single continuous public space. To achieve this, the National Parks Authority and PUB had collaborated and compromised, particularly in shifting away from the historically risk-averse management approach. This involved removing channels and fencing, and allowing intermittent flooding of public parkland. Users are made aware of the inherent risks through signage, a system of flood sirens and rescue devices. The responsibility for personal safety is given to the individual in a managed and informed way, rather than the previous solution of complete risk avoidance by exclusion fencing. This approach has significantly enhanced the level of amenity for the local community and city as a whole. High levels of use observed during the tour visit clearly demonstrated this value.

TOP L-R: People actively connecting with the new space in Bishan Park, Singapore. Bringing people close to the water while reinforcing the stability of the river bend, Isar River, Munich, Germany.

OPPOSITE PAGE L-R: Naturalised river edge and people engaging with the river on the first warm spring day, Isar River, Munich, Germany.

The City of Munich and the Regional Office for Water Management implemented the IsarPlan to improve flood control, ecological functions and recreation. To assist with the complex and far reaching planning required for the project, a multi-disciplinary steering group including water engineers, landscape architects, city planners and biologists was formed to work through the technical issues. The planning was also heavily guided by community input through many meetings with citizen-groups and non-government organisations including nature conservation, fishing and kayak groups. Eventually a representative group known as the 'Isar-Alliance' was formed to represent the Isar Rivers broad user groups.

In urban areas, where available space is limited, river restoration projects are mostly restricted. In Munich, the flood corridor offered some space and was integrated in the restoration project. From the start in 1995 the public was involved in the planning process. People were interviewed about the new river and what they would prefer. Younger people sought more gravel banks and an open, easy access to the water, while older people wanted more grassland. The compromise was to widen the river by 30 per cent to bring back the gravel bank, but keep about 60 per cent of the existing meadows for passive and active recreation (i.e. walking dogs and soccer).

Interview results provided guidelines for the planning process and included:

- Flood control.
- Restore alpine character of Isar River into the city.
- Enlarge the gravel banks along the river.
- Retain flood meadows.
- Keep trees and natural vegetation.
- Improve opportunities for recreation (sunbaking and bathing).
- Restore ecological functions, e.g. riparian connectivity.

For the last restoration section, a competition to find an acceptable solution was held for architects and engineers. The winner recommended a more technical solution, but this was resisted by local residents. After a mediation process a solution was found, which follows the more natural restoration principles, which were chosen for the sections already finished. One further aspect of this restoration project was the need to improve water quality flowing into the urban reach of the River Isar. An upstream wastewater treatment plant that discharged treated effluent into the river was redesigned to improve the quality of the discharge and hence improve the downstream water quality, enabling recreational use of the urban reach of the river. This upstream intervention, coupled with the re-naturalisation of the urban reach of the River Isar expresses the holistic approach to a river restoration project, and is an exemplary example of an urban river development project.

AUSTRALIAN CONTEXT

Effective engagement needs to occur at multiple levels within communities, private organisations and government agencies. It requires top down support and committed 'doing' champions to develop the understanding and ownership of IWCM initiatives at the grass roots level. We have many good examples of effective engagement to draw on within Australia, but across the industry this is very inconsistent and must be improved. It represents a major challenge to most if not all water service providers from local government to large utilities.

For the water industry to progress toward more Water Sensitive Cities, we will need to bring the community on a journey. A key element of effective engagement is to enable the community to play a significant role in the planning and implementation of key projects. We will need to explain the risks and why they are greatly outweighed by the benefits.

But some risks will have to be managed through personal responsibility for the best community outcome and not solely by governments taking all the risk/responsibility, which can lead to over-engineering and excessive cost. There will need to be multidisciplinary steering groups to guide and participate in engagement. This is particularly necessary for larger, multi-year projects that require consistent and ongoing engagement.

This has begun in some areas where communities are being more effectively consulted and involved, some primary schools are installing and constructing rainwater tanks, wetlands, ponds and raingardens and developing educational programs around the functions of these systems. These types of schemes in public spaces require education of the community through interpretive signs at project sites that are comprehensive yet simple, backed up with detailed information on linked websites. Where possible a personal story should be told via guided tours.

We are moving in this direction and an educated, aware and engaged community will ensure success.

ABOVE: Residents fishing in pond retained within the Trabrennbahn Farmsen development, Hamburg, Germany.

BELOW L-R: Reuse of the concrete from the former channel as a landscape feature in Bishan Park, Singapore. Water feature fed by stormwater Western Harbour, Malmo, Sweden. An engineered and stepped waterfall retained within the Isar River allows a hydroelectric plant to continue operating while a naturalised channel was created on the other side of the island, Munich, Germany.

Developing Leaders

"It was great to see so many innovative and interesting projects being undertaking in the water industry, internationally and around Australia. Strong, long term leadership was a common factor in the success of these projects, along with the understanding that truly innovative projects will require us to re-assess the levels of risk that we will accept."

- Brant Mitchell

Photography by: Tim Buykx - Beautiful bridge detail, Amersfoort, Netherlands.

LEARNING FROM THE PROCESS

The WSCST is a collaborative 'action' learning and professional development program with objectives to deliver tangible outcomes and innovation back to the Australian water industry.

The group was brought together by Clearwater, having been nominated as potential leaders by their respective organisations. The major factor for organisations investing in this program was to foster leadership and professional development within the nominated individuals. The project began with a meeting in Melbourne, where individuals were introduced and given:

- Some background to IWCM and the Centre for Water Sensitive Cities.
- A brief history of the study tour program with input from previous study tour participants.
- The study tour brief, which included the budget of $10, 000 per person, assessment of best practice in Australia, a presentation to the Water Sensitive Urban Design Conference, and international tour of IWCM projects.

Following this introduction, the group constructed a unified vision for the tour and conducted many planning sessions over the ensuing six months. The planning process presented unique challenges and opportunities to learn and develop.

The following elements represent the most significant process-related learning taken from the tour. They also represent the critical success factors for the tour execution and describe how the group was able to work together to effectively manage decisions, ensure everyone's needs were met, and achieve goals within agreed time frames.

> "The tour was an invaluable experience, seeing the great work being done throughout Australia and Europe was inspiring, just as important was being able to share the experience with a group of amazing young people and discuss how we can apply our new found knowledge on our return home."
>
> - Daniel Muir

COMMUNICATION

In dealing with a large group, representing different organisations from different parts of the country and with varying types and levels of experience, the first key challenge was communication.

The first step for the group when bringing together people from different backgrounds was to get to know each other. The group discussed what specialist skills might be required and what existed within the group. Some immediate tasks were identified which focussed primarily on who was going to minute discussions, who would facilitate discussions and how such a large group should communicate effectively to ensure everyone gets fair input.

To enhance communication individuals established an internet-based communication portal. This was used to share documents and enabled multiple people to edit documents, and post agendas and minutes of meetings. Coordinators were nominated to manage major ongoing tasks and these were shared to allow for personal and professional development.

Small working groups were established to discuss finer details of major tasks. These smaller working groups assessed options and presented to the larger group for approval.

The group used various forms of communications including email, teleconferences, workshops, and structured meetings while the online portal housed all documents. Workshops were used where group planning and key decisions needed to be made. More structured meetings were held to run through progress of tasks and discuss itinerary, logistics, budget, marketing and communications and allocate additional tasks.

> "Many of the sites we visited placed great emphasis on community engagement and really demonstrated how important this was to a successful outcome."
>
> - Angela Ganley

PLANNING PAYS

It was evident that without thorough and clearly documented planning, the tour would risk failure once on the road. With such a large and diverse group travelling internationally for two weeks on a hectic program, meeting various organisations and trying to meet both personal and professional agendas, effective planning ensured no major issues throughout the pre-tour, on-tour and post-tour processes. This planning included:

FACILITATED PLANNING SESSIONS AND CONSENSUS-BASED DECISION MAKING:

This ensured the entire group had input to and agreed on the Vision and Objectives for the tour. This critical first step ensured the whole group agreed on tour objectives. In later stages of planning this approach ensured that meetings and activities supported the tour Vision and Objectives. Planning sessions always ended with an action plan, assigned tasks, deadlines and a follow-up meeting scheduled.

SHARING TASKS AND ACCOUNTABILITY:

For the large projects, small working groups were established which assisted in effective decision making. This ensured timely decisions and shared tasks and workload among the group. Sub-group decisions were always presented to the larger group for agreement. Major tasks that were running items on the agenda included the itinerary development including logistics and accommodation, budget, communications plan, and risk management.

TESTING THE WATERS VIA TOURS OF AUSTRALIAN CASE STUDIES:

The inclusion of the Australian component in the study tour served as a useful trial run and learning experience for the more logistically challenging international tour. Simple learning such as having a 'day lead', who provided background information, host and tour members contact details, an agenda and specifying meeting locations helped the Australian tour days running smoothly.

TRANSPARENT DOCUMENTATION AND TOUR PROGRAM:

All decisions made prior to the international leg of the tour were documented before departure and all participants were provided with a 'tour workbook'. The workbook provided details of the itinerary, hotels, flights, transport, emergency contacts, participant contact details, what sites we were visiting on what days, who was the project lead, who we were visiting and where. It detailed the working groups and their allocated daily tasks, including who was responsible for selecting and paying for food during the day, taking notes and photos. This document was the key to the success of the tour on the road. If issues did arise, when on-tour, participants would refer to the tour book where key decisions had already been made. This ensured that all participants knew where they needed to be and at what time. All participants were allocated groups and it was the responsibility of these groups to ensure that members were always accounted for.

> "The Study Tour was an invaluable experience for me in broadening my thinking to the breadth of issues that for me can be considered an element of a Water Sensitive City. The knowledge that was shared amongst the group from their own work pre-tour was exceptional, and combined with the insights that we all shared on tour resulted in a really well rounded learning experience."
>
> - Christine Jones

ABOVE: Group facilitated planning session in Melbourne Water's Boardroom.

CONSULTATION VERSUS ACTION

Making decisions within a large group can be difficult. It is a common challenge in democratic environments and one frequently encountered by infrastructure and other service providers, in balancing the needs and interests of many different stakeholders. Consultation is critical in ensuring all stakeholders are satisfied with a decision and that all aspects of a problem have been considered. The risk of consultation with large groups however, is for discussion and debate to go around in circles and delay an outcome.

This challenge was recognised by the group and was overcome with the use of a clear agenda, a trained facilitator and a consensus-based decision process for all planning sessions. This approach worked very well during the planning phase. However, at times decision making on-the-fly was also required. This is where there was probably the biggest potential for conflict given time pressures, fatigue and personal biases. Fortunately this was identified and accounted for during the planning phase. The solution was assigned leadership and accountability for each day of the tour. There was still capacity for consultation but it was also accepted the final decision would rest with whoever was leading the group on that particular day.

> “I found the tour a fantastic opportunity to learn about a totally new area of the water industry, learn from and implement a variety of leadership styles, and nationally network with a great group of young water professionals.”
>
> - Sally Rewell

LEADERSHIP: TAKING AND SHARING

As in any group, there are members who like to take control and others who are more laid back. Our group was interesting in this aspect as participants were chosen to take part for being emerging leaders of the water industry. While all members had identified leadership skills, there were differing levels and styles.

Leadership can be expressed in different ways; some lead through ideas and thoughts whereas others lead by example. As the study tour was designed specifically to develop leadership within the industry, members were aware that opportunities to lead needed to be taken but at the same time sharing it fairly around the group. While in the beginning some naturally took charge of running meetings and achieving tasks, it was clear that the workload had to be shared to manage our changeable availability, capitalise on individual strengths and ensure that everyone had the opportunity to challenge themselves.

The solution was to identify all key task areas (budget tracking, photography, notes, transport, host liaison, payment of food bills etc.) and assign leadership accountability for each. Sub-groups were formed and assigned a task area for each day of the tour and tasks were rotated each day to ensure the load was spread evenly. Sub-groups split individual leadership as they saw fit. Some tasks such as budgeting and travel coordination required continuity and as such were not rotated but were provided constant assistance. This approach was adopted for both the planning and on tour phases. Food purchasing was assigned to an individual per day to minimise the amount and collection of receipts and therefore the reimbursement process upon returning. Even this task required leadership skills in managing the requirement and expectation of the group. Some managed this by planning ahead and researching options prior to the day, others worked on-the-fly, and both approaches needed negotiation with the group.

> “For me, the tour was just as much about professional growth and leadership as it was about developing my knowledge on water sensitive cities. Each site visit held both a technical learning as well as an opportunity to fulfil the role of a team leader or team member depending on the situation. Developing the ability to assess the situation and choose an appropriate role is a skill that I have found invaluable since returning from the tour.”
>
> - Elise Paskett

BE ADAPTABLE

The study tour provided unique challenges beyond what most participants faced in their day-to-day work. It brought together a range of water professionals from across Australia of different ages and stages in their professional and personal lives. Interstate participants often phoned-in to meetings in Melbourne, where the largest number of participants worked.

The people physically present at meetings needed to be conscious of allowing the people on the phone to hear and be heard. Decisions needed to be made even if not all participants were in attendance or in agreement. Participants compromised, or argued their case, until the majority of the group where happy. Although not stipulated at any time, it was clear that we sought to be fair in decision making and to accommodate the needs of all participants. It was also clear that this would not always be possible and that adaptability was required to put personal preferences aside.

This is a pertinent theme of water sensitive cities and climate change impacts, where current practices need to be adapted to future challenges. Given that participants were 'change agents' within their respective organisation, they were familiar with being adaptable to get a positive, workable outcome.

> "The WSCST 2012 was an experience of a lifetime and one that has allowed me to grow both professionally and personally. It was an experience that has allowed be to gain a greater understanding of my strengths and weaknesses that I feel I would not have become aware of so strongly under other situations."
>
> - Nicole Sexton

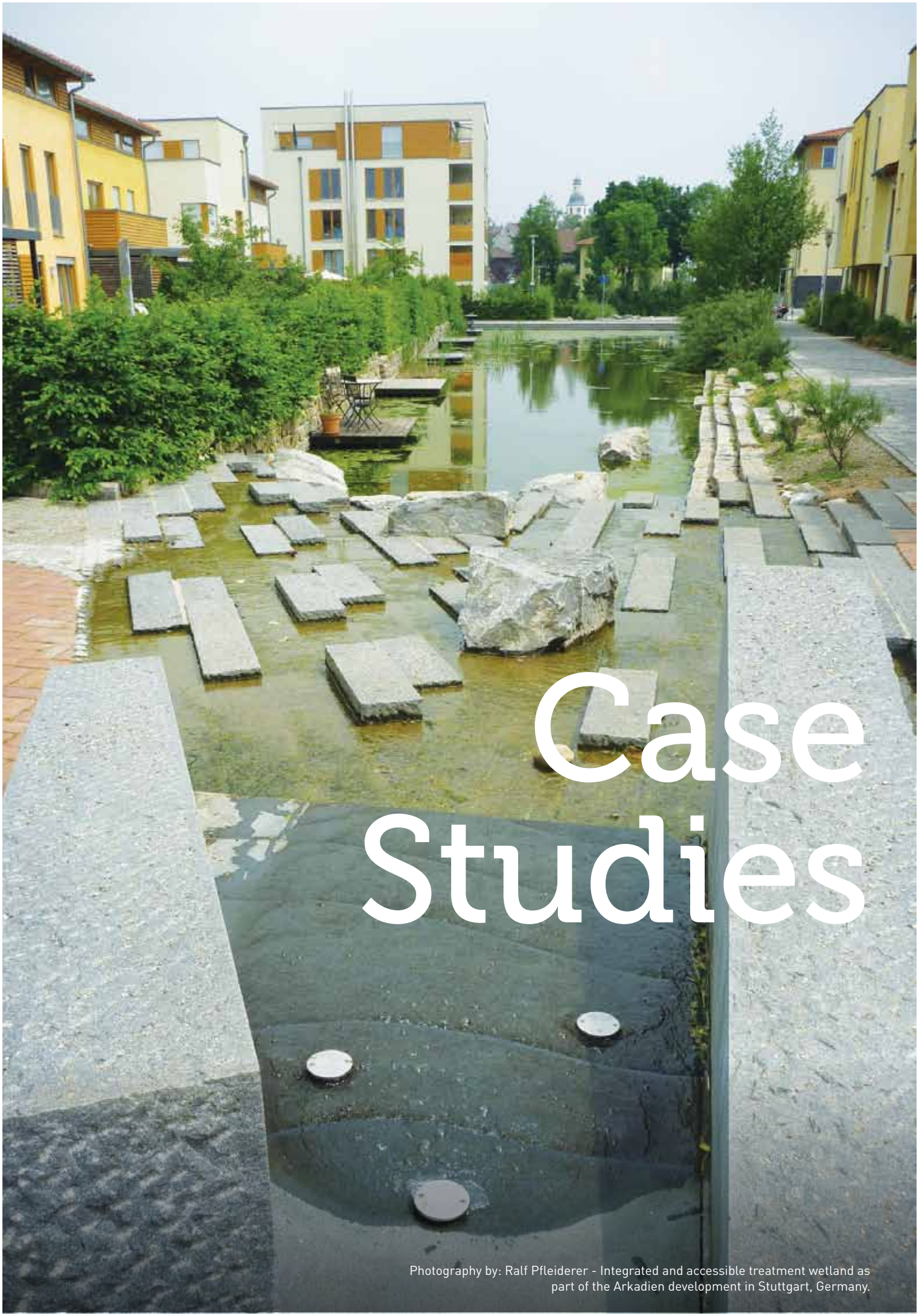
ABOVE: Participants during a reflection session towards the end of the tour capture ideas while they are fresh and the group is together.

Summary

The 2012 Water Sensitive Cities Study Tour was a great success with a huge amount of learning at many levels for all participants. It was also fun and lasting connections have been made.

The participants would highly recommend future tour opportunities to organisations wishing to provide an invaluable growth and learning experience to emerging leaders within their water or sustainability teams.

Following are the case studies of all the projects and sites that we visited. They outline the initiative, how it was presented to us and how we experienced each one. They also aim to determine the successes, the learning's, challenges and opportunities as well as how the initiative may be adapted to the Australian context.



Case Studies

Photography by: Ralf Pfleiderer - Integrated and accessible treatment wetland as part of the Arkadien development in Stuttgart, Germany.

01

European Union Water Framework Directive, UK

PROJECT

European Union (EU) Water Framework Directive

LOCATION

United Kingdom (UK)

ORGANISATION

UK Environment Agency

KEY SUCCESS ATTRIBUTES

- Improved waterway health throughout the EU.
- All waterways to be measured as 'good' status or equivalent by 2027.
- Strong stakeholder engagement.
- No deterioration of existing waterways post-2009.

DESCRIPTION

The EU Water Framework Directive is a key piece of European legislation introduced in 2002, rewriting existing water legislation into a new overarching program.

This program ensures consistent European legislation covering different aspects of water management.

The Water Framework Directive approach to managing water is called River Basin Management Planning. This approach looks at water within the whole ecosystem and entire water cycle, and involves a wide range of stakeholders.

The legislation seeks to improve ecosystem health and provide cleaner water for drinking, recreation and economic uses by improving the function of natural systems within existing and modified water bodies.

DISCUSSION

The EU Water Framework Directive is an important piece of legislation that is responsible for driving several policies and projects throughout the EU.

The directive dictates that water quality and waterway health throughout the EU must be improved; however it leaves it up to the individual countries to tackle the various sources of pollution in their own ways, and determine the best actions to bring about improvements.

Encouraging countries to look at the entire water cycle and improving overall water quality is driving implementation of water sensitive urban design throughout developments, as well as other initiatives such as permeable pavements and green roofs.

In addition to innovation at developments, the legislation is a key backing for the environmental agencies to enforce strict licence requirements on point source polluters, and also address diffuse source pollution.

The directive is an excellent example of how strong policy can be used to drive innovation in the water sector to achieve good environmental outcomes for the community and wildlife.

PROJECT INFORMATION

Drivers

There is increased demand from the public throughout the EU for cleaner rivers, groundwater and wetlands, and increased complaints about the declining quality of rivers. This demand drives a simplified approach to regulation that unifies water management approaches across EU nations.

Capital cost

This varies across each European country.

Operational cost

Operational costs will not be known until the project is implemented. A wide range of stakeholders, including water utilities and point source polluters will contribute to costs.

Funding source

Funding is provided by a range of sources for various projects. The UK Government Department for Environment, Food and Rural Affairs (DEFRA) have provided £9m for the Thames basin. Water utilities and other point source polluters fund the cost of managing their impact on waterways as enforced by the UK Environment Agency (EA).

Delivery time frame

By 2015 EU nations must meet 'good status' for all natural waterways and 'ecological potential' for modified waterways. Where objectives cannot be met for some waterways by this date, demonstrated evidence and future plans must be provided. By 2021 continuous improvement on previous targets must be shown, and by 2027 all planning objectives in the framework must be met.

Communication

Public participation is a core component of the Water Framework Directive. The EA engages with organisations and communities to produce implementation plans, and has identified effective ways to involve stakeholders.

Ongoing monitoring

The EA monitors waterways for physical and chemical factors, including fish status. Low results will trigger a 'walkover' for the entire waterway. The major long term water and ecosystem monitoring relies on self-evaluation and reporting to the EU.

CHALLENGES

The directive faces serious challenges from the limited technical, logistical and financial realities that characterise many EU member countries, the vast number of water bodies, and the scale of activity to monitor and manage data, undertake works, and regulate industries. It relies heavily on supporting legislation, on industry being proactive, and on support from community groups to fund and undertake works.

