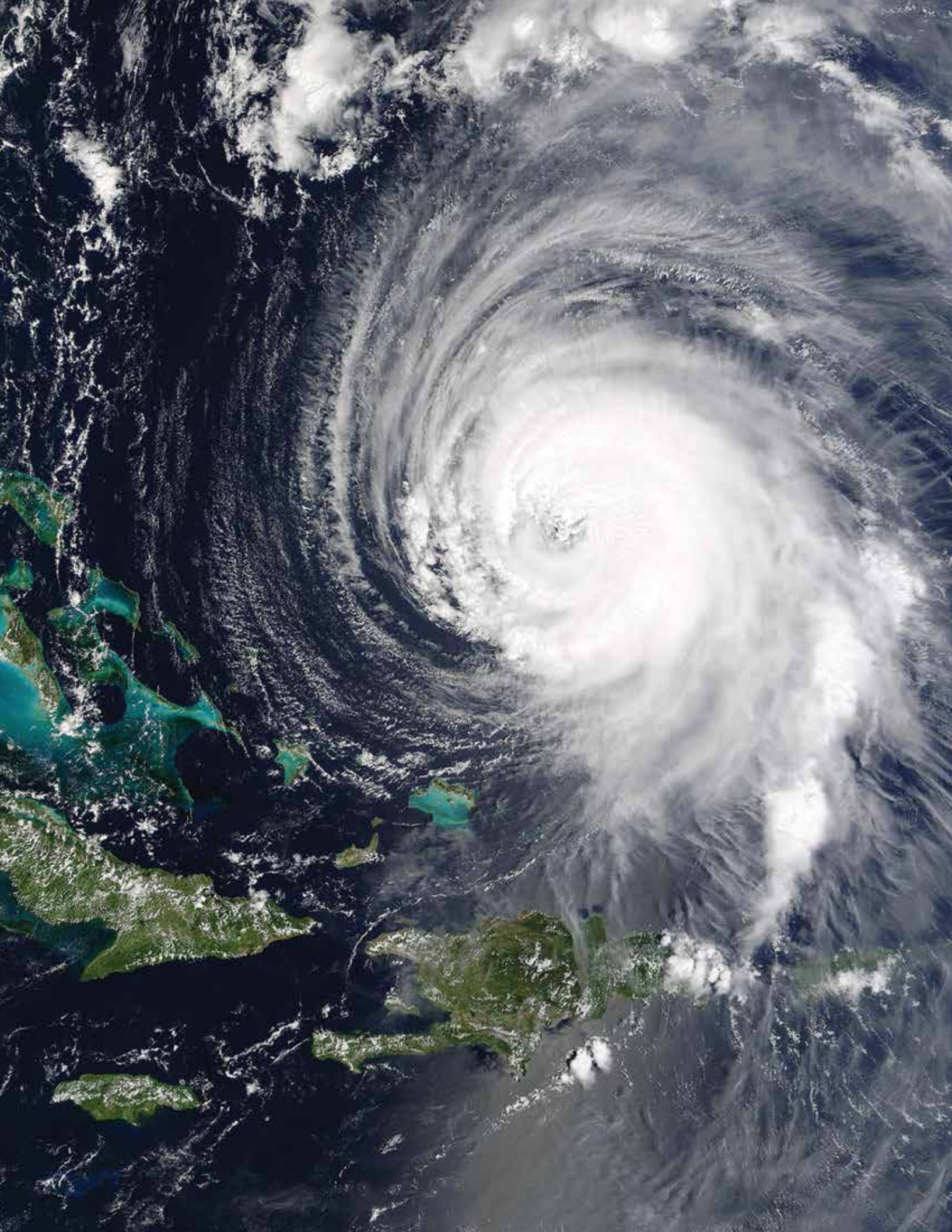
Solutions for Urban Flood Management

XYLEM'S CONTRIBUTION TO URBAN RESILIENCE

ISSUE NO. 1

xylem
Let's Solve Water



Letter from Xylem's President and CEO

Cities all around the world regularly confront natural disasters that threaten human lives, livelihoods and the natural environment upon which we all depend. In a world where many cities are growing rapidly and facing increasing exposure to water scarcity, changes in weather patterns, and other risks, today's municipal leaders have to work harder than ever to make their cities more resilient.

