ARUP

Global Water Annual Review

2015-16

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Climate is water

Water feels the force of a changing climate, with both widespread flooding and severe droughts.

Read more

Too much water

Our global flood and coastal management experts are involved in all aspects of flood alleviation.

Read more

Too little water

Water conservation has been at the heart of our work with water companies and communities.

Read more

Foreword

June 2016

Mark Fletcher
Global Water Leader

It has been a significant year for Arup across the world of water.

The high point of engaging with the sector through international events and conferences was presenting at the 2015 Paris Climate Conference (COP21). This also included making a video with the Alliance for Global Water Adaption (AGWA) to support the #ClimateisWater initiative.

Other creative initiatives included producing inDepth. This brings together a free-to-download global research resource with thought leadership on the future of water from global water sector experts.

Building on our foresight work with Sydney Water, we have rolled out the first two in a series of city workshops on The Future of Urban Water – in Manila and São Paulo. The programme considers plausible scenarios for the future of urban water in 2040 and has been well received.

Technology undoubtedly has a vital role to play in the future of water. Our recently released Venturi portal, developed with WRc, provides a platform for accelerating and validating technology to meet water-sector needs.

Some of the regional projects highlighted in the review are showcased through our ‘climate is water’ approach. This reflects the way our advisory services and major projects are evolving to meet water challenges around the world.

Finally, it has been a great year for our people. Their achievements have been recognised through prestigious awards and our network of over 1,500 people continue to make full use of the Arup University to update, develop and expand our water skills portfolio.

Lake Mead - one of our major projects in the USA. Further details of which can be read in our ‘Climate is water/Too little water’ section

Climate is water

Shaping a better world

The force of a changing climate has made its presence felt all over the world this past year, with widespread flooding on the one hand and severe droughts on the other.

We attended the 2015 Paris Climate Conference in December (known as COP – Conference of Parties) and were privileged to present with the Alliance for Global Water Adaptation (AGWA). We also keenly supported their international #ClimateIsWater initiative to make water issues a bigger part of the climate change discussions.

In this year's review we share information on climate issues and focus on events and projects Arup has been involved with, many of which are about sustainable solutions to topical problems.

In this section:

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Raising water's profile

Spotlight on COP21 and the Paris Climate Change agreement

The 21st Conference of Parties (COP21) United Nations climate negotiations in Paris during December 2015 resulted in an historic climate change agreement signed by 187 countries.

Together with other members of AGWA – a global collective of funding banks, government agencies, NGOs, research organisations and private sector multi-nationals – we organised the Climate is Water: Solutions For the Future event at the Paris COP. The event highlighted how climate changes are felt through changes to the water environment – such as flooding, drought and water supply – and that management and adaption can help mitigate the effects.

The event was part of an international effort from members of the water community to increase the prominence of water issues in climate change discussions, both during COP21 and beyond. It brought together international expert speakers from different sectors, all parts of society, and local and international governance to share their experience of water management and adaptation in a changing climate. We also produced a video which was launched at the event to support the #ClimateIsWater campaign.

Further #ClimateIsWater activities and events are planned during 2016 to maintain the profile of water within climate change solutions as countries ratify the Paris agreement. These include an event at COP22 in Marrakesh during November 2016.

Water is inseparable from climate change and variability; we must act to bring attention to this – both now and in the future.

COP21 campaign

COP21 video

Water and climate change have been and will continue to be explicitly linked. For different places, climate change will mean more or less rain, it will mean more or less extreme rainfall, and it will change where and when it falls. Humankind has always adapted to water cycles and will no doubt adapt again. The real challenge is how to adapt effectively and efficiently.

Therese Flapper
Australasia Water Skills Leader

Download

PARIS2015 UN CLIMATE CHANGE CONFERENCE COP21·CMP11

COP21 agreement

To read the full agenda for the adoption of the Paris agreement, including draft decisions, please click here.

Join our initiative by posting tweets, photos, and videos to #ClimateIsWater

© Dreamstime

Global water issues

Climate change and water crises continue to feature prominently in the global risks landscape and are inextricably linked to food security; about 70% of the world's freshwater withdrawals are used for agriculture. This rises to over 90% in many of the least developed countries.

At the same time, over a billion people lack access to clean water, 40% of the world's population suffers water shortages for at least a month annually and an estimated four billion people could be living in water-scarce areas by 2050.

Tackling global risks

Global Risks Report 2016

Commissioned by the World Economic Forum, the Global Risks Report 2016 features perspectives from nearly 750 experts on the perceived impact and likelihood of 29 global risks over a ten-year timeframe.

Risks the report has warned about over the past decade are starting to manifest themselves around the globe, harming people, institutions and economies in new and sometimes unexpected ways. After being ranked in the top five risks for the past three years, the failure of climate change mitigation and adaptation is perceived in 2016 as the most serious risk. Water crises rank third.

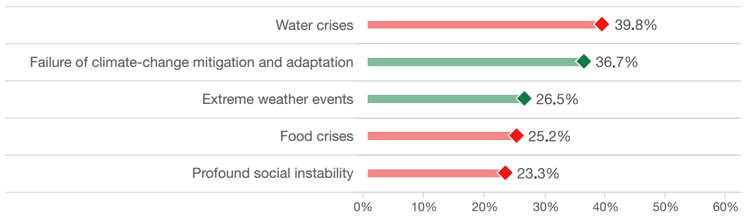
The Global Risks Report exists to raise awareness about global risks and their potential interconnections, and also to provide a platform for discussion and action to mitigate, adapt and strengthen resilience.

World Economic Forum

> *"Extreme weather events resulting in floods and draughts continue to become more frequent and intense in developed and developing countries. What is happening is more severe than predicted and likely to get progressively worse if we fail to act."*

Kenneth Kwok
East Asia
Water Leader

The global risks of highest concern for the next 10 years.



Top 10 risks in terms of **Likelihood**

1. Large-scale involuntary migration
2. Extreme weather events
3. Failure of climate-change mitigation and adaptation
4. Interstate conflict
5. Natural catastrophes
6. Failure of national governance
7. Unemployment or underemployment
8. Data fraud or theft
9. Water crises
10. Illicit trade

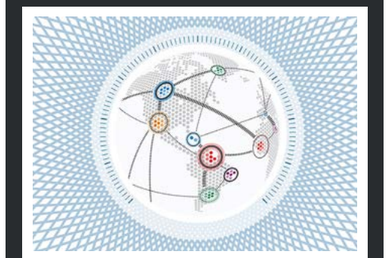
Top 10 risks in terms of **Impact**

1. Failure of climate-change mitigation and adaptation
2. Weapons of mass destruction
3. Water crises
4. Large-scale involuntary migration
5. Energy price shock
6. Biodiversity loss and ecosystem disease
7. Fiscal crises
8. Spread of infectious diseases
9. Asset bubble
10. Profound social instability

Categories

- Economic
- Environmental
- Geopolitical
- Societal
- Technological

Download



The Global Risks Report 2016

Now in its 11th edition, The full Global Risks Report 2016 is available to view by clicking here.

Exploring the future of urban water
Sao Paulo and Manila workshops

Our Future of Urban Water programme depicts four plausible scenarios for urban water in 2040.

Using Manila and São Paulo as reference cities in 2015 this research project explored through a series of workshops how social, technological, economic, environmental and political trends, along with the impact of climate change, could shape the urban water future. The scenarios have helped stakeholders better understand possible pathways and enabled conversations about how to influence and shape the direction of travel.

The Manila workshop focused on the current situation, future challenges and emerging opportunities for managing water in the Philippines and Metro Manila. Over 50 delegates from public sector bodies, developers, contractors, utilities and other stakeholders from industry and academia took part.

Key themes that emerged included:

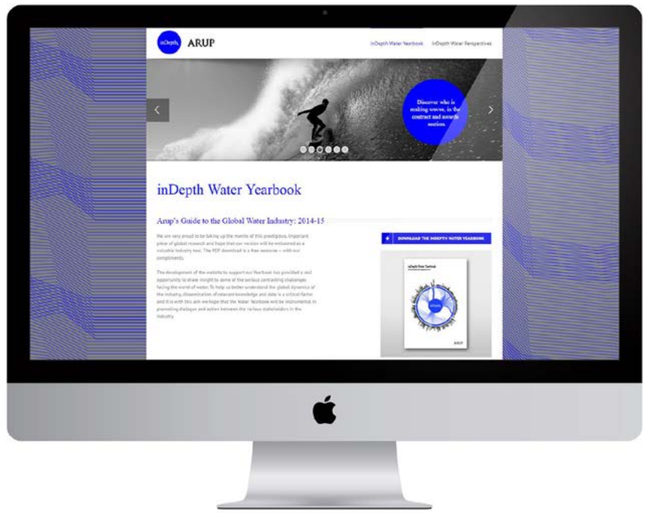
- The long-term impacts and uncertainties of population growth and demographic change
- The need for greater resilience to climate change
- A more coordinated and integrated approach across city departments, districts and agencies
- Local communities could become more autonomous in delivering solutions.

Although São Paulo is not considered a water-scarce location, exceptional drought and high temperatures have caused water levels in key reservoir systems to fall below 10% of their capacity. This workshop, which was attended by 35 participants from the water authority, public sector bodies, civil society and academia, prioritised the key drivers of change for water and explored future pathways to a more sustainable future.

Key recommendations included:

- Long-term strategic planning to respond to climate change impacts
- Improving water governance and water resource management
- Involving the population in decision-making, demand management and developing local solutions.

Future of Urban Water



A comprehensive guide to the water industry
inDepth Water Yearbook and Perspectives

In January 2016 we launched the inDepth Water Yearbook, a free, knowledge-based tool that offers a comprehensive review of the global water industry.

Drawing from a wide range of sources, inDepth offers a unique review of the dramatic changes affecting companies operating in the sector and of the investment climate. We are pleased to be sharing this important piece of global research and hope that it will be welcomed as a valuable industry tool.

inDepth also features Perspectives thought pieces from industry experts around the world, offering the individual's viewpoint.

The Perspectives were well received at the UK launch event, which focused on negating climate change by working together.

Over 90 industry professionals attended to learn more about inDepth and to hear the keynote speech by Richard Benyon MP, former Minister for the Natural Environment and Fisheries.

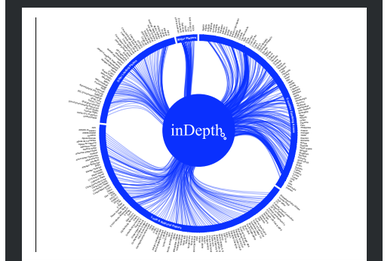
inDepth Water Yearbook

Download

Future of Urban Water

The full report of the Metro Manila Workshop this includes current and future challenges and the key themes which emerged. Please click here to download.

Download



inDepth Water Yearbook

All of the research from the Yearbook has been offered freely and is available as a PDF download. Please also visit our dedicated website to also view special content only available on the site. Click here to download your copy of the Yearbook

Protecting cities from rising sea levels
Flood hazard assessment and adaptation toolkits

Much of the urban population increase is concentrated in coastal cities, so predictions of sea level rises pose a threat not just to sustainability, but to cities' very survival.

Coping with sea level rise demands an integrated approach that will protect properties, businesses, infrastructure and services. This is what our experts in water, planning, geographic information systems (GIS), safety-critical design and engineering, and international development are working on.

Our specialists are developing processes and tools to identify the dominant and most significant flood risks to a coastal community, and provide options to make cities more resilient to sea level rise and other potential shocks and challenges.

Venturi
Helping technology to flow

Speeding innovation
Venturi portal

The Venturi innovation portal will speed up innovation in the water sector.

Launched by our water business in partnership with WRc Ltd, the portal speeds up innovation in the water sector by providing an end-to-end identification, evaluation and implementation scheme. The scheme includes pre-assessment, due diligence and piloting stages managed by industry experts and accredited third party validators.

The portal had a soft launch at the WATEC (Water Technology and Environmental Control) conference in Israel during October 2015 and has been well received by global partners.

Venturi portal

Training for the Water sector

Arup has begun rolling out introductory training for integrated catchment management and natural flood management, in partnership with JBA and Newcastle University. Developed by Alex Nicholson, team expert in Natural Flood Management, the training covers the opportunities and limitations of the techniques.

More than a dozen sessions have now taken place, attracting 213 delegates. Attendees have included land, water and drainage managers, consultants, researchers, engineers and planners working on projects influencing the water environment. Also attending were those working in related roles for non-governmental organisations, river and wildlife trusts, local government and water companies.

Strategic Information for the Climate Change Industry
CLIMATE CHANGE BUSINESS JOURNAL®

Americas water experts in the news

Three of our water specialists appeared in respected US publications during 2016.

Brian Swett (Boston) and Vincent Lee (New York) were both featured in the *Climate Change Business Journal* article 'Arup Advocates Resilience Before the Storm'. This summarised our work protecting New York City's subway system from future floods and on neighbourhood-scale green infrastructure projects across the city. Our partnership with the C40 Cities Climate Leadership Group (C40) and the Rockefeller Foundation were highlighted as examples of thought leadership.

Brian also highlighted how Hurricane Sandy was a near miss for the City of Boston. Had it arrived five hours earlier, 6% of the city would have been inundated with floodwater. Both he and Vincent noted Arup's partnerships and design contracts, as well as how we have transferred established frameworks such as seismic models for flooding and drought.

Vincent was also interviewed for the article 'How Engineers Can Adapt Infrastructure Design for a Changing Climate' on IHS Engineering 360. He discussed the effects of climate change on related infrastructure – such as how land subsidence puts utility connections at risk as buildings sink.

IHS Engineering 360 article

Too much water

Major floods that used to happen only once every 100 years now take place every 10 or 20 years. With an increase in rainfall, and the continued destruction of the environment, catastrophic floods may become regular occurrences.

Our global flood and coastal management experts are involved in all aspects of flood alleviation – including feasibility, modelling, research projects, prevention and long-term resilient solutions.

Drawing on ideas and projects Arup has used successfully in other regions, we provide sustainable solutions at a local, country or global level.

Flooding can be disastrous. Houses can be destroyed, lives can be ruined, and wildlife threatened.
Our projects have had a positive impact on the communities affected.

Managing flood risk in Risca

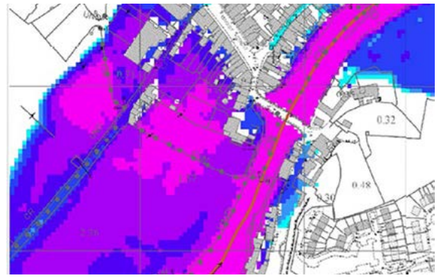
The town of Risca is situated along the banks of the River Ebbw north of Newport, South Wales. The community suffered widespread flooding in 1979 with 1.5m deep floodwaters in the main street.

Natural Resources Wales (NRW) appointed us to assess the risk of flooding and appraise management options. Our structural engineers and hydraulic modellers found that the 1980s flood defences were at risk of overtopping, outflanking and sudden failure during overtopping.

The subsequent £2.7m flood scheme for Risca comprises new flood embankments, improvements to existing defences, fish passage channel enhancements and a river viewing area. The scheme will significantly reduce the risk of flood damage by protecting 760 properties from high-probability flood events.

During the appraisal, we piloted NRW's ecosystem approach, identifying key services provided by the area and assessing how to maximise the environmental and social benefits of the scheme. This led to the incorporation of fish habitat resting places to support fish passage. Helping contribute to wider efforts to preserve and increase fish stocks in the river, ensuring wider benefits to local fishermen and creating an enhanced environment for visitors.

