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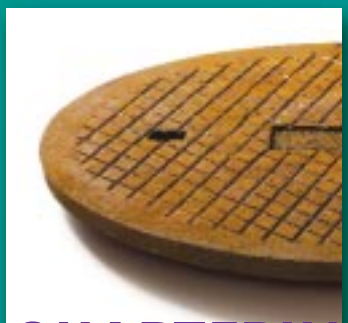
QUARTERLY

BURIED TREASURE

BROWN AND CALDWELL



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Marketing Communications Director	Terry Peckham
Editor	Lisa Bernstein
Writers	Lisa Bernstein Dan Foscalina Sam Wilson
Assistant	Kristy Yamada
Design and Illustration	Marc Rappaport
Printing	Bacchus Press

To speak with a Brown and Caldwell representative, call us at (800) 727-2224 or visit our web site at www.brownandcaldwell.com.

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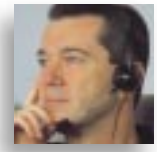
PETE BELLOWS, PETER MOFFA, AND JEFF SHARON





Confront Today's Wet-Weather Challenges

Three wet-weather experts from Brown and Caldwell recently took time out to discuss the field's most pressing issues. The trio comprised Jeff Sharon, P. E., based in the Midwest; Pete Bellows, P. E., of Northern California; and New York-based Peter Moffa, P. E., whose firm Moffa & Associates was recently acquired by Brown and Caldwell.

Peter Moffa: The most pressing wet-weather issue for many agencies right now is complying with the combined sewer overflow (CSO) policy. The municipalities and the industry at large are realizing—and quantifying—the megadollars involved to do what's necessary.

Pete Bellows: Peter, the CSO policy has been in place for almost 10 years now.

MOFFA But people have not reacted to it. A draft CSO policy came out in 1989 and then the formal policy in 1994, but even now many municipalities don't have a clear plan that portrays the real economic hit.

Jeff Sharon: Peter, you're focused on just one aspect of it. I think the most daunting wet-weather infrastructure need is to try to get the whole thing in perspective. How many times have we found you can dry up all the CSOs, but you're still not going to meet water-quality standards, because you've got stormwater pollution, wet-weather sanitary sewer overflows (SSOs), etc.?

BELLOWS You're saying, take a true watershed approach.

SHARON Exactly.

MOFFA I was responding in relation to what we've got in the way of guidelines. Regulatory agencies have offered, through EPA's Guidance on Implementing the Water-Quality Based Provisions in the CSO Control Policy, allowance for states to revisit water-quality criteria as they apply to wet-weather events, and perhaps allow relaxation of CSO water-quality requirements.

SHARON But at this stage of the game, I see EPA taking a back seat. There's not a lot of federal guidance. And how long is it going to be until the states take a look at lower wet-weather water-quality standards?

MOFFA It's true. EPA is putting the responsibility of wet-weather standards on the states. However, I would say that EPA's Guidelines are very good. They basically allow communities and their respective states to tailor standards to site-specific considerations. We can help our clients do that. You haven't done the client a service unless you've identified receiving-water impacts and used water-quality requirements to identify what the client has to do. I don't think the new guidance is going to result in anything different. It's just laying it out more clearly. It also lays out a procedure whereby you can argue to back off or to relieve some of the rather stringent requirements applying to dry weather.

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Wet-Weather Challenges

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BELLOWS I would agree with that. But for stormwater, the approach has been primarily best management practices, whereas for CSOs, it's been the nine minimum controls.

MOFFA I don't quite agree with you there. If you go through the stormwater regulations very carefully, you see they require that you do the necessary treatments and meet water-quality standards. Clearly there is a vehicle in these regs whereby a public interest group can challenge a municipality, charging that their discharge pipe is violating water-quality standards in the receiving water. But here in New York, while state regulators have admitted that, they're also saying they don't have the people to chase stormwater right now, because they're busy dealing with CSO.

I've been trying to explain to clients what they're going to have to do to meet *both* the CSO requirements and the stormwater regulations. Also, the presumption approach of the CSO policy is not always understood. You *presume* to meet water-quality requirements by doing certain things. You can do all that, and yet the next day you may be told by EPA that you have to do more.

SHARON This relates to the main thing that concerns me. We have the CSO policy. We've got CMOM, which really is oriented towards separate sanitary sewers. We've got stormwater. But not too many people are putting those three together. One community will work to reduce CSOs, another may go after SSOs, but the most appropriate approach is to look at the whole thing and come up with priorities for the community, getting the best bang for your buck in terms of water quality.

MOFFA I agree with you wholeheartedly, Jeff. As a matter of fact, the wet-weather protocols we just drafted for WERF identify right up front that before you consider any wet-weather scenario, look at the whole watershed. Put the pieces of the puzzle together so you don't overabate CSO and underabate nonpoint sources. Just because it doesn't come out of a pipe doesn't mean you shouldn't be able to do anything about it.