Fortunately, city leaders do not stand alone. It is now widely accepted, including as part of the United Nations' Hyogo Framework for Action, that the private sector has an essential part to play in disaster risk reduction. Companies like Xylem are working to help communities anticipate, prepare for, respond to, and recover from natural disasters, and to ensure continuity of basic services, no matter the circumstances.

Xylem is a global water technology company with almost $4 billion in annual sales, operating in more than 150 countries around the world. We are a trusted provider of innovative and reliable technologies that help to manage water sustainably across its entire cycle – from the headwaters of rivers to cities and farms and back to the oceans. Our tagline, "Let's Solve Water," points to our commitment to addressing the world's most pressing water challenges through partnership and collaboration. We work with partners including government agencies, municipalities, industry, universities and NGO's to deliver solutions that protect our cities against a volatile and uncertain future.

We believe increasing the resilience of urban areas is one of the most complex challenges facing public leaders around the world. Cities account for the majority of the world's population and much of the world's economic activity and this growing concentration in both areas means that they are acutely exposed to natural disaster risk. Moreover, many of the world's most destructive natural disasters involve water, whether through flooding (too much water in the wrong places); drought (not enough water in the right places); or contamination (unusable or hazardous water). These phenomena threaten human lives, endanger property and livelihoods, and inflict environmental damage. And in any disaster, natural or otherwise, ensuring the supply of clean and safe drinking water to affected populations can become an urgent challenge.

This paper provides real-life examples of products, services, and solutions that Xylem offers as part of our contribution to building urban resilience, with a particular focus on helping cities manage flood risk. But it is really intended to be a conversation starter. We are here to listen and participate in discussion, and we stand ready to share our global experience with leaders around the world as they seek to build more resilient and sustainable cities.

Patrick K. Decker
President and CEO
Xylem Inc.

Building urban flood resilience with innovative water technologies and business models

Flooding is one of the most universal – and destructive – challenges facing cities around the world. World Bank research suggests that floods are the most frequent of all natural disasters and that the number of flood events is rising rapidly. In 2010 alone, 178 million people were affected by floods, with losses exceeding $40 billion.

When it comes to managing flood risk, there is no substitute for effective urban planning and strong community engagement. But there is also an important role for technology and the private sector. Private companies are important partners that can bring new approaches, know-how, and "surge capacity" to help cities anticipate and address the complex realities of urban flooding. Xylem's innovative technologies and business models help cities minimize and recover from flood losses by supporting early warning systems, 24/7 disaster response, and resilience planning for the future.

Early Warning Systems

Early warning systems increase urban resilience by providing valuable lead time to prepare communities for incoming problems. City managers and community leaders can use this lead time to implement disaster plans to reduce vulnerability and minimize expected losses. When it comes to flood risks, real-time information on precipitation and water quality, water levels, and flow rates can not only reduce economic losses – it can literally save lives.

Xylem's Analytics business provides intelligent sensors, platforms and systems to measure water quality, level and flow. These technologies can be deployed in oceans, coastal zones, rivers, reservoirs and other surface water bodies to provide real-time information on environmental conditions. For example, Xylem's Flood Alert Kits, built around YSI® family of sensors and communications protocols, have been used by all major U.S. government monitoring agencies, including the U.S. Geological Survey and the U.S. Army Corps of Engineers, to monitor conditions that can lead to urban flooding.

Xylem also provides important technical advice and services to help cities implement new tools and technologies. Our teams work with partners to integrate, install, and maintain systems that can measure and transmit information on water levels, precipitation, and discharge rates in real time, providing city managers and emergency responders with actionable "resource intelligence" to guide decision-making and increase resilience during and after flooding events.

CASE STUDY 1

Monitoring the Onset of Hurricane Sandy

When Hurricane Sandy slammed into the Mid-Atlantic and Northeastern United States in late October 2012, disaster management experts were able to track the hurricane's impact in real time – without putting people in harm's way. This was possible because response crews all along the Atlantic seaboard could rely on field monitoring stations – equipped with Xylem's sensor instruments – that were in place before, during, and after the storm.

In coastal Delaware, Xylem instruments are used as part of an ongoing marsh and water-monitoring cooperative project between the U.S. Fish and Wildlife Service and the Delaware Department of Natural Resources and Environmental Control. During Hurricane Sandy, the project team watched the instrument readings closely to measure the impact of the "superstorm" on water levels in low-lying populated areas.