> *"Thank you for all your hard work on Risca ... Arup has shown great commitment and determination working with NRW to manage detriment issues on the Risca flood scheme. Extensive modelling has been produced to a high standard. The project has been classed as best practice with regards to managing and communicating the detriment issues within NRW."*
>
> **Melissa Mahavar-Snow,**
> NRW Project Manager

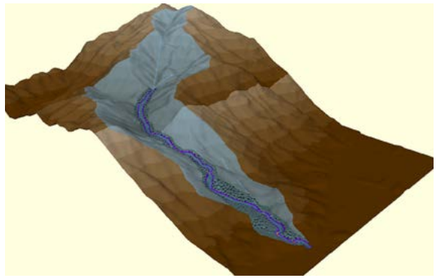


Piloting community response schemes in Kilkenny

In Ireland, Kilkenny County Council has appointed us to progress flood alert schemes and community flood response schemes in Thomastown and Graiguenamanagh. These schemes are intended to facilitate a community-based response to flood events by making the local community more resilient and better prepared.

The schemes will provide an early flood warning system for the two towns. They will also provide flood management measures for individual properties, such as demountable flood door barriers and non-return valves.

The Office of Public Works intends to use this project as a national pilot study as it considers the provision of flood management measures to individual properties.



Examining river flood risk in Hong Kong

We are examining the flash flooding risk of natural drainage catchments and rivers across the territory of Hong Kong.

To do this, we developed an innovative multiple-staged flood risk prioritisation methodology that uses Geographic Information Systems (GIS).

The flood risk assessments identified several flood-prone areas adjacent to river that are at risk of flooding and we recommended drainage improvement measures including first aid, flood warning systems and long-term drainage enhancement measures.

© Transport for NSW

Putting flooding at the heart of infrastructure design

Floods have taken lives and cost Australians billions in recent years. For this reason, flooding has become an essential component of infrastructure design. In many instances it is even the driver for change – such as the upgrade of a bridge or a highway to improve flood immunity.

In Arup, we put flooding considerations at the heart of our infrastructure design. We make sure that all the risks associated with flooding are captured at concept design phase, because failing to capture these risks can be disastrous for both our clients and the community.

Our technical expertise in numerical modelling contributes to our success. We stay on the cutting edge of new technology through workshops, training, conferences, and research and development.

We also bring an in-depth understanding of flood planning policies – something that is essential in major site development projects.

In 2015-16 we have applied our flood expertise to several projects across Australasia, including;

CBD & South East Light Rail (project CSELR), New South Wales (NSW)

Woolgoolga to Ballina Pacific Highway Upgrade, New South Wales

Harwood Bridge Replacement, New South Wales

Great Northern Highway Upgrade, Western Australia

Canberra Light Rail, Australian Capital Territory

Queen's Wharf flood impact assessment, Queensland

Toowoomba Second Range Crossing (TSRC), Queensland

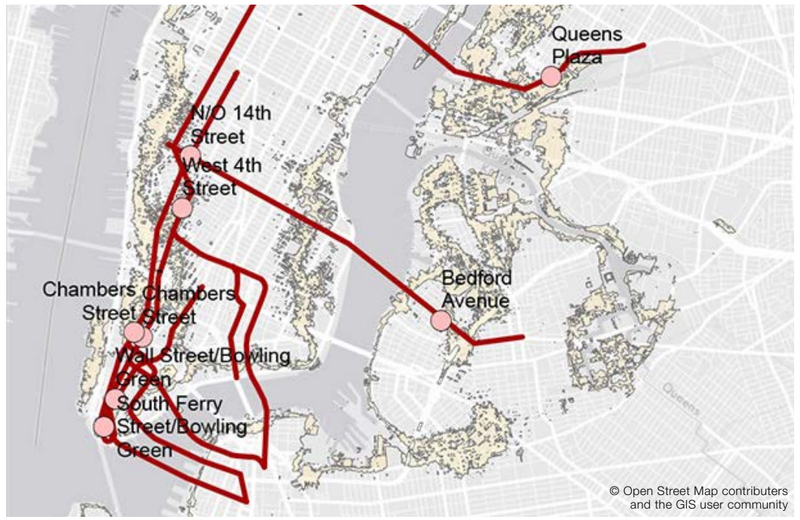
Gold Coast Cultural Precinct masterplanning and concept design, Queensland.

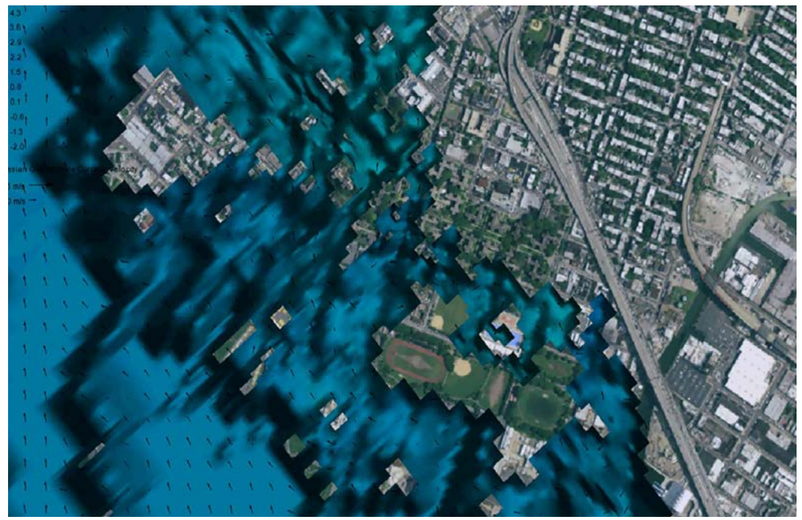
£40 million investment in East Belfast

The £40m Connswater Community Greenway and East Belfast Flood Alleviation Scheme will create a 9km linear park following the course of the Connswater, Knock and Loop Rivers, regenerating the area for the community.

Over 5.3km of floodwalls and bunds will be constructed to reduce the risk of flooding for 1,700 homes and businesses in East Belfast. River restoration is a central component of the greenway, which aims to increase biodiversity, community interactivity and improve the natural aesthetic of this National Lottery Living Landmark project.

The current Connswater channel is confined to a hard engineered channel and the scheme aims to improve the river environment by replacing the blockwork banks with a more natural form and introducing native aquatic planting.





Inform flood mitigation for New York's transit

The Metropolitan Transportation Authority (MTA)/New York City Transit (NYCT) is working to protect the city's subway from flooding. It selected us to provide feasibility studies, evaluate design strategies and perform detailed design for long-term flood mitigation measures.

To date we have carried out study and design work to protect eight stations and adjacent tunnels, two tunnel portals at one station, and one fan plant from storm surges.

We have also developed hydrologic models of five subway tunnels that would be impacted by Category 2 storm events. These models allow the city to identify the critical features affected and prioritise flood mitigation strategies.

In addition, our work has included collecting detailed data on all water ingress points, and surveying critical locations to support design efforts. And we have evaluated different mitigation concepts based on effectiveness, feasibility, and practicality.

Analysing flood investment programmes in Poland

Climate change, lack of natural or artificial retention in the upstream sections of river channels and development of rural areas leads to an increase in flood risk. This is what's happening along the Nida and Czarna Staszowska Rivers in Poland.

Our comprehensive analysis of existing flood defence and historical investment plans, alongside innovative solutions, helped to provide a complete and coordinated flood defence system for a 5,210 km2 catchment area.

We were asked to develop a complete flood protection programme and investment strategy, which we did through detailed analysis and hydraulic modelling of the existing, previously planned and proposed flood protection facilities. Multi-stage modelling maximised the hydraulic performance of the coordinated flood defence system while minimising investment costs and maintenance requirements.

Finding ways to make New York homes more resilient

The NYCHA (New York City Housing Authority) Red Hook Houses in Brooklyn, New York, were badly damaged in 2012 by Hurricane Sandy; with floodwaters more than six feet high in some places. A few years later the 32 buildings still had temporary external boilers adjacent to the existing plant rooms.

We identified options and developed MEP strategies for the permanent and resilient supply of heat and power. As part of the resilience masterplan, we identified strategies to make the site more flood-resistant and water-resilient. We also developed a stormwater resilience strategy, using green infrastructure to manage site ponding, and evaluated flood protection strategies using computational coastal modelling.

"Locally I have witnessed and participated in the growth of water-sensitive design in large cities such as New York, working on projects that involve green infrastructure approaches and flood resilience strategies. As a recent graduate at Arup I really appreciate the opportunity to work on projects that make a positive difference to communities."

Zachary Benedetto
Engineer,
New York

Defending King's Island

King's Island lies in the heart of Ireland's Limerick City and is surrounded by the waters of the River Shannon and the Abbey River. Both rivers are tidal at this location and the island is susceptible to both coastal and fluvial flood risk. Very significant flooding occurred in spring 2014, when the existing defences failed locally, both by overtopping and through a breach, allowing floodwaters onto the island and surrounding areas. The area was also affected by flooding in the spring of 2016.

Major improvements to the flood defences are required to prevent recurrences. With this in mind, Limerick City and County Council has appointed the Arup JBA team to assess, develop and design a viable, cost-effective and sustainable flood relief scheme to minimise risk to the existing community, social amenity, environment and landscape character.

Work to date has focused on the flood defence at Verdant Place, where the historic river wall is in poor condition and below the level of previously recorded floods. The design of a new flood wall has been submitted for planning permission, with emergency works and construction planned to start in summer 2016. In association with the Limerick Regeneration Plan for King's Island, changes to the road network and the construction of a new footpath have also been proposed.

The design of flood defences for the remainder of King's Island is also progressing, with site investigation due to be carried out for the area. A preliminary options study has also been completed.

Protecting Skipton from flooding

The £13m Skipton Flood Alleviation Scheme aims to protect people, homes, infrastructure and commercial enterprises in this North Yorkshire market town from flooding. It is one of several similar projects we have developed for the UK Environment Agency in recent years.

The steep hills that surround Skipton make it particularly susceptible to devastating flash floods. Two streams in particular – Eller Beck and Waller Hill Beck – have completely inundated the town centre on several occasions. This scheme will slow the flow on these two watercourses using flood attenuation basins upstream of earth embankment dams.

With substantial construction works required near an historic market town at the edge of the Yorkshire Dales National Park, gaining scheme approvals was particularly challenging. Consents were required from three separate planning authorities.

Too little water

Extreme droughts have become regular features. Consider Australia and the western United States, where drought conditions have continued for years with very few interruptions.

There are many food-related problems arising from a dry environment – there's no water for vital crops in southern and western Africa, and a reduction of fishing areas in the Amazon is affecting people's livelihood. These are just a few examples.

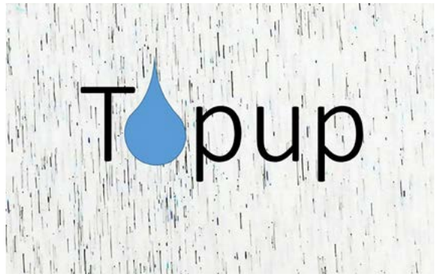
Conserving water has been at the heart of many Arup projects this year. We have worked with large municipals and private water companies on infrastructure and water treatment projects, and with communities to help change long-term behaviours – using emerging technologies to provide sustainable solutions.

The water scarcity crisis – tackling a global thirst

More than 740 million people are living without access to clean, safe water. We look at why managing this scarce resource is key to improving the lives of people globally.

Taking centre stage on the Arup website, we developed a global feature on this important subject – drawing on our water champions and key initiatives around the world. This can still be viewed on our website and to date has been visited be over 4000 users.

The Water Scarcity Crisis



Sizing rainwater tanks easily using Topup

Rainwater harvesting is an important component of regional water supplies, improving resilience as well as saving the owner money.

The most expensive part of medium- to large-scale rainwater harvesting systems is the cistern or tank. Yet many rainwater harvesting tanks are not sized to harvest as much water as possible at moderate or low costs. Many designers will use a thumb-in-the wind approach, often resulting in oversized systems.

Created by Arup, Topup is a first-of-its-kind tool that combines the power of global data with smart approaches to designing with water. Within minutes Topup allows designers and clients to visualise the feasibility and performance of rainwater harvesting systems at their site, based on their specific water demands and harvest areas, and on a full daily historical rainfall record. The triangulated daily rainfall record is a unique output that can also be used for other purposes.

Providing access to safe drinking water in Maldives

In Maldives, freshwater is scarce. Rivers and lakes are almost non-existent. This means that more than 6,000 people living on the islands of Mahibadhoo, Ihavandhoo and Gadhdhoo can't access safe drinking water, especially in the dry season. Prolonged dry periods, groundwater contamination and saltwater intrusion have caused serious water security issues. With the increasing effects of climate change, access to a year-round supply of clean, safe water has been an ongoing challenge.

We provided technical water resources expertise for a United Nations Office for Project Services (UNOPS) integrated water resources management for the three islands. The scheme includes constructing seawater desalination plants combined with rainwater harvesting schemes, a centralised water distribution system and a feasibility assessment for storing excess harvested rainwater by groundwater recharge.

The project was extended to a fourth island, Hinnavaru, which is still affected by the 2004 Boxing Day Tsunami which contaminated groundwater resources across the densely populated island. We designed a full water treatment and distribution system as well as targeted upgrades to the wastewater collection system across the island. The project consists of a combined rainwater harvesting and solar-powered seawater desalination scheme with a distribution network to reach all the properties on the island.

Safeguarding water supplies to the south-west US

Arup led the engineering design of a vital new intake tunnel at Lake Mead. This will safeguard future water quality for millions of people in the south-west US and the new Intake No. 3 will maintain water system capacity even if lake levels decline by an additional 30m.

The new intake is on the lakebed, 100m below the surface, and is the deepest subcutaneous tunnel in the world. From an onshore access shaft dug to a depth of 600m, a tunnel-boring machine worked to cut a 6.8 metre-diameter tunnel 4.6km long to connect to the new intake.

Meeting Manila's demand for clean water

In the Philippines, Arup has been working closely with Maynilad Water Services to develop a new water treatment plant at Putatan, Manila. Maynilad needed additional capacity at its existing plant, as current supplies are already over-stretched and aren't resilient enough to meet demand from its six million plus customers. We undertook a feasibility study looking at the incoming water quality and suitable process options. We then moved into the specification, procurement and contract administration of this US$100m project.

To develop a robust design we assessed more than five years' of process data. This minimised the risks associated with exceeding design levels. Working with the client team we set performance standards, giving flexibility to address future changes. The solution did not simply follow worst-case conditions but considered the risk and frequency.

We also specified a range of technologies, including the ultra filtration and reverse osmosis needed to ensure compliance during poor quality events. The lake water suffers from peaks of Manganese therefore a Manganese removal step (using Potassium Permanganate) was specified to ensure water quality always meets levels necessary to avoid health impacts on water consumers.

The project has recently been awarded to a consortium for construction and we will oversee the design, construction and commissioning.

Understanding and managing industrial water use in Bangladesh

Rapid and unplanned growth of the industrial sector in Bangladesh has led to increased pressure on the environment in Dhaka and other industrialised centres. To date, water has not been recognised as a critical issue by industry with little enforcement or control of water abstraction and wastewater discharge.

