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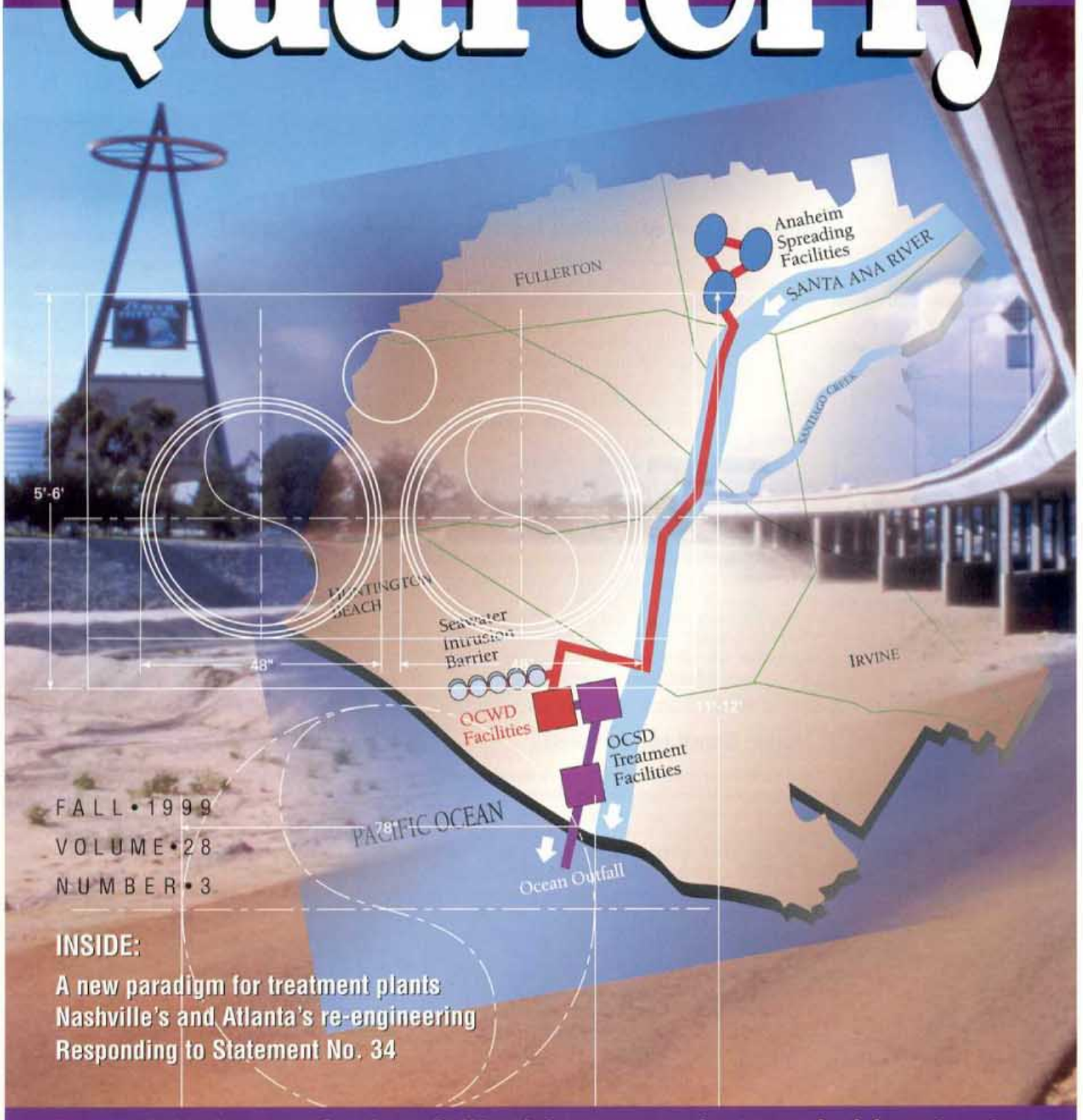

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INSIDE:

Featured this issue — Southern California's new groundwater replenishment system

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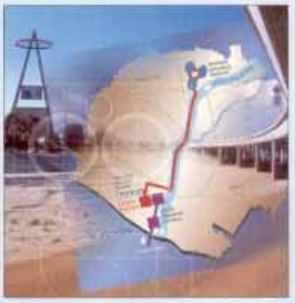

A portion of the route of the 14-mile-long, 78-inch-diameter pipeline for the Groundwater Replenishment System, to be constructed by the Orange County Water and Sanitation Districts, is shown along with conceptual drawings.

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Quarternotes

Denver Summit Emphasizes Increased Technical Specialties

Brown and Caldwell has stepped up efforts to keep employees abreast of its rapidly-expanding technical specialty base — especially for its growing private sector practice, which doubled last year through the acquisition of internationally acclaimed industrial water quality experts, Eckenfelder Inc.

More than 80 people from 32 offices recently gathered in Denver for a two-day Private Sector Summit. Linda Henry, the company's chief toxicologist and event organizer, explains, "The summit promoted companywide understanding of the people and expertise throughout the organization, and making these resources available to clients regardless of their location."

Cross-company teams representing specific disciplines presented case studies about new technologies they're executing in the field, while everyone participated in a "Private Sector trade show," exhibiting work samples and demonstrations of their specialties. "Never has there been an opportunity like this to cross sell services among ourselves," says Brian Anderson, senior geologist in Boise. "Many people had no idea, for example, that we were doing resource analysis for the sand and gravel industry."

The Summit also enabled the company's Quality Assurance and Control (QAC) task force to describe how protocol had been revised to incorporate the best practices of both Brown and Caldwell and Eckenfelder. Says Steve Haverl, senior vice president in Denver, "The new QAC represents just one of the leveraging aspects of the combined firms."

Brown and Caldwell's Private Sector Summit included seminars as well as a mini-trade show, in which representatives from different regions and disciplines within the company promoted and demonstrated their capabilities.

