



International
Specialised
Skills
Institute



Training for Water Conservation, Infrastructure, Treatment and Management



Michael Anderson

Skills Victoria (TAFE)/ISS Institute Fellowship

Fellowship funded by Skills Victoria,
Department of Innovation,
Industry and Regional Development,
Victorian Government

“When the well is dry, we
know the worth of water.”

Benjamin Franklin, (1706-1790), Poor Richard's Almanac, 1746



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Executive Summary

To fully understand how international water companies, associations and suppliers were maintaining the skills of their staff through training, Michael Anderson visited 22 international water companies in The Netherlands, Spain, the United Kingdom (UK), Israel and Singapore.

The goals of the Fellowship tour were twofold.

First, the Fellow was interested in hearing and seeing how sustainable water use and reuse issues were being addressed, such as:

- water scarcity
- effects of climate change
- population growth
- increased public demand for quality water and low environmental impact.

Second, and most importantly from a training provider's point of view, the Fellow investigated how international water companies addressed training issues in the water industry. In Australia there are several challenges in relation to maintaining a skilled workforce, including:

- an ageing workforce
- difficulty in attracting younger workers
- difficulty in attracting female workers
- impact of new technology
- difficulty of releasing existing workers to participate in training programs.

In short, the Fellow was interested in learning how international organisations develop the skills required to tackle the challenges facing the water industry now and in the future.

Meeting these challenges in a sustainable manner, such as water/energy inter-relationships and operating in a carbon-constrained world, will require new ways of doing things and a training system that can adjust to a rapidly changing water landscape.

While training does not provide a panacea to the challenges confronting the water industry, it does represent a vital part of the overall solution. This Skills Victoria (TAFE)/ISS Institute Fellowship provided an opportunity to gather information and advice on how Australia could apply training strategies to help alleviate skills deficiencies in the water industry.

The water industry is vital to Australia's long-term prosperity. This is recognised by such bodies as the Council of Australian Governments (COAG) and the National Water Commission (NWC). Much of the training effort in the industry in recent years has been in the higher education sector. While many water companies and private contractors do employ trainees and provide technical training for their staff, this is not widespread and technical training is often seen to be a poor 'second cousin' to higher education. In Australia, greater emphasis is now being placed on technical training through the National Water Skills Strategy. International companies are also seeing the need to better address technical training.

The Fellowship tour focused on visits to international locations with different water issues and how they maintained the skills of their workforce given the needs of the country. International water companies, associations and suppliers had significant input into the training systems in each country. While much of this training had been focused on higher education in the past, there is now recognition that technical training is essential as existing workers continue to retire over the years.

Executive Summary

This report outlines the variety of training delivery methods, including on-site and off-site methods, used by training providers and the water companies in the areas visited. It also outlines the funding methods currently available and the level of industry input into training programs in these areas.

The Recommendations included at the conclusion of this report are addressed to the various sectors involved in the water industry, including government, water industry associations and councils, educational institutions, educational staff, Registered Training Organisations (RTOs), experienced workers requiring updated knowledge, and school leavers.

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Abbreviations/Acronyms

AEDyR	Asociación de Desalación y Reutilización del Agua (Spanish Association of Desalination and Reuse)
AFRE	Asociación de Fabricantes de Riego Españoles (Spanish Association of Irrigation Manufacturers)
AGAR	Attached Growth Airlift Reactor
ASAGUA	Asociación Española de Empresas de Tecnologías del Agua (Spanish Association of Water Technologies)
AWA	Australian Water Association
BCM	Billions of centimetres per year
BOD	Biochemical Oxygen Demand
CCTV	Closed Circuit Television
CEDEX	Centro de Estudios y Experimentación de Obras Pública (Spanish Centre for Study and Experimentation)
CITB	Construction Industry Training Board
COAG	Council of Australian Governments
EU	European Union
EUS	Energy and Utility Skills (UK)
H ₂ Oz	Australian Water Association – careers in water ¹
IDA	The International Desalination Association
ICE WaRM	International Centre of Excellence in Water Resources Management
ICOLD	International Commission on Large Dams
IPU	Indirect Potable Use
ISC	Industry Skills Council
ISS Institute	International Specialised Skills Institute
IWA	Israel Water Association
KWR	Watercycle Research Institute (Joint venture of Dutch drinking water organisations)
MEWR	Ministry of the Environment and Water Resources
Mw	Megawatt

¹ http://www.awa.asn.au/H2OZ_careers.aspx

Abbreviations/Acronyms

MFC	Microbial Fuel Cell
NGO	Non-Governmental Organisation
NVQ	National Vocational Qualifications
NWC	National Water Commission
NWP	Netherlands Water Partnerships
PUB	Public Utilities Board (Singapore)
RNWS	Raising National Water Standards
RTO	Registered Training Organisation
SHEA	Safety Health and Environment Awareness
SMEs	Small-to-Medium Enterprises
SWO	Stichting Wateropleidingen
TAFE	Technical and Further Education
UK	United Kingdom
UVW	Unie Van Waterschappen, The Association of Regional Water Authorities, The Netherlands
VET	Vocational Education and Training
VWIA	Victorian Water Industry Association
WIOA	Water Industry Operators Association
WSAA	Water Services Association of Australia

Definitions

Attached Growth Airlift Reactor (AGAR) Process

Aqwise – Wise Water Technologies Ltd. has developed the patented AGAR process (Attached Growth Airlift Reactor). Implementation of the AGAR Process in an existing plant, will allow the plant to increase its treatment capacity, as well as improve its nutrient removal capabilities. The AGAR process, therefore, reduces the cost of upgrading, the project duration, and the area required for additional reactors.

Aquifer

An aquifer is an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) from which groundwater can be usefully extracted using a water well.²

Design

Design is problem setting and problem solving. Design is a fundamental economic and business tool. It is embedded in every aspect of commerce and industry and adds high value to any service or product—in business, government, education and training, and the community in general.

Reference: 'Sustainable Policies for a Dynamic Future', Carolynne Bourne AM, ISS Institute 2007.

Innovation

Creating and meeting new needs with new technical and design styles. (New realities of lifestyle)

Reference: 'Sustainable Policies for a Dynamic Future', Carolynne Bourne AM, ISS Institute 2007.

NEWater

The brand name given to reclaimed water produced by Singapore's Public Utilities Board. More specifically, it is treated wastewater (sewage) that has been purified using dual-membrane (via microfiltration and reverse osmosis) and ultraviolet technologies, in addition to conventional water treatment processes. The water is potable and is consumed by humans, but is mostly used for industry requiring high-purity water.

Safety Health and Environment Awareness (SHEA)

Utility Safety Health and Environment Awareness SHEA (Water) is a sample of one of the products the company Utilise offer.

Skill deficiency

A skill deficiency is where a demand for labour has not been recognised and training is unavailable in Australian education institutions. This arises where skills are acquired on-the-job, gleaned from published material or from working and/or studying overseas.

Reference: 'Directory of Opportunities. Specialised Courses with Italy. Part 1: Veneto Region', ISS Institute, 1991.

There may be individuals or individual firms that have these capabilities. However, individuals in the main do not share their capabilities, but rather keep the intellectual property to themselves. Over time these individuals retire and pass away. Firms likewise come and go.

² <http://en.wikipedia.org/wiki/Aquifer>

Definitions

Stichting Wateropleidingen (SWO)

The Dutch Stichting Wateropleidingen is a training institute for water management.

Sustainability

The ISS Institute follows the United Nations for Non-Governmental Organisations' definition on sustainability: *"Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"*.

Reference: http://www.unngosustainability.org/CSD_Definitions%20SD.htm

Unie van Waterschappen

The Dutch Association of Regional Water Authorities.

Wateropleidingen

The Dutch World Water Academy.

Acknowledgements

Michael Anderson would like to thank the following individuals and organisations who gave generously of their time and their expertise to assist, advise and guide him throughout the Fellowship program.

Awarding Body – International Specialised Skills Institute (ISS Institute)

The International Specialised Skills Institute Inc is an independent, national organisation that for over two decades has worked with Australian governments, industry and education institutions to enable individuals to gain enhanced skills and experience in traditional trades, professions and leading-edge technologies.

At the heart of the ISS Institute are our Fellows. Under the **Overseas Applied Research Fellowship Program** the Fellows travel overseas. Upon their return, they are required to pass on what they have learnt by:

1. Preparing a detailed report for distribution to government departments, industry and educational institutions.
2. Recommending improvements to accredited educational courses.
3. Delivering training activities including workshops, conferences and forums.

Over 180 Australians have received Fellowships, across many industry sectors. In addition, recognised experts from overseas conduct training activities and events. To date, 22 leaders in their field have shared their expertise in Australia.

According to Skills Australia's 'Australian Workforce Futures: A National Workforce Development Strategy 2010':

Australia requires a highly skilled population to maintain and improve our economic position in the face of increasing global competition, and to have the skills to adapt to the introduction of new technology and rapid change.

International and Australian research indicates we need a deeper level of skills than currently exists in the Australian labour market to lift productivity. We need a workforce in which more people have skills, but also multiple and higher level skills and qualifications. Deepening skills across all occupations is crucial to achieving long-term productivity growth. It also reflects the recent trend for jobs to become more complex and the consequent increased demand for higher level skills. This trend is projected to continue regardless of whether we experience strong or weak economic growth in the future. Future environmental challenges will also create demand for more sustainability related skills across a range of industries and occupations.³

In this context, the ISS Institute works with Fellows, industry and government to identify specific skills in Australia that require enhancing, where accredited courses are not available through Australian higher education institutions or other Registered Training Organisations. The Fellows' overseas experience sees them broadening and deepening their own professional practice, which they then share with their peers, industry and government upon their return. This is the focus of the ISS Institute's work.

For further information on our Fellows and our work see www.issinstitute.org.au.

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³ Skills Australia's 'Australian Workforce Futures: A National Workforce Development Strategy 2010', pp. 1-2
http://www.skillsaustralia.gov.au/PDFs_RTFS/WWF_strategy.pdf

Acknowledgements

Fellowship Sponsor

The Victorian Government, Skills Victoria is responsible for the administration and coordination of programs for the provision of training and further education, adult community education and employment services in Victoria and is a valued sponsor of the ISS Institute. Michael Anderson would like to thank them for providing funding support for this Fellowship.

Supporters

- Australian Water Association
- Chisholm Institute of TAFE
- Clean TeQ Limited – provider of water treatment technology
- International Specialist Skills Institute, Inc (ISS Institute)
- South East Water
- Water Industry Operators Association
- Water Services Association of Australia
- Jackie Dean, Training Manager, Severn Trent Water, United Kingdom (UK)
- Avital Dror-Ehre, Manager, Ra'anana Municipality's Waste Water Treatment Plant, Israel
- Ruth Khan, Public Utilities Board (PUB), Singapore
- Udi Leshem, Vice President Business Development, Aqwise
- Agnes Maenhout, Managing Director of Wateropleidingen, The Netherlands
- Roy Neijland, The Netherlands Water Partnerships
- Reinier Rutjens, Education Manager, Unie van Waterschappen (UVW), The Netherlands
- Ronen Shechter, Chief Technology Officer, Emefcy, Israel
- Shimon Tal, President, Israeli Water Association and private consultant for water and energy
- Sylvain Usher, Secretary General, African Water Association

Mentors

Industry Mentor

Peter Voigt, Executive Director and Chief Technology Officer, Clean TeQ Limited

Report Mentor

Maryanne Barclay, Professional Development Co-ordinator, Chisholm Institute of TAFE

Workplace Mentor

Malcolm Macpherson, Director – Centre for Sustainable Technologies, Chisholm Institute of TAFE

Employer Support

The aim of the Fellowship study tour was to gain contemporary international knowledge of the learning and development strategies and practical systems of water infrastructure, treatment and management companies. This is of immediate, substantive and practical benefit to the water industry in Victoria, as selected higher education institutions develop their relationships, training systems and courseware to strategically address identified skills shortages and deficiencies.

