Securing Sydney’s water supply
Desalination provides contingency against drought

Preserving water quality
Long-term restoration of Chesapeake Bay

Opinion
A conversation with Chris Hertle
GHD Global Leader Water

SPECIAL LIFTOUT
Dealing with extreme climate events
Delivering sustainable water solutions across the water cycle
Welcome to the first issue of GHD NEWS for 2011, a publication that features our leaders’ opinions, showcases recent projects and demonstrates our capabilities.

In this edition, we focus on water, a resource that is essential to the prosperity of communities around the globe. With a trend towards urbanisation, population growth and ageing infrastructure, the challenge to secure water supply and provide good sanitation for future generations is universal.

In the pages that follow, we illustrate GHD’s holistic approach to harvesting, delivering, recycling and managing water for our clients in Australia, China and the USA. Our talent in asset management, the application of innovative technologies and flood/drought mitigation is fuelling the company’s expansion in the global water sector.

Looking at recent extreme weather events, I am proud of our people who are working closely with councils, government departments and utility operators on rebuilding efforts. The inspiring way we have collaborated across geographical borders and responded to our clients’ challenges illustrates the core values that define us - Teamwork, Respect and Integrity.

I trust you enjoy reading this issue.

Ian Shepherd
Chief Executive Officer

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FRONT COVER: Chesapeake Bay in the US - a body of water that GHD has been helping to restore. See article on Page 10.
In the news

01 Environmental advice
GHD has commenced a project for VicTrack Access, a government rail agency that owns Victoria’s railway land and infrastructure and provides essential services to support a safe and efficient public transport system. Our team is delivering strategic environmental advice on a site known as E-Gate, a 20 hectare parcel of land located on the edge of the Melbourne CBD.

02 Evaluating Sweden’s aid
GHD has been awarded a contract to assess the effectiveness of Sweden’s aid to Laos, Sri Lanka and Vietnam. This is GHD’s first assignment for the Swedish International Development Cooperation Agency. Due for completion in April 2011, this study introduces a new methodology for the assessment of development cooperation.

03 Planning for sustainability
Our water business group, supported by our partners, has been awarded the contract for the Decentralised Water Master Plan for the City of Sydney. The plan forms part of the Sustainable Sydney 2030 vision, which seeks to introduce a decentralised (local) water supply network to allow recycled water and stormwater to be used for non-drinking purposes.

04 Asset management push
GHD is providing asset management advice and support to the Australian Synchrotron - a facility that provides researchers with an important tool for a wide range of scientific and industrial research fields. The first phase of work involves a review of the asset management maturity of the organisation and the development of an asset management improvement program.

05 Defence collaborative
GHD was selected to join the Australian Defence Force (ADF) and industry collaborative Rapid Prototyping, Development and Evaluation (RPDE) Program. Also known as RAPID, the RPDE Program is a group of focused problem-solvers helping Defence resolve difficult and challenging situations. Specifically, the program’s mission is to enhance the ADF capacity through accelerated capability change.
06 Al Bidda tower wins
GHD was recognised at the 2010 Arabian Property Awards in association with Bloomberg Television for our work on Doha’s iconic Al Bidda Tower – a stunning 45-storey twisting skyscraper on the Qatari capital’s corniche. The tower was recognised with a 5-star award in ‘The Architecture Award (Office) Qatar’ category.

07 Hydropower for Chile
Chile’s second-biggest electricity generator, Colbun has engaged GHD to prepare maintenance plans for two hydropower stations (the 50MW Hornitos and 30MW Chacabuquito Power Stations) located to the north of Santiago in the Andes Mountains. Our team will provide a range of services including maintenance and critical spare parts studies in accordance with Colbun’s standards, covering all equipment used in the mechanical, electrical, and civil works disciplines.

08 Hoxton Park recycled water
Sydney Water recently awarded John Holland the contract for the construction of a water recycling plant and reservoir in Sydney’s south-west. This is part of Stage 1 of the Hoxton Park Recycled Water Scheme, a key initiative of the NSW Government Metropolitan Water Plan. GHD has already provided tender design services and will now complete the concept and detailed designs for the Glenfield Water Recycling Plant and the reservoir at Edmondson Park.

09 Irrigation modernisation
Murrumbidgee Irrigation (MI) has joined forces with GHD, John Holland and UGL Infrastructure in a program alliance to undertake an irrigation modernisation project. Works commenced in January 2011 with completion scheduled for 2016. They will include the delivery of irrigation pipeline projects to replace open channel water supply systems and the incorporation of an integrated water delivery system.

10 Architectural win in China
Our Architecture Business Group in China has won an impressive project to design the Zhuzhou Yunlong Faculty Residential Area (Xue Fu Gang Wan). It is located in the north-east of Zhuzhou City in one of the five pilot districts established by the Chinese Government as ‘energy-saving and environmentally friendly cities’. Zhuzhou Yunlong is a high-end residential housing development for college faculty.
What are the challenges for the water sector?

Achieving a balance between the competing needs of communities, agriculture and the environment for sufficient water is one of the challenges we face. This is impacted by factors such as population growth, climate variations, and economic drivers. As an industry, we need to focus on delivering holistic solutions that integrate various measures such as demand management, recycling, efficiency improvements, new sources and more.

With climate variability likely to increase, the frequency and intensity of extreme events may rise. As an industry, we need to focus on a balanced approach to water management and low-energy solutions.

What are the opportunities and how can clients capitalise on them?

Part of it is about adapting to a variable climate by building resilience into water management and providing solutions to deal with the challenges at hand. In extreme weather events, such as floods and cyclones, this approach is underpinned by risk management. For example, the risk of flood impact and loss of life or business continuity should be considered and would require some properties to be raised and/or retrofitted, gauges to be installed, levees to be built, and new planning/building regulations to be implemented.

In non-extreme weather situations, Integrated Water Management (IWM) is a balanced portfolio approach that is gaining momentum. An example of this is our work on the award winning Pimpama Coomera Waterfuture project, which uses multiple sources of water in 6000 homes and businesses. Now constructed, the project features a treatment plant with Class A+ recycled water for flushing toilets, watering gardens and washing cars. The results to date have been outstanding - a 60-70 percent reduction in potable water demand has been achieved. GHD has been leading the way in this

Security of water supply is one of the toughest challenges we face. It is driving major investment in water infrastructure, integrated water management, water use efficiency, water loss management, irrigation and groundwater management. In this article, Chris discusses the opportunities for sustainable water management and supply.

AN INTERVIEW WITH CHRIS HERTLE GLOBAL LEADER WATER
area for some time, having developed an award-winning IWM toolkit – an innovative water balance software tool – to help our clients assess the complex inter-relationships between different quality source waters. We were recently awarded landmark projects for the City of Sydney and SE Water in Melbourne to provide master planning for IWM.

The cost of water is rising around the world. How does this affect the industry and consumers?

As we move to a more integrated water management approach and expand into recycled water and desalination, prices for water will continue to rise. This provides the opportunity to improve efficiencies, not just within the household but also within the systems.

For example, pressure and leak management in water reticulation systems can transform current non-revenue losses of 50 percent to less than 5-10 percent. This provides incredible opportunities to reduce water use simply by optimising system pressure and leak management through proper metering and control.

Within the industry, pricing is a key driver for our clients to focus on water management, particularly as security of supply is reduced due to drought. We are seeing a trend towards minimising water consumption and maximising reuse. Our work has provided water consumption reductions by up to 70 percent with recycling systems.

Tell us about some of the emerging technologies and innovative practices that are shaping the future of the industry?

Membrane technologies have improved considerably, driving down the cost of desalination. GHD has been involved with many of these developments in conjunction with key universities in Australia and the USA. Brine management (dealing with waste from desalination facilities) is another burgeoning area. Industry is currently looking at ways to recover commodity chemicals from brine such as soda ash.

The rising price of energy is driving new practices such as the use of anaerobic technologies to recover the inherent energy in wastewater by converting organic carbon to methane biologically. While this practice has been around for some time, it has been revived and is being adapted to today’s challenges.

There has been a lot of talk about the importance of peak oil, but there is a more pressing need to human survival and that’s peak phosphorus. It is now estimated that the world only has enough phosphorus for the next 150 years. We are now looking at ways to recover phosphorus from wastewater.

Stormwater management is another area where industry is looking for innovative solutions to remove pollutants. Dr Kostas Athanasiadis, GHD’s Manager for the Industrial Water and Waste group in Brisbane has developed a compact and cost effective stormwater treatment solution to filter small concentrations of soluble nutrients and dissolved heavy metals at the point of source in residential, commercial and industrial locations. We are currently working with a leading water utility in Victoria to trial this technology, for which Kostas received a Leaders’ of Innovation Award from Brisbane City Council earlier this year.

There is a perception that the water sector is a large consumer of energy. Can you give us some insight?

The water industry’s use of energy accounts for only three to four percent of total energy usage. It is what the average household does with the water that is energy intensive.

The dams or catchments that supply large cities are often located hundreds of kilometers away from households. This means that to supply the city, water flows by gravity or is pumped and then it is reticulated. When you take this into account and consider that if you have to convey water through a 300 km pipeline, your energy costs will be quite high – on par with that of a desalination plant.

I believe we still need to focus on improving energy efficiency in the water sector. If you are losing half of your water due to leakage, you are paying twice as much for your energy. So if you optimise leakage and improve pressure management, you get twice the amount of water for the same energy. There are also opportunities to improve energy efficiency in reticulation systems by putting in more efficient pump systems. With wastewater, there are some promising developments in low energy waste treatment including improved recovery of energy via biogas. This is a reality in Europe where there are some wastewater treatment plants running at zero net energy requirements.

GHD is working with a leading Australian Water authority examining ways of mixing sewage sludge with fats, oils, greases, milk factory wastewater, brewery waste and food scraps to produce energy via biogas. On a large sewage plant, a total of three to four MW of energy can be produced, which is enough to power the whole site.

Climate variable events are increasingly being reported. How is GHD equipped to assist clients?