I do have a caution about the watershed approach: it can conjure up a long, drawn-out investigative program that regulators may perceive as a community's way of delaying. But it doesn't have to be. Even with a big watershed that crosses jurisdictional boundaries, you can do some careful planning with upstream sampling during wet weather, and identify roughly through framework modeling what is coming into the area and where the client is going to have to assume responsibility. And that responsibility actually may be limited.

BELLOWS You know, many of our clients have problems with that approach because different political entities have to get involved.

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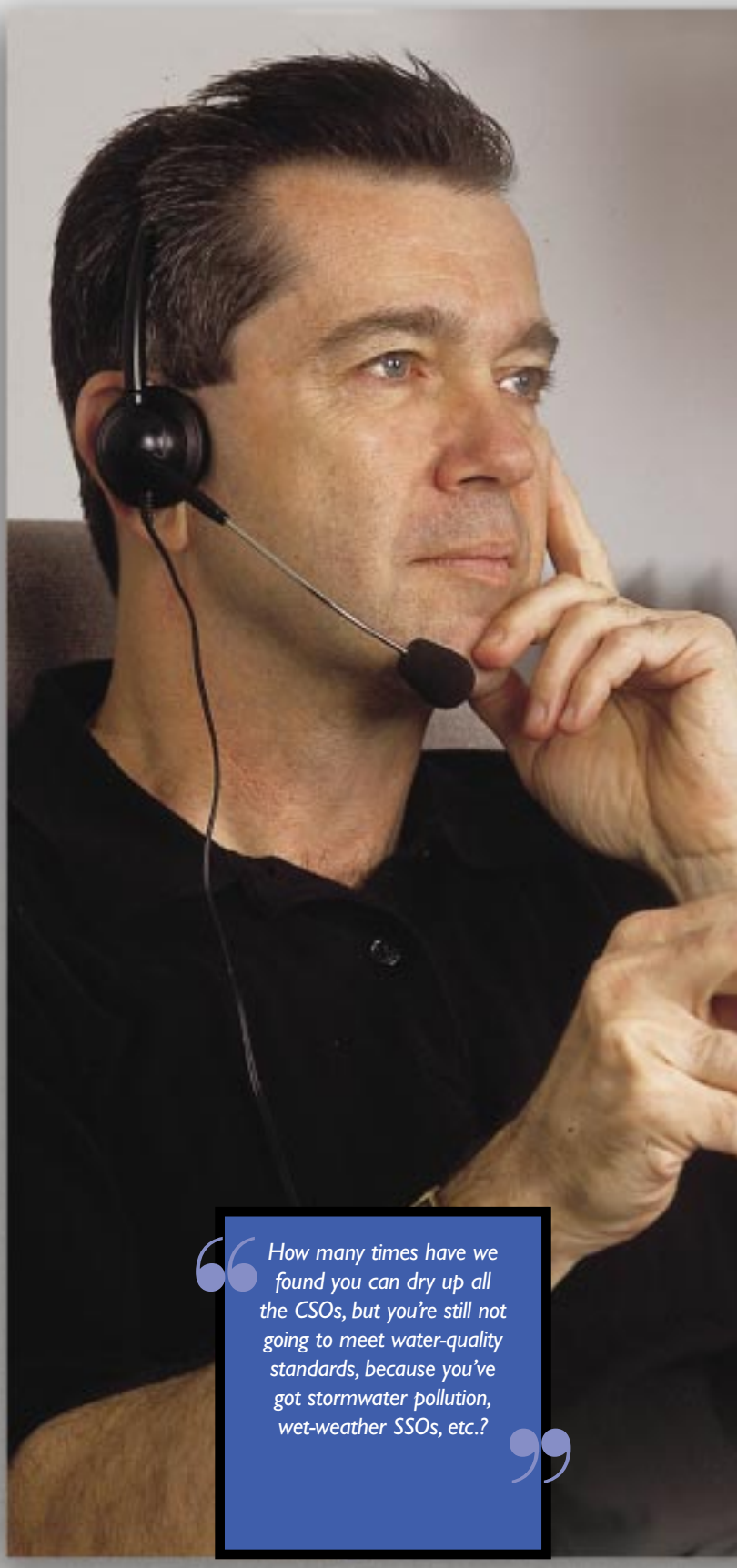

> *How many times have we found you can dry up all the CSOs, but you're still not going to meet water-quality standards, because you've got stormwater pollution, wet-weather SSOs, etc.?*

We should continue bringing together the watershed approach and the asset management perspective. What is the goal for the client's assets? If you have an overriding goal to protect public health and water quality, then you need to do asset management that prevents overflows.

The presumption approach of the CSO policy is not always understood. You presume to meet water-quality requirements by doing certain things, and yet the next day you may be told by EPA that you have to do more.

