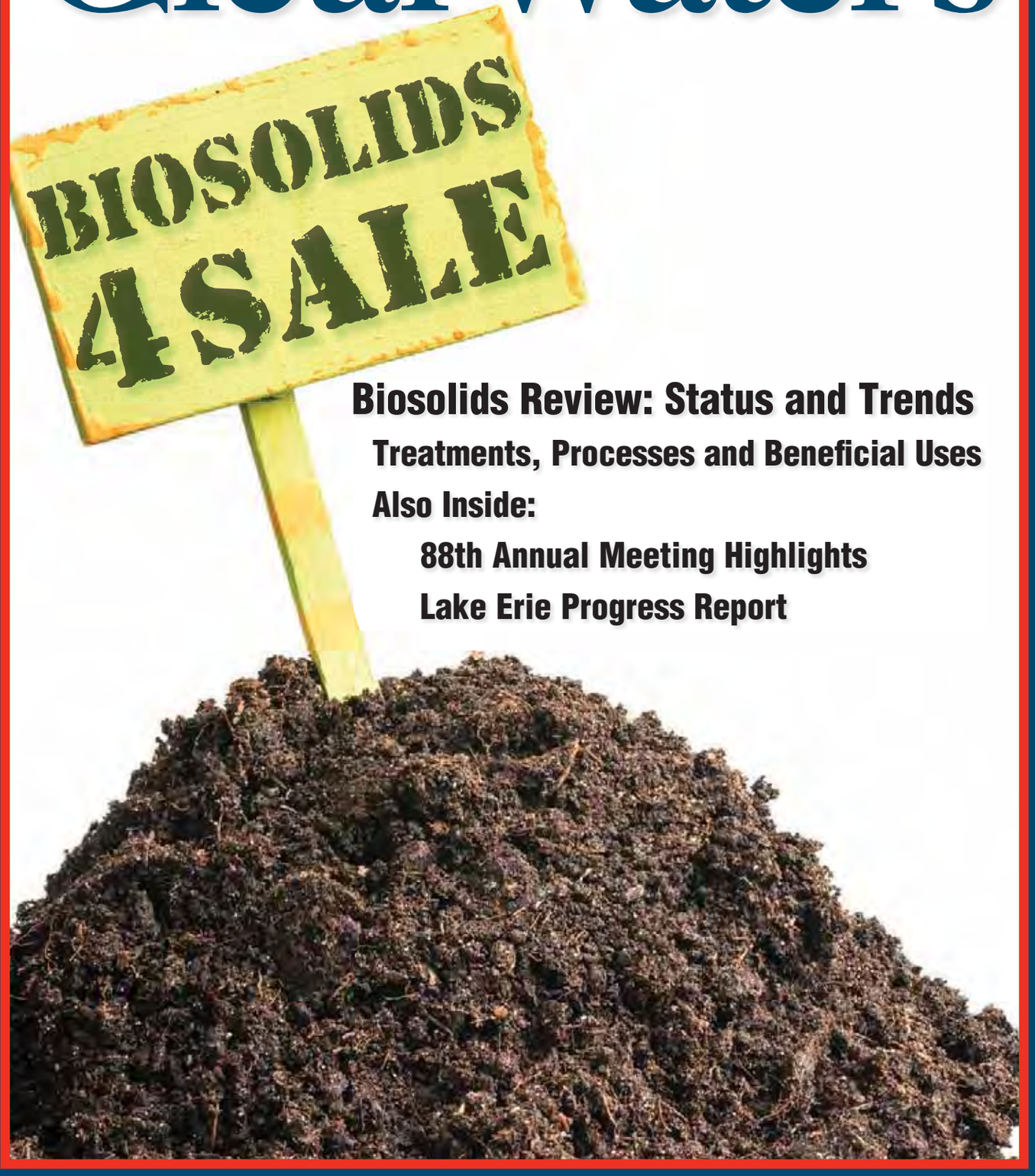
Spring 2016, Vol. 46, No. 1

New York Water Environment Association, Inc.

ClearWaters



Biosolids Review: Status and Trends

Treatments, Processes and Beneficial Uses

Also Inside:

- 88th Annual Meeting Highlights
- Lake Erie Progress Report

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Clear Waters

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Cover Image: Biosolids, the residuals left over from municipal water resource recovery, are rich in organic matter and nutrients. When quality standards are met, biosolids can be beneficially used as a soil amendment for agricultural, landscape and land reclamation projects. *Photo: istockphoto.com*

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President's Message | Spring 2016

Changing Public Perception

Immediate Past President Mike Garland declared 2015 the "Year of the Operator", during which the New York Water Environment Association (NYWEA) celebrated the dedication of the men and women working at our water resource recovery facilities. Under Mike's leadership, NYWEA renewed its focus on this core constituency in the Association, and it is my firm belief that we cannot let that momentum be lost.

Last year a survey of operators revealed much about the opinions and attitudes of those that work 24/7 to protect public health and water quality. One significant takeaway from this survey was that, while operators value the service they provide, they believe the public does not generally appreciate the importance of what they do. To support operators with the resources necessary to advance their good work, I believe that there needs to be a fundamental shift in how the public views these critical services, and a greater appreciation that our industry is worthy of investment.

This year NYWEA will be advancing initiatives to challenge the notion that our industry is "dirty" by exposing the tremendous water quality and public health gains already effectuated across the State, even while improvements continue to be made. We will be touting that water resource recovery is an industry of environmentalists – not polluters – and that the work of operators, engineers, scientists, collection system workers, mechanics, and other water quality professionals must be valued in that spirit. In short, NYWEA will be promulgating a positive message that will celebrate and promote accomplishments in the clean water industry in an attempt to change public perception.

NYWEA will advance this cause in a number of ways including meetings with elected officials, advertisements in magazines, partnerships with key stakeholders in the industry, and greater persistence in disseminating our message. Each issue of *Clear Waters* in the next year will include an article on a New York State waterway that describes how water quality improvements have been advanced through the efforts of our industry and others (see page 42 for an informative piece on Lake Erie). These articles will illustrate that environmental progress has been made throughout the State. I hope that water quality professionals will use these examples to promote our industry and demonstrate that additional investments are worth our time, energy, and capital.

The largest public perception undertaking this year will be NYWEA's development of a professional messaging document. Borrowing a strategy from various advocacy groups, the Association will produce a glossy, attention-grabbing publication that will promote the work of the clean water industry. It will provide a clear perspective, from NYWEA's vantage point, on the need for further investment. This messaging document will be drafted as a handout for elected officials, for promulgation by municipalities to their constituencies, and even perhaps for employers to present to prospective water quality professionals as a recruiting tool to bring talented individuals to our important work.

Annual and Spring Meetings

The 88th NYWEA Annual Meeting in New York City was once again a success. Between the opportunities to reconnect with our colleagues and friends, the high quality exhibits, the top-notch technical presentations, and the other fantastic programs throughout the conference, it is no wonder that this is one of the most successful WEF member association events in the country! Please see pages 6 – 7, 54 – 55 and 57 for details from the conference.

I am very pleased to announce that our 2016 Spring Meeting is a joint venture with the New England Water Environment Association (NEWEA). This year, the theme of the conference will be "Environmental Stewardship in the 21st Century", which complements NYWEA's 2016 goal to change public perception. The event will be held June 6–8 in Mystic, Connecticut and I hope to see many of you there.

My Thanks and Our Future

I first would like to recognize the members of the NYWEA Board. I have been impressed by the dedication of these volunteers and the tremendous job they do advancing the goals of the Association. My thanks to the outgoing Board members: Adam Cummings, Rob DiGiorgio, Steve Fangmann, and Wendi Richards. Each of them made the Board better and I enjoyed working with them over the last few years. I would be remiss if I did not specifically acknowledge Mike Garland for his tireless efforts presiding over the Association last year (and also for rocking out during the Spring Meeting President's reception!). NYWEA is in a superior position to serve its members because of his vision and leadership during the "Year of the Operator." Finally, all Board members know how fortunate we are to be working with Patricia Cerro-Reehil and the rest of the NYWEA Executive Office. Patricia and her staff keep the Association running and are a consistent force that maintains NYWEA as one of the best organizations of its kind.

Earlier this year Patricia mentioned to me that I may be one of the youngest – if not the youngest – Presidents of the Association. I highly doubt that I would be in the position of President at this time without my involvement in the Young Professionals (YP) Committee earlier in my career. With great vision NYWEA commenced its YP program 13 years ago to "foster participation and increase opportunities for YPs in the organization." YPs bring great energy and ideas that make NYWEA more dynamic and successful. In my early days as a consultant, a project manager approached me and very succinctly stated: "Join NYWEA, it will be good for your career." I ask that you all encourage YPs in your workplace to get involved in the Association; a NYWEA YP membership is very affordable and brings terrific value to both the person and their employer.

Joseph L. Fiegl, PE, NYWEA President

Executive Director's Message | Spring 2016

Our Message is Being Heard

The last few years have been filled with collaboration with environmental advocacy organizations on the theme of Infrastructure Funding. As our relationships evolve with these groups, we are beginning to realize that our amplified voices are being heard. We are encouraged by the Governor's budget proposal to increase monies in the Water Infrastructure Improvement Act of 2015. The total investment of $300 million in grants over three years will leverage more than $1.5 billion in local investments in water infrastructure across the state. This is an impressive action by Governor Cuomo and we appreciate his support. However, it is clear we all have to take ownership and communicate better about what our members do on a daily basis, and ***bring value*** to a traditionally *undervalued* resource. This will take assistance from National, State and Local levels of government to fix. Although these increases will spur much needed investment in clean water systems, the real infrastructure needs statewide are much greater than that amount can address. That is exactly why we need to continue our pleas for further investment.

In January, I had the opportunity to testify at a Senate Budget Hearing on the need for infrastructure funding. A few weeks later, Water Ambassador and Past President Richard Lyons campaigned in Albany for increased water infrastructure funding at an event coordinated by Environmental Advocates. That same week, NYWEA's President Joe Fiegl was in Washington, DC with representatives from Buffalo Niagara Riverkeeper and Citizen's Campaign for the Environment. They met with nine elected officials and/or their staffers on the topic of the Great Lakes Restoration Initiative. Combining our voices with other advocacy organizations when we are in strong agreement strengthens our message to elected officials and the relationships that we developed are making it easier to tighten and prepare our messages when our goals fall into alignment.

Eliminating the Concept of Waste

Recently, I had the pleasure of visiting with Professor John Belt at a robotics competition that my son participated in at Oswego State University. Professor Belt is a true renaissance man, a teacher for 40 years who inspires his students to go beyond their limits in industrial and graphic arts. After spending some time talking about NYWEA, he handed me a sheet of paper labeled "The Hanover Principles" by William McDonough. I had the sense from my conversation with Professor Belt that "The Hanover Principles" were deeply ingrained in his day-to-day life, and something that he worked to instill in his students on a daily basis. Many of you might relate to the concepts in this document – one in particular struck a cord for me. **Eliminate the Concept of Waste**. In our industry we are seeing a slowly advancing paradigm shift, from wastewater treatment to water resource recovery. In so doing, the word "waste" is being eliminated from any conversation having to do with water. As time goes on we'll likely be hearing more about the transition from wastewater treatment to water resource recovery.

This issue of *Clear Waters* is dedicated to that concept and to the beneficial use of biosolids. Our industry is trying to do the right thing by effectively using the byproducts of treatment processes to eliminate the Concept of Waste. While there is disagreement on the "how" – and there is certainly is no perfect solution - many of our members are working hard to make sure the safe reuse of biosolids can take place.

We hope you enjoy the articles included and learn something about biosolids management that you didn't already know. Many thanks to Bill Toffey and Jeff LeBlanc for being the champions of this issue.

New *Clear Waters* Editor Hired

Join me in welcoming as part of the NYWEA team, Kerry Thurston, as our new editor. Kerry's technical background and keen interest in environmental issues, as well as her photography skills, makes her a perfect fit for the position of Editor. Welcome aboard, Kerry!

Patricia Cerro-Reehil
pcr@nywea.org

In Memoriam: Beth Petrillo Sexton

It is with a heavy heart that we share the news of Beth Petrillo's sudden passing on Saturday, March 5. Her passion for environmental education was strong, and she was instrumental in helping to bring environmental awareness to many school-age children by developing NYWEA's *EnviroEd* newsletter. Beth's volunteerism was "off the charts" with her service on the Energy, Program, Public Outreach, and Residuals & Biosolids Management committees. Beth also found time to give back to the local NYWEA chapter and served as a member of the Metropolitan Chapter Board from 2000–2005. Beth was known outside the borders of NYS and served as a representative from NYC Department of Environmental Protection (NYCDEP) to the Mid-Atlantic Biosolids Association. Her talent and dedication was recognized in 2007 when she received NYWEA's Public Outreach Award.

At the time of her passing, she worked as Associate Project Manager of the Biosolids & Building Maintenance Contracts Section of NYC Department of Environmental Protection.

Beth was married to John Sexton, and was the loving mother of Kerri Ann and John Pat.

With Biosolids as the primary theme of this issue of *Clear Waters*, it is with great honor that we dedicate it to Beth Petrillo Sexton, we know she would have enjoyed it cover to cover!

Marriott Marquis, New York City

Highlights of 88th Annual Meeting

Presidents Reception

L-r: William Grandner, Tony DellaValle and John Ruggiero gather at reception.

Gail Heiner (left) and Darlene Ciuffetelli

L-r: Joe Fiegl, Robbie Gaiek, Dick Pope, Dave Barnes and Jonathan Ruff

Adam Zabinski (left) and Thomas Lauro provide big smiles for the camera.

Janice Jijina (left) and Kathleen Lauro

Monika and OJ McFoy

L-r: Fotios Papamichael, Gail Heiner and Joe Massaro pose for a photo opp.

L-r: Tony DellaValle, John Ruggiero, Joyette Tyler, Tanya Jennings and Darlene Ciuffetelli say cheese.

Tucker Cox and Kristin Rau

Nat and Geoff Baldwin (right)

Jonathan Ruff (left) and Gerard Moscinski

Opening Session

Following up on his commitment to the Year of the Operator, President Mike Garland holds up the cover of the Annual Meeting program during the Opening Session.

WEF Vice President Jenny Hartfelder addresses the members during the Opening Session.

Congressman Paul Tonko gives the keynote address of the 88th Annual Meeting Opening Session.

NYSEFC President, Sabrina Ty talks about the funding programs available to municipalities during the Opening Session.

Jim Tierney of NYSDEC addresses NYWEA members during the Opening Session.

Operator of the Future Panel Discussion

The Operator of the Future Panelists, left to right, Jon Ruff, Robert Wither, Mike Letina, Donna Bee, Tom Tieppo and Howard Robinson

Robert Wither from NYSDEC serves as a resource on the Operator of the Future panel in discussing the regulations.

President Michael Garland and Executive Director Patricia Cerro-Reehil

The Exhibit Hall Opens

President Mike Garland cuts the ribbon with Conference Management chair, Joyette Tyler.

Jim Hampson (right) receives a Long Standing Exhibitors Award presented by Joyette Tyler and President Garland.

The Exhibit Hall shows a flurry of activity.

continued on page 54

New water for a thirsty world

In nature, the innate connection between the sun, sea and wind existed long before man. Using today's technologies, we are re-connecting these elements to create resilient water and energy solutions. By coupling the power of sunlight and wind, we can harness sustainable energy to provide new water supplies to water scarce areas. Advances in desalination technology not only convert sea water into freshwater, but make it an affordable reality.

Our global desalination and sustainability experts help communities develop solutions to produce, manage and conserve water supplies. The mission is simple – to bring new water for a thirsty world.

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Water Views | Spring 2016

Follow the Money

It's not uncommon to see a headline about a community needing to upgrade or repair their wastewater infrastructure. As those of you know, the price tag of these projects is often high. Municipal officials often look to the state and federal governments for help.

As with most clean water infrastructure issues, the place to start is an engineering study to identify the best options and costs. NYSDEC and EFC co-sponsor the Engineering Planning Grant Program to help municipalities with this initial phase of a project. This grant program offers $2 million annually, and is part of the Governor's Consolidated Funding Application (CFA), with more than $6.8 million awarded to date.

Once a municipality has an engineering plan in hand, the next step is to design and construct the solution. There are a number of grant and loan programs available. The NY Water Grants and the Clean Water State Revolving Loan Fund are the two biggest players in this arena in terms of dollars available. The NY Water Grants program is slated to have at least $125 million available in each of the next two years. Both of these programs are overseen by EFC. NYSDEC and EFC staff provide a great deal of assistance to help municipalities get the best mix of grants and low interest financing.

Another grant program for the construction of wastewater infrastructure is the Water Quality Improvement Project grant program. It is funded through the state's Environmental Protection Fund and is also part of the Governor's CFA program. Since 1996 more than $470 million has been awarded through WQIP for municipal wastewater infrastructure improvements.

USDA Rural Development has a loan/grant program that is run annually for small community wastewater infrastructure improvements. The state also offers wastewater infrastructure funding through the NYS Department of Housing Community Renewal Community Development Block Grant and the Empire Development Corp. Both programs are offered annually through the CFA.

If you are trying to fund green infrastructure, you should look to the Green Innovation Grant Program which, like many of the other programs, is in the CFA. It is run by EFC and this year will likely have about $12 million available.

This is a quick overview designed to provide a sense of the variety and number of clean water infrastructure funding options. Each one of these programs has its own rules in terms of what can be funded, how much funding is available and whether it is a loan or a grant. And, since funding is tight, you will need to do your homework to figure out what is the best solution for your community.

Fortunately, each of the programs I mentioned have very knowledgeable and helpful staff to assist. The involved agencies will coordinate with you to assess funding options through the state's "Co-funding" initiative. I urge you to look at the different programs on-line and to contact us for more information.

– James Tierney, Assistant Commissioner for Water Resources
NYS Department of Environmental Conservation

Focus on Safety | Spring 2016

Workers in water treatment facilities may be exposed to pathogens when they have direct contact with sewage, sludge, or biosolids. It is incumbent upon the employer to protect workers from the harmful effects of pathogen exposure by providing training, suitable personal protective equipment, protective procedures, and a method to check for compliance.

These protective measures do not have to be expensive or time-consuming. Some basic hygiene practices and common sense will go a long way. Such measures include:

1. Frequent routine handwashing with soap and water. This is a cornerstone of personnel safety. An operator should wash his/her hands after any contact with biosolids, before eating or drinking, and both before and after using the toilet. Handwashing stations should be readily available.
2. Avoid touching one's face – including eyes – or touching wounds to prevent the transmission of pathogens. Keep wounds covered at all times.
3. Do not eat in an area where biosolids are handled. Do not smoke, or chew tobacco or gum, in these areas.
4. Use personal protective equipment (PPE) to keep a barrier between the operator and the biosolids. PPE are items that include gloves, glasses, goggles or face shields, respirators, rubber footwear and coverall uniforms. The disposable PPE should be properly disposed after use while the reusable PPE should be properly cleaned. Dirty uniforms should not be worn home but left for laundering at the plant. Boots should be designated for biosolids use only, and after use they must be rinsed off and stored in the biosolids area.