The water environment faces several challenges including pollution from point sources such as sewage treatment plans, diffuse pollution sources such as agriculture and urban runoff, physical modification of water bodies, water abstraction, invasive flora and fauna, population growth, changes in land use, and climate change.

OPPORTUNITIES

The directive encourages partnerships between community groups and government organisations towards a common goal of waterway health.

It will provide increased waterway health, biodiversity and provide clean water supply security throughout the EU, securing healthy waterways for future generations.

AUSTRALIAN CONTEXT

This directive is a great example of where strong policy can achieve step-change on-ground results. The directive sets long term water quality and waterway health objectives, which are then monitored and reported. In particular, the EU's ability to impose fines for failing to meet water quality and waterway health objectives provides incentives for participation.

An example where Australia could learn from the EU experience is the use of River Basin Management Planning. This process brings together all stakeholders to plan catchment management actions that will achieve 'good' status for waterways by 2015 and beyond. This model is difficult to implement, and is often not done very well within Australia, so lessons can be learned here.

The Water Framework Directive has driven a number of community-initiated waterway improvement projects within the Thames basin region, drawing clear links between early engagement of the community in planning activities and strong community ownership in achieving outcomes. This included innovative solutions such as lobbying local business to secure commercial funding for on-ground projects.

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ABOVE L-R: Jubilee River, a project conducted as part of the EU Water Framework Directive.

BELOW: Presentation from the UK Environment Agency.

02

Green Park, UK

PROJECT

Green Park

LOCATION

Reading, UK

ORGANISATION

Prudential, Foster & Partners, Driver Jonas, PLACE Design & Planning

KEY SUCCESS ATTRIBUTES

- Attraction of successful hi-tech tenants.
- Successful redevelopment of flood-prone land.
- Proves there is a market for clean and attractive industrial and business development.

DESCRIPTION

The redevelopment of South West Reading began with the concept of a new business park and improved highway network linking the M4 to the Inner Distributor Road system.

The farmers who owned the Green Park land had begun looking at the development potential of the floodable farmland around 1984. The property crash of 1989 put the proposal on hold, however the interest of the developer and new commercial opportunities allowed proposals to begin in 1995.

A team of engineers and landscape architects worked on the master plan of approximately 180 acres of Green Park, ultimately providing 130 acres of development land raised above the 200 year flood level, 40 acres of flood storage and a balance of retained woodland and highway margins. A central water feature was designed with remodelled existing streams. Design work was carried out in consultation with the National Rivers Authority (now the EA) to achieve increased biodiversity within and around the site.

Considerable research went into the development of the site, and the evolving needs of business park users. Sports and child care facilities, dedicated bus links to Reading station, eating facilities and shopping were seen as essential support infrastructure.

DISCUSSION

The Green Park development is an excellent example of how the integration of water sensitive urban design principles into a development can provide many benefits.

The development successfully treats the flood storage areas on site as an amenity and recreation feature, used by the tenants on site, as well as residents from neighbouring areas.

Remodelled existing watercourses transport and treat stormwater throughout the development, and also increase biodiversity.

Installation of a wind turbine shows that sustainable urban developments contribute to their own power, rather than using off-site power generation.

PROJECT INFORMATION

Drivers

Business Park development was a commercial growth area with a new 'use class' in the planning system. The use Class B1 was introduced in 1987 for offices, and research and development uses which recognised emerging high-tech development sometimes connected to a university campus, as seen in Cambridge.

There was national support for high-tech developments as a use sitting between offices and industry, and for the encouragement of clean industry. This enabled development to occur when industry would not have been seen as an acceptable use.

Capital cost

By 2002 £58m was spent on infrastructure including over £24m for off-site highways and service diversions, and £3.5m on electricity reinforcement. Individual buildings had individual budgets on a plot-by-plot basis.

Funding source

The major funding came from Prudential Assurance but other contributions came from the developers of the football stadium and retail complex, the new office development at the M4 A33 junction, the local authority and other contributions came in the form of land to allow the development to proceed with profit sharing. There were eight signatories to the agreement for Green Park alone.

Delivery time frame

Initial design work was carried out from around 1984 to provide the basis for a planning application. Planning conditions and partnership agreements

were discussed between 1988 and 1992. Final planning consent was given in 1995. Main development platforms were finished by 1999 as well as the first building and the A33 relief road. Other development quickly followed.

Communication

Numerous engagements were made with schools through the park development and lectures at other events. Regular school visits are made to the wind turbine interpretation centre where a dedicated park member explains the issues of sustainability.

Ongoing monitoring

The Park biodiversity action plan is monitored and updated. A team of ten staff provide full time management of the landscape from a base on the Park.

Challenges

The development was in a floodplain, and had to retain the same volume of water on site and not displace it and cause problems downstream. In addition, building within a flood plain was difficult due to flooding during the construction phase.

A new link to the M4 motorway was constructed to gain site access, and a total upgrade of service infrastructure was required.

The creation of a new landscape setting in place of flat farmland required considerable planning and design.

The development had to mitigate the effects of existing and proposed adjoining developments, including the remodelling of a former rubbish dump, the new Reading Football Stadium and a new retail complex.

Expansion to the west of the Green Park area into Kennet Valley Park has stalled due to various obstacles in the planning process.

OPPORTUNITIES

The Green Park site's accessible location, with excellent road and rail links and airport access, meant the development was available to a high number of users. Green Park is part of the UK 'Silicon Valley' and in an area of information technology (IT) growth with other major developments at Stockley Park near Heathrow and other IT clusters such as Winnersh, Wokingham, Bracknell, Swindon and Newbury.

AUSTRALIAN CONTEXT

Development of flood-prone land in Australia is often contentious and avoided. The expense of treating stormwater on flood-prone land, using traditional 'hard engineering' infrastructure, can lead to public mistrust.

The Green Park development proves that development within flood-prone land can be successful and commercially viable.

Treating stormwater using water sensitive urban design (WSUD) features such as remodelling the stream on site, rather than hard infrastructure has improved the amenity of the surrounding area and helped attract key commercial clients to the development.

Commercial and industrial developments within Australia traditionally do not contain green space. This development proves that increased green space can attract residents and other consumers to the area; for example the restaurant located on site does 80 per cent of its trade from people living outside the park.

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ABOVE L-R: Presentation by the head designer around the scale model of the industrial estate. View from the lunch room of one Green Park business. WSUD car park within the industrial estate.

BELOW: The lake surrounding the estate with walking path network, viewing platforms and information signs.

03

Rain InfraStructure Adaptation, Germany

PROJECT

Rain InfraStructure Adaptation (RISA)

LOCATION

Hamburg, Germany

ORGANISATION

Hamburg Water, City of Hamburg

KEY SUCCESS ATTRIBUTES

- An integrated approach will lead to satisfactory solutions for stormwater management and urban planning.
- Information and knowledge exchange within planning processes and between different disciplines and the public must be effective.
- All disciplines have to work together towards agreed solutions.

DESCRIPTION

In 1845, the City of Hamburg finished construction of an 11km combined sewer and stormwater system. Hamburg was the first continental European city (after London) to have such a system and much of it is still in use today.

There are 800km of rivers in Hamburg which have been heavily affected by pollution in heavy rain and floods.

Stormwater management has been a focus in Hamburg for many years. Several projects undertaken by various lead agencies including Hamburg Water resulted in the inclusion of 'stormwater management' as a topic in the 2007 Climate Protection concept (CPC) for Hamburg.

Following inclusion in the CPC, political support helped establish the Rain InfraStructure Adaptation (RISA) project in 2009.

The four-year RISA project looks at innovative and unconventional ways to maintain current drainage levels in Hamburg to preserve internal flood protection and reduce water pollution.

DISCUSSION

The RISA project includes the development of new technical solutions and the integration of appropriate water management measures in urban and regional planning. The results from the RISA project will be incorporated in to a 'structural stormwater plan' which will guide the actions of management, water industry professionals and property owners.

Four multi- disciplinary working groups were established to address individual issues within the urban stormwater management framework:

Urban water management

Hazard analysis and flood detection.

Urban and landscape planning

Integrating water management and the planning process.

Transport planning

Using roads as drains in times of flooding.

Water planning

Developing a water balance and improving water quality.

These working groups collaborate to ensure outcomes required by project stakeholders.

PROJECT INFORMATION

Drivers

The RISA project has four key drivers:

- The requirement of the EU Water Framework Directive for all European surface water bodies to achieve a 'good status' by 2015.
- The 'Federal Water Act' in Germany which governs the regulation of matters relating to water including management of stormwater infiltration and the quality and quantity of stormwater discharge to surface water bodies.
- EU Flood Directive which requires an assessment of the risk of flooding for all water courses, mapping of extent of floods and risks and taking adequate and coordinated measures to reduce the risk.
- Climate Change: Increased intensity and frequency of rainfall events, and temperature increase (heat island effect).

Capital cost

Project budget approximately 1.75M Euro.

Funding source

The City of Hamburg and Hamburg Water.

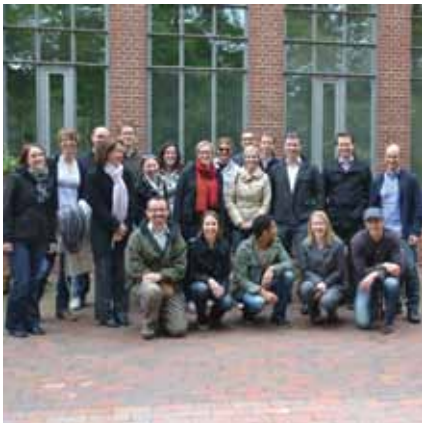
Delivery time frame

2009 - 2013.

Communication

Regular meetings are held to share information between the working groups, which comprise multiple stakeholders.

Participation at conferences and expert meetings with relevant stakeholders



are also part of communication activities. General information is available at the project website: www.risa-hamburg.de

Ongoing monitoring

The project is not yet complete.

CHALLENGES

Adaptation and improvement of legal, financial and administrative circumstances have been a challenge for this project. Some processes were difficult to use and required the 'administrative working group' to analyse problems and identify potential solutions and adaptation strategies. These solutions included financial tools, competencies and identification of responsibilities.

Coordination of identified solutions was highlighted as the most difficult part of the project.

OPPORTUNITIES

Extensive project consultation will help ensure engagement and ownership of stakeholders in stormwater management concept developments. Once finalised, the concept will be applicable across other areas of Germany as well as at international levels.

AUSTRALIAN CONTEXT

The interdisciplinary nature of this project is applicable to the Australian context. Overcoming challenges associated with various levels of government and multiple stakeholders by forming working groups is central to successful concept development and implementation.

In many parts of Australia poor quality of discharge and pollution flowing to rivers has led to dangerous algal blooms, kills fish and other aquatic species, and attracts negative public attention. Management of discharge quality is not the sole responsibility of one organisation and as such a coordinated effort is essential.

In Western Australia (WA) the Swan River Trust - the organisation responsible for health of the Swan Canning river system in WA - is finalising its River Protection Strategy (RPS). More than 700 community members, State and local government, and key non-government organisations have been consulted and directly involved during the strategy's four-year development.

The strategy provides a blueprint for managing the Swan Canning Riverpark and describes the responsibilities of more than 20 State government agencies and 21 local governments to protect the Swan and Canning rivers.

Comparison of the RISA strategy with the RPS will identify any knowledge gaps for future revisions. The RPS will be reviewed every five years.

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ABOVE L-R: Hamburg Wasser training facility. Presentation on Hamburg Wasser projects. Study tour members with Hamburg Wasser staff.

04

Sewer heat recovery, Germany

PROJECT

Sewer heat recovery

LOCATION

Hastedtstraße, Hamburg, Germany

ORGANISATION

Hamburg Wasser

KEY SUCCESS ATTRIBUTES

- Uses existing and proven technology.
- Recovers waste energy.
- Reduces the carbon footprint.
- Reduces energy cost to the customer and provides a more stable price.
- Generates political support for renewable energy projects.

DESCRIPTION

Hamburg is the second largest city in Germany, and Hamburg Wasser is the monopoly provider of water and wastewater services. In recent years, Hamburg Wasser has actively sought out opportunities to diversify its commercial activities. At the same time, the company has increased its commitment to sustainability and reducing its reliance on non-renewable energy. Sewer heat recovery is one new initiative being applied by Hamburg Wasser, to both reduce greenhouse gas impacts, and diversify commercial activity.

The Hastedtstraße project was installed to provide heating to an old apartment building containing 214 units. It was chosen, because it had an old inefficient electric heating system, and was in close proximity to a large sewage carrier. The building has a heating energy demand of 1100 MWhrs per year. The project reduced carbon emissions by 75% from the pre-existing system.

Recovering heat energy from sewers is achieved using a heat exchanger. The approach used by HAMBURG WASSER, involves the retrofit of a new section of sewer pipe, as pictured in Figure 2. Water is pumped through the heat exchanger to capture heat. The temperature adjusted water is then passed through a heat pump, where the energy is harvested via a typical condenser process (see heat pump description for a basic explanation of heat pump function). An important requirement to applying this technology is ensuring minimum distance (no more than 100-150m) between the source sewer and the end use.

DISCUSSION

This project demonstrated that energy recovery from sewage is viable, and represents an exciting new opportunity for water utilities. It applies existing and proven technology to a new application. The initiative is limited by the degree to which suitable demand aligns with suitable source sewers. The collaboration required between utilities, regulatory agencies, local government and customers, also present a challenge to water utilities in implementing sewer heat recovery.

The contractual arrangements for the Hamburg Wasser project were a key challenge due to the parties involved. In this case, Hamburg Wasser sells the captured heat energy to the building owner/manager. The details of this arrangement were not provided to the study group.

PROJECT INFORMATION

Drivers

- Cost savings for heating.
- Reduced carbon emissions.

Capital cost

€700,000 total system cost, including sewer work, heat exchanger and gas heat pump.

Operational cost

The system produces energy at a lower cost than the pre-existing system so is cost positive on operations.

Funding source

Hamburg Wasser, with support from the Hamburg Ministry of Environment (BSU) and sponsorship from the regional gas supplier (E.ON).

Delivery time frame

The project was delivered in 2009 and has been operating successfully since.

Communication

Residents were engaged from the early planning stages.

Ongoing monitoring

The system has performed well to date and met all financial and technical objectives. Further opportunities are being sought.

CHALLENGES

A medium to large sewer (900mm or larger) with constant flow (12 litres/second or more) is required within close proximity (<150m) to the heating/cooling demand. Renewable/clean energy grants or rebates would offset capital cost but are not critical.

OPPORTUNITIES

This system could be successfully applied to high density residential and commercial buildings located near large sewer mains, with heating and cooling systems that require upgrades. There is also the potential to install this system to existing large sewer carriers that need to be replaced or refurbished.

AUSTRALIAN CONTEXT

Electricity prices in Australia have increased significantly in recent years and are forecast to continue this trend into the future (doubling in the next 10 years). Australian water utilities are amongst the top energy consumers in the country with Melbourne Water, Water Corporation, Sydney Water and SA Water all ranking in the top 50. Most electricity consumption by water utilities is associated with water pumping and wastewater treatment. In saying this, all water utilities have both heating requirements (anaerobic digestion, facility heating in winter) and cooling requirements (facility/building cooling in summer). In most capital cities, there would be numerous opportunities to provide heating and cooling to high density residential and commercial buildings.

Sewer heat recovery is an innovation with strong potential for Australian water utilities. It is based on simple and existing technology, and addresses the real issues of energy cost and greenhouse gas emissions. Applications will be somewhat limited to new developments, or buildings requiring new heating/cooling systems. Viability will only improve as energy costs increase, so it makes sense for utilities to gain experience now to be positioned and ready to take up opportunities as they arise.

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ABOVE L-R: Presentation from Kim Augustin, Hamburg Wasser, on the Sewer Heat recovery system. Photo from a community information session on the project (supplied by Hamburg Wasser).

05

Jenfelder Au, Germany

PROJECT

Jenfelder Au

LOCATION

Hamburg, Germany

ORGANISATION

Hamburg Water

KEY SUCCESS ATTRIBUTES

- Precinct-scale IWCM.
- Connecting the energy water nexus.
- Resource recovery – phosphorus and nitrogen.
- Low energy precinct.
- Livability and urban renewal.

DESCRIPTION

Jenfelder Au is brownfield redevelopment of a former military barracks in the north east of Hamburg. The development site is 30ha and will accommodate 770 dwellings when complete. Civil works began in late 2012. Key project aspects of are precinct-scale water and energy servicing strategies. The principles behind the integrated water cycle strategy are defined in the Hamburg Water Cycle © and the project includes vacuum sewer, precinct wastewater treatment, wastewater biogas cogeneration, greywater treatment and re-use, renewable energy sources and wetland systems.

DISCUSSION

Hamburg Water is a leader in IWCM in Germany, exhibiting a high level of innovation and a willingness to move beyond traditional water management boundaries.

The Hamburg Water Cycle concept delivers sustainable, integrated water infrastructure to the Jenfelder Au project. The concept will result in significant reductions in potable water use (35 – 70 per cent), fit-for-purpose technologies, close to CO2 neutrality and deliver water as an integrated component within the urban form. The landscape design has a central focus of reinvigorating an old neighbourhood through the new Jenfelder Au hub.

The use of a vacuum sewer system delivers the blackwater waste stream to bioreactors in concentrations appropriate for anaerobic digestion. This results in significant potable water reductions (80 per cent less per flush) and improves biogas production for the electricity cogeneration plant. Phosphorus and nitrogen capture are proposed as a component of the Jenfelder Au concept, however the inclusion of this technology is still at a concept level and would form a further stage of the project. Nutrient capture would improve the environmental outcomes for receiving waters and also address the nutrient recycling and long term food security objectives inherent in the Hamburg Water Cycle concept.

Greywater will be managed as a separate resource stream and will be treated and either used as a fit-for-purpose third pipe water source or returned to the local natural water cycle.

Stormwater will be treated in a wetland system and will supply water features throughout the development, forming an important aesthetic component for improved livability outcomes within the precinct.

PROJECT INFORMATION

Drivers

Adaptation to climate change, recognising the nexus between water, food, energy, and organic waste, closing the loop for water, energy and material flows, the development of synergies between infrastructure sectors, new technology implementation, and new business models for water utilities.

Funding source

Hamburg Water, the City of Hamburg and co-funding by the European Union LIFE program. A research project studying the Hamburg Water Cycle in Jenfelder Au is funded by the Federal Ministry of Education and Research.

Delivery time frame

Civil works 2012-2014.

Communication

Throughout the project design and planning phases community consultation has been a fundamental component. The project has involved a competition design process for urban planning and is a 'marquee' demonstration project for Hamburg Water Cycle.

Ongoing monitoring

Maintenance of the integrated water components will primarily be the responsibility of Hamburg Water and the City of Hamburg.

CHALLENGES

The project has faced a number of specific challenges during planning and design:

- Multi-stakeholder, multi-agency effort.
- Increased costs due to infrastructure requirements associated with the lake system (as opposed to the more common distributed infiltration systems).
- High level of restrictions regarding the discharge of treated greywater into a nearby creek by the regulating authority.

OPPORTUNITIES

First large scale demonstration of the Hamburg Water Cycle

- Excellent sustainability outcomes linking the water cycle with energy and resource recovery.
- Excellent 'livability' outcomes - a green water precinct.
- Integrates a 'whole of water cycle' approach.
- Accessing resources from multiple stakeholders.
- Demonstrates alternative water servicing strategies to drive and market a new business innovation area for Hamburg Water.

AUSTRALIAN CONTEXT

Integrated water cycle strategies which deal with the water cycle at this level of detail and within a single project are rare in Australia. Such projects often do not go beyond the concept stage. From an international context this project demonstrates what is possible.

The successful integration of energy and water provides a useful example for necessary reforms needed to realise similar opportunities in Australia. Currently innovation in crossover technologies which integrate energy and water are usually undertaken by water authorities in Australia as a means to improve their own efficiencies or to provide sources of alternative energy. The model adopted for Jenfelder Au supplies thermal and electrical energy to residential allotments, and demonstrates a much more sophisticated interaction between water and energy service provision than is currently undertaken in Australia.

The stormwater management components within the project contain the least innovation, aside from design aesthetic and livability aspects. This is due to the fact that stormwater essentially provides a landscape design service. However, the extent of the urban water features means the volume of runoff leaving the site is significantly reduced and improved water quality and quantity benefits flow to the downstream environments.

The project is exceptional in other areas of the water cycle. The major points of interest are the management of greywater and blackwater. Source separation of the greywater and blackwater allows for the development of two resource streams with an appropriate level of treatment according to stream, and achieves a concentrated blackwater for the bioreactor. Resource recovery and cogeneration are also key project aspects. These are all highly innovative technologies which could be used in Australia at a range of scales.

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ABOVE L-R: Presentation on the Jenfelder Au development and Hamburg Wasser's unique approach to the planning of the water infrastructure given by Kim Augustin.

06

Trabrennbahn Farmsen, Germany

PROJECT

Trabrennbahn Farmsen – Urban Development

LOCATION

Hamburg, Germany

ORGANISATIONS

City of Hamburg, Developer: Max Herz with GATOR Beteiligungsgesellschaft mbH

KEY SUCCESS ATTRIBUTES

- An ecologically sensitive and family friendly development.
- Creation of multifunctional urban spaces.
- Collaboration between major stakeholders.
- Strong community engagement.
- Innovation to overcome on-site challenges.