Wet-Weather Challenges

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SHARON That's why it's such a challenge. Also, not only are you worried about the pollution loads, you're worrying about maintaining or re-creating riparian zones and restoring regional habitats so that streams can be fishable and contain a naturally healthy environment.

BELLOWS For those of us in the West, the wet-weather problems are different from those we've been discussing. We're mostly concerned with stormwater runoff and wet-weather SSOs, because we have few combined sewer systems. Stormwater runoff presents many water-quality issues, while the issue with SSOs is primarily pathogens.

MOFFA Actually, the whole wet-weather approach isn't terribly different than the dry-weather approach, if you stop and think about it.

SHARON This is a good point. What EPA ought to do is to revisit all the 303E plans that emerged out of PL 92-500, which amended the Clean Water Act. The first time through, the emphasis was mostly on dry weather. Now the same procedures should be applied using a wet-weather perspective. It would allow us to transcend the jurisdictional issues Pete was talking about, or least give some big-picture guidance.

BELLOWS Many communities overcame jurisdictional issues in the 1970s and '80s to develop regional wastewater treatment systems. Of course, that process was made easier by EPA grant funding. Now, most collection system and storm drain construction is funded locally.

That's one of the reasons we should continue bringing together the watershed approach and the asset management perspective. What is the goal for the client's assets? If you have an overriding goal to protect public health and water quality, then you need to do asset management that prevents overflows. If otherwise, you manage your assets as many people do now, which is by crisis.

MOFFA I think the watershed approach and asset management may have two different objectives. Asset management is coming up with the best way of taking care of what you've got. It doesn't reveal what you may have to build to meet a requirement, does it?

BELLOWS Well, another difference between East and West is that our watershed issues *can* be related to asset management, in that SSOs are caused by deteriorating collection systems. Consequently, our approach to resolving wet-weather pathogen issues is rehabilitating and repairing collection systems. We're not looking to provide treatment of the overflows. That's a CSO issue.

> *If you had an intact city with no sewers, and you considered all sources of pollution holistically, you'd find it more cost-effective to build combined sewers.*
>
> –JEFF SHARON

Asset management involves both long-term and short-term planning. If a city has a tremendous amount of deferred maintenance, then it's going to spend most of its money correcting existing problems that are causing overflows, particularly dry-weather overflows. Addressing wet-weather overflows can fall under long-term planning, including sewer rehabilitation, relief sewers, and pump station expansion.

Another point regarding the watershed approach is that SSOs are not a big factor, except for pathogens, and sometimes even pathogens are not a big factor if major CSOs are in the area. So how much money do you really invest in controlling wet-weather SSOs? I got the impression that EPA didn't like where the watershed approach to the SSO policy was going, so they didn't want this approach to control the SSO program or control CMOM.

MOFFA I think you're right. EPA's attitude on SSOs is that they shouldn't occur, since they are tributary to a separate sewer system. But why do we even treat SSOs and CSOs differently? I've always said we should follow the duck principle as far as SSOs are concerned. If it quacks like and walks like a duck, it's a duck. If an SSO responds largely to rainfall intensity, it's really acting as a CSO and should be treated accordingly. Allow some relief to the ambient water-quality requirements that otherwise would be applied to dry weather.

BELLOWS It's interesting to consider what happened in certain cities when they went through a program to separate stormwater and wastewater flows. They went from being permitted to have four overflows a year to being permitted one overflow every five years—but then flows were a lot higher after separation than they had projected, and they couldn't meet the new overflow requirements.

MOFFA You can separate your sewers and you're left with stormwater, but it's just a matter of time before those stormwater pipes have to meet those same water-quality requirements. You may not have to disinfect the stormwater, but you have to deal with your oils, your greases, your solids, and your floatables.

BELLOWS But what I was driving at was a bit different—once you separate, you have to deal with SSOs.

SHARON Once again, that just begs the whole watershed approach. If you're looking at it from a watershed perspective, chances are you'd never separate.

MOFFA Here in Syracuse, the Corps of Engineers took on a separation program as part of a consent-order process and funded it. We proposed that the whole program should go right up into

the houses, but the Corps said, Nope. We kept saying, Well, if you don't do that, you're missing a good component of the problem.

SHARON I don't think you can get more than 50 percent removal of infiltration/inflow, generally, without going into the private laterals.

BELLOWS Yeah, if you can disconnect basement drains and footers, you can get a pretty good reduction. But what we've been seeing more in the West, where we don't have a lot of basements, is that rehab projects on the publicly owned mains have had disappointing results, with only 10 or 20 percent reduction sometimes.

> *We're coming up to the economic limits of what we can do engineeringwise. It's not feasible to raise rates and take care of all these problems by having engineers design new or bigger or better facilities. Instead, public education has to expand.*
>
> —**Pete Bellows**

MOFFA You know, we had a roundtable discussion on separation up in Quebec City when the WEF Wet Weather meeting was held some four years ago. We agreed that if the community population is over 20,000, it made no sense to separate a combined sewer.