This is quite topical at the moment, with communities being impacted around the world.

One of the ways we are helping clients address some of these issues is with modelling. We recently appointed Bruce Harper, an engineer that specialises in modelling storms and surge tides to head our Climate Change group. He is currently undertaking storm and tide studies for the Gold Coast Council, the Gulf of Carpentaria and the Fraser Coast. Bruce is also assisting Woodside Energy better understand the storm, surge tides and wave impacts on its new port facilities, so they can be designed to mitigate risk.

About seventy percent of water used around the world is for agriculture. How can we meet irrigation water needs in a sustainable fashion?

The key here is modernisation of irrigation system practices and efficiency improvements both on- and off-farm. For example, moving from flood irrigation to spray irrigation or a drip-fed system can reduce the amount of water consumption on farms by up to 80 percent. Addressing leakage and evaporation is also important and the latter can be achieved by simple methods such as lining and covering open irrigation channels.

There has been a lot of discussion recently surrounding water in the mining and resources sector, particularly with coal seam gas. Tell us about this.

Mining and resources companies are experiencing ongoing pressure to be more water efficient. There are opportunities to improve practices to handle both the lack and excess of water in mines. Coal seam gas is an interesting proposition. Before gas is accessed, there is saline water to deal with. At the moment, it is desalinated so it can be reused and the brine is stored. Innovation has a role to play in this debate and GHD is currently involved in a project to find ways to recover salt from brine for commercial purposes.

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One of the most fundamental challenges facing Australia, and indeed the rest of the world, is ensuring we have adequate safe water supplies for critical human needs. In the face of climate uncertainty, reliance on conventional water sources is no longer an option. Instead, diversifying our water supplies is increasingly seen as an effective strategy that combines climate-independent methods of sourcing water, such as desalination and recycling, with increasing efficiency, by ensuring adequate infrastructure, reducing leakage and evaporation, as well as promoting efficient water use at the consumer level.

Securing Sydney’s water supply

GHD has played a key role in bringing desalination to Sydney.
In 2006, with dam levels in Sydney falling, and a deepening drought, the NSW Government’s Metropolitan Water Plan proposed desalination as a measure to increase Sydney’s water supply and as contingency for future droughts.

According to Sydney Water’s Mike Watts, Desalination Project Manager, “For the growing population of Sydney, desalination represents an extra source of water that doesn’t rely on rain. While desalination can provide up to 15 percent of the city’s water supply needs, the plant has been designed in such a way that it can be quickly upgraded to twice its size.”

The project includes a reverse osmosis desalination plant located at Kurnell (capable of providing 250 million litres of water per day), seawater intake and outlet structures located offshore in the Tasman Sea and an 18 km pipeline, crossing Botany Bay and joining the existing distribution network at Erskineville, for transporting water.

GHD was part of the project\(^1\) team which built the plant and was a member of the Water Deliver Alliance which built the pipeline.

Mike adds, “With a total cost of AUD1.8 billion, this desalination project is the largest water project in New South Wales since Warragamba Dam was built 50 years ago. Delivered on time and under budget, it is a great example of safety, performance and the power of collaboration.”

Long-term partnership

Along with Fichtner, GHD has had a long-standing association with the Sydney desalination plant, which was officially opened in January 2010. We began our involvement in 2005 as part of an integrated project team tasked with undertaking a feasibility study to determine if a desalination plant to complement Sydney’s existing water supply was practical.

The engagement continued throughout the various phases of the project, including the preparation of an Environmental Assessment, the management (delivery) of the bid design (reference design), and the role of Owner’s Engineer. We also took on the role of technical advisor to Sydney Water, which was extended through the design, construction and commissioning phases of the project and we are currently providing an array of services during the first phase of operation.

GHD Job Manager Peter Eccleston, explains, “Drawing on GHD's broad consulting base, we provided a range of services to support Sydney Water throughout this significant project.

“In the pre-construction phase, this included feasibility assessment, engineering design and environmental assessment, geotechnical investigations, community consultation, cost estimating, strategic scheduling, as well as project management services (project controls, risk and procurement), for all three main project components (with significant support on desalination technologies from Fichtner).

“For the detailed design, construction and commissioning phases of the plant, the GHD Fichtner team provided design and compliance reviews, construction and commissioning compliance reviews, materials and durability assessments, hydraulics assessments, and plant operational assessments.”

Mike Watts says, “The reason GHD was chosen to provide continued support to Sydney Water throughout the various phases of this project is because of our association since the start of the project in 2005, as well as the continued high standard of service delivery and support we receive from the company’s skilled professionals.

“Due to our joint history on the desalination project, Sydney Water has come to rely on GHD for their technical advice and specialised experience. Their commitment to keep the very best resources on this project has been very much appreciated and I am confident this will continue.”

Industry recognition

To date, the project has won a range of awards including the 2010 Government Partnership Excellence Award from Infrastructure Partnerships Australia, 2010 Civil Contractors Federation New South Wales Earth Awards, 2010 Engineers Australia Engineering Excellence Award for Project Management and the 2010 National Australian Institute of Project Management (AIPM) award, as the best project in the Construction/Engineering category for projects in excess of AUD100 million. In addition, the project contributed to Sydney Water winning the 2010 Public Water Agency of the Year Award from Global Water Intelligence.

Speaking of the recognition, Mike says, “GHD and Fichtner, along with other partners, have provided valuable support to Sydney Water throughout the six years of the desalination plant project. Without that support we would not have achieved the remarkable success we have.”

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\(^1\) Project team was comprised of GHD along with partner Fichtner, as well as Sydney Water and its advisers including Hunter Water, TSA/Evans & Peck, DLA PhillipsFox and KPMG, together with the Blue Water Joint Venture.
The 165,000 square kilometre body of water is subject to marine influences. The Bay watershed encompasses land in six states including New York, Pennsylvania, Maryland, Delaware, Virginia, West Virginia plus the District of Columbia. The flows reaching the Bay contain nutrients and sediments from both point and non-point urban and agricultural sources. Hence, the Bay’s recreational, economic, cultural and ecological value has been under threat.

Ecology challenges

GHD’s Global Technical Leader for Water, Rip Copithorn says, “Excessive amounts of nitrogen and phosphorus entering the Bay stimulate algae growths that consume oxygen upon decay and create ‘dead zones’ of low or no dissolved oxygen within portions of the water body. The algae also block the sunlight necessary for the growth of submerged aquatic vegetation that supports the diverse ecology of the region.”

Efforts to protect the Bay, which features more than 300 Wastewater Treatment Plants (WWTPs) discharging approximately 5,700 ML/d of wastewater, began in in the eighties when the first Chesapeake Bay Agreement was established, with the primary goal of reducing nitrogen and phosphorus loads introduced to the bay by 40 percent. Since then, the program has been through a number of iterations and continues to evolve.

GHD’s considerable experience in nutrient removal led the company to work with several Anne Arundel County WWTPs located in the coastal area between Baltimore, Maryland and Washington DC. Numerous other projects followed and by 2010 GHD had helped more than 30 plants in the Bay implement cost-effective methods for Biological Nutrient Removal (BNR) and upgrades for achieving effluent nitrogen and phosphorus limits. This work has enhanced GHD’s experience in treatment technologies, ranging from conventional activated sludge processes to hybrid fixed-film / suspended growth processes and membrane systems.

Partnership drives results

Deputy Director, Bureau of Utility Operations for Anne Arundel County, Michael Bonk says, “GHD led a team based workshop approach comprised of their design engineers along with a subcontractor, County plant managers/ project managers, technicians and subject matter experts to ensure the design of our Enhanced Nutrient Reduction project will achieve the intended safety, operability, cost efficiency and performance requirements. This collaborative process was a rewarding experience and I am confident it will result in a successful and innovative outcome for the County and the environment.”

In 2000, the Chesapeake Bay Program established the goal of removing the Bay from the list of impaired water bodies by 2010. This was to be achieved by establishing annual Waste Load Allocations (WLA) of nitrogen and phosphorus for each watershed - goals based on a hydrodynamic model of the Bay. Each state within the estuary developed its own approaches to implementing the target Total Nitrogen (TN) and Total Phosphorous (TP) reductions. While the Environmental Protection Agency has reported that the 2010 goal has not been achieved, considerable improvements to the Bay have been made.

Rip says, “Currently the program has evolved to a point where the major WWTPs in Maryland and Virginia have either upgraded treatment facilities or are planning to do so, to achieve effluent TN and TP limits that approach or are at the limit of technology - generally 3.0 mg/L TN and 0.3 mg/L TP. We continue to work closely with many of the WWTPs in the watershed including Pennsylvania and New York, undertaking a range of projects such as recent upgrades to the Elkton and Havre de Grace facilities in Maryland, and the Maury Services authority and Cape Charles WWTPs in Virginia.

“Overall, GHD has made a solid contribution to improving the health of Chesapeake Bay. We have pushed the boundaries of innovation by introducing new and unique technologies.”

Future outlook

The Chesapeake Bay’s clean up effort has been bolstered by continuing government and community commitment. The most recent iteration to the Chesapeake Bay Program is to restore the health of the Bay to its targeted water quality criteria by the year 2025, with even tighter nutrient limits in some watersheds and increased accountability through biannual reporting requirements.

Rip concludes, “While the new targets will prove challenging for some WWTPs, there is plenty of help at hand. GHD has the experience, capabilities and resources to assist communities achieve compliance with these permit requirements. We are committed to Chesapeake Bay for the long-haul.”
New Zealand Earthquake

The devastating news of another earthquake in Christchurch has deeply affected the wider community. Our people, who were already assisting with works following the 2010 earthquake, have also supported the civil defence authorities in the immediate recovery operation from the 2011 event. They will shortly begin to lend a hand with broader infrastructure recovery works.

Queensland floods and cyclone relief

Our people have been instrumental in helping affected communities with recovery efforts. Significantly, GHD was appointed to assist the Brisbane City Council’s Flood Response Review Board, headed by former Queensland Governor Peter Arnison. The Board is reviewing the effectiveness of the council’s disaster management arrangements, the impact of existing planning regulations in flood-affected areas and the effectiveness of public warnings and advice. We have also been assisting the Department of Transport & Main Roads and a number of local governments around the state in assessing flood damage.