Training in the proper procedures is a part of any safety protocol, and biosolids safety is no exception. However, with adult learners, the reason "why" something is recommended or required is just as important as the rule itself. Convey the importance of doing things the right way by providing explanations so workers understand the purpose. Proper procedures – dull as they are – are the framework of protection. Remember that this protection extends beyond the water treatment operator at the facility by also protecting the worker's family when he/she returns home.

One of the 'sneaky' aspects of pathogen exposure is that an illness resulting from workplace exposure may have similar symptoms as other illnesses, making the source of the pathogen difficult to determine. It is important for source detection and identification to report illness or symptoms even when the illness is only suspected to be related to occupational exposure. While a bout of diarrhea may be caused by the proverbial 'bad clam', it might also be from pathogen exposure at work. Reporting illness requires a delicate discussion with a supervisor who is sensitive to both the situation and the potential ramifications, and is crucial for reviewing workplace practices to prevent further exposure.

Treatment plant workers have some unique occupational risks and exposures. Through conscientious work practices, personal hygiene habits, and a supportive supervisory structure, the risks related to biosolids production may be managed to an acceptable level.

– Eileen M. Reynolds, Certified Safety Professional
Owner, Coracle Safety Management

From wef hq Leading-edge updates from the Water Environment Federation

The 2015 Legislative Year in Review

Last Year Brought Victories for WEF and Water Agencies

by Steve Dye

The final months of 2015 were busy for the Water Environment Federation (WEF; Alexandria, Va.) government affairs efforts in Congress. Several major funding priorities for WEF and water were accomplished, and several significant policy goals were enacted into law.

Final FY16 Omnibus Appropriations Bill Restores Funding

In mid-December, the U.S. Congress reached a final agreement for the fiscal year (FY) 2016 budget for the federal government, the Consolidated Appropriations Act of 2016. The bill provides $1.067 trillion in base funding, which includes $73.7 billion for overseas contingency operations, $7.1 billion in disaster aid, $1.5 billion for program integrity, and $700 million in emergency funding. Read the Consolidated Appropriations Act of 2016 at *https://rules.house.gov/bill/114/hr-2029-sa*.

Funding to all federal agencies is included in the bill, and it retains or increases the funding amounts for the agencies from FY 2015. The bill holds the U.S. Environmental Protection (EPA) at the FY 2015 enacted level of $8.139 billion. The Clean Water State Revolving Fund is funded at $1.394 billion and the Drinking Water State Revolving Fund is funded at $863 million, restoring severe cuts proposed in 2015 in the draft House and Senate committee bills. The bill did not include funding for Water Infrastructure Finance and Innovation Act (WIFIA) loans and loan guarantees, but it did include language directing EPA to continue to use administrative monies to establish the program.

The bill was free of many of the policy riders that had been hotly debated in Congress, including any restrictions on EPA in proceeding with the implementation of the Clean Water Rule and the Clean Power Rule.

In 2016, WEF will be advocating before Congress and the Administration for full funding for the SRF programs, as well as funding for the WIFIA program to provide low interest loans for infrastructure projects.

Rider That Banned CSO and Wet Weather Bypassing Excluded

Also, in the FY16 Omnibus bill, a major effort to strip an unfunded mandate was successful. The Senate version of the appropriations bill that funds EPA included a rider that would have forbidden wet weather bypassing and combined sewer overflows (CSOs) in the Great Lakes watershed. The compromise language in the final bill will require some additional reporting for CSO events only, but it makes no changes to the Clean Water Act requirements or additional fines.

The Senate's FY16 appropriations bill contained a policy rider *(Sec. 428 of S. 1645)* requiring all combined sewer overflows (CSO) in the Great Lakes watershed to be eliminated, including overflows discharged in compliance with a CSO Long Term Control Plan (LTCP) or consent decrees. The rider would have also required water resource recovery facilities (WRRFs) to eliminate discharges of blended effluent that otherwise meet standards established in a WRRF's National Pollution Discharge Elimination System (NPDES) permit during peak wet weather events.

A recently completed survey of Great Lakes WRRFs estimated the cost-of-compliance to the policy rider exceeded $72 billion in the region. A coalition of cities, counties, and associations is aggressively lobbying Congress in opposition to this policy rider because it has the potential to be extremely costly, requiring massive infrastructure expansion, ratepayer increases, and reopening of consent decrees and/or LTCPs. More than 45 letters were sent to Congress from public agencies and organizations opposed to the policy rider, including WEF; the Water Environment Associations of Indiana, Michigan, New England, New York, and Ohio; and WEF members at agencies throughout the Great Lakes region.

WIFIA Fix and Better Highway Stormwater Management

The highway reauthorization bill, known as the Fixing American Surface Transportation Act (FAST Act) that was enacted into law in December, included a fix to the WIFIA program that WEF helped create and a stormwater management provision that WEF helped draft.

Highlights:

Appropriations Bill FY16

- Funding is restored for State Revolving Funds for Clean and Drinking Water.
- Policy rider to eliminate all CSOs in the Great Lakes Basin is removed due to high cost to the communities involved.

FAST Act

- Restriction on tax-exempt financing in WIFIA program is lifted.
- Provision is added to promote better stormwater runoff management in the planning process for surface transportation.

The fix removed a restriction on the use of tax-exempt financing on WIFIA-financed projects. WEF and other water associations have been advocating for the provision since the program was enacted in 2014. The WIFIA program required that WIFIA can finance only up to 49 percent of a total project cost, and the remaining 51 percent could not come from a tax-exempt source, such as tax-exempt municipal bonds or private activity bonds. This was limited by Congress in 2014 to keep the cost of creating WIFIA budgets neutral, with the intent of fixing it later. The restriction on tax-exempt financing was removed by the provision in the FAST Act that WEF and other water associations strongly advocated.

Also included in the FAST Act was a stormwater management provision that WEF helped draft that directs metropolitan, non-metropolitan, and statewide transportation planning agencies to "improve the resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation," among the list of items to be included when agencies are planning surface transportation projects that use federal funding.

Rep. Donna Edwards (D-Md.), who was a member of the conference committee negotiating the final bill, included the provision. Language similar to the provision was originally developed by Sen. Ben Cardin (D-Md.) with WEF staff assistance and was introduced as the Highway Stormwater Management Act as stand-alone legislation in 2014 and 2015 (S. 518). On behalf of WEF, Dr. Dan Medina of Atkins Global (Epsom, U.K.) and Jim Gibson of Sanitation District #1 in Fort Wright, Ky., participated in a hearing in May 2014 before the Senate Water & Wildlife Subcommittee chaired by Sen. Cardin. During the hearing, the WEF members testified on the importance of better stormwater runoff management during the surface transportation planning process. Sen. Cardin introduced his legislation shortly after the hearing.

The provision that Rep. Edwards included in the bill is a significant step toward better stormwater management included early in the planning process of surface transportation bills. Currently, planning agencies that use federal dollars for projects are given eight criteria to consider during the planning process, such as increased safety, economic growth, and intermodal connectivity. The Edwards provision amends U.S. Code 23, Section 134(h)(1) and 135(D)(1), and will urge planning agencies to "reduce and mitigate stormwater impacts of surface transportation." Planning agencies are not required to include these criteria in projects, but projects that meet more criteria will score higher.

In 2016, WEF will be working closely with EPA to help complete the formation of the WIFIA program and establish another federally backed source of low-interest financing. WEF will also be working with the Federal Highway Administration to incorporate the stormwater management provisions into the project planning process so that stormwater management costs are built into the federally funded highway projects and are not left to local agencies to address after a project is completed.

Save the Date: WaterWeek 2016

WEF invites everyone to attend the National Water Policy Forum, Fly-In, and Expo on April 11–13, in Washington, D.C. Save the date and plan on joining your colleagues from around the nation to participate in the -1/2 day meeting, which will feature congressional speakers, policy briefings, visits to Capitol Hill, and roundtable dialogues with key policymakers and experts on important regulatory and policy matters. The Forum, Fly-In, and Expo are hosted by WEF, the National Association of Clean Water Agencies, the Water Environment Research Foundation (WERF), and the WateReuse Association. It will take place during WaterWeek 2016 (April 10–15). Registration and more details about the event will be coming shortly. The WEF Government Affairs Committee will also hold a full committee meeting on the morning of April 11 for committee members. We hope to see you there!

Since 2011 Steve Dye has served as Legislative Director for the Water Environment Federation (WEF). In his government relations role Steve represents the Federation before Congress, monitors key legislation and federal policies, develops and executes legislative strategies and proposals, and maintains WEF's excellent reputations before public and private interests in the water sector. He also leads WEF's Water Advocates Program, a grassroots program designed to mobilize and train WEF members to advocate before federal, state, and local officials.

How Regional Biosolids Associations Can Help You

by William Toffey and Ned Beecher

New York biosolids managers are lucky. You have one of the most active state biosolids committees housed within NYWEA – thanks to Chair Jeff LeBlanc and Vice Chair Beth Petrillo – and you have two regional associations watching out for your interests. Both Bill Toffey with the Mid-Atlantic Biosolids Association (MABA) and Ned Beecher of the North East Biosolids and Residuals Association (NEBRA) stand ready with NYWEA's Biosolids Committee to address your solids issues and opportunities.

This may be lucky, but luck is not enough. When it comes to recovering and using the resources in biosolids, it takes a lot of hard work, sound policies, and strong regulations. New York is fortunate to have an excellent and stable regulatory program, led by knowledgeable staff at the New York State Department of Environmental Conservation (NYSDEC). But biosolids recycling requires sharing information, networking, technical savvy, and support at the local level. This is where your NYWEA Biosolids Committee, MABA, and NEBRA come in,

MABA and NEBRA were organized nearly 20 years ago, not long after the 1993 release of the Part 503 National Standards for the Use or Disposal of Sewage Sludge. These standards were the catalyst for organizing specialists in the public and private sectors responsible for biosolids. Initially, there were concerns about how the federal regulations would be written and promulgated. These were replaced by concerns about state implementation, enforcement and public acceptance. Biosolids associations started up in the Northwest, Northeast, Mid-Atlantic, California, and, for a while, in the Great Lakes regions. Members of these associations were interested in accomplishing a broader set of goals: increasing public support; advancing best management practices; and addressing, with sound science, the common concerns regarding metals, chemicals, pathogens, and odors.

By some measures, the world of biosolids is essentially the same now as it was then. The overall federal regulatory system remains. Landowners continue to need nutrients, and biosolids continue to be a useful fertilizer, soil amendment, and biofuel. Landfills and incinerators remain as options for solids management.

The predictability of controversy is also unchanged when it comes to biosolids. Episodes of adverse public sentiment continue to erupt on occasion, sometimes leading to more regulations and legislative initiatives. It seems that each year, a new issue demands our attention – right now, it's microconstituents and phosphorus. Yet at the same time, few people have any idea what biosolids are, and we as biosolids managers remain vulnerable to being misunderstood.

Although much has remained the same, the world of biosolids has also changed substantially in the last 20 years. Research continues to show that biosolids, by and large, have positive environmental potential. The long record of regulatory reporting on biosolids quality shows that nearly all biosolids easily surpass national standards, and are far better than twenty-three years ago when the Part 503 standards were enacted. Treatment processes are improving to the point where we can select equipment that extracts more "value" from the biosolids, either as fuel or as fertilizer (e.g., biogas production and struvite recovery).

At the same time, the infrastructure investments of the 1980s need to be replaced, so we have many opportunities to "trade-up" to more robust equipment. We have a new generation of operators and managers who have grown up in a world where the term "sustainability" is not novel or dismissed. Today, our profession reaches beyond the confines of the wastewater professional associations, into the fields of agriculture and energy. It reaches well beyond the traditional confines of the chain-link fence encircling our treatment plants. It extends to communities that don't pay for our treatment services, such as distant rural communities where biosolids are used. And, we have new tools for global, instantaneous communication, wholly unforeseen in 1993.

All of these factors affect your solids management program. Who keeps track of biosolids management issues for you? What might you be missing? Who is connecting you, the water quality professional, to research and policy; to farmers, regulators, agricultural advisors, and other stakeholders? To meet these challenges, we need coordinated information sharing, public outreach, and media responses. We need people whose job it is to track research and regulations, respond to threats, provide consistent information, and promote biosolids recycling.

This is the work of our organizations – MABA, NEBRA, and the NYWEA Biosolids Committee. We have been steadily tracking these things and working for you:

- Monitoring legislation introduced in Albany that would restrict biosolids use on land;
- Tracking local opposition to biosolids use on farms in western New York and the positive actions of NYSDEC, the Department of Agricultural Management, and the courts in protecting farmers' right to use biosolids;
- Tracking and reporting research on trace chemicals (microconstituents) in biosolids, as well as other "hot topics;"
- Supporting water resource recovery facilities that are advancing energy recovery from biosolids;
- Tracking the interplay of food waste diversion efforts and wastewater treatment;
- Supporting land application, composting, and advanced stabilization programs; and
- Publicizing the good work of New York's biosolids managers.

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cost-effective insurance against public and regulatory challenges that could knock your biosolids program off the tracks. Will you join us and help ensure that our vital organizations continue their critical work?

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To Learn More, Visit the Association Web Sites:

MABA, William Toffey Executive Director (www.mabiosolids.org)

NEBRA, Ned Beecher Executive Director (www.nebiosolids.org)

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The Results Are In!
Survey of Status and Trends in Biosolids Management in New York State

by Molly Baker

New York State has about 580 publicly-owned treatment works (POTWs) that generate biosolids (sewage sludge) from their treatment processes. These facilities treat approximately 2.5 billion gallons of wastewater per day. That is a lot of biosolids, on the order of 350,000 dry tons annually.

In 2010, the Department of Environmental Conservation (NYSDEC) conducted a survey to acquire updated information on biosolids treatment and management at the plants in New York State. This survey was sent to all POTWs across the State and had a response rate of over 90 percent.

An array of treatment plant processes was represented in the survey, including: anaerobic digestion; aerobic digestion; various types of settling and holding tanks; lime stabilization; and lagoons. Results from the survey suggested that facility managers chose their processes based on a variety of factors such as cost, complexity, wastewater characteristics, climate, nearby land uses and local preferences.

POTW operators manage end use of biosolids in similarly diverse ways. What binds them together are the NYSDEC regulations governing the storage, land application, composting, and anaerobic digestion of biosolids and septage. These regulations *(6 NYCRR Part 360 Subparts 4 and 5)* incorporate the quality standards set forth in the federal statute *(40 CFR Part 503: Standards for the Use or Disposal of Sewage Sludge)*.

The 2010 survey gathered data describing the end use, or destination, of the biosolids material generated within New York State, including data compiled annually from organics recycling and disposal facilities. The survey results showed that in 2009 approximately 69 percent of biosolids were disposed in solid waste landfills or incinerated. Incineration occurred at 12 facilities across the state, including fluidized bed and multiple hearth technologies. In 2009, 27 landfills were accepting sludge for co-disposal with solid waste.

In addition to landfilling and incineration, treated biosolids may be beneficially used in New York State as fertilizers, liming agents, and sources of organic material. Application occurs on farms and landscaping sites, in public works projects, and for land reclamation. The material is also used as a constituent in topsoil blends. State rules prescribe the suitable uses based on level of pathogen removal, and regulatory guidelines assist users in determining the allowable application rates of nitrogen when biosolids are used for fertilization. When the 2010 survey was conducted, 45 facilities in New York State were permitted under Part 360 for beneficial reuse of biosolids. These included 24 biosolids composting facilities, 18 land application, two heat drying, and one chemical stabilization facility. ***Figure 1*** shows the distribution of biosolids' end uses, on a dry-weight basis, across New York State.

Among the biosolids methods for beneficial use, composting was the most prevalent in 2010. Direct land application is a common practice where treated biosolids (i.e., digested or lime stabilized) are applied as either a liquid or dewatered semi-solid material, in a manner similar to animal manure. Application rates are regulated by the NYSDEC based on nitrogen requirement that do not exceed the needs of the crop grown. Composting, chemical stabilization, and heat drying are all processes for advanced stabilization that destroy pathogens and that result in commercial soil products as organic matter or lime amendments.

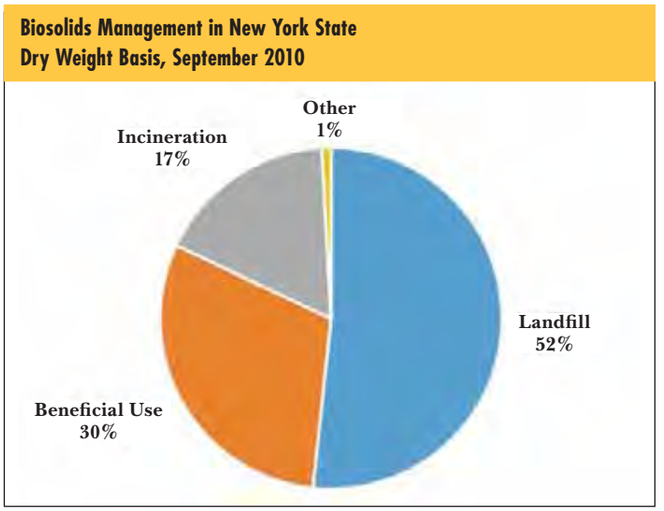

Figure 1. "Biosolids Management in New York State," NYSDEC, *June 2011 Report*

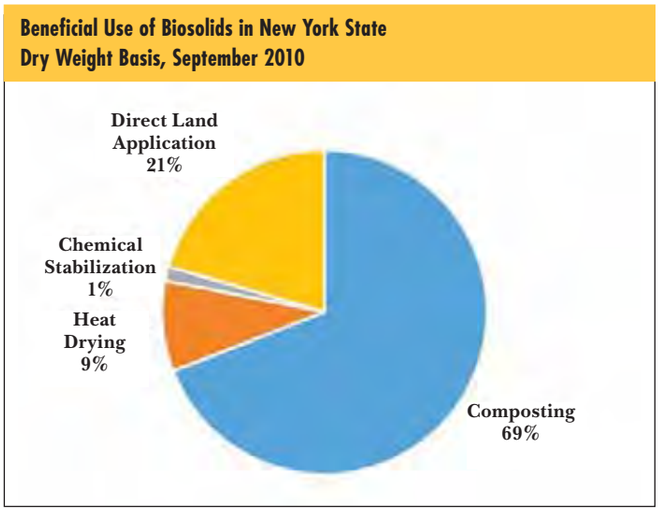

Figure 2. "Beneficial Use of Biosolids in New York State," NYSDEC, *June 2011 Report*

Figure 2 shows the results from the 2010 survey for the beneficial use of biosolids in New York State, based on the dry weight tonnages being sent for beneficial use to each type of facility.