Joining Brown and Caldwell

Newly appointed Manager of Instrumentation and Control Technology **Miroslav Zelezny, P.Eng.,** is based in Brown and Caldwell's Seattle office. Both an electrical engineer and a certified wastewater treatment plant operator, he has more than 15 years of professional experience with electrical systems, instrumentation, and process control engineering…**J. David Zuber, R.G.,** is a principal geologist/hydrogeologist in Sacramento, Calif., with 13 years of experience, including soil and groundwater remediation, groundwater geochemistry, site assessment, monitoring plans, and clay minerology…**Diane Henry, R.G., C.H.G.,** joins the Irvine, Calif., office as a principal geologist/hydrogeologist with more than a decade's worth of experience with oil and gas research and exploration and 13 years of experience with investigations and cleanups…Also joining the Irvine staff is **B. Richard Sacks, P.E.,** with more than 25 years of experience with industrial water and wastewater design, engineering, and field construction for multi-million-dollar, large-scale industrial projects worldwide…**Robert Getter, P.E.,** a supervising engineer in Irvine, has 15 years of experience with design and construction of water, wastewater, and solid waste facilities, including a 480-million-gallon-per-day wastewater treatment plant for the Boston Harbor Project…Principal Geologist/Hydrogeologist **Linda Conlan,** also in Irvine, has more than 12 years of experience with management of subsurface soil and groundwater investigations for aerospace, industrial, and other facilities…**Manuel Arroyo, P.E.,** a principal engineer in San Diego, has 32 years of experience master-planning water and wastewater facilities and designing and managing pipeline, sewer main, pump station, and reservoir projects…Based in the Twin Cities office

Continued on page 8

IT Is It: Fostering Successes in Water and Wastewater System Management

Information-technology expert Scott Bash outlines some of the new ways managers can regulate, simulate, and improve operations.

Information technology (IT) has become the key ingredient for greater success in water and wastewater organizations. With the transition from an industrial economy to an information-based economy, the management of hard resources (oil, coal, and gas) has been supplanted by the management of soft resources (knowledge, design, and systems) as the primary activity of organization leaders. Like other leaders, water and wastewater managers are staying in closer touch with the living data around them and adapting more quickly to changing conditions. With the help of IT advances, wastewater collection system managers and plant operators can continuously adjust a range of variables for optimal control.

For many years, IT for wastewater collection and treatment meant automation. Now, IT is also taking on overflow management; data collection; process and system simulation; computerized maintenance; and work-flow optimization. Managers need to keep up with these technologies if their operations are to thrive in an increasingly competitive industry.

For instance, an existing network for flow monitoring can be converted into an automated control system that not only monitors overflows, but also regulates the rate of flow into the treatment plant, controls overflow activity, and reduces or eliminates overflows altogether. This concept is becoming more reliable with every tick of the technological clock, every click of the computer mouse.

Automatic flow-control systems require fast and reliable methods of data collection from the flow monitors and simulation of that information. This can be gained through the coupling of supervisory control and data acquisition (SCADA) with modeling. Modeling software, installed on top of the SCADA system, uses available online data to perform simulations and predict flow conditions.

Simulation and modeling permit a feedback/adjustment loop. As conditions in the wastewater system — including collection, treatment, and outflow — change, algorithms can be used to instruct controllers, located throughout the system, to throttle flow here, open gates there, or operate other types of controllers so that another part of capacity is utilized. With this forecast-based, real-time control system, flow monitoring, flow regulation, and model predictions are used together to control activities.

To further improve control, small storage facilities can be built throughout the wastewater system to temporarily hold flow and provide capacity relief. When peak flow subsides and conditions begin to return to normal, gates can be opened and the stored flow can be bled back into the system at a controlled rate. Peak flow reductions achieved in this way can help eliminate overflows and improve plant performance.

SCADA, simulated system performance, and forecast-based changes are the essential tools for optimizing control, but they must be complemented by a good maintenance program. A computerized maintenance management system (CMMS) is a crucial part of the IT toolbox for water and wastewater operations. CMMS is a proactive tool for maintaining system inventory, controlling the number of physical bottlenecks, managing the work-flow of maintenance personnel, and allowing for greater operational capacity. CMMS is paying for itself many times over as maintenance managers find the time to be more proactive and less strained by the process of reacting.

Many other information technologies are becoming available to measure performance, provide control, and manage work flow — document management systems, asset management, environmental management systems (EMS), data warehousing, and online operation and maintenance manuals, to name a few.

Of course, IT advances in our industry call for the "brainware" to effectively apply them. In Brown and Caldwell's experience, that means taking a broad systems-engineering approach. That is, we integrate IT into an organization's legacy of computer systems *and* systems for operations and management — linking and expanding traditional services for all of those areas.

For more information on managing change and integrating IT into operations, contact Scott Bash in Atlanta at (770) 673-3647.

A Vision of Groundwater Replenishment in Orange County, California

A pipeline and treatment system of unprecedented scale will augment groundwater with treated wastewater for the first time in the state.

Nature has endowed Orange County, Calif., with a huge groundwater basin, which supplies 75 percent of the water required by more than two million people. But the aquifer has long been overdrawn and is vulnerable to seawater intrusion. Moreover, years of intensive agriculture and industry have contaminated it with nitrates and other pollutants.

Now, the Orange County Water District (OCWD) has embarked on a joint project with the Orange County Sanitation District (OCSD) to recharge the aquifer itself with highly purified, tertiary-treated wastewater.

Although its underlying technologies aren't new, the scale of the Groundwater Replenishment System is unprecedented. As much as 100 million gallons of water per day will be pumped to spreading basins via 78-inch-diameter pipeline. The process will add 100,000 acre-feet of water per year to the aquifer — enough to serve 200,000 families. Until now, reclamation projects in California have produced water for landscape or agricultural uses; none has been designed to augment groundwater, and none supplies the anticipated output of the Groundwater Replenishment System.