GHD is partnering with the Victorian Government to implement the Innovation Interchange.

The Innovation Interchange is designed to more efficiently solve challenges and respond to opportunities in various business sectors.

The initial focus will be the global water sector, given the enduring drought in some regions with flooding in others, exponential population growth, and demand for more energy efficient, low carbon emitting water solutions.

According to Jeremy Stone, GHD’s Group Manager of Innovation, “This initiative will drive business growth and innovation by matching the capabilities of Victorian Small and Medium Sized Enterprises (SMEs) to the needs of a broad range of end users within this sector. The SMEs will also be able to readily access associates who have the specialist skills, services and products to help deliver their solutions.

A central component of the Innovation Interchange is an interactive web portal that will facilitate the communication of the end user needs and provide connections and partnerships across geographic boundaries.

Jeremy adds, “GHD will mentor and partner with selected SMEs, providing support to maximise their opportunities for successful implementation or commercialisation of their products or services and where appropriate, facilitate introductions to key decision makers in end user organisations around the world.

“We have already undertaken a number of workshops with end users and SMEs and the feedback has been very positive.” Initial fields to be explored under the program include drinking water, wastewater, stormwater, irrigation and industrial water.

The program will also promote and provide connections and opportunities in small technologies such as nano and microtechnologies.

If your organisation owns, or is responsible for, the management of urban or regional water and wastewater, irrigation, stormwater, or groundwater, or large consumer of water, such as power stations, local government and industrial water users, we encourage you to register now by visiting www.innovation-interchange.com
Transforming a major transportation corridor of Seattle

Following damage to the Alaskan Way Viaduct (AWV) in the 2001 Nisqually earthquake, the City of Seattle and the Washington State Department of Transportation (WSDOT) debated the issue of how to restore or replace this vital transportation link that carries more than 110,000 vehicles a day.

In a joint effort, WSDOT, the Federal Highway Administration (FHWA) and the City of Seattle asked a team of consultants, including GHD, to assess and provide options to replace/upgrade the AWV and supporting seawall. Completed in 1959, the AWV is a double-decked elevated section of Washington’s State Route 99. Located along Seattle’s historic waterfront, it is one of two major north-south traffic corridors that run through the City.

As part of the AWV team, GHD worked with utility providers and surveyors to research, assess and resolve discrepancies for more than 100 years of utility records for the historic 3.7km corridor and adjacent seawall. GHD’s Project Director Rick Schaefer says, “This first step was critical to ensure the AWV team had an understanding of the existing systems’ locations, operations and interfaces before evaluating impacts of roadway design options.”

Following the survey, GHD developed conceptual utility relocation designs for the entire corridor, coordinating a full spectrum of public and private infrastructure in tightly constrained areas.

Rick adds, “In such a dense urban environment, it was vital for us to present multiple options on utility relocation and subsequent operating and financial implications so that the client could prioritise their thinking.” Utilities included storm drainage, combined and sanitary sewers, water systems, steam, natural gas, petroleum, fiber optics and electric transmission and distribution networks.

In completing the preliminary utility relocation design, GHD considered the need to minimise excavation and associated costs, reduce the impact of a proposed streetcar system on the final streetscape, and maintain service and access to businesses and utility providers throughout project construction. Equally important to the delivery of the project was accurate, dynamic cost estimation. GHD provided utility relocation preliminary designs for three options: a cut-and-cover tunnel; an elevated structure; and a surface street provision.

Following a non-conclusive public vote in 2007 on a viaduct replacement option, the AWV program was divided into multiple ‘Moving Forward’ projects intended to improve safety and replace almost half of the structure while the decision-making process continued for the viaduct’s central waterfront section.

As part of these projects, GHD completed detailed designs of phased water system modifications and drainage improvements to serve the south portion of the AWV Program area, from S. Holgate Street to S. King Street (H2K). In addition, we provided construction and regulatory documentation for Temporary Erosion and Sedimentation Controls (TESC) for utility relocations and construction of the new roadway.

Construction of the H2K projects is currently underway. Replacement of the southern mile of the viaduct is scheduled for completion in late 2013. The preferred alternative for replacement of the central section of the AWV is a bored tunnel.

The proposed tunnel would include two levels of 9.7 metres (32ft) wide roadway and extend approximately 3.2 kms (2 miles) under Seattle’s business core at depths up to 60.96 metres (200 ft). Tunnel construction is proposed to begin in late 2011 and be completed by the end of 2015. GHD assisted with preparation of the Request for Proposal for selecting a Design/Build Contractor to complete this unique project, which will help transform Seattle’s downtown waterfront.

Photos kindly provided by WSDOT
No surprises for security master plan

GHD’s risk assessment approach is being used by the City of Surprise in the US to address future security issues in its water and wastewater systems.

Located about 45 minutes from downtown Phoenix, the City of Surprise is Arizona’s tenth largest city. Home to more than 115,000 people, the city’s founder, Flora Mae Statler, named it Surprise as she “would be surprised if the town ever amounted to much”. Not only would Flora be surprised by the city’s rapid growth, but she would be proud of its forward-thinking approach to master planning.

GHD recently completed a security master plan for the city’s water and wastewater facilities, which includes 20 water supply wells, five water treatment, pumping and storage facilities, two wastewater reclamation plants, and wastewater collection and water distribution systems.

GHD Job Manager Kerry Brough says, “Surprise wanted to better understand the potential threats and vulnerabilities of their water infrastructure, as well as identify potential improvements. Usually adopted by much larger cities, the risk-based approach we used is allowing Surprise to improve safety while optimising investment to enhance security.”

The plan identifies multiple improvements to deny, deter, detect and respond to water and wastewater facility and system threats. These improvements include administrative, physical and electronic barriers, Crime Prevention Through Environmental Design (CPTED) principles, and access control and monitoring.

According to GHD’s Project Director, Wayne Francisco, “Our risk assessment approach was used to identify potential security threats, determine site vulnerability, and detail the likelihood and consequences of a successful security threat to determine risk levels for each site for each type of threat. Potential security improvements were also evaluated using the risk assessment process to determine risk reduction benefits for comparison with improvement costs.”

Surprise Project Manager Fred Stevens, believes the master plan will greatly benefit the city. “Actions recommended by GHD will enable us to improve the safety of Surprise’s water and wastewater assets. It will also allow us to optimise our investment in infrastructure, due to the prioritisation of improvements.”

The master plan was developed over a ten-month period. Surprise is now evaluating recommendations and will finalise its water improvement plan in the near future.
Jamestown Wastewater Treatment Plant
GHD worked closely with the Jamestown BPU to obtain government funding, assist with bid preparation and design. Specifically, we were asked to design a green wastewater treatment plant with two 22.86 m (75 ft) diameter digesters that would service the region with a reduced carbon footprint and subsequently offer operating cost savings.

Mike Saar P.E, Deputy General Manager for Jamestown BPU says, “GHD was pivotal in the preparation of our ‘Green Grant’ funding application which provided USD2.5 million toward the USD3 million construction cost.” The design of the plant, which was fast-tracked over a six week period, was considered for funding due to its green credentials: the inclusion of a micro turbine which re-uses digester gas to generate power for plant operations ‘off the grid’ and a heat exchanger which salvages heat from the treatment process to be used in other parts of the plant.

GHD coordinated the project with local regulatory and funding agencies, ensuring the design aligned with stringent ‘Made in America’ requirements and delivered benefits to both the client and the community.

GHD Project Director Bob Armstrong comments, “Our team worked diligently with local authorities to deliver this benchmark 45 MLD (12 MGD) plant. This carbon-reduced design will improve facilities and lower electricity and natural gas costs.”

Broken Hill Water Treatment Plant
Across the Pacific, Country Water in Broken Hill selected the GHD/Tenix team to bring its 60 year old water treatment plant into the next century. It sought to reduce operator input, improve occupational health and safety for operators, and to ensure compliance with aesthetic and health requirements of the Australian Drinking Water Guidelines.

GHD Project Director Sarah Wheeler says, “We adopted an innovative approach in providing a robust, reliable design of this modern plant – integrating existing infrastructure, creating scope for future upgrades and allowing for efficient treatment of highly variable water qualities and multiple raw water sources.”

GHD worked closely with Tenix and Country Water to ensure the project was delivered on time and budget - providing process and detailed design, concept review, technical specifications and construction advice.

The plant, which was completed in July 2010 provides the community with safe and reliable potable water.
Water is an essential part of mining and mineral processing activities, affecting the entire lifecycle. Effective water management practices can improve efficiencies through a mine’s life while at the same time minimising environmental impacts.

Concerned with the management of water resources at some of its mine sites, the Centennial Coal Group (Centennial) sought to better understand the demands on its processing activities.

Established in 1989, Centennial supplies thermal coal to the domestic and export markets. The company operates ten mines in the Lake Macquarie and Western regions of New South Wales (NSW). It is a major supplier to the NSW energy industry, fuelling approximately 46 percent of the state’s coal-fired electricity.

With GHD’s help, Centennial embarked on an assessment program to determine the water management capabilities of its mine sites. This involved the development of detailed water balances for existing and future operational conditions, as well as groundwater models. To date, six sites have been evaluated.

GHD Project Director Dr Ian Joliffe says, “The viability of mines is based on a range of factors including water management. Our water assessments, which include a review of conditions according to Australian and New Zealand Environment Conservation Council (ANZECC) guidelines, allow resources companies such as Centennial to better understand the impact of water management on mine operations and sustainability requirements.”

Newstan Colliery, one of the six sites already assessed, is an underground mine that has been progressively developed over the last 120 years. Centennial Coal Group Environment Manager Mary-Anne Crawford says, “Over time, many different water management systems were created, none of which were detailed enough for our purposes. GHD helped us to develop a comprehensive water management plan that is aligned with our business objectives. This document is easy to understand and helps our people comprehend the complexities of the coal production system and the water cycle.”