This survey highlighted some trends. Back in 1992, the Ocean Dumping Ban Act went into effect and prohibited the disposal of sewage sludge into the ocean, which had been the disposal method of choice for the POTWs in New York City and a few on Long Island. During the 1990s, more than 50 percent of the biosolids were beneficially used, including biosolids that were formerly disposed in

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the ocean. Since the 1990s, a number of changes occurred, that affected the amount of biosolids recycled in the state. Landfill tipping fees have dropped and some treatment plants, including those in New York City, have moved away from beneficial use. Also, aging equipment and new regulations have reduced the number of incinerators across the state. These trends can be seen in ***Figure 3***, below.

When the 2010 survey was conducted, 45 facilities in New York State were permitted for beneficial reuse of biosolids. Today (2016) the total count of NYSDEC-regulated beneficial use facilities is 47, although the total quantity of biosolids has decreased. The number of land application facilities has increased to 20, with only 1 heat drying facility and 1 air drying facility operating under Part 360 regulation.

NYSDEC supports the beneficial use of biosolids. However, if landfill tipping fees continue to remain low in New York State, it is likely that the amount of biosolids recycled will remain stagnant for the next few years. NYSDEC plans to conduct another biosolids survey at all POTWs in the Spring of 2016 and once again publish a report on the results. A copy of the 2010 report referenced in this article can be found at the following link: *http://www.dec.ny.gov/docs/materials_minerals_pdf/bioreprt.pdf.*

Changes in Biosolids Management in New York State (% Dry Weight)

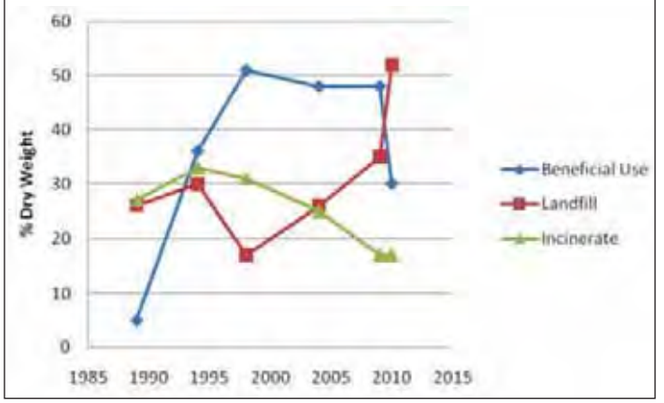

Figure 3. Changes over time in "Biosolids Management in New York State," NYSDEC, *June 2011 Report*

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http://www.dec.ny.gov/docs/materials_minerals_pdf/bioreprt.pdf

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Thermal Hydrolysis with Anaerobic Digestion: State of the Practice

by Todd O. Williams, PE, BCEE

With ever increasing attention to cost, biosolids quality, and resource recovery, the thermal hydrolysis process (THP) has been introduced as a pre-treatment to mesophilic anaerobic digestion (MAD). This relatively new - and sometimes cost effective - technology alternative is being implemented in water resource recovery facilities that focus on biosolids management.

What is THP?

The THP utilizes both high temperature and high pressure to pre-treat sludge prior to anaerobic digestion. The high temperature (~160°C) of the THP, combined with high pressure (6 bars for roughly 30 minutes) effectively lyses, or breaks down, bacterial cells. More importantly, the process disrupts the exopolymetic substances (EPS) in waste-activated sludge (WAS). The presence of EPS, carbohydrate-based microbial polymers, prevents solids from dewatering as completely as desired. The high temperature of this process also pasteurizes the solids to Class A standards, as long as the time and temperature exposure can be verified. Subsequent anaerobic digestion stabilizes the solids to a low-odor non-putrescible state, meeting US EPA standards for Class A pathogen reduction and approved vector attraction reduction standards.

The Thermal Hydrolysis Process is most effective on Waste Activated Sludge only; the primary disadvantage is that only Class B biosolids are achieved.

Several vendors, including Cambi, Veolia, Sustec-TurboTec and Haarslev, are developing or expanding their thermal hydrolysis technology offerings. Today, more than 50 THP installations are in operation at domestic wastewater facilities around the globe *(Table 1)*.

Table 1. THP Installations in Operation at Domestic Wastewater Facilities Worldwide

THP Vendors as of 2015	Full-Scale Facilities Built (const.)	Capacities of Installed Base DT/Day	Since
Cambi – THP	35 (+17)	6 to 360	1995
Veolia – Exelys	1 (+2)	7 to 60	2010
Veolia – Biothelys	5 (+2)	3 to 80	2004
Sustec – TurboTec	1 (+1)	20 to 35	2012
Haarslev	2 (0)	20 to 25	2014

Source: Vendor supplied information on websites

In the North American marketplace, the emphasis is growing on producing Class A exceptional quality biosolids products. Unlike traditional Class B quality biosolids which are primarily used in agriculture, Class A quality biosolids can be applied to a range of diverse end uses. Not only are there fewer regulatory limitations, but since Class A quality biosolids are low odor and will not decay, their use draws less public opposition than that of Class B quality biosolids.

For these reasons, many utilities in North America are in the process of building or planning to install THP systems to process both primary and waste activated sludges prior to anaerobic digestion. For example, DCWater installed the first THP facility in North America using the Cambi technology. In its first year, this facility has achieved both a dramatic decrease in solids being land-applied and significant energy recovery in the form of biogas that is gen-

Table 2. Advantages and Challenges to THP Implementation

Advantages	Challenges
• Digesters can be fed at up to 10 percent solids concentration due to decreased sludge viscosity.	• A high solids thickening/dewatering step prior to THP is required to achieve the desired 16 percent total solids content.
• Solids retention time is reduced due to faster reaction kinetics.	• Additional solids screening to approximately 6 mm is needed.
• The required digester volume is reduced by more than half due to the combination of higher solids concentration and lower solids retention time, as compared with conventional anaerobic digestion.	• Low pressure steam needs to be provided, which adds complexity and requires significant amount of biogas to fire a steam boiler.
• Increased volatile solids destruction.	• There is a cooling demand on the hydrolyzed solids prior to digestion.
• More biogas production in digestion.	• There is a need for sterile water for use in post THP processes such as dilution water, polymer addition, and wash waters in dewatering.
• Elimination of digester foaming problems.	• More attention is required at higher digester loading rates to keep digester feeding even.
• Less polymer consumption during dewatering.	• Higher rates of biogas production must be managed by the biogas systems.
• Higher dewatered solids content, typically 3 percent to 5 percent total solids higher than without THP.	
• Elimination of pathogen regrowth or sudden increase phenomena after dewatering.	
• Lower cake odor.	
• Significant reduction in cake mass.	
• Class A cake biosolids.	

erating over 10 MW of electrical power (Personal communications with Chris Peot, DCWater, 2015).

THP with anaerobic digestion offers several advantages over conventional mesophilic anaerobic digestion alone. Although the benefits are significant, there are also challenges with THP processes ***(Table 2)***.

As utilities consider means to minimize their energy footprint, maximize sustainability and minimize capital outlay for solids improvements, other nuances to the application of THP become apparent. Specifically, THP is most effective on waste activated sludge as primary solids are readily digested without the need for supplemental hydrolysis pretreatment. For these reasons, utilities and engineers are considering applying THP to streams with waste activated sludge only (WAS-only), rather than to the entire sludge stream.

The Benefits of Waste Activated Sludge Only THP

CH2M has compared the overall life cycle of WAS-only THP versus THP of the entire sludge stream and found this to be a favorable solution in many cases. THP of WAS-only streams could be a more economical choice if a wastewater utility does not need to achieve Class A status for their biosolids through digestion. Other key benefits of WAS-only THP installations compared to full THP of WAS and primary solids include:

- Significantly less (50 percent) steam/heat energy is required
- Significantly smaller pre-dewatering and sludge screening system
- Less polymer use in pre-dewatering
- Smaller THP system
- No or little supplemental cooling is required by using primary sludge to cool the THP solids prior to digestion
- Digester throughput is increased due to the increased treated WAS solids content
- More biogas is available to fire a combined heat and power system
- More favorable overall energy balance results
- No need for sterile polymer dilution or wash water in post dewatering

The major disadvantage with WAS-only THP is that only Class B biosolids will result. This may not be a concern for utilities where Class B biosolids land application is already practiced, or where subsequent downstream Class A processes such as heat drying are also included.

As engineers and utilities consider the application of THP with anaerobic digestion for plant improvements or upgrades, evaluating the merits of applying THP to WAS-only should be part of the analysis. This is especially true in locations where higher unit energy costs prevail and when capital is a limiting factor.

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Increasing Methane Generation from Your Anaerobic Digester

by Mark Greene

According to the American Biogas Council *(2016)* there were over 2,100 sites in the United States producing biogas in 2015: 247 anaerobic digesters on farms; 1,241 wastewater treatment plants using an anaerobic digester (approximately 860 currently use the biogas they produce); 38 stand-alone (non-agriculture and non-wastewater) anaerobic digesters; and 645 landfill gas projects.

The majority constituent of biogas is methane, and it is commonly used as fuel to generate hot water, steam, electricity, or heat. Biogas purified to high quality methane gas, similar to pipeline-quality natural gas, can be pressurized and injected into an existing natural gas pipeline. In addition, biogas can be liquefied for storage or even used as a vehicle fuel. Increasing digester methane generation will have a direct impact on reducing the cost of energy purchases when the resulting biogas is used to displace the purchase of other fuels.

There are several ways to increase methane generation in your digester; the more volatile solids you feed your digester, the more methane you will make. The factors that should be considered when evaluating the feasibility of increasing methane generation in your facility include: digester capacity, digestion process stability, characteristics of the feed sludge, modification of digestion processes, impacts to other aspects of the wastewater treatment process, and beneficial use of the extra methane generated.

Digester Capacity

The first step is to determine the existing digester loading and calculate the available capacity. Several sources are available to identify your digester capacity, including: the design basis report for your publicly-owned treatment works (POTW); design guidelines like Ten States *(GLUMRB, 2014)* and TR-16 *(NEIWPCC, 2011);* performance of comparable WWTPs; and the regulatory requirements for disposing of your sludge.

It is likely that sludge disposal regulations will dictate your maximum digester loading capacity. For example, your digester may have a design basis of 80 pounds of volatile solids per thousand cubic feet per day (ppd VS/kcf). If your feed sludge is 1.8 percent volatile solids (VS) at a loading of 80 ppd VS/kcf, the solids retention time in your digester would be 14 days. This retention time is non-compliant with the USEPA biosolids rule *(40 CFR Part 503)* that sets a regulatory minimum limit of 15 days of detention in a mesophilic digester for sufficient vector attraction and pathogen reduction purposes. In this example, your maximum loading would be limited to 75 ppd VS/kcf and your available capacity for additional volatile solids would be lower. However, if the VS in the feed sludge was increased to 4.8 percent VS, a 15-day solids retention time at 80 ppd VS/kcf loading would mean a capacity increase of 2.7 times over the previous example, resulting in more available digester capacity.

Photo courtesy Mark Greene

Four 65-kw microturbines for converting biogas into electricity and heat are shown here.

In addition to limitations arising from sludge disposal regulations, your digester capacity may be limited by the mechanical systems associated with its operation, like mixing, heating, feed sludge concentration, and the nature of the feed solids. Modern digester mixing systems are more efficient than older ones, and improved mixing provides better VS destruction with the associated increase in methane generation. There are several mixing systems that meet the modern designation including hydraulic, biogas-driven, and mechanical systems. An economic life-cycle analysis and a survey of experiences at other facilities can assist in the decision on which mixing system is most appropriate for your facility.

Digestion Process Stability

Adequate mixing will maintain a uniform temperature throughout your digester and allow for maximum contact between anaerobes and VS. This is important for stimulating the maximum rate of the biological reactions that lead to VS destruction. Anaerobic bacteria are slow growing; they convert most of the carbon they ingest into methane and carbon dioxide gases, with very small amounts of carbon going into making new cells. Small changes in temperature can slow down, even temporarily, the methane-generating activity of the anaerobes, so it is important to maintain a stable digester temperature. About 75 percent of the heat demand in a digester is used to bring the feed solids' temperature up to digester levels. The other 25 percent of the heat demand is applied to overcoming heat loss through the walls and cover during cold weather months. Ensuring adequate heating capacity is a necessary component to maintain stable digester operating temperature and optimized methane generation.

While increasing mixing energy input has been an attractive solution for digester designers to increase the biogas generation rate, digester over-mixing is becoming a concern as it contributes to rapid rise foam formation. Rapid rise foam formation results from excessive and rapid lowering of the density within the digester. Density gradients can be created as a result of too little mixing, which allows pockets of gas to accumulate, or too much mixing, which can entrain gas on a wider scale. Temperature gradients and variability in feeding can also foster density gradients. Other factors that may cause foaming include: changes in feed rate or composition; changes in mixing regimen; power outage/shutoff of mixing; inadequate or excessive heating; and rapid digester pressure drops. Even under the best of circumstances there will be some foaming, so most digesters are designed to accommodate some of this nuisance foaming. Codigestates like FOG (fat oil and grease) and food wastes may add to the potential for nuisance foaming.

Characteristics of the Feed Sludge

Increased feed sludge VS concentration has a direct impact both on methane generation and on the detention time in your digester. The higher the feed concentration, the longer the detention in the digester and the greater the methane generation per pound of feed VS. There are several methods to increase the feed sludge VS concentration, and therefore increase the production of biogas. Some digesters that receive highly soluble food wastes have installed recuperative thickening devices to increase digester VS concentrations. Another common practice is to co-thicken primary solids with waste activated sludge (WAS) to increase feed VS concentration. Mechanical sludge thickening systems typically yield higher feed solids concentrations than gravity thickening systems.

Primary treatment solids are more digestible than WAS solids, therefore enhancing primary treatment to capture more solids can lead to greater methane generation due to a higher loading proportion of primary solids compared to WAS. There are several technologies that have been proposed, tried and, in some cases, installed to make WAS more digestible. These technologies include hydrolysis, disintegration, oxidation and pasteurization techniques.

- Hydrolysis technologies are utilized primarily as pretreatment for WAS prior to anaerobic digestion. Hydrolysis is a chemical reaction that can split or break down chemical compounds through the addition of water to a covalent bond. Encouraging these reactions in wastewater sludge can be beneficial, as hydrolysis reactions can break open cell walls of microorganisms, making the sludge more readily biodegradable. Hydrolysis processes can be induced or encouraged in sludge through the addition of heat, chemicals, enzymes, or a combination of those factors. Examples of these technologies are: thermal hydrolysis (Cambi™, Exelys™), thermo-chemical hydrolysis (LysteMized™), and enzymatic (Enviro-zyme®).
- Disintegration processes are used as pretreatment prior to anaerobic digestion or as treatment of a portion of a sludge recirculation flow. Sludge can be disintegrated in various ways: mechanically; electrochemically, by applying high voltages;

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Photo courtesy Mark Greene

A floating digester cover that provides a small amount of biogas storage volume

Photo courtesy Mark Greene

A biogas storage sphere

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Typical primary and secondary anaerobic digesters *Photo courtesy Mark Greene*

by sending ultrasonic sound waves or microwaves through the sludge; and by cavitation. Examples of these technologies are: mechanical (MicroSludge®[1], SBM Ball Mill), electrochemical (Bio-Crack®, OpenCEL®)[2], ultrasonic (Sonix™, Sonolyzer™), and cavitation (Siemens Crown®, Mitton Valve).

- Oxidation is a chemical reaction where an oxidizing agent or oxidant loses an electron. These reactions are coupled with a simultaneous reduction reaction, where a compound accepts or gains the electron lost through oxidation. Through the combined process of these reactions, chemical compounds can be broken down and transformed. When these reactions are used to treat sludge, they can cause microbial cells to rupture, improving the biodegradability of the sludge and minimizing overall sludge production. Oxidation of sludge can be catalyzed through the addition of strong oxidants, such as ozone and hydrogen peroxide, or by using thermal combustion. Examples of these technologies are: ozonation (Praxair), chemical (riOx™ hydrogen peroxide, CleanB proprietary process), and thermal (Thermylis™).
- Pasteurization is a stabilization process that holds a substance at a high temperature for a specified period of time in order to kill or inactivate pathogenic organisms. The time and temperature of pasteurization required to adequately kill or inactivate pathogens in sewage sludge can depend on a variety of factors, including the sludge concentration, the pH of the sludge, and if there are any warming gases contained in the sludge. The Eco-Therm™ process is an example of a continuous pasteurization technology that has been applied to digester feed sludge with heat recovery for minimization of energy consumption. While the Eco-Therm™ process is reported to significantly increase existing digester capacities, pre-pasteurization is not proven to increase volatile solids reduction or improve biogas production when used as a pretreatment to anaerobic digestion (Lukicheva, 2009). When a batch pre-pasteurization process was tested in the UK, no evidence of increased digestibility of the sludge was reported. Still, when the Eco-Therm™ process was used at a WWTP in Hemet, California, the overall volatile solids reduction (45 percent–55 percent) was at least similar to reduction values reported for normal digestion processes *(Lukicheva, 2009)*.

[1] Paradigm Environmental Technologies Inc. the provider of MicroSludge® may not be currently offering this product.
[2] OpenCEL® is a Research Development Initiative of Trojan Technologies and may not be a commercially available product.

Although these techniques – hydrolysis, disintegration, oxidation and pasteurization – have been identified as methods to improve WAS biodegradability, WAS destruction should be considered as a last option when optimizing your digester for maximum methane generation. The small amount of additional methane that may be produced by WAS destruction has not been worth the additional complexity of treatment processes, greater operator attention and increase in cost.

Modification of Digestion Processes

If you are looking for more digestion capacity, the addition of a smaller thermophilic acid digester may provide that capacity for a much lower capital cost. This is a two-phase modified anaerobic digestion process that increases digestion efficiency and methane generation by separating the acid and methane forming digestion phases into two separate reactors with different temperatures and detention times. One example of this two-phase digestion is the 2PAD® process, which utilizes a thermophilic acid phase with a mesophilic methane phase. The system can be retrofitted into an existing plant or built as an entirely new operation. In the 2PAD® process, sludge is first heated with a heat recovery exchanger and a hot water boiler, powered by biogas produced in the system. Heated sludge is then detained in the well-mixed thermophilic acid phase digester (at 55° C) for two days. Following thermophilic treatment, the hot sludge is cooled to 37° C (using the heat recovery exchanger that recycles heat to raw sludge) before it enters the mesophilic digester. The sludge is retained and mixed in the mesophilic digester for 10 days. Methane generation and VS destruction rates have been found to be similar to single stage digesters at a 40 percent shorter detention time *(Kabouris, 2009)*.

Theoretically, any biodegradable biomass can be used as feedstock for methane production. However, waste feedstocks are not equally degraded or converted to methane through anaerobic digestion, and their potential for biogas production varies in terms of carbon to nitrogen (C/N) ratios. Feedstocks with either excessive carbon or nitrogen can result in poor digester performance and biogas with low methane content. Nitrogen is released as ammonia during digestion and high levels of ammonia in the digester can be directly inhibitory to the anaerobes. Feedstocks containing high C/N ratio could be mixed for codigestion with those containing low C/N ratio to obtain a desirable C/N ratio for the digester feed.