Industrialisation and export development are major policy objectives of the government but sustaining growth requires solutions to the emerging water risks. Managing the availability, quality and efficiency of use of water resources is vital.

Our report for the 2030 Water Resources Group (2030 WRG) was published in February 2016. It highlights the impact of industrialisation on water security in Bangladesh, with a focus on the textile and leather industries, and makes the scale of the water challenges facing those sectors clear. It analyses the opportunities for the sector to manage water risk through improving water use and effluent treatment, enabling more sustainable growth. The analysis also identifies water-management themes that need to be addressed for sustainable growth of the industrial sectors.

Our work led to the creation of the Bangladesh Water Multi-Stakeholder Partnership to help address these challenges. It is supported by the government, the 2030 WRG, the International Finance Corporation, World Bank Group and local private sector and civil society stakeholders.

WRG 2030 report

Download

An analysis of industrial water use in Bangladesh with a focus on the leather and textile industries

Bangladesh report

Please click here for your downloadable copy of the full report, highlighting the impact of industrialization on water security in Bangladesh with a focus on the textile and leather industries.

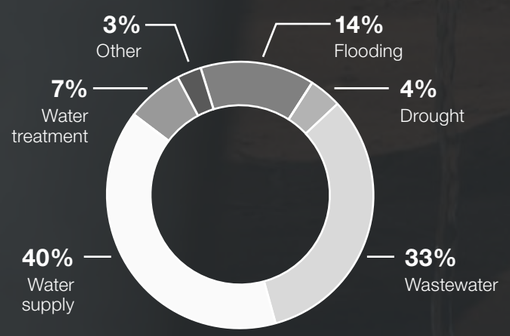
Social Impact

Shaping a better world by helping communities

Arup aims to have a positive impact on water issues in the world. We endeavour to add value to our work and consider the communities our projects affect. This is so important to us that it forms an integral part of our 10-year business plan – to have a positive social impact on 500 million people.

Our water team is also involved in community engagement on the ground, which this year resulted in a wealth of charitable events that raised awareness and money for important causes.

This year our project work has positively impacted 211 million people, bringing us nearly halfway to our 10-year target in only three years. We monitor these key themes to assess where we have had the greatest impact.



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Clean water for schools in Nepal

We collaborated with Splash, an organisation that provides clean water for washing hands and drinking to public schools in developing countries, on a project in Kathmandu in Nepal.

Because the supply from mains and wells is inconsistent, water is stored in tanks on the rooftops of schools. Reserve tanks are located underground. The height of the rooftop tanks depends on the pressure required at the tap outlets and filter system; where buildings are not tall enough a tank frame or a booster pump is installed.

We developed a user-friendly design tool for Splash that determines the right pump to transfer water from the underground tank to the roof. It will also work out the height of the rooftop tank (or pump where that height is not achievable) needed to transfer water through the filter system and on to the outlet taps at the right pressure.

This will make Splash's work easier and simpler, as well as enabling them to minimise the height of each rooftop tank frame – improving safety.

Splash website

Partnering with FRANK Water on safe water for all

FRANK Water is a charity with a simple, bold and ambitious goal: safe water for all. It works towards this goal by providing a safe water supply, sanitation and hygiene education (WASH) to communities. Since 2005, the charity has reached over 300,000 people in India, working with communities to identify and develop sustainable solutions that meet their needs.

Building on our existing relationship, FRANK Water became a strategic partner under Arup's UKMEA Community Engagement agenda 2016-19. They receive direct funding from us, plus help from our staff with technical support and capacity-building activities.

FRANK Water

Inspiring the next generation to explore STEM

Our team in the west of England has been inspiring young people to consider careers in science, technology, engineering and mathematics (STEM).

Through workshops, presentations and mentoring schemes, our engineers engage with primary, secondary and university students to debunk some of the myths surrounding engineering. They encourage students to explore their inquisitive sides.

> *"As young, articulate and fun-loving engineers, they [Arup Bristol Graduates and Engineers] presented themselves as people our students could identify with. The 'I could be like that' factor is a very important one. Your engineers left a very positive message about engineering!"*
>
> **Bristol Grammar School**

Pedalling hard for Engineers for Overseas Development (EFOD)

For the 2015 annual EFOD cycle challenge 22 riders from Arup and other local companies, each covered 200 miles (320km) over two days. The route looped from Cardiff, across and back over the Brecon Beacons, took in some of Wales's finest valleys and ascents as well as a lap of the spectacular Llyn Brianne reservoir. With over 5,000m of climbing, plus rain, wind and a bit of sun, this was no mean feat – but overall it was a great success.

Promoted by Jeremy Fletcher from our Cardiff office, the ride helped raise over £2,000 for EFOD. This money goes a long way to helping the charity with development projects in Africa. Past projects have included schools, hospitals, boreholes, village halls, women's refuges and nurseries. The charity also helps develop UK engineers' understanding of working in developing countries.

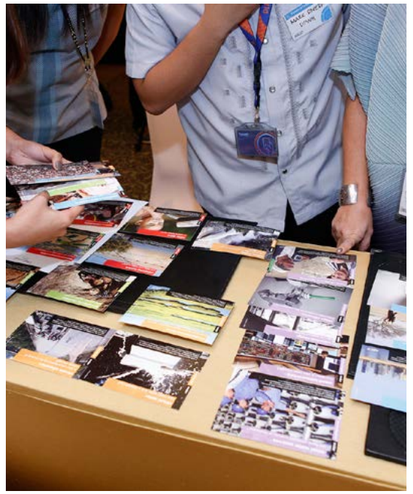
Partnering with Eco Action Games to change behaviours

We've formed a strong partnership with Eco Action Games, a water-themed playground that encourages the behaviour changes that will make our water use more sustainable.

The playground combines fun and games (including giant Snakes and Ladders and Eco Twist) with the serious topic of climate change. The games encourage engagement, get people talking and inspire positive action through a series of targeted questions on topical water issues.

Over the last year, with the help of our water experts - the games have been played at schools, universities, events and festivals. These have included World Water Week in Stockholm COP21 (the Paris Climate Conference). The team also attended our inDepth launch - providing delegates with a chance to get involved.

Eco Action Games website



Download

Drivers of Change Cards Water

Drivers of Change Water explores some of the key trends and issues shaping the future of water globally. The drivers showcase some of the immense challenges we face. For a free download of the cards, please click here.

Assessing the Gunt River mudflow dam in Tajikstan

In late July 2015 accelerated snow and glacier melting, caused by unusually high temperatures, triggered severe mudslides and flooding in Tajikistan's Gorno Badakhshan Autonomous Region (GBAO) in the Pamir Mountains. Events like these are sometimes referred to as glacial lake outburst floods, and the situation required expert advice.

As a result of the mudflows, debris blocked the Gunt River 20km upstream of the town of Khorog, forming a natural, mudflow dam about 1,000,000m3 in volume. The lake that formed behind the mudflow dam – referred to as Barsemkul – was assessed to be about 2,000,000m3 in volume. To give that some context that would fill at least 800 Olympic size swimming pools!

The Tajikistan government expressed particular concern about the potential risk to life if the mudflow dam were to breach suddenly. This could trigger significant flash floods downstream and affect up to half a million people living in these areas, as well as the Khorog power plant and major transport infrastructure.

The government declared a state of emergency in GBAO and the World Bank mobilised a team of experts to undertake a rapid risk assessment and make recommendations. The bank commissioned Ljiljana Spasic-Gril and Dr Matthew Free from our London office to undertake the risk assessment and recommend immediate and long-term remedial measures. The recommendations were adopted for a safe and timely solution to the problem.

Supporting Well of Hope's work in challenging environments

Our Polish water team is fundraising and providing much-needed technical support forthe Well of Hope Foundation. The organisation delivers water supply and sanitation projects for communities in need, in challenging environments. It works mostly in Africa – including in Cameroon, Uganda, Zambia and Tanzania.

The Well of Hope Foundation cooperates with local organisations, who understand local needs, and prepares descriptions of the facilities together with cost calculations. It ensures that funds are used to build and maintain installations according to engineering principles.

All projects include local communities. They help enthusiastically with preparatory works, transporting materials and assembling the installations. People involved in these projects develop new skills and competencies that they can use to support their community. The team are planning to provide technical expertise on where to best situate wells for water supply.

The Well of Hope Foundation

Celebrating World Water Day, 22 March 2016

Did you know that 650 million people in the world still lack access to safe water?

World Water Day is an opportunity to learn more about water-related issues, be inspired to tell others and take action to make a difference.

Our offices across Africa, the UK and the Middle East took part in lunchtime workshops to the celebrate the 24th annual World Water Day on 22 March. Over 120 staff used Arup's new Water 2.0 Drivers of Change cards to prompt discussions about current and future water management around the world.

Lots of ideas, along with pledges for personal action, were then shared across the company.

Meanwhile in Poland, the team took on a water quiz to raise awareness and money for WaterAid, a global charity that helps communities improve their access to safe drinking water.

Drivers of Change Water cards 2015

Building on our partnership with WaterAid Americas

Throughout 2015 we maintained our strong partnership with WaterAid Americas, continuing to focus on their Nicaragua programme – their first in the Western Hemisphere and now thriving.

Over the course of the year we organised internal fundraising and awareness-building events that raised thousands of dollars for WaterAid Americas. In addition we provided much-needed translation of essential technical documents from English into Spanish for use in Nicaragua.

We are now looking to strengthen the partnership with a more rigorous multi-year agreement with WaterAid Americas and to support the organisation as it explores expansion throughout Latin America and the Caribbean.

Upgrading the Lama Lama people's water supply

In Australia, our Queensland engineers, working with the Centre for Appropriate Technology (CAT) in conjunction with the Yintjingga Aboriginal Corporation (YAC), have provided engineering design and cost estimates for a new water intake structure for the community of Port Stewart. The structure is part of the water supply system that supports around 50 Lama Lama people living in two homelands, Mojeeba and Theethinji, as well as their ranger base and planned tourism facilities.

For almost ten years since flooding destroyed its previous intake, the community has relied on a temporary intake and water supply. The service this delivers is far below what would be considered acceptable by most Australians.

Throughout the design process it was important to consider why the previous design may have failed and balance the requirement for a robust technical solution with the limited budget and resources for construction. The length of the wet season also means that the intake may be inaccessible for weeks or months at a time.

The final design is a non-vertical bore intake with a solar-powered bore pump. The intake will deliver water to existing high-level tanks, which feed the community water supply network.

The new intake will make the supply significantly safer and more reliable, and it will help the community achieve some of its wider objectives. These include proposed new business opportunities such as a Safari Camp tourism venture – currently constrained by water supply issues.

The Lama Lama water supply upgrade is one example of our Australian water team's involvement in projects with social impact. Others include technical support for wastewater treatment anaerobic biodigesters in Cambodia, ongoing learning and support through the Engineers without Borders Water Study Tour and local initiatives.

Partnering with A Drop of Life to build rain-saving water cellars

The Hong Kong office have partnered with A Drop of Life, a non-profit organisation that builds rain-saving water cellars for arid areas in China. We're sponsoring and participating in activities that promote water-saving and water resource conservation.

As part of this partnership we sponsored the organisation's Race for Water event in March 2016 to celebrate World Water Day. This saw 51 Arup staff each carry 4.5 litres of bottled water along an arduous trail to experience the hardship of the people in China who carry water from a clean water source to their home every day. The event had a finish line of either 15km or for the four hardiest teams a 30km trail.

We raised a total of HK$131,000, which will go towards the new water cellars for communities in north-west China.

A Drop of Life

Year in review

A snapshot of activities, communications, research and Arup people

It's been a busy year. Arup's people have been much in demand for events and conferences and have had the opportunity to present on a range of topical subjects.

We have developed strong relationships with international organisations –to improve standards, to share information and to raise awareness of global water issues. And we have published newsworthy articles and thought pieces in support of our events and projects.

We have also rolled out research projects in the regions, which, along with core water research subjects, explore green infrastructure and the circular economy.

Finally Arup's skills community is growing, and we are very proud of the recognition our people and teams around the world have received.

In this section:

Out and about

Around the world the Arup team has been stepping up to the podium, tackling issues such as water risks, sewage challenges, green infrastructure, resilient buildings and innovation in the water sector – to name but a few.

We have also attended international forums and events where climate change is the main focus, contributing to discussions and abstracts that could have a big impact in the water sector.

Attendance at events and conferences gave the team an opportunity to meet new contacts and potential partners. The quarterly Wet Networks UK event we hosted with law firm Pinsent Masons, which showcased water-sector technology, proved so popular last year that we are now developing a global road show.

Focusing on the future at the British Water International Reception

In September 2015 Keynote speaker Martin Shouler, Arup's Associate Director for Water Infrastructure, titled his presentation at the British Water International Reception 'Future Water Challenges'. He took attendees through the water risks facing the world, such as water scarcity and adapting to climate change. In closing Martin invited the audience to think about the opportunities that would arise on both the supply and demand sides and encouraged them to network to help find solutions.

> *"The International Reception held by British Water provided a fantastic opportunity for colleagues across the water supply chain to meet old friends and build new partnerships. By making the most of our shared knowledge and expertise, the UK can work with partners across the industry to meet the world's water challenges, such as water security, affordability and resilience."*
>
> **Martin Shouler**
> Associate Director, Water Infrastructure

British Water event article

Taking part in World Water Week in Stockholm

Several of the Arup water team from the UK attended World Water Week in Stockholm. Hosted and organised by Stockholm International Water Institute (SIWI), this event is an annual focal point for water issues. It encourages experts, practitioners, decision makers, business innovators and young professionals to network, exchange ideas, foster new thinking and develop solutions to the most pressing water-related challenges.

During the event, Anders Berntell, 2030 Water Resources Group Executive Director, and Mark Fletcher, Arup's Global Water Director, took the 'SIWI SOFA' to be filmed discussing currently available, replicable and practical solutions for transforming water use.

Mark also took part in several sessions during the week, as well as doubling-up as a games player in the breaks with our sponsored partners Eco Action Games.

SIWI SOFA video

Showcasing innovation in the water sector at Wet Networks

Not since the industrial revolution has the water industry been subject to so much change. Technological innovation, compounded by political, social and environmental uncertainty, brings great challenges.

However, these factors can also provide opportunities. The global industry is estimated at US$400bn, with an annual growth rate of 7%. With more than 50 countries suffering water shortages, and 60% of European cities over-exploiting groundwater technology, companies and entrepreneurs have an opportunity to help adapt to this challenging environment.

Embedding innovation in the water sector can be difficult. With this in mind, Wet Networks has, over the last nine years, provided a unique meeting point for water technologists and innovators, the investment community and those in the water sector who are looking to facilitate change.

Arup, together with the international lawyers Pinsent Masons, hosts a networking event three times a year. To date, over 120 technologies have been showcased with a view to helping them through the so-called ‘valley of death’ where good ideas are stifled due to a lack of market engagement and investment.

The Venturi Water Innovation Portal, mentioned in this year’s review, is just one example of a technology that has received a boost from Wet Networks.

Wet Networks

Organising a seminar on water company challenges, Poland

During the annual meeting of our regional global business leaders on 24 April 2015, Arup’s water team in Kraków organised a seminar on the challenges for water companies in water and sewage management. Our client, Kraków Water Company (MPWiK SA), hosted the event at its Kraków-Bielany venue –a magnificently revitalised, operational, historic water treatment plant.