Tom Dawes, OCWD/OCSD program manager for the new Groundwater Replenishment System: "We have excellent engineering and good science behind us, and we've had good success dealing with regulators and technical people. But the key to acceptance is how we're viewed by the public."

The evolution of groundwater replenishment

Problems with the aquifer were evident as long ago as 1933, when the California legislature created the OCWD to manage it. The centerpiece of the OCWD management program has been the Talbert Gap Seawater Intrusion Barrier, where reclaimed wastewater is injected to block infiltration from the Pacific. The OCWD has branched out from its original mandate to protect groundwater to augmenting it as well, shunting water from the Santa Ana River, along with imported water, into recharge basins.

The OCWD/OCSD's new project will augment the groundwater much more extensively, conveying treated water via pipeline along the course of the Santa Ana River to spreading basins 14 miles inland from new advanced treatment facilities. To be built near the existing Seawater Intrusion Barrier and OCSD landscape-irrigation treatment facilities, the new facilities will provide tertiary treatment including microfiltration, reverse osmosis, and ultraviolet disinfection. Brown and Caldwell is part of the design team, which includes Camp Dresser & McKee and ASL Consulting Engineers, Inc.

To put the scale of the program into perspective, OCWD/OCSD program manager Tom Dawes explains, "If this project were already built today, it would be the biggest of its type in the world, and probably all the similar projects in the world put together wouldn't add up to the size of this one." He adds, "All the studies and the research we've done have led us to believe that this is the type of project that will be necessary to serve not only Southern California but also most of the arid areas of the world with new sources of high-quality and safe water. We want every element of this project to be best-in-class, and the entire project to be world-class."

Economically right on time

In terms of economics, the project's time has arrived. Refinements in microfiltration and reverse osmosis have reduced energy requirements sufficiently to allow the Groundwater Replenishment System to produce high-quality water using half the energy it now takes to pump water into Orange County from Northern California or the Colorado River. Also, it will reduce the need for costly upgrades of the ocean outfall.

Bob Finn, Brown and Caldwell's project manager in charge of pumping systems, points out that the purity of the treated water allows for flexibility in uses and potential marketing: "Cities along the route will be able to buy and sell the water for irrigation. In California, that's all we ever use reclaimed water for. But this water will be put in recharge basins, and into groundwater, becoming part of the water resources — thereby becoming very valuable."

Engineering in the age of mitigation

The Groundwater Replenishment System is slated to achieve full capacity

in 2020. This might seem to be a long timeline, even given the scale of the project. But, as Brown and Caldwell's project manager in charge of the pipeline, Jeff Heden, puts it, "Because of the many different permits required and the variety of mitigation measures that we've agreed to do, this is more of a people project than a pipeline project."

Much of the mitigation will be associated with laying large-diameter pipe along the course of the Santa Ana River, which traverses a complex expanse of urban and suburban neighborhoods. Typically, the pipe will be installed within levee banks on property owned by the County Flood Control District. Flood-control issues also involve the Army Corps of Engineers, which is concerned about preserving its system of levees and channel modifications.

Residential communities along the way are concerned too. Then there are city streets that cross the river every mile or so, several interstate freeways, and bicycle paths; the Anaheim Sports complex, with its professional ballpark on one side of the river and hockey arena on the other; and the Riverview Golf Course, which seeks assurances of compensation in case of lost tee times.

Contributing to the design challenges are more than a dozen different flow scenarios based on seasonal use, weather, and where the water is needed. Hence, sophisticated flexibility will have to be built into the pumping system, along with 100 percent reliability of backup power.

A people project more than a pipeline project

The Groundwater Replenishment System has broad public and political support. The budget proposed for water projects last February by the Clinton administration included $1.5 million to support it, and most of Orange County's political and environmental interests have given the project a thumbs up.

The benefits are manifold. By recharging the area's aquifer with highly purified water, the system will reduce demands on external sources of municipal water, minimize the need to dispose of wastewater via an ocean outfall, and dilute such pollutants as the salts and nitrates that still enter the aquifer from upstream dairy operations. And the water will be purified beyond drinking water standards by tertiary treatment.

In spite of these benefits, feelings of queasiness persist, and are sometimes exploited by the media — one televised survey asked for opinions on what it termed Orange County's "toilet-to-tap" project.

"It's certainly a controversial project," says Tom Dawes, "so I've always seen public information and confidence building as its biggest single element. We have excellent engineering and good science behind us, and we've had good success dealing with regulators and technical people. But the key to acceptance is how we're viewed by the public."

Toward this end, the OCWD offers a monthly class on project issues at its headquarters, and it has even taken the show on the road, making presentations available at no cost to groups of 10 or more at locations of their choice. Dawes himself has become directly involved. "In the last year and a half," he says, "we've spoken to every Orange County service group that will let us in the door. It truly is a people project, in my mind."

—SAM WILSON

A 14-mile-long pipeline will extend from new Orange County Water District treatment facilities to spreading basins in Anaheim, Calif. The new facilities will provide tertiary treatment including microfiltration, reverse osmosis, and ultraviolet disinfection. (Illustration courtesy of the Orange County Water District.)

Reducing Variability: A New Paradigm for Wastewater Plant Efficiency

Eric Wahlberg argues that by adopting techniques already widely practiced in other industries, wastewater treatment plant operators can minimize process variation and dramatically improve plant performance.

Put 16 operators in the control room of an activated sludge plant that is performing well, give them long-duration trend charts of the variables they typically monitor, and you will hear one reason for the plant's success. But put the same operators in the control room with the same charts when the plant is running badly, and you will hear 16 explanations. Something's wrong.

Captives of reactivity

My experience as a wastewater treatment plant operator and my involvement in operations have led me to what I believe are the roots of the problem: 1) operators may not be monitoring the right variables; 2) many operators lack understanding of the processes at their plants and interactions among them, and 3) operators know how to exert only reactive control.