DESCRIPTION

Trabrennbahn Farmsen is residential development located in the City of Hamburg, approximately 10 km north east of the city centre. Formerly a harness race track, the Trabrennbahn Farmsen residential development was planned and constructed between 1993 and 2000. It is a high quality living environment that integrates open recreation areas, with an ecologically sensitive open drainage system.

Business man, investor and site owner Max Herz was instrumental in creating the overall vision for a high quality housing district. It features an open stormwater management system that recreates the natural water cycle, provides flood flow attenuation, improves water quality and does away with the need for underground pipe drainage.

Concepts for the development were submitted in 1992 by way of a competition. The winning concept was for a high density low rise development with an open stormwater management system and a built form that captured the essence of the sites historical use as a race track.

Trabrennbahn Farmsen residential development is a car-free zone. Residents park their cars in a multi-storey car park located outside the development thereby creating a safer, more relaxing and family friendly environment for residents to enjoy.

DISCUSSION

The following features make Trabrennbahn Farmsen a successful, innovative and sustainable development:

- Green open spaces that promote an outdoor lifestyle for residents.
- Open stormwater management system.
- High quality housing.
- A multifunctional landscape that improves stormwater quality, reinstates a more natural water cycle and provides flood attenuation, while also providing habitat value for wildlife and providing an area for recreational activity.
- Using an open stormwater system in a residential area while achieving a high standard of safety.
- Overcoming low on-site soil permeability to provide flow attenuation for flood events.
- Maintenance of existing high ecological values.
- No cars allowed within the development.
- An on-site gas power plant that supplies power and heating for the development and surrounding district.

PROJECT INFORMATION

Drivers

The Trabrennbahn Farmsen residential development was primarily driven by investor and site owner Max Herz. The concept was supported and developed by the City of Hamburg and water and landscape design firm KFP, conceptual landscape architecture firm L+O Dresel-Gur-Herbst and urban design and architecture firm NPS & Partner, and PPL Planungsbüro Professor Laage.

Capital cost

Unknown, however it was noted the project was costly relative to a more typical residential development.

Funding source

Private (Max Herz), subsidies.

Delivery time frame

Planning: 1993-1995
Construction: 1995 - 1997 (phaze 1); 1997 - 2000 (phase 2).

Communication

Key project stakeholders, including the City of Hamburg, were involved throughout the conception and development stages of the project. The project features an education program that informs residents of the benefits and safety considerations of living around water.

Ongoing monitoring

GATOR Beteiligungsgesellschaft mbH undertakes ongoing water quality monitoring and maintenance at the site.

CHALLENGES

A number of challenges were overcome to achieve the key objectives of the development.

The soil at the site was found to be highly impermeable and therefore traditional infiltration methods to attenuate stormwater peak flows were unviable. The solution was to convey stormwater in a system of grassed swales and open channels into two centrally located detention ponds. The detention ponds retain water during dry periods, for aesthetic purposes and to provide wildlife habitat, while acting as flood storage during high flow events.

The safety of residents within the development was a key consideration that informed the design of the open water system. Low grade banks, to reduce edge water depth, and stepping stones were incorporated into the design to reduce the drowning risk. Residents were also educated on the safety aspects of living around waterways. German public safety policy requires handrails to surround water bodies with a depth in excess of 300 mm. It was noted that even with the education program and safety in design features, this project would not have been viable on public land, due to the additional safety infrastructure requirements.

Educating residents on the benefits of living around water, and the value of improving surrounding and downstream ecosystems, may contribute to a shift in cultural thinking towards a water sensitive future amongst the broader population.

Maintenance and monitoring are undertaken by a locally based contractor, which means residents can provide immediate feedback on the system's operation and have any problems dealt with swiftly.

AUSTRALIAN CONTEXT

Some of the key drivers behind the success of the Trabrennbahn Farmsen development are applicable to residential developments, and many other infrastructure projects, within Australia. Collaboration between stakeholders throughout the course of the project, the use of innovative design practices to overcome site challenges, community engagement and education, and the creation of multifunctional assets have all played a role in the success of this project and could be applied in the Australian context.

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ABOVE AND BELOW: Images capturing the interface between the residential housing, walking paths, green open space and water features.

07

Amersfoort Eco-Centre, Netherlands

PROJECT

Amersfoort Eco-Centre Development

LOCATION

Amersfoort, Netherlands

ORGANISATION

Amersfoort City Council, West8, Vathorst Development Company

KEY SUCCESS ATTRIBUTES

- Housing for everybody – mix of cheap and expensive housing close together.
- Successful from both an environmental and commercial perspective.
- Reduction of energy use.

DESCRIPTION

The town of Amersfoort (population 135,000), near Utrecht, has developed three new settlements - Vathorst, Kattenbroek and Nieuwland - on its outskirts to provide over 20,000 new homes.

In 1990-1991 the Dutch Government issued the VINEX spatial planning report, which proposed the building of 455,000 new houses between 1996 and 2005. The 285,000 houses to be built around cities in suburbs would be required to be:

- Compact - in order to preserve the countryside.
- Close to existing cities to keep car travel to a minimum.
- Developed around existing or new public transport.
- Close to shops and employment opportunities.

Amersfoort municipality developed the three new settlements to exceed the Government's standards wherever possible; as a result Amersfoort is now regarded as one of the 'greenest' cities in Europe.

DISCUSSION

The Vathorst development at Amersfoort can be regarded as a successful and innovative development as the result of a number of factors.

The community was invited to participate in the planning stage of the development, resulting in the community having an ownership of the scheme. A modular type housing was used that can be expanded as the needs of the residents change. Sustainable building practices took into account the full life cycle of construction, from the materials used to re-use of waste materials, and passive and active energy reduction techniques. Social and expensive housing were placed in close proximity to create a cohesive community, and due to the large amount of open space, the high density nature of development does not feel cramped.

Collaboration between city planners and developers created an excellent opportunity to create a fully integrated development, taking into account social, community and environmental aspects for the city, while delivering profits for the developers.

PROJECT INFORMATION

Drivers

Creating a point of differentiation for the development to attract residents to the area was a critical driver for developing an eco-city at Amersfoort.

Funding source

The City of Amersfoort provided 50 per cent of and funding, the remainder was provided by private investors/ developers.

Delivery time frame

The three new suburbs have been developed since 2001 and are scheduled for completion in 2014.

Communication

A collaborative approach towards planning and design involved approaching the community to ask for ideas about what they wanted from the development. Engagement with the community continued throughout the project.

Ongoing monitoring

The City of Amersfoort is responsible for the ongoing maintenance of public areas. The developers will continue to monitor property sales and make adjustments to the development to meet sales targets.

CHALLENGES

There were various minor challenges throughout the development, such as architects putting solar panels on the south side of buildings rather than the north and residents not taking care of the public spaces out the front of their properties.

The community attitude towards the sustainability features of the houses was mixed, as several residents open their windows in the mornings, letting in cool air which then required further energy use to heat the property.

There were declining growth rates, 1000 lots per year were desired to be sold, however they were currently selling 300 per year.

OPPORTUNITIES

The collaborative arrangement between the council and developers created an excellent opportunity to create an integrated development.

Due to the declining growth rates the council and developers were able to work together to come to a solution to provide more of the types of residences that people desired, without altering the aesthetic of the development.

AUSTRALIAN CONTEXT

Traditionally in Australia, high density, low rise development has been restricted to townhouse style 'gated communities' with a body corporate being in control of the small amount of open space located within these communities. This has commonly resulted in open spaces being hardstand areas such as a pool and paved surrounds, with very little green space.

The Vathorst development favours a mix of multi-storey apartments and a variety of high density townhouse style units, with a large amount of green and communal open space, all managed by the city. This gives the high density development a much more pleasant aesthetic for the local community, and also does not close off the open space to members of the community that do not necessarily live in the area. While this type of development could potentially be successful in Australia, it would take a shift in attitude from developers, local governments and residents to be successful.

The sustainable building techniques used throughout the development could be directly applied to Australian construction, and many of the materials and techniques used here already are common within the Australian development landscape.

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ABOVE L-R: The grid layout of the development makes it easy to navigate by foot and bike. Housing form displaying balconies over garages. Townhouses with productive backyards.

BELOW T-B: Copper facade offers a point of interest. The model layout of the development displaying how the forward planning and integration of the various elements.

08

DEUS 21, Germany

PROJECT

DEUS 21

LOCATION

Knittlingen, Germany

ORGANISATION

Fraunhofer IGB (Institute for Interfacial Engineering and Biotechnology)

KEY SUCCESS ATTRIBUTES

- Applied research project.
- Proves emerging technology at a compact scale.
- Funded by the Federal Ministry of Education and Research (BMBF).
- Collaboration with local municipality.

DESCRIPTION

DEUS 21 (decentralised urban infrastructure systems) is an applied research project designed to test a new approach to integrated water management. The project serves a new development of approximately 100 detached residential dwellings and combines a variety of new and emerging technologies.

Project components include:

- Vacuum sewer network connected directly to fixtures where possible.
- Anaerobic membrane bioreactor plant to treat wastewater and produce biogas.
- Ceramic rotating disc membranes for filtration of wastewater and rainwater.
- Rainwater collection, storage, treatment and distribution for toilets, gardens, washing machines, dishwashers and showers.
- Struvite or magnesium-ammonium-phosphorous (MAP) precipitation.
- Zeolite columns and ammonia stripping for recovery of nitrogen.
- Biogas combustion for heating of digester tank.

The project aims to test innovative approaches to minimise resource use and maximise resource recovery.

DISCUSSION

The DEUS 21 project demonstrates the importance of applying research to achieve innovation. The project pushed the boundaries of water management by combining variety of new or emerging technologies at a very small scale and integrating facilities in close proximity to residential dwellings. The system does not operate exactly as originally planned; however the project as a whole has provided valuable lessons.

The scale was proven not economic for this level of technology; to succeed financially more than 5000 lots would be required.

Anaerobic membrane bioreactor (MBR) technology was proven as a viable process to maximise energy recovery from wastewater, and an optimal process configuration was identified.

While there were challenges connecting vacuum systems into houses, the project demonstrated that wastewater facilities can be successfully integrated into residential communities. Pesticide leaching from cladding materials into rainwater was discovered and has triggered new research.

The compromises made in this project were possible in part because it is within an existing development backed up by conventional systems and additionally, because it was supported by research funding.

PROJECT INFORMATION

Drivers

Fraunhofer IGB was seeking new and innovative water management solutions in cooperation with the Fraunhofer Institute of Systems and Innovation Research (ISI). The driver was to prove new technologies and systems that reduce water use and maximise the recovery of energy and nutrients from wastewater.

Cost

The project capital cost was €2 million for the water house, including all associated research costs. The sewer network and development related infrastructure costs were met by the developer (in this case the city). The vacuum network was equivalent cost to a gravity system.
A premium of about €2000 per house was required to connect directly to the vacuum system. This comprised vacuum toilet and plumbing costs.

Funding source

Funding was provided by the Federal Ministry for Education and Research and industry project partners.

Delivery time frame

Fraunhofer IGB managed the treatment plant project while ISI did parallel economic and ecological analysis and stakeholder communication. The city and its consultants and contractors carried out the development and associated civil works (including construction of the vacuum network).

Communication

Community questionnaires provided opportunity for community input, and the water house has educational information about the process for residents and visitors to view.

Ongoing monitoring

Fraunhofer IGB is using the DEUS 21 project for ongoing research and monitoring activates, focussing on ceramic membrane performance, anaerobic reactor performance, and pesticide origin and removal for rainwater and water efficiency.

ABOVE L-R: Discussing the project with lead engineer (Marius Mohr). Biogas combustion system. Ceramic membrane units.

BELOW: Arriving at the DEUS21 water house.

CHALLENGES

Unexpected high levels of pesticides in the rainwater (discovered to be from cladding) meant that the rainwater is not used and is instead backed up by the town water supply. The treatment system was not designed to cope with the measured levels of pesticide and it is considered uneconomic to upgrade the system.

There was no mandate for residents to connect with vacuum toilet or kitchen waste disposal unit. This resulted in higher than anticipated water use and wastewater characteristics that are not optimal for anaerobic treatment (more dilute). There was only 20 per cent uptake on vacuum toilet and 25 per cent on kitchen waste. This was partly due to additional cost and partly due to the choice of prefabricated homes which were incompatible with vacuum system plumbing.

Water quality standards for the rainwater collection system are quite high because internal uses including showers and dish washing are connected. As a result, rainwater must meet drinking water standards. If only toilets and gardens were connected the supply would receive greater use. Rainwater is supplied free of charge to encourage use.

Procuring process units at a small enough size to fit the treatment plant footprint was difficult. The scale of the project was found to be too small to be viable – economic viability is estimated in the range of 5,000 up to 20,000 properties.

OPPORTUNITIES

There are opportunities to explore new technology at the treatment plant, and the plant can be modified and brought online and offline whenever required.

The Anaerobic MBR plant has proven the system can work and can be expanded and used in future developments at a larger scale. It represents a step forward in energy recovery from wastewater.

AUSTRALIAN CONTEXT

Most Australian cities face significant growth in existing urban areas and in new greenfield areas. It is neither acceptable nor possible to build water and wastewater infrastructure to ultimate capacity, as has been the approach in the past. Greater financial constraints, more uncertain growth trends and more constrained and expensive resources require a servicing approach where investment is matched closer to revenue and resource recovery is maximised.

While the DEUS 21 project is applied research at a less than economic scale, it has proven to be technically viable. It represents an attractive option to be considered for servicing greenfield development in Australia. The technology is compact, scalable, minimises water use and maximises energy recovery.

Some challenges to applying this approach in Australia may include:

- Complexity of process design and operation.
- Limitations of vacuum sewer network and connecting directly to fixtures.
- Complexity of nutrient removal/ recovery processes.
- Community resistance to local sewage treatment plants.

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OPPOSITE PAGE: Image by Tim Buykx - Discussing the DEUS21 project in front of the wastewater treatment building which is integrated within the development and located only 50m from the nearest house.

09

Hohlgrabenäcker, Germany

PROJECT

Hohlgrabenäcker

LOCATION

Stuttgart, Germany

ORGANISATION

Diem.baker GbR and DDV (Green Roof Association of Germany)

KEY SUCCESS ATTRIBUTES

- An integrated approach to the management of stormwater quality and quantity.
- Biodiversity and environmental protection.
- Urban heat island benefits.
- Reduction in energy use.
- Policy, community and developer alignment.

DESCRIPTION

Hohlgrabenäcker is a new 270 dwelling, 15ha precinct located on the northern outskirts of Stuttgart. It provides an excellent example of integrated stormwater management solutions. Primarily focussing on flow attenuation, the development also achieves a range of broader sustainability outcomes, and demonstrates what is possible when enabling policies drive a 'best fit' approach. The development includes features such as mandated green roofs, mandatory on-site detention and retention, and 'pervious' pavement within roads and footpaths.

DISCUSSION

The state of Baden Württenberg, Water Act 2005, requires developments to deliver on-site stormwater infiltration, or the implementation of a separate drainage network (transitioning from the combined sewer which predominates in many areas). The Water Act flows through to local planning controls, where the City of Stuttgart carries the delegated responsibility for the regulation and management of stormwater.

The City of Stuttgart has a range of policies which regulate, or incentivise the integration of solutions, such as green roofs and pervious pavement as was illustrated at Hohlgrabenäcker, where they were mandated for their stormwater attenuation benefits. Refinements to green roof specifications, maximised stormwater outcomes, where substrate depth (and therefore storage capacity) was increased from the standard 80mm to 120mm. For single or semi-detached houses, combined on-site detention/ retention systems served as an alternative to manage flow volumes and provide an alternative water source at the lot scale. Pervious pavement was also included within the streetscape (footpath and road way) throughout the development where possible.

The City of Stuttgart levies a stormwater charge which is based on estimated effective imperviousness.

The implementation of a strategy which reduces runoff volumes through source treatments can reduce this charge. This opportunity will result in benefits to the landholders within Hohlgrabenäcker into the future.

To meet Federal biodiversity protection requirements, the developers rehabilitated a channelised section of creek adjacent to the development. This is known as 'ecological compensation'.

The final water servicing strategy was the most cost effective approach and was significantly cheaper than business as usual. Not having to upgrade the receiving sewer and drainage network, maximised lot yield through attenuation in street and on rooftops (avoiding a retarding basin) and the ability to use green roofs as ecological compensation offsets, have all played a role in ensuring the project's viability.

PROJECT INFORMATION

Drivers

A major factor driving the outcome of the development has been state and local stormwater regulation and aligned policy. The possibility of an upgrade to the receiving sewer and drainage network or delivering a 0.3 runoff coefficient (70% retention of stormwater) was critical to the outcome. Sub-drivers included community expectations, ecological compensation – offsets through green roofs, and reductions to annual stormwater charges.

Funding source

Developer.

Delivery time frame

Design 2004 – 2006; civil works 2006 – 2009; lot development 2009 – present.

Communication

A collaborative approach was taken towards planning and design for the development. This was undertaken according to statutory requirements, as part of the master planning process, and there was a strong consensus to undertake a water sensitive approach. Ongoing communication and engagement is necessary as new residents take on responsibility for the on-lot infrastructure

Ongoing monitoring

The City of Stuttgart is responsible for the ongoing maintenance of public areas, and private owners maintain their assets.

TOP L-R: Overlooking the development with the green roofs, solar hot water and PV panels. Mixture of facades and set-backs.

MIDDLE L-R: Construction of the permeable roadway with services underneath. Permeable resident parking.

BOTTOM: Close up of green roofs with solar hot water panels and air-conditioning services on top.

CHALLENGES

The development faced a number of challenges including:

- Illegal property connections – roof water to sewer.
- Permeable pavement (in street) needing reinstatement after housing construction (a bond was held for this).
- Maintenance of green roofs and rainwater detention/retention tanks relies on resident participation and understanding.

OPPORTUNITIES

- Avoided augmentation of the downstream pipe network assisted with alter native business case.
- Successful implementation of green roofs, open drainage system and pervious pavement has shown 70% stormwater attenuation.
- Naturalisation of adjacent creek was included as an ecological compensation for the development.

An IWCM approach realised multiple benefits including reduced energy demand (insulating properties of green roofs), habitat establishment (green roofs), and reduced potable consumption (rainwater harvesting).

TOP L-R: Overlooking the development. Playground within the development.

MIDDLE: Permeable paver blocks used as part of the stormwater retention strategy.

BOTTOM AND RIGHT: Green roof throughout the development to off-set biodiversity loss and retain stormwater runoff.

OPPOSITE PAGE: Image by Tim Buykx - Restoration of the previously channalised stream as part of the development (ecological compensation). Note that the stream is not directly connected to the development.

AUSTRALIAN CONTEXT

There are a number of aspects to this development which can provide insight into how things can be done differently in Australia. Local and state planning frameworks were essential to enabling the suite of solutions delivered in this development. Conversely, the ability to mandate green roofs has not yet been achieved in Australia. This is a critical area where Australia could learn a lot from the German experience.

Incentives, such as reductions in a stormwater charge, reduce the ongoing costs and improve the business case. There are examples of stormwater levies in Australia however, they are not often used to incentivise on-lot water management (through a differential charge), and are generally viewed as a revenue earner for councils. On-site detention has been used widely in Australia, but there has generally been a one-dimensional approach taken. Rainwater tanks, green roofs and other 'alternative' mechanisms have not been a significant feature. There is opportunity to include these technologies into planning policy through a performance based approach.

The use of pervious pavement is also much more widespread in Stuttgart than Australia, and serves as a strong indicator that we could be doing more. Concerns about structural loading and maintenance have traditionally driven the Australian agenda. The Stuttgart examples, demonstrate that structurally robust and cost effective options are possible.

