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SUSTAINABLE WASTEWATER MANAGEMENT
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The American Society for Civil Engineers, in their report card issued on January 28, 2009, graded wastewater infrastructure with a D-, which is the lowest grade they gave. The dismal assessment points to a national infrastructure that is unable to meet current and future demands and, in some cases, may be unsafe. In early recognition of the crisis, the Water Environment Research Foundation has been in front of the curve, conducting research that helps communities provide reliable and cost effective wastewater service as we seek to improve the sustainability of wastewater treatment facilities across the country.

BACKGROUND ON WASTEWATER SERVICES IN U.S. COMMUNITIES

Wastewater services have undergone explosive growth over the past three decades. The population receiving wastewater treatment from publicly owned treatment works (POTWs) increased almost 250 percent from 1972 to 2004, from 84 million people to 205 million. Local governments across the United States estimate that they will serve approximately 285 million people by 2024.

There are 16,600 POTWs in the United States (not including Native American tribal facilities). In addition to collection and treatment facilities, America's water systems include 600,000 miles of sewer line.

About 70 percent of centralized wastewater treatment and collection facilities serve small communities, comprising only 10 percent (27.2 million people) of the population served by centralized collection.

The water quality industry is facing tremendous growth. The 2004 U.S. EPA Clean Watersheds Needs Survey indicates that, on average, 34.4 billion gallons of wastewater actually flows through the facilities each day. The designed national capacity is 47.2 billion gallons per day and, as of 2004, facilities had plans to increase capacity to 52.5 billion gallons per day.

The people who run our communities' wastewater treatment plants are true public servants. In 2004, local governments employed 124,380 full time equivalent "sewerage" workers, with an annual payroll of $5.54 billion. These wastewater treatment employees face a daunting task, building new systems and replacing or rehabilitating current systems.

INFRASTRUCTURE CHALLENGES ARE BIGGER THAN JUST REPLACING DETERIORATING PIPES

Bigger service areas, increased flows, and replacement or rehabilitation of deteriorating infrastructure translate into additional financial need. In 2004, the U.S. EPA estimated that wastewater treatment and collection projects require $189.2 billion in capital costs alone.

While replacing or fixing the infrastructure, agencies must address demands for better treatment and removal processes for an increasing array of contaminants – while using less energy, imposing smaller carbon footprints, and dealing with the challenges of climate change. Meeting the challenges will require a multi-pronged research effort: analyzing conditions, developing and assessing technologies, measuring results, and providing solutions.

Infrastructure must address climate change challenges. Wastewater utilities are well aware that changes in temperature, precipitation, sea levels, and the hydrologic cycle in general affect delivery of services and potentially affect receiving water quality. Changes in human behavior – such as changes in water demand, changes in land use and land cover, and more legislative protection of adversely affected species – may also accompany climate change. These factors add additional uncertainty to the future sustainability of municipal wastewater services.

The wastewater industry must minimize air emissions (such as methane and nitrogen greenhouse gas) and mitigate other impacts resulting from energy and chemical use. Plant managers must weave economic considerations into every decision and find the best balance between multiple goals: achieving effluent quality requirements; planning for add-ons that will meet future effluent requirements; using all resources (i.e., powering equipment with methane); and optimizing the use of external resources (such as chemicals and electricity).

RESEARCH PAVES THE WAY FOR PLANNING "SHOVEL READY" PROJECTS

Researchers are examining new processes and technologies that will help communities conserve resources, especially improving energy efficiency and reducing the amount of potable water used in wastewater treatment. WERF is particularly looking to reduce sludge production, lower methane and nitrogen greenhouse gas releases, and lessen chemical usage. Researchers are also testing new technologies that reuse sludge, nutrients, methane, and treated wastewater.

One WERF project, started this summer, is identifying and measuring key factors that contribute to the sustainability of a wastewater treatment facility. The project, *Improving the Wastewater Plant Environmental Footprint: Options for Your Locality*, will help wastewater treatment plants define their current carbon and ecological footprint as they take timely and truly effective steps towards reducing impact. Communities will be better able to collect information on the mass, energy and ecological footprint of wastewater treatment facilities on a unit process basis. That information will support a database that plants can use to match their processes and optimize their sustainability.