Pressured to reduce costs, utility managers and administrators are captives of their operators' reactivity. Many a utility manager has begged the plant superintendent to save money by operating the plant "so it just makes permit." But most operators don't know how close to permit levels they can operate. Instead they focus on making the best water possible, reasoning that if the process goes south tomorrow, it will all average out.

A new paradigm in operations is needed, in which operators and engineers focus on measuring and controlling treatment variability. For example, in activated sludge plants, they control sludge quality rather than expecting it to be controlled by targeting a distantly related parameter. In this new paradigm, real optimization is possible.

Al West's legacy of sludge quality

From the invention of activated sludge in the early 1900s until the late '60s, plant design and operation were based on experience, rules of thumb, and questionable safety factors. In the early '70s, Al West, an EPA employee, devised several tests to measure activated sludge quality to help operators control plants and get the right effluent quality. At the same time, advances in microbiology demonstrated that microbial growth rate was key to design and operation of the activated sludge process. Al West was pulled into this kinetic approach, and he developed the concept of sludge units from which one can calculate sludge age, a kinetic parameter related to growth rate.

The problem with this and other kinetic approaches to control is that it puts the cart before the horse. Operators target a certain sludge age (or SRT or MCRT or MLSS concentration or mass inventory or F:M ratio) in hopes of growing a high-quality sludge. But it's the high-quality sludge, not the sludge age, that produces high-quality effluent.

Shifting from "product" to "process"

Instead of focusing on the *product*, plant operators should focus on controlling the treatment *process*.

North America's manufacturing sector learned long ago from the Japanese that controlling quality at the end of the assembly line is inefficient and expensive. If, like a wastewater treatment operator, a manufacturer produced a product that *only on average* met specified quality characteristics, the manufacturer would be out of business.

The objectives of process control are to dampen influent variation, minimize effluent variation, and prevent or recover from process upsets. Variability is the key to two of these objectives. And reducing variability is the key to plant optimization.

Variability you can't control and variability you can

Variability has two types of sources. *Unassignable sources of variation* are inherent in the system and cannot be easily removed. *Assignable sources of variation*, on the other hand, can be removed.

In wastewater plants, *unassignable* sources of variation include:

- Influent flow and organic loading
- Type and concentrations of pollutants
- Temperature
- Presence of toxics
- Microbial population dynamics

Assignable sources of variation include:

- Too much sludge in primary clarifiers
- Fluctuating dissolved oxygen concentrations in aeration basins
- Changing waste activated sludge (WAS) flow rates
- In-plant recycle flows
- Changing secondary sludge blankets

You can't control what you don't measure

To control process variability, you have to quantify it. An excellent charting technique to measure variability, called statistical process control (SPC), was developed in the 1920s at Bell Labs by Walter Shewhart. This technique has been refined over the years and is used in a myriad of computer applications.

SPC consists of defining work into a series of processes; describing each process; identifying quality characteristics for each process; collecting statistical data on the quality characteristics in the form of process learning charts; identifying variation in the behavior of the quality characteristics; and taking action to regulate or eliminate the variation.

Process learning charts are the heart of SPC. Unlike the trend charts typically used by operators, process learning charts show when action is needed and when it

is not. The charts show when a process goes out of control, which means that an assignable source of variation has come into play. The operator then must seek the variation's source.

The charts also show when only unassignable sources of variation exist. In this state, the process is in statistical control and performance is predictable. This does not mean that there is no variation in the outcomes of the process, or that the variation is small, or that the outcomes meet the requirements set by the operator. It means only that the variation in outcomes is predictable within statistically established limits.

Optimizing by minimizing variability

Example 1: Control sludge quality, not effluent quality. In wastewater treatment (as in manufacturing), product quality is assured when quality is maintained at each step of the treatment train (or production). If effluent quality deteriorates because of a sludge withdrawal problem in the primary clarifiers, a lot of bad water is discharged in the time it takes to identify the problem, initiate a change, and wait for the change to run through the system. Instead, variability needs to be minimized much earlier in the process.

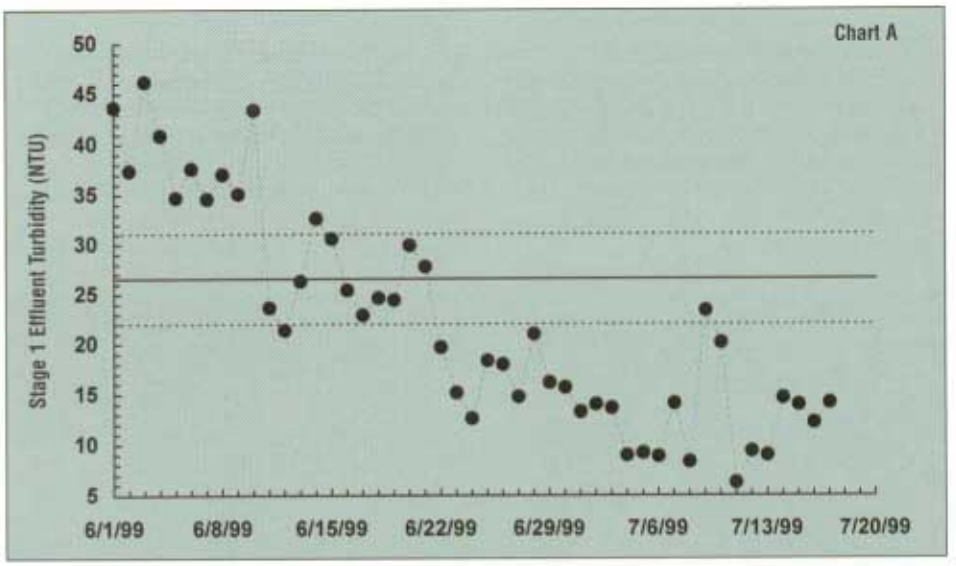
Sludge quality, for example, is crucial to the success of the activated sludge process. Ask any operator: If an activated sludge settles, compacts, and flocculates well, effluent quality is virtually assured to be well within most permit limits. Yet while most operators measure SVI, a measure of a sludge's compactability, very few measure activated sludge settleability, and almost no one measures an activated sludge's flocculation characteristics. I recently developed a new tool, dubbed the Wahlometer by my colleagues, that measures these key sludge characteristics (see page 7).