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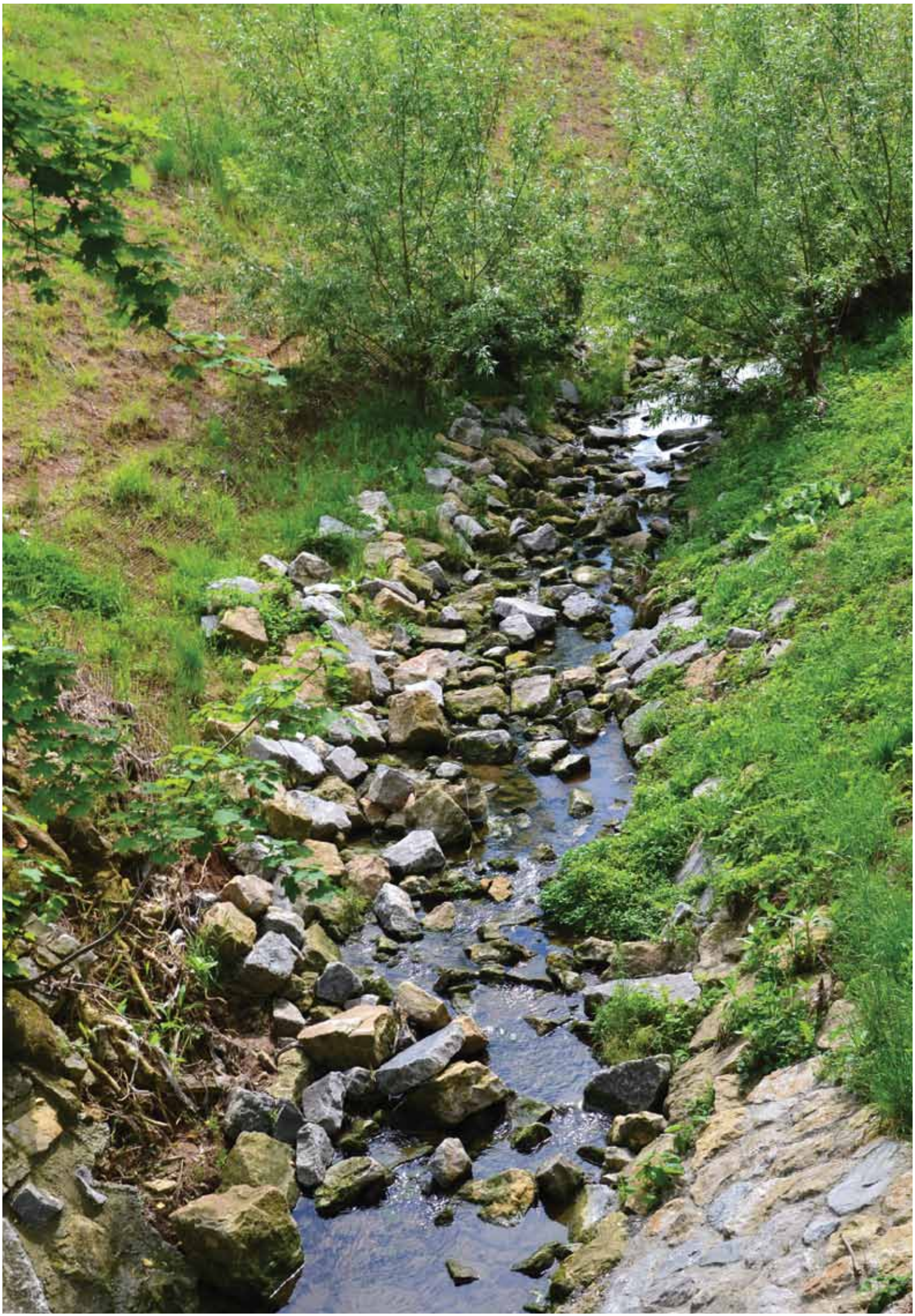

10

ABC Waters Program, Singapore

PROJECT

Active Beautiful Clean (ABC) Waters Program

LOCATION

Singapore

ORGANISATION

Public Utilities Board (PUB)

KEY SUCCESS ATTRIBUTES

- Projects delivering multiple benefits.
- Community involvement.
- Long term political support.

DESCRIPTION

Singapore is a highly urbanised island country, with limited water supply catchments.

Historically, many of Singapore's rivers, drains and canals have been lined with concrete to reduce erosion of river banks caused by high water flows, and to quickly convey stormwater to discharge points. However this has increased downstream impacts, such as high peak flows and pollution, and provides no habitat or ecosystem for flora and fauna.

The ABC Waters program is a strategic initiative launched by Singapore's PUB in 2006. The program aims to improve water quality to minimum standards set out in ABC guidelines and engineering procedures, and harness the full potential of water bodies by integrating them into Singapore's environment and lifestyle. It provides a holistic approach to catchment scale water management by integrating drains, canals, rivers and reservoirs into the surrounding environment to create clean, vibrant waterways and spaces. The intention is to bring people closer to water so that they can better appreciate it as a precious resource.

Active

- Provide new community space
- Bring people closer to waters
- Develop a sense of ownership of Singapore's waters, through public education

Beautiful

- Integrating reservoirs and waterways with the urban landscape
- Creating aesthetically pleasing lifestyle attractions

Clean

- Improving water quality

The project has a long term focus, and aims to implement more than 100 projects over 10 to 15 years.

DISCUSSION

The ABC program demonstrates what can be achieved with long term political support. The program was launched in 2006 and is expected to last 10 to 15 years. There are currently 18 successful ABC Waters projects around Singapore.

A number of ambitious goals have been set, including ending Singapore's reliance on imported water from Malaysia. This has required a significant increase in water recycling and stormwater capture and treatment. The use of recycled water for drinking shows that community acceptance of drinking treated sewage can be achieved.

Two-thirds of the country now forms part of the water supply catchment, including urbanised areas, and the city now forms its own water supply catchment. Water reservoirs have been created in the middle of the city, with water-based activities encouraged. Design guidelines were prepared by PUB to create a common vision of sustainable water management with the three 'Ps' – People, Public and Private. On-site signage forms of part of all projects, and project information is incorporated into school curriculum.

PROJECT INFORMATION

Drivers

Identified need for a self-sufficient and sustainable water supply. One water supply agreement with Malaysia expired in 2011, and the final agreement expires in 2061.

Funding source

The program is funded by the Singapore Government.

Delivery time frame

The program commenced in 2006, with over 100 programs expected to be completed over 10 to 15 years.

Communication

Community consultation is undertaken on each project. Once complete, community events and festivals are organised near the water. A technical

design manual is prepared for consultants and developers, and project information signs are erected at each site. Schools are encouraged to incorporate local projects into the curriculum to educate the next generation about water management, stormwater pollution, biodiversity and environmental issues.

ABC WATERS PROJECT EXAMPLE: LORONG HALUS WETLAND

The Lorong Halus landfill site was located adjacent to the proposed Serangoon water reservoir site. As part of the ABC Waters program an artificial wetland was constructed to treat the leachate from the landfill site, and protect water quality in the adjacent reservoir.

A 6.4km long and 18m deep underground bentonite wall was constructed along the river bank to stop groundwater from the landfill site flowing into the reservoir. Water is pumped out from wells located along this wall and then treated through aeration ponds and then the wetland system. The use of the wetland system provides a natural treatment system that encourages local wildlife back into the area.

The site has been designed with a series of pathways for the local community to explore, with a number of educational diagrams displayed to explain the function of the wetlands and the adjacent water reservoir.

This project is an example of how a single project can effectively meet multiple objectives – improving water quality, public amenity, education and biodiversity.

AUSTRALIAN CONTEXT

Many Australian cities face similar challenges to those addressed by Singapore's is ABC Waters program. Water supply shortages and storm water quality issues are common and the value of integrating water into the public landscape is increasingly understood.

The ABC Waters program shows there are a number of ways these goals can be achieved, with many projects achieving multiple benefits.

The use of the city as a water catchment, increased use of recycled water and naturalising drainage canals are all directly applicable to Australia. The way in which PUB has been able to implement these projects and achieve the additional benefit of bringing people closer to the water is a valuable lesson for the Australian water industry.

Challenges which may be faced in applying this approach in Australia include:

- Resistance to the use of recycled water (stormwater or sewage) for drinking.
- Reluctance to accept risk of bringing people closer to water.
- Lack of long term political support.
- The number of different stakeholders involved in the Australian context.

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ABOVE LEFT AND MIDDLE: Project examples forming part of the ABC Waters program include, Bishan Park and the Lorong Halus wetland.

ABOVE RIGHT AND BELOW: Interpretive signs are a feature throughout the ABC Waters Project helping to inform residents and visitors.

11

Bishan Park, Singapore

PROJECT

Bishan Park (Kallang River)

LOCATION

Singapore

ORGANISATION

Public Utilities Board (PUB) and National Parks Board (NParks)

KEY SUCCESS ATTRIBUTES

- Strong political commitment to water security and increased public amenity.
- Strong funding arrangements through PUB and NParks.
- Riparian land availability and collaborative arrangements between PUB and NPA.

DESCRIPTION

The Bishan Park project involved restoring a 3km length of the Kallang River from a concrete stormwater channel back to a natural, vegetated and meandering river bed. The river bed is constructed with rock, some recycled concrete and alluvial gravel from the site. Stormwater from neighbouring catchments flows into the river via naturalised channels along its length. Flood plain areas are constructed in the riparian zone to allow expansion during storm events. The non-flood zone riparian areas are rehabilitated as parkland with a variety of amenities such as picnic areas, dog parks and walking paths.

DISCUSSION

Singapore is unique in many ways. It is a geographically tiny nation with one of the highest population densities in the world. As a result, land use is very constrained. The Singapore Government is relatively wealthy due to the nation's strategic position for shipping, trade and commerce within South East Asia. The nation relies on Malaysia for over 50 per cent of its water supply.

The combination of these factors has resulted in the Government placing a major priority on achieving water security and on maximising green space and public amenity throughout the highly urbanised island. The Government has developed a vision to "transform into a city of gardens and water" (PUB).

The Kallang River restoration was possible in the first instance because there was riparian land available in Bishan Park. This is often not the case for stormwater canals elsewhere in Singapore and other big cities internationally. While the project required the NParks to forfeit land to be used as flood plain area, the land available to NParks actually increased and was enhanced by opening up access to the whole river basin. It was a win-win for the two key stakeholders.

The substantial cost of the project was justified against PUB's 'ABC Waters' program and the NParks' 'City in a Garden' program, of which both enjoy strong political and financial support. The relative cost is also made more attractive due to the very high populations adjacent to the project who receive immediate amenity benefits.

PROJECT INFORMATION

Drivers

The project was driven in part by a need to improve runoff water quality flowing into the reservoir. It was equally driven by the vision for a "city of gardens and water" which aims to provide amenity to high density communities and helping reconnect people with the natural environment.

The "ABC" Waters program (see case study 10, page 60) is the key policy instrument behind the project.

Funding source

It was jointly funded by the PUB and National Parks Authority (all Government funds).

Delivery time frame

Bishan Park restoration was delivered over two years from late 2009 until late 2011. Atelier Dreiseitl (Asia) provided landscape architecture expertise and CH2M Hill were the primary engineering consultant.

Communication

The project is purposely designed to be open and accessible to the public with lots of story board information provided along the river, describing its functions. The project is also being used regularly by school groups. It demonstrates how water moves through a catchment and shows the link between water in the environment and water as a resource that we use.

The Bishan Park project is part of the PUB's ABC Waters program, which protects and enhances catchments for water supply and public amenity. The project is communicates the broader ABC Waters program.

TOP L-R: Tour members using the dry weather stream crossing. Green roof within the park amenities. Sculpture positioned on recycled concrete from the channel.

RIGHT T-B: Flood level marker. Safety instructions. The rehabilitated creek line and adjacent high rise.

Ongoing monitoring

NParks have operation and maintenance responsibility for the park and river. PUB is conducting water quality monitoring at points along the river.

Challenges

Bishan Park was the first project of its type in Singapore so the design was untested. Public safety during flooding was a design challenge. It has been mitigated using flood level markers, level sensors linked to audible alarms and flashing lights and life rings situated along the river course.

Noise and lights (flood warning lights and alarms) have nuisance potential for adjacent residents during the night. This is currently being addressed through community engagement. One resident complained that the project gave a "third world" appearance due to the natural un-manicured look of the river.

The project is young so while there were no apparent implementation issues, there is likely to be in the future. Community behaviour and use of the area may bring issues and require management, particularly with regard to flood safety.

OPPORTUNITIES

The existing riparian parkland was a key opportunity that allowed the design to be realised. The space was available for flood plain area and to naturalise incoming stormwater channels.

While still a young project, it has been very successful and demonstrates the value of this approach. It has helped pave the way for this approach to be applied across Singapore and internationally.

The stability of the river bed and vegetation was confirmed during recent floods. This is critical for gaining support for further projects.

AUSTRALIAN CONTEXT

Channelised stormwater drains are common in Australian cities. Stormwater runoff into these channels is typically of poor quality. This suggests that there is high potential for the successful application the 'channel naturalisation' approach in Australia. However, there are several differences between Australia and Singapore that present challenges to such projects being implemented:

- Water supply security is not yet a significant driver in Australia and stormwater is not harvested for drinking.
- Relevant drivers in Australia include enhancing swimming area water quality, enhancing water quality to improve ecosystem health, and enhancing the aesthetics and amenity of urban areas. These would be considered a lower priority to water supply security and so are harder to fund.
- Australian cities have a typically low population density, which results in a lower availability of funding and a higher per capita cost for projects.
- Australia has a drier climate than Singapore which may result in slower establishment of vegetation and a longer lead time to get projects to a fully functional and stable state.

In spite of these factors, there is significant opportunity within Australian cities for channel naturalisation projects. There are several examples where this has been applied in Australia, including Cup and Saucer Creek restoration in Canterbury (Sydney).

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12

Environmental Sustainability Knowledge Transfer Network, UK

PROJECT

The Environmental Sustainability Knowledge Transfer Network

LOCATION

University of Oxford, Kidlington, UK

ORGANISATION

Technology Strategy Board

KEY SUCCESS ATTRIBUTES

- Helping to support innovation in the UK.
- Based on a 'concept to commercialisation' approach.
- Driving the flow of knowledge within the Environmental Sector.
- Influencing the uptake of innovation across the Environmental Business sector.
- Informing government on technology needs, issues and regulation.

DESCRIPTION

The Environmental Sustainability Knowledge Transfer Network (KTN) was formed by the Technology Strategy Board (TSB) in the UK. This network is one of 15 similar networks covering a range of sectors including Defence, Financial services, Electronics and Transport. The TSB is funded by the Government, which provides around £320 million per year for various activities, including supporting the KTNs. The main role of the TSB is to identify how and where to invest in order to grow UK revenue streams. The main role of the KTNs is to improve knowledge and improve the transfer of knowledge within and across the 15 KTN sectors.

The Environmental Sustainability KTN (ESKTN) is also supported and hosted by Oxford University. This network covers four main priority areas:

- Sustainable water management.
- Sustainable energy.
- Sustainable land management and food production.
- Resource efficiency – sustainable waste management.

The ESKTN aims to accelerate the UK's transition to a low carbon, resource and energy efficient economy. With a membership of over 6,000 people, the network has 21 sub-groups which underpin the four priority areas, and each sub-group focuses on a particular aspect of environment and sustainability.

DISCUSSION

This network framework is an innovative approach to a structured, informed knowledge acquisition and exchange process. The ESKTN undertakes a variety of activities to support the mission statement. These activities include:

- Organising and sponsoring conferences, workshops and meetings.
- Assisting businesses and universities with funding applications for projects and investigations related to the advancement of knowledge in any of the key priority areas.
- Assisting with the development of consortia to address key environmental challenges.
- Undertake and support case studies in the area of environmental sustainability.
- Sponsor competitions to address present and emerging problems in the water industry.
- Maintain a database for displaying outcomes of case studies, reports etc. via the website.
- Provide a forum for members to contribute and discuss issues and experiences, share knowledge and support the ESKTN community.

One clear function of the ESKTN is to inform Government policy, but not influence policy. This maintains the arms-length relationship with the Government to ensure independence of the network.

The ESKTN is currently supporting a TSB initiative to address the gap in future water supply in the UK. Current predictions show that by 2050 the demand will exceed the availability of water by a massive ten gigalitres (GL) per day across the UK. The TSB is currently running a competition to gain ideas on how an extra 1 GL/day can be made available within the next year or so.

Knowledge Transfer Network

Environmental Sustainability

One example given during the discussion at Oxford University (as part of the WSC Study Tour) was the problems associated with the over-use of residual pesticides in the agricultural catchments (used on canola crops) and the impacts this is having on water quality. As EU's Water Framework Directive is likely to create strong incentives for improvement, the management of this emerging issue is receiving priority.

The free membership and access to reports, case studies and other information and resources enables this network to be used by a wide range of water industry professionals and interested parties.

The approach appears well structured and provides multiple avenues for inputs and outputs in the area of innovation in environmental sustainability.

PROJECT INFORMATION

Drivers

The main driver for this network was the development of the TSB and the need to have a communication network to enable the transfer of information inwards and outwards. Another driver for this particular KTN was the EU Water Framework Directive, which provides funding (via the EU), and governs improvements and regulation on the condition of surface waters in Europe. While funding is available from the EU to implement water quality-related projects, the EU also have system of compliance and regulation, including penalties, for inaction and environmental harm

Operational cost

TSB funding of £320 million per year.

Funding source

The ESKTN receives it funding through the TSB. There is also in-kind support provided by British Water and Oxford University, including administration of the ESKTN.

Delivery time frame

Delivery depends on the specific project or initiative that is being funded.

Communication

Communication is the principal activity of the ESKTN. The main form of communication is via the website, which provides a database of case studies, reports and projects, and also hosts forums for all members. The site promotes user input, with the ability for members to share documents, advice and experience through the online forum.

Ongoing monitoring

Monitoring is via the membership of the ESKTN and the continuation of funding from the Government to support the TSB directly, which indirectly supports the ESKTN.

ABOVE L-R: The study tour members with staff from Knowledge Transfer Network. The study tour group entering Oxford University. KTN logo.

CHALLENGES

One of the main challenges is to ensure that the network continues to provide the level of support needed to ensure that knowledge is transferred within and across the 15 networks. It is also important to ensure that there is continued information exchange with the TSB to realise TSB objectives.

From observations made after the tour it is clear that one of the challenges is the competition between the 15 KTNs for the available funding. One of the methods used to address the competition for limited funds is the collaboration that occurs between the 15 individual KTNs as many projects often overlap between two or more KTNs.

OPPORTUNITIES

One of the opportunities that this framework presents is return on investment. An economic assessment on return on investment for normal, structured research, and development projects found that the return on investment is expected to be about 7 to 1, or £7 for every £1 invested. The returns on investment through the TSB are in the order of £15 to £20 for every £1 invested. This is due to the benefits associated with economies of scale (large investment, less administration costs) and also due to the efficiency and quality produced when using the 'competition' approach to innovative challenges.

AUSTRALIAN CONTEXT

From experience in Australia it is clear that each research institutes, government agencies and utilities will run their own individual research and development program, with the outputs from these programs generally staying with the organisation that paid for the research. The interstate rivalry and competition for Federal and State research money forms barriers between universities and to a lesser extent, between State agencies from each State.

There are numerous examples of universities repeating work that was already conducted interstate and is transferable, but due to the universities need to mark out their own patch this work is repeated interstate.

As the competition for Federal funding is fierce, and State funding does not consider funding that has occurred in other States, this narrow approach to knowledge sharing will continue.

The way forward is for a similar Federal agency to be developed, using the TSB and KTN framework, to track Federal and State funding and to establish an Australia-wide data base for all research to be tracked and presented. This should be done under the heading of 'encouraging innovation', not necessarily under a research banner. This will require leadership from the Federal Government and will require universities and State agencies to change their current stance on knowledge sharing and networking.

Other industry organisations do, and will continue to play an important part in this role. Organisations such as Water Services Association Australia (WSAA) have a vast network of interest groups and partially provide the service that the TSB have achieved, however they do not have the same financial backing and depth of resources exhibited by TSB.

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RESOURCES

www.oxford.ac.uk

www.innovateuk.org

www.innovateuk.org/sustainabilityktn

www.britishwater.uk

www.defra.gov.uk

OPPOSITE PAGE: Image by Tim Buykx - Park feature in Amersfoort, The Netherlands.

13

London 2012 Olympic Park, UK

PROJECT

London 2012 Olympic Park

LOCATION

London, UK

ORGANISATION

Olympic Delivery Authority (ODA)

KEY SUCCESS ATTRIBUTES

- Strong sustainability goals guided construction.
- Local government supported 'green' planning policies.
- Large event funding provided capital for key environmental initiatives and innovations.

DESCRIPTION

London Olympic Park was constructed for the 2012 London Olympic and Paralympic Games, using clear sustainability principles. The vision for the development was use of existing structures where possible, and only develop new structures where required and where such new structures would have long term use after the Games.

Development also supported a broader initiative to host the Olympic and Paralympic Games within a sustainability plan based on five key themes:

- Climate change (minimising greenhouse gas emissions);
- Waste (minimising waste);
- Biodiversity (minimising impact and enhancing existing habits);
- Inclusion (promoting access for all); and
- Inspiring healthy living.

The site is built on an old industrial wasteland, where the River Lee and its tributaries wind through.

DISCUSSION

Built on land used previously for a myriad of industries, the land and water rehabilitation aspect of this project is significant. It was one of the largest soil decontamination projects in Europe, with 1.6 million tonnes of contaminated soil cleaned and returned to site. In an industrial and low social-economic area of London, the project has regenerated the whole region, with improved transport links and other infrastructure.

The strong sustainability aspects of this project were a key feature of the London Olympic bid, particularly the broader objective of using the Games as a catalyst for change encouraging more sustainable living across the UK. A £10m blackwater treatment plant - using water from the sewer and treating it to be used for irrigation, toilets and energy cooling – was an important water initiative, and led to a 40 per cent reduction in of potable water use on site. Energy was also another primary consideration, with a biomass boiler using woodchip to generate heat, and a natural gas-powered combined cooling, heat and power plant – both of which reduce greenhouse gas emissions. The design of the centre is modular, enabling future technologies to be used as they are developed.

The River Lee flows in ribbons through the site and was rehabilitated in partnership with the EA, with the banks revegetated, and fish and other wildlife returning to the river.

The athlete's housing will be turned into 40 per cent affordable housing, and 60 per cent private housing.

PROJECT INFORMATION

Drivers

The construction project was driven by the need to construct Games venues and housing for the athletes taking part in the 2012 London Olympic and Paralympic Games. The area was selected to regenerate a poor environmental area (contaminated land from previous industrial use) and regenerate the community in this lower socio-economic area of London. The environmental improvements were driven by an aspiration to demonstrate best practice and go further than the Greater London Authority's planning regulations, designed to encourage 'green' development.

Capital cost

The total construction cost of the London 2012 Olympic Park was £9bn. Regeneration of the area was a key driver, not profit. This included £5m for the sewer mining project, with a further £5m match funded by Thames Water.