Acknowledgements

The government and community needs for water security will directly benefit from this Fellowship in the long term, and strong industry and provider relationships will ensure the immediate, direct transfer of relevant knowledge to the Victorian industry and other Vocational Education and Training (VET) providers.

Organisations Impacted by the Fellowship

- Australian Water Association
- Chisholm Institute of TAFE
- City West Water
- Gippsland Water
- Goulburn-Murray Water
- Grampians, Wimmera Mallee Water
- Melbourne Water
- South East Water
- South Gippsland Water
- Southern Rural Water
- The wider TAFE and VET sector
- Water Industry Operators Association
- Water Services Association of Australia
- Westernport Water
- Yarra Valley Water

About the Fellow

Name: Michael James Anderson

Employment

- Chisholm Institute of TAFE

Qualifications

- Graduate Certificate in Leadership (Chair Academy), Victoria University, 2008
- Certificate IV in Workplace Training and Assessment, Swinburne University, 2003
- Microsoft Certified System Engineer, Swinburne University, 2000
- Project Management for Workplace Training, Victoria University, 1995
- Bachelor of Education (Business) University of Melbourne, 1991

Memberships

- Australian Water Association

Brief Biography

Michael Anderson is committed to developing and using his skills and experience in the education and training sector.

Prior to beginning a career in education and training in 1992, the Fellow was employed in the water industry in the area of water and sewerage reticulation. He ran a small earthmoving and drainage company for two years, also working in water and sewerage and stormwater.

His vision for this Fellowship was to study water industry training in an international context and to learn about the clever technologies and strategies that international companies are employing in water reuse programs that exhibit both low energy use and low environmental impact.

Further to this, the Fellow intends to continue to build networks within the international water sector to benefit the Australian water industry. He will disseminate the information gained by integrating international best practice into staff training and by presenting the lessons learnt to both industry and TAFE sector forums.

The Fellow has worked in the TAFE sector for the past 17 years in a number of roles including teaching, small team management and, most recently, as a project manager at the TAFE Development Centre. He is a regular overseas traveller and is very comfortable working with people of other nationalities. He also has a strong background in developing enduring partnerships and networks. After a 17-year career as a trainer and project manager, he is now the Project Manager of the Chisholm Institute of TAFE Water Industry Initiative.

Having worked as a small business owner, as a project manager, and as a teacher, the Fellow has the necessary interpersonal and communication skills to act as an ambassador for the ISS Institute, the water industry, Chisholm Institute of TAFE and the wider VET sector.

Key and Relevant Successes

- Successfully applied for funding to develop a Centre for Sustainable Water Management (\$8.2 million).
- Developed a training plan for the Queensland Water Directorate to deliver water industry training in south-east Queensland.

About the Fellow

- Developed a training plan for the Melbourne metropolitan and rural water authorities to deliver civil construction training.
- Liaised with Skills Victoria regarding developing a water industry training alliance in Victoria. This culminated in a \$1 million addendum to the Chisholm Institute of TAFE Performance Agreement under the Victorian Government's Jobs for the Future Economy initiative.
- Developed and managed the delivery of water operations training for the Queensland Water Directorate in Queensland.

Aims of the Fellowship Program

The goals of the Fellowship tour were twofold:

First, to determine how international water companies addressed sustainable water use and reuse issues, such as:

- water scarcity
- effects of climate change
- population growth
- increased public demand for quality water and low environmental impact.

Second, to investigate how they addressed training issues in the water industry. In Australia we are facing several challenges in relation to maintaining a skilled workforce. These include:

- an ageing workforce
- difficulty in attracting younger workers
- difficulty in attracting female workers
- impact of new technology
- difficulty of releasing existing workers to participate in training programs.

In short, the Fellow was interested in learning how international organisations developed the skills required to tackle the challenges facing the water industry now and how they planned to do so in the future. The Fellow visited water industry companies in countries regarded as world leaders in the provision of water industry services. These included The Netherlands, Spain, England, Israel and Singapore.

Chisholm Institute of TAFE, is a major provider of education and training programs in Melbourne's fast-growing south-east. Programs in sustainable resource management, including horticulture and water technologies are based at the Cranbourne campus.

Benefits to Australia of this Fellowship Program

In work undertaken for Skills Victoria early in 2008, the Victorian Water Industry Association (VWIA), the Industry Advisory Board, and Access Economics identified a number of key business cycle and industry-specific drivers likely to effect change in the water industry in the near-term and medium-term future.

Climate change (rainfall yields are often reported as collapsing dramatically, between 30% to 70%), rapidly growing populations and changing demographics, together with the need to provide additional environmental flows for stressed rivers are all challenges facing society in general, and the water industry in particular. Meeting these challenges in a sustainable manner, by developing water/energy inter-relationships, and operating in a carbon-constrained world will require new ways of doing things and a training system that can adjust to a rapidly changing water landscape.

While training will not provide a panacea to the challenges confronting the water industry, it does represent a vital part of the overall solution. This Fellowship enabled the Fellow to provide information and advice on how Australia could apply training strategies to help alleviate skills deficiencies in the water industry, which will enable the industry to cope with future challenges.

The learning strategy was to frame questions around the description of what the Fellow would be investigating as stated at the beginning of this section. The information gained was then collated into this report and a presentation format available through ISS Institute developed for dissemination to government, the water industry and the wider VET sector.

The Australian Context

Current Situation in the Australian Water Industry

Nationally, the water industry employs approximately 44,000 staff and is experiencing skill shortages and skill deficiencies across each of its sectors, particularly in the following roles:

- water treatment operators
- waste water operators
- electricians
- engineers
- technical officers.

The water industry will continue to provide a fundamental service to communities and enterprises across a dry continent. Concerns about water conservation and water quality standards are raising the profile of the industry in Australia. The industry is also undergoing significant change due to new technology, such as telemetry, information systems and water treatment equipment.⁴

Council of Australian Governments (COAG) Water Skills Audit and Strategy

The COAG Working Group on Climate Change and Water recognised the importance of skill and capacity shortages. In line with its recommendations, a COAG sub-group was established to develop a program on human resources, skills and knowledge.

Having commissioned a skills audit, this group developed a national strategy to address the gaps (deficiencies) identified and build knowledge and research capacity. At the time of writing (September 2010) the draft business plan to implement the national water skills strategy had been developed.⁵

National Water Commission (NWC) Skills Projects

In 2007–08, through five Raising National Water Standards (RNWS) program projects amounting to \$A4.5 million, the Commission contributed to improving water industry knowledge, information and skills.

Projects underway include:

- A graduate course in water planning and a national water sector skills project.
- \$A1.231 million for a National Water Skills Resource Project to develop consistent standards and resources for the training and assessment in accredited courses for improved water management in Australia.
- \$A80,000 for an Australian Groundwater School review of teaching resources project to improve education materials for groundwater professionals.
- A Fellowship research program in priority areas relevant to implementation of the areas of concern.⁶

Government Policy and Regulatory Requirements

The responsibility for natural resource management, particularly water resources, has taken on a new urgency and national focus with the recent experience in Australia of drought and climate change.

⁴ http://www.careergov.com.au/index.php?option=com_sm2careergov&task=showjobsector&Itemid=100&readmore=1&jobsectorid=5

⁵ <http://www.nwc.gov.au/www/html/271-water-industry-skills.asp>

⁶ <http://www.nwc.gov.au>

There is an increased emphasis by government on:

- water quality
- water source management (measuring)
- asset management.

The establishment of the National Water Commission (NWC) and the introduction of legislation to regulate water management have set new standards for water management and systems. This has focused the attention of COAG on the need for State and Territory Governments to introduce a national and consistent approach to water testing, measurement and reporting.

The NWC has continued its push for improved national water quality and accountability with backing from governments, industry leaders and scientific experts. Industry has responded by requesting that these new requirements, particularly the move to certification of water operators, be reflected in the national qualifications.

Research

Ongoing research into the interactions between training providers and the water industry being carried out by the International Centre of Excellence in Water Resources Management (ICEWRM) and the Australian Water Association (AWA) focuses on higher education and postgraduate programs. The draft business plan for implementation of the national water skills strategy is also focussing on technical training (September 2010).⁷

The Water Services Association of Australia's (WSAA's) assessment of skills deficiencies in the urban water industry (March 2008) identified the main current skills deficits to be:

- keeping abreast of developments in science and technology
- environmental sustainability
- technical skills, such as environmental engineering and process technology, water quality, wastewater and biosolids
- leadership and a range of 'people skills' (Managers and Professional Engineers)
- strategic thinking, business planning and risk management.⁸

A selection of the main providers in the industry and the training they provide follows. This list does not include organisations such as Melbourne Water that do their own on-site training:

- Chisholm Institute of TAFE
 - Short courses for the construction industry in pipe laying, trenching and compliance.
 - Certificate II in Water Operations for trainees.
- Civil Contractors Federation
 - Certificate III in Civil Construction.
 - Construction auditors one-day course.
- Deakin University
 - Graduate and postgraduate courses for engineers.
 - Deakin University's Water Industry Training Centre
 - Water treatment up to Certificate III in Water Operations.

⁷ Preliminary Water Industry Interaction with Universities Survey – April 2008

⁸ WSAA Occasional Paper No. 21 – An Assessment of the Skills Deficiencies in the Urban Water Industry

- Goulburn Ovens TAFE
 - Provide training in rural irrigation.
- Victoria University
 - Course for water industry technical officers with a traineeship with City West Water.
- University of Ballarat
 - Training in civil construction, mostly on-site assessment.

SWOT Analysis of the Australian Water Industry

Strengths

- The water industry is now seen as vital to Australia's prosperity.
- Water issues are front-of-mind for Australians and Australian companies.
- There are many infrastructure projects conducted in partnership with public and private sector organisations.
- A skilled workforce.

Weaknesses

- Low rainfall due to climate change.
- Poor water use in the past (now being rectified).
- Reduced run-off going into traditional storage facilities due to low rainfall.
- A limited career path in the industry.

Opportunities

- Significant government funding for infrastructure projects.
- Opportunities to sell Australian expertise internationally.
- Highly developed water reuse programs already implemented and the high possibility of exporting these.
- Ability to market the water industry as a vocation of choice to school leavers.
- Minimum competency standards for water treatment operators.

Threats

- An ageing workforce.
- The skills deficiencies in areas of new technology.
- An ageing infrastructure.
- Little formal training available.
- Limited RTOs that currently train in a wide range of Water Industry Training package competencies.
- The water industry is not seen as a career of first choice for school leavers.

Identifying the Skills Deficiencies

The primary focus of this Fellowship was to learn about water industry training in an international context. However, the Fellow also wished to learn about the clever technologies and strategies being used by international companies to manage water with low environmental impact in the context of climate change. While his focus was on how each particular company was maintaining the skills of its staff through training and other strategies, he was also able to learn about general water issues in the countries visited. For a more comprehensive outline of what the Fellow learnt, visit the water industry blog site: <http://watertraining.wordpress.com/>.

The Fellow advised each of the companies he visited that his interests were under the following general categories:

1. Grey Water and Storm Water Reuse Programs (Recycled Water)

There is an increased awareness of the need to reduce the use of potable water for such things as domestic gardens, toilets and industrial use. This requires dual water distribution systems and enhanced treatment processes.

Aim: To gain skills and knowledge on how world leaders in water industry innovation are using recycled water to replace potable water.

2. Environmentally Friendly Brine Disposal

While treatment processes are improving and the use of recycled water is increasing, this presents the problem of what to do with the brine that is taken out of the water. This often contains heavy metals and other contaminants and must be disposed of in a way that doesn't impact adversely on the environment.

