# world water

Volume 41 / Issue 1
January / February 2018




# Strategic Directions Report:
## Achieving sustainable water systems

Water Environment Federation
the water quality people®

A Supporting Publication of
weftec®
the water quality event™

Published by

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VA 22314-1994, USA
www.wef.org

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**Subscription rates**
1 Year: UK and Rest of the World £150



World Water is published bi-monthly by WEF and distributed in the USA by Asendia USA, 701 Ashland Ave, Folcroft PA. Periodicals postage paid at Philadelphia, PA and additional mailing offices. POSTMASTER: send address changes to World Water, 701 Ashland Ave, Folcroft PA 19032

ISSN 1354-313X / USPS No: 024-544

**Design and Repro** www.j-graphicdesign.co.uk

**Printed by** Buxton Press Ltd, Buxton, Derbyshire UK





# In this issue

## Features



*Cover image:* The Silicon Valley Advanced Water Purification Center (SVAWPC) is the result of a regional approach and cooperative effort between the Santa Clara Valley Water District and San José, California, to recover and purify water for multiple reuse applications. *Photo by:* Black & Veatch

## Regulars



## Editorial Advisory Board

Now in its fifth year, the 2017 *Black & Veatch Strategic Directions: Water Industry Report* reveals increased focus by water utilities on sustainability, public outreach, and data analytics. **Cindy Wallis-Lage**, president of Black & Veatch's water business, discusses top water industry issues based on findings from the annual report in an interview with *World Water* Editor-in-Chief **Pamela Wolfe**.

# Utility leaders view sustainability, data analytics as promising solutions

**World Water ____ The 2017 *Black & Veatch Strategic Directions: Water Industry Report* revealed interesting shifts in strategy and approaches to achieving sustainable water systems – a goal that is shared by water industry leaders. In your opinion, what are the most important takeaways from this report for water suppliers in terms of future planning?**

Cindy Wallis-Lage ____ I have really enjoyed working on this report because it is interesting to see how things change, how utilities are moving forward, and the resulting progress. Leadership, data analytics, and financing are three areas where I see progress. We are moving beyond the emotive message "water is life" to a conversation on the importance of water for sustainable communities and economic development.

Water is critical for the survival, quality of life, and growth of our communities and attracting new business. Water industry leaders who begin with a holistic, "big picture," integrative approach; who seek to collaborate; and who are informed, forward-thinking, and accountable help ensure we're using our dollars wisely. That leadership is paramount to changing the water industry.

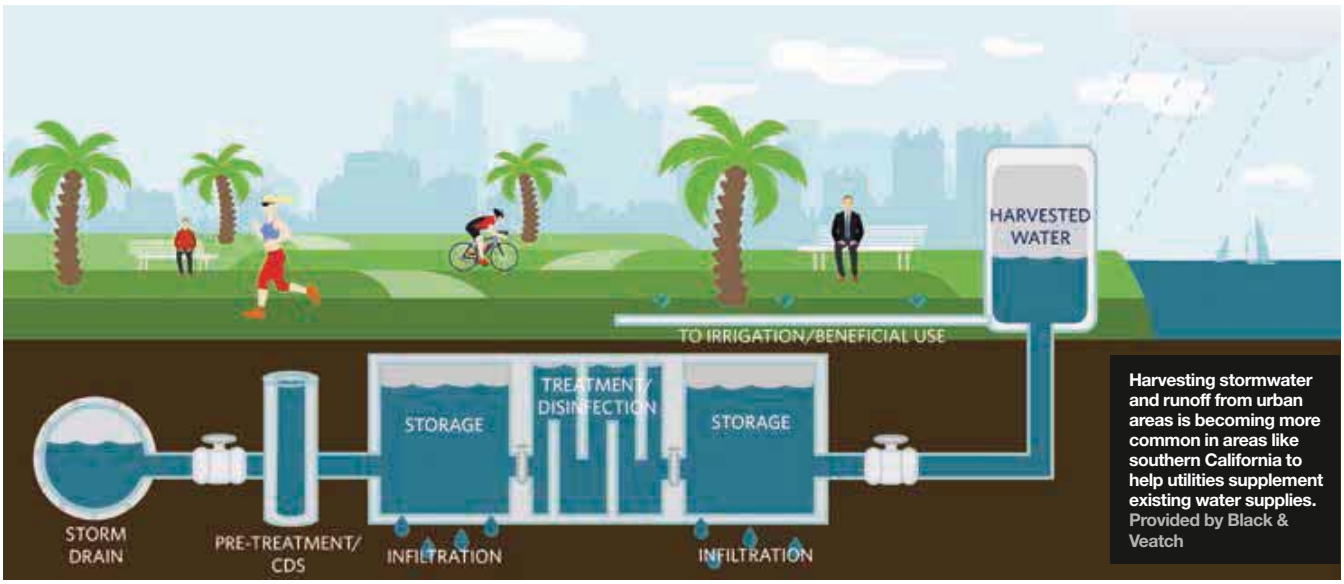
We are also seeing greater understanding of the benefits of data analytics in terms of increasing efficiency and maximizing asset potential. Financing future solutions is also essential, and this also puts customer engagement in the spotlight. Utilities and their leaders need to help the public understand why infrastructure investment is necessary and why rates may need to increase. It's important for water providers to help educate consumers about the critical value of water and utility services, and how foundational water is for any community to survive and grow.