Codigestion is the simultaneous digestion of a homogenous mixture of two or more substrates. The most common situation is when a major amount of a main feedstock (e.g., sewage sludge) is mixed and digested together with smaller amounts of a single or a variety of additional feedstocks. Implementation of codigestion at wastewater plants is increasing; however, implementation should not come at the expense of anaerobic digestion process stability. Some research has been conducted to measure the potential impacts of particular organic wastes in a codigestion feedstock arrangement on an anaerobic digestion system *(USEPA, 2014)*. The most common screening tool is benchtop batch digestion to measure the biochemical methane potential from the feedstock and assay the benefits of different mixture proportions under consideration *(Zitomer, 2008)*. Other experiences have been developed by gradual addition of new feedstocks into an existing digester operation and carefully monitoring their impact on process stability before increasing the proportion of new feedstock further *(Bevington, 2014)*.

It has been shown that codigestion can improve methane generation yields and provide good digestion process stability. Most anaerobic digesters with multiple feedstocks perform codigestion with between three and five sources concurrently, leading to approximately 10 percent higher methane yield compared to single feedstock digestion *(Wu, 2007)*.

The best method for improving methane generation rates is to feed digesters as steadily and as continuously as possible, especially when FOG and other high-strength organic wastes are added to the feed. To maintain steady, continuous feed rates in the face of factors such as the uncertainty of feedstock availability, long-term contracts with waste producers can be set up for this purpose. Many industrial facilities would prefer to spend their time making their products rather than making repeat arrangements for disposal of their wastes. Long-term contracts can be a win-win solution for codigestion facilities and industrial clients.

Impacts to the Other WWTP Operations

Your digester is not a stand-alone piece of equipment; it is a component of your treatment process. What you feed the digester in order to increase methane production may have impacts on other WWTP operations, especially secondary and/or tertiary liquid treatment processes. An anaerobic digester converts carbon to methane and carbon dioxide. The destruction of volatile solids releases ammonia and phosphorus into the liquid phase. Solids dewatering subsequently sends these substances to your liquid treatment processes in the filtrate/centrate return stream. If your plant is removing nutrients to meet tight effluent limitations, this additional nutrient loading from return streams needs to be considered, particularly when utilizing codigestion in your process.

Finally, the capacity of your solids handling system would need to be evaluated when outside feedstocks are brought in to generate more methane. Dewatering digested sludge typically yields higher cake solids concentration when digesters have higher VS destruction. Also, codigestion of food scraps has shown better dewaterability in some proportions. You may find that you need to operate your dewatering unit for longer periods and with high frequency to accommodate the larger solids loads from codigestion.

Beneficial Use of the Extra Methane Generated

Once you've made the improvements to your system, and your digester begins to generate more methane, its value is only realized if you use the additional methane to displace other energy purchases. You may need to expand biogas storage beyond what a floating cover can provide so you can maximize your methane consumption while dealing with variable methane generation from your digester. Biogas spheres or membrane covers can be installed to increase the biogas holding capacity at your plant. To determine the adequate size for biogas storage, take into consideration both the generation rate from the digester, and variable consumption energy needs of your plant.

The bottom line is that there are several ways to tune up your digester, as well as different options for feeding more organics to your digester, in order to generate more methane. The real value of generating more methane is in the utilization of this energy source as a means to replace other energy sources to save on energy costs.

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Casella Turns on Schwing Bioset: The Introduction of Advanced Lime Stabilization

by Jen McDonnell, Jeff McBurnie, Tony Barbagallo and Jeff Brinck

Chateaugay is a town located at the northernmost edge of eastern upstate New York, along the international border with Quebec, Canada. Chateaugay, a community of 2,000 residents, is the birthplace of Orville Gibson of guitar-making fame, and the source of award-winning McCadam's aged cheeses. Most recently, this small town is the location of the Grasslands Agricultural Manufacturing Facility, producer of the Class A biosolids product *Fertilimer*™

Grasslands is a merchant biosolids processing plant owned and operated by Casella Organics (Casella), a division of Casella Waste Systems of Rutland, Vermont. Formerly a compost operation, the facility is located on a 366-acre farm. It re-opened in March 2012 with equipment for advanced alkaline stabilization of wastewater solids. Using the Schwing Bioset process, Grasslands has the capacity to process 40,000 tons of solids per year.

Selection and Pilot Testing

Casella carefully considered many factors in its selection when choosing the Schwing Bioset process. While cost is always a factor, other criteria included affordability and scalability of technology, among others. The most important criterion, however, was conformance to Class A standards. As a residuals management service provider to multiple publicly-owned treatment works (POTWs), the Grasslands Facility needed to be adaptable to significant feedstock variability, unlike the consistent composition of solids from a single source. And since Grasslands is located in proximity to an extensive agricultural land base, the selected technology needed to generate a desirable product for farmers.

Photo courtesy Casella Organics

Front-view of the Bioset Reactor

For these reasons, Casella chose the Bioset process from Schwing Bioset, Inc. This is a technology comparatively new to the market place for advanced alkaline stabilization. The process utilizes a controlled exothermic reaction to pasteurize sludge with the addition of lime and sulfamic acid in such a way that it meets the time, temperature and pH standards of 40 CFR Part 503 regulations for Class A pathogen reduction and for vector attraction reduction (VAR). The Bioset process was approved by the EPA Pathogen Equivalency Committee in 2011.

With Bioset, solids and chemicals are mixed in a twin screw feeder and pumped with a piston pump through an insulated reactor vessel. The two chemical inputs, both readily available, are quicklime and sulfamic acid. The chemical reaction creates an ammonia-rich environment within the reactor, allowing an EPA-approved reduced minimum temperature of 131°F (55°C). Strategically placed temperature probes document conformance with minimum temperature requirements. All heat is created via chemical reaction, and no external sources of heat are used. The process is controlled via a single touch-screen control panel.

Because Grasslands would be the first large-scale merchant facility for the Bioset technology, Casella decided to initially lease and operate a mobile pilot facility. Schwing Bioset, Inc., provided this mobile facility, to both prove out the concept and help inform the design of the full scale facility. In early 2012, the mobile pilot facility was installed in a building formerly part of the composting operation. A key objective in this pilot testing phase was to assess how the variability of feedstock quality would impact the processing parameters of time, cost and final product quality.

The one-year pilot testing was successful. Through the pilot testing, significant lime storage and transport issues arose that were overcome by design improvements. In late 2012, Casella began construction of the full scale facility; start-up occurred in early 2013, and commissioning was completed in July 2013.

Full-Scale Implementation

The full-scale Grasslands Facility infrastructure includes: a scale; receiving building; processing building; lime silo; offices; laboratory; maintenance garage with wash bay; storm water collection and treatment infrastructure; and ample covered and uncovered storage located on top of asphalt pavement. The 4-acre facility is permitted to receive an average of 250 tons per day of dewatered solids, and to store up to 29,750 cubic yards of finished product for up to 24 months. All inputs are managed in an enclosed receiving area, where they are prepared for active processing. After active

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Photo courtesy Casella Organics

Entrance of the 4-acre Grasslands facility in Chataugay, NY. Heated garage bays are visible.

Photo courtesy Casella Organics

Tractor with spreader loaded to distribute *Fertilimer* on farm fields

processing is completed, the product is placed in storage until it is distributed to agricultural markets.

Unlike other alkaline stabilization processes that rely upon external heat sources and subsequently lose the high pH shortly after processing, the Bioset process results in a product that maintains its Class A Exceptional Quality (EQ) status with respect to pH for months after processing.

The essential reaction in Bioset is called slaking. This is the exothermic reaction of quicklime with water to form calcium hydroxide: $CaO^{+}\ H_2O \Rightarrow Ca(OH)_2$. To this is added the reaction of quicklime with sulfamic acid which, together with slaking, generates enough heat to raise the temperature of the sludge above 55°C, a temperature effective for inactivating pathogens in the material. Slaking also raises the pH above 12 and releases ammonia at a concentration of 0.5 mg/NH_4/g dry weight. These are two effective biocides.

The Bioset process is operated through a single control panel and SCADA (Supervisory Control and Data Acquisition) system. Remote HMIs (Human-Machine Interfaces) allow the system to be monitored and adjusted from either the adjacent office or wirelessly by the loader operator who is filling the system's infeed hopper. All material feed rates are variable and need to be adjusted to predetermined set-points for each specific recipe of merchant sludges that the facility is processing at any given time. The SCADA system displays and records key data points throughout the process, and contains controls that allow operators to change the settings from touch screens at multiple points in the building.

Once all processing parameters are met, the biosolids exit the Bioset vessel into the product discharge building. The product, marketed as *Fertilimer*™ for its high nutrient and liming value,is moved onto the product storage pad for the curing stage. The operators push up the product piles, rotate stored material to enhance product drying, and manage the inventory to maximize storage space and shed rain and snow. Product inventory is tracked and updated regularly to help predict product storage capacity and product availability for sale.

Lessons Learned

Casella has learned important lessons in its two years of operations using the Schwing Bioset process:

- The equipment was not designed to handle the higher solids contents being realized by recent advances in dewatering technologies. To solve this problem, higher solids sludges are bucket-blended with lower solids sludges prior to loading into the infeed hopper.
- The original discharge piping had several bends in it that caused too much back-pressure in the reactor, resulting in plugging. The elimination of all bends, combined with the pre-blending of high solids sludges, has reduced the incidence of blockages.
- The recipe needed for each sludge and sludge blend varies significantly not only by types of sludge but also by the material's temperature. In the end, achieving and maintaining the most cost-effective recipe is more art than science.
- The original system did not log data. Adding this feature later on turned out to be more complicated than if it had been included in the original system package.
- The old adage was reconfirmed that you can never have too much product storage area.

The Grasslands Agricultural Manufacturing Facility operates as a great example of a successful merchant biosolids processing facility. *Fertilimer* is showing itself to be a product that improves soil health and fertility, increases crop yields and closes a resource loop. The success of *Fertilimer* is, however, the intersection of an effective product, good service to farmers, and a nurtured relationship with the community. For the farmer, stockpile duration in the field is monitored closely. Casella loans appropriate spreading equipment to customers and avoids spreading *Fertilimer* during sensitive times or in high traffic areas. For the community, Casella proactively communicates with municipal officials, local stakeholders, and neighbors in advance of using application equipment. Visitors are always welcome, and Casella holds to housekeeping standards to make this possible. Casella also supports local events in this tight-knit agricultural community, such as supporting a Future Farmers of America chapter.

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High Quality Biosolids from Wastewater Research Project:
A WERF Sponsored Study to Shape Future Standards

by Trudy Johnston and William Toffey

Biosolids technology developments over the past 20 years are transforming our expectations for biosolids quality. Thermal hydrolysis for pretreating sewage was introduced in the 1990s in anticipation of increased biogas yield for electricity production, but the process also greatly improved odor qualities. Phosphorus removal during wastewater treatment has helped plant managers to reduce struvite mineral build-up within treatment systems, but now it may hold promise for improving the balance of nitrogen and phosphorus for land application. Twenty years of research into odorant emissions and pathogen regrowth in dewatered solids has given direction to technology developments that achieve improved stability.

Technology has outgrown the 20-year-old state and federal regulations which today are the basis for decision-making by public agencies for capital improvements. The US EPA's Standards for the Use or Disposal of Sewage Sludge (40 FR Part 503) from 1993 are not a distant memory, but are still the current regulations governing biosolids. Unfortunately, these Technical Standards no longer provide a driver toward improving performance of treatment processes and utilization practices.

The District of Columbia Water and Sewer Authority (DC Water) has demonstrated that a new set of targets for biosolids treatment, beyond Part 503, are warranted and that the results can be compelling. DC Water has rolled out its new integrated system of thermal hydrolysis, anaerobic digestion, belt press dewatering and co-generations, including design of soil products for marketing. The system is a prime example of a public investment based on a higher target for performance beyond meeting minimum regulatory standards.

The Water Environment Research Foundation (WERF) approved funding for a project titled High Quality Biosolids from Wastewater (WERF project #NTRY7R15) with the goal of creating new standards relative to High Quality Biosolids. WERF has contracted a team of agencies – with DC Water at its heart – along with a working panel of universities, public agencies, and consultants to help define "High Quality Biosolids," or HQB. This team will: examine new ways of measuring "stability;" create products that meet customer specifications; demonstrate product performance; and market products to potentially generate revenue for the producer.

The research project is split into four separate tasks:

- **Task 1:** Establish a parameter, or combination of parameters, that will directly correlate to biosolids odor potential.
- **Task 2:** Document the efficacy of high quality biosolids in meeting product requirements and address challenges that could encourage (or limit) their use in urban and suburban applications.
- **Task 3:** Develop a guidance tool for identifying and assessing markets for high quality biosolids.
- **Task 4:** Test methods of sharing the research findings from Tasks 1 through 3.

Task 1: Establish Parameters

A group of 18 agencies that use various combinations of technologies to produce both exemplary and typical biosolids will participate in the study. Samples of these biosolids will be supplied for odor and chemical assessment. A smaller subgroup of eight of these biosolids samples will also be assessed for attractiveness to house flies, the one vector of most direct relevance to biosolids management. The odor and chemical assessment tests will be performed at Penn State University, while testing for attraction of flies will be conducted at Kansas State University.

The parameters quantified in Task 1 research fall into three broad categories: odor parameters (human odor assessment; including Dilution-to-Threshold, Recognition Threshold, odor intensity, hedonic tone); chemical parameters related to stability (pH, Total Volatile Solids, SOUR, Oxitop®, methionine content, Fatty Acid Methyl Ester analysis); and bioassay parameters (fly ovipositing percentage, survival to pupation, adult emergence). The relationships between the dependent odor parameters and independent chemical and bioassay parameters will be investigated using several multivariate statistical techniques. Ultimately, Task 1 will identify the combination of predictive measurable variables that can be used to identify a high quality biosolids product based on its low potential to generate objectionable odors and remain stable until the time of use.

Task 2: Document Efficacy and Address Challenges

During the first year of the project, established Exceptional Quality (EQ) and HQB products already generated and marketed in the United States will be compared with three to four products being developed by DC Water through its new system of Cambi® thermal hydrolysis, digestion, and belt press dewatering. Properties of the products will be analyzed for agronomic and environmental attributes aimed at growing and sustaining vegetation in disturbed urban soils. Virginia Tech and the University of Maryland will be spearheading the product blending and demonstration studies.

In the second year of Task 2, three field research sites will be established in degraded urban soils in Virginia, Washington DC, and Maryland. Data collected at these sites will be used to determine and demonstrate the benefits of various EQ biosolids products on soil and water quality, and vegetation establishment and maintenance. At each site, two to three DC Water EQ biosolids product blends designed for urban and suburban vegetation establishment and maintenance will be compared with two established EQ biosolids products and a non biosolids-based compost at nutrient management-based recommended rates. The research will cul-

minate in comparisons of the chemical and physical property data of EQ biosolids products. Results of these comparisons will identify the best processes for developing the ideal agronomically and environmentally beneficial products for rehabilitating urban soils.

Task 3: Develop a Guidance Tool

The Task 3 guidance tool for identifying and assessing markets for high quality biosolids will be based on case studies of successful programs. The guidance tool will be tested in the Washington DC regional area. The team will first create a survey for distribution to utility managers with high quality biosolids experience. The survey will be used to determine the managers' definition of success, in terms of a high quality biosolids marketing program, and to identify the necessary steps they have taken to achieve success. Specific attention will be given to: the methods used to identify and target appropriate beneficial use markets; how connections were made with local customers; and how to improve product(s) to meet market demands. A second survey will be designed and distributed to product users to identify the desired biosolids characteristics and utility operations critical for continued biosolids use. Specific attention will be given to the relative importance of product quality, product availability, and transportation.

Task 4: Sharing Research Results

The final task for the research project is to test methods of effectively sharing the research findings from the first three tasks. Traditional communication products such as reports, brochures, updates, webinars and workshops will be used. These are one-way flows of information. In addition, the team will also draw on the power of social media to create a community network of biosolids producers, distributors and users. The network will be fostered within LinkedIn and Facebook websites. The research team will extend invitations to join these groups, as they prepare inventories of biosolids marketing programs and follow up with on-line and direct surveys.

The intent of this element of the research is to foster interaction among participants. Members will be requested to share information about their marketing programs, such as problems solved and success stories. Contributions in written, audio and video formats will be requested. The measure of success will be on the number of participants, the number of posts, and the pace of enrollment of new participants as the sites are shared. Material from the groups will be posted to the research website. Google Analytics will be deployed over the course of the research project to measure changes in traffic to the website.

The High Quality Biosolids research project has established groups in Facebook and LinkedIn that wastewater professionals can join to learn more about the results and to share their experiences with technologies and products. The research project also has a website where project updates will be posted (www.highqualitybiosolids.com).

The research team believes that its findings will help set the wastewater profession on course to create new biosolids technology performance and product standards. You are invited to follow us and join in the effort.

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Respect the Housefly: The True VAR Target

by William Toffey

The housefly deserves your highest respect.

Musca domestica, as scientists have named it, is a common resident of every continent except Antarctica. The housefly relishes sweet, fattening foods, so it is no surprise that it is synanthropic, meaning that it thrives in proximity to humans. And it is committed to making good use of manure, biosolids and organic residuals. While you and I seek to use the nutrients and organic energy of biosolids, the housefly is looking to lay its eggs. This is why we, in the wastewater profession, really need to respect the housefly.

When we are working to meet Vector Attraction Reduction (VAR) goals in our biosolids processes, we should hold a mental picture of the housefly in mind. For all practical purposes, the "vector" in Vector Attraction Reduction is almost exclusively the housefly. Houseflies are incredibly efficient mechanisms for spreading microbes. That is what they are doing when swarming organic residuals (filling their mouth parts with microbes) and feeding on your picnic lunch (regurgitating microbes to stimulate decay). Some of these microbes are human pathogens. Potato salad on a warm summer day is a great breeding ground.

Who among us, working at a WRRF or a land application site, has not been unpleasantly shocked by the flies harboring inside our cars' windshields? Flies are highly attracted to a suite of light, water-soluble organic chemicals that easily deposit on our hot windshields when odorous, humid air evaporates. If the glass were instead a moist bed of decaying organic material, the fly would deposit her eggs and seven days later new flies would emerge.

You get the picture. Houseflies are not benign, incidental nuisances to your operations. They are a meaningful threat to human health and, more specifically, to your health.

Houseflies deserve your respect at the plant or in the field. We should aim to stop flies from hitting on biosolids. We need barriers – be they tarps, lime or soil – to prevent fly landings, egg-laying, and pathogen transmissions. We need to keep our workplaces clean of even small piles of biosolids and muddy surfaces. Better yet, we need treatment processes that produce, at the end of the day, a material that it so well treated it attracts no flies.