Throughout the storm, real-time data were transmitted from our YSI multiparameter sondes to the web, using our YSI EcoNet monitoring system. The data showed water levels in the area drastically increasing between three and four feet as Sandy made landfall, causing severe flooding and erosion to shorelines and roadways.

In Delaware Bay, several Waterlog bubbler systems from Xylem helped the National Oceanic and Atmospheric Administration record storm surge water levels at their Physical Oceanographic Real-Time System stations. The stations recorded storm surges that were anywhere from four to six feet higher than predicted water levels. Many homeowners in coastal Delaware relied on real-time data from YSI's EcoNet monitoring system to warn them to flee before rising flood waters covered roads and stranded them.

Similar systems in Virginia and Maryland verified that Sandy's impact was not severe, because winds from the west pushed most of the water offshore, sparing these states from the massive flooding that occurred elsewhere.

Aftermath of Hurricane Sandy's floodwaters

Shimen Reservoir, Taiwan

CASE STUDY 2

Shimen Reservoir, Taiwan

Typhoons regularly strike the mountains around the Shimen reservoir. Rapid floodwaters can wash millions of tons of sediment into a critical water source for the people of Taiwan – with potentially catastrophic consequences.

In 2004, Typhoon Ailii unleashed 20 million tons of sediment and debris from the surrounding mountains into the reservoir. Sediments travel in subsurface plumes that can quickly overwhelm a dam's water treatment facility. The sediments from Typhoon Ailii's floodwaters choked the reservoir's water treatment plant, cutting off water supply for days to thousands of households downstream and forcing residents to rely on water trucked in by the Taiwan Water Supply Corporation.

The next year, before the 2005 typhoon season, Taiwan's Water Resources Agency deployed unmanned YSI Vertical Profiling Systems to measure water quality. These sensors report turbidity, chlorophyll, pH, and dissolved oxygen readings every five meters from surface to bottom, every three hours. When turbidity reaches critical levels, the sensors trigger an emergency plan at the water treatment plant, enabling operators to respond.

Advance warning enables decision-makers to choose from a number of management options. For example, based on sensor readings, decision-makers can choose to accelerate the fill-up of the storage pond immediately above the water treatment plant before sediment plumes reach the intake. Or they can close any of the plant's five water intakes and open others to draw in waters from clearer levels in the water column and avoid a turbidity plume. Alternatively, they can draw water into the plant from a backup source in a nearby river. Real-time intelligence enables real-time response that can prevent costly infrastructure failures with real downstream effects.

The chlorophyll and dissolved oxygen sensors could someday also be used to track the movement of algae in the reservoir, protecting the lake's carp fishery by helping management prevent anoxic events.

Disaster Response

When storms strike, flooding can be immediate, disruptive, destructive, and even fatal. To cope with the onset of water pouring into streets, homes, commercial buildings and subway tunnels, cities need resilient drainage systems powered by reliable and powerful pumps. They also need 24/7 drainage assistance to "dewater" flooded areas quickly during and after the crisis.

Xylem offers innovative technologies and business models designed to help cities control the flow of water through drainage networks and remove stormwater from flooded areas. Xylem's monitoring and control technologies, for example, provide real-time situational awareness and control of wastewater networks, allowing city managers to manage capacity through lift station networks and lower the probability of dangerous sewer overflows.

Xylem's dewatering and flow control businesses provide products and services that can quickly remove water from flooded areas to promote public safety and minimize damage. For example, our rental business model enables cities to contract for emergency, 24/7 dewatering services – allowing them to avoid capital expenditure on dewatering equipment while securing access to vital flood control services in times of crisis.

Xylem's dewatering pump products are designed to work in any environment on a range of power sources, including gas, diesel, and in some cases, even car batteries to ensure resilience even in the event of power failure. And Xylem's dewatering smartphone application allows cities to locate the nearest Xylem service provider and calculate requirements based on friction loss, pressure, power and flow conversion coefficients.

Godwin pumps dewatered approximately 30,000 cubic meters of water in Buenos Aires

CASE STUDY 1

Dewatering Argentina's Cities After a Massive Storm

A massive rainstorm swept through Buenos Aires Province on April 1, 2013, causing flash floods and extensive flooding that swept away cars and killed at least 60 people. In the province's capital of La Plata, 40 centimeters (16 inches) of rain fell in just two hours, overwhelming drainage systems and flooding some homes up to their roofs. The Argentine government called the storm an "unprecedented catastrophe." More than 3,000 people were evacuated from their homes during the storm, and tens of thousands were left without electricity.