**WW ____ How does the recent trend of extreme weather events, such as hurricanes and severe rainstorms with record-breaking precipitation levels, support water leaders and utility managers in presenting their case for increased investment in infrastructure?**

Wallis-Lage ____ It gives water leaders an opportunity to have a dialogue, but it's also challenging because we have to be careful. We can't say that we could spend enough money to never have an impact from a Category 5 storm or that we could design a system that would never have an issue.

Instead, looking forward, we need to plan to the best of our ability and build in as much resilience as is logical for our water infrastructure. Utilities can't plan for everything, but they need plans for how to recover services as quickly as possible. They need to ask the questions: What can we manage through the

**Effective planning enables the Water Corporation in Western Australia to develop and maintain sustainable water supplies. Upgrades to the Woodman Point Wastewater Treatment Plant in the Perth metro area will increase treatment capacity and the quality of treated wastewater, which is used to produce recycled water for industry use.** Photo by WP180 Alliance




**Harvesting stormwater and runoff from urban areas is becoming more common in areas like southern California to help utilities supplement existing water supplies.** Provided by Black & Veatch

event? How long can we go without power? How long can we go without our pump stations? What backup plans do we need? How will we recover? Beyond extreme storms, utilities also need to plan for population changes, shifts in supply and demand, long-term quality requirements, and aging infrastructure.

**WW ____ The report says that one-third of respondents "want to incorporate data into their strategies." What are the reasons for this growing interest in using data technology as part of the integrated planning process?**
Wallis-Lage ____ One of the greatest opportunities we have is in data analytics. Utilities are data-rich, but it doesn't mean that they are knowledge-rich. Real knowledge requires data collection, data analytics, subject matter expertise, visualization, and real-time information to understand our systems and customers' usage, and to make nimble and informed decisions as a utility. Utilities are interested in data analytics tools due to workforce challenges and the resulting need to automate more. Use of more complex technology also calls for automation to input and extract information to optimize performance.

Use of data analytics gives us an opportunity to be predictable and to optimize operations and maintenance. It allows us to get the most out of our assets. Utilities that really embrace data analytics gain a knowledge platform to make real-time decisions in a manner that drives efficiency in their operations. Use of data analytics also lets them optimize their assets and asset life. It's a win-win.

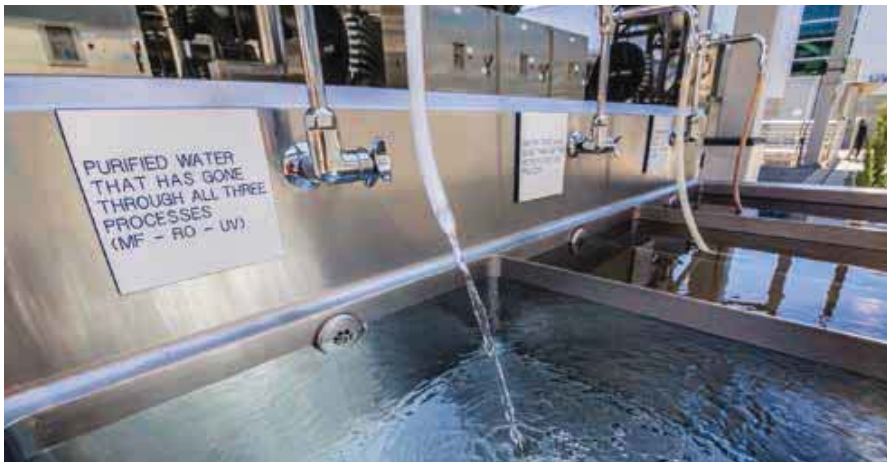
**WW: So is that essentially the business case for data analytics?**
Wallis-Lage ____ Yes. It is really automation, predictability, and the ability to optimize assets. When done well, the resulting savings will quickly recover the cost of the investment.