Aim: To compare what we do with brine in Australia to how other countries are able to use brine for such things as fertilisers, compost, to generate energy and as a road base.

3. Energy Conservation in Water Treatment Plant Equipment

The technologies used in the treatment of water, such as desalination and demineralisation are well developed. In particular, the problem associated with the reverse osmosis technology, is that it is incredibly resource intensive. A challenge for the water industry is how to offset the power use with renewable forms of electricity.

Aim: To evaluate how world leaders in water industry technologies are applying renewable energy strategies to the treatment of water.

4. Appreciation of the Sensitivity of the Environment in Relation to how Operations (Sewerage Spills etc.) can Effect the Environment

Currently water treatment operators do an extremely capable job of treating water, but they are less aware of the downstream implications of their processes.

Aim: To see how international water companies train their staff to have an appreciation of the risks associated with their treatment processes.

5. Design and Planning of Water and Waste Water Collection and Distribution Systems

The use of recycled water requires newly designed water distribution systems. This is currently being implemented by dual pipe systems, which are presenting challenges for the civil construction industry. There are issues associated with these systems; when there are two pipes in the one trench pipes can become blocked and blow-outs can occur.

Identifying the Skills Deficiencies

Aim: Training in this area needs to be developed, as all new subdivisions are required to have dual pipe systems. Countries like The Netherlands, Spain and Israel use recycled water to a greater extent than Australia currently does and they have already tackled these challenges.

6. More Efficient Water Resource Management and the Impact of Climate Change

Australia has implemented water efficiency programs, such as Victoria's Target 155, and the industry has developed more water efficient technologies. Most of the big gains in water efficiency have now been made. Any new programs will be marginal in their impact on water efficiency.

Aim: To compare Australia's water efficiency programs with how other countries are tackling the challenges of lower rainfall and reduced runoff.

The International Experience

The Fellow visited 22 organisations in various locations including The Netherlands, Spain, England, Israel and Singapore.

This section of the report highlights:

- Why these locations were chosen.
- An overview of the water system and water related issues highlighted in each country.
- The core business and activities of the individual companies visited.
- The Fellow's response to the information about how international water companies are maintaining the skills of their workforce.

While the primary focus of the Fellowship was on identifying how international water companies maintain the skills of their staff, the Fellow also learnt how international water companies are tackling contemporary issues through innovation and technology.

In Attachment 1 the Fellow has identified the clever technologies and strategies that international organisations are employing to mitigate the impact of climate change and water scarcity in a low-energy, carbon-constrained environment.

Attachment 2 outlines the international locations, and Attachment 3 details the itinerary and the water industry specialists the Fellow visited. As stated above, the Fellow endeavoured to cover a broad cross section of the international water industry in order to gain the best possible exposure to water industry training in an international context.

For more information on any of the investigations and findings of this Fellowship program, please contact the Fellow, Michael Anderson, via ISS Institute.

Why These Locations Were Chosen

The Fellow consulted widely with the Australian water industry about their training needs and the types of plant and equipment, and training infrastructure that would service the needs of the water industry. This resulted from the Fellow's involvement in building the Centre for Sustainable Water Management at Chisholm Institute of TAFE. Everywhere he visited in Australia, and everyone he met with highlighted different water issues. These issues differed according to the environment, geography and other local factors that affected the water system.

When planning water industry visits in international locations, the Fellow identified proposed locations that had different water issues. For some countries it was water scarcity, for others too much water, or plenty of water, but in the wrong places. The countries the Fellow visited are recognised as world leaders regarding water management and technology and they had a range of water issues. They represented the perfect environment in which to study a diverse range of water industry training strategies and water industry technologies.

The Netherlands

The Fellow chose The Netherlands, where water security (protection from the sea and rising rivers) and also saltwater intrusion into inland water ways were of prime concern.

Spain

In Spain, with a climate and environment very much like Australia, the problem was scarcity of water and the impact of 60 million tourists a year. As 85% of the country is involved in the production of agriculture, water distribution and moving water around the grid present a problem, especially since the country rises sharply from sea level on the coast to very high above sea level near Madrid. The highest point in Spain is Pico de Teide, which is 12,198 ft (3,718 m) above sea level, in the Canary Islands.

The International Experience

United Kingdom

In the UK, London's water supply is strained during summer. This led to a desalination plant being built that runs on biofuel (cooking oil). London also has the added difficulty of disposing of the sludge generated by 16 million people in a relatively small island nation.



The International Experience

Israel

Israel has turned an arid environment into arable land via advanced irrigation strategies and is also heavily involved in advanced waste water treatment technologies and generating energy from sludge.



Singapore

The Fellow's final destination, Singapore, was chosen because, of all the countries visited, it was the only one with a 'closed' water system. In other words, it generates new water from treated effluent, which is then mixed with the nation's drinking water supply. Many of the countries visited have indirect potable use of water, but Singapore has the only planned potable use of treated effluent.

The Fellow also had an opportunity to attend the Africa/Spain of Water Congress. One of the main issues in Africa is that they have ample water, just in the wrong places. Sixty-two per cent of the population live in rural areas with severely inadequate infrastructure. This means that there is an inability to move the water to where it is needed. Sylvain Usher, Secretary General, African Water Association, reported at the congress that in approximately 40 African countries the access to adequate sanitation is lower than 50%.⁹

⁹ Powerpoint presentation by Sylvain Usher, Secretary General, African Water Association, Africa/Spain for Water Congress, Madrid, June 2010.



Water Management in International Locations

The Netherlands

The Netherlands is a country that is highly susceptible to both rising sea levels and river flooding, with 55% of the country at risk. This flooding occurs where 60% of the country's population lives and where 65% of its Gross National Product is produced.

The Dutch water system is characterised by:

- 16 million customers
- 125 litres per capita/day
- 60% of water harvested from groundwater
- 40% surface water, mainly in the western part of The Netherlands
- Water is treated to a potable standard either via direct treatment or after soil passage (artificial recharge).

Threats:

- A projected sea level rise of between 85 and 130 cm by 2100 threatens the Dutch coastline.
- Increased risk of flooding from the Rhine river, which may damage infrastructure and increase chemical and microbiological risks to the groundwater quality.
- The decline of water quality during low river flows in summer droughts.
- Low river flows increase seawater intrusion through the Rotterdam Waterway creating a threat to abstraction points.
- Salinisation of fresh water abstraction point in the Rhine estuary due to low river flows.

And of course, climate change has strong (actual and potential) impacts on water supply in The Netherlands. For example:

- The physical threat to production facilities.
- The decline of water quality during floods and droughts.
- Salinisation of river deltas and coastal aquifers.

Spain

Water supply and sanitation in Spain are characterised by universal access and generally good service quality, while tariffs are among the lowest in the European Union (EU). About 60% of the population is served by private water companies, which operate under concession contracts with local municipalities.

Droughts affect water supply in southern Spain, which is increasingly turning towards seawater desalination to meet its water needs.

Another factor is the demand of a growing population, which will be greater than 49 million by the year 2018 according to the National Institute of Statistics, Spain. Included in this population growth is a current annual influx of over 60 million tourists and the need to supply more water to remote areas for both urban and agricultural purposes. This is making the need to reuse water a major issue.

Other factors relating to the need to reuse water resources more extensively include:

- An increase in arid areas: a third of Spain is expected to become barren (desert).
- Exploitation of aquifers: 65.6% of water is surface water.
- The special requirements to supply water to islands such as the Canary Islands and the Balearic Islands, both major offshore tourist destinations.

United Kingdom

According to the United Kingdom (UK) National Environment Agency, water resources are already under pressure in many parts of England and Wales. Recent figures from this agency suggest about 25 million people in England live in areas where there is less water available per person than in Spain or Morocco, and the situation is expected to become worse over the next few decades, particularly in the densely populated south east.

The global population increase that will affect water resources at a macro level will also be felt in the UK. By 2020, demand for water in the UK could rise by five per cent, or 800 million litres, every day. Forecasts of a population increase of about 15 million by 2051 will strain resources even further.

In England, effective planning and management of water resources is essential now and in the future if sustainable development is to be ensured. There are major challenges ahead including:

- Providing adequate water supplies for the projected large growth in population and housing.
- Taking action to make water abstraction more sustainable and compliant with EU legislation.
- Adapting to and mitigating the effects of climate change, which will be substantial.

Israel

Water shortage was a common feature of all the parties in the region (Jordan, Palestine and Israel). These countries also shared mutual natural water resources. Therefore, the Fellow concluded that it was impossible to manage the water sector in one country separately from the regional water problems. This region is on the edge of the desert and extreme changes in the climate are common.

Natural water resources in the region can supply around 200 cubic metres per capita every year. This quantity of water is only 40% of the Shortage Red Line, the line determined by the United Nations as the quantity of water that represents a severe shortage of water. In 20 years natural water resources will only be able to satisfy the domestic and municipal demand if action is taken now. Israel will not be able to satisfy the overall demand for food, to sustain environmental values or to develop places of work.

Shimon Tal, past Israeli Water Commissioner, stated that even if Israel uses the regional natural water resources efficiently (2.65 Billions of centimetres per year [BCM]) and reuses all the sewage effluents mainly for agriculture, it will still incur a water shortage of 1.3 BCM of fresh water. This means that the region has to produce new freshwater resources, 50% more than the average yield of the natural water resources. Currently, Israel relies on unconventional water resources, including reclaimed water and, more recently, seawater desalination for about 20% of its water supply.

The Sea of Galilee and the Coastal Aquifer are Israel's main water storage facilities, with a combined storage capacity of about 2 BCM. The coastal aquifer is used as underground storage.

Singapore

The water resources of Singapore¹⁰ are particularly precious given the small amount of land and territory in Singapore's geography¹¹ and a large urban population.¹²

Without natural freshwater lakes, the primary domestic source of water in Singapore is rainfall, collected in reservoirs or water catchment areas. Prior to the opening of the Marina Bay reservoir, rainfall supplied approximately 30% of Singapore's water. This has now increased to about 47%, due to the additional catchment area.

¹⁰ <http://en.wikipedia.org/wiki/Singapore>

¹¹ http://en.wikipedia.org/wiki/Geography_and_climate_of_Singapore

¹² http://en.wikipedia.org/wiki/Demographics_of_Singapore

Today, the nation has a diversified and sustainable water supply from four different sources known as the Four National Taps, which include water from local catchment areas, imported water, reclaimed water known as NEWater and desalinated water.

By integrating the system and maximising the efficiency of each of the Four National Taps, Singapore has ensured a stable, sustainable water supply capable of catering to the country's continued growth.

Training Within International Water Companies

International water industry training has a significant input from water industry companies and associations, with on-the-job training and training delivered by existing water industry workers. This section outlines how water industry training is conducted in the countries visited from a historical perspective and the reasons behind the industry becoming more heavily involved in training.

The Australian water industry is highly regarded in all the places visited for its governance and its ability to ensure all the sectors of the industry communicate and work cooperatively. With the exception of Singapore, where the Public Utilities Board (PUB) governs water, waste water and storm water, the companies visited in The Netherlands, Spain, Israel and England, all described their water industry as being slightly disjointed but as having the desire to work more cooperatively between the various sectors.

For example, there are now 26 water boards in The Netherlands. The water boards run a total of 390 treatment plants and have a total of approximately 10,000 staff. About one-third of these staff are involved in water treatment, the rest are involved in water management and water security. Municipal organisations collect sewerage for treatment or disposal.