The downpour also caused a power outage and fire at Ensenada Station, Argentina's largest oil refinery, operated by YPF. President and CEO of YPF Miguel Galuccio said in a press conference that while the plant's drainage systems could process and properly dispose of 95,000 cubic meters of rainfall in six hours, the April 2013 storm flooded the plant with 315,000 cubic meters of water, well beyond its capacity. Stormwater rose to 1.7 meters (almost 6 feet) in some areas of the plant.

During and following the storm, Buenos Aires city officials and private customers contacted Xylem for help in removing floodwater from buildings, underground parking lots, and supermarkets. A staff of six people from Xylem's Rental & Aftermarket division provided 24-hour service throughout the entire crisis.

"Our Godwin pumps dewatered approximately 30,000 cubic meters of water in Buenos Aires city," says Osvaldo Greco, Managing Director at Xylem Water Solutions Argentina. "In the flooded neighborhood of Barrio Privado San Andrés, Tigre, the operational flow was 29,000 cubic meters, and in Pasionaria, San Isidro, our Flygt equipment transported water amounting to 9,000 cubic meters."

Xylem was also called in to dewater the Ensenada oil refinery in La Plata. "We drained 4,000 cubic meters from the refinery's pump house and 205,000 cubic meters from the streets and area around the plant," says Gustavo Ortega, Head of Aftermarket and Rental. "We began our technical assistance at the plant on April 2nd and finalized our work on April 4th, though our equipment continued to operate after that. Overall, we have learned a lot from this experience and have now formed a crisis committee for these kinds of emergencies."

CASE STUDY 2

Hurricane Sandy

The devastating impact of Hurricane Sandy on New York City and the northeast U.S. surprised some people, but the people at Xylem were not among them. Xylem's dedicated water professionals stood ready to fight the surging seawaters and torrential rainfall that threatened thousands of homes and commercial properties in Sandy's path.

As early warning systems began to predict Sandy's path, Mike Delzingaro, Vice President of Xylem's Godwin dewatering business and his entire team sprang into action. They spent the days leading up to the hurricane gathering hundreds of powerful Godwin brand dewatering pumps from all across the country and pre-positioning them in Xylem branch locations and distribution sites near the hurricane's projected path.

"We have a lot of experience with tough storms like this," said Delzingaro. "We think of ourselves as the 'fourth emergency service' – 24/7 rapid reaction is part of our culture and our commitment to our customers."

As this "super storm" raged across the region on October 29 and 30, 2012, causing massive flooding and power outages, hundreds of Godwin brand Dri-Prime© and hydraulic submersible pumps were deployed to customers who needed to move massive amounts of water without any available electricity. Distributors of Xylem's Flygt brand submersible pumps prepared to help customers, as well. "For us, it's not just about selling or renting pumps," said Andrew Jones, VP of Xylem's global dewatering business. "We have a mission to help people stay safe and dry and we will install, maintain, service, and provide valued engineering advice to ensure that when the flooding comes, our customers are ready."

Xylem's dewatering pumps are made for various applications, including large-scale emergency and on-the-move projects. They are portable, capable of moving lots of water quickly and can be rented or purchased as required. In addition, they feature the breakthrough Godwin Dri-Prime capability that provides automatic self-priming so operators don't have to fill the pumps with water manually.

From the World Trade Center site in New York City to a refinery in New Jersey, to numerous wastewater treatment plants and other flooded locations throughout the Northeast, customers used the pumps to minimize – or eliminate – flood damage at their operations.

One customer, a major wastewater treatment plant, was swamped by the storm surge and out of commission due to flooding. Xylem provided technical support along with diesel-driven hydraulic submersible pumps, centrifugal pumps and electric submersible pumps driven by generators, to dewater the plant that was four feet (1.2 meters) under water. Since completing the dewatering process, Xylem has continued to supply back-up equipment to ensure that the plant is protected from future storms or floods.

Xylem also moved quickly to ensure that homeowners and small businesses had the pumps they needed to recover in the wake of Hurricane Sandy. Pump distributors throughout the Northeast were supplied with excess inventory of Bell & Gossett and Goulds Water Technology branded sump pumps that could be used once power was restored to remove flood waters from basements and other low-lying structures.

