The Road Taken, the Road Ahead

The storm water & erosion control industry reflects on the past while looking to the future

As we celebrate a decade of progress and innovation, it is important to reflect on the trends and developments that guided us along the way, as well as keep an eye on where we are headed. In this section, key figures discuss the evolution of the industry and speculate about what the future holds.

THE NEXT BIG THING

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It may be the 10th anniversary of SWS, but my reflection goes back 20 years. In the early years of Phase I, permittees started developing manuals on BMP design and required civil designers to incorporate these designs into their plans. The options were limited—mostly ponds, wetlands and sand filters. Then (based on one study), the 200-ft swale was thrown in at the last minute. Why 200 ft? That was simply the length of the unit tested. Thus, a 200-ft swale was credited for 80% total suspended solids (TSS) removal, and ponds were credited with a 50% removal of total phosphorus. Sounds kind of primitive now, doesn't it?

Around this time, manufactured treatment devices (MTDs) were being introduced into an emerging marketplace that needed more options for what was termed the ultra-urban environment. These were interesting times. There were few data available on these devices, which were trying to gain acceptance in a regulatory environment that had not really defined what is meant by percent removal—or TSS, for that matter.

Needless to say, as more data have been collected on BMP performance, we have become a little wiser on what to really expect, and the options for BMP design have become more sophisticated. The advent of evaluation programs has helped to legitimize MTDs and support the growth of small businesses while providing solutions that meet the economic needs of the developer.

The advent of low impact development (LID) about 10 years ago caused a market shift. Now we are focused on both water quality and volume reduction with distributed systems that incorporate green infrastructure. The industry responded to this new challenge and is marketing products such as green roofs, porous paving systems, and rainwater harvesting and bioretention/filtration technologies.

For the most part, the marketplace has been associated with new construction and some redevelopment work. But ever-tightening regulations for MS4s and combined sewer overflows, along with total maximum daily loads, is precipitating a potentially enormous retrofit market, estimated in the tens of billions of dollars. To pay for this, creative financing options such as public-private partnerships, storm water fee structures to incentivize retrofits, and trading programs are all being explored.

Other chickens are coming home to roost, such as long-term facility maintenance and lifecycle costs. The notion of the "zero-maintenance facility" has gone the way of the dinosaurs. Agencies are looking at the plethora of BMPs available from a perspective of asset management, and figuring out how to both manage and pay for them, as well as enforce maintenance compliance for privately owned facilities.

So, what is the nexus for storm water? When will we understand what is appropriate for land use and what is practicable? I think it is just around the corner—to think otherwise implies we could waste billions of dollars chasing the next storm water "flavor of the month" while watching the continued degradation of our precious waterways. ■

WATER: OUR FUTURE DEPENDS ON IT

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At the turn of the 20th century, our lifespans were considerably shorter and a large portion of our population died from waterborne illnesses, much like in the developing world today. A blend of science, technology, know-how and force of will combined to change the nature of water delivery and bring clean, reliable and safe drinking water to almost every household in the country. There was one other important ingredient, however: money.

As a nation, we invested considerable amounts of money in building this water infrastructure, including wells, storage tanks, pumps, pipe and treatment facilities. This massive investment allowed us to charge little for drinking water. In fact, at less than a penny per gallon, drinking water is the cheapest product available to a consumer.

We are now at a crossroads. Drinking water infrastructure is at or near the end of its useful life and must be replaced. New contaminants have been discovered in our drinking water that must be removed through additional treatment. With the changing climate, growth patterns and competing uses for water (agriculture, industry and energy), addressing the need for an adequate water supply—including reducing use, reusing wastewater and developing new sources—is critical.

The first problem will be technically easy to solve—we know how to put water infrastructure in place—but it will be financially difficult, as the cost of needed national infrastructure is estimated to be in the trillions. There is only one place the investment can come from: us. Either it will come directly, through increased user rates, or it will come indirectly, through state or federal tax dollars being invested in infrastructure as grants or low-interest loans. It is time for a national conversation on the most rational, cost-effective and fair approach to infrastructure investment. We could reduce that amount, but we need to be willing to think differently about how we deliver water. For example, there are tens of thousands of small, stand-alone water utilities in the U.S., which is a less cost-efficient way of delivering service than a larger entity managing multiple systems. If systems collaborate with each other or merge, costs can be reduced.