To help the industry better understand the connection between treatment processes and VAR, the WERF High Quality Biosolids research project is including a "fly attraction" component. Our website, *www.highqualitybiosolids.com* has a resource page that has reference materials pertaining to the natural history of *Musca domestica* and the aspects of its life cycle that connect flies to serious health issues.

Wheatfield and quasar energy group: Lessons Learned and the Road Ahead

by William Toffey and Ned Beecher

Zero-waste and renewable energy concepts are popular in many communities. Organic wastes, recoverable for nutrients and energy, have joined plastics, metals, and paper as recyclable materials. Although biosolids can be part of such a community recycling program, the wastewater profession needs to be ready to sell the idea. For one company in Western New York, local opposition to a comprehensive organic waste recovery program provided an opportunity to learn how to address public concerns.

quasar energy group (quasar) is well experienced in anaerobic digestion of organic waste. The company has designed and built 14 anaerobic digestion facilities in Ohio, New York, Maine, and Massachusetts; **quasar** also operates most of these facilities. These are co-digestion systems (biosolids and other residuals) with biogas-fueled electricity generation, and each utilizes land application for management of digestate.

In 2012, **quasar** commissioned two new projects in Western New York, and secured the state approvals required to move forward with a comprehensive organic waste recovery program. Everything seemed in place – permits, local employees, farm customers, and beneficial use approvals. One final component was needed: digestate storage ponds. The company needed local permits to construct these ponds, and that's when local opposition emerged.

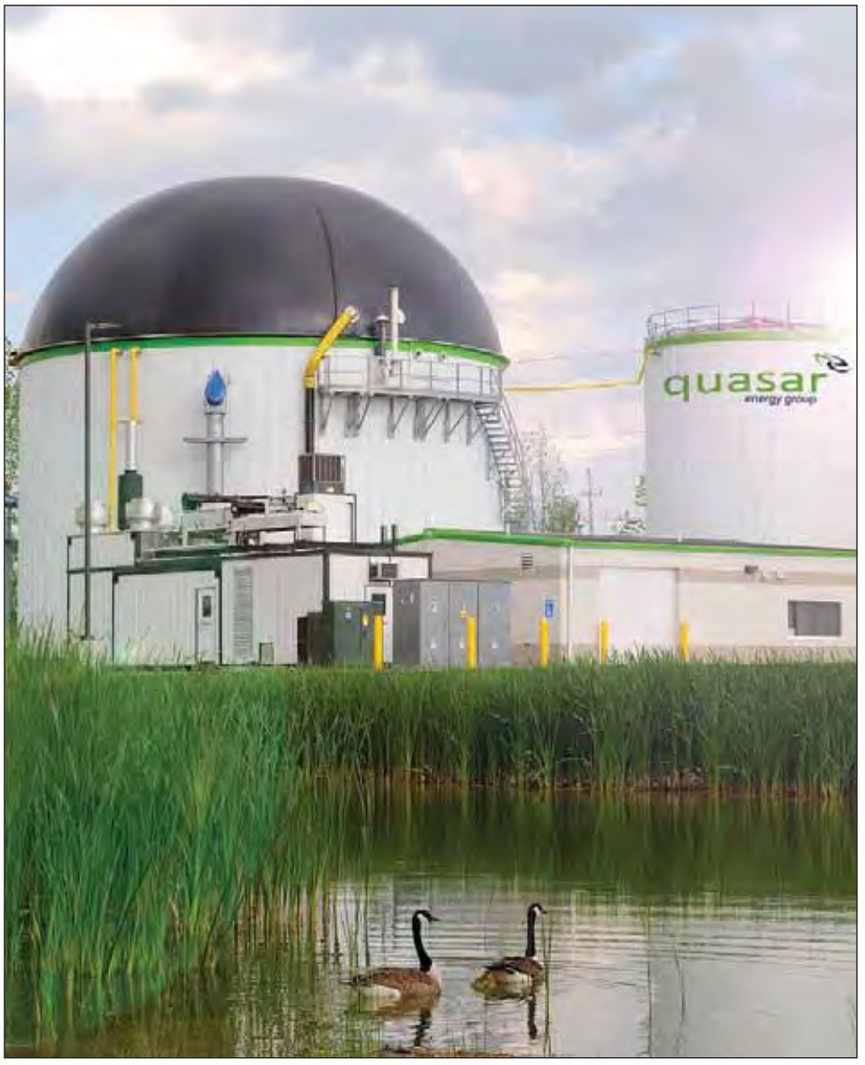

Photo courtesy Nate Carr, quasar

The Buffalo BioEnergy plant, located in West Seneca, NY, is designed to co-digest biosolids, food waste and FOG. Constructed and commissioned in 2013, the plant is a complete mix mesophilic anaerobic digester with a throughput capacity of 45,000 wet tons per year or roughly 120 tons/day.

What Went Wrong?

A small group of residents across several towns in Erie and Niagara counties were concerned about the organic waste recovery projects. They raised questions about pathogens, heavy metals, pharmaceuticals, and other pollutants, largely based on misinformation obtained through the Internet. The small group of opposition quickly grew into a larger contingent, and they began to organize, recruit, and apply pressure to town officials. Eventually the town officials responded with ordinances that either banned or greatly restricted the storage and land application of biosolids. Signs appeared on lawns: "Sewage Sludge, NOT IN OUR TOWN." and the local media began to cover the controversy.

quasar was caught off-guard by the opposition. In response, the company held public forums, brought in biosolids experts, circulated literature, attended numerous town meetings, offered facility tours, and gave media interviews. But the opponents had framed the discussion in negative terms, and their position was entrenched. **quasar** sought to bring to its side residents who had not yet formed opinions. But the traction of the vocal minority compelled nine local towns to pass moratoriums or bans to restrict the use of biosolids. These towns rely on "Municipal Home Rule" to support their authority to pass such restrictive ordinances in the face of valid New York Department of Environmental Conservation (NYSDEC) permits to store and land apply class B biosolids.

New York State Department of Agriculture and Markets Takes Action

New York State law, through AML 305A – typical state "right-to-farm" law – provides farmers in agricultural districts a defense from unreasonable restrictions by municipal ordinances. The New York State Department of Agriculture and Markets (NYSDAM) has been reviewing biosolids ordinances adopted in the towns of Wheatfield, Marilla, and Bennington. NYSDAM

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sent preliminary notices to these towns informing them that their laws may represent unreasonable restrictions and directed the towns to specify conditions where current NYSDEC regulations are insufficient to protect public health and safety. In the case of Bennington, NYSDAM concluded that the local law is an unreasonable restriction and has directed the town not to enforce the law. Final NYSDAM decisions regarding the ordinances in Wheatfield and Marilla are forthcoming.

NYSDEC Does Its Part

In the permitting of **quasar**'s digester operations and sites for the associated storage and land application program, NYSDEC followed all proper review and notification processes. The three affected towns all deferred to NYSDEC as lead agency. As is its long-standing practice, the NYSDEC reached out to answer questions and provide information within the towns. Faced with local opposition, however, the towns were not deterred from passing moratoria and bans.

In July 2014, in defense of its anti-biosolids position, the Town of Marilla argued that NYDEC had acted arbitrarily, capriciously, and unlawfully in their issuance of a Part 360 permit for a biosolids storage tank. A State Supreme Court judge dismissed the Town's arguments, siding with the farmer seeking to install the storage tank and approving of NYDEC's permitting. However, Marilla's ordinance restricting beneficial use of biosolids remains an obstacle.

In late 2014, **quasar** filed a suit against the Town of Wheatfield to challenge its ban on biosolids storage and land application, and its restrictions on expanding or altering its digestion processes. A decision on that case is expected this year.

Lessons Learned

• *Know Your Market.*

Social climate and cultural history are significant aspects of project feasibility. **quasar's** plant in Wheatfield sits just a stone's throw from Love Canal, the first federal Superfund site and one of the worst environmental disasters in history. The area is host to many landfills, including ones for hazardous wastes and several for radioactive wastes. The community is understandably skeptical of government's capacity to protect citizens from environmental damage. **quasar** neither took this history into account in the siting of its facility, nor understood the potential threat posed by the public's lack of faith in the environmental regulatory system.

• *Get Your Message Out Early.*

Most communities are not familiar with biosolids recycling. Although biosolids composting was being practiced in the area where **quasar** developed its digesters, direct land application was not a familiar operation. **quasar** witnessed the public's tendency to form fast opinions when they hear about land application of biosolids. Those who seek to confirm negative information find support easily on the Internet. Although biosolids recycling provides benefits to farmers and to local wastewater agencies, **quasar** had not sought to have the case for biosolids recycling made by recognized local experts and other independent voices until after public opposition was raised; by then, it was too late.

The projects in Western New York are a reminder that public outreach and education needs to happen early in the process of permitting biosolids treatment and utilization programs. Required public hearings with the local town and planning board may not be enough. Often, these meetings are not well attended. As the project moves forward and more people hear about it through multiple channels, misinformation can start to spread; once that happens, it may be too late for public outreach and education. We need to put a strong focus on presenting the scientific facts to the public early in project development, stressing that the service provided by wastewater agencies is essential and biosolids recycling is a wise management choice.

There is guidance available on proactive public outreach around biosolids recycling, including two major studies by the Water Environment Research Foundation (WERF) and numerous articles in trade publications. But, as **quasar** learned, conducting proactive public outreach requires a strong commitment on the part of the project developer and associated treatment facilities and farmers. These people and organizations must be willing to spend the necessary staff time and money on proactive public outreach that begins early and extends through the life of the project.

• *Class A vs. Class B*

The distinction between classes of biosolids is one that can alter the public response to projects. **quasar**'s proposal was for land application of biosolids treated to a Class B level of pathogen reduction. Initial public response to **quasar**'s project suggests the community may have accepted the higher, Class A level of pathogen reduction. But after opposition had solidified, even a Class A product was unacceptable. Going forward, project developers may need to consider Class A technology as a starting point for gaining public acceptance.

• *Public-Private Partnerships*

quasar's projects in Western New York were stand-alone, not co-located with a wastewater facility. In light of the opposition **quasar** faced, a municipal model involving public-private partnerships seems a preferred pathway to public acceptance of co-digestion. The capability of a private entity to install both the equipment to receive food waste and FOG, along with the electric generators to utilize biogas, serves to provide a municipal wastewater treatment plant with a fuller economic return on its public investment. This is a tangible economic and environmental benefit that can be put to the public in a positive narrative of community sustainability.

Summary

Society produces massive amounts of organic waste. The citizens we serve can appreciate that a sustainable solution to organics management does not reside with landfills and incinerators, but with equipment that extracts renewable energy and nutrients. That is what wastewater professionals do. We can choose to offer our expertise as reliable and responsible solution providers for organic waste recycling. But we can't expect our citizens to accept this sustainable solution approach blindly. **quasar**'s experience in Western New York reminds us to get out early and vigorously with our positive message of sustainability. We must be willing to invest in public education before the shovel hits the ground. As professionals, we need to understand public apprehension and address their fears with the best information that we have, before someone's fear steers them to the wealth of misinformation available on the Internet.

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This article by James B. Slaughter, Beveridge & Diamond PC, was originally published on The National Law Review website (http://www.natlawreview.com), on Wednesday, December 23, 2015, shortly after the long-awaited conclusion to this challenge to biosolids land application. This court finding contributes to a body of precedents in support of biosolids use in agriculture, on which agencies and courts in New York State may also turn in their policies and decisions.

Unanimous Ruling in Pennsylvania Supreme Court Shields Biosolids Land Application from Tort Claims

Supreme Court of Pennsylvania voted in favor of Synagro and held that land application of biosolids is an agricultural activity shielded from untimely litigation by Pennsylvania's Right to Farm Act (RTFA).

The Court's opinion reversed the Pennsylvania intermediate appellate court and resolved critical questions regarding the division of labor between judge and jury, the scope of the RTFA, and the use of biosolids as fertilizer on farms. In *Gilbert v. Synagro Central,* A.3d , 2015 WL 9282354 (Dec. 21, 2015), the Court unanimously held that (1) application of the RTFA's statute of repose presents a legal question that only a judge may resolve and (2) biosolids application is a "normal agricultural operation" protected by the RTFA.

The suit arose from farming operations in York County, Pennsylvania. Neighboring landowners complained of odors from farmers' use of biosolids – nutrient-rich material produced from sewage sludge – and filed a lawsuit asserting claims of nuisance, negligence and trespass. The trial court granted the defendants' motion for summary judgment on the ground that the plaintiff landowners filed their claims outside the RTFA's one-year statute of repose. On appeal, the Superior Court of Pennsylvania reversed, holding that whether biosolids application qualified as a "normal agricultural operation" protected by the RTFA required a jury to evaluate the manner in which biosolids had been applied.

The Pennsylvania Supreme Court's majority and concurring opinions reject the lower court's rationale in full. In language with implications for future tort cases, the justices emphasized that the RTFA, like any statute of repose, is jurisdictional and thus, its "applicability is a question for the trial court, not the jury." The Court further explained that whether a particular activity, such as biosolids application, falls within the definition of a term used in a statute of repose is to be treated as a question of law that only a judge can resolve. The opinion makes clear that the RTFA can only function properly if its bar against litigation is not contingent on a jury's determinations.

The *Gilbert* decision confirmed that biosolids application is a normal agricultural operation entitled to protection by the RTFA and likely will influence courts across the country in their review of legal issues regarding biosolids recycling to farmland. Citing numerous statistics and the briefs of a broad coalition of amici, the Court acknowledged the widespread use of biosolids in agriculture in Pennsylvania and America across the country. This opinion represents a clear statement by a state's highest court that biosolids use is an accepted and common practice in modern farming that is entitled to protection from untimely and burdensome litigation.

Biosolids-borne Phosphorus: The Gorilla in the Room

by Ned Beecher, William Toffey and Lisa Boudeman

A federal court in Yakima, WA, ruled in January 2015 that a dairy farm is liable for over-application of nutrients that impacted groundwater quality with nitrate pollution. This new case law puts a heightened emphasis on both developing and carefully following formal nutrient management plans. Most biosolids are applied in accordance with such plans for nitrogen. But the question can be much more complicated when phosphorus (P) is simultaneously managed.

The court's ruling in Washington raises the question of how balanced a recycled soil amendment (manure or biosolids) must be. In the future, might excess P in applied manure that negatively impacts surface water be the subject of a lawsuit? Could biosolids be a target of similar action?

Biosolids inherently contain phosphorus. When applied to farmlands to meet crop nitrogen (N) requirements, biosolids deliver more P than needed for crop growth. Over years of repeated biosolids use, P loadings to the soil increase and soil test reports may register high or extreme levels.

Is this a problem for the environment or for regulatory compliance? Yes, and no, depending on your state and the type of biosolids produced. Some states are moving to regulating farmland and residential fertilizer use to ensure that soil P levels are not allowed to reach high levels.

The Massachusetts Case – Regulatory Conflicts

An example of just such a state is Massachusetts. In 2014, the Massachusetts Department of Agricultural Resources (MDAR) proposed a new fertilizer nutrient management regulation on the basis of a law passed by the Legislature in 2012. That law required MDAR to adopt regulations that would reduce non-point P sources in order to "maximize the credits relative to storm water discharge or similar permits issued by the United States Environmental Protection Agency (EPA)." The MDAR promulgated regulations for fertilization of turf starting June 5, 2015. Agricultural parts of the regulation went into effect in December 2015.

The scope of MDAR regulatory control over fertilizer-borne P, including and especially biosolids and biosolids-derived products, is enormous. MDAR has provided a fact sheet that cuts through any uncertainties:

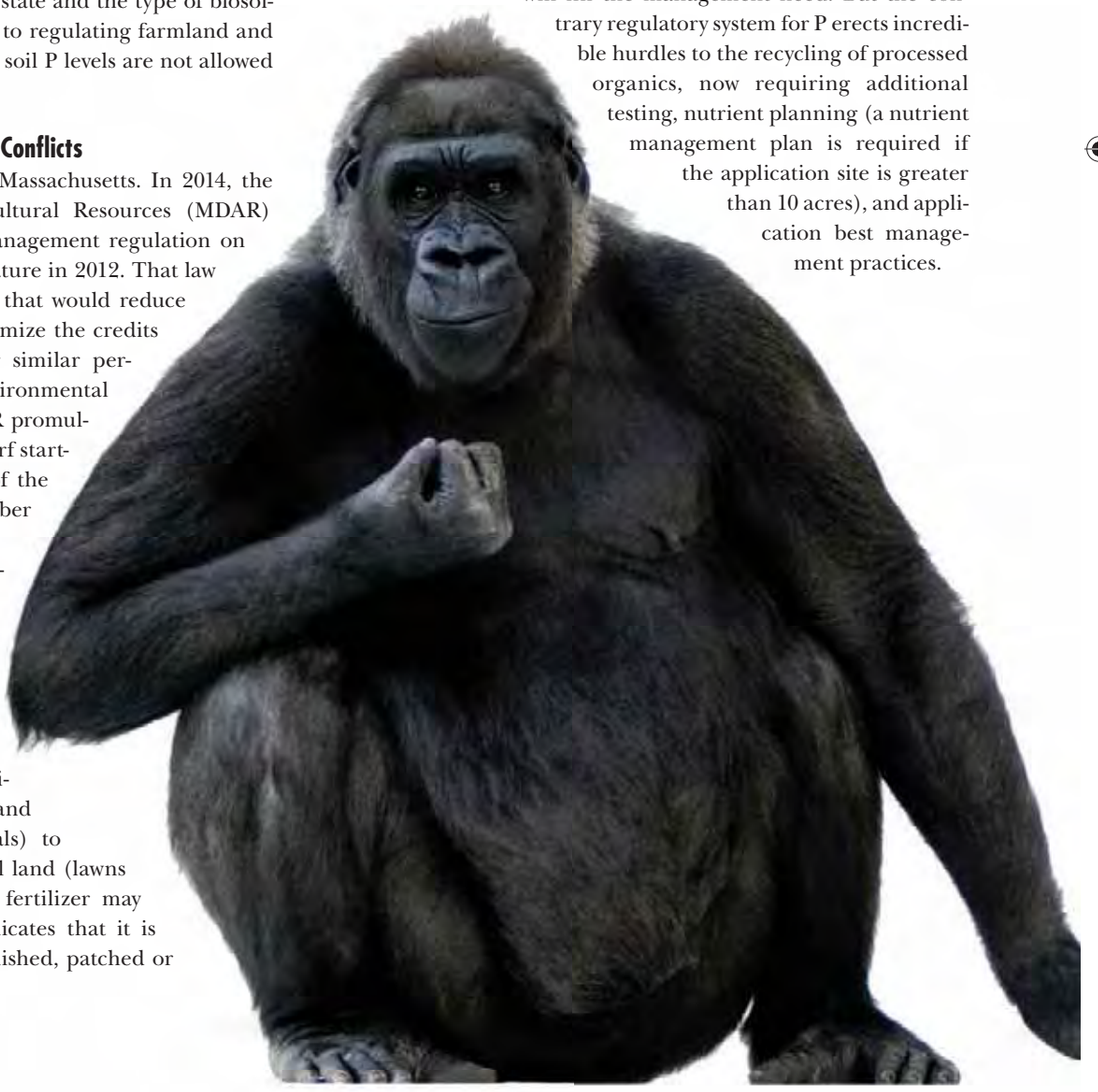
"In general these regulations impact anyone who applies plant nutrients (including commercial fertilizer and various other plant nutrient materials) to both agricultural and non-agricultural land (lawns and turf)…. Phosphorus containing fertilizer may only be applied when a soil test indicates that it is needed or when a lawn is being established, patched or renovated." *(MDAR, 2016)*

Further:

"In determining the amounts of phosphorus and nitrogen that may be applied, the amount known to have been applied with organic plant nutrient sources (such as natural organic fertilizer, compost, and biosolids) should be accounted for," and "[t]he amount of phosphorus applied with organic sources shall not exceed the maintenance phosphorus rates for turf as specified in the UMass Guidelines. Soil testing provides the most accurate method for determining the phosphorus requirements." *(MDAR, 2016)*

Unlike New Jersey and Virginia, in which biosolids advocates were closely involved in developing turfgrass phosphorus regulations, Massachusetts has no breaks for naturally-sourced organic fertilizers. It offers no waivers for composts or for heat-dried pellets. Massachusetts regulations impact residential turf and they impact farmers. You can apply P only to newly-established lawns and to soils shown by soil test to be deficient in P.