Example 2: Optimize process units, not unit processes. Consider a hypothetical plant with four primary clarifiers. The plant historically removes 66 percent of the influent total suspended solids (TSS) — not bad for primary sedimentation as a unit process. Suppose, however, that the operator measures the performance of individual clarifiers and discovers that primary clarifiers 1, 2, and 3 individually reduce TSS concentrations 75 percent, whereas primary clarifier 4 reduces the TSS concentration only 40 percent. If clarifier 4 is exactly like the other clarifiers and receiving the same flow, the problem is internal to that tank and probably fairly easy to solve. By fixing clarifier 4, the operator increases the overall efficiency of primary clarification by more than 13 percent, from 67 to 75 percent.

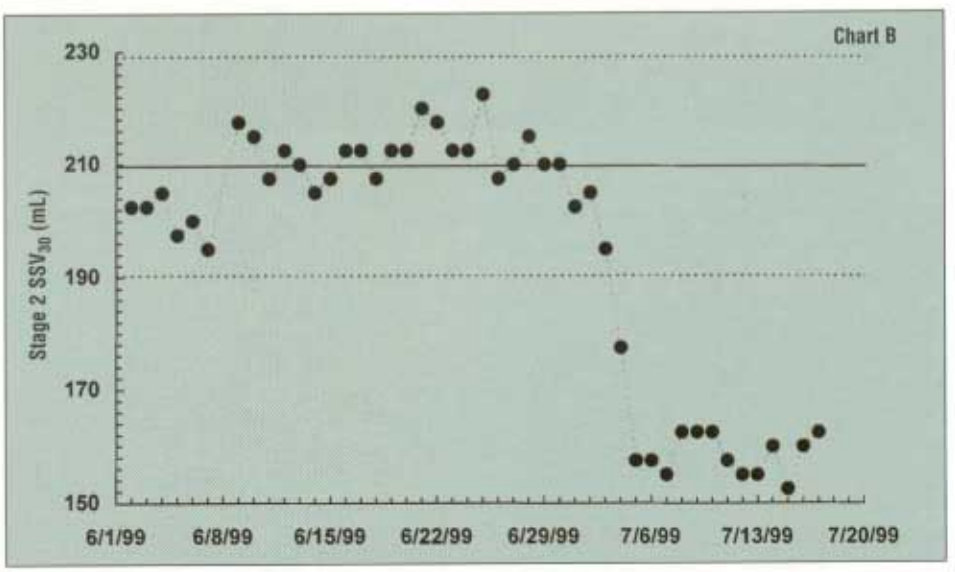
These two simple examples illustrate how much we can do to reduce process variability. With this new approach to process control, we can increase efficiency and truly optimize the way we do business.

— ERIC WAHLBERG, PH.D., P.E.

Eric Wahlberg leads process optimization services for Brown and Caldwell. Contact him at (925) 210-2407 for information and training on how to implement statistical process control at your treatment plant.



Process Learning Charts A and B show different quality characteristics measured using the Wahlometer in stages 1 and 2 of a two-stage activated sludge system. Chart A shows the stage 1 effluent turbidity (each data point represents the average of four measurements made throughout the day). The control limits shown (solid and dotted horizontal lines) were calculated using the data collected in the first month covered by the chart. The fact that many of the points fall outside the control limits indicates a process out of statistical control. The data, however, show improved performance in stage 1 (indicated by the decreasing trend), likely due to an increase in the wastewater temperature.



The stage 1 effluent enters stage 2 for nitrification. Chart B shows that the improved performance in stage 1 eventually caused the stage 2, 30-minute settled sludge volume (SSV_{30}) to go dramatically out of control on July 4 and 5. A decrease in the SSV_{30} can be caused by a decrease in either the mixed liquor suspended solids concentration or the sludge volume index — parameters typically measured by operators to monitor the activated sludge process. Neither of these parameters, however, showed any discernable change during this time, in contrast to the definite and linked variation of the two quality characteristics tracked by the process learning charts.

Automated Startup for Lulu Island Secondary Treatment Plant

The Lulu Island wastewater treatment plant, which started operation in March 1999, features a completely automated, plantwide electrical distribution and control system, requiring staffing for only 8 hours each day. A computerized data acquisition and control system (CDACS) is the key to the plant's automated process.

The 18-million-gallon-per-day secondary treatment plant was designed by Brown and Caldwell in conjunction with joint venture partners Associated Engineering and Reid Crowther for the Greater Vancouver Regional District, British Columbia, Canada.

To ensure automatic plant operation, the designers had to account for possible power failures in addition to process control and plant performance issues. So they programmed the CDACS system to control electrical distribution and emergency power generation, as well as to protect all systems. Then they integrated these functions into one seamless system that would react automatically and predictably to a variety of situations.

Most utility power failures stem from micro-interruptions lasting from half a second to a few seconds. In these instances, the Lulu facility is automatically restored within 10 minutes of utility power restoration, with dissolved oxygen (DO) control back to normal within 15 minutes of restoration. Recovery within this time frame allows the plant to remain in full secondary treatment, without bypass. In the case of utility interruptions longer than a few seconds, emergency power is automatically generated and distributed to the primary treatment process within 15 seconds of power failure. Primary treatment is automatically restored within 30 to 100 seconds after utility power failure, depending on conditions and plant flows. Secondary treatment is automatically restored within 10 minutes of utility power restoration.

The Lulu Island wastewater treatment plant, in Richmond, British Columbia, features a completely automated, plantwide electrical distribution and control system, requiring staffing for only 8 hours each day and featuring automatic startup in the event of power outages.