Senior representatives from major Polish water companies attended the conference, and our business leaders presented challenges faced by the water companies around the world. They focused on flooding, resilient cities and the future of urban water.

Former United Utilities director Tony Conway gave a speech introducing the panel discussion. This provided an opportunity for participants to share their experience of stormwater management and improving customer service, efficiency and innovation.

Presenting to WEFTEC in Chicago on green infrastructure

In September 2015, Vincent Lee from our New York office presented at the Water Environment Federation’s Annual Technical Exhibition and Conference (WEFTEC) in Chicago. He gave a joint presentation with New York City Department of Environmental Protection (NYCDEP) on green infrastructure and navigating the underground of cities to retrofit green infrastructure.

Assessing climate risks and coastal cities: a China-UK workshop

In January 2016, flood risk experts from Arup’s Hong Kong and Beijing teams participated and presented in this workshop co-organised by Tsinghua University, the Chinese Meteorology Administration (CMA), the University of East Anglia and the British Embassy in Beijing. The workshop shared the experiences of Chinese megacities in assessing and managing sea-level rise and river floods to build resilience.

We presented our novel risk-based approach, which combines the considerations, flood hazards and vulnerability to rapidly assess river flood risk across the territory of Hong Kong. This identifies higher-risk catchments and rivers to focus attention and resources on. Our approach makes extensive use of geographic information systems (GIS) for managing and analysing data.

Presenting and facilitating at the 7th World Water Forum

In April 2015 more than 20,000 participants from over 150 nations convened for the 7th World Water Forum 2015 in Daegu, South Korea. They included government officials, legislators, international organisations, public and private companies, universities, and non-governmental organisations. The Forum is the world’s largest meeting about water and occurs once every three years. Kenneth Kwok (Hong Kong) and Vincent Lee (New York) represented Arup.

Kenneth and Vincent supported the International Water Association (IWA) in two sessions. In a thematic session titled ‘Putting the water-energy nexus into practice: economic and policy incentives’ Vincent presented and facilitated round-table discussions. In another thematic session titled ‘Built and natural infrastructure for water-secure cities’ Kenneth presented Arup’s Design with Water Framework to demonstrate how we re-integrate the water cycle to create sustainable cities.

World Water Forum

Riding a high tide at Flood & Coast 2016

Flood & Coast is a unique new annual conference that advances the debate about flood and coastal erosion risk, resilience and response among key stakeholders. These include governments as well as the communities, businesses and infrastructure operators affected. The event focuses on the concept of a changing climate, drawing on expertise from around the world.

Over 1,200 people attended Flood & Coast 2016, which Arup attended in force. Speaking at the event over the three days were our Associate Director for Water Will McBain and David Wilkes, and Senior Engineers Jennifer Laight and David Hetherington.

We also had posters accepted from Associate for Water Donald Daly and Arup San Francisco office Senior Consultant Yana Waldman and our exhibition stand in the main hall attracted lots of visitors. It proved a great opportunity to develop and build on relationships with leading people and organisations in this field.

Flood and Coast website

> *"All round a great team effort which produced some great opportunities for us as a business. We hope to capitalise on this over the coming months"*

Will McBain
Associate Director, Water

The Americas team in demand

Our team in the Americas has been very busy this year, presenting and moderating at regional events, as well as taking part in the global events highlighted elsewhere in this review.

The American Water Works Association (AWWA) Sustainability Water Management conference on 10 March 2016 in Providence, Rhode Island focused on: 'How Do We Adapt and Plan for the Future?' Participants included leaders from the Boston Water and Sewer Commission, the State of Rhode Island Department of Coastal Resources Management, Rhode Island State Treasurer and the City of Newport Rhode Island. Paul Kirshen, Professor of Climate Adaption at the University of Massachusetts Boston, also provided a perspective on how climate change and resiliency efforts are likely to affect different communities. Janine Witko, Associate Principal for Water in our New York office, ran a closing panel discussion on the day.

Janine Witko also moderated sessions at the local New Jersey and New York Water Environment Association (NYWEA) annual meetings in February and May 2015. In addition, Jenna Hermann presented on resiliency in the New York City transit system – specifically on using hydrological tools to assess risk and develop improvements – at the annual NYWEA conference in February 2016.

Rowan Roderick-Jones presented at the American Institute of Architects (AIA) Monterey Design Conference on 17 October 2015 and at the Next Conference in San Francisco on 12 November 2015.

Charles Ormsby presented at the INFRA Congress, Quebec, in November 2015 – talking about 578 Rain Gardens in New York, relating to the green infrastructure designs were are doing for the city.

Speaking at the 2015 World Water Source Summit in Yushu, Qinghai, China

Most parts of Yushu, the Tibetan autonomous prefecture in western China, lie in the upper basins of Asia's great rivers – the Yellow, the Yangtze and the Mekong. This provides the historical and geographical context for the 2015 World Water Sources Summit, organised by the Chinese authorities in August last year.

Joining other urban planners, academics, non-governmental organisations (NGOs) and professionals, Shao Lanzhu from Arup's Shanghai office gave a speech on how to better manage water resources.

In her presentation Lanzhu explored issues like sustainable water usage and the changes in water engineering in the context of rapid urbanisation and climate change. She presented ways to re-explore the relationship between humans and water and make cities adapt to climate change by incorporating the idea of water cycles.

Relating issues to the local context, Lanzhu outlined some of the measures that China's government has been experimenting with, such as the 'Sponge City'. The presentation was well received and paved the way for future collaboration.

Shaping the future at the NYC Waterfront Alliance Conference

The theme for the Metropolitan Waterfront Alliance 2015 Conference, held on 7 May, was ‘Shaping Your 21st Century Waterfront’. It featured NYC officials, practitioners, and advocates for a sustainable and resilient waterfront. Vincent Lee from our New York office was a panel speaker at the session on resilient waterfronts, resilient communities – adapting capital projects to improve coastal protection and benefit communities. Moderated by Nancy Kete, managing director of the Rockefeller Foundation, the panel discussed the critical importance of community engagement and participation to enable resilience.

Vincent highlighted Arup’s experience on Hunter’s Point South in Long Island City and the NY Rising Communities Reconstruction Program (for the Long Island south shore). Both projects exemplified the importance of integrating engineering design and decisions with stakeholder coordination (>70 stakeholders for Hunter’s Point South) and community engagement (55 community meetings across seven months).

Doggerel Conference article

Presenting at Innovations in Infrastructure

Arup presented two sessions in November 2015 at the European Chamber of Commerce Philippines Congress, Innovations in Infrastructure.

Adrian Marsden, Associate Director for Water in Manila, covered water-sensitive infrastructure design, discussing current issues with poor planning and a lack of integrated thinking in the design of infrastructure. This, he argued, contributes to poor drainage, and then flooding, property damage and a reduction in quality of life for urban residents in Philippine cities.

Adrian discussed the ideas contained in Arup’s recent Design with Water brochure, focusing on possible solutions for metro Manila and other urban areas. This included large-scale designs, such as for the Melbourne Outfall Sewer and smaller-scale ideas such as tree box filters to trap pollutants and delay flows to rivers.

In addition to Arup’s water work, Fergal Whyte, Director of Water Hong Kong, presented on the future of transport – focusing on using technology, planning and integration to deliver better urban living conditions.

Speaking at the Australian National Water Policy Summit

Arup water specialists spoke at the National Water Policy Summit in Melbourne, October 2015, and launched the Australian Water Customer Survey - part of the Australian Water Consumer Outlook initiative.

Authorities and other agencies are increasingly recognising that, to manage water resources and improve their customers’ experience, they need to hear what customers know, what they don’t know, and what their concerns are.

To support that, the Australian Water Association and Arup surveyed Australians nationwide to understand consumers’ views about water. This helped us to produce the 2015 Water Consumer Outlook.

> *“The water industry in Australia has recognised the importance of continuing to shift from a compliance focus to a customer focus. This commitment has been reflected in the utilities statements of obligation which acknowledge the importance of their customers.”*

Daniel Lambert
Australasia Water and Urban Renewal Leader

Building relationships

Arup continues to forge important relationships with partners around the world in the fields of climate change and wider global water issues.

This year the team has been engaged in policy reform discussions, consulted on flood risk frameworks and hosted exchange initiatives. We have also developed high-profile communication tools for discussion throughout the global water sector.

AUSTRALIAN WATER ASSOCIATION

Informing water policy reform

In the past year we have engaged in top-down policy reform discussions and generated bottom-up insights into Australian water customer perceptions and attitudes.

Policy reform remains an ongoing interest of the water sector and Arup has been active in discussions during 2015. We've contributed to the Infrastructure Partners Australia (IPA) and Water Services Association of Australia (WSAA) report, Reforming the Urban Water Sector, and supported its launch at the Australian Parliament House in November 2015.

Also in 2015, the Australasia Water Group partnered with the Australian Water Association to research the attitudes and preferences of water consumers. The Australian Water Consumer Outlook report was presented at the National Water Policy Summit in October 2015. Following this, we have been working with water service providers across Australia to provide regional and valuable insight into public perceptions and attitudes.

Reforming the urban water sector

Re-appointed on Bristol flood risk framework

Continuing Arup's strong links with Bristol City Council, we have been re-appointed on its 4-year Flood Risk Consultancy Framework.

We will be providing multidisciplinary services to the council's flood risk team – including structural, flood modelling, project management, and digital services.

Projects will include project managing the Bristol Flood Defence Strategy, structural assessment of local flood defences and developing the asset management strategy for the floating harbour.

Presenting at the India-UK water security exchange initiative

The UK Water Partnership (UKWP) has led a joint UK-India initiative to clean up the River Ganga (Ganges). As part of the India-UK Water Security Capability Exchange Initiative, Arup's Associate Director for Water Infrastructure, Martin Shouler, presented our global water capability and integrated water management expertise.

UKWP facilitated the event as part of a programme of direct engagement between UK companies and Indian water planners and practitioners to exchange knowledge on governance, regulatory issues and innovation. The exchange followed a UK-India agreement to cooperate on the Ganga clean-up in November 2015 when India's Prime Minister Narendra Modi visited UK Prime Minister David Cameron in London.

The initiative marks the first in a series of exchanges between the two countries.

The UK Water Partnership

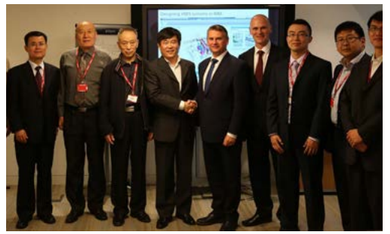
Hosting a workshop on Iranian water challenges

In January 2015, Arup hosted a workshop in the UK to explore current and emerging water challenges in Iran. This was part of a week-long event connecting British and Iranian specialists in water – sponsored by the British Council and run by Imperial College London.

Chaired by our Associate Director for Water Infrastructure, Martin Shouler, the included theme-setting presentations and a workshop. Experts presenting included Siraj Tahir, who spoke about applying integrated water management, while the workshop used Arup's Drivers of Change cards to investigate the key water issues for Iran.

Arup University researcher Elisa Magnini facilitated the workshop, which identified issues such as managing water in a scarce environment and dealing with a fast-growing urban population as critical water needs for the country. Key Iranian contacts were provided by our Associate Director for Building Engineering, Dr Mohammad Tabarra, who helped plan and deliver the workshop.

Future Water Challenges for Iran – a collaborative approach



Reviewing plumbing standards with a Chinese delegation

China is revising its codes and standards for water supply and drainage systems for buildings. In September 2015, our Associate Director for Water Infrastructure, Martin Shouler, led a workshop with The China Plumbing Association (CPA) as part of CPA's week-long tour of the UK.

The CPA was keen to understand how the UK deals with issues including safe hot distribution water systems to innovative drainage schemes.
Mr Zhao Li, President of the Water Supply and Wastewater Association, was keen to understand how innovative technology is adopted and the role of British Standards.

Working with AGWA on #ClimateIsWater

Arup worked closely with the Alliance for Global Water Adaption (AGWA) in the lead-up to the December COP21 Summit in Paris, supporting the #ClimateIsWater initiative. Working with our visual communications team we developed a striking video to impart the key messages of the campaign. This is now live on the #ClimateIsWater website.

The #ClimateIsWater initiative emerged from members of the international water community joining forces to make water issues a more important part of the climate change discussions during COP21 and beyond. This initiative has brought together organisations representing thousands of stakeholders to achieve recognition for water at a political level. It encourages everyone to communicate with a single voice: climate is water.

Alliance 4 Water

Getting SMART with UK Water Partnership

The UK Water Partnership (UKWP), which includes Mark Fletcher, our Global Water Leader, and Martin Shouler, our Associate Director for Water Infrastructure, has published a discussion document, Future Visions for Water and Cities: A Thought Piece. This provides five visions of how cities might tackle water cycle management in 2065 - summarising current and recent research activities.

These visions cover issues including flooding, food production, smart homes, and harnessing the deep geology beneath cities. The document provides a framework to bring businesses and academics together to address the challenges.

Future visions for water and cities: a thought piece

Download

Future Water Challenges Report

This report summarises a workshop held with UK and Iranian experts, sponsored by the British Council, to explore the water management challenges faced by Iran. Please click here to download.

Download

Visions for Water and Cities Challenges Report

This thought piece sets out 5 different visions for water management in future cities, and explores the research and innovation challenges to achieve them. Click to download the report.

In the news

Our water events and projects have featured in too many publications to list them all in this year's review, so we've selected a few highlights from around the globe.

These include the RainScape project in Wales, which attracted Royal attention during a visit to the region. At the other end of the world in Hong Kong, the Harbour Area Treatment Scheme Stage 2A has attracted worldwide media attention.

Showcasing the engineering of Harbour Area Treatment Scheme Stage 2A (HATS2A)

HATS2A started the 'flow turning' process on 18 September 2015. This involved progressively conveying all preliminary treated sewage from the upgraded preliminary treatment works on northern and south-western shores of Hong Kong Island to Stonecutters Island Sewage Treatment Works for treatment and disinfection.

HATS2A then began its final commissioning in December 2015 and a ceremony celebrating this milestone was held on 19 December 2015.The Chief Executive, Secretary for the Environment and the Director of Drainage Services officiated at the ceremony.

The commissioning of HATS2A has attracted worldwide media attention. It was showcased as an exemplary way to engineer utilities for high-density cities, especially in Asia, in an article on Nikkei Architecture –a sister publication to the Japanese broadsheet The Nikkei.

HATS2A is vital for improving Hong Kong's marine environment and quality of life. We are proud to be the key player in the project team, having managed the overall project and designed the upgrade works since 2007.

The project was recently awarded 'Distinction – Wastewater Project of the Year' in the Global Water Awards 2016.

Nikkei article

Getting a royal nod of approval for RainScape

In March this year, the Llanelli Herald covered HRH The Prince of Wales' visit to Stebonheath Primary School to view a RainScape. This is Dŵr Cymru Welsh Water's approach to sustainably managing surface water – the rainwater that runs off roofs, highways and paved areas.

As part of his visit The Prince viewed the water catchment system that has been installed on the school's site, before meeting staff and pupils and watching a performance in the school hall. To read the full article please click on the link below.

We played a key role in developing the initial catchment strategy for Dŵr Cymru Welsh Water and have since begun implementing the RainScape schemes that will do the most to reduce surface water.