SHARON I would contend that if you had an intact city with no sewers, and you considered all sources of pollution holistically, you'd find it more cost-effective to build combined sewers.

BELLOWS But there are some advantages to separate systems. If you separate, you're going to have fewer pathogens in receiving streams because you probably won't have wastewater overflows as often. On the other hand, combined sewers can make a lot of sense if you can address disinfection. In California, there has been a push to pseudo-combine some systems, such as at Huntington Beach, which is considering diverting their dry-weather discharges from storm drains into sanitary sewers to improve water quality at beaches.

MOFFA Does the state want you to define the actual risks involved from the current exposure, or are they just measuring fecal coliform and assuming you've got a pathogen problem?

BELLOWS I think the second. New regulations came out that required much more extensive beach-water testing, and the health department saw results in violation of their standards, so they started closing beaches.

It's an interesting dilemma. You can step back and look at how much money you're going to put into improving water quality as compared to other things. Lead paint abatement, prenatal care, police forces, fire protection—a lot of these address more acute problems, with larger numbers of people dying or being seriously injured, than what we've seen with a lot of wet-weather water problems.

MOFFA Pete, I couldn't agree with you more. It gets back to Jeff's watershed approach, and it relates to health risks. Define the real basis for abatement before you go too far. On behalf of the client make sure you understand the real basis for the law, and then even the 1972 amendments to the Clean Water Act can be used on your side. Identify the water-quality impacts up front and do the community the real service of saying we would challenge arbitrary standards out there. The very ambient water-quality standards themselves have to be questioned sometimes.

BELLOWS But regardless of the water-quality standards, there's a lot that needs to be done. A lot of collections systems need improvement on the face of them. Working with the public is a big factor in doing this—in helping us find creative solutions without bankrupting the community. We're coming up to the economic limits of what we can do engineeringwise, because the cost becomes so great. It's not really feasible to raise rates and take care of all these problems by having us engineers design new or bigger or better facilities. Instead, public education has to expand. Are you going to take care of this problem in your house by changing certain behaviors, or are you going to pay higher rates *and* have a greater risk of overflows?

SHARON If we look back, we do see that things have progressed—slowly, but they have moved along. The regulations have evolved as our understanding has evolved. We in the industry have worked in the areas where we could see measurable benefits and the most cost-effectiveness. Then we've started tackling things on a more and more watershed-related basis.

> *If it quacks like and walks like a duck, it's a duck. If an SSO responds largely to rainfall intensity, it's really acting as a CSO and should be treated accordingly.*
>
> —**Peter Moffa**

MOFFA You're right. We focused on treatment plants, and recently we've been focusing on CSOs. Stormwater and SSOs are probably next, and nonpoint is quickly behind stormwater. And the watershed perspective is finally becoming more popular and making sense. So the progression of abatement has taken a logical approach. It's just that we had to be around for almost 30 years to see it.

TRUE IMPACTS

Onondaga Lake Achieves CSO Compliance

At one of the country's most polluted urban lakes, a watershed approach helps to achieve one of the first instances of compliance with the USEPA's CSO policy.

The USEPA's policy on abating combined sewer overflows (CSOs) was officially registered in 1994, but most municipalities are still struggling to figure out how to comply with it.

Onondaga County, N.Y., is the exception. "More than any community I know of, the County is meeting the requirements for both the presumption and the demonstration approaches to achieving compliance," says Peter Moffa, P.E., who developed the CSO abatement program begun in 1987.

The County's long-term CSO control plan results from a hard-won consent-order agreement among many parties, including a public-interest group and regulators at all levels. "It was a feat to put together a program that eventually everyone agreed with," says Moffa.

What did the trick?

- A watershed approach to identify relative loadings
- Receiving-water modeling to assess the real impacts of pollutants
- Multi-year systemwide modeling to show over 85 percent capture of the combined sewer flow, including CSOs, upon the addition of abatement facilities

"We took the watershed approach to put pollutants into proper perspective," explains Moffa. "And because of the results, we were able to cut back on the size and cost of abatement facilities." In fact, the initial projected price tag of $395 million was cut by nearly two-thirds.