The plant electrical system consists of an approximately 15-millivolt-amp installed capacity delivered through six major distribution transformers and seven vacuum circuit breakers, each operating at 25 kilovolts. All process equipment operates through 40 distribution circuit breakers, each at 600 volts. Two emergency power generators can deliver 1,250 kilovolt-amps of standby power to treatment processes.

The designers developed three supervisory-level automatic software controllers to operate independently or jointly, depending on the situation, to restart the plant after a power failure. The first controller operates the emergency power generation and distribution and the primary process restart and control. The second controller operates the 25-kilovolt plantwide electrical distribution system after utility power has been restored. The third controller operates sequential automatic restart of secondary treatment after utility power restoration.

The master controllers don't memorize the state of the plant before a power failure or restore the plant to the same running condition. Instead, they respond to process requirements defined by low-level controllers for each process stream, directed by set process parameters. Rather than forcing equipment into operation, the master controllers enable equipment to start operating as required by the process. The only predefined sequencing relates to the order in which power and reset signals are applied, to prevent generator overloading.

An intuitive, logical, graphical user interface is the operators' window to startup. And all operations features, including detailed descriptions and settings, have been incorporated into an electronic operations manual available to the operators online within a few mouse clicks.

Office News and Moves

Led by **Charles Myette, L.S.P.,** Brown and Caldwell's new **Salem, N.H.,** office is providing environmental engineering services throughout New England. Myette has 22 years of experience, including hazardous waste site investigation and remediation, hydrogeologic investigations, contaminant assessments, groundwater modeling, and design and construction of soil and groundwater remediation systems. Initially focusing on site restoration projects, the office also offers expertise in water and wastewater, solid waste, and environmental compliance to New England clients. Contact Myette and the staff at 1 Stiles Road, Suite 202, Salem, N.H., (603) 890-6263 (calls), (603) 890-6209 (faxes).

Charles Myette

Austin, Texas, is the location of Brown and Caldwell's newest Gulf Coast office, joining the company's Houston and Baton Rouge, La., operations in the region. Office Manager **Russ Kimble,** with 23 years of environmental engineering experience, was Director of Programs and Chief of Enforcement for the Texas Water Commission's Hazardous and Solid Waste Division in Austin, then spent nearly a decade as an environmental engineering consultant before he joined Brown and Caldwell. Contact the office at 2499 Capitol of Texas Highway South, Building A, Suite 200, Austin, Texas, 78746, (512) 328-8975 (calls), (512) 328-8985 (faxes).

Russ Kimble

Wetlands To Be Restored in Design-Build Landfill Closure

To enhance the closure of a 250-acre landfill in Miami, Brown and Caldwell is designing and building a groundwater remediation and groundwater/storm water co-disposal system; constructing an engineered cover over waste and a storm water management system; and restoring about 40 acres of wetlands. The project will be completed in 2002.

"Permitting was definitely a challenge because so many agencies were involved. Our expertise in groundwater modeling was extremely valuable in making the agencies comfortable with our approach," comments Eduardo Smith, Brown and Caldwell principal in charge. Approval by the National Parks Service, Army Corps of Engineers, Florida Department of Environmental Protection, and local and regional environmental agencies had to be coordinated in concert with the activities of the client, the Miami-Dade County Department of Solid Waste Management. But aggressively managed negotiations and the design-build nature of the work have shaved at least a year from the original project schedule.

Two years ago, the County Department of Solid Waste Management undertook the closure enhancement at the Old South Dade Landfill, which ceased operation in 1979. Monitoring at the site had indicated excessive concentrations of ammonia in groundwater that was migrating toward Biscayne Bay, designated an Outstanding Florida Water, located within one-half mile downgradient of the site.

Together, consultants including Brown and Caldwell and the Department of Solid Waste Management analyzed more than 50 alternatives before finalizing the closure enhancement concept agreed to by the regulatory agencies. The plan includes waste relocation from the eastern portion of the site, the area nearest Biscayne Bay, to the western portion, where it will be covered and where storm water management and groundwater remediation systems will be installed. One million gallons of groundwater will be withdrawn per day using large-diameter open boreholes equipped with submersible pumps. Through pilot testing, the open boreholes were found to be much more efficient than typical recovery wells containing screen sections. Extracted groundwater will be treated by a sequencing batch reactor (SBR) containing two parallel process trains, nitrifying and denitrifying the groundwater in one reactor vessel.

After waste is relocated from the eastern part of the site, an approximately 20-acre shallow lake will be developed, along with a 39.5-acre salt-marsh-like wetlands area expected to provide excellent habitat for wildlife. This will compensate for the 19 acres of wetlands to be affected by the enhancement project. In addition, 8 acres of test plots will be planted with native species to help determine which should be planted. More than 25 acres of existing wetlands will be enhanced to promote recruitment of native plant life.

The 250-acre Old South Dade Landfill, Miami, is undergoing closure enhancements that include approximately 40 acres of wetland restoration along with new groundwater remediation, storm water management, and engineered cover systems.

PHOTO BY SMITH AERIAL PHOTOGRAPHY

Wahlometer Measures Characteristics of Activated Sludge

Eric Wahlberg, Ph.D., P.E., has designed an instrument called the Wahlometer ("wall-*ah*-meter") that measures the settling, compacting, and flocculating characteristics of activated sludge.

The Wahlometer is undergoing pilot testing at the 12-million-gallon-per-day Empire Wastewater Treatment Plant, owned and operated by the Metropolitan Council Environmental Services, in Minnesota. After fine-tuning, the unit will be manufactured by Brown and Caldwell and available for sale by the end of 1999.

The Wahlometer, shown with Eric Wahlberg, Ph.D., P.E., and an associate at a Northern California wastewater treatment plant, measures the settling, compacting, and flocculating characteristics of activated sludge. The unit, now being pilot-tested, will be available for sale by Brown and Caldwell by the end of 1999.