**WW: Are utilities beginning to understand the benefits of data analytics enough to invest in it?**
Wallis-Lage ____ Some have embraced the journey, and some see it as a cost versus an investment. Those that look at it as an investment because they see its potential are the ones that are moving faster toward smart integrated infrastructure. While the value of big data analytics is gaining momentum, it's a complex challenge for many utilities as they have to rely on good instrumentation and sensors to have confidence in the data. The devices and technology have come a long way, and there are fabulous and very reliable instrumentation sensors available now compared to several years ago. It's important to install the right ones and get the analytics in place so that utility leaders can make decisions based on reliable information.

So there is still a journey. Those that still look at it as cost ask, "Can I afford it?" The question I ask is, "Can you afford not to?"

**WW: What reasons explain the hesitation in adopting greater reliance on data analytics in asset management and utility operations?**
Wallis-Lage ____ I would say it's probably a

**Recent improvements in instrumentation and automation can be combined with data analytics tools like Black & Veatch's Asset 360® system to help utility managers leverage data for improved decisions and operations.** Photo courtesy of Black & Veatch




**The Groundwater Replenishment System (GWRS) in Orange County, California, takes highly treated wastewater that would have previously been discharged into the Pacific Ocean and purifies it to produce high quality water that meets or exceeds all state and federal drinking water standards. The world's largest water purification system for indirect potable reuse, the GWRS currently provides 379 million liters (100 million gallons) of water every day, enough to meet the needs of nearly 850,000 people.** Photo courtesy of Black & Veatch

comfort level with data analytic tools. Some contend that the current mode of operations is sufficient and that high-tech equipment is unnecessary or invites additional challenges. There is also the discomfort of change with IT, requiring a different skill set, which the staff may not have. However, it's also an absolutely wonderful opportunity for us to engage millennials and young professionals in our industry. Using IT is their "sweet spot." So the question is how to bring them in and give them the opportunity to help continue to move into big data analytics much faster.

For example, we use 3D design software that enables engineers to use virtual reality to walk through a plant and "see" it in 3D. It's phenomenal. Younger professionals, who have grown up during the proliferation of information and digital technology – and yes, that includes mastering video games – are comfortable with this, while others are not and prefer to see designs in 2D on paper. But we are not doing paper anymore.

**WW: What is the "new normal" for water utilities? The report says it's the need for water suppliers to accommodate a changing climate and rising public scrutiny of water supply utilities. Given the recent extreme hurricanes in the Caribbean and the Gulf of Mexico and extreme rainfall in other parts of the world, how does the "new normal" affect future strategy?**

Wallis-Lage ____ The change goes back to our discussion on resilience. Part of the new normal is accommodating changing weather patterns. While change is a constant, the challenge is to understand the ramifications of changes and plan for it. We have financial limitations, so we need to consider different ways to pay for resilience. And, through heightened traditional media coverage and social media availability, we have a public that is much more conscious of water and the utilities than ever before.

The challenge for water leaders is to form "collaborative communities" – positively engaged stakeholders at all levels that understand the goals of sustainability and resilience – and communicate clearly to the public. More specifically, people need to understand what resilience and sustainability mean for their community because these can be different in every location.

Resilience must be defined and incorporated into everything we do. Equipment and facilities need to endure and perform under a variety of conditions. Better public understanding of our role as responsible stewards of resilient water infrastructure would also improve understanding about the need for investment.

Regarding project delivery, we need to be more open in the public sector to finding other finance mechanisms to add value, such as P3s (public-private partnerships) or a more collaborative delivery method such progressive design-build.

Current demands require that we operate differently, so the new normal is also recognizing that everything we've learned in the past is an information point, but the past may not always be an accurate predictor of the future. With that in mind, we need to examine the "what-if" scenarios and determine where we can operate within them.