Rapid revelations from watershed-based modeling

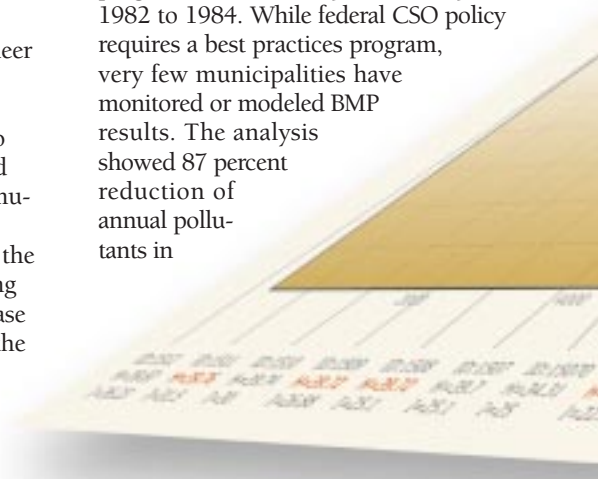
Communities sometimes resist watershed modeling, believing it would be easier to just meet the presumption approach of the federal CSO policy, which says that a municipality is presumed to comply if it meets one of the three criteria.

Onondaga County's Chief Engineer for Wastewater Collection Systems Stephen Martin advises otherwise. "I would encourage other agencies to look at their situation on a watershed basis," he explains. "Too many communities don't because of local political factors. But that can be a negative in the long run. You should monitor existing conditions intensely and well, and base your modeling on good data. That's the key to regulatory buy-in."

One of the most polluted lakes in the country, Onondaga Lake receives discharges from a combined sewer system serving the city of Syracuse, N.Y. The County Department of Drainage and Sanitation was a year into voluntarily updating its CSO facilities plan when it was hit by a water-quality lawsuit from the Atlantic States Legal Foundation. The New York Department of Environmental Conservation (DEC) later enjoined the lawsuit.

Moffa & Associates (now a part of Brown and Caldwell) switched gears from leading the CSO plan update to helping craft the required long-term CSO control plan and consent judgment.

One of the team's initial steps was unusual: analyzing the effectiveness of the Best Management Practices (BMP) program undertaken by the County from 1982 to 1984. While federal CSO policy requires a best practices program, very few municipalities have monitored or modeled BMP results. The analysis showed 87 percent reduction of annual pollutants in receiving waters—and indicated what remained for the long-term control plan to accomplish.



Next, the team began the modeling effort that was key to the program's suc-

cess. Because the lake's drainage area lies wholly within Onondaga County, CSO impacts could be assessed within the context of an entire watershed.

First, modeling the combined sewer system

The team's first step was to model the sewer system and estimate the CSO loadings to receiving waters. Using the EPA's Storm Water Management Model (SWMM), along with flow monitoring, the County/Moffa team determined CSO discharge flows. With sampling and analysis, they then characterized the flows' quality.

Next, they determined peak overflow rates and total overflow volumes resulting from storms of different frequencies, which helped to identify the conveyance capacity of the sewer system. From these data, a 1-year frequency and 2-hour duration was selected as the design storm.

Real impacts revealed with 3 types of modeling

Putting the CSO loads (and needed abatement) into proper perspective called for demonstrating their true impact on water quality. This led the County/Moffa team to perform three types of modeling: limited modeling of the watershed for nutrient loads; dissolved oxygen (DO) modeling of the receiving streams; and—an unusual component—modeling of receiving-water bacteria.

Moffa performed the watershed analysis on water-quality parameters that the team had verified were cumulative rather than event-specific: solids, phosphorus, and nitrogen. (Heavy metals, while cumulative, were present in concentrations too small to merit analysis.) The goal was to identify how much CSOs really contributed to these loads, and how much was contributed by the sewage treatment plant and agricultural sources.

The team used the EPA's HSPF watershed model in combination with a geographical information system and SWMM.