"Unfortunately, the monitoring toolbox available to activated-sludge operators consists primarily of troubleshooting, not process control, tools," says Wahlberg [see Wahlberg's article on statistical process control, page 4]. "Proactive process control requires maintaining good sludge quality; that is, growing a sludge that settles, compacts, and flocculates well. But, until now, a simple way to measure these characteristics hasn't been available."

The Wahlometer is essentially a 2-liter settlometer fixed with a sampling port, a motor, a mixer, and a series of baffles. To obtain truly meaningful results, operators should use it three or four times per day to test activated sludge. Wahlberg recommends monitoring the daily results using statistical process control techniques.

The test procedure is similar to that of a settling test performed in a settlometer:

1) A mixed liquor sample is collected at the aeration tank discharge.
2) Well mixed, this sample is poured into the Wahlometer.
3) The top portion of the Wahlometer, containing the motor, mixer, and baffles, is placed into the lower portion of the unit.
4) The sample is then flocculated for 30 minutes, at which time the top portion is removed.
5) The settled sludge volume is recorded after 5 and 30 minutes of settling.
6) After the 30-minute settled sludge volume reading is taken, a 500-milliliter supernatant sample is collected from the sampling port and analyzed either for turbidity or total suspended solids.
7) The settling, compacting, and flocculating characteristics are quantified using the 5-minute settled sludge volume, the 30-minute settled sludge volume, and the supernatant turbidity (or total suspended solids concentration), respectively.

Quarternotes

Nashville and Atlanta Initiate Re-Engineering Strategies

Using strategies similar in some ways and divergent in others, the Metropolitan Government of Nashville and Davidson County, Tennessee, and the City of Atlanta are re-engineering their water, wastewater, and sewer services. Nashville's brand-new efficiency project does not include private operations, whereas Atlanta's ongoing effort does. Brown and Caldwell is helping to lead the efforts of both cities.

In June, Nashville's Metro Department of Water Services (MWS) hired Brown and Caldwell/PricewaterhouseCoopers (BC/PwC) to re-engineer its business and operational processes. The project has unusually specific goals: MWS's annual operating and maintenance expenses must be reduced to at least $64 million by mid-2002. The Metro Council has now rejected private operation of water and wastewater services, but has declared "its intent and desire that the Mayor take all actions necessary to pursue privatization by contracting with a private entity" for operations if the O&M reductions are not accomplished within three years.

Also unusual is the project's arrangement to give MWS employees and BC/PwC an equal percentage of the dollars saved beyond the $64 million target. This innovative gain-sharing was designed to promote teamwork to meet the savings goal.

Nashville is no stranger to efficiency efforts. MWS was the first public-sector organization to partner with Belmont University in a total quality management program extending to its entire staff. The program increased efficiency and reduced operating costs. Since 1990, MWS has been administering a $750 million effort to reduce collection system overflows through major capital programs; the resulting rate increases have spurred the need for even greater efficiency. BC/PwC teams are now analyzing every part of the Department's operations, with the deep involvement of numerous city staff.

The City of Atlanta has been optimizing its water, wastewater, and sewer services in a three-part effort since 1995, with Brown and Caldwell's help. The first part is a capital improvement program to upgrade wastewater systems to comply with state and federal environmental mandates, replace aging infrastructure, and add capacity. The program has included more than $700 million dollars worth of capital improvements at the City's three water reclamation centers (WRCs), including new technologies such as biological nutrient removal, ultraviolet disinfection, and filtration. [See the Summer 1999 *Quarterly*'s story on the Utoy Creek WRC upgrade.]

Downtown Nashville is shown along the riverfront area. In June, Nashville's Metro Department of Water Services (MWS) hired Brown and Caldwell/PricewaterhouseCoopers (BC/PwC) to re-engineer its business and operational processes. MWS's annual operating and maintenance expenses must be reduced to at least $64 million by mid-2002 to forestall adoption of private contract operation. MWS employees and BC/PwC will receive a percentage of the dollars saved beyond the target.

Re-engineering and partial private operation constitute the second part of Atlanta's change efforts. After Brown and Caldwell's extensive operations assessment and identification of alternatives [see the Winter 1998 *Quarterly*], the City concluded that retaining a private operator for its water system was the best way to quickly guarantee cost savings to support an urgently needed bond issue. The City then embarked on private operation of its entire water department, the largest municipal utility in the U.S. to do so to date. Brown and Caldwell helped the City hire a private firm to manage the water department and has been overseeing the contract since January 1999, as well as performing re-engineering of the sewer division. The City has just initiated a similar process to hire a private firm to manage one of its three WRCs.

The third part of Atlanta's optimization involves a consent decree negotiated among the USEPA, the Georgia Environmental Protection Division, and the City of Atlanta to minimize wastewater collection system overflows and to better operate and maintain treatment plants. Part of the decree was signed almost two years ago, and the amended decree was finalized in late summer 1999. Brown and Caldwell helped the City negotiate the decree and is leading implementation of its requirements for the WRCs.

An integrated management system designed by Brown and Caldwell is a cornerstone of consent decree implementation. It's also readying the City of Atlanta for the new millenium. The system includes web-based laboratory information management; a business management system to link all the City's treatment plants; a comprehensive safety program; a construction contingency program; a computerized maintenance management system (CMMS); training in operations, treatment process fundamentals, process control, and business management for staff; risk management; and an energy management system.

Joining Brown and Caldwell...(continued)

since last fall, Principal Engineer **Lori McIntyre, P.E.,** is a civil and environmental engineer with more than 17 years of experience, including wastewater planning and design projects, contract administration, and construction inspection...**Tom Noerenberg, P.E.,** also principal engineer in the Twin Cities, has more than 20 years of experience with infiltration/inflow, combined sewer overflow, and other major elements of wastewater systems, from planning through construction...**James Vickery, Jr.,** principal engineer in Baton Rouge, La., has more than 24 years of experience as an agricultural engineer for oilfield construction projects, soil bioremediation, soil and sediment characterization, and risk assessment...**Gerald Gresh, P.E., G.C.,** has designed more than 25 solid waste facilities throughout the U.S., responsible for siting, building, and operating many of them. He is now a managing engineer in West Palm Beach, Fla...**Noel Green, G.C.** and certified underground utility and excavation contractor, is a principal construction engineer based in Miami. He has 19 years of experience in the construction industry, focusing on pump stations and water/wastewater transmission lines...Denver's Managing Engineer **Leo Eisel, Ph.D., P.E.,** has more than 29 years of experience with water rights and water resources. He was Director of the Illinois Environmental Protection Agency, the Illinois Division of Water Resources, and the U.S. Water Resources Council.