The Dutch water industry consists of many companies, all involved in a wide variety of different activities. Unie van Waterschappen (UvW), The Dutch Association for Regional Water companies works closely with these various companies. The main function of the UvW is to influence policy making, both in The Hague and in Brussels. They also do regular benchmarking to show the various stakeholders what is working and is, therefore, good policy, and what is not. European countries, such as Holland, also have the added problem that their water systems are connected to the water systems of other countries. For example, most of the river water in Holland comes from Germany. In the lower reaches of the Rhein in Germany there is a lot of manufacturing and other heavy and light industry that takes place. This results in the water that comes from the Rhein being somewhat polluted by the time it flows into Holland.

There is also a European framework for water quality and it is part of UvW's role to have input into, and to influence, that framework.

In another collaborative effort, the Dutch drinking water companies have pooled their resources to employ and support a research company. KWR Watercycle Research Institute began as a research institute focusing on drinking water but has now moved into research into the entire water cycle.

Likewise, in Spain, associations such as the Spanish Association of Water Technologies (ASAGUA), Spanish Association of Desalination and Reuse (AEDyR) and the Spanish Association of Irrigation Manufacturers (AFRE) are working collaboratively on a variety of projects with Spanish water companies to share knowledge. AFRE are also working with the African Water Association on in-country irrigation and water distribution projects in Africa.

For example ASAGUA, an association of companies committed to a sustainable world are convinced that the protection and conservation of water is a priority for our society. ASAGUA companies want to be an instrument for all government and private sector companies to achieve more efficient management of water resources, and to this end, have decided to join forces to multiply their capabilities.

In England, water companies such as Thames Water and Severn Trent are working together to develop training programs and to arrange viable groups to undergo training. Finally, in Israel, Shimon Tal, president of the Israeli Water Association describes the water system in Israel as slightly disjointed but having a desire to work cooperatively within Israel. Importantly for this area of the world, this includes other countries in the region, such as Palestine and Jordan, with whom they share water resources, to better manage the water system.

Industry Input Into Training Programs

Industry input ranged from companies setting up, and to some extent funding, the training organisation, through to working with technical and tertiary training organisations to influence the training programs. For example, Wateropleidingen (the World Water Academy) in The Netherlands was set up by the drinking water companies to provide training in water systems, production and distribution of drinking water, sewerage and waste water treatment. The academy was established to maintain the skills of the drinking water companies' workforce. It has since been expanded to provide training in waste water management and also to run leadership and communication programs for water industry workers.

In the past, in countries like The Netherlands, Spain and Israel, training efforts were focused on higher-level graduate and postgraduate programs for engineers rather than on practical training for technicians. In order for new staff to work as technicians, it was assumed they had gained the necessary technical skills in other areas, and that they would learn on the job once they joined the water industry. This has led to a shortage of skilled technicians in the industry.

For example, Reinier Rutjens, Education Manager from the UVW in The Netherlands stated:

"In the fairly recent past, technical training in Holland was not well catered for and technicians mostly learn[ed] on the job. We are now paying for the lack of training in technical skills and not introducing new workers to the industry. The water industry generally took on staff in their 30s who had been working as technicians in other industries, and neglected new entrants. Skills are now largely held in an ageing demographic and we are needing to focus more now on technical training. Wateropleidingen, which was established by the drinking water companies, has a role to play and caters for the skills required for that industry, not so much into water distribution or water security".

UVW is now putting some effort into ensuring that what is being offered at schools and knowledge institutes is what is required by the industry. They are also trying to influence the curriculum at universities. In Holland, they don't seem to have a TAFE equivalent; they still have a technical school sector where trades are taught. There are also training academies like Wateropleidingen in various industry sectors.

Companies in the Australian water industry, European companies, UK companies and Israeli companies are all experiencing skills shortages. Singapore did not have the same level of anxiety about needing to replace an ageing workforce, even though the average age of water industry workers in Singapore was as high as the other countries visited (between 45 and 50). The PUB in Singapore has a high degree of input into pre-vocational programs delivered by polytechnic institutes. Water companies and the PUB can then select graduates of these programs for employment in the water industry. The water industry is marketed as a green, sustainable industry and there is a high level of competition for available places.

In the UK the same skills shortages exist even though they do not have much difficulty attracting younger workers. Water Industry Worker is a job title in the UK and young workers can do apprenticeships in field operations, networks, processes and metering. The problem in the UK is that they are not keeping up with the number of retirees. At Thames Water they will have 120 retirees in 2010, and, with an ageing workforce, this trend is set to continue.

Most international water companies and associations have significant input into the training system due to skills shortages and the fact that most of the skills and experience is held by an ageing demographic. However, in Spain and, until recently, in The Netherlands, this training seemed to be at postgraduate level rather than at a technical level. In Spain and The Netherlands it is assumed that workers will have the technical skills before they are employed and that they will learn the specifics of the work on the job. This is changing in The Netherlands with providers such as Wateropleidingen delivering water industry training to existing workers. In Spain, companies such as Veolia Environmental Services, Socamex SA and Isolux-Corsan SA run their own internal programs for staff. This is mostly non-accredited training on the specific plant and processes employed by the company. Accredited training would enable more mobility between companies, if that was desired, but with the current skills shortages, specific non-accredited training may be more appropriate.

For example, about one-third of training at Wateropleidingen is accredited training that leads to a diploma qualification and the rest is non-accredited training (one- to two-day courses). If workers do participate in diploma level training, they can get incremental advancement in the company, based on their advanced skills. The award is granted by the water boards rather than the Dutch Government.

Difficulty in attracting younger workers is fairly universal in the water industry. In every country visited they used the same or similar words: *"the water industry not seen as sexy"*. These international water companies are now focusing on describing the water industry as sustainable and environmentally friendly and promoting the industry as a viable career choice.

Roy Neijland from The Netherlands Water Partnerships stated:

"The paradox is that The Netherlands and water are closely integrated and can't be separated and everyone knows it, but it is seen to be going on in the background (dykes, dunes, etc.) and is not seen by the general public as an industry".

The PUB in Singapore provides scholarships and awards for excellence in order to attract and retain younger workers. The PUB also works closely with polytechnic institutes, and in many cases develops programs which are delivered by the polytechnic institutes. This enables Singapore training providers to deliver pre-vocational courses. This means that staff begin working at the PUB already equipped with some water industry knowledge.

The president of the Israeli Water Association, Shimon Tel is responsible for promoting the professionalism of people working in the water industry. This includes the maintenance of a skilled workforce. Tel believes in promoting the water industry as a profession with an identified career path. The Israeli Water Association is working with treatment plants, such as Ra'anana Municipality's Waste Water Treatment Plant, to develop programs in water quality testing, water treatment, sewerage treatment and water resource management.

As seen in Australia, water companies in Europe and the UK have been privatised and most of their functions outsourced. The large water companies like Thames Water still have training programs for staff, although they engage private training providers, generally consisting of ex-water industry workers, to deliver the training. There are some companies like Wessex Water and Severn Trent Water that still hire direct labour. Generally, sewerage workers will be hired for direct labour in UK water companies and the rest of the employees will be outsourced. But, at Wessex Water and Severn Trent Water, water treatment and distribution workers are also hired for direct labour. These companies still maintain a strong training culture and have their own training facilities and training departments, only outsourcing some of the actual delivery. Wessex Water, for example, has a very large training centre in Yeovil and workers come in for regular training.

The shortage of industry experts in Spain has led to the industry becoming more proactive in developing training programs. There is a general shortage of experts who have skills in the water management on a broader Mediterranean level.

Out of the top 10 desalination companies in the world, six are Spanish, so there is a huge amount of skills and experience within these water companies. AEDyR is the peak body for desalination companies. Seeing the need for specific training in desalination throughout the world, it has developed a two-week desalination course and has also developed a reuse course. This has been done in conjunction with Spanish companies, such as Norit Südmo and Valoriza Agua. This is an example of the Spanish Water Association working with Spanish water companies to develop and deliver industry training programs to a master-class level.

Spanish water companies also have a structured mentoring system, whereby in each company there are up to 10 experts who mentor new and less experienced here staff. There is also a system of companies mentoring other companies in order to pass on skills in desalination.

Skills shortages are also evident in the UK; there is a need to employ 200,000 staff over the next five years to reach the growth targets set for the industry. Energy and Utility Skills, which is the UK Industry Skills Council (ISC) responsible for water, has set the target but doesn't know where the 200,000 staff will come from. The UK Government is putting £40 million into direct training costs over this period. Due to the lack of pre-vocational training programs for potential water industry workers in all the other countries visited, with the exception of Singapore; the only way to bring people in is taking in people and training them to be competent.

Industry Trainers

"Experto Credite (trust one who has proved it)" – The Roman poet, Virgil.¹³

There were some universal concepts throughout the water industry in every country. For example, once a worker joins the industry, they make a career of it. According to those visited in the UK there is only a 3% turnover of workers per year in the UK water industry. Another important universal concept is that water industry workers must be trained by existing water industry workers.

The Netherlands

At Waterpleidingen in The Netherlands there are 20 full-time employees and 250 freelance trainers, all of these employees either work in the water industry or are consultants. They all work full-time so can only be used as trainers a few times a year. This is why they have such a large pool of 250. The 20 full-time staff are involved in project management, resource development, managing the pool of freelance trainers and administration. The organisation also has a full-time Managing Director.

United Kingdom

At Thames Water in the UK, there is a training department with a training manager and staff, but the actual delivery is outsourced. There are about eight training providers in the UK. The trainers are mostly ex-water industry workers. The skills required and delivered by the providers are very much driven by the water companies. Thames Water tends to use the two smaller providers as they will customise training to suit Thames Water's needs. The bigger providers tend to deliver training that they have already created.

¹³ Virgil, Aeneid, Part XI, Line 283, 1st century BC (29–19 BCE), <http://en.wikipedia.org/wiki/Aeneid>

The use of industry experts as trainers was universal in all the companies visited. Training was either delivered on site, at the companies, by their own staff, or outsourced to training providers that employ ex-industry staff as trainers.

Maintaining the Skills of Trainers

The Netherlands

To maintain the skills of the trainers, Waterpleidingen holds half-day to one-day master classes on learning styles, how to write questions, how to assess, and the other skills necessary to deliver quality training.

After each course the participants rate the course in a written evaluation. They provide ratings on the contents, how the group interacted, and the trainer. Trainers are rated 1 to 5. The average is 4.1. If a trainer scores less than 4, they are given support and attend additional training.



Agnes Maenhout, Managing Director of Waterpleidingen, believes trainers need to have a balance of didactical and practical facilitation skills, with emphasis on practical aspects as the client group needs practical things to do rather than theoretical. Because they don't have professional training in education, the trainers need to use a mixture of lecturing techniques and practical techniques.

It is also very important that trainers continue to be mentored by the 20 full-time staff and attend master classes themselves.

United Kingdom

As already mentioned, the UK water companies use a network of private training providers to deliver training to their staff. The maintenance of the skills of the trainers in these organisations is a matter for the companies and they work closely with Energy and Utilities Skills (the industry skills council responsible for water) to ensure that trainers are qualified to train at the various National Vocational Qualifications (NVQ) levels.

Spain and Israel

In Spain and Israel the water companies themselves develop and run most of the training programs and use current industry staff to deliver the training. In Singapore, polytechnic institute staff deliver the training, but the programs are either fully developed by water companies and added to the curriculum as attachment programs, or are heavily influenced by the water companies, mostly the PUB.

So the lesson is clear for Australia. The industry workers respond best to training delivered by trainers with current industry experience. This training could be developed in conjunction with Australian water companies and RTOs and could be overseen by RTOs, with all their experience in training delivery, but the actual training should be delivered by industry staff.

How Training is Delivered

Many of the water companies visited have developed a skills matrix identifying the skills required in each job category and the training that will enable a worker to become competent. Some countries have formal industrial agreements about skills.