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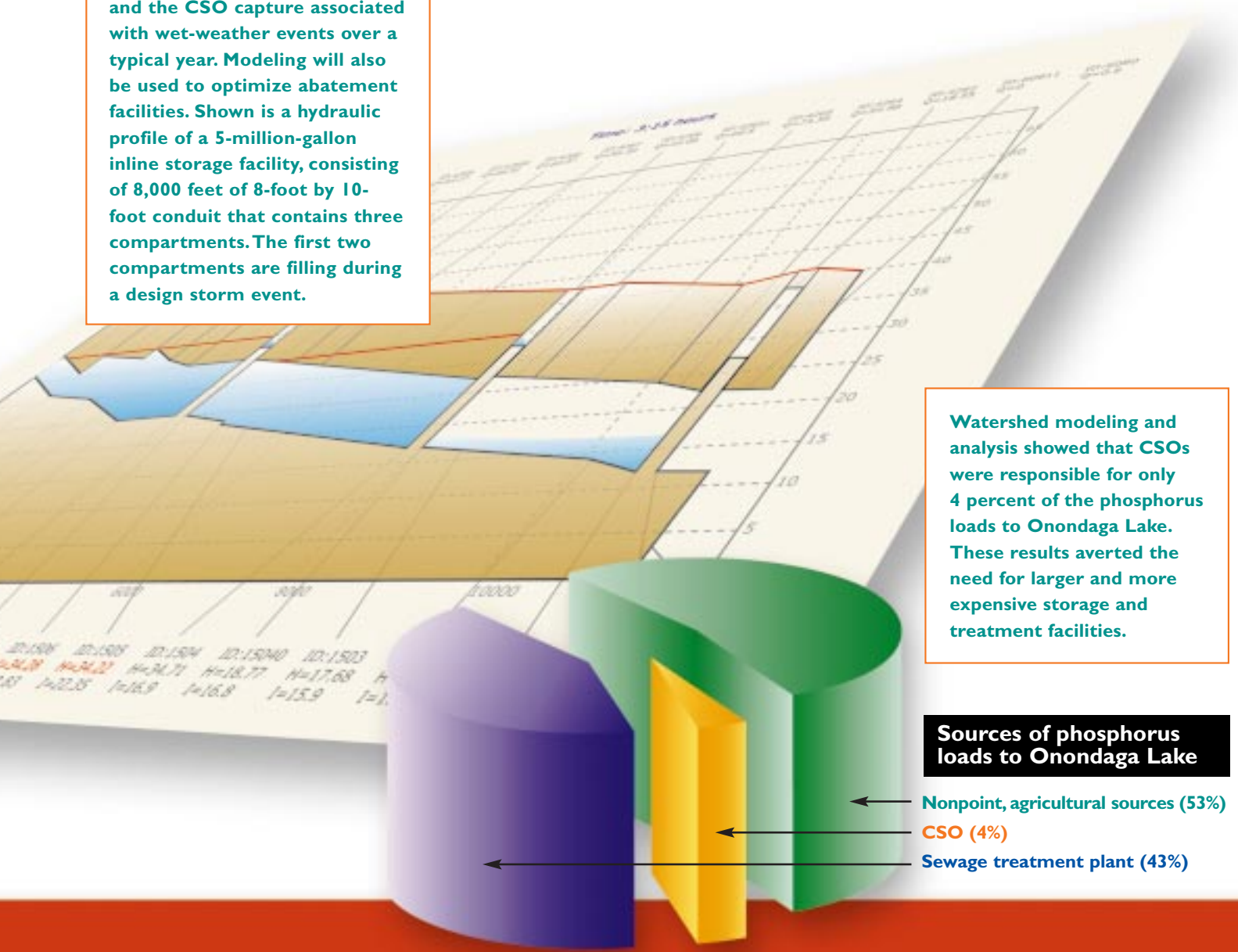
The team used modeling to identify design flow conditions and the CSO capture associated with wet-weather events over a typical year. Modeling will also be used to optimize abatement facilities. Shown is a hydraulic profile of a 5-million-gallon inline storage facility, consisting of 8,000 feet of 8-foot by 10-foot conduit that contains three compartments. The first two compartments are filling during a design storm event.



Watershed modeling and analysis showed that CSOs were responsible for only 4 percent of the phosphorus loads to Onondaga Lake. These results averted the need for larger and more expensive storage and treatment facilities.

True Impacts

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The result: CSOs were responsible for only 4 percent of phosphorus loads, 2 percent of nitrogen loads, and 22 percent of solids.

"From the onset, we challenged some regulatory perceptions that we needed to do more to take care of the nutrients associated with CSOs—particularly phosphorus," says Moffa. "If we'd had to deal with phosphorus, it would have meant a whole array of very large storage and high-level treatment facilities."

For the event-specific parameters (DO and bacteria; floatables were determined not to require evaluation), the team projected the effects of the design storm. DO was a concern because the critical tributary

tions per cell under existing and future conditions.

Advocating for affordable abatement strategies

With a wealth of modeling and analysis results in hand, Onondaga County and its consultant Moffa embarked on the long process of technical meetings with all the participants to resolve differences. Twenty-nine abatement strategies were considered. These were whittled down to three: regional treatment using vortex units for floatables and solids removal followed by high-rate disinfection; regional treatment and storage; and centralized treatment at the existing sewage treatment plant.

the sewage treatment plant 85 percent of the annual combined sewer flow. With this program, the County would achieve compliance based upon the presumption approach.

The State DEC accepted the program. After more negotiation, participants agreed on phased construction of facilities over 15 years. The State developed a total maximum daily loads (TMDL) document that allowed the program to forge ahead, with the stipulation that the County needs to "build and measure" to re-evaluate the TMDL estimates in 2009, three years before planned program completion (though completion may occur earlier). The program would ultimately meet the criteria for the demonstration

A netting system (center) was installed within an Onondaga County combined sewer in 2000; the system has successfully captured floatable material during wet-weather overflows. Flanking it are views of a boom-and-collection-basket system, to be installed in summer 2001 in Onondaga Creek.

Onondaga Creek both receives a great deal of CSO loading and has been viewed as a future fishery. The team's analysis of the results of the one-year storm assuaged this concern, showing DO levels above New York State stream standards.