Llanelli Herald article

Llanelli Herald video

https://vimeo.com/156852607

Hosting the Americas Water Link

On 15-17 March 2016, our Americas region conducted its first internal water forum, called the Americas Water Link, in Los Angeles. Vincent Lee and Janine Witko (both from our New York office) organised the forum to answer the question: Where can we make a difference and where do we go next with water?

The first day of the forum included a Drivers of Change workshop to collectively identify priorities and frame the discussions. The day concluded with a client event on re-imagining the role of water in Los Angeles.

This featured a keynote speech by Mark Fletcher from our Leeds office and three city engineers from Los Angeles. On the second day attendees learned about a variety of our water projects in the Americas. Taking inspiration from Arup's current work, the event focused on identifying investment ideas for the future of water in the Americas.

This article featured in the Americas Region News within the Arup network.

Drivers of Change cards

Debating the next big flood – chaired by Janet Street-Porter

In November the construction industry gathered to have its say in a panel debate addressing one of the industry's – and the UK's – most pressing issues: 'The next big flood: why the UK won't be ready'. The debate, chaired by journalist and broadcaster Janet Street-Porter, allowed four experts from across the sector to put forward their view of the UK's preparedness for future flooding, before opening the question to the floor.

Panellists Alison Baptiste of the Environment Agency, Will McBain from Arup, Sue Illman of the Landscape Institute and Peter Caplehorn of the Construction Products Association addressed flood preparedness in the UK. Key issues include building regulations, government funding, the threat to infrastructure and difficulties with planners and local authorities.

You can also see video of the whole debate on the Water Matters portal by clicking on the link below. The event and webinar also featured in the December edition of Building magazine.

Wavin article

Commenting on Broken Hill water crisis

Broken Hill is preparing for a difficult future – possibly without water. The prospect of water running out has sparked concern in this city of 19,000 people 1,110km west of Sydney. Broken Hill has exhausted its supply of water that can be treated conventionally, forcing it to turn on a desalination plant, designed by Arup, to process the salty remains.

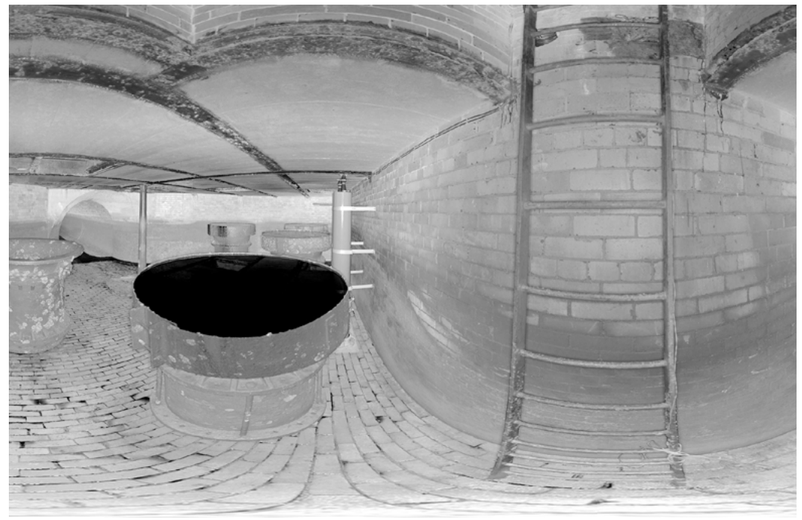
Broken Hill's plight underlines the vulnerability of the world's driest inhabited continent. Our Australasia water leader Daniel Lambert was asked to offer expert comment in a recent article in the Financial Review. The full article can be viewed by clicking the link below.

Bloomberg article - Broken Hill

Celebrating a clean sweep on Welsh multidisciplinary framework

Arup's Cardiff office has been appointed to the National Procurement Service (NPS) Construction Consultancy services framework Phases 2 and 3. This four-year framework is accessible to all public bodies in Wales, offering clients new ways to access Arup's skills and services.

We were successful on all 46 lots we bid for across the two phases. The successful lots enable us to market services offered by our consulting and infrastructure teams. Of particular note are the flood risk mapping and modelling, water management consultancy and multidisciplinary engineering lots. Influenced by leading bodies such as Natural Resources Wales, these provide opportunities for collaborative working in water and flood risk management.



Seeing the full picture with advanced survey techniques

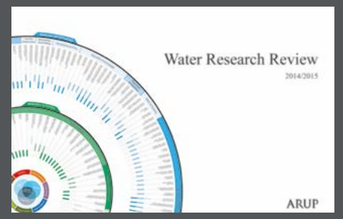
The Elan Valley Aqueduct provides most of Birmingham's water and is only accessible for a few days per year when the system is shut down. Even then, access is difficult due to rules about workers entering confined spaces. In some locations, it's just not possible to get people into the aqueduct. This has meant there is a lack of information about the asset.

To solve this problem, we trialled LiDAR to scan the aqueduct remotely – meaning there is no need to send teams down. The scanner was lowered 5m into the aqueduct on a 2-way telescopic tripod, and then set up to communicate via a WiFi connection.

Although the scan was restricted because the scanner couldn't move around the chamber, it provided information on the asset that couldn't otherwise have been gathered – and it was done safely, efficiently and quickly.

An article about the aqueduct tunnels featured in on the Birmingham News website in December 2015. The full article can be viewed by clicking the link below.

Birmingham Mail article



Research

Arup's Water Research Roadmap sets the direction for our research investment and potential partner collaborations.

Below are the highlights of our activity this year, and more details of all our research can be found in our Annual Research Review. Collaborating with clients continues to be a priority for us, and has produced valuable work such as the Sydney Water decision framework discussed below.

In addition to our core water research, water has been central to three of Arup's Global Research Challenge projects over the last 12 months: city sensors to measure the impact of green infrastructure, new approaches to financing green infrastructure, and data and governance for a city-scale circular economy.

Engaging communities with integrated water management

Typically, water management strategies are developed to achieve tangible outcomes in areas such as stormwater management, flooding or water scarcity. Project Pebble is different.

Project Pebble is a methodology and a support mechanism to implement an integrated water management strategy by engaging the community. This helps to frame choices and interventions that impact the community. It uses a generic approach to tackling water issues to address specific local needs.

The concept is being tested on the Plug-In initiative at Tyseley and Hay Mills in Birmingham, UK – a community-scale, living laboratory demonstrating the practicality and societal benefits of combined water reuse and sustainable drainage.

The project has been designed to be flexible, replicable, and pave the way for future urban, multicultural community engagement.

Plug-In will link up with other local initiatives, such as projects to improve the local river by removing a weir and improve surface water management through green infrastructure and sustainable urban drainage systems (SUDS). The initiative will act as a case study that can be used elsewhere, providing a bottom-up approach to effective water management at house, community and city scales.

Once implemented, the community will act as a living laboratory to demonstrate the practicality and societal benefits of water-sensitive living, water reuse, and community-scale and green infrastructure incorporating sustainable drainage.

Sydney WATER

Creating a first-of-a-kind decision framework with Sydney Water

We envision the future of demand management as user-friendly decision-support tools that enable utilities to compare the economic and operational benefits of different demand management activities across its network.

A spatially enabled decision tool brings together disparate data sets into an analytical framework. This enables utilities to target particular groups of customers and specific operational drivers, such as infrastructure constraints or energy costs.

Working with Sydney Water and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), we developed a first-of-a-kind decision framework that quantifies the potential benefits of demand management options and identifies areas to target.

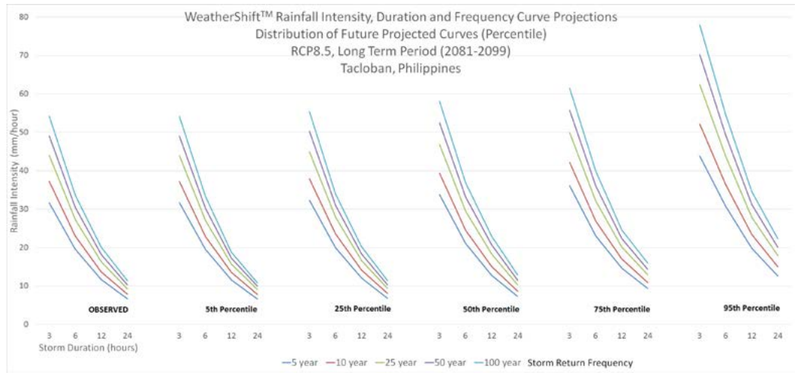
Our multidisciplinary team has now drawn on Arup's digital capability to create a web-based data management and visualisation tool that can give utilities easy access to this advanced decision-making framework.

Assessing Irish rail infrastructure in the face of coastal erosion and flooding

In September 2015, our water and maritime teams in Dublin completed research into methods for assessing areas vulnerable to coastal erosion and flooding across the Irish Rail network. These research projects were undertaken with Irish Rail and produced two new tools.

One tool can be used to assess coastal erosion and rank remediation strategies using a multi-criteria analysis tool. The other can rapidly assess and prioritise large sections of the rail corridor vulnerable to flooding.

The methodologies developed for these studies are adaptable for use on other infrastructure projects worldwide.



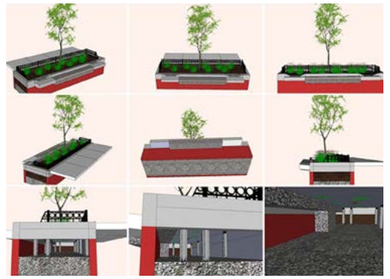
Projecting rainfall intensity, duration and frequency with WeatherShift

In conjunction with our partner Argos Analytics, we developed the WeatherShift toolset to help resilience and adaptation planners understand what they will need to prepare for.

New to the WeatherShift toolset is the ability to generate projected rainfall intensity, duration, frequency (IDF) curves that reflect changes in the future climate. IDF curves are a key hydrological engineering tool, used for everything from sizing storm drains to estimating the risk of flooding in a watershed.

As the climate continues to warm, evaporation from the oceans is increasing – leading to more moisture in the atmosphere. Climate scientists have concluded that this will result in more frequent and more intense precipitation events, which are not accurately reflected in the current IDF curves that are based on historical rainfall data.

The WeatherShift IDF tool uses an ensemble of climate projections from multiple global climate models (GCM) to construct projected IDF curves. Because of the range of possible future climate conditions there is also a distribution of future curves included in the set. The single most important benefit of the tool is that it will enable engineers to design stormwater systems using future rainfall projections that account for predicted climate change rather than using historic (and potentially outdated) data.

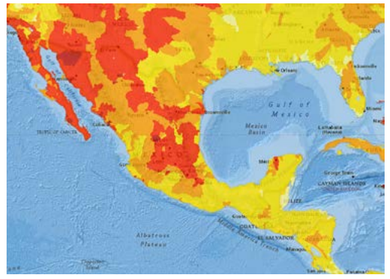


Using BIM green infrastructure models for design

In recent years, green infrastructure and building information modelling (BIM) have become hot topics. We saw the need to explore how BIM can be used to improve the design process for green infrastructure.

Our research identified the impact of BIM on commissioning urban stormwater management measures. We also identified the challenges and opportunities for using BIM in green infrastructure (BIM GI) for flow reduction and water quality treatment design. And we developed components and procedures for using BIM GI for engineering design.

Our report includes a case study on how BIM was used on the Westchester Creek Green Infrastructure project in New York City.



Over 80 Water Resources Group case studies now available

The 2030 Water Resources Group (2030 WRG) has brought together case studies from around the world that demonstrate replicable and practical solutions for transforming water use. The solutions collected in the online catalogue, Managing Water Use in Scarce Environments, can inspire action and are being used by policy-makers and the 2030 WRG country programmes.

During 2015-16, we have increased the total of number case studies in the catalogue to 82.

WRG 2030

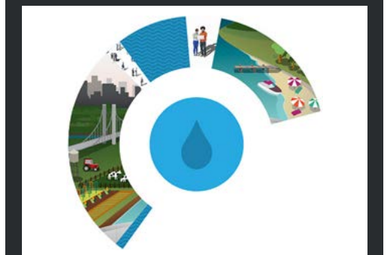
Researching Australian water customer engagement

Arup partnered with the Australian Water Association (AWA) to deliver a unique insight into consumers' views about water and produce the 2015 Water Consumer Outlook. The findings demonstrated a strong acceptance of water recycling and significant ongoing concern about the availability and resiliency of Australia's water systems to drought and climate change.

The Water Consumer Outlook will inform our work with local water authorities to prioritise and target key projects and communication with the community about water issues.

Australian Water Consumer Outlook

Download



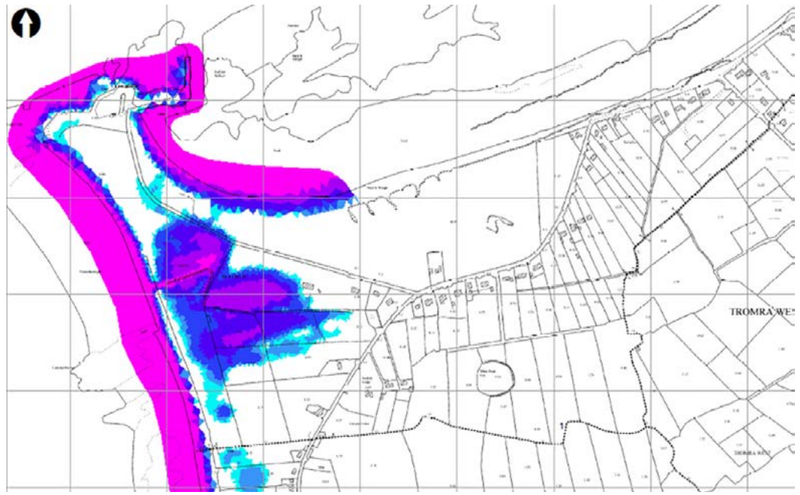
Australian Water Consumer Outlook

A consumer overview about water resources in the region, what the perceptions are and what is considered important. Please click here for the full copy.

Download

2030 WRG Managing Water Use in Scarce Environments

Presenting a catalogues of 'best practice' solutions to water scarcity. Please click here to access all of the case studies.



Developing our 2D coastal flood modelling

The primary objectives of this project were to develop our expertise in 2D coastal flood modelling and to produce a set of guidelines for flood and erosion risk mapping. The case study for the research was Cloughaninchy beach and adjoining area in County Clare, Ireland, which was severely damaged and flooded during a significant storm in January 2014.

A 2km-long embankment protects the site from tidal inundation but can be overtopped by near shore waves. The results of the modelling indicate that extensive areas of the site are at risk of flooding from wave overtopping. The results also suggest that the previous, simplified approach to estimating the wave overtopping flood risk at the site may not have been sufficient to highlight the risk.

Cities and Sea Level Rise – Adaption toolkits

This extensive research project created an accessible, comprehensive and project-delivery-focused methodology to identify sea level rise impacts and the ways in which coastal communities may adapt. The methodology can be applied by any Arup team at any geographical location.

The research team collaborated with the University of Leeds, Birkbeck College (University of London) and Old Dominion University in Norfolk, Virginia, USA. The collaborators identified global references research that contributed to the project's knowledge bank.

> *"Working in the Flood and Coastal Management team in the UK I get to see first-hand how Arup works with clients to find long-term solutions to critical issues affecting our cities."*

Alex Renton
Leeds Water
Team Secretary

Our people

Arup's skills community and breadth of knowledge are vital to our clients and to the wider relationships we build in the water sector.