The International Experience

The Netherlands

In The Netherlands there is a collective labour agreement that states that if you have a function, you should have the qualifications to do that function. Associations such as The Netherlands Water Partnerships (NWP) build and maintain the skills in the industry by:

- Arranging master classes in schools (universities and technical schools)
- Providing regional programs about important water issues in each of the regions. Each region has a very different focus. Some are involved in water security (from the sea) such as dunes and dykes; others are involved in desalination of brackish ground water, and other waste water.

The bigger Dutch water companies also collaborate with the knowledge institutes in their region around industry training needs. The knowledge institutes will adjust their courses to suit the local water sector, so the institutes and the industry influence each other. This is mainly around higher education, with less attention given to technical/practical training.

United Kingdom

Wessex Water in the UK has a relatively large training facility. They provide training for their own staff, contractors and outsiders. They use outside trainers (from the four companies that Thames and Severn Trent use). Wessex Water provides the facility. They also have some experienced staff who train in some areas such as confined space, electrical and mechanical areas.

Israel

Avital Dror-Ehre is the manager of the Ra'anana Municipality's Waste Water Treatment Plant. She is also a member of the Israeli Water Association and is a PhD student. Dror-Ehre works closely with Shimon Tal from IWA, especially around developing training programs for operators. According to Dror-Ehre, the experience in Israel is that workers may have a qualification but may not understand the environment they are working in. The aim of the Israeli Water Association is to take people who already work in water plants and teach them the theoretical and academic knowledge, as well as the practical side of the processes.

Singapore

In Singapore, the PUB is like most organisations in that it has regular planning days where staff are consulted about the future direction of the company. Training programs in Singapore are always developed around a framework of leadership, technical skills and so called 'soft' skills (such as team work and customer service). The PUB also provides 10 scholarships per year to help attract and retain younger people. Ruth Khan, who supported the Singapore visit, joined the PUB under one of these scholarships and has been with the organisation for several years.

Training programs for staff in international water companies are continuously ongoing throughout a staff member's career and are also conducted on demand. Much of the training is done in relation to the specific demands of individual projects. Staff are trained either on the job, if there are the appropriate numbers, or at the campuses such as at the World Water Academy, Wessex Water's training facility, various polytechnic institutes or in the case of Veolia Water, at one of their 10 world-wide campuses.

While many international companies outsource to training providers who deliver training on site, others maintain training facilities. Wessex Water, in the UK, has a purpose-built facility and Veolia Water, in Spain, has its own campuses.

Specific Training

Examples of more specific training and the reasons behind these training efforts are included under the following headings.

The International Experience

Isoluc-Corsan SA, Spain

Isoluc-Corsan SA is the seventh largest building company in Spain. Training sessions are developed for two main reasons:

1. To help globalise the company.
2. To support specific large projects such as:
 - roads
 - building treatment plants
 - building waste water treatment plants.

The company also partners with technical training companies such as Centro de Estudios y Experimentación de Obras Pública (CEDEX), which is the Spanish Centre for Study and Experimentation, and with business and management tertiary institutes who provide management training.

Socamex SA, Spain

Socamex SA is involved in the maintenance of water treatment plants. They maintain two main training programs:

1. They study the job description for each job and the skills that are required to do that job.
 - Staff should have the skills necessary to do their specific task. They realise that they will not always get that so they train for skills gaps.
 - The important skills that each worker should have, and for which training is given, are:
 - Understanding the risks associated with their job role (for example, drinking water operators do a food handling course).
 - Understanding the legislation that underpins the job they do.
2. Each worker will have a skills matrix. In the first three months of the year, the worker can negotiate what training they require for the year. This is matched with the company's needs, such as a global matrix of the company skills needs. If they match, the training will be funded.

Some training is conducted at the plant, if numbers are appropriate, and some is conducted at other venues off site.

The company aims to keep its workforce trained in the latest technologies. It keeps up with the technologies mainly by being informed of technological advancements by suppliers. Company staff can also express an interest in doing a particular type of training in a new technology. If the staff training plan matches that of the company, it will be funded.

Severn Trent Water, UK

At Severn Trent Water in the UK, Jackie Dean is the training manager. Dean stated:

"As the company is comparatively small (even though it services 8,000,000 customers), it can't afford to put existing workers through a whole new course so they currently run a series of up-skilling courses. In the near future, new entrants will do a whole National Vocational Qualification (NVQ) when they begin. Operators are currently trained/mentored by existing, experienced staff. This is not ideal as the mentors don't always give the correct information or show how to implement skills correctly".

The company is introducing a five-day induction program for new workers who then undertake the full level two NVQ training. New entrants to waste water go through a 15-day training program. On the water distribution network's side there is a massive program happening now to put 150 staff through the NVQ for pipe leakages qualifications. They are also putting 85 sewerage workers through the NVQ for sewerage qualifications.

The International Experience

Emefcy, Israel

Israel is also working on a program of certification for operators, overseen by the Israel Water Association. Ronen Shechter, the Chief Technology Officer at the innovative waste water technology company, Emefcy, advocated training in specialist technologies. Shechter was mostly concerned with the waste water industry and believed a solid grounding in the most common technologies was essential. According to Shechter, activated sludge is the most common technology used in waste water in Israel; therefore, he believed that if a worker had a good grounding and learnt everything there is to know about activated sludge, they could then learn more sophisticated technologies.

Ra'anana Municipality's Waste Water Treatment Plant, Israel

Dror-Ehre at the Ra'anana Municipality's Waste Water Treatment Plant, explained that the delivery method was to run a training program for a week. Each group of workers attended a one-day training program and this was repeated over five days with a different group attending each day. This limited the absence of staff to just one day per week for the duration of the training and was more flexible in regards to work flow commitments. Workers also had the option to engage a trainer for a whole week, if needed, and take leave from their normal job. Of course Ra'anana had the economies of scale and less problems with distance, but Australia could use a method like this.

This program is delivered over five days at a training facility and then one day at the Ra'anana plant. At the plant they set up a range of scenario situations. Each group of students was divided into smaller groups and they went from station to station solving the scenario problem. There was an experienced mentor at each of the stations to guide them. To ensure the outcome of the four days in the training facility was successful they had to apply the knowledge in the one-day plant session. There was 20 to 25 staff in each course.

One of the important things that Dror-Ehre suggested was that technical training be required to use the 'language' of the industry. All operators internationally, in all plants, should speak the same 'language' and describe processes and procedures by the same name. It seemed that there was a different meaning for different processes across the country (Israel), which made it hard to share information.

Dror-Ehre also focussed on practical skills for operators and engineers in the training programs being developed. She was in a good position to do this, having the academic qualification and the practical experience. She provided a bridge between the academic/theoretical side of the business and the practical side.

Aqwise, Israel

Udi Leshem, Vice President Business Development from Aqwise, which is a waste water technology company in Israel, is also an advocate for training to incorporate the 'language' of the industry so that water industry workers in different companies can communicate effectively. Leshem also made an interesting comment about the difficulty in developing training programs that can be delivered across the whole water industry. He highlighted the Japanese study conducted on waste water treatment plants that reported that there are 482 different ways to configure a plant. He made the point that just having one program to work on is not going to enable teaching all the different configurations. He suggested using a pilot plant with a variety of processes available to enable training providers to teach a selection of them and that workers could then go back to their own plant with a workbook and continue training. This is very much along the lines of what Chisholm Institute of TAFE is doing with the Centre for Sustainable Water Management.

Leshem suggested the US Sacramento course was a good model. In the US operators must maintain their points to remain licensed. They receive points for attending conferences and courses. A union-sponsored system like this was trialled in the UK where staff were given financial rewards for attending conferences and courses.

The International Experience

In Israel there were particular mandatory courses for operators, such as sampling courses, which were considered lower-level courses. There was not a huge range of mid-range, operator-level training programs available.

Thames Water, UK

Thames Water didn't continue with the program as they found that staff attendance at the course didn't necessarily translate into knowledge benefits for the staff. However, a points system linked to accredited training and assessment that is based on applying the skills learnt could be used in Australia.

The PUB, Singapore

In Singapore, the PUB also has a mandatory requirement for contractors to undertake training in leak detection and the use of Closed Circuit Television (CCTV) and will be bringing in more mandatory training in the future.

How Training is Funded

The Netherlands

Water industry staff in The Netherlands are funded by the water boards to undergo training, with 0.1% of labour costs in the industry put into an education fund. In fact, in Holland there is a collective agreement that 2% of labour costs should be spent on staff training.

Spain

Spanish companies also contribute to a government/union fund, with 50% of funding for training coming directly from the company and 50% covered by the government/union pool. All the companies met with in Spain have a skills matrix that relates jobs to the skills required to do that job. If a worker wants to participate in training and the training relates to the skills needed to do the job, that training can be funded from the pool.

United Kingdom

In the UK in the 1970s the water boards paid a levy to the training boards that delivered training for the water industry. After privatisation in the late 1980s, boards were set up and companies could pay a levy to such organisations as the Construction Industry Training Board (CITB) so that these companies could later draw on these funds for training. National Training Organisations were set up and most were not employer-led. Now, water companies pay a levy to the Energy and Utility Skills (EUS). The EUS have a role to play in determining minimum competency standards. They have a group consisting of unions, contractors, suppliers and water company representatives that plan skills needs and training needs.

One of the training providers used by Thames Water, Wessex Water and Severn Trent Water, Utilise Training and Development Solutions, has been able to obtain funding from Train to Gain (a Learning Skills Council) and this covers the cost of training but not staff downtime. If a contractor pays a levy to CITB, they could draw down on that funding to cover staff downtime as well. The combination of government skills funding and CITB funding, for staff downtime, made it more appealing for contractors to send staff to NVQ training.

Knowledge Transfer: Applying the Outcomes

This report findings will be utilised by the Centre for Sustainable Water Management to provide support for training needs analyses and resource development for water companies. A reference group consisting of a cross section of the industry was formed to guide this process.

There will also be sharing of knowledge at the Australian Water Association education event in March 2011 in Melbourne. The Fellow will also submit papers to other organisations, such as the Water Industry Operators Association, where appropriate.

As a result of this Fellowship a number of water industry experts were supported by Chisholm Institute of TAFE to complete the Certificate IV in Training and Assessment. The aim was to provide support up to 50 industry experts over the next three years, and to share the lessons learnt.

The lessons learnt as a result of this Fellowship will also be reflected in training delivery strategies, resource development and competency assessment strategies in the water industry.

Recommendations

The following recommendations are based on the experiences gained during this Fellowship activity and the discussions with various experts in the organisations visited during the tour.

Government

1. A significant barrier to improved education and development in this area is the cost of training. RTOs, government and the water industry organisations should consider a mandatory contribution to a funding pool that employers can draw from in order to support training or, if training is already government funded, to support the downtime when employees are off the job. This works well in Spain and The Netherlands, where employers pay into a pool that can be used to support accredited training.

Education

2. RTOs to work with water industry companies such as South East Water to develop training resources that suit the needs of industry. Resources may be developed or existing resources can be contextualised. The purpose is to develop resources that reflect current industry practices and procedures. This should be an ongoing process with resources to be reviewed regularly (perhaps every two years). These resources need to be of the sort that can be given to an industry trainer to deliver on site. Resources should include theory, applied examples, case studies and a range of assessment items – *Commenced in 2010*.
3. RTOs to develop and deliver a pre-vocational Certificate II in Water Operations (NWP20107) as an entry-level course for school leavers and others who wish to join the water industry. The course should cover a range of water distribution, water and waste water treatment, irrigation, catchment and dam and environmental water management competencies of the type that will give new industry entrants a broad range of skills. New entrants could then join any of the water sectors and be productive immediately. The aim is for RTOs to be able to approach water companies with a selection of graduates who already have the skills required by the industry. In this way, water companies would be relieved of the cost of training new entrants before they become productive. Pre-vocational courses are already being delivered in Singapore with great success.
4. RTOs to work with water companies to provide work-based training supported by intensive off-the-job training followed up by workbooks, mentoring, and support from the RTO. On-the-job training can be provided by industry experts (current industry staff) who are qualified in Certificate IV in Training and Assessment (TA40104) and supported by the RTO – *Commenced in 2010*.
5. RTOs to support existing water industry staff to complete the Certificate IV in Training and Assessment. This has been successfully piloted at some Victorian RTOs with funding from the TAFE Development Centre – *Commenced in 2010*.
6. RTOs to invite international industry specialists to deliver short training programs within Australia. This can be designed to coincide with other water industry events such as the AWA Ozwater and the WIOA events.
7. RTOs to develop partnerships with international water companies with a view to working collaboratively – *Commenced in 2010*.