Where power wasn't restored for days, customers used our Evacuator Series of dewatering pumps, which run on DC batteries and are capable of moving anywhere from 2000 to 8000 gallons of water per hour depending on the model. Xylem donated a number of Evacuator units to the affected communities, focusing on specific locations where they were best used.

Xylem launched a website with helpful information on how to recover from a flood at http://www.getwaterout.com.

"At Xylem, our goal is to solve water – and that's especially important in emergency situations like this one," says Ken Napolitano, president of Xylem's Applied Water Systems business. After Sandy slammed into the U.S., everyone with a flooded factory or wet basement was looking for solutions. Through the quick actions of our employees and our distribution network, plus an industry-leading dewatering product portfolio, we were able to provide the right type of solutions for thousands of people."

Hurricane Sandy flooded streets of New York City, NY

Planning for Resilience

The best time to build resilience to a natural disaster is before it strikes. As cities learn from past disasters, Xylem works with urban planners and community leaders to build both the physical and social infrastructure needed to reduce future risk exposure and create more resilient cities. Physical infrastructure includes solutions ranging from backup dewatering stations that can survive power outages to stormwater pumping solutions that can reduce the risk of overflows. Social infrastructure includes disaster planning, capacity-building and training that can help communities mobilize in the event of disasters. Both are critically important elements of an urban resilience strategy.

CASE STUDY 1

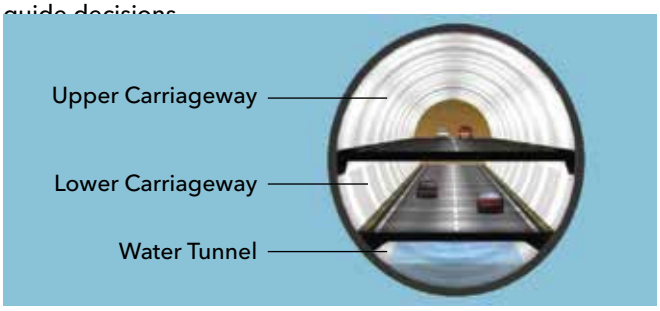
SMART Urban Development in Kuala Lumpur

Located at the confluence of the Klang and Gombak rivers, the area around Kuala Lumpur is prone to serious flooding. As the city continues to develop, growth has placed additional pressure on its drainage system's ability to cope with flash floods. Between 2000 and 2003, the city experienced devastating floodwater damage.

In 2004, the SMART project was initiated as a solution to control stormwater. Kuala Lumpur would divert stormwater before it entered the city center by constructing a 9.7-kilometer long tunnel, which could hold up to 1.0 million cubic-meters of water. The water could then be released into the river downstream from the city to prevent flooding. One of the most innovative features of the tunnel was that it included a three-kilometer "double-decker" motorway. During drier periods, vehicles could use the SMART tunnel motorway, thus relieving traffic on the city's main highways.

This US $600-million project included several elements: a holding basin with a floodwater storage capacity of 600,000 cubic meters, a reservoir with a capacity of 1.4 million cubic meters, and the bypass tunnel. It also included a control center for managing, operating and maintaining the SMART system.

Sensors form an important part of the SMART system, providing information that control center operators need to manage the innovative tunnel and motorway system. The SMART system uses 16 of Xylem's SonTek brand Argonaut acoustic Doppler current meters, positioned at specific heights in the water, to offer real-time data on water level and velocity. As river levels rise, the SMART control center uses water level and velocity information flowing from Xylem's Argonaut Doppler units to guide decisions.



A diagram of the SMART system

To handle large volumes of water in extreme storms, pumps also have a huge role to play – as in any project involving floodwater control. In the SMART project, 23 pump stations were installed, to ensure that all floodwater in the tunnel could be dewatered within 24 hours. To power these stations, the SMART project reviewed a vast array of pump offerings from multiple manufacturers and selected 76 of Xylem's Flygt pumps due to their superior performance and quality.

"Flygt has a proven track record, with many successful installations in irrigation and flood control applications," says Koon Sing Low, Director of SMART. "That, combined with their competent technical support and after sales service, and our close relationship via frequent in-house trainings and seminars, is why we chose them for this project."