Funding source

The £9bn Olympic Park and transport development was funded by taxpayers.

Delivery time frame

On-site work to decontaminate the soil started in 2007, and construction commenced in 2008. The majority of Olympic Park was completed in July 2011 by the ODA (who project managed the £9bn).

Communication

Communication was a core component of the development of the Olympic Park. Local residents were kept informed about project progress through quarterly update meetings. On-site bus tours for interested individuals and groups were held until two months prior to the Games starting in July 2012.

Strong media interest resulted in many news articles being written about the site, and a website was maintained throughout construction. A 'Learning Legacy' website set up to share knowledge and lessons learned from the construction of Olympic Park includes over 200 papers on town planning, sustainability, and procurement.

Ongoing monitoring

Some athletes housing will be sold off to private owners post-Games, while some will be retained for government housing. Temporary Games venues are being turned into community hubs and features. Waterways are monitored by the EA. The venues will have post occupancy analysis on water and energy consumption by the London Legacy Company (who took over form the ODA) to ensure the venues are operating efficiently. Thames Water has a seven year research and monitoring program underway on the wastewater recycling plant.

ABOVE L-R: The study tour visited the Olympic site on a grey and wet spring day, left and middle photos show the restoration and on-line treatment wetland on the river Lee which flows through the site. Right shows the main stadium.

CHALLENGES

This was one of the largest ever developments of its kind in the UK. The contaminated soil was a major challenge, which initiated the largest soil decontamination project in Europe.

The driver to reduce on-site potable water use by 40 per cent was a challenge, which was overcome by the creation of the blackwater treatment plant, but brought about regulation, governance and public perception challenges.

Combined sewer overflows and diffuse pollution still threatens riparian wildlife. This threat is monitored and managed by EA which uses a new hydrogen peroxide dosing plant to manage low dissolved oxygen incidents to minimise the potential for fish kills.

OPPORTUNITIES

The initiatives implemented on site (including the blackwater treatment plant) have pushed the boundaries for the UK water industry. These initiatives have been used as test cases, and stimulate similar future positive development in other areas.

The regeneration of a disadvantaged part of London has been presented great opportunities, including the return of wildlife to improved local waterways, which were previously used as industrial drains.

The Learning Legacy website http://learninglegacy.london2012.com/ established to share knowledge and learnings of the development, is an excellent information resource, applicable across different countries.

AUSTRALIAN CONTEXT

Development of this site capitalised on a large event – the London Olympic Games - that was subject to significant investment. This funding provided an opportunity trial new initiatives and innovations. If Australia hosts a large sporting or other event there may be similar development opportunities

Specific lessons can be taken from two initiatives:

- The blackwater sewer mining project successfully reduced the on-site potable water demand, but proved to be expensive – a £10m plant that produces 0.5 megalitres (ML) per day.
- The technique of using hydrogen peroxide to manage dissolved oxygen levels in rivers to prevent fish kills could be relevant in some Australian situations.
- This project was a good example of stakeholders working together in an integrated manner. The strong holistic, sustainability drivers behind the project, and the use of sustainable materials also added to the project's success.

Overall, the future-thinking, ambitious vision – to use the Games as a catalyst for change to create more sustainable living across the UK – could be applied in Australia, in terms of adopting bold and ambitious visions to capture stakeholders' attention and involvement.

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OPPOSITE PAGE: Image by Tim Buykx - The ArcelorMittal Orbit is a 115-metre-high sculpture and observation tower in the Olympic Park in Stratford, London. It is Britain's largest piece of public art and is intended to be a permanent lasting legacy of London's hosting of the 2012 Summer Olympics, assisting in the post-Olympics regeneration of the Stratford area (wikipedia).

14

City of the Sun / Park of the Moon, Netherlands

PROJECT

City of the Sun / Park of the Moon

LOCATION

Heerhugowaard, Netherlands

ORGANISATION

Heerhugowaard municipality

KEY SUCCESS ATTRIBUTES

- An integrated community with a strong focus on environmental sustainability.
- 3000 houses situated in a polder landscape (a low lying tract of land enclosed by dikes), in the middle of a lake.
- Focus on natural water filtration systems to provide water suitable for swimming.
- Multifunctional spaces.
- Increasing property values. The high sustainability 'island houses' have doubled in value over 4 years.

DESCRIPTION

The City of the Sun/ Park of the Moon (Stad van de Zon / Park van Luna) is a new residential development in the polder landscape north of Amsterdam, in the City of Heerhugowaard, Netherlands. The project emerged from a 1992 master plan, which was an artistic impression by architect Ashok Bhalotra showing integration and balance of red (urban area), green (parks & recreation) and blue (water) on a grid structure, orientated to allow maximum benefits from the sun.

The City of the Sun is a 118ha site, comprising a 49ha square island, in the middle of a 60ha lake. The island is a fully self-contained and functioning city of approximately 3000 houses. It is the largest photovoltaic (PV) housing project in Europe. The City of the Sun is fitted with 25,000 photovoltaic panels (solar panels), and three 2.3MW wind turbines.

The Park of the Moon is a 177ha recreational area which includes 75ha of water suitable for swimming and canoeing. The Park of the Moon is the main open space for the City of the Sun, and plays a key role in the sustainability outcomes of the overall site. Given that water surrounds the city and provides for recreation opportunities, the water quality, accessibility, and water purification system were given high importance. The park includes a 1km long stretch of 'beach', a multifunctional sports centre and an area for dry land activities (walking, cycling, rollerblading, mountain biking).

DISCUSSION

The project applies general sustainability principles alongside integrated water management. The most important factor in the City of the Sun was being CO^2 neutral and generating as much energy as possible on site. The recreational opportunities provided by the water body and surrounding parklands were emphasised, to create a balanced and cohesive community.

The lake surrounding the City of the Sun, is designed to store and conserve water during the summer months. Stormwater runoff from the urban areas of the City of the Sun is separated in a 50/50 drainage system. Road runoff is separated and enters the sewer system, while clean runoff is diverted to supply the water bodies.

To enable water sports such as swimming, water is treated to a high standard via natural wetlands and chemical dosing with iron chloride. Iron chloride reduces phosphates and total suspended solids (TSS), however this is only used when the water supply is supplemented.

The wetland and lake system has six water quality measuring points. Primarily, this measures volume of water in the systems and records precipitation, water loss via seepage and evaporation. Water is pumped around the site, via pumping stations. These are essential for the health of the system; otherwise the water would remain stagnant.

Details of the wetland including detention times:

- Shallow lake average depth is 1.4m, and detention time is approximately two weeks. The minimum pumping station capacity is 1.5 ML/hr.
- The labyrinth detention time is three days.
- Deep lake average depth is 3.8m, the minimum pumping station capacity is 3.5 ML/hr.

PROJECT INFORMATION

Drivers

The VINEX policy developed in the 1990s by the Dutch ministry of Housing, Spatial Planning and the Environment, identified outer city areas suitable for large new developments, which also focussed on reducing unnecessary car traffic.

Energy and CO^2 reduction goals were key drivers for the project, with the sun being the main inspiration. Water quality was driven by proposed recreational uses.

An internal champion at council (Reint Mellema), who had worked there for over 30 years, reinforced by political support from a Councillor who was re-elected four times, provided consistent leadership required for a project like this.

Capital cost

The total estimated cost is €140 million. The PV system modules cost approximately €25 million.

Funding source

Three main funding sources were involved in the project - the Dutch Government, Province of North Holland and the European Commission (Fifth Framework Program).

Delivery time frame

The master plan for the City of the Sun in Heerhugowaard was developed in 1992 by architect Ashok Bhalotra. The Park of Luna was designed from 1997-2003. Construction occurred from 2003-2008. Final houses within Stad von Zon are now under construction, with completion expected in 2012.

Communication

Maintaining constant communication with all the parties involved in the project was critical to its success. Extensive consultation and dialogue with the community and stakeholders was undertaken throughout the project, with a focus on building relationships. A critical message identified by the project champion, was that 'council works for the people, not the managers'.

The neighbourhood residential committee has a dedicated Neighbourhood Manager at council, who deals with residents daily.

Ongoing monitoring

Ongoing monitoring and maintenance is quite intensive. Water volume in the system is regularly measured. Weekly tasks include general maintenance and rubbish collection. Vegetation is reduced or removed annually. Dredging of the sediment pond and partial dredging of the labyrinth and shallow lakes occur periodically, as required.

ABOVE L-R: Row houses with PV panels. The labyrinth wetland system as part of the stormwater treatment system. Housing by the water with one of the wind turbines that were built as part of the development in the background.

BELOW: Housing examples on the edge of the dyke.

CHALLENGES

Some of the challenges encountered during the project included:

- The earthworks required to form the City of the Sun / Park of the Moon, an entirely man-made area, dramatically changed the existing polder landscape. Part of the challenge was to maintain a 'soil' balance, so that no additional soil was required for the project, nor any removed.
- Most home buyers are seeking a nice home in a good location with good facilities nearby. While most people support sustainability and sustainable development, they are not willing to pay a premium for it. The challenge became making sustainability part of the package.
- The development is in a polder landscape approximately 2.0m below sea level, therefore the water board's priority was managing water levels and flooding, rather than water quality. Recreation opportunities would have been adversely affected if pumps were not installed to circulate water around the development.
- Finding a balance between water quality, design of the treatment wetlands and recreational water uses in a closed water system was achieved with a mix of natural treatment and chemical treatment.
- Adapting photovoltaic technology so that it fitted on residential rooftops.
- Calling the development a 'climate proof' city to avoid climate change arguments.

OPPORTUNITIES

The City of the Sun / Park of the Moon project has presented many opportunities to the city of Heerhugowaard, including:

- Largest photovoltaic housing project in the world at the time of the 2012 study tour.
- Knowledge exchange with multiple stakeholders.
- To be front runner and take the lead in developing a sustainable city.
- To provide a unique selling point and create an iconic development in Heerhugowaard.
- To secure support from sustainability focussed organisations.

Since its opening in 2006, the municipality of Heerhugowaard has hosted 130 delegations from 30 countries, in the two years from 2010 that have come to visit and explore the development, learn about the approach taken and the witness the outcome.

AUSTRALIAN CONTEXT

There are significant differences between Heerhugowaard and Australia. The most obvious being the abundance of water, with most of the Netherlands being well below sea level. As a result, there is much greater emphasis on controlling water quantity and levels near residential areas, rather than water quality, as in Australia.

While it may be hard to directly adapt the City of the Sun / Park of the Moon model to Australian conditions, there are physical elements, as well as the process of the concept implementation, which can be adapted to increase sustainable development in Australia.

The key learnings which could be applied include:

- The IKDURF philosophy – "I dare". Take opportunities to strive to be a front runner and take the lead. Stable, long term leadership is required to maintain project momentum and drive, and helps maintain strong relationships with stakeholders.
- Relationship-based working, rather than working based on contractual obligation. This helps to foster trusting relationships between the various stakeholders.
- Turn community 'visions' into your mission.
- Develop support by encouraging the participation of community, key stakeholders, and residents. All stakeholders and participants need to be dedicated to the project.
- For PV systems need to be considered early in the project to be successfully integrated into residential developments, because their function is dependent on their orientation to the sun.
- Opportunity to experience the water (through various recreation activities) and the purification systems (seeing the pumps, interesting wetland train design), integrating water into the development.
- All systems, particularly water, need strong commitment to ensure ongoing maintenance of the system to keep it fit-for-purpose.
- Remember that 'The strength of a chain depends on the weakest link' so all stakeholders, must recognise possible weaknesses (in processes and functions) and take action to ensure the chain does not break and the developing process stop.

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BELOW: View to the housing over the water body from the Park of the Moon.

OPPOSITE L-R: Treatment wetlands and recreational water bodies as part of the Park of the Moon.

15

Augustenborg, Sweden

PROJECT

Augustenborg (Malmo)

LOCATION

Malmo, Sweden

ORGANISATION

City of Malmo, Developers, National Government

KEY SUCCESS ATTRIBUTES

- Integration of flood retention with the urban landscape.
- Acceptance of flood risk within the community.
- Demonstration of the possibilities of green roofs in urban areas.
- Improved perception of the neighbourhood.

DESCRIPTION

The neighbourhood of Augustenborg (Malmo, Sweden) has frequently experienced periods of floods caused by overflowing drainage systems. Augustenborg underwent significant regeneration, between 1998 and 2002, to transform it into a more socially, economically and environmentally sustainable neighbourhood. Significant physical changes in infrastructure took place as a result, focussing on the creation of sustainable urban drainage systems including ditches, retention ponds, green roofs and green spaces.

The project was carried out collaboratively by the city council and a municipal housing company, with extensive participation from the residents in Augustenborg. The project has resulted in a successful outcome, as stormwater runoff has decreased by 80% and the increase in green space has improved the image of the area.

DISCUSSION

Malmo is Sweden's third largest city, and is located in the south of the country. It has traditionally been an industrial city. In the 1970s and 80s the city experienced an economic downturn and associated population decline. In the 1990s the mayor (a former urban planner) looked to the future and how the city could again prosper and expand. The focus was to transform the city into an eco-centre.

The neighbourhood of Augustenborg was traditionally considered a less desirable neighbourhood of Malmo. The area provided a good opportunity for urban renewal and to improve the image and aesthetics of the community. There was input from the residents' right at the planning stage of the redevelopment, which has given the community more ownership of their public spaces. It has become an attractive, multicultural neighbourhood in which the turnover of tenancies has decreased by almost 20% and the environmental impact has decreased to a similar degree.

Augustenborg has a strong sense of community. The council has empowered the community to develop and implement projects such as community housing for pets and public transport.

One community member was even involved in the design of the drainage gutters that are commonly known as 'onion gutters'. The involvement of the community has been one of the key reasons why many of the environmental projects have been successful.

Along with a reduction in flooding in the neighbourhood a number of initiatives have been implemented to reduce energy use and increase renewable energy sources.

PROJECT INFORMATION

Drivers

Social issues, flooding, the mayor's commitment to sustainability, energy efficiency and the economic downturn.

Funding source

The European Union, national government, City of Malmo and a housing company.

Delivery time frame

1998 - 2002.

Communication

The community has been heavily involved in the integration of the public open space. As such there has been a general acceptance of the flood risk. There is an information centre in the neighbourhood which demonstrates different types of green roofs and the world's first roof botanical garden.

Ongoing monitoring

The housing company developers are maintaining the site. There has been a flooding reduction and social issues have been improved.

CHALLENGES

- Consultation, integrating the different disciplines.
- Overcoming social issues.
- Reducing the turnover of residents within the town.

OPPORTUNITIES

- Reduction of flooding.
- Improved amenity.
- Improved energy efficiency.
- Creation of a centre of excellence featuring world first botanical green roof.
- Demonstration of multiple uses of green roofs.
- Improvement of the "image" of Augustenborg.
- Environmental programs to bring the community together.

AUSTRALIAN CONTEXT

Over the past 20 years, Malmo has transformed itself from an industrial city into an eco-centre. Much of the success on the ground has been the result of high levels of involvement with the community throughout the planning stages.

The integration of flood retention within the urban landscape was well accepted within the community of Augustenborg. Flood retention basins are located within multiple areas such as playgrounds, outdoor school class rooms and sporting fields. The drainage is generally bought to the surface and is visible to the public. During heavy rain the community has a good understanding around the flood risks and accepts that these public areas are not usable during this time. This acceptance of risk, through high levels of consultation within the community, could be applied within Australia.

Green roofs are not widely used within Australia. Augustenborg demonstrated the potential applications of green roofs from low maintenance systems to architectural features and even vegetable patches.

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TOP L-R: Energy efficient building with solar panels. Outdoor classroom doubling as a retarding basin during rainfall. Substrate and root mass of a 10 year old demonstration green roof.

SIDE: Water features doubling as retention and filter ponds within Augustenborg

BELOW L-R: Rooftop vegetable patch at Augustenburg's Botanical Roof Garden. "Onion Drain" designed by a local resident to help slow stormwater runoff.

16

Western Harbour, Sweden

PROJECT

Western Harbour (Malmo)

LOCATION

Malmo, Sweden

ORGANISATION

City of Malmo and Developers

KEY SUCCESS ATTRIBUTES

- Using 100 per cent locally produced renewable energy, which acts as a demonstration project.
- Conversion of a highly degraded industrial site into a housing development.

DESCRIPTION

Western Harbour is a modern city-front development on former brownfield land. The development was planned as a stand-alone community in close proximity to goods and services. It has its own energy system with 100% locally produced renewable energy, proving that a zero CO^2 vision is possible.
The first phase was built in 2001 and demonstrates several integrated solutions for sustainability. The strong architectural focus of the development is highlighted by the spiralling skyscraper 'turning torso', which is Sweden's highest residential building.

DISCUSSION

Malmo is Sweden's third largest city and is located in the south of the country. It was historically an industrial city that saw its population decline in the 70s and 80s in line with an economic downturn. It experienced a renaissance in the 1990s thanks to the vision and leadership of its then mayor, who transformed the city into an eco-centre.

On-site stormwater is all managed above ground, which promotes the connection of people with water and its impacts. The development has a strong focus on community with a number of public places, including aqua spots, becoming popular recreational gathering points. It is pedestrian friendly, with minimal access for cars. Private outdoor spaces also have low or no fencing which promotes communication between neighbours.

The development has a strong sustainability focus with a number of energy initiatives to enable the 600 lot housing site to use 100% locally produced renewable energy. Initiatives include roof top solar panels, wind turbines and the use of waste and food scraps to produce energy. Individual metering of each household also enables residents to see and manage their energy use which promotes conservation.

The development implemented a number of sub-projects, as part of the overall project, including the development of an international section called the 'European Village', where countries from around Europe were invited to develop a house which represented their origin. For the most part, this was a success, although it posed some challenges due to different regulations from their respective countries.

PROJECT INFORMATION

Drivers

The city hosted a housing expo, showcasing energy efficient housing and energy neutral developments.

A desire to transform a previously unused piece of industrial area into an attractive, energy neutral, residential development.

Costs

The total costs for this project are unknown as each developer carried their own costs.

Funding source

It was primarily developer funded with assistance from the municipal housing company.

Delivery time frame

Regeneration of the Western Harbour area was highlighted through the BO01 housing expo in 2001. This was the first stage of regeneration to be completed. The last development in the Western Harbour will not be finished until 2030.

Communication

Marketing the city of Malmo as an 'eco-centre' attracts many study tours every year. The success and learnings from the project have been widely communicated with key stakeholders including the local university, sustainability groups and residents, providing information about the unique energy and water systems.

Ongoing monitoring

Energy use is continuing to be monitored and used to inform residents of their energy use. Maintenance is carried out by council and a body corporate for the development.

CHALLENGES

- Delivering on low energy targets.
- Providing a village atmosphere through the creation of community places and limiting vehicle access.
- Marrying energy targets, initially modelled in the housing, with residents' energy usage behaviours.
- Building a multi-country section within the development to showcase international eco-homes and achieving Swedish standards and regulations for its construction.

OPPORTUNITIES

- Use of central waste management.
- Integrating and promoting energy efficiency with architecture.
- Creating a community atmosphere within a high density development.
- Implementation of a public transport system at the commencement of development.
- Use of food waste and rubbish for generation of electricity and heating.
- Building a demonstration project to showcase international eco-homes in the city's housing expo.

AUSTRALIAN CONTEXT

Over the past 20 years Malmo has transformed itself into an eco-centre and is no longer the industrial city it was once founded upon. A major factor in the successful transformation of the city has been the long term and consistent vision by the city's local Government. Much of the success on the ground has been through the high level of involvement with the community when redevelopment occurs.

Western Harbour development is a great example of how a high level vision can be transformed into tangible outcomes on the ground. There are a number of opportunities in Australia for energy focussed development, and this project is a great example of having an energy self-sufficient site while still maintaining a modern architectural appeal.

There are many examples in Australia of high density water front development where the main water body (such as a river or bay) is the focus; however Western Harbour illustrates the connection with water in a much more integrated sense. Having a strong focus between water and community was a highlight of the development with much of the community open spaces and meeting places focussed around water and integrated throughout the development along with the larger surrounding harbour.

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ABOVE: Stormwater is highly visible and well integrated throughout the Western Harbour development providing residents with landscape architectural features, play elements and "meeting points".

17

Isar Plan, Germany

PROJECT

Isar Plan

LOCATION

Munich, Germany

ORGANISATION

Landeshauptstadt München (City council) and Wasserwirtschaftsamt München (water authority)

KEY SUCCESS ATTRIBUTES

- Creation of near- natural riverside features.
- Improved flood protection.
- Improved public amenity and access.
- Environment protection and creation of species diversity.
- Meeting the needs of the local community.

DESCRIPTION

The Isar River is 295km long and flows from the Alps in Tyrol, Austria through to the Danube near Deggendorf Germany. It is Germany's third most important tributary of the Danube after the Iller and Lech rivers.

The Isar River has been highly modified since the early 1800s, with its fast-flowing waters used in mills and for timber transport along the length of the river. Initially channelised for improving land use and reclaiming land, the Isar is now being used for hydroelectric power generation, and dykes have been constructed for flood protection. These activities have had adverse impacts on flora and fauna. To make electricity generation easier and to avoid flooding further downstream and to maintain a minimum amount of water in the river during dry periods, several dams have also been constructed.