Industry

8. The Australian water industry should consider a system similar to the UK model that delivers a training program over a three to four year period, resulting in a trade certificate that will be recognised nationally. This would offer new entrants a recognised career path and support mobility between water companies. This could appeal to the current generation of workers who like to move around between organisations and gain more experiences.

Recommendations

9. There is a need for greater support for technical training in the water industry. Traineeships are a great way to inject new blood into the industry, and to have the cost of training supported by government. Traineeships are not well supported in the industry with only a few companies taking on trainees in any one year. Better support for trainees from water associations would promote traineeships to employers. For example, there may be some scope to have an annual award for Water Industry Trainee of the Year in much the same way as there are currently awards for graduate and secondary student of the year. H₂Oz could also support technical training the same way as it currently supports higher education.
10. One of the great barriers to industry staff participating in training programs is the downtime, or time off the job, required to send a staff member through a training program. RTOs should further develop online resources (where appropriate) in those areas that are common to water industry sectors. An example, leak detection or safe handling of chemicals. Theory components of most competencies could be provided online so that they can be completed at a time and place that suits the participant. If a three-day course, such as trenching and shoring, can be reduced to two days by having the theory component online, that would make it more palatable for employers to send their staff off site to undergo training.
11. Experienced workers within water companies to mentor new workers. This could be formalised and become part of the structure of the organisation.

References

- Bourne, C 1991, ISS Institute, *Directory of Opportunities. Specialised Skills Courses with Italy. Part 1: Veneto Region*, ISS Institute, Melbourne.
- Bourne, C 2007, ISS Institute, *Sustainable Policies for a Dynamic Future*, ISS Institute, Melbourne.
- Franklin, B 1746, *Poor Richard's Almanac*, n.p.
- 2008, *Preliminary Water Industry Interaction with Universities Survey*, n.p.
- n.d., *WSAA Occasional Paper No. 21 – An Assessment of the Skills Deficiencies in the Urban Water Industry*, n.p.
- <http://www.africaspainforwater.org>
- <http://www.awa.asn.au>
- <http://www.careergov.com.au> (Government Career Guide)
- <http://www.nwc.gov.au> (Australian Government National Water Commission)
- <http://watertraining.wordpress.com/>
- <http://en.wikipedia.org/wiki/Aeneid>
- <http://en.wikipedia.org/wiki/Aquifer>
- http://en.wikipedia.org/wiki/Demographics_of_Singapore
- http://en.wikipedia.org/wiki/Geography_and_climate_of_Singapore
- <http://en.wikipedia.org/wiki/Singapore>
- <http://en.wikipedia.org/wiki/Virgil>
- http://www.unngosustainability.org/CSD_Definitions%20SD.htm

Attachments

For more information on the topics covered in these Attachments please see the Water Industry Training Blog: <http://watertraining.wordpress.com/>

Attachment 1

Clever Technologies and Strategies to Manage Water With Low Environmental Impact in the Context of Climate Change

Grey Water Systems and Water Reuse

In Spain, the basic concept of treating and recycling water has now moved on to cover:

- Treatment of grey water (now represents 40% of daily consumption per person of drinking water).
- Capture and use of rainwater.

The increased use of rainwater would have a significant effect on the overall water management practices as well as on the use of recycled treated water. The Spanish authorities are trying to eliminate the use of the term 'residual waters' as this still has the connotation of 'dirty, highly contaminated water' and they prefer to use the term 'generada' or 'reciclada' (generated or recycled).

In terms of encouraging Spanish industry to adopt water recycling practices, there is a need to convince companies already active in the water management sector to use recycled water. The maximum cost of water must not surpass the price they are currently paying. However, for new users/projects, the price of water will be the higher 'real cost' rate.

In some areas of The Netherlands they separate the black, grey and white water at the source. For example they have had some problems with the residue of medical discharge into water ways such as when pills from hospitals enter the water. Many hospitals now treat water before discharge into the sewerage. Treating water at the source also has the side benefit of providing a source of energy. Holland is also investigating ways to turn waste water treatment plants in power generators. There is more than enough energy available, especially in the sludge, to enable this to happen.

Treating water at the source, e.g. hospitals, separating grey, black and white water at the household (or subdivision at least). Discharge costs in The Netherlands are high so it is in the interests of households and industry to reduce waste water and treat it at the source. Also using it as an energy source.

The Dutch economic ministry will fund innovative projects coming from industry, the water industry included. For example, Del Chemical was funded for a project that used communal waste water for cooling water.¹⁴

Environmentally Friendly Brine Disposal

One of the biggest impacts of climate change on The Netherlands is salination. They have open access from the sea through Rotterdam harbour and as sea levels rise, saltwater intrusion will increase. They already practice desalination in Holland. This is desalination of brackish water. In many areas there are only a few metres of fresh water above the brackish water; therefore, the brackish water needs to be treated for drinking purposes.

There is a desalination plant in Holland that treats salt water but it has been built more to demonstrate the technology and for emergency use. Holland has no need to treat sea water to produce drinking water as they have enough to satisfy demand. The problem they face on a constant basis is having too much water.

Because the brackish water is being treated, there is a problem with brine disposal. It is illegal in Holland to dispose of brine in ocean outfalls or rivers. One of the clever technologies KWR is working with is disposal of brine by deep water aquifer injection. The Netherlands water authorities have developed several adaptive strategies.

¹⁴ <http://watertraining.wordpress.com/2010/06/06/spanish-water-management-research-compliments-of-austrade/>

At Thames Water in London, two-thirds of the research and development is in the waste side of the business. There is a major push to use sludge as energy. The catch cry is 'this black stuff is not waste, it is a source of energy'. Thames has 50 Mw installed capacity on the waste side.

Thames Water is the biggest producer of brown energy in the UK. They tend not to call it 'green energy' because one of the methods of turning sludge into energy is by incineration.

Thames Water has two sludge strategies, incineration and anaerobic digestion (which kills the pathogens, creates a bio-gas and also cuts down the volume of sludge. They have the two biggest incinerators in the UK. One at Becton waste treatment plant (which services South London), and the other at Cross Ness (which services North London). Both plants also have sludge powered generators (20 Mw each). If Thames Water didn't burn the sludge they would be in all sorts of trouble with disposal. Burning has the added disadvantage of contributing to the Thames greenhouse gas emissions.

Thames also uses the energy for combined heat and power. They can clean the bio-gas they create and sell it back to the grid. Electricity generated from the sludge is also sold back to the grid after Thames Water have used it to power their own processes. They are able to get Renewable Energy Credits for the energy they create.

Thames had done research and concluded that for a community of between 50 and 100 thousand, it is viable to generate energy from sludge.

Anaerobic digestion is seen by the community to be clean whereas incineration is seen to be dirty. Digestion also is less smelly and farmers are happy to take the bi-products. In fact Thames has difficulty maintaining supply as demand from farmers is so high.

The new desalination plant runs on biodiesels (cooking oil). This new plant uses 20 Mw when it's on. In fact, they will only use it for three months of the year. London is considered to be water stressed in the summer months. Using waste cooking oil has two benefits. It gets rid of a waste product and also keeps it out of the sewers.

The overall UK benchmark is to reduce landfill by 50%. Thames Water is already doing that. They have 97% recycling of waste products. In order to further finetune their waste management, they have regular round tables between staff and contractors on how to further reduce waste.

In Israel there is a law regarding the degree of treatment that is required before discharge. Sludge must have a very low bacterial count. It goes through digestion, composting, and thermal then alkaline treatments before it is discharged to the environment. They do have a problem with sludge. If all the sludge was to be used as compost they could cover Israel every year so and that is not an option. Ronen from Emefcy believes they will have to start to incinerate and generate power to get rid of the sludge.

Energy Conservation in Water Treatment Plant Equipment

At Thames Water, power is the second biggest cost after salaries. The two main emissions are carbon dioxide and methane, and the overall mission of Thames Water is to reduce greenhouse gas emissions by 20%. In order to cut down on energy use they have sub-metering, this consists of meters at the point of use. They also provide people with a set of interventions they can make in order to save power.

The incentive for Thames Water has been around showing people power use in pounds so it means something to staff. It is no good showing the people power use in kilowatt hours as it doesn't mean anything to their workers. When it is shown in pounds, it's easy for management to show staff that saving x amount of pounds equates to a certain number of jobs. They also have a process where they build the carbon footprint of the business using Leggo blocks. As these are hands-on staff are able to build the processes and see which bits can be taken away, thereby saving energy but not effecting performance.

Thames Water also employ dashboards showing what the state of power use is and what can be done to reduce energy consumption, e.g. turning off lights. The key point is, if you don't give workers the clues (interventions) they won't do anything about saving energy. Energy targets are also set in Performance Review and Development. They can be set for individuals or groups. Thames has 3,500 operational sites. The top 20 sites account for 50% of energy use. They save power by providing a history of what energy different processes use and set targets to reduce it.

Workers who have been in the industry for years are concerned about the quality of water and effluent, not power use. This has to be changed so that they understand that quality is important but reducing energy consumption is just as important.

Shimon Tal is a water engineer who worked for Mekrol, the Israeli national water company for 23 years and has been head of the Israeli Water Association for six years. Tal was also the Israeli Water Commissioner, which is the highest ranked official responsible for management, planning and regulation of the Israeli water system. Tal has been involved in an initiative connected to efficient desalination technologies and production of clean energy. For example, Israel is currently covering its water storages. The covers will become solar panels to generate energy, which will be used to offset the energy use of the treatment processes.

Emefcy, which is an Israeli waste water technology company opened two-and-a-half years ago to develop leading-edge treatment technologies. While companies like Aqwise focus on technologies that lower the cost of treatment, Emefcy focus on return on investment. In the future, companies will see sewerage treatment as an investment as they can generate income for the energy generated. Emefcy looks at how to apply technology to produce electricity and hydrogen. They are also looking at technologies to treat sewerage without using electricity. Everything they do is about the connection between treatment and energy. The process should create energy, not expend energy.

At Aqwise, another Israeli waste water technology company, they look at a single principle and develop technologies that will improve the process in a particular plant. For example, if you already have a plant that treats organic material, they can fit new media that will do nitrification as well.

The systems work so well you can control the level of treatment needed. Once you have reached the bacterial level required for discharge, you can stop using money and energy to treat it further. The technology also enable companies to plan for population increases. The company can add more media as it needs it. This spreads the investment in the plant over time.

In Israel, the current focus is to reuse water when possible and encourage the growing of low water use plants.

Appreciation of the Sensitivity of the Environment in Relation to how Operational Issues (Such as Sewerage Spills) can Affect the Environment

Thames Water

Of the 24 UK water companies, Thames is the largest. It supplies drinking water to 8 million people and waste water services to 13 million people. As it is London's water company, it is also in the most politically sensitive area. If another water company has a burst pipe or water main, or other problem, a local councillor may turn up, if Thames has one, you are going to get an MP turn up.

In other research, they are working on sorting out their distribution profile for fresh water. Things that can cause strange distribution cycles (which are difficult to plan for) are:

- Tourism
- Illegal immigrants (who mostly work at night)
- Ramadan – as Muslims during Ramadan can't drink during the day so they drink at night. There is such a huge Muslim population in London that this affects distribution patterns.