People ask, "How do you not use the past to predict the future?" The Water Corporation in Western Australia offers a good example in terms of sustainable water supply planning. Since the 1970s, rainfall in the southwest of Western Australia has decreased by some 19 percent – however stream flows to Perth's drinking water dams has decreased much more dramatically. Water Corporation planned for the future through its Water Forever plans, which adopts a three-pronged approach that includes working with the community to reduce water use, increasing the amount of water recycled, and developing new water sources.

Now desalination provides about half (145 billion liters) of Perth's water supply and it is the first city in Australia to operate a Groundwater Replenishment Scheme.

**WW ____ Water suppliers are trying to meet increasing demands for water through a variety of strategies – leak reduction, conservation, water reuse, stormwater harvesting – that could require a more integrated approach. The report mentions that water leaders are "exhibiting new levels of leadership and political will." Is this what's necessary to implement integrated solutions?**

Wallis-Lage ____ We have to use a holistic approach and look at the overall water supply that includes raw water, used water, and even stormwater. An interesting point raised in the report is the shift away from looking for new supplies to understanding that we have a lot of water available to us. It can have different quality, but we can clean it up, move it, store it, and keep reusing it. This requires collaboration because more reuse means the utility is selling less water. This shouldn't be a competition; it should be complementary. Regional water agency collaboration provides the opportunity for holistic thinking: reusing water for beneficial purposes versus wasting it as well as using green infrastructure to capture stormwater and replenish aquifers.

**WW ____ What are the prospects for regional collaboration among US water districts?**

Wallis-Lage ____ A more holistic approach based on watersheds that cross city, county, and state lines should be used to drive our decision-making on water supply issues. For example, the Central Florida Water Initiative is a collaborative water supply planning effort among three of the largest water districts in the state. Their holistic approach is based on a watershed and not city, county, or other political boundaries. I think we're going to see more of this type of collaboration in California and Texas.

**WW ____ In the US, some water utilities are exploring alternative, collaborative financing models such as public-private partnerships (P3s) to fund the replacement of aging infrastructure. In fact, the report says more than 50 percent of respondents said they'd consider a P3. Is there a growing acceptance of P3s?**

Wallis-Lage ____ I think utilities are interested in saying they would consider it, but considering and doing it are two very different things. There is a lot of dialogue, which is good, about how a P3 works. Part of that educational process is helping people understand the benefits it can provide, such as being able to solve financing and infrastructural modernization challenges faced by utilities. New investments through P3s can help utilities stabilize rates, optimize utility assets, and/or upgrade services. Rates may increase, but they probably won't increase as much because the delivery model and financing structure are much more predictable in the long term. P3s enable utilities to optimize their assets or upgrade services through new assets. So costs for utilities may be reduced due to improved efficiencies from new technologies. A key element in the education process is differentiating P3s from privatization. With P3s, the utility retains ownership and keeps operations staff. The P3 is a mechanism that can help drive greater efficiencies in the operation, equipment, and assets that are owned by the utility.

**WW ____ Water suppliers are increasingly engaging customers to increase awareness about the true costs of water infrastructure. How have these initiatives affected issues such as rate increases and use of recycled water for direct and indirect potable water?**

Wallis-Lage ____ In the past, public utilities stayed out of the press. The accessibility of more information and more instantaneous

communication has changed the industry. Public utilities are now engaging with the public to communicate on infrastructure issues. The utilities are helping the public understand the services that utilities provide and that a great deal of planning, infrastructure construction, and asset maintenance goes into ensuring system reliability to turn on the tap and flush the toilet. Helping people understand the big picture of water infrastructure – something we didn't do as proficiently in the past – makes a big difference.

**WW ____ Do you think you have seen concrete results from that?**
Wallis-Lage ____ Yes. DC Water has made major investments and incurred substantial rate increases each year, but George Hawkins (former general manager of DC Water) did a great job of talking about why and the benefits for the community. Water industry leaders have to help people understand the why and get past the emotion of rate increases. Sometimes you also have to highlight the ramifications of not doing it. During the recent recession, some utilities deferred preventative maintenance and asset investment. This led to asset failures such as pipe breaks and water quality issues, and subsequently rate hikes to cover the repair costs. The cost to fix infrastructure in a crisis mode is multiple times the cost of well-planned investments and timely maintenance.