Arup University plays an important role in supporting our development, adding to our skills base and keeping us at the front of topical global water initiatives. We also share this resource with clients, running courses to inform and challenge traditional thinking.

In the last year, our people's achievements have been recognised through awards and commendations. We are very proud to share here just some of the successes from around the globe.

Supporting skills development through Arup University

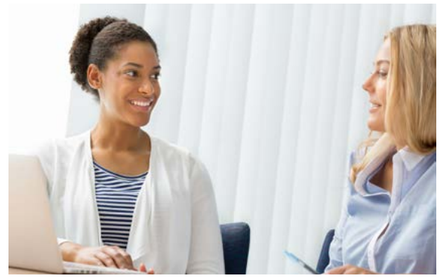
Our water skills network has a well-established relationship with Arup University's learning team. This has resulted in new training courses to up-skill and transfer knowledge across our regions.

In 2015, we developed and delivered a global virtual classroom course on hydraulic modelling to participants across East Asia, Europe, UKMEA and Americas. The course for the Australasia region will begin in 2016.

The online module on asset management for the water sector is accessible to participants from all regions. It was designed to raise awareness about this discipline and establish cross-regional connections.

Encouraged by positive feedback and the impact on business performance, the water skills network continues to call on Arup University's learning team's guidance and expertise.

Arup Graduates and Interns



Growing the water skills community

Arup's water skills community has grown to over 1,500 people in the last 12 months. It continues to be a very active network and it is one of our key tools for sharing global knowledge and expertise with clients. We have strengthened our skills through appointments in water technology, dams and reservoirs, and process functional safety.

Our Global Water Link 2016 event brought together over 30 water specialists from around the world to explore the future of modelling in the water sector. The interactive 2-day session, with external speakers, explored themes including integrated catchment modelling, linking BIM to real-time control and developing our visualisation techniques to share outputs with clients and stakeholders.

We have also worked closely with Arup University to expand its learning modules to help us increase our technical capacity and continue to improve the quality of everything we do. The online module on asset management in the water sector is being rolled out across all the firm's core water staff.

Hosting the first global water skills link

In February 2016, our UKMEA region hosted the water skills network's first skills link, which focused on how the water environment will be modelled in the future.

Almost 30 people covering all our regions attended the event in Birmingham, UK. Over two days they discussed what each region currently does to model the water environment. They considered what could be done better and what should happen in the future. In addition to the network's input, we also had speakers from our software house Oasys and the Open Data Institute, who provided insight into computational modelling and wider data usage and management issues.

Appointment as government special adviser

Flooding this winter affected many communities across the UK, costing more than £5bn and disrupting thousands of lives and businesses. Arup's consultant Dr Paul Quinn, based in our Newcastle office, has been appointed as a special adviser to the UK Environment, Food and Rural Affairs Committee, which has set up a select committee to investigate future flood prevention in a changing climate.

The inquiry will run until August when a Government report will outline its findings and recommendations. Paul is currently a Natural Environment Research Council (NERC) Knowledge Exchange Fellow in the Arup water team specialising in natural flood management.

At Arup, we believe that catchment systems engineering is the best way to address catchment restoration issues – including floods, droughts and pollution. Paul has spent the last few years campaigning for new catchment-based methods to address flood management and alert stakeholders to the threat of increased rainfall.

Working hard on diversity and inclusion – our statement

We are already leading the industry when it comes to diversity and inclusion. However there is still more to do. Everyone is different and everyone's perspective matters. At Arup we recognise that diverse teams stimulate innovation and respond better to society's needs.

By embracing an inclusive culture that supports diverse talent, our people collaborate successfully and enable Arup to compete effectively.

> *If we can reach a stage where each man or woman is respected for the job they do, and is doing his or her best because the atmosphere is right, because they are proud of what we are and do and share in the general enthusiasm, then we are home."*
>
> **Sir Ove Arup**

Dr Therese Flapper joins our Australasia team

We are pleased to have Dr Therese Flapper join Arup as our Australasia Water Skills Leader and Transport and Resources Leader in Canberra. Over her 25+ years' work, Therese has substantial and practical experience in bringing infrastructure from policy and planning to procurement and delivery. She has delivered more than AUS$500m in water infrastructure over the past few years.

Louise Ellis named in Forbes' 30 Under 30

Bristol-based Senior Engineer, Louise Ellis has been named one of Forbes' 30 Under 30 (along with the singer Adele and high-profile entrepreneurs, scientists, actors and musicians).

This was the first-ever Forbes 30 Under 30 Europe list. It features 300 young innovators, entrepreneurs and leaders across Europe who are transforming business, technology, finance, media, culture and more – as judged by some of the most accomplished and acclaimed individuals in each category.

Louise was also named as a finalist on the Forbes 30 under 30 in the industry category – as was James Holloway, an engineer from our infrastructure team based in Scotland.

For she's a jolly good fellow

Sue Spink from our Leeds office, who is PA to Mark Fletcher, Global Water Leader, has been congratulated this year on achieving Fellowship of the Institute of Administrative Management FInstAM. This is a major personal and professional achievement.

Rewarded for outstanding contribution to water effeciency

Mark Fletcher, Arup's Global Water Leader, has been presented with the Award for an Outstanding Contribution to Water Efficiency at the World Water Leadership Awards in Mumbai.

This a prestigious accolade presented annually to individuals who have made a significant contribution to the credibility of the water industry and who work tirelessly to deliver solutions to complex global water management problems.

This award recognises Mark's contribution to the water industry and his work with the Alliance for Global Water Adaptation on the #ClimateIsWater initiative. The campaign has been launched to improve the visibility of water issues within climate change discussions.

Recognising our Australasia team's achievements

Our team in Australasia has been recognised for its achievement throughout the year.

At the Australian Water Association New South Wales Water Awards, Daniel Lambert was runner-up in the 2016 Australian Water Professional of the Year. Arup was also a finalist in the Research Innovation Award for two projects: the Future of Urban Water and the Sydney Water Demand Management Decision Framework.

Daniel Lambert and Rene Garcia were both made Fellows by Engineers Australia.

Ragini Prasad completed the Arup University smart cities module with distinction. And Rene Garcia completed a Masters in Business Economics from Arup University and Imperial College London with a double distinction.

Daniel Lambert has been nominated as one of 2016 Australia's Most Innovative Engineers through Engineers Australia.

Gabrielle McGill was recognised as the 2015 Australian Young Water Professional and Walter Reinhardt has been recognised as the ACT Young Water Professional. Walter is now in the pool of talented and committed water professionals who will be considered for the Australian 2016 Young Professional of the Year.

Daniel Lambert was selected as a national judge for the Australian Water Association Awards for both the Infrastructure Innovation and Research Innovation Awards.

CIWEM recognises young Arup environmentalist

Arup's Dr Alex Nicholson has received the 2015 Young Environmentalist of the Year Award from the Charted Institution for Water and Environmental Management (CIWEM). The award, sponsored by Jacobs, recognises an exceptional contribution to environmental understanding by a top professional under 30 years old.

Alex, an environmental engineer in our water business, completed a PhD in natural flood management at Newcastle University and has continued to develop and champion natural flood management since joining Arup.

Alex has been involved in a long-term, part-time secondment to the UK's Environment Agency. He has also developed and delivered an assessment tool, design guide and training courses with organisations including Natural Resources Wales and the River Restoration Centre.

> *"I am absolutely delighted with the news of this award. Not only does it recognise my contributions to environmental research, it also endorses natural flood management. I really enjoyed the assessment day – I'd like to thank the CIWEM for the opportunity to present at this competition, my colleagues at Arup for their support throughout the process, and Jacobs for generously sponsoring the award."*
>
> **Alex Nicholson**
> Environmental Engineer

Scooping technical award for resiliency improvements presentation

In February 2016, the New York Environment Association (NYWEA) presented Mike Hall, our Civil Engineering Leader based in the New York office, with the Kenneth Allen Technical Award for his February 2015 presentation on New York City Transit resiliency improvements.

The NYWEA was founded in 1929 by professionals in the field of water quality as a non-profit, educational organisation. Association members helped lead the way towards existing state and national clean water programmes. Today the association has over 2,500 members representing diverse backgrounds and specialties – but all are concerned and involved with protecting and enhancing precious water resources.

The Kenneth Allen Award is given annually for papers or presentations describing work of a research or engineering nature.

NYWEA

Appointment to expert water panel

Arup's Australasia Water Leader, Daniel Lambert, has recently been appointed as member of the Expert Review Panel for the Australian Water Partnership (AWP).

The AWP is focussed on managing water scarcity in the Indo-Pacific region to support sustainable economic development, improve water security for all, and reduce environmental and social impacts and regional tensions.

The expert review panel members will select Australian partners to provide expertise in the region in four key water domains. These are: river basin planning and management, urban water policy and management, irrigation modernisation and management, and enabling methods and technologies for water reform.

Year in review

Project awards & affiliations

In 2015-16, our Water team's achievements and contribution to the sector have been recognised internally and externally.

Internally, our Westchester Creek Green Infrastructure project in New York City won the top Arup Digital Transformation Award for its use of technology. Externally, honours have come from some of the longest-established bodies in our industry, including the Institution of Civil Engineers and the Institution of Chemical Engineers. We've also won brand new accolades, with our Hunter's Point South Project in New York becoming the first to be certified under the new Waterfront Edge Design Guidelines.

As we look forward to next year, we hope to continue our success and build ever-closer relationships with organisations at the heart of the sector.

Winning the inaugural Chris Binnie Award

Arup, along with Morgan Sindall, celebrated winning the inaugural Chris Binnie Award for Sustainable Water Management at the annual Institution of Civil Engineers' (ICE) awards. Presented by the ICE President, Professor David Balmforth, the award went to the RainScape Llanelli green infrastructure and sustainable storm drainage project.

ICE's Water Expert Panel praised the project was for reducing peak flow runoff from the area by over 70%. Commissioned by Dŵr Cymru Welsh Water, the 5-year project involved bespoke water modelling, civil engineering, geotechnics, tunnelling and hydrogeological services.

Professor Chris Binnie, commented: "The scheme is at the forefront of good practice and resulted in reducing flood runoff flows considerably and thus benefiting the environment and those who might otherwise have been flooded downstream. Arup and Morgan Sindall are to be congratulated on what they have achieved."

Chris Binnie a visiting Professor at Exeter University, is a consulting engineer in water demand, water supply, water treatment, water resources development, hydro and tidal power, and flood risk assessment.

Awarded corporate partnership by IChemE

We have recently been awarded a corporate partnership status with the Institution of Chemical Engineers (IChemE), in recognition of our progressive graduate training programme and continued commitment to the profession.

This is one of the first steps to achieving a closer relationship with IChemE that will raise our profile and develop our process engineering capability. We join other corporate partners such as Costain, Sellafield and BP – and the partnership applies to all the Arup offices around the world.

IChemE is the global professional membership organisation for chemical engineering professionals and anyone involved with the process industries. With over 44,000 members in more than 120 countries they set the standard for chemical and process safety engineering professionals.

Awarding digital transformation – Westchester Creek green infrastructure

We want to promote the implementation of building information modelling (BIM) on our projects. So we have created an internal award programme that offers both recognition and prizes to projects demonstrating innovation in the integration of BIM, geographical information systems (GIS), and big data. The awards will supply successful case studies for others to share and learn.

This year the Westchester Creek Green Infrastructure project in New York City won the top Arup Digital Transformation Award in the Next Work category. It exemplified ingenuity and collaboration in technology use and data integration across multiple planning and design stages.

With hundreds of pieces of green infrastructure to design within a defined geographic area in The Bronx, the team used the data from each consistently across the project life and dynamically across multiple platforms – including design software, tablets, online web maps and client database.

Gaining a waterfront certification for Hunter's Point South

Our Hunter's Point South project – a 30-acre affordable housing development in Queens, New York – was awarded certification under the Waterfront Alliance's Waterfront Edge Design Guidelines (WEDG) programme.

The WEDG programme is known as 'LEED for the waterfront', and serves to make waterfronts more resilient, environmentally healthy, accessible, and equitable for all.

Hunter's Point South achieved certification by providing public access to water, carrying out community outreach, ensuring resilience, designing ecologically, selecting materials carefully and considering how the waterfront can be maintained.

Hunter's Point South is the first project to be certified since the launch of the WEDG guidelines. Arup was the lead consultant for the Waterfront Park and infrastructure for the Hunter's Point South project.

Waterfront Alliance - Hunters Point South

Regional activity

A snapshot of Arup's impact around the world

The Arup water team operates in all corners of the globe. These regional round-ups are just a small cross-section of our recent projects – on top of those already mentioned in other sections of this review.

This section also focuses on our specialist advisory services, which offer global reach. Many of our featured projects have an advisory element to them.

Find out more about our water projects at www.arup.com/water.

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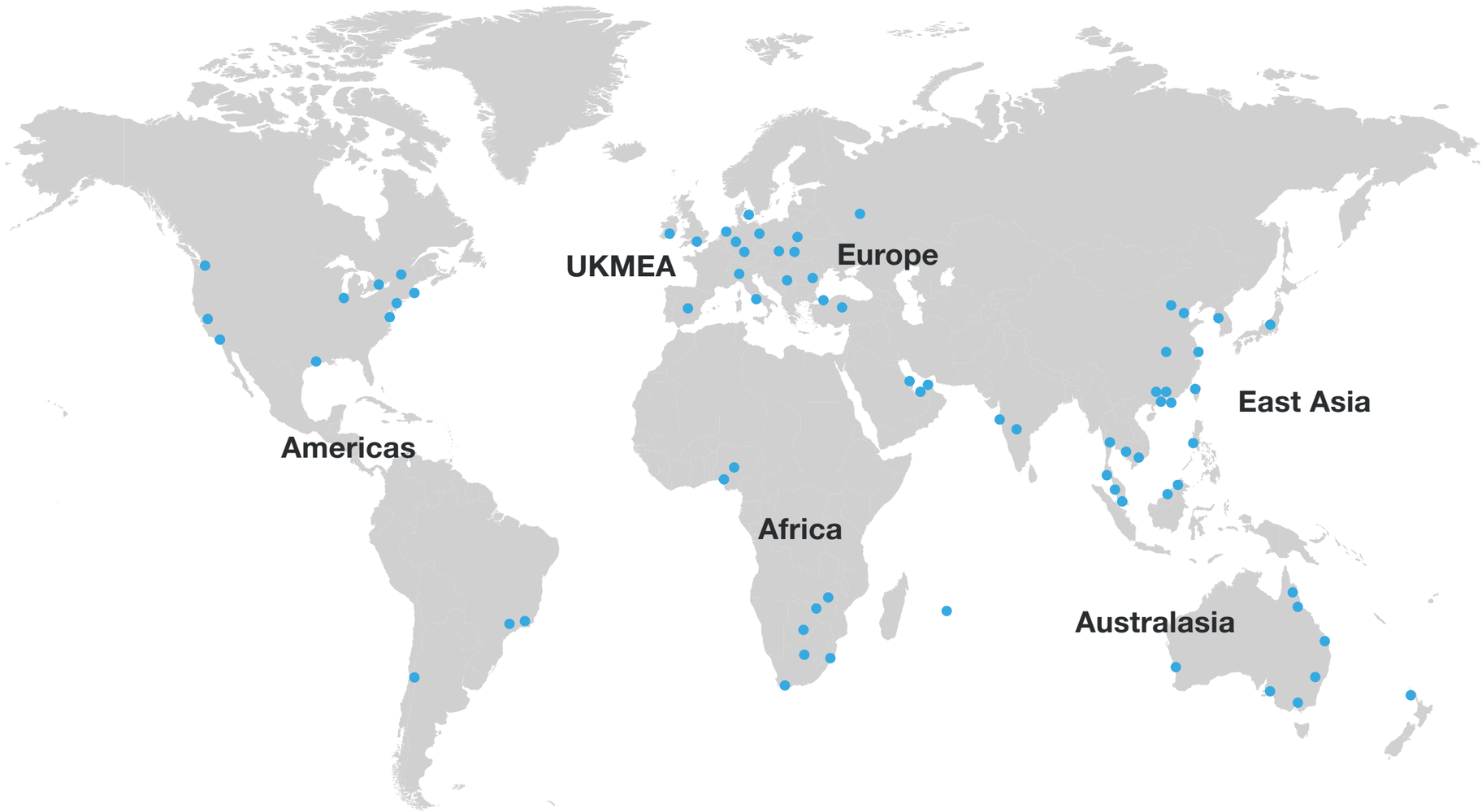

Regional activity

Advisory

Steven Lloyd
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Our water advisory teams are helping clients address some of the major challenges affecting the global water sector.