Modeling of the bacteria in Onondaga Lake itself was marked by a unique approach: demarcating the lake into eight cells based on distinct depth boundaries. Using a field-calibrated bacteria model and bacterial loadings from a typical year, the team identified the number of annual bacteria viola-

The State lobbied for more storage. Many participants argued for projects high in costs and benefits. But the projected price tag was $395 million—a difficult burden for the County.

Finally, the team proposed a program of five regional treatment facilities with vortex and high-rate disinfection (5-minute contact time) sized for the instantaneous peak of the 1-year storm. The program also included five floatable control facilities (netting, screening, and boom facility types). Long-term modeling showed that these facilities would capture and transmit to

approach to compliance, which all municipalities must do eventually.

Total program price tag: $144 million. According to Moffa, watershed modeling had reduced program costs by 30 percent, and receiving-water modeling had cut costs by another 46 percent.

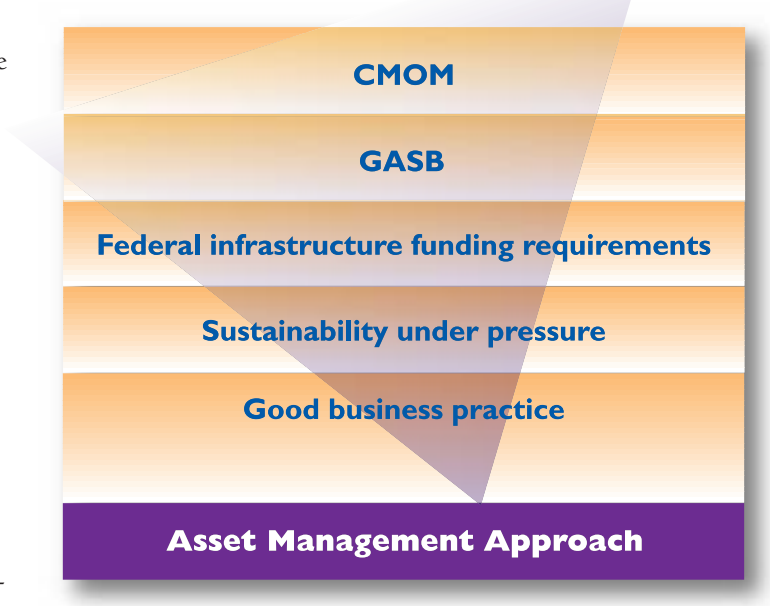
"We showed that the County didn't have to disinfect at every CSO location," explains Moffa, "only at enough locations to meet water-quality requirements."

Getting Started with Asset Management

To save money, improve reliability, and sustain infrastructure, many utility managers are turning to the asset management approach. Ken Harlow outlines why, and gives tips on ways to get started.

A number of recent developments have made asset management a top concern of water-resource utility managers:

- EPA's proposed CMOM (capacity, maintenance, operation, and management) regulations will require a much greater focus on the assets of sewer systems.
- GASB 34, the new financial reporting standard, offers utilities the opportunity to manage their assets to meet self-defined objectives for asset condition, and to report these results in their annual financial statements, an approach endorsed by the American Public Works Association.
- Upcoming federal funding for water and wastewater infrastructure rehabilitation and replacement (the Voinovich Bill and other legislation being advanced under the WATER-21 initiative) may well require good asset management as a precondition for federal funding of local projects.
- While pressures to "be competitive" continue, many utilities have exhausted the benefits of cost-cutting management approaches such as deferred maintenance, and are looking for new ways to operate as sustainable business entities.



Apart from these economic and regulatory forces, utility managers are realizing that better asset management means real cost savings. For example, the USEPA estimates that better asset management can save at least 20 percent of total asset ownership costs.

Still, the whole concept of asset management is new to some in our industry. What is asset management? How can it save me money? Where are the hurdles to getting started? Let's look at each of these questions.

What is asset management?

To put it simply: Asset management is a structured program to minimize the costs of asset ownership while maintaining required service levels and sustaining infrastructure.

That may sound a bit abstract—so let's examine the elements of the definition one by one:

Minimize the costs of asset ownership...

Imagine how small your utility's annual budget would be if it had no infrastructure assets at all—that is, if it could deliver its services without plants, pumps, pipes, and the rest of the usual service delivery paraphernalia. Clearly,

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Asset Management

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asset ownership accounts for the bulk of all costs for most utilities. And any significant reduction in such costs means major savings.

...while maintaining required service levels...

Even though asset management reduces costs, it actually improves reliability, because it emphasizes detailed attention to assets. And because you are monitoring the condition of assets and their maintenance costs, you can better allocate resources to where they're needed—and away from where they aren't.

...and sustaining the infrastructure.