As part of this project, GHD also delivered a hydrogeological model, an ANZECC and geomorphic assessment and investigated future water management options at Newstan.

Mary-Anne adds, “The water management plan has been provided to the Department of Environment, Climate Change and Water to detail Centennial Newstan’s operations. Specifically, it outlines our approach to sustainability and details our pollution reduction program.”

Centennial’s Charbon Mine, an open cut and underground mine with 80 years’ heritage and inconsistent historical records, provided GHD with the opportunity to develop a GOLDSIM model. This enabled the assessment of the existing water systems and helped calibrate against recorded discharges.

Ian explains, “As part of the model development, GHD recommended that a number of locations be closely monitored. This will enable accurate data to be captured, which will be used to update the GOLDSIM model at six month intervals. In turn, the model can be used to assess future mining operations and assist with decision making.”

Looking to the future
GHD Project Manager Mary-Jane Piggott will continue to oversee the work with Centennial including the undertaking of a number of water balances, ANZECC assessments and water management plans.

Mary-Jane says, “Centennial has adopted a long-term approach to water management which will see us working closely together for some time. More importantly, it will enable Centennial to improve the efficiency and sustainability of its operations.”
A fresh approach to groundwater management

In this article, Michael Mozina, GHD’s Water Resources Manager discusses the significance of management of groundwater in engineering works, water supply and natural resource management. With prolonged drought and climate variability impacts, Michael observes that the need for managing groundwater resources is ongoing and increasingly pressing.

Underpinning the feasibility assessment, design and construction phases for a range of engineering infrastructure works requires knowledge and understanding of how hydrogeology can be impacted and managed. Droughts, floods, population growth and increasing demand for groundwater are some of the factors challenging the engineering sector.

Impacts
During any construction, the engineering works will temporarily or permanently change in situ or surrounding groundwater conditions. For example, groundwater level decline can cause land subsidence impacts to adjacent built environments. Falls in groundwater levels affect other stakeholders dependent on this water source by altering natural processes (reduced stream base flows) or engineered methods of abstraction (yield decline for stock or domestic water supply bores).
It is helpful to understand and manage the impacts of rising groundwater levels on built infrastructure, such as salt attacks. Similarly determining groundwater inflow estimates for site water management arrangement and post construction structure stability is valuable to the design process.

Both horizontal and vertical movement of groundwater with constructing civil works can mobilise polluted groundwater sources or change aquifer geochemistry in water quality.

When designing or constructing the extracting and distribution engineering works, knowledge of the sustainable aquifer yield of the target groundwater resource is beneficial. In addition, ascertaining groundwater chemistry for any necessary treatment as part of a sole or augmented supply source for a water treatment plant is valuable. Identifying and appraising the effectiveness of engineering options - to manage groundwater disposal during construction activities or within the operation of commissioned works to meet statutory environment discharge requirements - is dependent on knowledge of the chemical composition of groundwater.

There are many examples of areas where groundwater management requires particular attention in terms of implementing engineering works for urban development infrastructure, augmenting potable water supply (demand management and drought response purposes) and for the health and wellbeing of the industry. The following projects that GHD has been involved in, demonstrate the increasing importance of how engineering works need to be designed and operated - in a manner that takes into consideration the interdependency groundwater has in the bio-physical and hydrological cycles of our environment.

**Groundwater implications for urban development in Melbourne**

The south eastern Melbourne suburb of Pakenham is located in a region historically affected by waterlogging and land salinisation processes that have restricted land use and development. Significant population growth over the past decade, which is projected to continue for Melbourne, has subsequently increased pressure to fully utilise remaining land parcels in urban growth corridors for residential and associated development. Located in the Cardinia Shire Council, the Pakenham area is one of these key growth areas where significant investment is occurring, in particular, on land prone to the effects of shallow ‘brackish’ groundwater levels.

Considerations for land developers in these areas relate to assessing both direct and indirect groundwater impacts before selecting engineering options that can adequately protect residential developments.

The first step involves identifying, characterising and distinguishing the relative contribution that local and/or regional groundwater systems have on existing or potential salinity and waterlogging processes. At this point, the effectiveness of a range of engineering options can be gauged in their ability to control groundwater levels and suppress salinity impacts on subsurface infrastructure. Plus, the sustainability components of various options need to be considered, in terms of construction costs, post construction operation and maintenance costs, estimated annual capital replacement costs and wider environmental issues.

GHD helped to rank each option based on overall effectiveness in groundwater level control and associated ongoing costs including establishment costs, monitoring and management requirements for the council/water authority, and capital works infrastructure refurbishment/replacement frequency. From this process, the preferred option was selected as the most effective solution to realise the lowest economic cost to the community and environment. Representation of salinity impacts and options for management in this manner can streamline statutory planning approval requirements and residential development investment decisions.

**Waste stream disposal considerations for hot springs**

Victoria’s first natural hot springs spa centre opened in 2005. Natural hot mineral waters flow into thermal pools and private baths - from an aquifer 637 metres below the surface. The geothermal heated water, which varies from 37°C to 43°C, rises under its own pressure through a groundwater extraction bore to within 10 metres of the surface. The water contains a range of naturally occurring minerals including sulphur, calcium, magnesium and potassium.

Faced with extracted groundwater salinity that was too high for the spa’s waste stream, solutions were sought. Disposal of spa water back into the aquifer that provides the geothermal waters is currently being assessed. However, disposal water is of significantly lower temperature than ambient aquifer temperature, and concern over cooling of the extracted groundwater via this option is being explored.

To successfully achieve waste stream re-injection requires a succession of several technical uncertainties, principally through innovative injection bore and pre-injection treatment system design.

Feasibility of the re-injection scheme, achieved by conducting chemical analysis and geochemical modelling of the extracted water, and geothermal modelling of the aquifer has been recently undertaken. Geothermal modelling indicated that re-injection of disposal water would significantly cool the resource in the medium term. However, adaptive engineering measures have been proposed that will provide a suitable re-injection bore design, utilising project data to date.

**A clear perspective**

Through adaptive design, engineering and operation, GHD has the opportunity to assist water authorities and stakeholders toward valuable awareness of the interdependency groundwater has in the bio-physical and hydrological cycles of our environment.
Protecting the Great Barrier Reef

For more than fifty years, GHD has contributed to the successful management of wastewater in the greater Cairns region. Most recently, our team lent its experience and skill to the Cleaner Seas Alliance, an initiative designed to significantly improve the water quality released to the marine environment.

The million dollar project involved the upgrade of the four main Wastewater Treatment Plant (WWTPs) servicing Cairns and its surrounding areas. It is being delivered under an alliance contract involving GHD.

The Northern, Southern, Edmonton and Marlin Coast WWTPs will all be upgraded to increase capacity and include Biological Nutrient Removal processes.

The project had been in the planning stages for three years and now moves into the delivery stage involving design, procurement, construction, commissioning and process validation and optimisation. It will provide significant environmental benefits by reducing the load of nutrients discharged to the Great Barrier Reef by up to 80 percent.

Jose Foruria, GHD Operating Centre Manager for North Queensland said, “One of the key factors to the success of this project is that each member of the alliance brings specific skills to the table that complement those of the others. GHD’s responsibilities comprised design of the civil and structural components of the project. Some of the challenges we faced included the design of the fully post-tensioned bio-reactor structures and some of the geotechnical conditions. However, with a team of more than 1500 water professionals in the GHD network, we were able to leverage the skills needed to drive innovation and deliver effective solutions that met the tight timeline and budget demands of the project.”

The project has received a High Commendation in the Environment Category of the 2010 Engineers Australia Awards (QLD Division).

Jose adds, “We are very proud to be part of the alliance involved in delivering a project of this scale that has a focus on protecting our unique environment. We were involved in the inaugural Cairns sewerage system and wastewater treatment system sixty years ago, which is a testament to the longevity of our client relationships. To have received an award for working with our clients and protecting a beautiful part of the world is a fantastic bonus.”
Stockland, Australia’s largest diversified property group, has completed a project to assess the potential impact of climate variability on its business. In the residential market, the company holds considerable land assets and develops masterplanned and mixed-use communities in growth areas across the country.

Realising that climate variability could have an impact on the future of Stockland’s business, the company undertook a strategic review of risk. It identified three key areas for initial focus: sea level rise and flooding, bushfire, building integrity and reliance.

**Risk assessment**

Stockland appointed GHD to assess the risk of sea level rise and rainfall change on all of its residential land holdings. “We decided to go with GHD for this component of work because the team possessed the necessary skills,” said Ramana James, Stockland’s National Sustainability Manager, Residential. “As an organisation we are extremely focused on sustainability, so this project was particularly important to us, as some of our properties are located in coastal areas.

“We had already undertaken our own high-level analysis of the appropriate climate change risks to be assessed, and engaged GHD to undertake a desk-based review of our residential land assets around the country. This initial assessment identified projects that were exposed to risk of sea level rises or rainfall generated floods.

We decided to undertake a more detailed assessment on these projects to quantify the risk and identify potential mitigating strategies.”

**Pro-active approach**

Led by Dr Ian Joliffe, Principal Water Engineer, the GHD team set about identifying the high-risk properties – those that would be impacted by rainfall and sea level rise where more than a third of the site would be lost – and ascertain the level of risk.

“The intent of this study was to help Stockland better understand its business risk – particularly in terms of potential exposure to loss on land assets not yet developed or those land assets being considered for purchase,” says Ian. “This is a rather unique project and we are not aware of any other developers having taken such a pro-active approach towards climate risk. In doing so, Stockland has demonstrated a high level of leadership towards environmental management.”

As part of the project, GHD facilitated an internal workshop with key stakeholders to provide information, gather requirements and agree on an approach and process for the asset review.

“The workshop was particularly beneficial,” says Ramana. “It brought together a broad range of people from across the business - including marketing, finance, design and sustainability – and it enabled us to engage in the process as a united team.”

The study has revealed that Stockland only has a small risk of impact on low-lying land for a couple of projects at 50 years and beyond.