To manage flooding issues, an interdisciplinary working group was established in 1995 to develop a concept for restoring the Isar River course in the southern inner city area of Munich to its natural state. The working group included members of Munich city council and the local water authority. The aim of the 'Isar Plan' was to ensure flood protection, to create a more natural riverside area and to improve recreational and leisure qualities of river banks. Since 2000 several construction stages have widened the riverbed; flattened the banks; installed small gravel islands to assist with slowing water flows, and replacing in-stream energy dissipation ground sills with more natural rock rapids, which allow better passage for fish and other river organisms.

DISCUSSION

The Isar Plan shows how synergies can be created and proves how landscaping measures in cities can be sustainable. By recovering a semi-natural riverside area, the quality of life and flood protection in a large city are improved.

Success factors included urban and riverside area development aspects were taken into account and a related cooperation across different disciplines and institutions was established. In this context, the City of Munich and the Federal State of Bavaria have combined and concentrated necessary professional, personal and financial resources.

The City of Munich and the Munich water authority supported this ambitious project by continuously consulting urban residents. The project benefits, including flood prevention, environmental protection, urban quality and quality of life, were communicated ensuring the project's acceptance by the community. By combining the nature-oriented redesign of a river with an urban lifestyle, the Isar Plan goes beyond simple cost-benefit analyses and delivers ongoing value for the population.

PROJECT INFORMATION

Drivers

The primary driver for the project was flood protection for the City of Munich while ensuring the river did not dry up during dry periods. There were also water quality, ecological and public amenity issues that need to be resolved.

Capital cost

The total costs for implementing the Isar Plan amounted to approximately 35 million Euros.

Funding source

The project was jointly funded by the City of Munich (45 per cent) and the Free State of Bavaria (55 per cent).

Delivery time frame

2000 - 2011.

Communication

The City of Munich and the Munich water authority communicated with urban residents about project benefits including flood prevention, environmental protection, urban quality and quality of life.

Ongoing monitoring

Species monitoring occurs along the banks of the restored sections.

CHALLENGES

- Securing the Dykes without affecting existing tree stands.
- Proper disposal of contaminated soil.
- Hydrosaat methods for planting saplings.
- Hydraulic impact and river morphological impact of the works were tested in a laboratory using a scale model.
- Zoning off areas during works to ensure continued public use and recreation.
- Clear information and communication avenues for the public.

OPPORTUNITIES

- A near-natural riverside area is recovered.
- Cooperation across different disciplines and institutions was established.
- Quality of life in a large city and flood protection are improved at the same time.
- Water quality (for bathing) is improved.
- Swimmable river through a major urban centre.
- Increased biodiversity and protection of rare species.

AUSTRALIAN CONTEXT

The Isar Plan provides an excellent example of how diverse organisations and people can work together for an agreed and multi-beneficial outcome: improved water quality, recovery of a semi-natural riverside area, and providing a recreational area for the community.

There are many rivers that run through major urban centres across Australia. Many of these will have issues with flow and water quality at times, and are not heavily used by the community. Using the Isar River example we can learn that there are opportunities for these rivers.
By working together, identifying the drivers and the agreed outcomes, the result is "a semi-natural riverside area that is recovered, quality of life in a large city and flood protection are improved - an aspect of which city, nature and man may altogether benefit."

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ABOVE L-R: Bank of the River and walking/cycling trail. The more formal central city section with harder edges for access and erosion control on the bend. Retention of the stepped waterfall to maintain the water levels for the hydroelectricity plant.

BELOW T-B: Access and seating opportunities incorporated into erosion control measure on a bend. The reinstated gravel bank and meadow, well used on the first warm spring day at the end of May.

18

Scharnhauser Park, Germany

PROJECT

Scharnhauser Park

LOCATION

Ostfildern (Stuttgart), Germany

ORGANISATION

Atelier Dreiseitl and City of Ostfiltern

KEY SUCCESS ATTRIBUTES

- Strong drivers from increased housing demand and treatment plants operating at capacity.
- Low soil permeability in the area made stormwater management difficult and resulted in multi faceted use of stormwater retention methods.

DESCRIPTION

The goal of the project was to develop a new 140ha district in Ostfildern. Formerly a US army barracks, the site was marked for residential development in 1992. A key objective of the new district was not to send any stormwater to the wastewater treatment plant. All stormwater is drained, through open channels and swales into a green "T", which also functions as a social meeting place and children's playground. Water within the green "T" is drained into constructed layers of hummus, sand and volcanic rock or into underground storage tanks. The project also retains stormwater with green roofs and green parking spaces. Any remaining overflow is directed to retarding basins which retain water for a short time. In total, there is over 37,000m² of collection space, most of which also functions as public open space.

DISCUSSION

Increased demand for housing in the Stuttgart area was the driver for developing the housing estate. The local wastewater treatment plant was at capacity so there was a need to separate the stormwater from sewage. In addition, to maintain the ecology of the local creek, stormwater runoff had to be maintained at pre-development rates.

The site also had an issue with the management of stormwater. Due to the low soil permeability, stormwater management was difficult and resulted in on-site and off-site impacts prior to the implementation of this project.

PROJECT INFORMATION

Drivers

Increased demand for housing, need to separate stormwater from sewage, protection of local waterways, stormwater management.

Capital cost

The total capital cost was €11M (€15.70/m²) for the modified system at Scharnhauser Park. In comparison, a conventional stormwater management system for Scharnhauser Park would have cost €15M (€21.40/m²).

Operational cost

Maintenance costs are €170,000/yr, which equates to €12.80/m³.

Funding source

The City of Ostfildern and Atelier Dreiseitl designed and funded the scheme.

Delivery time frame

A planning stage was undertaken in 1992, followed by the beginning of construction in 1998. To date, 100% of the public infrastructure and 80% of the housing is complete.

Communication

The community was recognised for its importance in maintaining the system, given that most of the system doubled as public open space. The project team held a workshop to allow the community to contribute ideas to the project.

Ongoing monitoring

Maintenance is contracted to external companies. The costs are divided between the city and public utilities.

CHALLENGES

There were a few small issues with the project:

- During construction there was a lot of garbage in the drain ways, which added to cleaning costs. This problem resolved itself on project completion.
- Frost caused damage on some downpipes and drainage.
- There was a flooding event in 2007 caused by excessive hummus in the soil layer with low permeability and one drainage pipe blocked because it was installed in the wrong direction. These problems were corrected.
- Installation of solar panels reduced the retention effect of green roofs.

OPPORTUNITIES

Flood mitigation in the area has improved waterway health through on-site retention of stormwater. The design means that up to 45% of water is evaporated (compared with approximately 15% for standard drainage system), up to 55% is detained on-site and up to 5% infiltrates into the soil. The likelihood of cross connections between sewer and stormwater is also reduced with the system.

The project has high amenity values for the community and has received numerous prizes for town planning and architectural design. It shows how multiple benefits can be achieved by integrating stormwater management into public open spaces.

AUSTRALIAN CONTEXT

The forecast, under a climate change scenario, is for more extreme weather events. In southeast Australia, it is predicted there will be less rainfall overall, but the rainfall events will be more extreme causing flood mitigation issues. This project offers multi-faceted solutions for stormwater management, any of which could be applied in the Australian context.

Stormwater capture for re-use was not a consideration for this project, but would be a key consideration for an Australian application. However, the ideas for capturing and storing stormwater combined with high amenity values could be adapted for capture and re-use projects. An Australian application would require treatment to enable re-use for non-drinking purposes.

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ABOVE L-R: Green car port roofs help retain stormwater at the household scale. Stormwater management and social functions are integrated. An open stormwater channel also provides amenity benefits to the area.

19

NEWater, Singapore

PROJECT

Changi NEWater and Deep Tunnel Sewerage System

LOCATION

Singapore

ORGANISATION

Public Utilities Board (PUB)

KEY SUCCESS ATTRIBUTES

- Securing long term water supply through treatment of sewage to produce potable quality recycled water.
- Innovation in centralisation of sewer systems to improve the viability of centralised recycled water schemes.

DESCRIPTION

NEWater is the brand name given to high quality recycled wastewater in Singapore. The treatment process includes advanced technologies (e.g. reverse osmosis) to produce water of comparable quality to potable water. NEWater is mostly used by industries but a small proportion is also blended into reservoirs to be re-treated at the water works before it is used as potable supply for human consumption.

A 1998 study by the PUB and the Ministry of the Environment and Water Resources (MEWR) determined NEWater was a viable source of raw water for Singapore. The purpose was to explore how Singapore can in the long term reduce its reliance on Malaysia for its water supply. The WSC Study Tour group visited the Changi NEWater Factory, which is one of four NEWater factories. Currently, the factory is producing up to 228 ML of recycled water per day with provision for expansion to meet future demands. The viability of NEWater projects also relies on the Deep Tunnel Sewerage System (DTSS) project. The DTSS project transfers sewage from the northern part of the country to the Changi NEWater Factory in the south east and south west to maximise the extraction of sewage for treatment at the NEWater plants (see Figure 1).

DISCUSSION

Strategic fit

Historically, Singapore's water supply has been entirely reliant on water from local catchments and imported water from Malaysia. In an attempt to provide a more robust and secure water supply system, the water sector in Singapore has undergone significant reform over the last decade. Currently, Singapore uses an average 1.7 GL of water per day (60 per cent more than metropolitan Melbourne), and consumption is expected to double over the next 50 years. To address this challenge Singapore has developed the Four National Taps strategy. The Four National Taps strategy considers two additional alternative water sources (NEWater and Desalination) along with the existing two conventional water supplies to create a fully integrated water supply system.

Currently, NEWater and Desalinated water are meeting 30 per cent and 10 per cent respectively of the country water demand. The long term objective is to increase the supply of NEWater and Desalinated water to meet respectively 50 per cent and 30 per cent of the total water demand by 2060.

NEWater

The Changi NEWater Factory currently produces 228 ML of water per day. The plant processes include advanced technologies to:

- Produce water comparable to potable quality.
- Recover bio-solids.
- Treat odour emissions.

The water treatment train is very similar to what is used in Australia to produce desalinated Class A recycled water (see photo on the right).

Deep Tunnel Sewerage System

The DTSS is a new sewer trunk system built to centralise the sewer system and more effectively redirect sewage towards the Changi NEWater Plant.

The DTSS is designed to be deeper (20 to 50m deep) to achieve the required drainage slope and create minimal disruption to the surroundings during installation. It is also designed to have larger diameter (greater than six metres) to cater for long term urban development (see photo on the right).

PROJECT INFORMATION

Drivers

- To enable Singapore to sustainably gain self-sufficiency in water.
- To create an integrated sewer and water supply system to cater for significant increase in population growth.
- To maximise the utilisation of all available water resources.
- To centralise the water system, free up valuable land and provide wastewater storage to prevent overflows into the surface waters.

Capital cost

The DTSS is expected to save $SNG 3.7 billion compared to the cost of upgrading the current sewer system. At full capacity Changi NEWater Factory will cost an estimated $SNG 2 billion.

Operational cost

The operation and maintenance cost for the Changi NEWater Factory is estimated to be higher than the price of drinking water from Malaysia. The sale of NEWater is therefore significantly subsidised by the Government to make it viable for industries.

Funding source

The DTSS project was largely funded by the Government, but the Changi NEWater Factory was implemented through a design, build, own and operate model under a public-private partnership arrangement.

Delivery time frame

Design of the DTTS and the Changi NEWater Factory started in 2001 and were completed in 2008 and 2010 respectively.

Communication

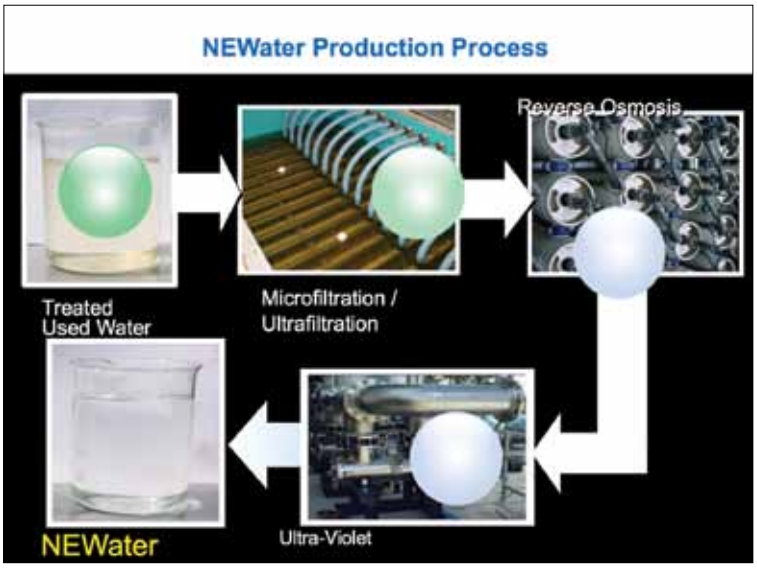
PUB has a comprehensive and active communication strategy to engage a wide range of stakeholders - government and non-government bodies, private industries, community groups, and schools. This is mainly achieved under the banner of its Four National Taps and ABC (Active, Beautiful and Clean) Waters programs. Through these programs, businesses and the general public are continually being educated and kept informed on the status and plans of the NEWater and DTTS projects.

Ongoing monitoring

PUB is the only water utility in Singapore and is responsible for the ongoing operation and maintenance of the two NEWater plants and the DTSS.

ABOVE L-R: Inside the huge Reverse Osmosis plant as part of the NEWater system with masses of membrane tube and huge pipes.

BELOW: Interpretive image from the NEWater website displaying the production process (source: PUB).



CHALLENGES

Implementation and operation of NEWater factories requires highly specialised skills. Given the novelty of these schemes for the water industry in Singapore, increasing workforce skills is critical for the immediate and longer term success of the NEWater and DTSS schemes.

Future expansion of the NEWater schemes is highly dependent on the timely completion of the DTSS projects. This critical relationship between these two systems creates greater complexity from project planning and investment perspectives.

Cost of NEWater projects are normally higher than traditional water supplies and rely significantly on government support.

OPPORTUNITIES

The successful implementation of current NEWater projects provides greater certainty in the country's long term objective of becoming totally self-sufficient in water. This also helps to sustain the high urban development and associated economic growth forecast for the country. Singapore's water demand is expected to double over the next 50 years.

The NEWater and DTSS schemes enable water and sewage to be managed in a more centralised way, thereby freeing up valuable land to accommodate the country's high population growth.

OPPOSITE PAGE: Image by Tim Buykx - A treatment plant under the frangipanis, NEWater plant, Singapore.

AUSTRALIAN CONTEXT

Recycled water derived from sewage treatment is still an under-utilised resource in most cities across Australia. Singapore is already meeting 30 per cent of its water demand through recycled water in an urban setting and is planning to increase this to 50 per cent by 2060. This is a real indication of how recycled water can play a significant role in diversifying our cities' water supply portfolios.

The technology used at the NEWater factory is very similar to those used in Australia to produce high quality recycled water (or Class A recycled water in some States). Some of these treatment technologies (e.g. MBR) are manufactured by Australian companies.

The DTSS may present learning opportunities for enhancing the viability of localised sewer mining schemes, where sewer sub-catchments can be connected to improve sewage availability at the point of extraction.

Singapore has spent a lot of resources in educating and raising public awareness on the importance on these water security projects, from the planning through to the operational stages. The communication model used seems to have gained good traction in the community, which in turn has made it easier for the Government to continue justifying expenditures on these projects. This is still a delicate area locally where the value of water is interpreted in many different ways which limits the ability to holistically recognise the true value of water.

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sembcorp
sembcorp

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Marina Barrage, Singapore

PROJECT

Marina Barrage

LOCATION

Singapore River, Singapore

ORGANISATION

Public Utilities Board (PUB), Singapore

KEY SUCCESS ATTRIBUTES

- Treating the city as a catchment.
- Strong stakeholder engagement.
- A combined flood control and water catchment system to protect and improve Singapore's self-sufficiency.
- Provision of a reliable and safe recreational water body in downtown Singapore.

DESCRIPTION

The Marina Barrage is a 350 metre mechanical dam, constructed across the mouth of the Singapore River. It controls flows to the sea from the Marina and Kallang Basins, and prevents sea water from entering the River. The dam is both a control gate for tide and flood flows, as well as a dam wall to capture and hold urban runoff for potable water. The Barrage has created the Marina Reservoir, the fifteenth reservoir in Singapore, and the first in the downtown area. The Singapore River is the heart of the nation – home to the historic wharves and warehouses that supported the shipping trade that has given Singapore its wealth. The city grew around the banks of the River, and for many years the river estuary was full of trading vessels from around the world. The estuary is now the centre of Singapore for different reasons, as the City transforms into a leisure and tourism centre.

DISCUSSION

Singapore is a highly urbanised nation, with a small land area (approximately 700km2) and a reliance on fresh drinking water from neighbouring Malaysia. The move to reconfigure the tropical river estuaries from natural systems to managed catchments and storages has reached its peak with the opening of the Marina Barrage. A large area of Singapore drains to the Kallang and Marina Basins, which means a significant area of the City has now become catchment.

The sewer system in Singapore was historically very poor, with significant amounts of raw sewage washed into the River during rain reducing the systems' catchment potential. Modernisation of the sewer system has ensured that fresh river water is now captured and stored for treatment and potable use. The addition of the Marina Barrage to the Reservoir system has increased the water catchment of Singapore from approximately half to two-thirds of the land area. The Marina Reservoir, created by the Barrage, was officially commissioned in November 2010 and supplies approximately 10 per cent of Singapore's current water demand. Historically, low lying areas of Singapore have flooded with significant rain and high tides. The Barrage was designed to allow excess water to flow from the River/reservoir to the ocean during low tide as gravity flow.

When flooding is anticipated due to high tides, a battery of large pumps can move water over the Barrage to the ocean, maintaining the high water levels outside the Barrage and protecting the city. The Barrage has a large and well-designed visitor's centre that houses a cafe, a 'Sustainable Singapore' gallery and hosts public tours.
The centre enables residents and visitors to understand the operations of the Barrage, to explore the complex nature of Singapore's water catchment system and the reliance of the city on its urban catchment as one of the 'four taps' of Singapore's water supply – the others being imported water (from Malaysia), NEWater (reclaimed) and desalinated water.

The centre and the Barrage were awarded the top prize by the American Association of Environmental Engineers 2009. The complex includes a large publicly accessible green roof that connects with the new 'Gardens by the Bay' botanical garden, and a solar photovoltaic (PV) generation facility. It provides excellent views over the city skyline and the large roof is used for photographs, picnics, kite flying and other leisure activities. The centre is promoted by PUB and Singapore Tourism as a visitor attraction.

PROJECT INFORMATION

Drivers

- Vision of a significant political figure (Lee Kwan Yew, Prime Minister 1959-1990).
- Flood control requirements for low areas of the Kallang and Marina Basins.
- A desire by Singapore's leaders to become more self-reliant in water supply.

Capital cost

$(SGD) 226 million.

Funding source

Singapore National Government.

Delivery time frame

The Barrage opened in November 2008. The Marina Reservoir was desalted from 2009 – 2010 and commissioned in November 2010.

Communication

The Marina Barrage is a significant community facility and the Singaporean Government, through PUB, supports its operation. The Barrage was constructed with little true community engagement before its completion; however it now has a significant place in the city's calendar of events, and maintains a significant web presence and social media profile.

Ongoing monitoring

As a piece of flood and potable water supply infrastructure, the Barrage requires constant monitoring and maintenance. This is carried out by technicians from the PUB.

ABOVE L-R: Barrage between the Straits of Singapore (salt water) and the new Singapore River basin (fresh water). Tensile structure for shade and shelter over the roof top garden of the Marina Barrage Visitors Centre. Study Tour participants in the Sustainable Singapore Gallery.

BELOW: Graphic showing the catchments and context of Marina Barrage.

ABOVE T-B: Image of the Singapore River in the 70's as part of the Sustainable Singapore Gallery tour. Tensile structure for shade and shelter over the roof top garden of the Marina Barrage Visitors Centre. Study Tour participants walking on the Marina Barrage.

RIGHT: Taking in the presentation and tour of the Sustainable Singapore Gallery.

OPPOSITE PAGE: Image by Tim Buykx - The Marina barrage in the foreground with the attached visitors centre including the "Sustainability Gallery".

CHALLENGES

- Funding and politics – the funding of significant pieces of infrastructure in Singapore is largely undertaken by the national Government. While a democratic system is in place, the influence of the key political figures in this and other projects is undeniable. The challenge for this project was it breadth and the scale, because it affects the entire downtown area of Singapore and modifies the cultural heart of the city.
- Technical – the construction of the Barrage and the use of a large part of the urbanised area as potable water catchment, is a technical challenge managed by PUB and the national Government.

OPPORTUNITIES

The Marina Barrage delivers three main opportunities:

- The catchment of water from the city to provide additional potable water.
- The protection of the city from flooding. The provision of a stable and clean water body for water-based leisure activities.

AUSTRALIAN CONTEXT

The Singaporean Government's approach with the Marina Barrage and other similar projects differs significantly to the Australian experience. From a technical perspective, the physical and mechanical processes undertaken in this project could be replicated in Australia, however the investment requirements would be uncertain.

The use of an urban area for the collection of potable water is a challenge for the Australian community but one that it must come to terms with as urban population growth continues and climate change affects rain fall patterns. The pressure on existing catchments is already significant and additional catchments of urban areas may need to be considered. In this example, the PUB has undertaken considerable consultation to educate the Singaporean population about the sources of their water, and the impact their day-to-day behaviours have on the catchment. The cultural expectation of drinking water being derived from natural catchments is significant in Australia, and any change in this thinking, would require significant investment in education and consultation.