This year we worked with Melbourne Water to increase performance levels and reduce costs through best practice asset management approaches. We also drew on our experience post-Sandy in New York to address complex urban water resilience challenges for cities across the world. This has seen us use innovative blue and green infrastructure solutions and strong collaboration with other stakeholders.

In addition we have enabled water companies, such as Dŵr Cymru Welsh Water and Yorkshire Water, to make better-informed, proactive and real-time decisions, We have worked alongside UK regulated companies to analyse the changing regulatory framework, identifying risk and opportunities for optimising returns. And we have advised investors on strategic investments in water projects across the world.

Helping a Malaysian water company move forward

The Malaysian sewerage system is an exemplar in the region but the domestic sewerage tariff has remained unchanged for the last 16 years. A step change in performance was needed to ensure that Malaysians today and in the future will be able to enjoy a clean and healthy environment through a proper and well maintained sewerage system, and to allow Indah Water Konsortium (IWK) to raise the domestic tariffs.

Our Institute of Asset Management (IAM) endorsed assessor team took the asset management principles from international standards PAS55 and ISO 55000 and developed a blueprint for robust management systems to improve the operation and maintenance of IWK's assets. This helped IWK to deliver a better service to their customers.

Enabling transformation at a UK water company

South Staffordshire Water, a small water-only company in UK, like all utilities, is required to operate its business 24/7/365 to maintain service to its customers. Yet the company faces significant challenges from climate change, population growth, increasing customer expectations and aging technology – plus UK market pressures from wholesale/retail separation. In light of these pressures, the company recognised it needed to modernise and change its approach to centralised control rooms and out-of-hours operations.

We were commissioned to carry out a strategic review of South Staffordshire Water's control environment, which would enable it to manage strategic risks and transform its operations. We proposed key risks in the areas of people, process and technology, 20 interim mitigation measures, four key strategic needs and a high-level roadmap for change.

Gaining insights from Wales' water data

We were asked by Welsh water to do a deep dive in to their data of over 9,500 million data points. The results of which generated insights that could help improve services and operational efficiency. Such as:

Non-value adding alarms. 30% of all alarms presenting to control rooms were cleared without intervention. By applying data-driven techniques alarm volumes could be reduced considerably.

Troublesome assets. Careful analysis of the data identified the most troublesome assets. This information, together with our water knowledge, enabled us to develop actionable insight to tackle these.

Human factors. Trends in control room behaviour revealed potential for operational savings. E.g. variations in decision making from control room operators such as how long to leave an alarm before responding if their previous experience has been that it self-clears.

Network prediction. Predictive analysis revealed potential for preventative maintenance that could generate significant savings.

Ensuring due diligence for Chinese water and wastewater treatment

Our technical advisers have been supporting a major international infrastructure investment fund by providing technical, health and safety due diligence on a large portfolio of water and wastewater treatment plants across China.

Arup's knowledge of the water market in China, coupled with experience on similar water assets, has been essential to understanding and highlighting the technical risks associated with the portfolio.

We continue to support investors and asset managers across Asia.

Regional activity

Africa

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Water scarcity, water governance and access to water continue to be challenges in Africa. We are working across the continent with both the private and public sector on analysis, risk reduction and delivery.

We are currently delivering large-scale water and sanitation improvements in Botswana that will bring significant social benefits to communities around the Okavango Delta. In South Africa we continue to lead the market in technical advisory services and construction monitoring to lenders on their hydropower investments, with the Stortemelk Hydropower successfully progressing on site.

Arup has also worked with the South African Water Research Council to publish analysis and guidance on risk governance in the South African water sector. Meanwhile in West Africa we continue to help private sector clients in the food and drink industry manage their water risk – a core part of their businesses.

In East Africa our work under the Kenya Water Security and Climate Resilience Programme has continued. We have been working closely with developers to address their water management challenges on significant new site developments.

Delivering water and sanitation improvements in Botswana

The village of Maun in Botswana is the gateway to the UNESCO World Heritage listed Okavango Delta. It and other surrounding villages have experienced acute water shortages for years, despite ample local surface and groundwater resources.

The Maun Water Supply and Sanitation Project, on which we are working in a joint venture with Haas Consult, is designed to alleviate the problem. It will upgrade the existing water supply and sanitation scheme to meet the village's requirements until 2038. Arup and Haas will undertake a conceptual design study and make recommendations for the water and sanitation schemes, which will be let out as design-and-build schemes.

The first phase of the project involves water supply and sanitation scheme optimisations – identifying and implementing quick-win measures to improve things while the bigger 5-year scheme is underway. Our recommendations include zoning networks to address water losses, which are as high as 40%, and give the operators a better handle on the day-to-day operation of the scheme.

The main scheme will then link up the surface and groundwater resources, so that available sources can be used to best effect.

The sanitation scheme concept has recommended a combined gravity and vacuum sewer, making use of the flat landscape and the fact that the vast areas of the village are unplanned. Two treatment plants on either side of the Thamalakane River will serve the scheme, with the effluent used for irrigation.

Solving a South African mine's potable water problem

Our UK water process team helped our Johannesburg office find a solution for disinfecting potable water at a coal mine in Mpumalanga province of South Africa.

Their challenge was the low levels of phenols in the source water. Phenols can react with traditional disinfectants such as chlorine to form chlorophenols, giving the water a 'medicinal' taste.

The water process team assessed the options and found a technology (chlorine dioxide) that was technically suitable, safe and low-maintenance.

Supplying options for one of Mozambique's most modern plants

In 2013 Diageo acquired Lusomoc, a company that would later be designated Diageo Supply Marracuene (DSML), with the aim of transforming it into one of Mozambique's most modern drinks production plants.

A water supply and treatment strategy was needed to support the investment in and expansion of the Marracuene plant, which produces spirits and ready-to-drink products for both the domestic and export markets.

We undertook a water resources study to determine supply options. The site is located on a productive and good-quality aquifer, so we designed a groundwater exploration and targeted drilling programme as part of the long-term water supply strategy for the site.

Enabling an Ethiopian brewery to expand

Established in 1963 by the Ethiopian government, the Meta Abo Brewery at Sebata near Addis Ababa originally had a production capacity of 50,000hl a year. Diageo acquired the plant in 2012 and progressively increased its capacity to 1.6Mhl a year by a series of major upgrades to site infrastructure, the brew-house, the bottling line and associated civil works.

The expansion prompted Diageo to call on our complete range of engineering services – including civil, structural, geotechnical and front-end engineering design services. Fundamental was a feasibility assessment of the site's water supply and treatment strategy followed by the detailed design, supervision and successful development of a high-quality groundwater supply.

Regional activity

Americas

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In recent years the Americas region has experienced prolonged drought, extreme flooding, and coastal storms. We have used our regional and global resources to help communities address the impacts of these extreme events and increase their resilience. Several of the key projects included in the Climate is Water section of this review illustrate some of these efforts.

Community and client needs are increasingly complex and require integrated services that address not only water related issues but community needs as well. Examples of this complexity include the 7-acre New Stapleton Waterfront infrastructure development project in New York noted in this section.

Designing waterfront infrastructure for New York

We have been retained by the New York City Economic Development Corporation (NYCEDC) to design infrastructure to support residential developments along the New Stapleton waterfront – a 7- acre waterfront area in Staten Island, New York.

The project includes new roadway alignments, associated water and wastewater lines, stormwater drainage and collection systems and waterfront hardening. Waterfront improvements will include both soft and hard landscape features. The area was significantly affected by Hurricane Sandy and the project will support residential developments, including affordable housing in the area.

Areas have been designated for public space development, improving connectivity between communities and the waterfront. Significant efforts are being placed on collecting, compiling and analysing site-specific information on critical flood and storm surge areas, infrastructure, planned improvements and community needs, to be incorporated into the schematic plans and construction documents.

Recycling water at Los Angeles International Airport

As part of the recent central utility plant replacement project at Los Angeles International Airport (LAX), we designed the entire new recycled water distribution infrastructure throughout the central terminal area.

The piping provides operator Los Angeles World Airport (LAWA) with the flexibility to connect future buildings and the new cooling towers to municipally supplied recycled water when it is available at the right quality.

Through an on-call contract, Arup has been advising LAWA on the requirements for treating recycled water for use in the cooling towers. This included meeting with the Los Angeles Department of Water and Power (LADWP) to help negotiate a deal that would have LADWP construct a new reverse osmosis treatment facility to meet the water quality requirements.

The airport's cooling towers currently use 3,600 litres a day so converting this facility to recycled water will significantly reduce potable water consumption at LAX. Projects are also underway to convert all irrigation systems on the campus to recycled water to reduce demand for potable water even further.

Protecting the New York City Transit system from flooding

Vulnerabilities in the New York City Transit (NYCT) system became apparent during Hurricane Sandy, which showed that the underground subway network was vulnerable to flooding from tidal surges.

We are designing flood protection for critical assets including, fan plants, stations and tunnel portals. These assets present a major risk of flooding through grade-level gratings, hatches, and structures. The improvements will protect the associated structures, equipment, and systems from future storm damage and provide greater resiliency so that operations can resume more quickly after a storm.

We were tasked with some of the subway's first Hurricane Sandy recovery and resiliency projects and led the development of solutions for problems areas such as stair entrances, hatches, manholes, conduits, and ventilation gratings. We came up with deployable flood panels, a mechanical closure device and a tensioned fabric stairway protection canopy that is permanently installed and derives from technology used in the aerospace industry.

Regional activity

Australasia

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We have continued to develop our reputation as thought leaders in the water industry in Australasia through strategic advice to water authorities and private sector clients in both urban and rural areas.

This advice has focused on key risks and opportunities for our client's business operations – including asset management, demand management, business case analysis, integrated water management, liveability, privatisation and effects-based licensing. Our ability to provide this strategic advice to both the public and private sector has been underpinned by our strong design capability in water supply, wastewater, desalination, dams and stormwater management.

First-of-a-kind projects plus team and individual awards illustrate our success over the last 12 months.

Investigating a best-for-region sewerage solution in New South Wales

We are undertaking a feasibility study for the La Mesa 1 water treatment plant in Manila, which processes 1,500 million litres of water per day. Working with one of the local water utilities, Maynilad, we will confirm the condition of the plant and identify the process improvements needed for it to cope with future conditions.

Changing climate patterns mean the plant's inlet water, received direct from river sources, is often more turbid – it has lots of solid material mixed up in it. Our study will focus on the most cost-effective and robust ways to cope with this and comply with local regulatory standards.

We aim to eliminate the equipment that uses the most energy, such as the flash mixers, and replace them with much more efficient static mixers. We will also carry out a structural assessment of the existing sedimentation basins and filters to identify the work needed for them to be able to resist a 7.2 magnitude earthquake in accordance with current codes.

Our extensive process, mechanical and electrical knowledge, plus our excellent structure and seismic assessment skills, will provide Maynilad and their customers with a substantially more resilient plant.

Melbourne Water

Assessing Melbourne's drainage and sewer assets

We have been working with Melbourne Water to inspect and assess critical drainage and sewer assets. These projects have included three large diameter main drains and the western trunk sewer – a 4m-diameter concrete sewer for 50% of Melbourne's sewage.

Our role has included materials testing and analysis and structural assessment – including modelling loads across the various structures.

We have also been able to provide significant value to Melbourne Water by integrating its materials and structural engineering capability. We conducted confined-space inspections and structural modelling to identify defects and potential rehabilitation options.

QUEENSLAND Urban Utilities

Renewing Queensland's sewers

For the last four years the Arup Water Team in Queensland has been involved in the design of water and wastewater infrastructure for Queensland Urban Utilities (QUU), the largest water utility provider in South East Queensland.

Arup has been undertaking the design as part of a Design and Construct (D&C) framework for a number of contractors that form part of a Standing Offer Agreement arrangement.

These works are part of the yearly renewal program for QUU to ensure their assets meet key performance indicators and standards of service for the city of Brisbane Australia. Arup is helping to achieve the targets by undertaking the designs and construction inspections of the infrastructure upgrades.

One the major targets achieved with these D&C projects is the replacement of aging water assets that have been causing major disruptions to local businesses when failures have occurred in the past.

Regional activity

East Asia

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In East Asia we have continued to deliver major water infrastructure projects to tackle water stresses, improve supply reliability and sanitation, and increase resilience to flooding and climate change.

For example, in Hong Kong we are undertaking a feasibility study for relocating a sewage treatment works into a rock cavern site. In Manila we are studying the upgrade of the La Mesa 1 water treatment plant, which processes 1,500 million litres of water per day. We are also delighted to see the commissioning of the 2.45Mm3/day capacity HATS2A after almost a decade of hard work.

Policy-makers increasingly value the role of water in building or regenerating mega cities. This has led to a growing number of business opportunities in water-sensitive water cycle management and in providing blue and green infrastructure solutions.

This year we have made a significant breakthrough in China; we were appointed as the technical adviser on China's first deep sewage tunnel project in Wuhan. We have also delivered water-sensitive urban design and guidelines for a city in northern China. We look forward to continuing to support the building of 'sponge cities' to cope with flooding, drought and building resilience.

Rehabilitating a Manila treatment plant

We are undertaking a feasibility study for the La Mesa 1 water treatment plant in Manila, which processes 1,500 million litres of water per day. Working with one of the local water utilities, Maynilad, we will confirm the condition of the plant and identify the process improvements needed for it to cope with future conditions.

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Our extensive process, mechanical and electrical knowledge, plus our excellent structure and seismic assessment skills, will provide Maynilad and their customers with a substantially more resilient plant.

Implementing water-sensitive urban design in Inner Mongolia

Our Shanghai water team has signed the first major contract for water-sensitive urban design (WSUD) works in mainland China. This is a major win, with China channelling its resources into water-related infrastructure under the concept of 'sponge cities'.

The project site is located in Beiliang District – a 1,500ha area mostly consisting of slums. China's central government has earmarked ¥20bn for the redevelopment, which is backed by China's premier Li Keqiang, who visited the site and approved the project in 2013.

Like many other cities in northern China, Baotou suffers from water scarcity due to dramatic seasonal variations in rainfall and flooding caused by poor drainage. Our work is to provide engineering solutions to these two problems. We will carry out WSUD research, study the project area and write guidance notes spelling out principles and best practices for future development.