The strange irony of the Massachusetts situation is that this state holds a leading position in commanding diversion of organics away from landfills. The presumption is that digesters and composters will fill the management need. But the contrary regulatory system for P erects incredible hurdles to the recycling of processed organics, now requiring additional testing, nutrient planning (a nutrient management plan is required if the application site is greater than 10 acres), and application best management practices.



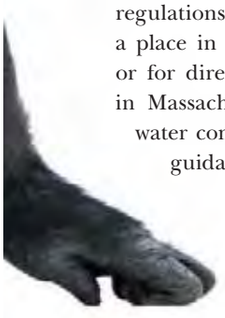
Scientific Understanding of Phosphorus Mobility in the Environment

To make matters worse, many scientists believe Massachusetts regulations are not based on sound science. Tests of P concentrations in biosolids and in soils very poorly predict risks to the environment relative to P release and mobility. Scientists have shown that an abundance of Fe, Al, and Ca in the soil bind a great deal of P added as fertilizer, holding P strongly in mineral form and making it environmentally unavailable for surface water eutrophication. What is more, the P borne in biosolids is held tightly in a mineral and organic matrix, and when the properties of the P are measured with a test of "water extractability," most of the P stays undissolved. Using this test, when compared with commercial fertilizers, biosolids P solubility is merely 40 percent of that in commercial fertilizers *(Sullivan, Cogger and Bary,2015)*. What is relevant is not the total concentration of P in soil and organic matter, but rather that portion of the P that is water soluble. A water extractable test for P has been tested extensively and in some states has replaced a Total P test for environmentally available P. Massachusetts is not one of those states. Neither is New York.

Phosphorus regulations in Pennsylvania, Ohio, and New Hampshire, for example, are not a threat to organics recycling. These states take into account the P "source coefficient," meaning approximately the proportion of total P that is prone to dissolving in water. Some biosolids products, such as those produced by the Biological Nutrient Removal (BNR) Process, and biosolids generated without iron and/or lime, have a greater coefficient, and have been shown to increase the more labile forms of soil P over time when applied repeatedly. Many forms of biosolids contain abundant iron, aluminum, and/or calcium and tend to have favorably low coefficients. In fact, multiple studies have found that the added iron and aluminum found in biosolids can significantly mitigate potential for P losses in runoff and via leaching, especially if applied to soils with high P saturation. Most heat-dried biosolids fertilizers measure in the very lowest category of P availability in the "source coefficient". The phosphorus regulatory approaches of Pennsylvania, Ohio and New Hampshire would not raise the barrier to local recycling outlets of Massachusetts if the state adopted this approach.

Also an irony in Massachusetts' regulatory approach is that organic residuals provide a suite of benefits to soil and plant growth that promote healthy environments and are sought by landowners for the benefits to plant and crop growth. Sustainable management of organic wastes will only be possible if there are vibrant markets and customer demand for the end products; meaning that the demand for organic-based soil products helps pull organic wastes out of landfills. A stiff rule on P stymies the growth of markets for organic-waste based fertilizers that are so helpful in keeping organics out of landfills.

Today, in New York State, regulatory initiatives have targeted chemical fertilizers used to grow turf, both residential and commercial. Regulations don't extend to composts or digestates, and regulations don't apply to commercial farming. Biosolids still have a place in New York State as an ingredient in soil amendments or for direct application to farms. But the regulatory approach in Massachusetts seems to have its champions, and the wastewater community is advised to monitor changes to statutes and guidance.



Managing for Phosphorus in Biosolids

In the meantime, there are multiple steps that can be used wisely to improve the environmental impacts of phosphorus in biosolids, and, in turn, provide argument against regulatory initiatives banning biosolids as a fertilizer. This would include matching the biosolids application rate with the crop's P needs, and supplement with the addition of N and potassium (K). However, when biosolids are applied to meet one year's P crop need, the application rate is very low and may be difficult to accomplish due to limitations of spreading equipment. A more suitable and realistic method is to land-apply on a 3- to 5-year cycle based on the N application rate, and allow other fertilizers to be applied in off years. The applications can be better managed under this approach, and additional fertilizer applications are not necessary during biosolids application years. Also, farmers are accustomed to having the N need of the crop satisfied from biosolids applications. Soil P levels may continue to increase slightly over time using this method, but at a slower and more acceptable rate.

Another method to reduce the potential of the environmental impacts of biosolids P includes technology being developed for use in facilities that include anaerobic digestion to extract phosphorus from the wastewater stream as it passes through treatment processes. The genesis of this technology is for control over the damaging deposition of a crystalline mineral called struvite (highly concentrated phosphorus, ammonium, and magnesium) on pipes and pumps within the plant that can substantially reduce flow capacities and increase maintenance requirements. One company that has gained traction in the industry is Ostara, which operates a controlled precipitation of struvite granules, typically extracted from the liquid discharge of dewatering equipment. The result is a "mining" of P from wastewater, to generate a commercially-desirable slow release fertilizer with a formulation of phosphate-P (12.7 percent) and ammonia-N (5.7 percent). The main payback for a wastewater plant is avoiding unintended struvite deposits within the treatment plant equipment.

The wastewater industry is in the early stages of seeing a variety of P extraction technologies being developed. One option precipitates and separates a calcium phosphate salt. One provides a technology for production of a saleable mineral product, others produce a residual liquid that can be hauled away economically. The promise that is ahead is the refinement of a P extraction system that enables wastewater operators to "dial-in" the ratio of nitrogen to phosphorus of greatest value to the users receiving the biosolids.

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Rensselaer County Sewer District's Biosolids System Upgrade Project Results in Beneficial Reuse of Biosolids

by Brian Hilts and Gerard Moscinski

For almost four decades the Rensselaer County Sewer District (RCSD) wastewater treatment plant (WWTP) utilized a wet air oxidation process, Zimpro®, to stabilize its biosolids. Those biosolids were placed in an on-site monofill that served as the disposal location. RCSD reconsidered this program when several factors became clear: monofill capacity was diminishing; the biosolids process equipment had reached the end of its useful life; process-related energy and maintenance costs were high; and return-stream effluent from the process had negative impacts on the liquids treatment process. Given these factors, RCSD knew it was time to upgrade its biosolids process system.

RCSD conducted a biosolids alternative analysis, and selected an alternative with the lowest lifecycle cost that also generated a beneficially useful biosolid product. An anaerobic digestion process with new dewatering equipment and a thermal dryer was the selected alternative. Biogas generated from the anaerobic digestion process satisfies the heat demands of the digesters and is utilized as a fuel source for the thermal dryer. The dryer produces Class A biosolids. In an effort to reduce capital costs, the project reused three concrete tanks and two metal tanks by converting them into anaerobic digesters and thickened sludge holding tanks respectively.

The project was divided into two phases. Phase 1 consisted of anaerobic digestion conversion, biogas handling and storage, and installation of new dewatering equipment. A fourth anaerobic digester, thermal dryer, and dried product handling and storage were installed in Phase 2. Phase 1 was completed and operational in 2013, while Phase 2 was finished in late 2014.

In preparation for the production of a Class A biosolid, RCSD developed a biosolids marketing plan which identified outlets for the dried product. Based upon the plan, a request for proposal was issued to commercial biosolids users and brokers. They were asked to propose to RCSD a "turn-key" partnership, in which the broker would take responsibility for the dried product from the loading facility to the outlets. The five-year contract was awarded to Resource Management Inc. (RMI) for the dried product, and the deal included revenue sharing guarantees with RCSD. At the completion of the 2015 growing season - the first complete season utilizing the dried product as a soil amendment - RMI reported that farmers were very happy with the product. The value and demand for this Class A product has potential for growth in the market.

The primary function of the Rensselaer County Sewer District is to protect the Hudson River by providing secondary treatment to the wastewater before it is discharged. The RCSD serves the Towns of Brunswick, North Greenbush, Schaghticoke and Sand Lake, and the Cities of Rensselaer and Troy.

The biosolids system upgrade project has allowed RCSD to replace its existing biosolids process with one that reduces energy and maintenance costs, that doesn't have negative impacts on the liquid treatment process, and that beneficially utilizes biosolids, both as a biogas source and as a soil amendment.

For more information on this project please contact Brian Hilts, P.E., CDM Smith, via e-mail at hiltsba@cdmsmith.com. Gerard Moscinski, P.E., is the Administrative Director of the Rensselaer County Sewer District who may be contacted throug the Sewer District at (518) 283-2235.

Photo by Brian Hilts

Dryer

Photo by Brian Hilts

Dried product loadout

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Maximizing WRRF Infrastructure with Food Waste Acceptance: The NYC Case Study

by Tami Lin

In the footprint of one of the Newtown Creek Wastewater Treatment Plant's de-commissioned thickeners, Waste Management is building what will eventually be an enclosed receiving tank for organic bioslurry. Once the facility is completed, Waste Management will deliver bioslurry (pre-processed organic food waste) to the Newtown Creek WWTP where it will be added to the digester eggs and further broken down along with the sludge from the wastewater treatment process. This is part of a three-year demonstration project between the NYC Department of Environmental Protection, Waste Management, and the New York State Energy Research & Development Authority to assess the operational impact of large-scale co-digestion on the wastewater treatment process. *See full article in an upcoming issue of Clear Waters.*

Tami Lin is Deputy Director in the Energy Office of the New York City Environmental Protection, and may be reached at tlin@dep.nyc.gov.

Receiving tank under construction *Photo courtesy of NYCDEC*

Saving Lake Erie, Again

by Dereth Glance and Dave Dempsey

We did it before, and we can do it again.

The environmental recovery of Lake Erie from the 1960s to the 1980s reminds us how far and how fast we can travel toward clean water with the right science, the right technology, the right dollar investment, and the right public will. This lesson is particularly timely in light of the trend of increasing harmful blue-green algal blooms in the western basin of the lake.

Bordered by Ohio and Michigan and the Province of Ontario, Lake Erie's western basin experienced large-scale, disruptive and toxic algal blooms in 2011, 2014 and 2015. These blooms are of a magnitude not seen in decades. The precedent of Lake Erie's water quality recovery in the 20th century shows the path forward to improving and maintaining the lake into the 21st century.

The 1960s

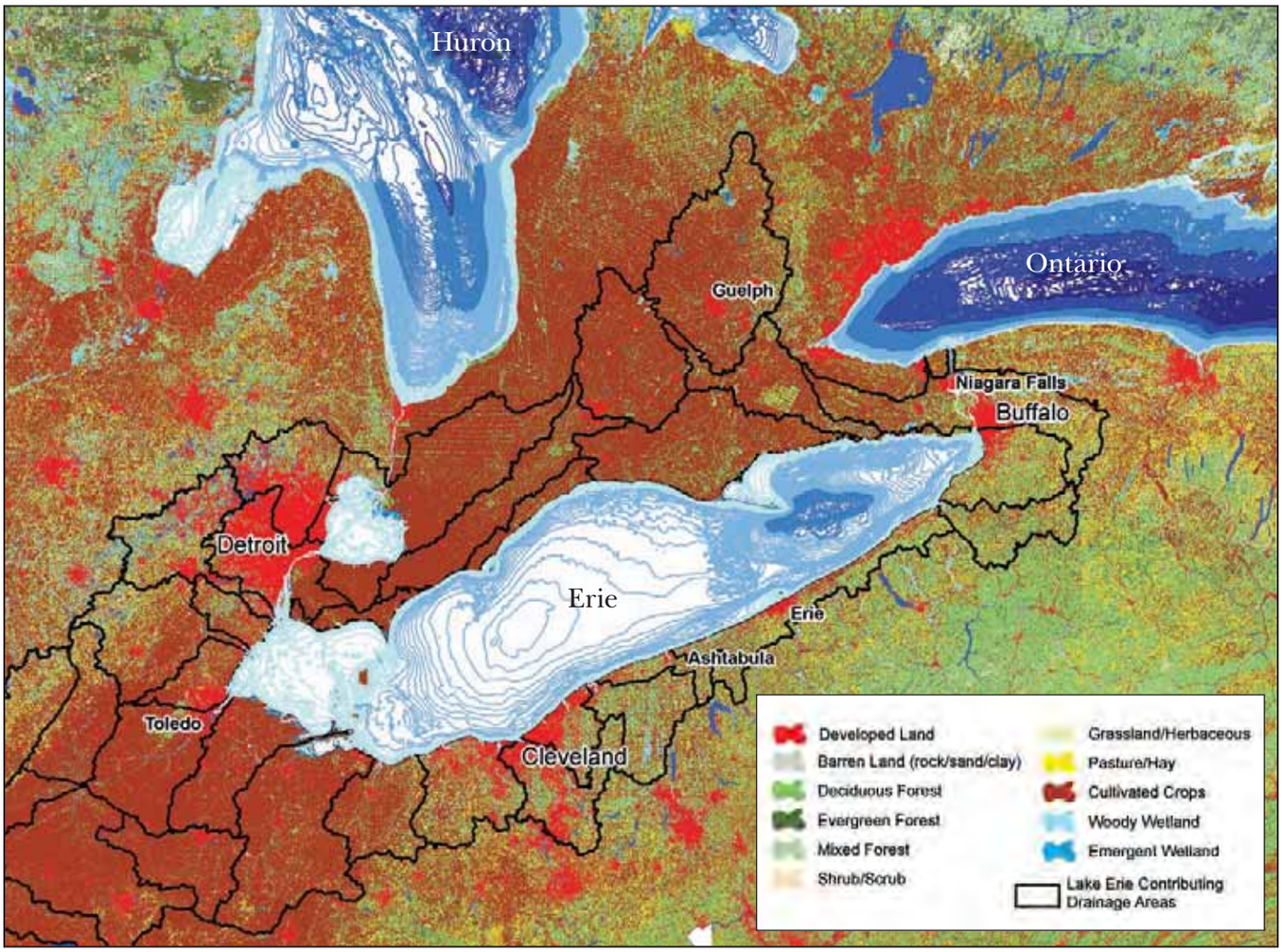
In the mid-1960s, Lake Erie was a world-class disgrace, teeming with unsightly algal blooms. There was a broad consensus that the lake was dying. The public clamored for action. David Blaushild, a Cleveland auto dealer, rented a freeway billboard saying "Let's Stop Killing Lake Erie," galvanizing public demands for a cleanup. In Buffalo, a group called "Housewives to End Pollution" lobbied the Erie County Legislature to crack down on phosphorus in laundry detergent.

By the late 1960s, it was apparent that the key to controlling excessive algal growth was to limit phosphorus loads to the lake. A coordinated, lake-wide approach among the regulatory agencies in five U.S. states and Canada was necessary to deal with the phosphorus issue.

The 1970s

Among many other actors, the International Joint Commission (IJC) played a role in the comeback of the lake. A binational Commission, established by the Boundary Waters Treaty of 1909, the IJC helps the governments of the United States and Canada prevent and resolve disputes over transboundary waters. In 1970, responding to a request from the U.S. and Canadian governments, the IJC found that the waters of Lakes Erie and Ontario, as well as the international section of the St. Lawrence River, were seriously polluted on both sides of the boundary (IJC 1971).

The IJC found that 70 percent of the phosphorus in U.S. sewage –



Lake Erie and environs, showing the land cover types, major municipalities, and drainage areas in the Lake Erie watershed. Blue bathymetric lines within Lake Erie show the three separate "basins" within the lake.

and 50 percent of the phosphorus in Canadian sewage – originated from laundry detergents. In addition to calling for improvements to municipal and sewage treatment, the IJC recommended reductions in the phosphorus content of laundry detergents "to the maximum practicable extent at the earliest possible time."

The IJC recommended cleanup objectives and called for incorporating these efforts in an agreement between Canada and the U.S. That recommendation paved the way for the Great Lakes Water Quality Agreement (GLWQA) of 1972 – the same pact that, overhauled three times since, guides binational Great Lakes protection policy today *(Binational.net, 2012a)*.

Within seven years of this pact, Ontario, Indiana, New York and Michigan enacted strict limits on phosphorus in laundry detergents based on the science assembled by IJC and others.

An equally significant contributor to a cleaner Lake Erie was public investment in sewage treatment. New York State voters got on board early, approving by a four-to-one margin a $1 billion Pure Waters bond in 1965 – the equivalent of more than $7.5 billion today. Congress embraced public wastewater treatment investment in the 1972 Clean Water Act. The act paid a generous 75 percent of costs for municipalities improving their sewage treatment, spurring a construction boom across the nation. In the Great Lakes region alone, spending on sewage treatment exceeded $10 billion from the late 1960s to the 1990s.

The 1980s

The recovery of Lake Erie was swift. In 1983 the IJC's Water Quality Board, established to monitor the health of the lakes under the GLWQA, reported that municipal sewage plants on both the Canadian and U.S. sides of Lake Erie had achieved on average the target concentration of 1 milligram of phosphorus per liter (mg/l). Detroit's contribution of phosphorus to the Lake Erie Basin had plummeted from 4,720 metric tons in 1975 to 515 metric tons in 1982.

Algal blooms in the lake were shrinking, oxygen in the water was rebounding and swimming and fishing were once again desirable. Cleanup of unsightly Great Lakes pollution was an internationally known success story. One reason was that, by the early 1970s, controlling water pollution had been fully institutionalized as everyone's cause.

The 21st Century

But today, Lake Erie isn't the same lake it was in the 1980s. The western basin of the lake – bordered by Ohio and Michigan as well as Ontario – suffers from eutrophication and toxic algal blooms. And in the eastern basin of Lake Erie, there is another problem. Mats of *Cladophora* – considered nuisance algae – have fouled some beaches, created odors as they decomposed, clogged industrial intakes and degraded fish habitat. Reductions in phosphorus will also be necessary to limit the scope of *Cladophora*.