The second problem is a little more difficult: We have to determine the potential for contaminants to make us sick and then design treatment technologies that are effective in removing them. No matter how much we know about water quality, there are always new issues of concern. Some chemicals may not have been able to be detected before, while the toxicity of others may not have been fully understood. Adding further treatment will ensure our safety, but, as with infrastructure, it comes with a cost. Water rates may need to increase to cover the initial investment or the ongoing operational costs of running a new treatment system.

The third issue is arguably the most difficult: We will face tough choices regarding how to balance the competing needs for water. We may have to make changes in our lifestyles or think about where and what types of industry, agriculture or energy production are appropriate in different areas of the country. We have to move beyond our distaste for direct potable reuse. We are not accustomed to these types of discussions, but the sooner we engage in a rational, balanced and comprehensive dialogue, the more time we will have to develop and implement solutions.

Addressing the issues with water—infrastructure, treatment and supply—is a critical component of ensuring our sustainable future. Without water, we will compromise our health, quality of life, economic well-being and recreation. It's time to put water first and make the necessary investment in our future. ■

HARNESSING THE POTENTIAL

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Driven by climate change impacts, changes in the amount, timing, and intensity of rainfall and snowfall are driving the amount of storm water runoff to municipal sewers. Storm water-mixed wastewater flowing through sewers contains different types and levels of constituents, depending on its source and level of treatment. These constituents can be beneficial, such as essential plant nutrients, or harmful, such as salts, metals and metalloids, pesticides, residual pharmaceuticals, endocrine-disrupting compounds, and active residues of personal care products in toxic concentrations. The treatment of storm water-mixed wastewater is key to safe and productive water recycling and reuse.

There are large gaps between developing and developed countries, as well as low- and high-income countries, when it comes to managing storm water-mixed wastewater generated within their boundaries. Lower-middle-income countries, on average, treat 28% of the generated wastewater, while only 8% of the wastewater is treated in low-income countries. The treatment and use and/or disposal of storm water-mixed wastewater in the humid regions of developed countries, such as eastern North America, northern Europe and Japan are motivated by stringent effluent discharge regulations and public preferences regarding environmental quality. Treated wastewater also is used for irrigation, but this end use is not substantial in humid areas. The situation is different in the arid and semi-arid areas of developed countries, such as western North America, Australia, parts of the Middle East and southern Europe, where post-treatment storm water-mixed wastewater is used primarily for irrigation, given the increasing competition for water between agriculture and other sectors.

In developing countries, treatment of storm water-mixed wastewater is limited, as investments in treatment facilities have not kept pace with persistent increases in population and the consequent increases in wastewater volume in many countries. Thus, much of the storm water-mixed wastewater is not treated, and much of the untreated water is used for irrigation in dry areas by small-scale farmers with little ability to optimize the volume or quality of the storm water-mixed wastewater they receive. Apart from lack of supportive policies, unclear institutional arrangements and a critical shortage of skilled human resources, public budgets in most developing countries for water recycling and reuse are inadequate. In addition, limited economic analysis, lack of reuse cost-recovery mechanisms, little or no value for treated wastewater, lack of awareness about the potential of water recycling and reuse, and inefficient irrigation and water management schemes are constraints to water recycling and reuse. Some countries in dry areas, such as Jordan, Israel and Tunisia, have employed a range of conventional and non-conventional systems and have national standards and regulations in place for water recycling and reuse. The policymakers in these countries consider reuse of water reclaimed from storm water-mixed wastewater an essential aspect of strategic planning and management of water resources.