The need for Australian cities to manage either tidal or riverine flooding with a barrage is not warranted. Most urban areas in Australia do not experience the characteristics of Singapore and therefore the investment is not justified.

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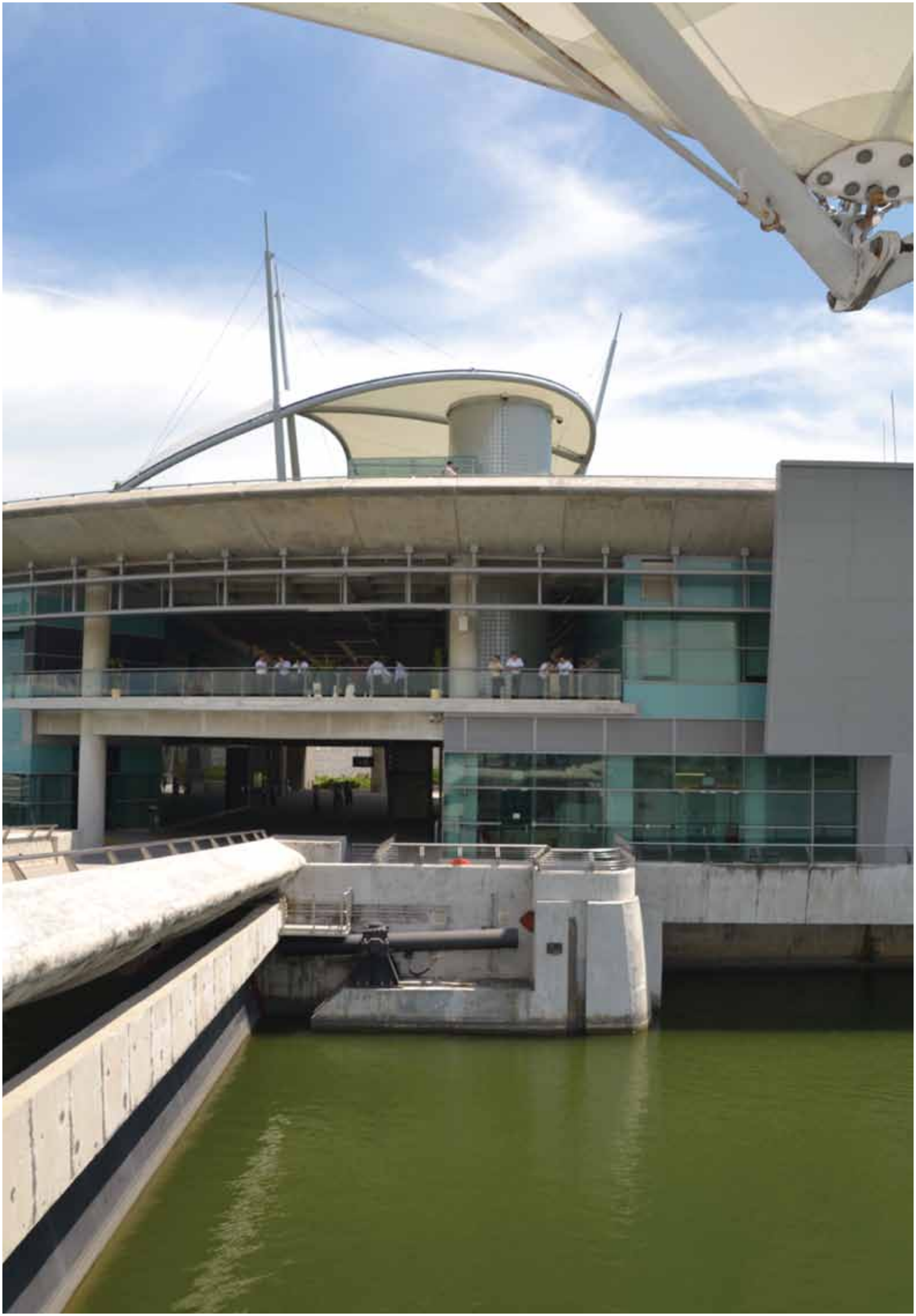

21

Barking Riverside, UK

PROJECT

Barking Riverside Development

LOCATION

South East London

ORGANISATION

Home and Communities Agency, Bellway Homes

KEY SUCCESS ATTRIBUTES

- Greater integration of ecological designs within an affordable housing development.
- Demonstration of benefits of green roofs (energy, water and biodiversity).
- Strong local government policy driving 'green' development outcomes.
- One of Europe's largest brownfield developments involving a wide range of project partners.

DESCRIPTION

The Barking Riverside development is one of the largest brownfield development projects in Europe. The development site is the former Barking Power Station in South East London, which closed in 1981. The project is in line with the London's Green Enterprise District strategy which aims to regenerate designated areas across London into low carbon communities. The site covers an area of 140 hectares which will provide over 10,000 new homes by 2025. It will also carefully integrate a number of community services infrastructures - retail, office, schools, public transport, recreational spaces and water sensitive design amenities - into the built environment.

Construction at the site began in 2008 under a joint venture between Bellway Homes (a leading UK developer) and Home Communities Agency (a division of the Greater London Authority). A number of organisations including the Environment Agency (EA), London Wild Life Trust, University of East London, and a variety of local interested parties have been involved in various aspects of the development. The University of East London has been involved with a significant study into green roof design. Collaboration between the university and the London Wild Life Trust has explored potential for biodiversity restorations. This collaboration led to an improved scope for the green roofs study to include biodiversity perspectives as well as energy and water benefits.

DISCUSSION

This leading project demonstrates how new developments can be made affordable while at the same time achieving high levels of sustainability and livability standards. The Barking Riverside development, once complete, will have over 10,000 residential dwellings with up to 40 per cent built for affordable or social housing options. The whole development is being built under a public-private partnership (Bellway Homes and Home Communities Agency) where £50m public funding will be drawn upon along with an estimated £120 million of public infrastructure funding to create a wholly integrated district.

A number of stakeholders are involved to support the project developers in exploring innovative designs, to continually inform development plans as construction proceeds. More than 40 per cent of the development area will be public open space, while some of these areas will incorporate biodiversity improvement features.

The development includes a number of water sensitive features including vegetated swales, rainwater tanks, green roofs and wetlands. These are designed both to retard water and to clean it before it enters the small tributaries and River Thames.

Collaboration between the University of London and the London Wild Life Trust led to an innovative Green Roofs study which explored designs to enhance the area's biodiversity. Recent reports suggest that Britain has lost over 60 per cent of its bumble bees due to land clearing. The Green Roofs study included the investigation of plant species that can provide bumble bee habitats while still maintaining other key functions of insulation and stormwater retention and treatment.

The development's location within a low socio-economic area and inclusion of a large number of social housing options makes it also an exemplary project in improving the socio-economic standard of the area.

All the buildings at Barking Riverside will be certified to Europe's highest environmental assessment and rating standards (BRE Environmental Assessment Method) which is similar to the Green Star Rating system in Australia. This includes provisions for solar panels as part of the house design.

PROJECT INFORMATION

Drivers

The project is part of the London Riverside project which aims to regenerate the riverside area of East London through providing new homes, jobs, and services.

The London Riverside also forms part of the Green Enterprise District, a project initiated by the Mayor of London to create a low carbon economy region in Greater London.

Barking Riverside is located in a socially disadvantaged area of East London. The aim of the project is to provide for the development of more sustainable communities, where all services (social, environmental and financial) are carefully integrated into the built environment, including the provision significant affordable housing options.

Capital cost

The project will draw on £50 million of public funding and £120 million of public infrastructure funding to create a wholly integrated district. This will include expansion of the public transport systems (e.g. extension of the London railway and bus routes) to connect the site to other major city centres as well as subsidising of social housings.

Operational cost

The operation and maintenance cost will be covered by the local council authority once the development of an area is completed and transferred over. Each residential unit will pay a £425 per year maintenance service charge for maintenance of the housing development of the environmental features.

Funding source

The project is being jointly funded by Bellway Homes and Home Communities Agency. It is working in partnership with the London Borough of Barking and Dagenham (LBBD), Southern Housing Group (SHG) and the London Thames Gateway Development Corporation (LTGDC).

Delivery time frame

Construction at Barking Riverside first started in 2008 and is expected to be fully developed by 2025.

Communication

The project involves a number of stakeholders (local council, developer, social housing body) who collaborated in distribution of project information. Relevant community groups have been engaged to assist in continually informing and refining the design of the developments to promote opportunities in line with the overall sustainability objectives - social, environmental, and financial.

Ongoing monitoring

The local council authority will have the ongoing operation and maintenance responsibility in ensuring that all shared infrastructures and services are adequately maintained. Local community groups will work with council in overseeing the recreational amenities within the development.

ABOVE L-R: Housing type. WSUD swale. Aerial of the development site outlined in yellow next to the Thames.

CHALLENGES

Barking Riverside project is one of the first projects in UK to explore the model of developing affordable housing while meeting high environmental and social standards. The site is located about 20km east of London. The success of the scheme largely depends on the significant funding required for new public transport infrastructures. The master plan proposed to connect the site to the London railway system though extension of the railway system to the area. As a result of the recent global financial crisis coupled with priority investment towards the London 2012 Olympic public funding towards the project have been reduced. The rate of property sales have also slowed down making it harder for the developer to progress as quickly as previously planned.

To meet the 40 per cent target of social housing presents another significant financial challenge for the project developer. In recent years, the Government project partner (Home and Communities Agency) has significantly reviewed their financing framework to come up with a model that provides greater range of social housing options, ranging from affordable rent to shared home ownership and grants.

A number of challenges are expected after the implementation stage as most of the sustainability and livability benefits that are expected depend largely on the behaviour of the community in taking ownerships in maintaining the associated assets. Significant effort will be required to engage and educate the community.

OPPORTUNITIES

Opening the project to other groups to assist in reviewing the master plan design created significant opportunity for innovation and funding initiatives to help deliver improved environmental outcomes as the development proceeded.

The University of East London have successfully developed a green roofs study. Stage 1 of the study has demonstrated that green roofs can have a wide range of benefits depending on their designs. These benefits include improving building insulation, water attenuation, biodiversity and increasing green space. Stage 2 of the study will include determining the life cycle costs for various green roofs design options to inform project developers and designers. Study findings, including project updates are published online.

AUSTRALIAN CONTEXT

From an environmental and livability perspective, the learning from the Green Roofs study can help inform decision making in considering green roofs in new developments by looking beyond just their insulation properties. The biodiversity and aesthetic benefits become more appealing for medium to high density developments where the proportion of green space can be limited.

Green roofs present significant opportunity for future 'city as water catchment' designs where significant water quality improvements and water retention can be achieved.

The financing models that are being used to sustain the affordable housing options with high environmental and livability standards can help inform the review of the current social housing financing framework in Australia to promote social welfare within low socio-economic areas.

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OPPOSITE PAGE: Image by Tim Buykx - Green roof trial beds on top of the sales and information centre at Barking Riverside with the Thames in the background. Experiments are being conducted in collaboration with the University of East London.

22

HafenCity, Germany

PROJECT

HafenCity

LOCATION

Hamburg, Germany

ORGANISATION

HafenCity, Hamburg GmbH

KEY SUCCESS ATTRIBUTES

- Adaptive flood control and flood damage prevention methods.
- Rejuvenation of under-utilised harbour land close to the city centre.
- Mix of residential, business and institutions including HafenCity University.

OPPOSITE PAGE TOP L-R: Park with seating panel that can go under water during flood events. Public plaza and cafe that can also be submerged during high water event from the River Elbe, the cafe has floating screens that protect the glass from flotsam damage. Building overhanging the river to gain more floor space.

SIDE T-B: The old river channel, warehouses and bridge retained and converted as part of the redevelopment. Flood shutters that cover the ground floor window in the new building that fronts the old road level. Close up of the floating cafe screen to protect the glass in flood events.

DESCRIPTION

On an area of 157 hectares, a lively city with a maritime feel is taking shape, bringing together workplace and residential uses, culture and leisure, tourism and retail facilities. A unique feature of HafenCity is an intensive interaction between land and water. With the exception of quays and promenades, the whole area will be raised to around eight metres above sea level. The concept of building on artificial compacted mounds creates a new, characteristic topography, which retains access to the water and the typical port atmosphere, while guaranteeing protection from extreme floods.

DISCUSSION

HafenCity lies to the south of the main Hamburg dike, which means that the existing dike offers the new district no protection. By elevating the buildings on plinths made of mounds of compacted fill, it has been possible to connect HafenCity with the existing city area and develop it step by step. All new buildings stand eight meters above sea level - out of reach of the most extreme flooding. This has dispensed with any need for premature financing of flood protection measures years - or even decades – ahead of the sale and deployment of the sites concerned. Charm, proximity to water and sightlines down the river are also retained.

Underground car garages are accommodated within the plinths. Roads and bridges are also being built above the flood-line. The district can continue to function virtually without restriction even during flooding, despite its "island" situation. Traffic keeps flowing even during a storm surge by diverting around the lower-lying Speicherstadt.

To conserve the historic Speicherstadt, the Am Strandtorkai roadway has not been elevated - unlike most streets in the district. This roadway passes directly adjacent to the historic warehouses and was not elevated in order to preserve the identity and function of the whole Speicherstadt ensemble. Planners of the heritage listed Speicherstadt had worked on the assumption that this area could be flooded in cases of extreme high water.

PROJECT INFORMATION

Drivers

- Linking the inner city with the Elbe River and increasing the inner city area of Hamburg by 40 per cent (157ha).
- Generating residential space for 12,000 people and about 45,000 jobs over a time period of 20 years.
- Generating a high degree of regional and international attraction via cultural, retail, entertainment and tourism activities.
- 21st century city development with high impact, identification and outstanding quality.
- To provide flood protection without the cost and time delay of building a traditional dike protection system.

Capital cost

Total investment for the whole redevelopment is expected to be €10.4billion, of which 25 per cent will be from public funds.

Operational cost

Flood protection measures are predominantly controlled by the individual building owners.

Funding source

Funded by the private development and land sales to HafenCity Hamburg GmbH.

Delivery time frame

Planning started in 1997 with master plan adopted in 2000. Construction started in 2001 and is expected to continue to 2025.

Communication

The project website provides detailed information in German and English. HafenCity has an InfoCenter and Sustainability Pavilion open to the public, with regular guided tours.

Ongoing monitoring

The individual building owners/managers are responsible for the maintenance and operation of the building-scale flood protection measures. Flood protection and evacuation drills are held as per fire drills.

Police and emergency services are responsible for providing flood warnings and assisting with evacuation. The warning system can give a minimum of four hours lead time.

CHALLENGES

- Providing flood protection for both new and existing buildings.
- Level of existing streets and entries to warehouses below flood levels.
- Redevelopment area outside Hamburg's existing flood protection dike system.
- Cost and time to create a dike around the new development too great.
- Conversion of existing warehouses to offices and residential properties.
- Providing emergency vehicle access to HafenCity during floods.
- Selling the proposed flood protection measures to developer and building owners/managers.

OPPORTUNITIES

- Rejuvenating under-utilised river frontage at the door step to the inner city.
- Increasing the inner city area by 40 per cent, creating 22ha of new public realm including parks, 50,000 square meters of new retail and restaurant areas, 12,000 new homes, and 45,000 new jobs.
- Using the development of HafenCity for an economic, cultural and ecological mobilisation of Hamburg.
- Developing the metropolitan character of Hamburg while preserving the city's identity.
- Balancing growth and integration, economic dynamism and social cohesion, international scale and local character, and innovation and tradition.

AUSTRALIAN CONTEXT

HafenCity provides a great example for Australian cities that also have under-utilised riverfront land close to the inner city with potential to be redeveloped and subject to flood inundation. HafenCity's approach combines raised building floor levels, flood protection levy bank or flood walls, and active building flood protection measures. Costs are minimised by allowing public realm areas to go under water temporarily during flood events. Access is maintained for residents and emergency vehicles through elevated platforms and bridges. Flooding has been designed to be part of the landscape, so the emphasis is on 'living with flood' as opposed to keeping flooding out. There was clear acceptance of this and the associated risks within the community. The responsibility for active building management systems is placed on the building managers who are notified of flood risks by government authorities. This is similar to a fire protection plan and practised yearly as per fire drills.

Australians capital cities have been built on river courses close to the ocean. Many have areas that are already experiencing regular inundation. Sea level rise will increase these occurrences. Redevelopment of these areas could look to HafenCity for a manageable, cost effective approach.

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23

Nereda®, Netherlands

PROJECT

Epe Waste Water Treatment Plant - Nereda®

LOCATION

The Netherlands

ORGANISATIONS

Royal HaskoningDHV, Delft University, Vallei and Veluwe Water Board

KEY SUCCESS ATTRIBUTES

- Effective nutrient removal.
- No chemical use.
- 20 per cent less energy consumption.
- Small footprint.
- 10 times faster settling rates than conventional activated sludge processes.

DESCRIPTION

Epe Waste Water Treatment Plant (WWTP) is the first full-scale municipal and industrial wastewater treatment plant in Europe using Nereda® granular activated sludge. The plant has been operational since 2011, and requires little on-site attendance.

Smaller-scale plants were built in both South Africa and Portugal in 2008. In all installations, Nereda® has proven to be effective in various climates and capable of treating various influent types and concentrations. New plants are now under construction in various countries.

DISCUSSION

Activated sludge has been a proven wastewater treatment method for over 100 years. Conventional activated sludge treatment of wastewater is effective at removing nutrients (nitrogen and phosphorous). However, the typically fluffy (low density) structure of conventional activated sludge flocs results in slow settling rates. This means that wastewater has to be retained in the activated sludge reactors for an extended time, which requires large holding capacity and results in a large total plant footprint. Increasing spatial and general resource constraints on water utilities has sparked interest and research into more compact and efficient wastewater treatment technology.

Research has proven granular sludge processes to be a viable alternative to conventional activated sludge and demonstrate much faster settling rates, smaller footprint and lower energy demand.

Nereda® is a granular aerobic biomass, developed at Delft Tech University in collaboration with Royal HaskoningDHV. Nereda® is grown with a mix of bacteria that is able to treat and remove biological oxygen demand (BOD), nitrogen and phosphorous. Compared with conventional activated sludge systems, Nereda® produces higher effluent quality. Under specific conditions, the bacteria grows to form dense granules that clump together. The granules are dense, and settle ten times faster than conventional activated sludge process, which results in a smaller reactor volume, smaller footprint, and a much lower energy consumption, due to a more efficient batch process in cycles.

PROJECT INFORMATION

Drivers

Need for improvements in conventional activated sludge processes for wastewater treatment.

Capital cost

€15M, as opposed to €24M for conventional treatment plants.

Operational cost

Unknown. The operation and maintenance costs are significantly lower than conventional treatment plants, due to smaller footprint (less tanks required), little to no chemical consumption, higher effluent quality, less aeration and energy required.

Funding source

Public-private partnership between STOWA (Dutch water boards research council), six Dutch water boards, Delft University and Royal HaskoningDHV.

Delivery time frame

1993 to present – research at Delft University.

2002 – Successful lab scale trial.

2003 – Pilot research in municipal wastewater.

2004 – Reference on industrial wastewater.

2005 – Breakthrough and introduction of Nereda®. First full-scale trial by retrofitting storage tank to treat 250 kilolitres (KL) per day cheese manufacturing wastewater.

2007 – Dutch National Nereda® Program (public-private partnership).

2008 – Municipal full-scale demonstration plants in South Africa and Portugal.

2006 to 2010 – Pilot plant model was tested at Epe site, treating 1.5KL per day.

2011 to 2012 – First full-scale municipal treatment at Epe WWTP, and international roll-out

Communication

Stakeholders were consulted during the planning process and post commissioning of Epe WWTP. University, launching customers and Royal HaskoningDHV wrote journal articles and presented conference papers about Nereda® and won numerous awards. In the international roll-out process, Royal HaskoningDHV contracted company Aquatec-Maxcon to market and sell Nereda® in the Australian market.

Ongoing monitoring

The Amersfoort Water Board is responsible for ongoing monitoring, operations and maintenance of the treatment process. Energy consumption and nutrient removal is continually monitored and compared with conventional treatment processes to prove Nereda® is more commercially viable.

ABOVE L-R: Bioreactor in aeration mode. The Nereda clumping solids in action, settling much faster than standard biomass. (Source: Aquatec-Maxcon) Free advertising!

BELOW: The bioreactor in settling mode.

CHALLENGES

The main challenge with this project was the resistance from the Government and host organisation to take a risk on Nereda® until the technology was proven to work at full-scale. Epe WWTP would be the first treatment plant in Europe to use the Nereda® technology.

To overcome this, support was found offshore in South Africa and Portugal to build smaller full-scale demonstration plants in 2008. The plant in South Africa was designed to treat 4 ML per day of high strength influent. Effluent standards were met with the effluent used for off-site irrigation.

Building on the experience of the offshore plant, the first full-scale application using Nereda® was commissioned at the end of 2011.

OPPORTUNITIES

The key opportunities for Nereda® are:

- Lower capital and operational costs.
- Reduction in energy use due to more efficient aeration and batch operation in a one tank concept.
- Small footprint due to higher biomass concentration and absence of settling tanks.
- Little to no chemical consumption.
- Advanced organic waste and nutrient removal.
- Granular biomass allow short settling times.
- Simple operation in remote controlled batch process.