Public Utilities Board – Singapore

There is a greater emphasis in Singapore on community engagement. The community are considered to be fellow custodians of the water ways and are encouraged to use them for recreation. All but one of the nine catchments are open to the public. If they are seen as public amenities, the public contribute to the management of the catchments.

They are now focusing on letting people know that water is a green industry and making it look like a more appealing place to work. It is promoted through the media so that people see it as a live industry rather than a sunset industry.

Design and Planning of Water and Waste Water Collection and Distribution Systems

Each of the water companies in Holland have very different and specific roles and research needs. Some are involved with dunes, some with dykes and others with deep ground water.

Ground water is extremely important as it is a source of drinking water and also needs to be monitored to guard against flood. There is also a problem of saltwater intrusion into ground water therefore desalination of brackish water is used extensively.

The monitoring of groundwater is extremely precise. It is monitored to within 5 cm on a daily basis. Like most things, there are competing opinions as to what the appropriate level of ground water should be. Ecologists like it higher and farmers want it to be lower. But all the time it has to be assessed as to the likelihood that a combination of river floods and rainfall events will cause flooding, which is an ever-present threat in The Netherlands.

Anderson was invited to a conference of AFRE companies and African companies who are looking at water projects in Africa.

One of the speakers was from the International Commission on Large Dams (ICOLD). Dams used to play a major role in water infrastructure. There was a movement in the '90s against building more dams. In the 21st Century there is an agreement to include the World Water Commission in planning strategies to build more dams. Most of the southern hemisphere will experience water scarcity by 2025, so more dams are likely to be needed.

There are 50,000 large dams in the world, half of them in China. Spain has 1200 dams.

Spain has been using dams for over 2000 years and dams are considered a part of the Spanish water management strategy. About half the Spanish water capacity is held in dams. Most of this is in 300 dams.

Of the 300 Km³ of rain in Spain per year, 100 Km³ is run-off (to dams), 109 Km³ goes into the sea and 80 Km³ goes into aquifers.

The African Water Association provided the following information:

- The continent includes 54 countries and 900 million people. The population will increase to 1.9 billion by 2050.
- 61% of people live in rural areas. That is where the challenge is, getting water to the regions.
- There is an abundance of water but it is unevenly spread across the continent.
- 15% is ground water.
- They need infrastructure (this is where AFRE comes in)
- 300 million people have less than 50% access to safe drinking water.

- Africa needs substantial improvements in access to safe drinking water. This includes:
 - Better delivery
 - Better performance of governance
 - Adequate financing (donors, World Bank etc.)
- 40% of water infrastructure is not functioning after 10 years. This is because of a lack of maintenance, lack of skilled staff and poor investment decisions in the first place. They went for cheaper options but these break and there are no parts available.
- They want to ensure good training by permanent capacity building strategies.

More Efficient Water Resource Management and the Impact of Climate Change

Desalination in Spain began in the Canary Islands. It began because there was no source of water for locals. As tourism grew, demand for water grew and they had to build more desalination plants in the islands. Spain itself has 50 to 60 million tourists a year so desalination is important on the mainland as well.

Spain has state companies that govern what water projects go ahead and where irrigation goes. Up until recently there were four of these companies, all geographically based. They have now been made into one big company so there are huge changes happening in Spain around the governance of water.

All over Europe governments are cutting down on public service due to the GFC and debt problems. They are cutting down the number of state-run overseers of water to save money.

In Spain they are moving towards a national policy because it is easier to manage and that is what the water companies want.

In Spain, 40 million hectares (85%) of the country is utilised for agriculture. Seventeen million hectares are under irrigation and 3.4 million consist of dry land. Spain is moving from flood irrigation and sprinklers to drip irrigation. This is more efficient but it brings with it the problem of power consumption.

In Spain they are looking for alternative energies but also looking at how to make the technology more energy efficient.

Singapore NEWater Factory

In 1963 Singapore lost water for 12 hours a day due to a prolonged dry spell. Singapore has nine reservoirs but even at 100% full, they only have three months supply. They had to think of new water sources so they came up with the four taps:

- Reservoirs
- Imported water (from Jahour Bahru). They have two contracts. One ends in 2012 and they will not renew it. The other ends in 2061. The problem with this is every time the Malay and Singapore governments had a disagreement, Malaysia threatened to cut off their water.
- NEWater – reused treated effluent
- Desalination

Attachment 2

Brief overview of Companies Visited

The following is a brief overview of each company visited.

World Water Academy (Wateropleidingen)

SWO (Stichting Wateropleidingen) is a training institute for water management. Established in 1993 by the Dutch water sector in order to improve the quality of their employees with regard to their specific knowledge on water issues, SWO offers very practical courses for all water related issues (like integrated water resource management, the abstraction and production of drinking water, the distribution of drinking water, sewerage, waste water treatment and water & communication).

Each year about 2,000 employees working for the water sector participate in one of over 80 educational programs and courses.

KWR Watercycle Research Institute

KWR has provided research and development for the Dutch drinking water sector companies for around 60 years. This collaboration of Dutch water companies has resulted in a powerful knowledge base and an extensive collective memory for the drinking water sector.

KWR has an extensive international network of universities and research institutes within which it works for both Dutch and international clients. These collaborations open up international expertise for the benefit of the water sector in The Netherlands, and bring together the most advanced knowledge resources for the solution of trans-national water questions.

Dutch Association of Regional Water Authorities/Unie van Waterschappen

The Dutch Association of Regional Water Authorities (Unie van Waterschappen) aims to promote the interests of Regional Water Authorities at a national and international level. All 26 Regional Water Authorities are members of this association. Unie van Waterschappen is the voice of the water industry in The Hague (local issues) and Brussels (broader EU issues). It is especially about safeguarding the interests of the 26 water authorities with regard to third parties, more particularly the National Government and parliament. The Association also supports Regional Water Authorities in areas such as legal affairs.

The Netherlands Water Partnerships (NWP)

The Netherlands Water Partnership (NWP) is an independent body set up by the Dutch private and public sectors in The Netherlands to act as a national coordination and information centre for water-related issues abroad. The principal aims of the NWP are to harmonise the activities and initiatives of the Dutch water sector abroad and to promote Dutch expertise in water worldwide.

The NWP is the channel through which government bodies, Non-Governmental Organisations (NGOs), knowledge institutes and private organisations in the water sector share information on their activities and services.

The NWP supports the international ambition of the Dutch water sector to stimulate the exchange of knowledge and enlarge the export of specific knowledge, services and products. The main fields of interest of the NWP are international network development, business development, information exchange and knowledge transfer.

Association of Spanish Water Technology companies – ASAGUA

ASAGUA, Spanish Association of Water Technologies, is an association of companies committed to a sustainable world and convinced that the protection and conservation of water is a priority for Spanish society.

The ASAGUA companies want to be an instrument for all government and private sector companies to achieve more efficient management of water resources, and to this end have decided to join forces to multiply their capabilities.

Member companies are:

- Deisa
- Elecnor Hidroambiente
- Isolux Corsan
- Joca
- Passavant Espana
- Socamex
- Tedagua
- Veolia Water

The Spanish Association of Irrigation Manufacturers – AFRE

Asociacion de Fabricantes de Agua Riego Espanoles (AFRE), is the only non-profit national association which objectives are to represent, defend, promote and develop Spanish irrigation technologies.

AFRE clusters the best Spanish companies and organisations in the water technology industry, and acts as interlocutor with the various institutions related to water and irrigation in the world.

AFRE's mission is to contribute to the efficient use of water and energy, to promote the quality and professionalism of the industry's firms, favour the development of productive and sustainable agricultural practices, and to consolidate the position of the companies in the association as leaders in national and international markets.

Africa/Spain for Water Congress

AFRE heads a consortium of Spanish water companies and African water authorities with the aim of developing projects in irrigation, water reticulation and water treatment which will help alleviate the water related problems in Africa.

AEDyR – Spanish Association of Desalination and Reuse

AEDyR was created in 1998 to gather all individuals, companies and organisations dealing with desalination and water reuse in Spain. The International Desalination Association (IDA) added AEDyR to its member list in recognition of its technological development and its desalination track record.

Some of the areas of interest of AEDyR include:

1. Fostering research and development on desalination and water reuse technologies.
2. Promoting information exchange and dissemination in connection with these technologies.
3. Acting as a public forum for information and document dissemination.
4. Supporting and encouraging the creation of standardised specifications and procedures.

5. Cooperating and communicating with national and international institutions both public and private on matters regarding research, development and proper utilisation of desalination and water reuse technologies.
6. Promoting technician training and certification.
7. Supporting energy efficiency in water production endeavours.

Thames Water – London

Thames Water Utilities Limited is the utility responsible for water supply and waste water treatment in parts of Greater London, Surrey, Gloucestershire, Wiltshire, Kent and the Thames Valley in the UK.

Thames Water is the UK's largest water and wastewater services company, including Europe's largest wastewater treatment works at Beckton.

Every day Thames Water:

- Supplies 2,600 million litres of tap water to 8.5 million customers across London and the Thames Valley.
- Removes and treats 2,800 million litres of sewage for an area of South England covering 13.6 million customers.

Thames Water is also responsible for some of the largest civil engineering programs in Europe, including:

- The £2.2 billion London Tideway Tunnels (due to be completed in 2020)
- The proposed Reservoir at Abingdo, Oxfordshire, which will be the largest enclosed reservoir in the UK.

Wessex Water

Wessex Water is the regional water and sewage treatment business serving an area of the south-west of England, covering 10,000 square kilometres including Dorset, Somerset, Bristol, most of Wiltshire and parts of Gloucestershire and Hampshire.

The Wessex Water region is predominantly rural, but with two major urban areas.

The area of Bristol and Bath in the north-west has a population of around 750,000 and in the south-east the Bournemouth and Poole area has a population of about 300,000.

Facts and Figures

- Supplies 1.25 million people with around 353 million litres of water a day.
- Infrastructure includes:
 - 100 water sources
 - 110 water treatment works
 - 209 booster pumping stations
 - 344 service reservoirs and water towers
 - 11,400 kilometres of water mains.
- Treats 490 million litres of sewage from 2.6 million customers a day. Sewerage system comprises:
 - 16,700 kilometres of sewers
 - 405 sewage treatment works
 - 1,006 combined sewer overflows and 1,455 pumping stations.

Utilise Training and Development Solutions – Lancashire

Utilise is a training company situated in Lancashire. Some of the training programs Utilise offers include Water Regulations and an extensive range of operational training events to all water companies and their contracting companies. These include areas such as process, leakage and distribution.

A sample of the products Utilise can offer in this area includes:

- National Water Hygiene
- Network Construction Operations
- Controlling Water Operations (Process)
- Operating Process Plant (Water & Waste)
- Leakage Control
- Utility Safety Health and Environment Awareness SHEA (Water).

Water Operations Training

Utilise delivers a range of operational training events to all water companies and their contracting companies. These include:

- Chlorination/Hygiene Procedures
- Electrofusion Welding/Butt Fusion
- Leakage Control NVQ Level 2
- Polyethylene Welding EF & BF
- Pump System Maintenance
- Under Pressure Drilling & Chlorination
- Hygiene Procedures
- Pressure Testing
- Network Construction Operations
- NVQ Level 1 & 2
- Operating Process Plant NVQ Level 2.

Energy and Utility Skills

Energy & Utility Skills (EU Skills) is responsible for the skills agenda of the UK water and wastewater industry.

Their coverage of water includes transportation of water from source to the treatment works and subsequent distribution to property boundaries (clean water) or water course (waste water).