**WW ____ Is there also a growing trend in more and larger water reuse projects?**
Wallis-Lage ____ Yes. As I mentioned earlier, we can't afford to waste a drop. It is important to remember that we still have responsibility for environmental stewardship, so it isn't as if we are trying to reuse every drop and no longer discharge to receiving streams to support aquatic life or deplete reservoirs and adversely impact recreational value. We need to be cautious and remember there are a lot of touch points with water. But there are reuse opportunities, especially in coastal areas, for capturing water – including wastewater and stormwater – and keeping it within the community. Stormwater can be a major water supply that should be captured and used effectively to meet water supply needs within a community. While not as predictable as other resources, we still need to make sure we are using stormwater effectively rather than losing it to oceans or outside a given watershed.

**WW ____ Financial concerns are not as critical to water suppliers as in past years, according to the report. Instead, has concern about aging infrastructure risen in priority?**
Wallis-Lage ____ Yes. That's part of what's changing, and I think it's part of the answer. Utilities realize that rate hikes ultimately have to pay for the infrastructure and they are educating their customers to understand the need for investing in water infrastructure. The investment isn't a superfluous or extravagant spend, but rather an investment to build sustainable and resilient systems to ensure that multiple generations going forward have the quality of life that we have.

The 2017 *Black & Veatch Strategic Directions: Water Industry Report* is available for free download from www.bv.com.

# New urgency in adopting stormwater to strengthen water resiliency

**Andy Kwok**, managing director at Black & Veatch Hong Kong, shares his perspective with *World Water* on the rising trend in advanced stormwater management by utilities in the Asia Pacific region.

**World Water ____ According to the 2017 Black & Veatch Water Industry Report, utilities in the Asia Pacific region are investing in advanced stormwater management strategies to improve water resource resilience and overall sustainability. What factors are driving this infrastructure investment?**
Andy Kwok ____ The Asia Pacific region has been developing rapidly over the past decades. The pace of urbanization, particularly in Asia, is phenomenal. By 2025, it is projected that 21 of the world's 35 megacities (with populations more than 10 million) will be in Asia.

Most readers are generally aware of China's economic and urban growth. We are also seeing a rising middle class and rapid urban development throughout Southeast Asia. The Association of Southeast Asian Nations (ASEAN), as an economic block, ranks as one of the largest economies in the world and is supported by favorable demographics. These factors attract and drive investment in infrastructure, including stormwater management, as many cities in the region are facing intense rainfall duration.

City planners and citizens see opportunities and constraints from the continuous rapid

**Above: Vortex intake**
**Top right: Bottom rack intake**
Photos by Drainage Services Department of Hong Kong
**Top: Glenn Chan and Andy Kwok (right) at Happy Valley Underground Stormwater Storage Scheme**
Photo by Black & Veatch

urban development. Along with other utility infrastructure, roads, office buildings, and public spaces, drainage and stormwater infrastructure are competing for space.

Land is priced at a premium whether in established cities like Hong Kong or in adjacent, emerging cities like Shenzhen. This economic reality can be a catalyst to innovative approaches to stormwater management. Equally, there is growing awareness and understanding that advanced stormwater management strategies can improve water resource resilience and overall sustainability.

**WW ____ Traditionally, water and sanitation investment has lagged behind other infrastructure priorities; however, this trend could be changing. Is the new "urgency" in adopting advanced, integrated stormwater management strategies a positive cons quence of the growing realization of the opportunities to increase water supply and improve flood protection?**

Kwok ____ It is certainly a factor at play. Potable water is a precious resource in our daily life. The realization of the opportunities for integrated water resources and flood protection strategies enables a synergy for cost-saving in terms of water being conserved in the facilities of the water utilities while also mitigating flood risk. Instead of the traditional approach to address these items separately, integrated stormwater management is being explored to achieve sustainability in most cities.

However, I believe the urgency around investment in stormwater management is driven by the fact that many of the solutions of yesterday can no longer be applied for tomorrow. Patterns and experiences of intense rainfall are shifting where what we would term technically as a 1-in-50 year rainfall event is recurring more frequently.

Engineers are compelled to address climate uncertainties through technologies, such as real-time data monitoring and control similar to SCADA. For example, we proposed the scheme of installing a movable weir system at the Happy Valley Underground Stormwater Storage Scheme. Operation of the weir takes into account the water levels in the upstream and downstream storm drains as well as the tidal level. This allows stormwater to enter the tank at the right time, not too early or too late.