Although the work of the 20th century addressed the point sources of phosphorus to the lake, resulting in improvements to water quality, other factors have now come to the forefront. Phosphorus runoff has become more significant due to more intense storms coupled with intensified agriculture and urbanization. The introduction of invasive species such as zebra and quagga mussels, as well as climate-induced changes to water temperatures and winter ice cover, have influenced the nutrient balance of the lake.

Of particular concern is phosphorus runoff that is the most readily available to support algae growth and thus a primary cause of renewed algal blooms. The GLWQA originally focused on total phosphorus as the water quality parameter by which Lake Erie eutrophication was to be assessed and managed. Those load targets have generally been met since the 1980s. However, recent research has identified dissolved reactive phosphorus (DRP), a highly bioavailable form of phosphorus, as significant in feeding harmful algal blooms. While DRP loads declined in the early 1990s, they have increased since the mid-1990s, even as total phosphorus has remained relatively stable ***(Figure 1)*** *(ICJ, 2014)*.

The renewed GLWQA, signed in 2012, recognized the need to set reduced Lake Erie phosphoric targets by February 2016. The U.S. and Canada met this milestone on February 22, 2016 when U.S. EPA Administrator Gina McCarthy and Canada's Environment and Climate Change Minister Catherine McKenna finalized targets to reduce phosphorus entering affected areas of Lake Erie by 40 percent. With the modern pollution limits set for Lake Erie, it is now up to each nation and local communities to achieve the phosphorus reduction limit *(Binational.net, 2012b)*.

But as the smallest, most developed and most intensively farmed of the Great Lakes, Lake Erie is vulnerable. Eighty percent of Lake Erie's water flows from the upper lakes through the Detroit River. The remainder of the lake is fed by heavy spring rains and snowmelt which flush substantial loads of land-based phosphorus into the water. At what scale – and at what speed – will society evolve to live within the watershed's capacity to absorb all the nutrients we regularly feed it from our farms, fields, streets, and sewage treatment plants?

What Are the Agricultural Challenges?

Jurisdictions governing the western shores of Lake Erie recognize the problem and have begun taking action. Ohio banned the

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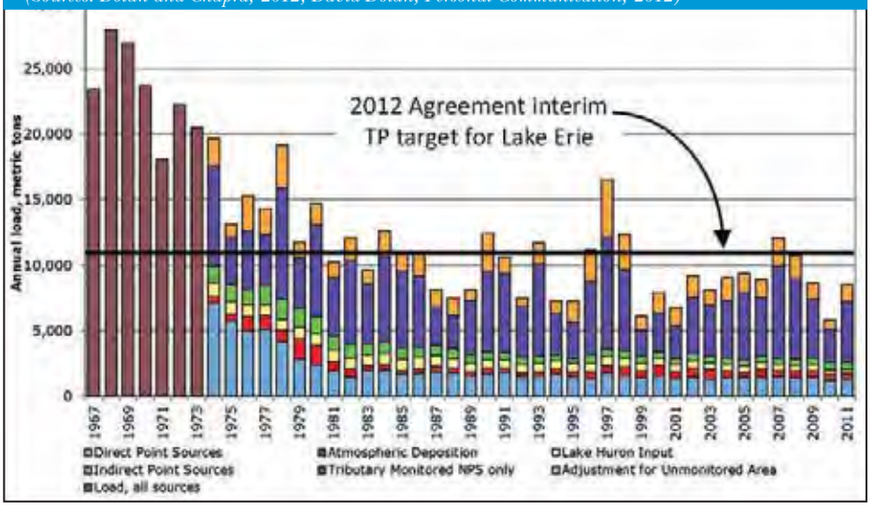
Figure 1. Annual External Total Phosphorus Loads to Lake Erie (metric tons)
(Sources: Dolan and Chapra, 2012; David Dolan, Personal Communication, 2012)



This figure shows the annual external total phosphorus (TP) loads (in metric tons, MT) to Lake Erie for the years 1967 to 2011. Total loads were not differentiated for the period prir to 1974. The horizontal black line refers to the 2012 Great Lakes Water Quality Agreement interim annual TP load of 11,000 MT. NPS stands for non-point source.

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application of phosphorus-rich animal waste and fertilizer on frozen, snow-covered or saturated ground, or when heavy rain is predicted for farmland in the western basin. Ontario, Ohio and Michigan announced an agreement on June 13, 2015 to achieve a 40 percent total load reduction in total and dissolved reactive phosphorus entering Lake Erie's western basin by the year 2025, with an interim goal of a 20 percent reduction by 2020. Each of these three jurisdictions has developed or is developing action plans to meet the goals.

Farmers in the western Lake Erie watershed are already 90 percent efficient in phosphorus application. Additional runoff control from agricultural best management practices will be helpful, but this alone is unlikely to get us to the agreed-upon 40 percent reduction. A fundamental look at agricultural policy is also necessary. Is Lake Erie the best place to grow a massive amount of corn? Currently, about 20 percent of the corn produced in the U.S. is for human consumption, 40 percent is for livestock feed, and the remaining 40 percent is for corn-based ethanol. Growing corn for ethanol on the current scale in the Lake Erie basin is simply not sustainable given fertilizer usage and its effect on runoff. Ethanol can be produced about 14 times more efficiently from crops like willow (see SUNY ESF Dr. Tim Volk's work at *http://www.esf.edu/willow/*). The Farm Bill shapes U.S. agricultural policy, and corn is currently its king.

Farmers require market and technical assistance. Federal support is needed for a transformation of crops and commodities that will support producer success and a cleaner Lake Erie. Opportunities abound to support American farmers and clean water through policies, conservation programs, and incentives. Congress tied crop insurance to maintaining conservation practices in the 2014 Farm Bill, but much more can be done.

Green Infrastructure Solutions

In the built environment, roads are the new tributaries. The hard surfaces of roofs, parking lots, and roads convey water downhill to the receiving water, which picks up all the grit, grease, and garbage in its path. The green infrastructure approach recognizes that building living systems better mimics the function of natural processes which slow down runoff, spread it out, and allow it to soak into the ground. This approach is a cost efficient way to manage polluted runoff.

Fortunately, U.S. EPA has been helping seed green infrastructure in the Lake Erie basin, awarding more than $8 million in green infrastructure funds through the Great Lakes Shoreline Cities grants program. Early recipients of funding included the City of Buffalo and the Buffalo Sewer Authority, who received a $500,000 grant – along with $500,000 in funding from Empire State Development – to construct green infrastructure projects along a 1-mile section of Niagara Street. Untreated stormwater from this section of roadway was draining directly to the Black Rock Navigation Channel and the Niagara River. This green infrastructure project is designed to capture stormwater along the Niagara Street right of way, controlling up to 4.9 million gallons of runoff per year and reducing road salt, nutrients, oil and grease and sediment flowing into the Niagara River.

Grey Infrastructure Improvements

Aging and chronically underinvested infrastructure characterizes too much of the nation, and the Lake Erie watershed is a poster child. Treatment operators have been doing all they can within limited and shrinking budgets, decreasing rate-bases, and more intense weather events that regularly undermine this essential civil service. Adequate financial resources to fund capital improvements, support innovation, and build resiliency for the pipes, plants, and treatment processes are necessary. Optimizing phosphorous reduction requires public investment to curb sewer overflows and achieve reduced phosphorus in treated effluent.

In the United States, federal and state regulators use the courts to mandate investments, helping communities get to the top of the list for loans. Federal funding for water infrastructure is primarily limited to no- or low-interest loans that cash-strapped municipalities struggle to afford, especially as these needs compete with more visible problems such as reducing crime, improving schools, and fixing roads and bridges. The construction grants program, launched in the 1972 Clean Water Act, aided a water infrastructure modernization effort that our nation had not seen previously. The loan fund that replaced it in the 1990s is simply not up to meeting the need.

It is heartening, then, to see some states stepping in to close the gap. New York Governor Andrew Cuomo's January 2016 announcement of $250 million for drinking water and wastewater infrastructure projects is a welcome step in the right direction.

At the same time, the need continues to outpace available funding. U.S. EPA's wastewater needs survey estimates that, nationally, $271 billion in additional funding is needed for publically owned wastewater pipes and treatment facilities, combined sewer overflow correction, stormwater management, and recycled water treatment and distribution. New York State's share of the need is over $31 billion.

But the costs of inaction are great as well. Closed beaches turn tourists away and polluted drinking water – which shut off Toledo taps for more than two days in the summer of 2014 – not only poses health threats, but stains the image of the region, with a harmful ripple effect on the economy.

The Path Forward

Increased investment is clearly necessary to rectify legacy concerns and begin a culture of proactive and more progressive treatment. Reinstating the construction grants program, establishing a Clean Water Trust Fund, and creating a National Infrastructure Bank are ideas that have floated around Congress for years. After a long period of neglect and relying on operators to 'MacGyver' solutions, leadership and adequate investment for clean water is long overdue.

We must have adequate investment to curb combined sewer overflows, optimize water systems to handle increasing storm intensity resulting from a changing climate, and embrace innovation in the water sector. There are significant energy and tax dollar savings to be had through an efficient water system that helps prevent and reduce toxic algal blooms, keeps downtowns dry with intact water mains, and delivers safe drinking water to residents.

The scope and complexity of western Lake Erie's degraded water quality today can be daunting. Solutions exist and must focus on the watershed as a whole including land use, agricultural practices and municipal sewer systems. Pessimists can say it may never recover, at least not in our lifetimes. But as the efforts from the 1960s and 1970s showed, this is a lake that can respond quickly to the right care. The pragmatists – informed by history, science and opportunity – will determine at what scale and at what speed society will

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evolve to live within the capacity of the watershed. By demanding effective management of the excessive nutrients regularly flushed from our farms, fields, streets, and sewage treatment plants, the people can save Lake Erie once again.

President John F. Kennedy said, "Our problems are man-made. Therefore, they can be solved by man. And man can be as big as he wants. No problem of human destiny is beyond human beings."

Today parts of Lake Erie are once again in great distress. This problem is made by human beings, and it can be solved by all of us. A previous generation already demonstrated that. It is incumbent on all of us to provide and demand the bold leadership to do it again.

Established by the Boundary Waters Treaty of 1909 the International Joint Commission assists the federal governments with preventing and resolving disputes along shared transboundary waters. Subscribe to IJC's newsletter at www.ijc.org or on Facebook, LinkedIn, Instagram and Twitter @IJCsharedwaters.

Dereth Glance was appointed by President Barack Obama and confirmed by the United States Senate as a Commissioner to the U.S. Section of the International Joint Commission (IJC), effective July 18, 2011. Ms. Glance previously served as Executive Program Director for Citizens Campaign for the Environment and also served on New York State's Great Lakes Basin Advisory Council, the Clean Water Network and the Onondaga Lake Partnership Outreach Committee. Ms. Glance graduated from Michigan State University. She lives in Syracuse. Dave Dempsey has been a Great Lakes policy advisor for IJC since 2011. He served as environmental advisor to former Michigan Governor James Blanchard and is the author of two books about the Great Lakes.

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Lake Erie Facts

The 11th largest lake in the world, Lake Erie is the fourth largest of the Great Lakes. The lake's surface area is approximately 10,000 square miles. With an average depth of 62 feet, Lake Erie is the shallowest, warmest, and most productive of the Great Lakes. Eighty percent of Great Lakes fish live in Lake Erie, which contains 20 percent of Great Lakes water by volume.

The lake itself is comprised of three separate basins: the western basin is the shallowest, averaging 24 feet in depth, and accounts for approximately 20 percent of the area of the lake; the central basin averages 60 feet in depth; and the eastern basin, which is the deepest with an average depth of 80 feet.

The drainage basin of Lake Erie covers 30,140 sq. miles, including parts of Indiana, Michigan, Ohio, Pennsylvania, New York and Ontario, Canada. While the land cover in the watershed is predominantly agricultural, there are also 17 different metropolitan areas with populations over 50,000 within the Lake Erie basin.

Resources for Lake Erie Information

Great Lakes Information Network *(http://www.great-lakes.net/lakes/ref/eriefact.html).*

Lake Erie LaMP. 2011. Lake Erie Binational Nutrient Management Strategy: Protecting Lake Erie by Managing Phosphorus. Prepared by the Lake Erie LaMP Work Group Nutrient Management Task Group.

From a NYC Classroom Tank to a NYC Watershed Stream

A Story about Trout

by Lillit Genovesi

It's a cool April morning at Ward Pound Ridge Reservation in Cross River, New York. This 4,315-acre park is the largest of the Westchester County Parks. On most weekday mornings visitors may feel like they have been transported to a remote forested island dominated by the sounds of singing birds and gurgling streams, with few signs of civilization.

On this particular morning, the scene changes quickly as a large yellow school bus drives into the gravel parking lot. As the doors of the bus open, two dozen kindergarteners from PS 77 shuffle out. The students' faces show mixed emotions – excited, worried, sleepy – after the nearly two-hour bus ride from the Bronx to this quiet forest habitat. The last parent chaperone exits the bus with his daughter. He carefully carries a white and blue 3-gallon plastic cooler, setting it down on the grassy field beside the parking lot. The 24 students gather around to peer inside, with exclamations of "ooh" "ahh" and "aww" as the cooler lid is opened. They are delighted to see that all 25 of their trout fingerlings have survived the journey to what will soon be their new home in the Cross River. This day marks the culmination of their school's year-long Trout in the Classroom project.

Trout in the Classroom (TIC) is a unique program in which preschool to 12th grade students raise and monitor trout in a classroom setting, studying the life cycle of the fish and learning about the delicate ecosystem the trout need in order to survive. Trout are known to be an indicator species, which means that the fish's success (or failure) indicates something about the quality of the ecosystem. Biologists from the New York City Department of Environmental Protection (NYC DEP) study wild trout populations within the watershed streams in order to assess the health of our lands and water. The TIC trout help students understand their connection to nature and the water supply, and better understand how our actions can impact the ability of their trout to survive in streams and rivers.

TIC curriculum is fully hands-on and offers a creative way for teachers to enhance their curriculum, from science to history, art,

PS 77 students pose for a photo with the trout, which they raised from eggs in their Bronx classroom over the course of the school year, before a bittersweet streamside parting.

After the trout release, students learn about the macroinvertebrates which are indicators of healthy water and are an important part of the trout's diet. Jim Gmelin, a volunteer from the Croton Watershed Chapter of Trout Unlimited, holds up a juvenile crayfish for students to observe and identify using a dichotomous key.

math and social studies. During the beginning of the school year teachers, students and Trout Unlimited (TU) volunteers create a miniature trout habitat in a chilled 55-gallon aquarium, obtain trout eggs from the New York Department of Environmental Conservation (NYSDEC) and begin caring for their trout. Students conduct water quality testing in both the trout tank and trout streams, monitor fish growth, document the life cycle of the trout, and learn about the New York City watershed streams into which the trout will be released. In the field, students have the opportunity to become Citizen Scientists and collect real-life data which can then be used for research, to include in global databases, or for reporting to local agencies.

TIC started in New York in 1997 through the effort of Joan Stoliar, a member of the Theodore Gordon Flyfishers. Since then it has grown from four to more than 200 participating schools, and includes five partnering organizations – NYC DEP, Trout Unlimited, NYSDEC, Westchester County Parks, and the NYC Department of Education – and is supported by hundreds of volunteers. The program also includes a website with more than 100 online lessons. TIC has always provided hands-on and interactive lessons for students. The initial, primary focus of TIC lessons was to connect students to the unique water resources that are used to sustain New York City. Although this remains as its fundamental core, the TIC curriculum has evolved to concentrate on problem-based learning, which is designed to encourage critical thinking and STEM enhancement (Science, Technology, Engineering, and Mathematics). The STEM effort has helped bring even more attention to this program as teachers and school districts strive to increase STEM engagement among students.

By the end of the school year, the young trout must be released from classroom tanks into approved watershed streams. Trout releases are perhaps the most important activity of the TIC program, bringing students from all over New York City to the natural areas of our watershed forests. This experience helps students create an even deeper understanding, appreciation, and connection to nature and their water supply system as they journey on their way to becoming lifelong environmental stewards. After a day of data collection, scientific study, and forest walks, many of these release trips conclude with a "Postcards from the Watershed." Here students are encouraged to be inspired by nature and create artwork on a postcard, along with a note to a loved one reflecting on their experience in the watershed forest that day.

As students from PS 77 prepare to board their school bus back to New York City, their kindergarten conversations bring a smile to my heart: "best day ever!"; "I love my mom as big as this tree!"; "can we come back here, dad?"; "I want to go for a hike again!"; and "I love the river!"

Lillit Genovesi is a Project Coordinator with Trout Unlimited, and is the Trout in the Classroom Coordinator for New York City and its watersheds. She may be reached at lgenovesi@tu.org.

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From wef hq Leading-edge updates from the Water Environment Federation

National Ingenuity Contest Champs Stun Judges with Amazing Ideas

by Steve Spicer

Four inventors received awards from the 2015 Ingenuity Contest at WEFTEC® 2015 in Chicago. This marks the fourth year that the competition has recognized fixes that tackle a persistent problem with nothing more than the materials at hand and a hearty dose of ingenuity.

Captains of the Inspection Squadron

When the City of Casper, Wyoming, worried about the condition of the pipes within its water resource recovery facility, the wastewater crew found a floating solution. The crew – Lane Christensen, David Ferguson, Matt Wilhelms, Jared Winzenried, Brody Allen and James Soller – pieced together some foam board, a piece of wood, rope, and fasteners to create a raft for its collection system camera. The crew nicknamed the contraption, The U.S.S. WWTP.

The crew needed a way to guide the camera through the pipe safely and ensure that it could be recovered at the downstream manhole. To accomplish this, the crew first dropped an inflatable ball attached to several hundred feet of twine into the pipe and tied the twine to the upstream manhole. When the ball made its way to the downstream manhole, the crew retrieved it with a hook. This left a long stretch of twine running the length of the pipe between the manholes.

Next, they tied the U.S.S. WWTP to the twine at the upstream manhole, gently lowered it into the pipe, and then pulled at a steady rate from the downstream manhole. Upon arrival at the downstream manhole, the U.S.S. WWTP was removed using the long-handled hook.

City of Casper, Wyoming

The U.S.S WWTP sits ready to sail through the facility's pipes.

The video collected from the camera was invaluable. It showed areas of severe corrosion and pipe collapse that must be repaired in the near future.

Master of the Machines

Vikas Bhaskaran, senior skilled trade technician at the Village Creek Water Reclamation Facility (Fort Worth, Texas), builds tools to aid his fellow mechanics. He created a plasma and oxy-acetylene cutting machine using parts salvaged from old traveling bridge filters. The machine cuts metal precisely to enable operators to fabricate metal pieces for custom repairs. Bhaskaran also created a ratchet to help remove and attach the stator from a screw pump more safely. The ratchet enables a single person to do a task that, before, took five people.