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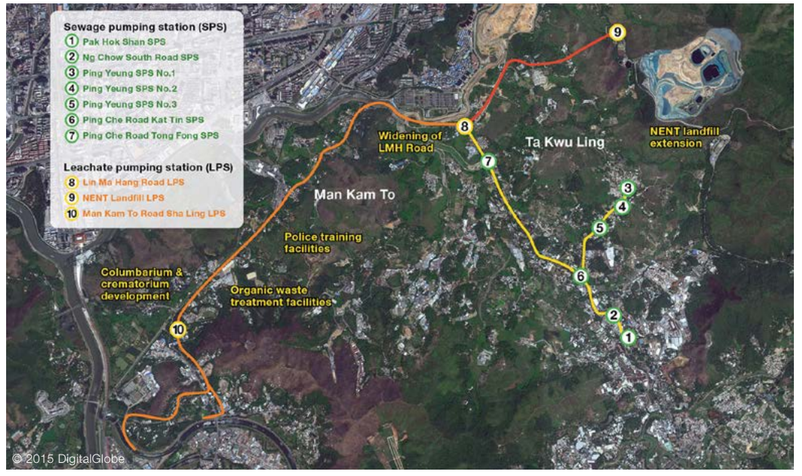

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Advising on a deep sewage tunnel in Wuhan

Arup has been appointed as the technical adviser to the local design institute for a large-scale deep tunnel sewerage system in the Wuchang district of Wuhan in central China.

The proposed deep sewage scheme, with a design flow of 1.5Mm3/day, will serve 3.2 million people. It includes a 19.3km long sewage tunnel with a diameter of 3m to 3.4m, three preliminary treatment works and a main terminal pumping station. Both tunnel- boring machines and pipe jacking will be used to construct the tunnels, which will be at 30-40m below ground to avoid conflict with the existing metro lines, underground structures and foundations.

We are providing technical input to critical design components of the project. These include choosing between gravity and pressure conveyance systems, and optimising the system using hydraulic, computational fluid dynamics (CFD) and physical modelling. Our advice also covers ventilation and odour control, operation and maintenance strategies and instrumentation requirements.

Upgrading New Territories' sewerage system

We will be carrying out investigation, design and construction supervision for the upgrading of the existing north-east New Territories sewerage system in Hong Kong.

The system comprises both a landfill leachate conveyance network (with three leachate pumping stations) and a village sewerage network (with seven sewage pumping stations) discharging to the existing sewage treatment works downstream.

One of the key challenges is upgrading the existing 6km sewers and rising mains along a major highway without disrupting traffic. Other challenges include engaging with the public for support and providing a cost-effective and energy-efficient design to improve on the performance of the existing sewerage system.

Regional activity

Europe

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This was a year of extreme climate events in Europe. Poland, Hungary and southern Spain experienced drought while the Riviera and the Balkans experienced flooding. In some countries there was not enough water to cool power stations, and rivers did not provide the minimum ecological flows, while in others flood events killed more than 20 people.

During 2015 we were commissioned to undertake several projects dedicated either to flood alleviation or to improving resilience. In Ireland we have worked on the Lower Lee flood scheme protecting Cork, while in Poland we determined environmental flows in rivers across the country. We also resolved a local flooding issue – modelling rainfall disposal options in the Kraków Kabel district.

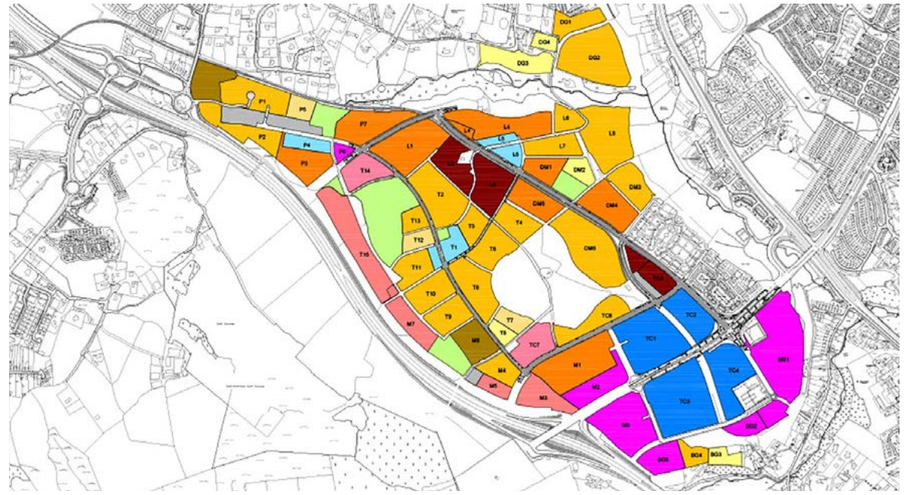
We hope to continue our contribution to climate change resilience next year.

Forming the Zaglebiowski Linear Park in Poland

This project will revitalise blue-green corridors along the Przemsza and Brynica Rivers, connecting six municipalities of the Zaglebie region to form a linear park.

High-value public realm will include renaturalised rivers, revitalised parks, increased biodiversity, cycle paths and footpaths, bathing space in the town and fountains. Landmark buildings will include an eco-education centre, watchtower and Egzotarium – a 25m-high glasshouse in the town of Sosnowiec that will host exotic plants.

We are designing seven locations that will form a starting point for the implementation of the whole vision, as well as a concept design for the Egzotarium.



Harnessing the natural amenities of south Dublin

The Cherrywood Strategic Development Zone (SDZ) in south Dublin is designed to be a highly sustainable, inclusive town.

We are developing a solution that harnesses the natural amenity of the rivers and valleys surrounding the SDZ to meet the stormwater requirements of the masterplan. Our proposed solution is a river valley incorporating wetlands and public walking routes to improve the amenity value of the area.

The river overbanks will be designed to contain floods, providing flood relief within the SDZ and, potentially, adjacent lands.

We are also undertaking the feasibility and detailed design for the road network, foul sewers, surface water drainage and water mains.

Estimating environmental flows in Poland

As part of the process of implementing the EU Water Framework Directive (WFD), we developed a methodology to estimate environmental flows in Polish rivers. Environmental flows describe the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems, and the humans that depend on these ecosystems. This is the first time that a methodology has taken into account the specifics of environmental conditions, the availability and reliability of data, and the requirements of the WFD.

We reviewed existing methods of estimating environmental flows and the characteristics of the natural and anthropogenic factors influencing the flow regime. We then tested and modified these assumptions before specifying the final method for estimating flows.

Our methodology was tested on seven different catchments and accepted by the National Water Authority.

Upgrading and optimising water treatment plants in Ireland

We evaluated the capability of three existing Irish Water treatment plants – Ballinasloe, Gort and Spiddal – to produce a safe and secure drinking water supply.

This was part of our work with Irish Water to develop risk-based drinking water safety plans for each supply scheme. These aim to identify hazards and apply appropriate control measures, which will ultimately inform the detailed design of upgrade works.

As part of this project, our Dublin team engaged the services of specialist water engineers from our Leeds office. They brought their experience of providing engineering and technical services for UK water utilities to the project.

Inspecting the safety of Irish Water's impounding reservoirs

When the water infrastructure asset transfers are completed, Irish Water will become the largest single owner of impounding dams in the Irish state. Many of these dams have been neglected over the years, with insufficient regular inspections and maintenance works.

Using our detailed knowledge of international standards, we developed a consistent and objective dam safety assessment methodology to determine the risk and likelihood of failure of each dam and to categorise them accordingly.

We inspected 63 dams and also identified key improvement works that will help to bring Ireland's dams in line with international safety standards.

Regional activity

UKMEA

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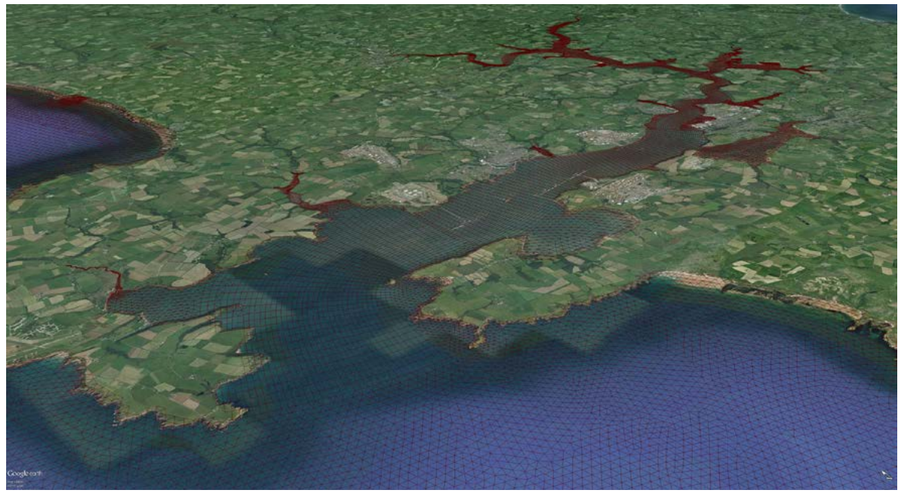
In a climatically challenging year we have been engaged on exemplar projects in UK flood risk – including flood alleviation schemes in Leeds and Pickering. We have also continued to develop strong relationships with Dŵr Cymru Welsh Water, Natural Resources Wales, and the Welsh government. Our work with Yorkshire Water and Severn Trent Water has progressed well and we have been leading global river assessments with the Scottish Environment Protection Agency.

Our advisory services are growing, and there is a real need for good design for safe infrastructure. We are also encouraging the incubation of new emerging technologies through our Venturi partnership with WRc. And we have had considerable success on major opportunities such as the Thames Tideway Tunnel in London and Project Idris in Qatar.



Undertaking Wales' largest ever coastal investigation work

The Dŵr Cymru Welsh Water (DCWW) Capital Delivery Alliance comprising Mott MacDonald Bentley and joint ventures between Morgan Sindall and Arup, and Skanska and Arcadis is starting the largest programme of scientific coastal investigation ever undertaken in Wales.

DCWW is investing over £8m in scientific investigations at 49 sites around the Welsh coastline.

The project will provide the company and its regulator, Natural Resources Wales, with the tools to better understand and protect Wales' coastal waters.

River and coastal survey work is already underway, with the project due to be completed in the first quarter of 2017.

Surveying over 300 rivers in Scotland

The Scottish Environment Protection Agency (SEPA) has commissioned a specialist survey programme covering over 5,000 km and more than 300 rivers in Scotland. Arup, in collaboration with with restoration specialists for freshwater and coastal environments cbec and AECOM, has been awarded the second phase of this programme, following successful completion of the first phase earlier this year.

This will be the biggest survey of its kind undertaken in the UK, and has led to the development of new tools and approaches that are unique to the field. These include a bespoke mobile application used in the field, with data downloaded directly to a central server and geographical information system.

The surveys will identify why certain rivers have failed to achieve good ecological status and inform actions to improve their condition. The results will also feed in to a wider national programme of proposals that aims to provide a better water environment for all of Scotland.

Boosting the circular economy with Yorkshire Water

We have been awarded the opportunity to collaborate with Yorkshire Water on an innovative approach to re-using coagulants in potable water treatment. It is an idea that could save the UK water sector over £100m annually.

> *"We are very excited about the potential for this project to have a positive long-term impact on the water sector and the wider global economy"*

Vincent Glancy
Arup Global Process Engineering Leader

The novel recovery process will allow what was once considered a waste by-product to be converted into a valuable resource, which can be recycled helping to close the loop and contribute towards a true circular economy.

This approach will reduce the impact of volatile commodity prices, minimise waste disposal costs by recovering the active component and contribute significantly towards carbon reduction commitments.

Solving a Welsh dam's stability issues

Upper Neuadd dam is a Grade 2 listed structure in the heart of the Brecon Beacons National Park just below Pen y Fan. It is formed from cyclopean concrete clad in huge masonry blocks.

The dam was constructed between 1896 and 1902 and has been plagued by leakage and safety concerns. We were appointed to deliver a solution that made the structure safe, satisfied stringent planning conditions and left an asset that could be returned to use in the future.

Our solution was to open up a tunnel through the dam originally used for river diversion, but which had been plugged after the dam was built. After carrying out hydraulic and computational fluid dynamics (CFD) modelling along with structural analysis, we recommended lining the tunnel with concrete. We also provided a visually sympathetic masonry apron to mitigate downstream scouring.

Securing a 4-year framework with Welsh public bodies

Arup Cardiff has secured a construction consultancy 4-year framework that will be used by the Welsh government and 190 other Welsh bodies.

We have already been successful on the first two bids submitted by Natural Resources Wales, which are aimed at producing project appraisal reports for managing flood risk at two different sites in South Wales (Stephenson Street Embankment in Newport and Aberbeeg Woodland Terrace in Blaenau Gwent).

Key to our wins was a straightforward methodology that 'cuts to the chase'. This clearly highlights the benefits we can deliver to the client through the quality of our team and the value and efficiency we have delivered in similar projects.

Improving wastewater treatment in South Wales

In partnership with Morgan Sindall we were commissioned by Dŵr Cymru Welsh Water (DCWW) to deliver improvements at four wastewater treatment works. These will enable the works to meet new environmental consent concentrations for final effluent discharges into Carmarthen Bay in south Wales.

Emphasis was placed on value engineering to challenge the initial process design. We reviewed its requirement for new plant, versus reusing or refurbishing existing assets.

Working closely with the teams helped identify cost and programme savings, adding significant value to the overall project.

Services

Our Arup water toolkit

We are the creative force behind many of the world's most prominent projects in the built environment and across industry. In 92 offices across 40 countries, our 12,000 designers, engineers, scientists, planners and business consultants deliver innovative projects with creativity and passion.

Advisory services

- Ensuring health, safety, wellbeing
- Strategic business planning
- Digital analysis & insight
- Managing programme risk
- Operational improvement
- Blue green infrastructure
- Knowledge management
- Asset performance
- Resilience
- Corporate risk
- Security and cyber risk
- Flood risk management
- Major planning consents
- Regulatory economics advice
- Technology innovation
- Developer offerings
- Strategic procurement advice
- Investor advice
- Masterplanning & urban design
- Customer Engagement

Technical services

- Water resource planning
- Dam engineering & planning
- Hydropower
- Water supply and treatment
- Desalination
- Water distribution networks
- Water efficiency
- Smart water management
- Flood risk management
- Natural flood management
- River engineering and management
- Green infrastructure & stormwater
- Water re-use networks
- Wastewater treatment
- Sludge management
- Coastal management
- Tidal power
- Renewable energy
- Ecology and ecosystems services
- EIA and sustainability assessment
- Catchment science
- Feasibility studies
- Anaerobic digestion
- Hydroecological assessment
- Integrated drainage modelling
- Water quality assessment
- Hydrodynamic modelling
- Climate change studies
- Community and stakeholder engagement
- Mechanical, electrical and ICA design (MEICA)
- Construction supervision
- Health, Safety and Welfare management
- Design management
- Commissioning
- Post-project appraisal
- Resource efficiency and waste management

Contacts

Who to get in touch with

For further information on our products and services please contact the relevant regional water leader directly.

If you would like to have more information about any of the projects or initiatives featured in this year's Global Water Annual Review, please contact Susan Hogan, our Global Water Marketing Manager at Susan.Hogan@arup.com.

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