The main pumps were installed right next to the tunnel gate, where strong turbulent flow was expected as the floodwater hit against the tunnel gate, so the strength and efficiency of these pumps was crucial. Before starting the project, Xylem did several calculations to minimize power requirements. "We were told that our client was able to downsize the generator setup by 1000 KVA with our assistance," says William Choong, Transport Business Unit Manager in Malaysia who was involved in the SMART contract.

The SMART project was successfully tested and commissioned in late 2007 and to date has prevented the city of Kuala Lumpur from further serious flooding. The project was a novel example of a public-private partnership to improve the functionality and affordability of resilient urban water systems and was recognized with considerable media coverage and several international engineering awards. The National Geographic Channel dedicated an episode of its "Megastructures" series to the SMART system.

"The key to success was careful planning, design and implementation, plus selecting the best construction method and equipment which also come with local expertise support," says SMART Director Koon Sing Low.

Other cities that face similar flooding issues such as Singapore and Jakarta have also visited the SMART tunnel to investigate a similar project back home.

"Since the success of the SMART project, we've received many orders from other flood mitigation projects across Malaysia," concludes Choong. "This has confirmed our position as the market leader in flood mitigation projects."

CASE STUDY 2

Community Education in Atlantico, Colombia

After torrential flooding in December 2010 and January 2011, nearly 90% of the southern area of the Department of Atlántico in Colombia was submerged by water; in some places, water reached the rooftops. It took three months for the water to recede and for residents to begin slowly trickling back to their homes. Now more than a year later, some families are still reluctant to return.

Mercy Corps, one of Xylem's partner NGOs, is helping those who returned to prepare for future disasters. One of the methods being employed is a flood simulation. As part of a water-related disaster risk reduction initiative (DRRI-Water), funded by Xylem Watermark, the company's global corporate citizenship and social investment program, Mercy Corps trained and organized a group of community leaders, collectively referred to as ECOPAD ("Equipos Comunitarios para la Prevención y Atención de Desastre") to work with the community on emergency response and prevention.

ECOPAD members participated in extensive disaster risk reduction trainings, and then went door to door talking with families about how to prepare for emergencies and why it matters. The group has helped community members develop emergency plans and emergency kits, consisting of important documents, such as birth certificates, diplomas, and identification, as well as medicine, flashlights, and a change of clothes. The first community to enact a full-scale disaster simulation was Candelária. ECOPAD worked tirelessly to prepare residents, many of whom are refugees still living in makeshift housing, as their original homes remain uninhabitable.

Energy was high on a Friday morning in anticipation of the flood simulation. When the whistle blew, sounding the call to start the evacuation, residents gathered their emergency kits and walked calmly from their homes to the assigned meeting point on higher ground across the highway. When everyone had reached the meeting point and was accounted for, members of ECOPAD thanked everyone for coming and after a round of applause, instructed everyone to return home just as calmly and in the orderly way that they had come.

One participant remarked on the way back, "This exercise has educated us and prepared us for an eventual disaster should it come." The feeling of preparedness from the mock exercise helped reassure the community residents that they are now ready for whatever the future may bring.

Colombia is one of six countries included in the DRRI-Water projects being implemented by Mercy Corps with funding from Xylem Watermark. The program in Colombia is expected to benefit over 55,000 people. Other DRRI-Water projects are underway in China, Ethiopia, Indonesia, Nepal and Tajikistan.

Atlantico, Colombia

Working Together

City leaders around the world have made it clear that they are stepping up to increase urban resilience – and that they need partners in civil society and the private sector to contribute to the effort. Together we recognize that building resilience is a large and complex challenge that will require collaboration to share experiences, expertise, and knowledge about how to reduce vulnerability and accelerate recovery.

Xylem is proud to step forward to answer the call. Our work on urban resilience covers the world – from Buenos Aires to Kuala Lumpur to the subway tunnels of New York City. Xylem has more than 12,700 employees, an unparalleled breadth of leading water-related technologies, a global footprint, more than 100 years in the water business, and a commitment to solve the world's most pressing water challenges. We welcome the opportunity to bring our collective experience and technical expertise to even more cities. For further information, please contact: urbanresilience@xyleminc.com.

Xylem |'zīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We're more than 12,700 people unified in a common purpose: creating innovative solutions to meet our world's water needs. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. We move, treat, analyze, and return water to the environment, and we help people use water efficiently, in their homes, buildings, factories and farms. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise, backed by a legacy of innovation.

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For more information on how Xylem can help you, go to www.xyleminc.com.

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