“We are pleased with the results of this assessment, which shows us that we are not exposed to high-risk,” adds Ramana. “It was certainly worthwhile to go through this process and gain a better understanding of our risk profile. The outcomes of our research are now informing development management practices, including monitoring of risks through regular project and asset reviews as part of our Project Performance Review process in our residential communities business, and environmental risk reviews as part of our acquisition processes as set out in our business unit sustainability policies.

“We enjoyed working with GHD. Ian and his team were responsive and produced a quality and detailed report incorporating valuable insights into how we can manage our risk. For example, we now know how to manage impacts on developments through design solutions such as natural vegetation corridors, rolling easements as well as sea and riverbank walls.”

For more information, contact Ian Joliffe on +61 2 4979 9934 or email ian.joliffe@ghd.com
GHD managed the design and construction of a state-of-the-art wastewater recycling plant that has given Castlemaine Perkins’ Brisbane brewery 21st century efficiency in water saving.

Established in 1878, the brewery was meeting best practice standards for an older plant but regulations introduced as a result of the drought required a minimum 25 percent cut in water use.

The AUD16 million plant was commissioned in late 2009 and has cut water consumption by about 35 percent, saving 1.1 million litres of drinking water per day.

This brings it in line with the world’s best practice standard of using 2.2 litres of water to make a litre of beer down from 3.5 litres per litre of beer previously.

While the plant has increased the brewery’s electricity bill, this is more than offset by the biogas produced during digestion of liquid waste, which is reused in boilers and has cut natural gas costs by about AUD90,000 per year.

“But the cost of water was not as significant a factor as savings in trade waste discharges – we have reduced these costs by around 60 percent,” Operations Development Manager Mike Kinder said.

Castlemaine Perkins contracted GHD to undertake a feasibility study to recommend the preferred technology and budget for the plant, identify the best location and carry out a geotechnical survey.

Preparation of tender documents and evaluation of the tenders also took place, which resulted in the appointment of Aquatec Maxcon to design and construct a plant with the latest reverse osmosis technology.

“GHD added a great deal of value in the preliminary investigation and contract documentation,” Mike said. “The team helped us enormously in taking the project from inception through to establishing a contract, and excelled in the ‘hazard and operability’ design phase.”

Overseeing the ‘hazard and operability’ phase, the GHD team carried out studies to finetune Aquatech Maxcon’s detailed drawings for the plant, which consists of tanks that hold 300,000 to 400,000 litres of liquid each, and which produces large quantities of biogas as well as 400 million litres of ultra pure water a year for use in cleaning and cooling.

It was recommended the plant use a new, high-quality shrouded biogas flare which burns with no flame – an important consideration because of its CBD location – and the brewer relied on GHD to provide technical information to secure approvals from the environmental regulator.

The project has strengthened an already strong working relationship. “We worked extremely closely with GHD and developed a great relationship which certainly contributed to the successful delivery of this project,” Mike said. “Our Project Director, Chris Hertle, was always available to answer our technical questions, and the team was extremely responsive to our needs.

“For example, we are putting in a wastewater treatment plant at our Crestmead Dairy south of Brisbane and needed a hazardous area study because we had to set out the layout of the plant. GHD was able to provide that fairly quickly.”
Adapting to water scarcity

GHD is helping regional communities in the Murray Darling Basin adjust to the risk of a future with less water.

The recent release of the Australian Guide to the Murray-Darling Basin Plan has brought to a head the longstanding debate about how to protect the environmental assets of the Basin whilst minimising the socio-economic impacts on regional communities.

Many regions are highly dependent on the irrigation industries which generate wealth and jobs. The prospect of reduced water availability in the future, whether from changes in public policy or climate variability, are understandably causing concern and uncertainty in communities. These concerns have been heightened by the recent experience of the worst drought on record.

Whatever, the final outcome on the Basin Plan or the future changes in our variable climate, those communities which plan for increased competition for water will be best placed to adapt to these changes and maintain their social and economic wellbeing. Options include improved water use efficiency and demand management, strategic infrastructure investment and alternative less water dependent enterprises.

MI and the wider regional community, including major centres such as Griffith, are facing significant challenges in adjusting to a water scarce future. The newly formed alliance will work with MI to realise the vision for an integrated modernisation program that will increase productivity with less water, and provide levels of service that will maintain the competitiveness of the region.

MI is one of the largest private irrigation companies in Australia. It provides irrigation and drainage services to some 3200 landholdings over an area of 660,000 hectares, and manages around AUD500 million of infrastructure assets that service more than AUD2.5 billion in water entitlements.

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Achieving efficiency

With the assistance of the Australian Government, MI has developed a modernisation plan to improve irrigation efficiency and reduce system losses. Additional benefits include improvements in levels of service delivery, infrastructure flexibility and sustainability, as well as lasting water savings.

The initial focus of the alliance will be on delivery of early works including:

- Replacing the ageing concrete-lined channel supply system within the Lake Wyangan catchment with an integrated water delivery system.
- A continuation of an existing commitment to gradually phase-in piped delivery systems to replace the deteriorating concrete-lined channel infrastructure.

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Response in the Basin

Elsewhere in the Basin, GHD has been engaged by the Liverpool Plains and Gunnedah Shire Councils to assist in planning for a water scarce future.

The project will help the councils to understand the risks and impacts of declining water availability across the region. It will enable the preparation of plans and business cases for projects to respond to change in each Local Government Area by enhancing water security and promoting growth based on water efficient, and less water dependent, industries.

The Dubbo City Council has also engaged GHD to undertake a similar study to plan for the future water security of its AUD2 billion economy.

GHD is also providing services to the Department of Sustainability, Environment, Water, Population and Communities on assessment of on-farm water use efficiency and other projects being funded in the Basin under the Water for the Future Program.

“Australia is recognised as a world leader in water resource management,” explains Peter Sutherland, NSW Business Leader – Water Resources. “This has been driven by our need to manage in one of the most unreliable climates on the globe. The Murray Darling Basin has been a focal point in these reforms and GHD is committed to assisting communities realise a sustainable water future.”

For more information, contact Peter Sutherland on +61 2 9239 7126 or by email peter.sutherland@ghd.com
Reducing congestion and removing trucks from local streets is set to improve quality of life for residents and boost transport efficiency.

The Truck Action Plan (TAP) is a key initiative of the former Victorian Government’s AUD38 billion Victorian Transport Plan (VTP). It is designed to reduce the number of trucks in Melbourne’s inner west residential areas by up to 70 percent and improve access to the Port of Melbourne precinct.

The project addresses key community concerns by providing an ‘around the clock’ access route to the Port of Melbourne from the West Gate Freeway, whilst offering an alternative route for trucks away from Melbourne’s inner west residential streets.

The reduced number of trucks will improve the liveability and long-term economic developments of Melbourne’s western suburbs, particularly Footscray, making the area a more appealing place for inner-city dwellers to live and work.

GHD is part of a team engaged by VicRoads, to carry out a number of studies for the TAP. “We assessed a range of options that would provide an alternative connection for trucks between the West Gate Freeway and the Port of Melbourne,” explains Daniel Gregor, GHD Project Manager.

“We identified an appropriate route and assessed the impacts based on detailed traffic modelling, road design and other specialist environmental, economic, social and land-use studies.

“Frequent and ongoing communication with VicRoads, key stakeholders and the broader project team was critical to the success and timely delivery of this project.”

The project involves the construction of new ramps connecting the West Gate Freeway to Hyde Street. These ramps will provide trucks with improved connectivity and more reliable travel times to the Port of Melbourne. The project also includes local arterial road and intersection upgrades as well as upgrades to the Federation Shared Trail.
When the New Zealand Government released the first draft of its National Infrastructure Plan (NIP) in 2010, there was general consensus amongst industry that improvements were required to provide certainty around plans and outline priorities for future infrastructure development.

Working in partnership with the New Zealand Council for Infrastructure Development, GHD hosted an industry forum involving more than 60 leaders from a range of industry sectors. The objective? To leverage the collective thinking of the group and find ways to get greater value and maximise productivity from the NIP.

“Very quickly participants developed strong consensus for an agreed vision,” says Stephen Selwood, Chief Executive of the New Zealand Council for Infrastructure Development. “They were also keen to see improved alignment of planning, at both a national and local level, to reduce boom-bust cycles and allow industry to both attract and retain a skilled workforce, and commit the capital necessary to deliver the infrastructure capacity New Zealand needs to grow. The idea of a National Spatial Plan that would ensure balanced development and more strategic funding and project prioritisation across the country was also explored.”

Rob Gilmore, GHD’s Business Leader Roads & Highways facilitated the workshop. He says, “Infrastructure bonds and public private partnerships were explored as a means of funding the investment required and delivering intergenerational equity to build infrastructure that would last for many decades to come. However, it was also recognised that these investments would need to yield a positive economic return and be supported by new revenues from user charges.”

The participants highlighted opportunities for aggregation of projects and shared services across boundaries and government ministries to achieve economies of scale in the delivery of services.

Feedback from each of the workshop sessions will be collated by GHD into a series of recommendations for input into the NIP.

Gary Payne, GHD’s Operating Centre Manager New Zealand said, “Hosting this forum underlines our belief in the benefit of ongoing dialogue and consensus building as a means to creating a NIP with the potential to improve quality of life for all New Zealanders.”

For more information, please call Rob Gilmore on +64 9 421 9223 or email rob.gilmore@ghd.com

GHD is helping shape the debate for infrastructure development to improve quality of life.
In 2010, Melbourne was ranked as the world’s third most liveable city by The Economist Intelligence Unit. ‘Liveable’ cities provide their people with an engaging combination of political stability, environment, culture, healthcare, education and infrastructure.

Since its inception in the 1850’s, the city of Melbourne has gathered an impressive collection of feathers in its cap. CBD alleyways overflow with cafes, galleries and small businesses, while major international companies employ professional workers. Residents have extensive public transport networks at their disposal and the city is renowned for its cosmopolitan nature, peaceful parks and gardens and love of celebration.