It is likely that the demand for storm water-mixed wastewater as a source for irrigation will increase in arid and semi-arid areas of developing countries at a faster pace than the development of the technical solutions and institutions that might ensure the safe distribution and management of storm water-mixed wastewater. Thus, the key technical and policy factors in developing countries include better methods for handling untreated or inadequately treated storm water-mixed wastewater on farms and in farm communities, better recommendations for the crops and cultural practices most suitable for settings in which wastewater is the primary source of irrigation, and better methods for protecting farm workers and consumers from the potentially harmful pathogens and chemicals in storm water-mixed wastewater. The implementation of research-based technical options for storm water-mixed wastewater treatment and reuse offers great promise for environment and health protection, as well as livelihood resilience through agricultural productivity enhancement. ■

THE LOWLY SOIL GAINS RELEVANCE

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Soil will play a larger role in the future practice of sedimentation/erosion control, and for storm water treatment and retention. Past practice had to oversimplify soils into broad groupings, such as "A to D," or general capability classes, in order to initially implement the practice to the many types of land. In reality, there are more than 21,300 classified soil series and more than 285,000 soil types within the U.S. alone, and this is at a relatively broad mapping scale of 1 in. to 0.25 mile. The natural character and composition of soil can vary greatly within short distances, and even more so when altered by past or current manmade activities. Governmental soil surveys should not be utilized for site-specific project design, and this is stated within their disclaimers.

The original objectives of sedimentation/erosion and storm water control generally are being met, but U.S. Environmental Protection Agency (EPA) water quality standards under the Clean Water Act and Sedimentation-Erosion Control Act have become more stringent on nutrient, temperature, sediment load and hydrologic parameters. There also are more innovative system types and practices, which require more knowledge of a specific soil's character and ultimate capabilities to match the correct technology to the actual site. Lastly, as potable water becomes a more precious commodity, future water quality and quantity and reuse will be in higher demand.

The standards and methodologies that demand specific soil characteristics for storm water control and treatment currently are advancing at a rapid pace. A good example of this is in the index to the North Carolina Best Management Practices Manual. Specific site and soil conditions are major components in this manual for successful storm water treatment and retention methods, such as infiltration basins, dry basins, detention basins, wetlands, bioretention, permeable pavement, green roofs, etc. Several projects have been designed and constructed in which zero storm water runoff has been achieved for 25- and 50-year storm events, and the treated storm water is beneficially reused or recharged to groundwater. Other projects now are creating prescribed manmade soil media to match storm water requirements and needs to specific site conditions, with beneficial reuse as a dividend. Redevelopment of urban areas to meet storm water requirements will be accomplished with many of these soil and treatment innovations. It will be interesting to see what other new and innovative technologies will emerge, but matching the storm water needs to the specific site and soil types will play a fundamental role in the future.

Sedimentation/erosion technologies also are advancing by paying close attention to the actual soil types being managed and the methods being practiced. Many times, site-specific knowledge of simple soil properties and "soft" engineering can overcome costly "hard" engineering practices to properly stabilize property in an economical fashion.

The advancement of sedimentation/erosion control and storm water treatment technologies will continue. Utilization of site-specific soil information, paired with innovative technologies, will greatly advance land stabilization, water quality, water reuse and a project's success. Sometimes the answer can be right on the tip of your tongue; just don't forget to first look down at what you are standing on. ■

HOW SMALL-SCALE MEASURES CAN MAKE A BIG IMPACT ON OUR WATER FUTURE

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As we move toward a circular economy based on virtually no waste, with raw materials continually recycled and reused, the crucial role of water is top of mind for corporate leaders across the globe. Conversations around water supply challenges have penetrated the boardroom level in 62% of large companies, according to the Carbon Disclosure Project (CDP), unlike in years past, when sustainable practices were relegated to mid-level management. Almost a quarter of the 830 companies surveyed by the CDP said that water-related issues could limit the growth of their businesses.