Village Creek Water Reclamation Facility

Building a precision cutting tool from salvaged parts enables the Village Creek Water Reclamation Facility (Fort Worth, Texas) to make the custom pieces it needs for repairs.

Valedictorians of the School of Hard Knocks

During a March 2011 thunderstorm, operators at the Hill Canyon Wastewater Treatment Plant (Thousand Oaks, California) noticed the pipe from secondary clarifiers to emergency retention basins was not flowing fully. After the storm, the crew – Mark Capron, Mike Mantor and Robert Richardson – determined that nothing but air was blocking the pipe, but it remained less than half full.

They realized that the high point of the base of the 875-mm (36-in.) diameter pipeline was too high. This configuration led to empty space within the headspace of the pipe.

Restoring the pipe's full 189-m^3/d (50 mgd) flow required getting the air out at the high point. Instead of a major construction project to lower the high point of pipe to prevent the air blockage, the crew installed a $500 vacuum pump to the exiting air release valve.

When the pipe is full of air, one vacuum pump requires a full day to remove all the air. After the air is removed, the pumps run less than 100 hours per year in sub-second bursts. The crew also decided to leave the air release valve itself in place to prevent the vacuum pump from pulling in water.

With the air removed, the line regained its full capacity.

Dean of Public Education

The Jacksonville (Arkansas) Wastewater Utility wanted to educate customers about how line inspections work. To achieve this, operators led by Walton J. Summers II, built a display that includes a replica manhole, lateral, and cleanout cap. Part of the display gives an underground view of the lateral, which is cracked and wrapped with tree roots. Operators can show residents how smoke added to the manhole seeps up out of the grass – green outdoor carpet – and signals the need to televise the line to produce a defect drawing.

Jacksonville Wastewater Utility

Jacksonville's (Ark.) smoke testing display helps customers understand the inspection process.

Share Your Ingenious Fixes

The WEFTEC Ingenuity Contest will return in 2016 to honor more smart fixes and quick repairs. So, throw together a roughly one-page description of the problem you faced and the fix you found. If your invention or idea can be photographed, snap a picture.

The submission window is open now until May 26, 2016. See the full entry details at *www.weftec.org/ingenuity*.

Steve Spicer is Managing Editor of the Water Environment & Technology magazine for the Water Environment Federation. You may contact Steve with any questions at sspicer@wef.org.

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The Exhibit Floor was Humming!

The Exhibit Hall is a great place to network.

Randy and Jane Long from Brunel

Roger Gauthier (left) and Mike Cavallero from Kemira are all smiles.

Happy exhibitors, Pete (left) and Erik, man the Borger booth.

Jack Schimpf from Clearbrook Tully

… and the Awards!

President Mike Garland addresses over 250 attendees at the Awards Luncheon.

John Mele (right) from Hobas Pipe receives the Longstanding Exhibitor Award from NYWEA President Mike Garland and Conference Management chair, Joyette Tyler.

Joe Macula (right) from Franklin Miller receives the Longstanding Exhibitor Award from Joyette Tyler and President Garland.

Greg Jager (right) of GP Jager Associates receives the Long Standing Exhibitor Award from Joyette Tyler and President Garland for Jager's 20 years of support of NYWEA Annual Meetings.

Sydney Harris, Koester Associates, receives the Robert M. MacCrea Award.

Mohammed Zaman from NYCDEP receives the Uhl T. Mann Award for Operations greater than 50 MGD.

Michael Hall receives the Kenneth Allen Memorial Award for his paper titled, "Retrofitting Resilience and the Development of New Technology".

Karen Clark receives the Outgoing Service Award for her tenure as chair of the Awards Committee.

WEF Vice President, Jenny Hartfelder, presents Constantine Yapijakis with a Life Membership recognition award.

Mike Garland passes the presidential gavel to the NYWEA's newest president, Joseph Fiegl.

WEF Vice President, Jenny Hartfelder, presents John Sansalone with the Arthur Sidney Bedell Award.

Joseph Massaro is inducted into the WEF Quarter Century Operators' Club.

Assemblyman John McDonald receives the Nelson A. Rockefeller Award from President Garland.

Alexander Emmerson from the Buffalo Sewer Authority receives NYWEA's Young Professionals Award.

Anthony Gasparini is presented a service award for his membership on the Wastewater Operator Certification Governance Council.

George Desmarais receives NYWEA's Environmental Engineer Award

Patricia Cerro-Reehil (left) looks on as Krish Ramalingam (center) of City College congratulates winners of the paper competition: Lindsey Bubkah (second from left), Nazanin Ghanbari (second from right), and Shashwat Vajpeyi (right).

Mike Garland presents Mike Coley with the service award for his tenure on the Wastewater Operator Certification Governance Council.

Taylor Brown from SUNY-–ESF receives the Student Chapter Service Award from President Garland.

President Garland congratulates Lawrence Vulis, a NYWEA Scholarship Winner.

President Garland recognizes Scholarship Winner LisaMarie Nilaj.

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Polymer Breakthrough Could Revolutionize Water Purification

by Tom Fleischman

December 21, 2015

We've all seen the Febreze air fresheners, which employ a derivative of corn starch to trap invisible air pollutants in the home and remove unwanted odors.

A team of Cornell researchers has used the same material found in Febreze, cyclodextrin, to develop a technique that could revolutionize the waterpurification industry.

The team is led by Will Dichtel. associate professor of chemistry and chemical biology and a 2015 MacArthur Foundation Fellowship winner. His group invented a porous form of cyclodextrin that has displayed uptake of pollutants through adsorption at rates vastly superior to traditional activated carbon - 200 times greater in some cases.

Activated carbons have the advantage of larger surface area than previous polymers made from cyclodextrin - "more sites for pollutants to stick to," Dichtel said -but they don't bind pollutants as strongly as cyclodextrin.

"What we did is make the first high-surface-area material made of cyclodextrin," Dichtel said, "combining some of the advantages of the activated carbon with the inherent advantages of the cyclodextrin. When you combine the best features of those two materials, you get a material that's even better than either class.

"These materials will remove pollutants in seconds, as the water flows by," he said, "so there's a potential for really low-energy, flow-through water purification, which is a big deal."

What's more, the cyclodextrin-containing polymer features easier, cheaper regeneration, so it can be reused many times with no observed loss in performance.

The results of approximately 18 months of work were published online in Nature on Dec. 21.

Support for the work came from the National Science Foundation (NSF) through the Center for Sustainable Polymers, which brings together a diverse team of researchers from Cornell, the University of Minnesota and the University of California, Berkeley, to discover high-performance materials from sustainable, non-petroleum-based sources.

Following the discovery of the cyclodextrin polymer, additional support to scale up and build prototype filtration systems has been provided by Cornell's Atkinson Center for a Sustainable Future.

Research began shortly after the NSF grant was awarded. It wasn't long before Dichtel's team identified the cyclodextrin polymer as showing promise in water purification. After spending a few more months analyzing the material, Dichtel reached out to Damian Helbling, assistant professor of civil and environmental engineering. Helbling's areas of study include water quality as it relates to human and ecosystem health.

"My role at that initial stage, last January or February, was a consultant," said Helbling, a co-author of the paper. "They said, 'We have this polymer that can do this; what are the water quality issues to which this could be applied?'"

Helbling noted that his group challenged the polymer in a way that Dichtel's group hadn't, to see if it would adsorb various pollutant mixtures at lower concentrations relevant for real-world water purification.

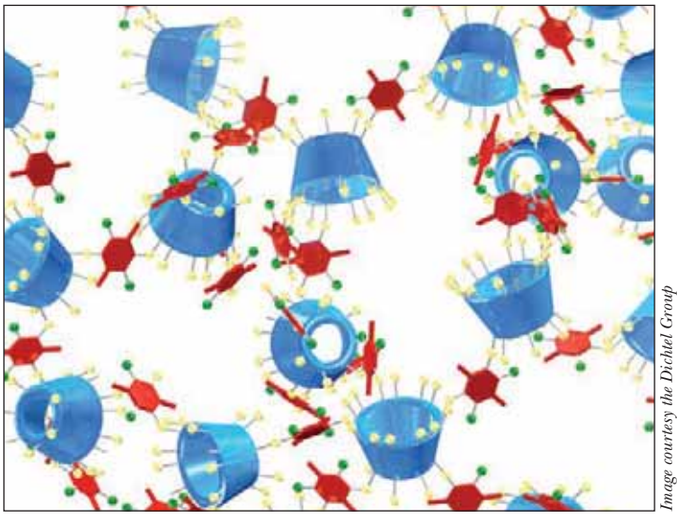

Image courtesy the Dichtel Group

A porous material made from cup-shaped cyclodextrins, which rapidly bind pollutants and remove them from contaminated water.

"[Our contribution was] proving that even under environmentally relevant conditions, the phenomena that they were observing were repeatable. And they were," Helbling said.

Recyclability is another advantage of the cyclodextrin polymer, Dichtel said. Whereas activated carbon filters must undergo intense heat-treating for regeneration, cyclodextrin filters could be washed at room temperature with methanol or ethanol. And a drop-off in performance following regeneration wasn't observed, Dichtel said.

Dichtel, whose MacArthur Foundation "Genius Award" will total $625,000 over five years, said part of that award will go to further research into cyclodextrin water purification, ultimately setting the stage for a product that can be manufactured on large scales.

"Traditionally, that gap between the laboratory discovery and getting something out in the world where it can help people is difficult to bridge," he said. "So to have support that is totally unrestricted, that can be used pragmatically in that space, is really valuable."

Dichtel is excited about the potential his group's results show in terms of the water-purification industry.

"There are a lot of things going for it," he said. "There are still some unknowns, but everything looks pretty promising."

Other co-authors of the paper, "Instant Removal of Organic Micropollutants From Water by a Porous beta-Cyclodextrin Polymer," are postdoctoral scholars Alaaeddin Alsbaiee and Brian Smith and graduate students Leilei Xiao in chemistry and chemical biology and Yuhan Ling in civil and environmental engineering.

The research made use of Cornell's Center for Materials Research User Facilities, which are supported by the NSF. Dichtel's group has filed a provisional patent application related to the cyclodextrin polymers reported in the Nature article.

Tom Fleischman is a Physical Sciences/Engineering writer for the Cornell Chronicle, Ithaca, NY. He can be reached by email at TJF85@cornell.edu.

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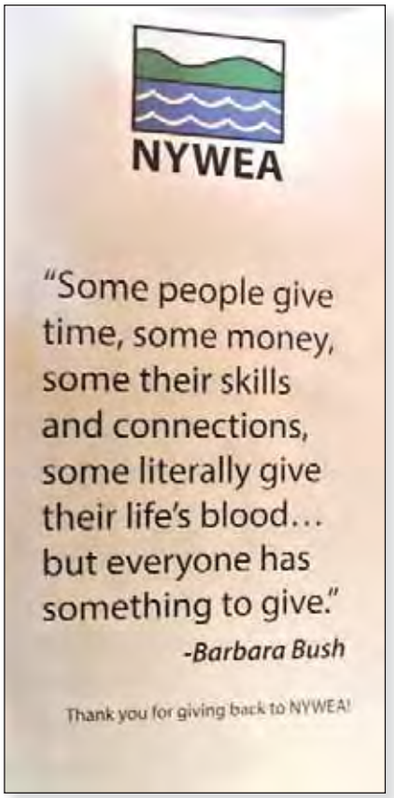
… and More Awards!

Richard "Doc" Lyons receives the prestigious Water Hero Award as well as Outgoing Committee Service Award.



A banner on display during the President's Reception, an event held to thank NYWEA's volunteers.

Robert DeGiorgio receives the Outgoing Board Service Award from President Garland.

Andrew Kittel from NYCDEP receives the Uhl T. Mann Award for Maintenance.

Assistant Treasurer Tony DellaValle and Conference Management Co-chair Dave Barnes pause a moment between sessions.

President Mike Garland recognizes Water Ambassador Adam Zabinski for his 40 years of continuous membership in NYWEA.

President Mike Garland presents Richard Crescenzo with the John Chester Brigham Award.

Wendi Richards receives the John Chester Brigham Service Award as well as Outgoing Board Service Award.

Professors John Fillos and Krish Ramalingam of City College catch up at the awards lunch.

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Rev. 2/15/16

Operator Quiz Test No. 111 – Disinfection

The following questions are designed for trainees as they prepare to take the ABC wastewater operator test. It is also designed for existing operators to test their knowledge. Each issue of *Clear Waters* will have more questions from a different section of wastewater treatment. Good Luck!

1. Calculate the chlorine demand given the following information:
   Feed rate = 150 lbs. /day
   Flow = 11.5 MGD
   Measured chlorine residual = 0.5 mg/L
   a. 1.06 mg/L
   b. 1.56 mg/L
   c. 2.06 mg/L
   d. There is not enough information to determine the chlorine demand.

2. Chlorine gas is:
   a. Lighter than air
   b. Heavier than air
   c. Has a "rotten egg" smell
   d. Is safe to breath in concentrations of less than 500 ppm.

3. Which of the following would be used to detect a chlorine leak:
   a. Sodium Hydroxide
   b. Ferric Chloride
   c. Ammonia
   d. Nitric Acid

4. A chemical commonly used for dechlorination is:
   a. Sodium Hypochlorite
   b. Sulfur Dioxide
   c. Ozone
   d. Fluoride

5. Which of the following methods is not used to determine chlorine residual:
   a. Amperometric Method
   b. DPD Method
   c. Iodometric Method
   d. Winkler Method

6. Subtracting the chlorine residual from the chlorine dose is:
   a. Chlorine Feed Rate
   b. Chlorine Demand
   c. MPN (Most Probable Number)
   d. Alkalinity

7. Pathogenic organisms can be removed from the wastewater treatment process by which of the following:
   a. Physical removal through sedimentation and filtration
   b. Die-off through natural means and unfavorable environmental conditions
   c. Destruction by chemicals added to the treatment process
   d. Pathogenic organisms can be removed by all of the above

8. Which of the following treatment processes is not an acceptable way to ensure all pathogenic microorganisms are destroyed:
   a. Chlorination
   b. Filtration
   c. Ultraviolet light
   d. Ozone

9. The addition of chlorine gas into water represented by the following equation can most accurately be described as yielding which of the following?:
   $Cl_2+H_2O \rightarrow HCl+HOCl$
   a. Hypochlorous and hydrochloric acids
   b. Sodium hypochlorite and water
   c. Sodium hypochlorite and hydrochloric acid
   d. Hypochlorous acid and sodium hydroxide

10. Calculate the chlorine dosing rate in lbs/day given the following information:
    Chlorine demand, mg/L = 16 mg/L
    Chlorine residual, mg/L= 2.0 mg/L
    Flow, MGD = 5.5 MGD
    a. 8.26 mg/l
    b. 826 lbs/day
    c. 8.26 lbs/day
    d. 8.26 mg/l

11. Which of the following parameters is not considered when operating a disinfection system using ultraviolet light?:
    a. Keeping the UV channel water at a constant level
    b. Preventing an excessive water level above the top lamp row
    c. Keeping the UV lamps submerged at all times
    d. Maintaining the proper chlorine residual in the effluent

12. Calculate the chlorine residual given the following information:
    Dosing rate = 5.8 mg/L
    Flow = 80 MGD
    Chlorine demand = 4.5 mg/L
    a. 1.3 mg/L
    b. 10.3 mg/L
    c. 0.3 mg/L
    d. 0.93 mg/L

13. Given the information in the previous question, calculate the required pumping rate of 15% sodium hypochlorite.
    a. 3096 lbs/day
    b. 3870 gallons/day
    c. 3096 gallons/day
    d. 1251 lbs/day

Answers on page 62.

For those who have questions concerning operator certification requirements and scheduling, please contact Tanya May Jennings at 315-422-7811 ext. 4, tmj@nywea.org, or visit www.nywea.org/OpCert.

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New York Water Environment Association, Inc.

Answers from page 61: 1 A, 2 B, 3 C, 4 B, 5 D, 6 B, 7 D, 8 B, 9 A, 10 B, 11 D, 12 A, 13 C

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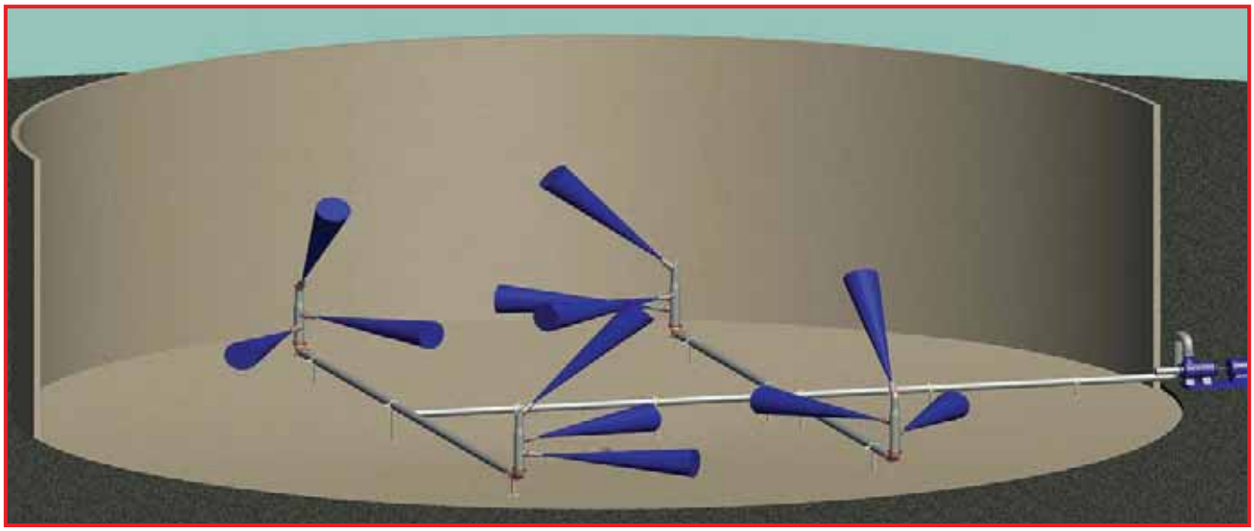

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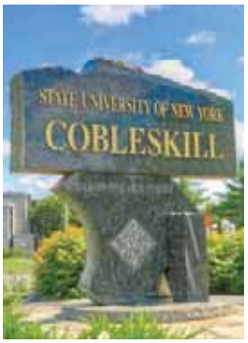

SUNY Cobleskill's pump station consists of two 10 HP submersible pumps and one 5 HP submersible mixer. Discharge from their dining hall and five dormitories creates a very thick layer of FOG (fat, oil, grease), which builds up in the station. The submersible mixer could not break up the grease layer and also required routine maintenance (every week) due to rags being caught on the blades of the mixer. The submersible mixer was removed and replaced with a 0.5 HP air-powered GridBee AP500 mixer.

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- Bob Blanchard, Plumber & Steamfitter, SUNY Cobleskill

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