The question is how will Melbourne, a vibrant city with four million people, cope once its population exceeds five million?

As a member of the invitation-only Committee for Melbourne (CfM), GHD is contributing to the debate. The Committee brings together Melbourne’s business, government, academic and community leaders, united by their passion to steer the city towards a successful future.

Since 2009, GHD’s Tom Fricke, a CfM Executive Board member has co-chaired the Committee’s Shaping Melbourne Taskforce, which is charged with raising key issues under the theme of ‘Melbourne getting better as we get bigger’.

During the past year, the taskforce has released a series of ‘Melbourne Beyond Five Million’ reports outlining the key challenges facing the city as it heads rapidly towards a population of five million and beyond – potentially even doubling in size. The reports provide strategic guidance for Melbourne’s development across three key areas: Governance and the Melbourne Proposition, Density and Localised Economies, and Physical Infrastructure and Connectivity.

Commenting on our involvement, Tom said, “Melbourne is not alone in the need to plan for a successful future. Global population increases, resource scarcity and a digitally-empowered citizenry mean all cities must think carefully about how they will develop in the future.

“GHD’s global presence gives us local insight into the challenges faced by cities around the world. Throughout Australia, New Zealand, Asia, the Middle East, the Americas and Europe, GHD is helping clients face similar challenges. We are providing advice in key city development areas such as integrated transport solutions, energy efficient buildings, water security, community consultation, asset management, resource management and environmental integrity – all critical elements of ‘liveable’ cities.

“With global populations tipped to peak at nine billion in the next 60 years, the issue of preparing cities for a sustainable future is sure to be a hot topic.”
Known as ‘Oriental Moscow’ for its mix of Western and Chinese cultures, Harbin is the tenth largest city in China. Located in the country’s northeast on the bank of the Songhua river, Harbin is famous for its moderate weather in summer and its wonderland of ice and snow in winter.

In recent years, the city has undergone great changes and is now an important international business port and distribution centre for Northeast Asia. With a population of 9.7 million, Harbin is one of the most industrialised cities in China. It boasts an advanced transportation network including five railways and seven main highways that pass through the city.

Since the 1980s, Harbin’s ecological resources have been deteriorating and pollution is rising. Fish no longer populated the Songhua River and the city’s natural ecological system is out of balance.

Realising it needed to restore and protect its environment, Harbin’s Water Resources Department commissioned GHD to prepare an urban master plan.

Known as the Harbin City Ecological Gallery Master Plan, this project details the necessary steps required to protect and rehabilitate the city’s water and ecological systems.

“We conducted studies over a 123 km stretch of the Songhua River to determine the state of the environment and the impact from hydropower activities,” explains Shujun Zhang, GHD’s Project Manager. “The resulting master plan proposes a range of protection measures including a monitoring and indicator system.

“Stakeholder consultation was an important part of the process. We held a project review workshop with representatives from the Ministry of Water Resources, China Academy of Science, the Office of State Flood Control and Drought Relief Headquarters, Beijing Water Bureau, Heilongjiang Fisheries Research Institute of Chinese Academy of Fishery Science, and local universities. This enabled us to marry the science with various priorities to produce a plan that promotes sustainable development.

“In the long-term, the master plan will benefit the residents of Harbin. It will beautify the city, restore the aquatic environment and promote economic development along with tourism.”
In this interview, GHD Principal Architect Craig Muir explores the idea that sophisticated clients seek the adoption of new project delivery practices.

Craig believes that GHD is ahead of the curve when it comes to Integrated Project Delivery (IPD). He says, “Collaboration underpins our business and the discipline of IPD, which helps us produce leaner designs and more sustainable outcomes.”

How are project delivery trends developing?
The most advanced players in industry now demand IPD. This uses business structures, practices, and processes to collaboratively draw on the talent and insight of each participant in the design, construction and fabrication process. Mobilising when the project is first conceptualised, the integrated process continues throughout the entire life cycle of the facility.

Where things get really exciting, especially now at GHD, is integrated delivery using Building Information Modelling (BIM). This tool is shaping the way the architectural, engineering and construction industry and associated professions will work for years to come. Although it is possible to achieve outcomes without BIM, we believe it is essential to efficiently achieve the collaboration required for IPD.

All players including businesses, consultants, contractors, subcontractors, government, education institutions, professional associations and software manufacturers now see the need to collaborate to develop and expand BIM tools, skills and resources. In the not so distant future, we will each be able to reap the financial and productivity gains that should result, and achieve the ultimate aim of making the built environment more economically, socially and environmentally sustainable.

What does IPD mean for GHD’s clients?
GHD’s Property & Buildings teams are responding to increased maturity in the market by adopting IPD. The benefits are clear - IPD is a collaborative alliance of people, systems, business structures and practices that can be integrated to optimise project results, increase value to the owner, reduce waste, and maximise efficiency through all phases of design, fabrication, and construction. For clients, this means a leaner finished product – fiscally and environmentally considerate – delivered in a faster timeframe and with reduced discipline clash when compared to traditional project delivery. The resulting model can also be linked with current facility management systems to ensure our work has longevity once the development is constructed – this is a fantastic value-add for clients.

How does IPD fit with what we already do as a company?
We deliver multi-disciplined solutions. This means our teams include professionals in architecture, structures, interiors, landscape, electrical, mechanical, hydraulic and civil engineering. IPD, specifically utilising BIM, means that we all work to one model, on one platform – in real time. We have always taken pride in our collaborative approach to project
outcomes – yet IPD now enables us to provide even more timely, accurate responses and to deliver a succinct project outcome that is technically, aesthetically and financially viable.

**How do you ensure each discipline works together across the project?**

We have standardised on a protocol that dictates a collaborative workflow. This means our professionals commit to the process in accordance with the project schedule, modelling standards and protocols provided by GHD prior to the schematic design phase. Once the design development phase is complete, the construction documentation phase commences using the same model – where all working drawings are managed within the central Revit® file. Housed on one server, all externally supplied component content must comply with the directed project standards. IPD means we are living our promise to be an integrated practice for our clients.

**Where does IPD work?**

Traditional design delivery involves technical staff sitting at their own desk, in different offices, coming together once or twice during the design process, and delivering their own design discipline largely in isolation. GHD’s complete in-house design capability provides a significant advantage as our teams will sit together and work on the same single model in real time. This improves the levels of communication and collaboration to ensure a highly co-ordinated model is developed in the shortest possible timeframe. There is only one version of the model and each discipline can be confident they are responding to accurate, relevant information at all times.

To fully illustrate the benefits of IPD, one should look at diverse, complex developments such as the work we have done on a AUD120 million research laboratory, the Grafton Superclinic in New South Wales, the AUD12 million Verve Energy Commercial Office Building, a AUD600 million mining feasibility study in New South Wales, and a AUD300 million rail infrastructure project we have undertaken in Queensland.

**Define BIM and outline the benefits it brings to clients and designers?**

BIM is a tool that allows a uniform approach to the design, engineering and analysis of a project. It utilises one platform (a model) to bring all disciplines together and review 3D clash detection in real time. All project stakeholders are able to communicate, with documentation and shop details being streamlined, linking directly to the project schedule and enabling seamless project delivery from concept through to asset management.

Improved levels of coordination and detailed 3D visualisation allow stakeholders to keep their finger on the pulse throughout the entire lifecycle of a project – this brings certainty to clients and asset owners, and consistency in design for our architects and engineers. Plus it brings cost and time savings during construction.

We now take entire project coordination to another level, through IPD. This includes an improved understanding and tracking of the construction sequences along with the ability to provide an industry-compliant facilities management model at project completion.

**How is it possible to engage GHD’s people in such a change?**

Our offering of IPD using BIM has created quite a buzz amongst our people and clients. The expanse of information available through BIM allows for greater confidence in the finished product. Solving design clashes or inconsistencies in the model can occur in one space (online) – meaning staff can collaborate in real-time and work closely to deliver results faster and more accurately than ever before.

Our people are collaborative by nature and constantly evolving, much like the design profession. They are ‘BIM-ready’, and skilled in the use of Autodesk® and Revit® BIM software.

**For more information on IPD using BIM, contact Craig Muir on +61 8 6222 8520 or email craig.muir@ghd.com**
A small group of Young Professionals from our Auckland office has made an outstanding contribution to a Habitat for Humanity project in South Auckland.

Habitat for Humanity is an international not-for-profit organisation that aims to eliminate poverty, housing and homelessness by building adequate and basic housing for people in need. Since 1976, Habitat for Humanity has built, repaired and renovated homes in nearly 100 countries, with a new house being completed every 15 minutes.

Our team in New Zealand has donated close to 500 hours of personal time on a project in Wymondley Street, Otahuhu – an 11 house Habitat for Humanity sub-development.

Marisha Jaglal, a traffic engineer with GHD’s Auckland Transportation Group, has been coordinating the GHD volunteer team. “Because our team contributed more volunteer hours than any other company in New Zealand, Habitat for Humanity has named one of the houses after GHD, in recognition of our support. Our people were incredibly supportive when it came to volunteering their services for the GHD House. Most weekends we had more volunteers than we needed, and people have really thrown themselves into the build. They have loved every minute of it.”

Vikram Dass is one Young Professional who has made a real commitment to the Habitat for Humanity project. “I feel privileged to have been one of many who provided regular support to this family, and I love the fact that Habitat for Humanity encourages volunteers to share their experiences and knowledge. My favourite things about working on the project have been learning the basic, and not so basic, including the tricks of DIY; gaining confidence in using power tools; building relationships with the volunteers and tradespeople on site; bridging the gap between my design and practical experience; and taking pride in the tasks assigned to me.”