Even though the global water crisis has received a lot of attention recently, the industry has been discussing and dealing with water issues for decades. The topic of water shortages has become a more relevant conversation, whether talking about its connection to food or energy, or just plain availability of water for drinking. Manufacturing is one of the sectors that is most vulnerable to water shortages. With global water demand for manufacturing anticipated to increase by 400% between 2000 to 2050, maximizing industry's efficient use of water is a critical step in the right direction, for both the environment and the bottom line. In order to solve the growing issue of water scarcity, we need to reduce consumption and be more efficient, recycle water where possible, and develop more freshwater sources—and industry plays an important role in these efforts.

Reuse

Industry is one of the largest users of treated water. Manufacturing sites require a reliable water utility that matches the water quality specifications needed for their products, as well as technologies to run their water purification systems. The extent of treatment required for a specific manufacturing application drives creativity for optimized solutions. Thus, conserving energy and water are primary goals for industrial manufacturers, as they look to produce high-quality goods in an efficient and cost-effective manner. Increasing water scarcity has driven companies to seek out both time-tested and new ways of purifying water and promoting water reuse that are cost-effective and offer an improved environmental profile.

Collaboration can play a strong role in helping to reduce water scarcity on a global and regional level. Through partnerships with municipalities and businesses worldwide, companies can help increase freshwater availability and reduce energy and production costs. Practices such as reusing wastewater, desalinating seawater and creating closed-loop water systems for everything from microelectronics to oil production enable more people to have access to safe, clean water while also improving business. Water cooperation can take many forms, including agreements across national, provincial and state boundaries over water rights regarding aboveground lakes and underground aquifers. Overall, successful public-private partnerships need commitment from both sectors to ensure the correct technology and financing are in place.

Recycle

Business value is at risk if companies do not take capital considerations surrounding water use into account and adjust their operations accordingly. Companies must strike a balance between meeting their business objectives and what is practical or reasonable in terms of costs. While zero liquid discharge (ZLD)—a water treatment process in which all wastewater produced is purified and recycled, leaving zero discharge at the end of the treatment cycle—is a viable solution for some companies, it is not the most realistic solution for all, given the steep expense. When facing significant discharge mitigation costs, businesses often wonder, "What are my other options besides ZLD?" One solution is minimal liquid discharge (MLD)—a more cost-effective and sustainable way for companies to improve their water footprints, enabling up to 95% liquid discharge recovery at a fraction of ZLD's costs. The term MLD might be new; however, the processes on which it is based rely on proven water treatment technologies such as ultrafiltration, reverse osmosis (RO) and nanofiltration, with a host of additional improvements.

Depending on individual regulatory and environmental needs and requirements, as well as capital and operating budgets, MLD may be a good fit for many industrial and municipal sites. By conducting a water audit to match waste streams and appropriate water needs and quality requirements, companies can better identify how much wastewater requires processing, the sufficient level of processing and the approach that will most economically and sustainably match their plant's needs, as well as benefit the environment and surrounding community.

The big challenge with MLD lies in adopting the mindset that "we can achieve significant gains without breaking the bank." More companies must realize they do not have to wait for the perfect ZLD solution when an MLD strategy will put them on a path toward higher recovery today. Traditional water treatment technologies have become advanced, and companies can achieve a better water footprint without going to the extreme—all while staying within budget.

Renew

Reducing water consumption and recycling water when possible is the first step, but when that is not enough, desalination is now a viable, economically feasible option, thanks to advanced water treatment technologies. While energy is one of the major contributors to the cost of desalinated water, RO filters have come a long way. In fact, today desalination costs only half of what it did 10 to 15 years ago. As advancing technology continues to drive costs down and freshwater continues to grow scarcer and more expensive, more cities will turn to seawater conversion as a way to meet this vital demand.

Beyond reducing their own environmental impact, businesses are in the unique position of being able to help customers and society become more sustainable. Science, together with strong water stewardship, can help preserve and restore the world's water supply and ensure access to clean water for billions. Not only do sustainable practices make ecological sense, but they also make good business sense. By adopting a "reuse, recycle, renew" mindset, and evaluating current systems for areas of improvement, companies can take significant steps toward a circular economy without breaking the bank. We are on a journey to zero, but the major steps along that path are ultimately what can help us make significant progress along the way. SWS