The researchers selected the Strass wastewater treatment plant (WWTP), near Innsbruck, Austria, as a case study. The Strass WWTP has achieved a laudable goal that the rest of the wastewater community aspires to: producing more energy than is needed to operate the facility. Through a two-pronged approach of continually exploring options to improve the plant's overall energy efficiency and optimizing methane production from the anaerobic digesters, the plant is producing more energy than it needs to operate the entire facility. The Strass WWTP is an ideal candidate for testing the new evaluation metrics, and establishing a benchmark in the database against which other facilities can compare themselves.

The mass and energy balance template containing the Strass WWTP data will be available in early 2009. WERF will subsequently develop a web-based self-evaluation tool that each wastewater facility can use to plan, design and build facilities that will meet the quickly emerging challenges of the 21st century.

RECOVERING ENERGY FROM SLUDGE

It's been a problem since the first indoor toilets were installed – what do you do with the sewage? Innovative wastewater agencies are doing a lot, it turns out. They are pulling reusable compounds out of the sludge and they are also using the sludge to generate alternative energy. That makes particular sense since research demonstrates that sewage actually contains ten times the energy needed to treat it.

Early in 2008 WERF and its global research partners issued a report, *State of Science Report: Energy and Resource Recovery from Sludge*, which presents an exciting picture of the possibilities. Interest in extracting products from sludge, while not recent, is rising because of increases in energy costs and impacts of global warming. Resource recovery from sludge is currently a worldwide topic and has become a key aspect of almost all sludge management master plans.

There is a lot of sludge to work with. In the U.S. alone, the 16,583 wastewater treatment facilities produce over 64 pounds of sludge per person, every year. It is estimated that the U.S. produces 6.5 million metric tons of "dry solids" – sewage sludge with the water squeezed out of it – annually. Currently, 45 percent of that sludge is incinerated or goes to landfills, 49 percent is treated and used in land applications, and only 6 percent is reused for other purposes – like energy production.

Wastewater treatment plants are net users of energy. In the U.S. they consume an estimated 21 billion kilowatt hours per year. There are important reasons for this energy use, as society demands increasingly intensive treatment to remove nutrients and chemicals from wastewater before it is discharged back into water bodies or is reused. But energy use is coming under increasing scrutiny, with the financial cost of energy and the environmental cost of energy generation driving new interest in the conversion of sewage sludge to energy.

Sewage contains ten times the energy needed to treat it, and it is technically feasible to recover energy from sludge. As renewable energy, it can be directly used in wastewater treatment, reducing the facility's dependency on conventional electricity. The greater the quantity of energy produced by the industry, the more the industry can help reduce emissions of greenhouse gases. Using solids as a resource rather than a waste may help stressed public budgets as well. Wastewater solids must be processed prior to disposal, and solids handling accounts for as much as 30 percent of a wastewater treatment facility's costs.

Converting solids to energy is feasible and desirable, from a treatment perspective. The challenge is finding a process that is also affordable, cost-effective, and acceptable to the public.

While the current technology is promising, none of the processes can fully extract all the energy available in wastewater. New technological developments, or improvements of current technologies, are necessary to take advantage of the maximum energy available in sewage and sludge. Researchers are leaving no stone unturned; they are examining physical, mechanical, biological, and chemical processes that can produce or contribute to energy recovery from sludge.

HELPING CITIES AND TOWNS MAKE INFORMED DECISIONS

There are about 2,000 central sludge processing facilities in the U.S. As of 2004, 650 of those facilities used anaerobic digesters to process its sludge. When sludge is digested, it produces methane gas. As an aid for municipalities considering energy recovery from digester gas, a Water Environment Research Foundation project developed the Life Cycle Assessment Manager for Energy Recovery (LCAMER) model. This model enables the cities and their engineers to judge the feasibility of recovering energy from anaerobic digestion of wastewater solids based on site specific design and operating conditions, and energy pricing.

Some examples of current use of technology:

- Watsonville, CA uses restaurant grease to increase sludge digester gas production by over 50%.
- Thermally dried biosolids substitute for 5-10% of coal used to fuel a cement kiln in Maryland.

- Methane as source of hydrogen to produce energy with molten carbonate fuel has been demonstrated at King County (WA) South Treatment Plant.
- In 2005 in the U.K., waste (including sewer sludge) combustion and biogas production accounted for 10.8% and 4.2% respectively of all UK renewable energy.
- In 2005, an average of 113% of the electricity used by a German plant was generated onsite by gas engines.
- A Swedish treatment plant produces and sells biogas to Stockholm's bus company, which uses it to run at least 30 buses.
- Stockholm's energy company uses heat recovery pumps to extract heat from treated sewage to provide hot water and heating to 80,000 apartments.
- The Sewerage Bureau of Tokyo Metropolitan Government turns dewatered sewage sludge into fuel charcoal for thermal power generation.