AUSTRALIAN CONTEXT

There is certainly a need for wastewater treatment plants using a smaller footprint, with lower capital and operational costs in Australia. Drivers for the use of this technology in Australia would be the ability to treat the same amount of wastewater to a higher effluent quality, using little to no chemicals and less power.

This technology would be suitable for retrofits and greenfield development within Australia. Royal HaskoningDHV have contracted Australian consultant Aquatec-Maxcon to market and sell Nereda®, as the first step to Australian treatment applications.

While the theory is proven in terms of wastewater treatment, there remains a gap in understanding sludge treatment digestion and dewatering characteristics.

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ABOVE L-R: Presentation by Ronald Niermans on the process. The outflow to the stream.

OPPOSITE PAGE: Image by Tim Buykx - The Nereda bioreactor treatment tanks at EPE.

24

Climate adaptation in Rotterdam, Netherlands

PROJECT

Climate adaptation in Rotterdam

LOCATION

Rotterdam, The Netherlands

ORGANISATION

Municipality of Rotterdam

KEY SUCCESS ATTRIBUTES

- Innovative approach to water management.
- Water as an opportunity rather than a threat.
- Projects at demonstration level are garnering support.

DESCRIPTION

The City of Rotterdam is a port city of approximately 600,000 people and is located 50 km south of Amsterdam in the Netherlands. While Rotterdam is still the busiest port in Europe, large areas of former industrial land are being redeveloped into residential housing. Many existing and redeveloped areas are low lying and susceptible to river flooding and seawater inundation, a situation that is likely to be exacerbated by climate change.

To protect the city from the impacts of climate change in a cost effective and 'liveable' way the Municipality of Rotterdam's Office for Sustainability and Climate Change developed the 'Water Plan 2 Rotterdam' to outline the city's approach to water management.

Water is an integral part of an attractive and liveable city

The 'Water Plan 2 Rotterdam' was created to allow the City of Rotterdam adapt to climate change and ensure it continues to be an attractive city during floods and increased rainfall.

The city focussed on developing a plan that creates a synergy between flood management, water safety, water quality and urban planning.

The philosophy adopted by the city was to consider water in the urban environment as an opportunity to create an attractive and economically strong city.

DISCUSSION

Water Plan objectives:

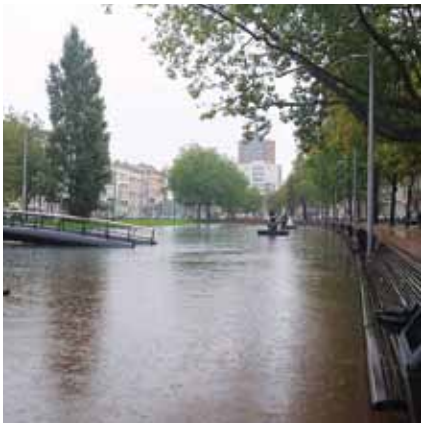
- To be 100 per cent climate proof in 2025.
- Develop an attractive and economically strong city.
- Use holistic approach to water management.
- Create a long term vision and short term action plans.

Five themes of Adaptivity were identified as drivers for new projects working towards the Water plan objectives:

- Flood management.
- Urban water system.
- Urban climate.
- Accessibility.
- Adaptive building.

Working within these five themes, several projects are underway:

- Connecting delta cities to work bilaterally and exchange knowledge.
- Blue solutions' that are multifunctional, for example water storage and residential areas. Creating new space for water using new solutions such as urban floodplains, underground water storage in parking garages– storing water on the surface where needed i.e. water plaza.
- A distributed approach to flood mitigation - rather than constructing a large pipe with a large cost, spread less costs over multiple open drains.
- Green Roofs for an Attractive City project - successfully increased the area of green roofs within the city by 100 square kilometres per year.
- Ecological solutions in the urban area– climate buffers and ecological zones with water storage. Roof park Levee – multifunctional and climate proof.
- Adaptive buildings – e.g. floating building design.
- Flood management – try to use dykes in multiple ways.
- Netherlands water centre – gateway to Dutch water expertise – expo showcasing Dutch knowledge, meeting point.



PROJECT INFORMATION

Drivers

The Water Plan 2 Rotterdam project was driven by the need to protect the city from flooding, rising sea levels and changing river discharges, to redevelop the city and to build the economy.

Funding source

Municipality of Rotterdam.

Delivery time frame

The city aims to be 100 per cent climate proof by 2025.

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CHALLENGES

Public safely and risk management in area of multifunctional use.

The project is at an early stage and while there were no apparent implementation issues, there is likely to be some in the future. The community behaviour and use of the area may bring issues and require management, particularly with regard to flood safety.

OPPORTUNITIES

The projects underway in Rotterdam present an opportunity for innovative research and technology to be applied to solve potential rising water issues. One example of this is the concept of a 'floating city'.

TOP L-R: A multifunctional "blue solution". Dykes and flood storage. Urban parks and flood plain. (Source: Municipality of Rotterdam)

SIDE AND BELOW: Images of a water plaza in various stages of utilisation according to the season and the water levels. (Source: Municipality of Rotterdam)

AUSTRALIAN CONTEXT

Severe flooding experienced in Queensland and parts of New South Wales and Victoria since 2010 have highlighted the need to improve planning and implementation of flood prevention measures in Australia.

The innovative ideas presented in Rotterdam as 'blue solutions' are readily transferable to the Australian water context.

Acknowledgments

Singapore	Geoffrey Stephens from the Industry Development Dept at PUB for co-ordinating the Singapore site visits, and the numerous people who hosted the tour group on the ground
Barking Riverside	We would like to thank Steve Read, Dr Stuart Connop from University of East London and Francesca Barker, London Wildlife Trust, for their presentations and insight as part of the Barking Riverside project.
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Green Park	Andrew Scharf from the Building Management Team of Green Park who organised a tour of Green Park with the key designer and landscape architect.
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Trabrennbahn Farmsen	Jacqueline Hoyer for her time and energy facilitating the site visit at Trabrennbahn Farmsen, as well as her enthusiastic and informative presentation and guidance on the day. Jacqueline has been of tremendous support to the tour and we look forward to continuing the relationship of sharing knowledge and experiences into the future. We would also like to thank the City of Hamburg for providing permission to visit the site. And last but not least, the people of Trabenbahn Farmsen for graciously accepting our presence at their place of residence
Hamburg Water	HAMBURG WASSER and in particular, Kim Augustin and Juliane Ziegler for their hospitality and 'gastfreundschaft'. The morning spent at HAMBURG WASSER was one of inspiring presentations which left the tour group in no doubt that HAMBURG WASSER are world leaders when it comes to new technologies and planning for water sensitive cities
Hafencity	HafenCity GMBH and in particular, Juergen Rux, for taking time to present to the tour group. Juergen provided an interesting and engaging presentation which gave us all an insight into the inspired approach taken to the development of HafenCity as a flood safe and liveable urban environment.
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Rotterdam	Rutger de Graff from the RDM research centre (part of Rotterdam University of Applied Science) who gained support from the City of Rotterdam and the RDM campus to host the Rotterdam Symposium. The tour learnt about Rotterdams transformation into a resilient delta city and Rotterdam municipality's Water Plan and Climate Adaptation Program
Amersfoort	Heino Abrahams, Project Manager at the Amersfoort City Council, Trudy de Mooy, Manager I-centrum, and Joost Koningen, Construction Engineer and Project Leader, West 8 Urban Design and Landscape Architecture. Together they gave the group a good understanding and a great tour of the development.
City of the Sun	Reint Mellema from the Municipality of Heerhugowaard for his hosting of the tour group and his continued dedication to the outcomes at the City of the Sun
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DEUS21	Dipl.-Ing Marius Mohr, Frauenhofer IGB, Stuttgart, for his tour of the DEUS 21 project site in Knittlingen and of his participation in the workshop in Ostfieldern

Appendices

Photography by: Ralf Pfleiderer - Children's playground incorporating a stormwater treatment pond as part of the Arkadien housing development, Stuttgart, Germany.

Appendix A: Tour planning process

WHAT IS THE WATER SENSITIVE CITIES STUDY TOUR?

The Water Sensitive Cities Study Tour is a collaborative 'action' learning and professional development program with objectives to deliver tangible outcomes and innovation back to the Australian water industry.

The 2011/12 study tour comprised 18 water professionals representing 14 organisations across five states, with diverse backgrounds from science and engineering to landscape architecture and policy development.

THE 2012 TOUR BUILDS ON TWO PREVIOUS TOURS:

1. North America and Canada (2005) - this tour focussed on the role of change agents, developed a model for capacity building and initiated what is now known as the 10,000 rain gardens program.
2. Europe (2009) - which delivered a book of ideas for a water sensitive city.

THE KEY OBJECTIVES FOR THE 2012 TOUR ARE

- Evaluate the drivers for integrated water management (IWM) at the city and project scale.
- Determine what tools are being used (policy, regulatory, community input etc.) to achieve change.
- Determine how IWM approaches are being implemented.

THE TOUR BRIEF AS PROVIDED BY CLEARWATER COMPRISED THE FOLLOWING

- Budget - $10,000 per person.
- Travel to another Australian city to review innovative approaches to water.
- Report to the Water Sensitive Urban Design (WSUD) 2012 conference in February 2012 on ideas and success in Australia.
- Travel overseas to further seek examples of cutting edge sustainable and water sensitive cities.
- Report back and engage with decision makers to progress ideas.
- Build a network of emerging leaders in Australian cities who can positively influence the transition to a water sensitive future.
- Draw inspiration from overseas examples of sustainable cities and water management that will influence practices within Australia.

The tour's aim is to strengthen knowledge sharing networks that are critical to bringing about change and adoption of best practice approaches to address the pressing challenges facing cities in Australia and around the world. The tour will aim to address this knowledge deficit and provide decision makers and industry with practical examples of how water projects and policy can contribute to liveable cities (i.e. organisational capacity building and change agent networking). The objectives of the tour support generational change in how Australians use and value water and aid in establishing Australia as a world leader in liveable cities and IWM.

START UP

Applications for the study tour closed in August 2011 with 20 successful applicants. For various reasons, 2 successful applicants withdrew from the group. The kick off meeting was held at the start of September, at which we all met for the first time and began the planning process.

UNIFYING OUR VISION

The first challenge we faced as a group was to condense 18 different perspectives, personal and professional agendas into a single unified vision for the tour. This process presented both a challenge and a unique opportunity to learn how we all functioned and made decisions as a group. After several hours of brainstorming our respective ideas, we settled on the following:

VISION STATEMENT

"United young water leaders come together with a 'can-do' attitude to communicate stories about change, present a blueprint of practical actions for enhancing livability and form a lasting network of leaders and change agents."

KEY THEMES

During the first group workshop, an exercise was undertaken to identify the key elements that make up a water sensitive city. The elements or themes were then used to help identify and shortlist potential projects. Projects that displayed outcomes against many elements were ranked as higher value. This ranking process was aimed at ensuring we got exposure to a maximum diversity of ideas, approaches and technology.

KEY THEMES THAT WERE EXPLORED AS PART OF THE TOUR INCLUDED:

SUSTAINABILITY AND RESILIENCE

Holistic | Footprint | Efficient | Cost effective | Closing the loop | Security | Water neutral | Adaptable | Security

COMMUNITY

Understanding | Involvement | Values | Ownership | Cost | Working together | Partnerships

INNOVATION AND TECHNOLOGY

Solutions | Policy | Portfolio of options | Using the natural environment | Supporting ecosystems | Decentralised | Options / choice | Water, stormwater and wastewater as one | Efficiency | Multiple use | Appropriate use | Alternative water use | Fit for purpose

LIVABILITY

Lifestyle | Amenity | Healthy living | Aesthetics | Well-designed

CATCHMENT SCALE

Ecosystems | Habitat | Catchment scale | Water balance | Balanced system | Integrated landscapes | Human ecosystem | Multiple values | Corridors of blue and green

KEY OBJECTIVES

- Develop our knowledge and learn from great examples.
- Provide input into policy / discussion where the opportunity arises.
- Go beyond Triple Bottom Line for Business Cases.
- Develop a communications plan which focuses on sharing our knowledge, spreading the work, educating the next generation and key campaigns.
- Develop a network and get people engaged in discussions.
- Implement a project planning demonstration.

ABOVE: Another kind of spring day wandering through the woods at the Skogholms änger wetland, Melmo, Sweden.

OPPOSITE: Tour participants enjoying a bicycle tour on a spring day along the Isar River, Munich, Germany.

Appendix B: Post-tour Action Plan

OBJECTIVES OF THE POST-TOUR WORKSHOP REVIEW

- Develop our knowledge and learn from great examples.
- Provide input into policy/discussion where the opportunity arises.
- Facilitate exchange of information on how to achieve good business cases.
- Develop and implement a communications plan which focuses on sharing our knowledge, spreading the word, educating the next generation and development and implementation of key communications campaigns.
- Actively engage in discussions.
- Develop a knowledge transfer network.
- Develop and maintain a professional network (Alumni) – including previous tours.
- Share our knowledge and initiate process for next study tour.

A group discussion was held to identify key actions that the group as a whole could focus on that were achievable. The result of this discussion was the draft Action Plan.

Appendix C: Conference papers

Outcomes of international Water Sensitive Cities Study Tour, Pfleiderer, R, (2012)

ABSTRACT

A national and international study tour was conducted in 2012, to investigate advances in water sensitive urban design. The sites visited, were chosen through the use of six selection criteria that were developed by the 18 study tour participants. The participants visited sites in Melbourne, Sydney and Adelaide prior to visiting sites in five countries in Europe. Of the sites visited, 12 are discussed in detail in this paper. The discussion centres on the aspects of these 12 sites that addressed the selection criteria.

These sites demonstrated a holistic approach to urban development and while there were differences between Australian and European sites that were visited, there are similar drivers directing urban development on both continents. It was concluded from this study tour that the aim for future development in Australia should be toward resource resilience, with water sensitive urban design being a major aspect of resource resilience.

BOLTON, M. 2012.
WATER SENSITIVE CITIES STUDY TOUR FEEDBACK SESSION

Workshop conducted at the 7th International Conference on Water Sensitive Urban Design, 21-23 February 2012

http://www.waterforliveability.org.au/wsud/index.php

ABSTRACT

The WSC Study Tour comprises 19 water professionals that represent diverse professional backgrounds and five Australian states. The group have embarked on a journey of learning and discovery to better define the context, drivers and opportunities for establishing a water sensitive paradigm for Australian cities. The tour objectives encourage collaborative learning and knowledge broking to establish a 'Community of Practioners' to assist the transition to water sensitive cities.

To do this the Tour have synthesised learning and knowledge from within Australia and overseas and have formed a cohesive partnership. The tour is not just about viewing technologies and projects but hearing about how and why organisational and community change occurred and promoting this knowledge across the water industry.

This is the third time such an international WSC tour has been run in Australia with the first being in 2005 and the second in 2009. The previous tours developed valuable partnerships and leadership skills together with a wealth of knowledge. The experiential learning aspects of the WSC Study Tour model creates an opportunity for participants to engage and apply professional understandings through hands-on experience, while simultaneously learning new information from interstate and overseas professionals. Beyond the value of this experience for participants themselves, tour participants also enrich the Australian water industry by bringing the analysis of this experience back to Australia and informing the viewpoints of colleagues, industry and Government.

INGLETON. G, 2012.
OUTCOMES OF INTERNATIONAL WATER SENSITIVE CITIES STUDY TOUR

Presented at ENVIRO 12 Conference, 24-26th July, 2012.

ABSTRACT

In mid 2011 a group of young-ish water professionals were selected to participate in an international study tour for water sensitive urban design. The 19 participants come from 5 States across Australia, all with diverse backgrounds but a common goal, being the implementation of WSUD principles to support the development of liveable cities in Australia.

The tour involves an assessment of Australian examples of WSUD from various States, including site visits and exchange of information about the projects. In May 2012 the group will travel to Europe to visit around 15 sites that represent innovative examples of WSUD. The sites were selected by the participants using a selection criteria that was underpinned by 7 main principles, being community (both social and policy aspects), innovation, livability, catchment scale, technology, sustainability and resilience.

The tour's aim is to strengthen knowledge sharing networks that are critical to bringing about generational change and adoption of best practice approaches to address the pressing challenges facing cities in Australia and around the world.

The presentation will focus on the knowledge gained from the Australian and European site visits, with a view to examining and comparing the drivers, impediments and successes of WSUD projects and importantly how they were implemented. The presentation will conclude with the outlining of strategies developed by the participants to actively progressing Australia as a world leader in liveable cities and integrated water management.

PEXTON. H, 2012.
OUTCOMES OF INTERNATIONAL WATER SENSITIVE CITIES STUDY TOUR

Presented at 15th International River Symposium Conference, 8-11th October 2012.

http://riversymposium.com/wp-content/uploads/B3A_Hannah-Pexton.pdf

ABSTRACT

19 young professionals from 15 water, environment, council and consultancy organisations across 5 Australian states embarked on an international study tour to Europe in May 2012, to build a network of emerging leaders in Australian cities who can positively influence the transition Australia to a water sensitive future. It also aimed to draw inspiration from overseas examples of sustainable cities, waterways and water management to influence practices within Australia. This is the third international tour of its kind, following on from two previous tours in 2005 (USA) and 2009 (Europe) which brought back practical examples and ideas of integrated water management activities and policy initiatives. Following from those, the key objectives for this tour were to evaluate the drivers for integrated water management at the city/project scale, the tools being used to achieve the change (policy, regulatory, community input), and their implementation. Importantly, this tour focussed on "how" to overcome barriers at the institutional, behavioural and technological level and gained valuable ideas, which will be presented. These ideas are also being shared by tour participants to the Australian water, environment and development industries to inform the viewpoints of colleagues, industry and Government.

OPPOSITE TOP: Surfers enjoying the standing wave on the Isar River, Munich, Germany.

OPPOSITE BOTTOM: Resident Geese and goslings in the middle of the Trabrennbahn Farmsen housing development, Hamburg, Germany.

PFLEIDERER,R, 2012.
OUTCOMES OF INTERNATIONAL WATER SENSITIVE CITIES STUDY TOUR

Presented at the 2nd National Stormwater Conference, 15 – 19th October 2012.

http://www.gemsevents.com.au/stormwater2012/Resources/Website%20PDF/Pfleiderer/Outcomes%20of%20the%202012%20Water%20Sensitive%20Cities%20Study%20Tour%20-%20Ralf%20Pfleiderer,%20City%20of%20Melbourne.pdf

ABSTRACT

A national and international study tour was conducted in 2012, to investigate advances in water sensitive urban design. The sites visited, were chosen through the use of six selection criteria that were developed by the 18 study tour participants. The participants visited sites in Melbourne, Sydney and Adelaide prior to visiting sites in five countries in Europe. Of the sites visited, 12 are discussed in detail in this paper. The discussion centres on the aspects of these 12 sites that addressed the selection criteria. These sites demonstrated a holistic approach to urban development and while there were differences between Australian and European sites that were visited, there are similar drivers directing urban development on both continents. It was concluded from this study tour that the aim for future development in Australia should be toward resource resilience, with water sensitive urban design being a major aspect of resource resilience.

INGLETON. G, 2013.
OUTCOMES OF 2012 INTERNATIONAL WATER SENSITIVE CITIES STUDY TOUR. WATER.

Journal of Australian Water Association, Vol 4 No 2, p 72 – 74.

https://www.awa.asn.au/AWA_Water_Journal/

PFLEIDERER, R. 2013.
WHAT MAKES A WATER SENSITIVE CITY - LEARNINGS FROM THE WSC STUDY TOUR 2012,

Presented at the Stormwater Victoria Conference, 7-8th May 2013

http://www.gemsevents.com.au/vic2013/proceedings.shtml

SEXTON, N, 2013
WATER MANAGEMENT AND LIVABILITY: KEY SUCCESS FACTORS FOR CHANGE.

Poster presentation at the 6th Healthy Cities Conference, 17-19th June 2013

ABSTRACT

The water sensitive cities study tour is a collaborative 'action' learning and professional development program with objectives to deliver tangible outcomes and innovation back to the Australian water industry. The 2011/12 study tour comprised 18 water professionals representing 14 organisations across 5 states, with diverse backgrounds from science and engineering to landscape architecture and policy development.

The overarching aim of the tour was to develop leadership and knowledge sharing networks across the different elements of the water industry. This aim recognises that leadership and collaboration are critical to bringing about change and adoption of best practice approaches to address the many challenges facing cities in Australia and around the world. In addition, the tour aimed to provide Australian decision makers and industry experts with practical examples of how integrated water management and policy can enhance the livability and sustainability of our cities.

The objectives of the tour support generational change in how Australians use and value water. They also aid in establishing Australia as a world leader in liveable cities and integrated water management by:

- Evaluating the drivers for integrated water management (IWM) at the city and project scale;
- Determining what tools are being used effectively (policy, regulatory, community input etc.) to achieve change;
- Determining how IWM approaches are being implemented.

Following 9 months of planning, implementation and evaluation, the group identified four key success factors as critical to effecting positive change. The group will present their observations of national and international projects that demonstrated these success factors and reflect on how stakeholders and teams can effectively collaborate to deliver positive change to water management and livability.

Photography by: Tim Buykx - Stormwater Treatment pond, Western Harbour, Malmo, Sweden.

www.wscstudytour.com