Marisha says, “We have paved the way and set up a great relationship with Habitat for Humanity in New Zealand. Our counterparts in Australia have also been very active with Habitat projects and we are looking forward to working with the organisation further, not just in New Zealand but around the world.”
CONSULT AUSTRALIA
- 2010 Silver Award – Environmental Category: Nyrstar Groundwater Interception System
- 2010 Silver Award – Environmental Category: Victorian Desalination Project
- 2010 Silver Award – Water Category: Sugarloaf Pipeline Project

CIVIL CONTRACTORS' FEDERATION - 2010 VICTORIAN EARTH AWARDS
- AUD5-20 million category: Werribee River Sewer Aqueduct project - The Pipelines Alliance
- AUD75 million plus category: Sugarloaf Pipeline Alliance
- Project up to AUD1 million category: Lake Condah Water Restoration Project

ENGINEERS AUSTRALIA
- 2010 High Commendation (Sydney Division) - Engineering for Regional Communities: Swansea Bridge Cathodic Protection
- 2010 Excellence in Project Economy and Ingenuity Award (Newcastle Division): Managing Rail Safety over Longwall Coal Mining
- 2010 Excellence Award (Newcastle Division): Managing Rail Safety over Longwall Coal Mining
- 2010 High Commendation (QLD Division) - Environment Category: The Cleaner Seas Alliance
- 2010 Young Professional Engineer of the Year (QLD Division): Dale Young
- 2010 Young Professional Engineers of the Year (Newcastle Division): Andrew Bagnall
- 2010 Young Professional Engineer of the Year (NT Division): Dr Elisha Harris
- Commendation, Building Projects Category (SA Division): Department for Families and Communities, Mt Gambier

MOUNT GAMBIER CHAMBER OF COMMERCE
2010 Outstanding Service Industry Award: GHD

PLANNING INSTITUTE OF AUSTRALIA
Commendation, Rural and Regional Planning Category (NSW Division): Western Councils' Sub-Regional Land Use Strategy
Award for Merit, Industrial Planning Category (QLD Division): Swanbank Enterprise Park

11TH VICTORIAN COASTAL AWARDS FOR EXCELLENCE
2010 Award - Natural Environment Category: Williamstown High School (Williamstown Wetlands)

WORKSAFE VICTORIA
2010 Awards – Best Workplace Health & Safety Management System: GHD

MIDDLE EAST

ARABIAN COMMERCIAL PROPERTY AWARDS
The 2010 Architecture Award (Office) Qatar: Al Bidda Tower

NEW ZEALAND

THE ASSOCIATION OF CONSULTING ENGINEERS NEW ZEALAND INC
2010 Silver Award: SH60: Eureka Bend Reinstatement, Takaka

USA

INTERNATIONAL WATER ASSOCIATION (IWA) GLOBAL PROJECT INNOVATION AWARDS
2010 Honour award (Small Projects Category): Downtown Scottsdale Booster Station, Arizona
Daniel Veryard, a member of our economics and policy group was awarded the David Willis Memorial Prize for the best paper submitted by a student or new professional in the transport research field. Daniel’s paper focused on ‘Tourism impacts of carbon pricing of aviation in the APEC region.’

Shaun Smedley, our Service Line Leader for Traffic Engineering & Transport Planning has been recognised by the Institute of Transportation Engineers Australia and New Zealand (ITE ANZ) as the Emerging Transport Professional for 2010.

Andrew Bagnall was named by Engineers Australia as the 2010 Young Professional of the Year Award for Newcastle, in recognition of his work in the area of Ecologically Sustainable Design and Building Information Modelling.

Dale Young received the same honour for the State of Queensland. Dale took leave of absence from GHD in 2009 to live in Tanzania and establish the MSABI project - a water, sanitation and hygiene initiative to empower and educate local Tanzanians.

The Northern Territory award went to Dr Elisha Harris who was chosen due to her significant academic and professional achievements and her contribution to the field of engineering.

Mark Thomson, one of our project managers has received an Australian Leadership Award at the 2010 Australian Davos Connection Future Summit. He was one of 30 leaders recognised for their contribution to Australia’s business, government, academic and community sectors. Mark was nominated for his 15-year involvement with the Lord Somers Camp & Power House Association, a youth leadership and development organisation.

Julie Green, a senior civil engineer with our Brisbane office was awarded a ‘Commander Joint Operations Commendation’ by the Department of Defence. Hayden Marshall, Group Captain, Director Logistics Plans, HQ Joint Operations Command said Julie had consistently displayed a professional approach to her duties and demonstrated a willingness to deliver high quality results and advice in a time critical environment, “Your achievements are of the highest order and in keeping of the finest traditions of the Royal Australian Engineers, the Australian Army and the Australian Defence Force.”

Young engineers shine

Claire Dixon has won the Australian Water Association’s Young Water Professional of the Year Award for Victoria. The judges were impressed with her involvement with Engineers Without Borders, World Vision in Cambodia and leadership of Indigenous initiatives, including a recent cultural heritage walking tour.
Sustainability advice

Howard LaFever, a member of our Cazenovia office, has been appointed to the nine-member board of directors of the newly formed Institute for Sustainable Infrastructure in the USA. The independent, non-profit organisation was formed by the American Public Works Association, the American Society of Civil Engineers and the American Council of Engineering Companies to create a sustainable infrastructure project rating system and certification program to enhance the sustainability of the nation’s non-building infrastructure. With 41 years’ of engineering experience, Howard is a well-respected Board Certified Environmental Engineer with specialty certification in Environmental Sustainability as well as Water and Wastewater.

Concrete knowledge

Peter Dove, a Senior Materials Consultant with our Materials Technology Group has won the 2010 Australasian Corrosion Association David Whitby Review Paper Award for his paper on standards for application of protective coatings to concrete structures.

Chile-Australia connection

Kylie Chick from our Santiago office was recently appointed Vice-President of the Chile-Australia Chamber of Commerce (Auscham), an organisation that seeks to promote trade and investment between Chile and Australia.

Environmental award

Sandy Tripp, one of our senior project managers in the USA, has been named the 2011 recipient of the Stanley E. Kappe Award from the American Academy of Environmental Engineers. The award is presented to a Board Certified Environmental Engineer to recognise the performance of extraordinary and outstanding service. Sandy is a registered Professional Engineer in Massachusetts, North Carolina, South Carolina, and Maryland. She is an active member of several professional organisations, including the Water Environment Federation and the American Water Works Association. She has 29 years of engineering experience and has served as project manager/lead engineer on numerous municipal water and wastewater projects.

Nurturing future talent

Our Newcastle office supported the 2010 Grand National Science and Engineering Challenge which was hosted by The Rotary Club of Gosford and The University of Newcastle. This year marked the 10th year anniversary of the Challenge which is designed to inspire students to study science and engineering at a senior level. The Challenge takes the students out of the classroom and gives them a day of fun, teamwork and discovery. GHD sponsored the bridge building activity that uses a standard test rig to deliver a dynamic load.
Is the weather changing?

Our climate is, and has always been, variable. While we cannot accurately predict future climate, it is fair to say that we can expect more volatile conditions. Recognised as having one of the most variable climates, Australia provides some valuable insights to other countries facing more intense and more frequent extreme weather events.

Bruce Harper, GHD’s Service Line Leader for Climate Change says, “We know that as temperatures continue to rise, the variability of our climate will be greater. For example we can expect droughts to be longer, more widespread and severe. And, rain is likely to be more intense as a result of a higher concentration of water in the atmosphere.”

Long term trends and natural weather patterns

Since 1900 precipitation has increased in eastern parts of North and South America, northern Europe and northern and central Asia. Drying has been observed in the Sahel, the Mediterranean, southern Africa and parts of southern Asia. Since 1950, eastern and south-western Australia have become significantly dryer. These long-term global climatic trends are occurring alongside weather variations that take place naturally such as the El Niño and La Niña weather patterns.

Bruce says, “Climate variability over relatively short timescales can strongly influence annual risks of strong winds, storm tide and flooding away from the derived long-term averages that are typically used for design of buildings and related infrastructure. Climate change may further exacerbate these risks.”

When considering weather trends, it is useful to examine the El Niño and La Niña activities. The black line in Figure 1 depicts the variation in the Southern Oscillation Index (SOI) since 1970, which is one of the measures used to describe the El Niño - Southern Oscillation (ENSO) phenomenon in the Pacific Ocean. While the relative number of El Niño and La Niña episodes over the past 120 years is similar, there has been a much higher occurrence of El Niño events since 1977. This has produced persistent drought over much of Australia and an absence of tropical cyclones. However, since 2008, La Niña has made a strong return, resulting in record rainfalls and flooding over much of eastern Australia.

The blue line in the graph is the accumulated value of the SOI since 1970. It indicates an initial rise to around 1977 due to the dominance of La Niña, followed by a steady fall to 2008 as El Niño exerts control. Since 2008, it suggests a possible return to La Niña dominance. This 40 year variability is consistent with the Pacific Decadal Oscillation (PDO), which together with ENSO may indicate a return to the wet and windy periods experienced in the 1970s. This means, stronger than normal winds may cause ocean temperatures to rise above average, thereby increasing the risk of cyclone and storm tides, particularly on the Queensland coast of Australia.

How does a storm tide occur?

The basic components of a storm tide are depicted in Figure 2 shown overleaf. It occurs when the extreme winds associated with a severe weather event such as a tropical cyclone, typhoon or hurricane act to create large-scale currents that interact with the coastal and continental shelf landforms. This ‘storm surge’ can raise the normally expected tidal water level along shallow coasts over periods of several hours, typically peaking at around the time the storm system makes landfall. At the same time, ocean surface waves are also being generated and can ride atop the combined tide and surge components.

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1 The SOI compares differences in the mean monthly sea level pressure between Darwin and Tahiti. It has been shown to be a strong indicator of rainfall and tropical cyclone activity in eastern Australia, which is directly related to ENSO.
reaching elevations not normally expected and creating severe erosion or structural damage. When the waves break on an exposed beach, a further localised increase in water level can also occur due to the expended wave momentum. The ‘storm tide’ is then the absolute vertical level reached by the tide, plus the storm surge and the wave setup. In addition, individual broken waves can intermittently reach higher levels through wave runup.