WERF'S INFRASTRUCTURE RESEARCH IS HELPING COMMUNITIES NOW

WERF is committed to putting research results into actionable form. Our current tools, accessible to wastewater agencies across the United States include:

Sustainable Infrastructure Management Program Learning Environment (SIMPLE)
SIMPLE makes asset management comprehensible. This software tool provides essential components of a state-of-the art program, promotes information exchange, and suggests practical implementation guidelines.

SAMGAP
This benchmarking mechanism, incorporated into SIMPLE, facilitates self assessments, allowing utilities to compare themselves to best management practices of North American industry leaders.

Sewer Cataloging, Retrieval and Prioritization System (SCRAPS)
This sewer inspection tool helps small- to medium-sized wastewater utilities estimate the probability and consequences of pipe failure. Utilities use SCRAPS to strategically focus sewer inspection programs in those areas most likely to need attention.

Condition Assessment Strategies and Protocols for Water and Wastewater Assets
This report assists water and wastewater utilities in their long-term planning as well as their day-to-day management of assets. It identifies the advantages and disadvantages of various tools and techniques for measuring the condition and performance of utility assets. (Stock no. 03CTS20CO)

New Pipes for Old: A Study of Recent Advances in Sewer Pipe Materials and Technology
Should a public wastewater agency rehabilitate, renovate, or replace their buried pipe? This report assesses the various pipe materials used by agencies throughout the United States, and presents additional options in the use of plastics, composites, and pipe structures. It also reviews designs for installation and rehabilitation of manholes. (Stock no. 97CTS3)

An Examination of Innovative Methods Used in the Inspection of Wastewater Systems
Investigation and diagnosis is fundamental to effective strategies for rehabilitation and replacement of our wastewater systems. This report provides a comprehensive review of investigation technology and suggests a structured approach to the investigatory process. Public agencies can use the information to determine which technology will serve them best. (Stock no. 01CTS7)

Methods for Cost-Effective Rehabilitation of Private Lateral Sewers

Millions of sewer laterals — the sewer pipes connecting individual properties to the public sewer network — exist throughout the United States. This report discusses options for inspection, evaluation, and repair of sewer laterals. It also addresses the financial and legal issues regarding access to private property in maintaining a public asset. (Stock no. 02CTS5)

Minimization of Odors and Corrosion in Collection Systems
This report explains the science underlying odor and corrosion mechanisms in sewer pipes, and suggests control strategies within the asset management framework. Researchers review affordability, system planning, design, and operations and maintenance. They also provide insights on public outreach and regulatory issues. (Stock no. 04CTS1)

WERF NEEDS CONGRESSIONAL SUPPORT TO MEET EMERGING CHALLENGES

We are grateful for Congressional support in the past, especially as WERF received special designation in FY '08 as a "national Congressional priority." To undertake a robust response to the growing challenges, WERF respectfully requests an appropriations match to the $7 million annual commitment from WERF subscribers. Certainly, the aggressive research agenda in front of us calls for no less than the $4 million allocated to the Foundation in fiscal years 2000 through 2005.

WERF, a 501(c)3 nonprofit organization, is one of the nation's leading research foundations and is supported by over 300 subscribing organizations. These organizations include approximately 200 wastewater and stormwater utilities, which provide service to over 75% of the sewered population in the United States. More than a dozen global manufacturers with private wastewater facilities also support WERF, as do nearly 100 companies that provide services and equipment to both public and private facilities.

WERF provides products and services to clean water professionals that are not available anywhere else. Constituent support attests to the value of WERF research. In a 2007 survey, 96% of WERF's subscribers said they would recommend WERF to others, and 90% use WERF research to improve processes, reduce costs, assist with compliance on regulatory issues, or to educate customers.

The need for WERF's credible, forward-looking research has never been greater, and recent funding reductions are crippling WERF's ability to serve the water quality profession and the ratepayers to whom we provide services. Fully funding WERF at between $4 and $7 million will ensure that vital programs – most importantly including the vital renewal of sustainable infrastructure – can be pursued with the vigor that the times demand.