Spotlight on Utility Assets and Statement No. 34


Craig Goehring

In an era past, we provided good engineering. Today, we still provide good engineering — but now it includes services with new names:

- CUP — competitive utility performance
- CFO — capital/finance/operations
- ROADmap — rerating, optimization, asset assessment, and debottlenecking
- OMS — on-line operations management systems

These Brown and Caldwell services are geared for the competitive era, helping public utilities implement best-in-class practices that improve operating performance. They emphasize the pivotal role of infrastructure assets, and a decision-making framework integrating capital projects, finances, and operations.

Unlike private utilities, many public utilities plan and spend capital budgets that are largely independent of operating strategies and budgets. This is the single biggest difference between the management protocols of public and private utilities, according to our research. And it has an impact on overall performance.

Two years ago, we put the spotlight on utility assets as a critical part of competitiveness, one that extended beyond the work force productivity issues then in the forefront of utility change efforts. Since then, we have advocated establishing common financial measures like those used in the private sector to indicate overall performance, both short- and long-term. Financial metrics enable managers to more readily connect assets with operations and to balance related tradeoffs. And using financial metrics is compatible with setting and meeting requirements for compliance, service, strategic thinking, and environmental protection.

Public utilities that start to use financial metrics beyond budgets and rates can reap the following benefits:

- Shared performance targets that bring capital, finance, and operation managers together
- A sustainable decision framework for infrastructure replacement and preservation costs and overall costs of service
- A uniform approach to monitoring and reporting the results of improvement actions
- Raised staff awareness and pride in the value of public assets they operate and maintain

Industry dialogue is now well underway (with apropos consternation and debate) about meaningful financial metrics for public utilities. Should they be different from those used in the private sector? Which metrics will help public utilities achieve optimal performance?

To help foster this discourse, Brown and Caldwell became a founding sponsor of the BTI Center for Excellence in Water & Wastewater Utility Management. While we remain completely independent of the Center's research and conclusions, we support its work to identify elements of improved utility performance and to strengthen the strategic tools of public utilities so that they can thrive.

The spotlight on utility assets has become even brighter with the release of completely revised guidelines to state and local governments, including utilities, on financial reporting. In June, the Governmental Accounting Standards Board (GASB) published the most comprehensive governmental accounting rule ever developed: "Statement No. 34, Basic Financial Statements — and Management's Discussion and Analysis — for State and Local Governments." While sweeping in its changes to current financial reporting practices, it is wholly consistent with the issues and changes of the competitiveness era.

Statement 34 establishes new financial reporting requirements aimed at making annual reports more comprehensive and uniform. GASB asserts it will make it easier to assess the annual financial health of utilities, and to make yearly comparisons. Standard financial statements and supplementary information that follow GASB guidelines will be required to obtain opinions from auditors and favorable bond ratings.

A centerpiece of the new standard is the requirement for detailed reporting on infrastructure assets. This reporting underlines the importance of comprehensive asset management systems and strategies to track the current condition of utility assets, estimated preservation or replacement costs, and actual expenditures.

The new reporting rules will be effective in three phases, depending on total annual revenues for the public entity. Larger entities, with total revenues of $100 million or more, are required to apply the Statement 34 standards for periods beginning after June 15, 2001. Smaller entities will begin within the following two years. Not that far away.

Brown and Caldwell is ready and able to help utilities meet these new reporting standards — not only by providing the competitiveness services named above, but by helping to establish business practices to comply with the new guidelines. For more information, please contact our Director of Management Services, Ken Harlow, at kharlow@brwncald.com or (949) 660-1070.

— *CRAIG GOEHRING, P.E., CEO*

Workshop on Activated Sludge Treatment

Eckenfelder/Brown and Caldwell (E/BC) will hold a workshop on activated sludge wastewater treatment on November 10, 11, and 12 at its Nashville office. The workshop will broaden participants' theoretical understanding as well as providing problem-solving tips. Tuition includes the textbook, and the workshop fulfills requirements for professional development hours. Contact **Jeannie Mackey** at (615) 255-2370 or jmackey@brwncald.com for more information.

Eckenfelder/Brown and Caldwell offers customized one- and two-day workshops on many environmental management issues to private and public organizations, at E/BC offices and clients' offices and plants. Topics include all aspects of water and wastewater treatment and hazardous waste management.

The primary faculty member is **W. Wesley Eckenfelder, D.Sc., P.E.,** a Distinguished Professor Emeritus of Vanderbilt University and the founding chairman of Eckenfelder Inc. Last April, Eckenfelder received the Gordon Maskew Fair Award from the American Academy of Environmental Engineers for his leadership, dedication, and contributions to environmental protection.

Steve Line Appointed VP, Chief Technology Officer

Steve Line, recently named a Brown and Caldwell vice president and chief technology officer, will lead the company's information technology (IT) business. Integrated within projects and delivered as stand-alone products and services, IT constitutes one of the fastest-growing business areas for Brown and Caldwell.


Steve Line

Line joined the company in 1997, contributing more than 13 years of experience and expertise in geographical information systems (GIS) applications, information management systems, automated data acquisition, and IT project management. His involvement has been instrumental in the success of many projects, including a data conversion and management system for the Northeast Ohio Regional Sewer District wastewater infrastructure and conversion of the City of Boston's water and wastewater infrastructure data into a GIS.

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