“Storm tides represent the greatest threat to life and property in low-lying or densely-populated communities over much of the tropical regions of the globe,” says Bruce. “A recent example of a storm tide event is in New Orleans resulting from Hurricane Katrina. In the future, potential increases in sea level and the peak intensity of tropical cyclones will further exacerbate risks in many areas.”

Climate variability - a reality

The extreme events we have experienced around the world in the past few years demonstrate the uncertainty of climate and the devastating impacts on communities and ecosystems.

“In light of this, strategies are clearly needed to adapt to enhanced climate variability,” says Ross Fryar, GHD’s Business Leader, Water and Environment. “Whilst we cannot completely climate proof our infrastructure, we can do a lot to better understand the risks we face - to define our accepted level of tolerance, and to plan accordingly. Certainly we can enhance our resilience, and where appropriate, build our capacity to cope with such uncertainty. We have to remember, that it is the extremes that impact us the most.”

The economics of variability

The Centre for Climate Change Economics and Policy in the UK believes that ‘climate change and its potential impacts are increasingly accepted, but economic, social and political systems have been slow to respond’. The Centre advocates the need to improve our understanding of climatic variability, so as to help private and public policy makers manage the risks and uncertainties of climate change policy and balance investments in adaptation and mitigation.

Figure 3 provides a summary of the economic impact of recent extreme events.

**Figure 3: Cost of extreme events**

<table>
<thead>
<tr>
<th>Date</th>
<th>Natural Disaster</th>
<th>Economic Cost (Billion US)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>Japanese Tsunami</td>
<td>$200 - 300</td>
</tr>
<tr>
<td>2011</td>
<td>Christchurch Earthquake</td>
<td>$15</td>
</tr>
<tr>
<td>2011</td>
<td>Queensland Floods and Cyclone Yasi</td>
<td>$9</td>
</tr>
<tr>
<td>2009</td>
<td>Victorian Floods and Cyclone Yasi</td>
<td>$1.2</td>
</tr>
<tr>
<td>2006/7</td>
<td>Australian Drought</td>
<td>$75</td>
</tr>
<tr>
<td>2006</td>
<td>Cyclone Larry</td>
<td>$5.8</td>
</tr>
<tr>
<td>2005</td>
<td>Hurricane Katrina</td>
<td>$81</td>
</tr>
<tr>
<td>2004</td>
<td>Indian Ocean Tsunami</td>
<td>$14</td>
</tr>
<tr>
<td>1995</td>
<td>Kobe Earthquake</td>
<td>$200</td>
</tr>
<tr>
<td>1974</td>
<td>Cyclone Tracy</td>
<td>$3.7</td>
</tr>
<tr>
<td>1974</td>
<td>Brisbane Floods</td>
<td>$2.1</td>
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* Figures compiled from a range of sources in the public domain.

Faced with one of the most variable climates on earth, Australia provides some great lessons in having to adapt and deal with extreme events. “A good example is the way the country has adapted to extreme droughts,” explains GHD Economist David Edwards. “As well as investing some AUD30 billion in infrastructure to enhance water supply security, it has implemented some excellent demand management initiatives making the country much more resilient to the economic impacts of future drought.”

Risk - the forgotten issue

The recent devastating floods in Queensland, where an area equivalent to the combined size of France and Germany was flooded, put the spotlight on the importance of risk management.

“Typically, the areas that experienced flooding are known flood areas,” explains Ross. However, ongoing urban development over many decades and the burgeoning density of developments means that increasing numbers of people have now been exposed to flood impacts in 2011.

“In many ways, this shows us that society still does not have a good understanding of risk. For example, if you build in a floodplain or along the coast and there is the possibility of a one in 100 year flood, your chances of being flooded in any one year is one percent. However, over the life of your mortgage, your risk increases. That is, the longer you have your home or business in a floodplain area, the more likely that you will be affected by any given event over that period. The question is - are you prepared to accept that risk - bearing in mind that just because you had a flood incident this year, it doesn’t mean you won’t have another one for 100 years, or if you haven’t experienced a flood in the past, it doesn’t mean you won’t tomorrow?"
What risk is society prepared to accept?

In our everyday activities, we accept some level of risk, be it crossing the road, driving the car to work, or making a business decision. We do this intuitively based on our experience, and are prepared to accept the consequences. When it comes to accepting risk for other people, communities and the environment the decision process is much more complex. Figure 4 illustrates this point. It shows the minimum safety levels our regulators have set for different public assets and activities. For example, the Australian National Committee on Large Dams (ANCOLD) set relatively stringent criteria for dam failure because the consequences can be so catastrophic.

Figure 4: Societal risk

Today, many authorities are strengthening their assets to provide a higher level of security. In the case of New Orleans, the flood levees were designed for a one in 50 to 150 year event. However, they were not sufficient to hold back the Hurricane Katrina storm tide event. Significant capital is now being spent to improve the level of security. Japan had a similar experience recently. Several of the impacted towns had walls designed to cope with tsunamis but these were not enough to cope with the event of March 11, 2011.

Paul De Mar, one of GHD’s Bushfire management professionals says there are five key steps in the risk management process. “Put simply, you need to establish the context, then identify, analyse, evaluate and treat the risks.

“In a risk management sense, communities, businesses and governments respond to a range of pressures, of which climatic factors are just one element. As climate variability is not something we can control, it may be useful to focus on reducing the pressure on our planning activities arising from ‘controllable risk factors’.”

Building climate resilience into infrastructure

Having spoken about the need for greater risk management, much can still be done to minimise the impacts of climate variability.

“I believe we need a portfolio-based approach to tackle this challenge,” says Ross. “Land use planning, engineering, design and modelling all have a huge role to play in building climate resilience into vulnerable infrastructure - including water, sewerage, transportation networks, energy supply, buildings and communication systems. We need to couple this with an understanding of risk, and the costs of dealing with that risk.”

Land use planning

Tim Fallaw, GHD’s Leader for Planning says that limiting development in vulnerable areas is the preferred position, but it is not always realistic, particularly for existing assets. He says, “This brings into focus the appropriateness of where we build. In the past, we located our main trading centres near ports and rivers. These are the vibrant global cities of today, which are inevitably located in flood plains or in areas prone to storm surges. The issue is that we have built up infrastructure in these areas, which we know is at risk from future extreme weather events.

“For existing assets, we need to mitigate risks through the most appropriate selection of strategies such as flood levees, dykes or bunds, and adaptation of buildings so that for example, they can flood without essential services being affected. For new developments, we need to leverage modelling and map vulnerable areas, so we can align planning regulations with proposed developments. Finally, we need to re-assess building standards and be sure that we are using suitable materials for the appropriate level of risk.”

In the context of this article, it is appropriate to revisit how risk is incorporated into land use planning. Ross says, “With most settlements deliberately located near water, there is a continued exposure to flood events. In more recent decades, the practice has been to adopt a defined flood level, typically based on a return interval (e.g. the one in 100 year event). However, this typically takes no account of the risk that may arise if that event, or a larger one, were to occur. In some areas, the difference between a one in 50, one in 100, or one in 200 years event may be negligible. In other locations, the larger event could result in water levels being several metres higher. Whilst the same standard may have been applied to both locations, the consequences are significantly different. Therefore, it is appropriate that land use planning is undertaken using a hazard based approach (for example, the joint consideration of velocity and water depth in a floodplain),
that considers what happens when the design standard is exceeded. That is, the design standard itself needs to be challenged from a risk perspective, and set according to the risk/consequence for each locality.

Resilient infrastructure

The recent natural disasters seen around the world highlight the need for engineers, planners, architects and scientists to make infrastructure more resilient.

Bruce says that the experience of such hazards is valuable for the profession. “It enables us to go back to the drawing board and sharpen our pencils. It forces us to re-examine the way we have been doing business and ask the hard questions - Are we sure that designing only for a one in 100 year flood is appropriate? Should we consider building to Category five cyclone conditions in coastal areas?

Looking at water infrastructure, Chris Hertle, GHD’s Global Leader, Water says, “For water supply, resilience is about minimising your dependence on a particular climatic regime and it is also a question of balance. Essentially you want to achieve a reliable water supply, irrespective of what the climate is doing. Preferably, this means a combination of demand reduction, dams, desalination, stormwater harvesting and water recycling.”

Paul Morris, GHD’s Leader for Property & Buildings says that from a design perspective, we continue to push the boundaries of our built environment. “Today we have structures that are more resilient, durable and sustainable than in the past. This trend will certainly continue in alignment with dynamic building codes and environmental guidelines. In the future, modelling technology will be increasingly used to assess a structure’s immunity to extreme weather events.”

Learning from China

China is one country that is dealing proactively with flood and drought events. In a historical sense, the country has suffered greatly from such events and has developed some sophisticated warning systems to mitigate risks.

Qing Ping Zhu, GHD’s General Manager for Water in China says that the country has changed the way it deals with floods and droughts - transitioning from emergency response to a risk management approach.

He says, “To enable this shift, a flood and drought management strategy framework has been adopted, based around a risk assessment modelling mechanism that informs and supports further actions. It involves an integrated system of monitoring, predicting and modelling of climatic influences on water resources coupled with demand management for water conservation and community education programs.

“Known as the National Master Plan for Water Management in China, this integrated strategy (to be released in 2011) covers flood and drought management, soil and water conservation and information technology systems for the entire country. GHD helped produce this plan and we continue to work closely with the Chinese Ministry of Water Resources to reduce the future impact of floods and droughts.”

Qing Ping believes the rest of the world can leverage China’s experience. He says, “We have learned some great lessons in dealing with natural disasters. We know that the principal elements in mitigating risks include resilient infrastructure, good planning, and effective monitoring systems.”

Looking to the future

In conclusion, an improved understanding of climate risk and the application of appropriate management techniques will be crucial to enhancing our ability to deal with extreme weather events.

Key take-aways

- Put climate change into perspective - think about the risk of increasing climate variability
- Better understand current risk - define your accepted level of tolerance and plan accordingly
- Be prepared - build climate resilience into vulnerable infrastructure and have emergency response plans in place
- Consider best practice - learn from the experiences of Australia and China

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