Also, the disposal of waste water from property to treatment works to water course, water collection, storage and treatment, waste water processes and water distribution. These areas have within them 166,500 employees.

The UK water industry has received a major expansion in the apprenticeship opportunities it can now offer to young people and adult learners.

Energy & Utility Skills (EU Skills) has been working with regulated water utility companies and utility contractors to design new apprenticeships that are now approved for England, Northern Ireland, Scotland and Wales.

Severn Trent Water

Severn Trent Water serves over 8 million customers across the heart of the UK, stretching from the Bristol Channel to the Humber, to mid-Wales and East Midlands.

The Company was established in 1974 as the *Severn Trent Water Authority*, one of the 10 water authorities in England formed under the Water Act 1973, to supply fresh water and treat sewage for people living in the Midlands of England and also certain regions of Wales. It took its name from the two major rivers in this area, the Severn and the Trent.

Shimon Tal – Tel Aviv

Shimon Tal is a private consultant for water and energy. He is the president of the Israeli Water Association.

Tal also served as the Water Commissioner of Israel and the Engineering Vice President of Mekorot the National Water Company.

Emefcy Bio Energy Systems – Tel Aviv

Emefcy was founded in 2007 with a vision of fundamentally changing the energy economics of wastewater treatment. The systems developed by Emefcy produce electricity directly from the treatment of different types of wastewater. This conversion is made possible by use of Microbial Fuel Cell (MFC) technology.

Emefcy's mission is to become a global leader in MFC technology implementation for waste water treatment. This goal was sparked by the ever-growing need for energy efficient waste water treatment, accompanied by the revelation of technological feasibility of MFC.

Microbial fuel cells feeding on waste water will produce free, renewable, green energy. In the future, MFC technology will be applicable in additional environmental processes, while generating renewable energy.

The Ra'anana Municipality's Waste Water Treatment Plant

The Manager of the Ra'anana Municipality's Waste Water Treatment Plant, Avital Dror-Ehre is a member of the Israeli Water Association and is involved in training development.

Dror-Ehre is in a unique position of have academic qualifications in water and also an acute awareness of the technical and practical requirements of running a waste water treatment plant.

During the past decade, the city of Ra'anana has become one of Israel's leaders in area of environmental protection and quality of life. The Council for a Beautiful Israel has recognised Ra'anana for its efforts in maintaining a beautiful urban appearance, clean streets, beautiful parks, gardens and decorative green areas.

AqWise – Wise Water Technologies Ltd, Tel Aviv

Aqwise – Wise Water Technologies Ltd. is a world leader in the development and implementation of innovative waste water treatment solutions for the industrial and municipal markets.

Waste water processes developed by Aqwise increase Biochemical Oxygen Demand (BOD) and nutrient removal capacity in wastewater treatment plants.

The advanced waste water treatment technologies offered by Aqwise are designed to meet the needs for cost-effective wastewater treatment technologies.

Most notably the company has developed the patented AGAR process (Attached Growth Airlift Reactor). Implementation of the AGAR Process in an existing plant, will allow the plant to increase its treatment capacity, as well as improve its nutrient removal capabilities. The AGAR process, therefore, reduces the cost of upgrading, the project duration, and the area required for additional reactors.

Plasson – Binyamina, Israel

Plasson manufacture pipe fittings and electro fusion welding equipment. Polyethelyn welding is used to fuse water pipes and is a technology that Chisholm is beginning to deliver training in.

Plasson is 80% owned by members of a Kibbutz in Binyamina, Israel. Twenty per cent of the company is listed on the Israeli stock exchange.

The technology Plasson has developed in electro fusion welding will be widely used in the water industry as it currently is in the gas industry for reticulation. The fused pipe joint becomes the strongest point as opposed to current technologies where it is the weakest point and the point where most leaks occur. Plasson also develops universal joints that can be welded when a pipe needs to be re-aligned. Pipes from relatively small diameter up to 700 mm can be fusion welded, and fittings are manufactured for a range of pressures.

PUB, Singapore National Water Agency

As the national water agency, the PUB is responsible for the collection, production, distribution and reclamation of water in Singapore.

The PUB is responsible for:

- Potable water
- Used (NEWater) and
- Drainage (not a municipal function in Singapore)

Singapore Water Association

The Singapore Water Association aspires to play a role in efforts to profile and promote Singapore as a one-stop centre for all water-related services and water technology hub. This Association will bring together local companies for the mutual benefit of developing a vibrant and dynamic local water industry.

Ngee Ann Polytechnic – Singapore

Ngee Ann Polytechnic is one of Singapore's leading institutions of higher learning. Ngee Ann hosts one of the five Centres of Innovation set up by the Government of Singapore to conduct research and business development in Singapore, mainly for small-to-medium enterprises (SMEs).

Singapore NEWater Treatment Plant

The Singapore Water Reclamation Study (NEWater Study) was initiated in 1998 as a joint initiative between the PUB and the Ministry of the Environment and Water Resources (MEWR).

The primary objective of the joint initiative was to determine the suitability of using NEWater as a source of raw water to supplement Singapore's water supply. NEWater is treated used water that has undergone stringent purification and treatment process using advanced dual-membrane (microfiltration and reverse osmosis) and ultraviolet technologies.

NEWater can be mixed and blended with reservoir water and then undergo conventional water treatment to produce drinking water (a procedure known as Planned Indirect Potable Use or Planned IPU).

Attachment 3

Itinerary

Date	Country and Location	Enterprise address and phone number	Contact name, phone and email	Notes
Tuesday 1 June	The Netherlands – Nieuwegein	World Water Academy (Wateropleidingen)	Ms Angnes Maunhout, Managing Director,	Training provider established by Dutch drinking water companies
Tuesday 1 June	The Netherlands – Nieuwegein	KWR, Watercycle Research Institute	Dr. Gertjan Zwolsman, Teamleader Integrated Water Management	Research institute – initially set up to conduct research into drinking water but now involved in entire water cycle
Wednesday 2 June	The Netherlands – The Hague	Dutch Association of Regional Water Authorities / Unie van Waterschappen	Erik Kraaij and Mr Reinier Ruffens Managers Personnel and Education	Association that represents the interests of Dutch water companies, primarily with government both in the Hague and Brussels
Wednesday 2 June	The Netherlands – The Hague	The Netherlands Water Partnerships (NWP)	Mr Roy Neijland, Project Manager	Association that acts as a national coordination and information centre for water-related issues abroad and to promote Dutch water expertise internationally
Monday 7 June	Spain – Madrid	ASAGUA, Spanish Association of Water Technologies	Mr Adrian Baltanás, Director General Also present: Antonio Gutierrez – Isolux Corsan Valentin Garcia Albiach – Isolux Joaquin Perez Novo – Veolia Water Roberto Torio Acha - Socamex	Association of eight Spanish water companies committed to sustainable water management. Member companies include: • Deisa • Elecnor Hidroambiente • Isolux Corsan • Joca • Passavant Espana • Socamex • Tedagua • Veolia Water
Wednesday 9 June	Spain – Madrid	The Spanish Association of Irrigation Manufacturers - AFRE	Ana Isabel Picon Gonzales AFRE Research and Development and Innovation Manager	A non-profit national association the objectives of which are to represent, defend, promote and develop Spanish irrigation technologies both locally and internationally.

Wednesday 9 June	Spain – Madrid	Africa/Spain for Water Congress	Antoni Serramia Bruxola AFRE President Sylvain Usher Secretary General African Water Association	AFRE heads a consortium of Spanish water companies and African water authorities with the aim of developing projects in irrigation, water reticulation and water treatment which will help alleviate the water related problems in Africa.
Wednesday 9 June	Spain – Madrid	AEDyR – Spanish Association of Desalination and Reuse	Manual Rubio Visiers AEDyR President Domingo Zarzo Martinez Technical Director Valoriza Agua	AEDyR was created in 1998 to represent the interests of all individuals, companies and organisations dealing with desalination and water reuse in Spain. Manual is also Country Manager, Spain and Portugal for Norit Group, a purification technologies company.
Friday 11 June	England – London	Thames Water	James Mitchell - Skills & Technical Training Manager John Gilbert - Head of Energy & Fleet Operations Alan Young - Waste & Recycling Manager	Thames Water Utilities Limited, is the utility responsible for water supply and waste water treatment in parts of Greater London, Surrey, Gloucestershire, Wiltshire, Kent and the Thames Valley in the UK.
Monday 14 June	England – Bath	Wessex Water	Kerry Wyatt Management Systems Compliance Coordinator (Operations) Cliff Lovell Training Coordinator	Wessex has a training centre at it's Yeovil office much like Chisholm's Cranbourne campus where they do pipeline construction and confined space entry
Tuesday 15 June	England - Wigan	Utilise Training and Development Services	Paul Dutton Construction, NRSWA Project Manager	Private training provider – delivers National Vocational Qualification level water industry training

Tuesday 15 June	England – Birmingham	Energy and Utility Skills	David Hellier Head of Sector Engagement	EU Skills is the Industry Training and Assessment Board equivalent responsible for water in the UK
Tuesday 15 June	England - Birmingham	Severn Trent Water	Jackie Dean Technical Training Advisor	Severn Trent Water serves over 8 million customers across the heart of the UK, stretching from the Bristol Channel to the Humber, and from mid-Wales to the East Midlands. Jackie is also a member of OFWAT the (The Water Services Regulation Authority) the economic regulator of the water and sewerage sectors in England and Wales
Thursday 17 June	Israel – Tel Aviv - Shimon	Tal Content Consulting	Shimon Tal	Shimon is a private consultant for water and energy. He is the president of the Israeli Water Association. Shimon also served as the Water Commissioner of Israel and the Engineering VP of Mekorot the National Water Company.
Thursday 17 June	Israel, Caesarea	Emefcy Bio-Energy Solutions	Ronen Shechter Chief Technology Officer	Emefcy's mission is to become a global leader in Microbial Fuel Cell (MFC) implementation for wastewater treatment.
Sunday 20 June	Israel, Herzelia	Ra'anana Waste Water Treatment Plant	Avital Dror-Ehre Manager, Raanana Waste Water Treatment Plant	Ra'anana City (~100,000 inhabitants) has a treatment plant based on SBR- Activated Sludge. The plant is currently being upgraded to enable tertiary treatment including phosphorus removal as required for release into Poleg stream or unrestricted irrigation. Avital is also a member of the Israeli Water Association

Monday 21 June	Israel, Herzelia	Aqwise wastewater treatment technologies	Udi Leshem Vice President Business Development	Aqwise - Wise Water Technologies Ltd. is a world leader in the development and implementation of innovative waste water treatment solutions for the industrial and municipal markets.
Tuesday 22 June	Israel, Binyamina	Plasson	Oren Linder Regional Marketing Manager Middle East	Plasson manufactures pipe fittings and electro fusion welding equipment.
Thursday 24 June	Singapore	Public Utilities Board (PUB)	Lawrence Tan Director Human Resources	As the national water agency, PUB is responsible for the collection, production, distribution and reclamation of water in Singapore.
Thursday 24 June	Singapore	Singapore Water Association	Michael Ng LEAD Manager	The Singapore Water Association aspires to play a role in efforts to profile and promote Singapore as a one-stop centre for all water-related services and water technology hub.
Thursday 24 June	Singapore	Ngee Ann Polytechnic	Li Phin Tam Director Environmental & Water Technology Centre of Innovation	Ngee Ann Polytechnic is one of Singapore's leading institutions of higher learning. Ngee Ann hosts one of Singapore's Centres of Innovation, the Centre for Innovation, Environmental & Water Technology
Friday 25 June	Singapore – Changi	Singapore NEWater treatment plant	Ruth Khan Assistant Director Environment & Water Industry Programme Office	New water is one of Singapore's 'four taps' (sources of water). The others are catchment water, desalination and water imported from Malaysia.