If all of these factors are converging and, critically, the solution reduces the overall cost, I believe we will see the deployment of advanced stormwater management solutions gathering momentum.

**WW ____ Hong Kong's award-winning Happy Valley Underground Stormwater Storage Scheme project is an example of how cities are adopting advanced subsurface solutions to manage intense rainfall and alleviate flooding. Since its commissioning in March 2017, do you see momentum in terms of this approach being replicated in other cities or locations in the Asia Pacific region?**

Kwok ____ Many in academia and in overseas public utilities have conducted visits and tours to the under-construction and commissioned Happy Valley Underground Stormwater Storage Scheme over the past few years. In addition to being a reference with the potential for replicating the approach, the scheme also initiates innovation in tackling flood risk in urban cities where space is a major constraint for infrastructural development.

Each city's challenge is unique, of course, and cost is always a significant determining factor. The project design was able to realize a number of savings opportunities. For example, the movable weir system enabled the volume of the tank to be reduced by 25 percent, from 80,000 cubic meters ($m^3$) to 60,000 $m^3$. This reduction translated into substantial time and capital cost savings. There is also a significant reduction in operation cost because the shallower tank allows discharge of about one-third of the stored stormwater by gravity without pumping.

**WW ____ Other approaches such as sponge cities in China and retarding basins in Singapore are being developed. How could these help to optimize stormwater reuse?**

Kwok ____ Stormwater could potentially be explored for reuse upon sampling and analytical testing to examine the water quality. Our recent projects on drainage master planning in Hong Kong require the drainage improvement proposals to incorporate sustainable drainage systems (SuDs) to reduce the potential impact of new and existing developments with respect to surface water drainage discharges. These components would involve the optimization of stormwater reuse in order to achieve a reduction in discharge to the adjacent receiving waters.

# Climate change drives stormwater innovation in Hong Kong

In December 2017, engineering consultancy Black & Veatch was awarded first prize for Construction Sustainability in the Construction Industry Council Construction Innovation Award 2017 in Hong Kong for its hydraulic design concept: using vortex intakes to manage urban stormwater.

In collaboration with Professor Joseph H. W. Lee and the Drainage Services Department (DSD) of the Government of the Hong Kong Special Administrative Region, the team identified the opportunity to implement the "upstream interception" scheme to relieve flooding risks caused by rapid urbanization and global climate change in the Northern Hong Kong Island areas, including Causeway Bay, Admiralty, Central, and Sheung Wan.

The key feature of the scheme was the construction of the Hong Kong West Drainage Tunnel (HKWDT) extending from Tai Hang, an area southeast of Causeway Bay located in the mid-north of Hong Kong Island, to an outfall at Cyberport, in the west of the island. The HKWDT was completed in 2012.

Central to the success of the HKWDT is a vortex intake system situated 100 meters below ground that efficiently and safely intercepts high-speed turbulent flow from the natural watercourses to a tunnel system.

Today, about 30 percent of the upland stormwater runoff in the northern Hong Kong Island is collected via 34 intakes into the main tunnel for discharge to the sea.

It was critical that the design avoided the high-velocity flow overshooting the intake structure and continuing its original path along the watercourse to the downhill low-lying urban area.

The team analyzed the inverse relationship between the efficiency of the hydraulic interception of the intake structure and the flooding potential of the downhill urban area. Inadequate intake designs could result in unstable flows and excessive air entrainment in the drop shaft, leading to formation of air pockets and negative pressure in the tunnel.

Construction was carried out to minimize the disturbance to surrounding residences and businesses and the impact on the local environment and landscape. When constructing the low-flow drain or the dry weather flow channel at the intakes to maintain downstream flow in the dry season and normal wet season, the team also considered environmental factors that would enable the ecology at the downstream watercourses to be maintained.

The vortex intake system now sets a standard for the hydraulic design of vortex intakes and drops. The design guidelines were documented in a 2009 paper, "Hydraulics of Tangential Vortex Intake for Urban Drainage," and have been adopted by the industry. The guidelines have since been applied to the design of the Thames Tideway Tunnel in London, England; London Mogden Sewage Works; the Toronto – Don River and Central Water Front in Canada; and the Singapore Deep Tunnel Sewer System.