For some, this will be the real payoff. A sound asset management program is both near-term (maintenance-oriented) and long-term (refurbishment- and replacement-oriented). Its planning horizon should be very long—typically, 40 years or more. Planning within these time frames will yield the information your governing body needs to understand system requirements, and to fund them.

Asset management is marked by its highly structured approach to identifying your assets and getting to know them very well. Properly practiced, it involves all parts of an organization and entails a living set of asset performance goals. With a solid program, you establish a plan for each of your assets from the very beginning; you monitor your resources on an asset-by-asset basis; and you measure the results achieved. The outcome: You become smart enough to choose exactly the right assets, to optimize your maintenance activities, and to refurbish and replace your assets at just the right times.

How can asset management save money?

The most obvious way asset management saves money is by minimizing unexpected failures—pipe collapses, pump station outages, etc.—that can result in damage claims, expensive emergency work, environmental penalties, and political fallout.

Asset management can produce additional savings during asset acquisition. By preparing life-cycle asset plans for new assets, you ensure that *all* ownership costs are considered—not only the initial cost but also ongoing maintenance costs and refurbishments over the useful life of the asset. This way you get the most asset for your money.

The most significant savings come over time, as you refine your asset plans and improve the allocation of resources. Consider:

- Monitoring asset-level conditions and recording asset-related costs allow you to accurately judge when an asset should be replaced—not too soon and not too late. Without these practices, such accuracy is usually impossible.
- Through the same analysis, you can re-allocate maintenance resources to where they're most needed and away from areas where the records show less frequent maintenance is required.
- By measuring actual maintenance costs against those in the asset plans, you can measure utilization of maintenance resources at the individual or crew level. The resulting figures will help you adjust your resources, increasing or decreasing maintenance as asset conditions warrant.

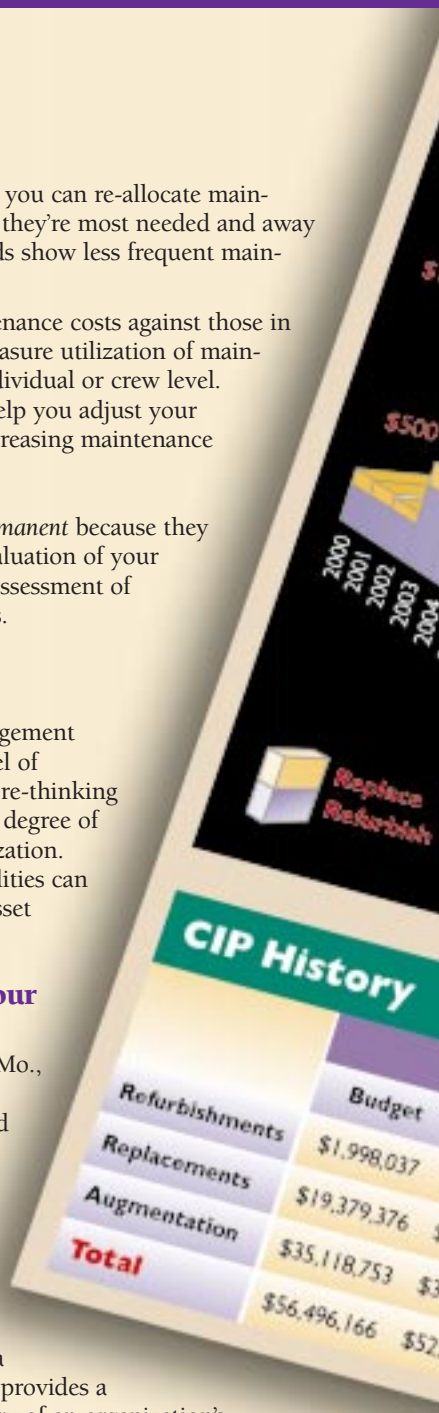
The resulting savings are *permanent* because they arise not from a one-time evaluation of your utility but from an ongoing assessment of day-to-day business practices.

How do I get started?

A comprehensive asset management approach requires a high level of commitment, a fundamental re-thinking of how to do business, and a degree of integration across the organization. But even without all this, utilities can start moving toward better asset management right now.

1 Take stock of your organization.

Example: The Kansas City, Mo., Water Services Department (KCWSD) has just conducted a classic competitiveness review, including an across-the-board assessment of its asset management practices and systems. For this assessment, KCWSD used Brown and Caldwell's Asset Management Status Review, a low-cost diagnostic tool that provides a concise and accurate summary of an organization's position relative to a comprehensive asset management program.



2 Look for ways to improve your knowledge and cross-departmental collaboration regarding asset management.

Example: Facing a looming infrastructure funding gap, the huge Metropolitan Water District of Southern California (MWD) is embarking on an ambitious replacement planning effort using Brown and Caldwell's Replacement Planning Model. The effort will yield better long-term capital planning and funding to ensure a sustainable infrastructure—a life-and-death objective for a utility that supplies water to 16 million people.

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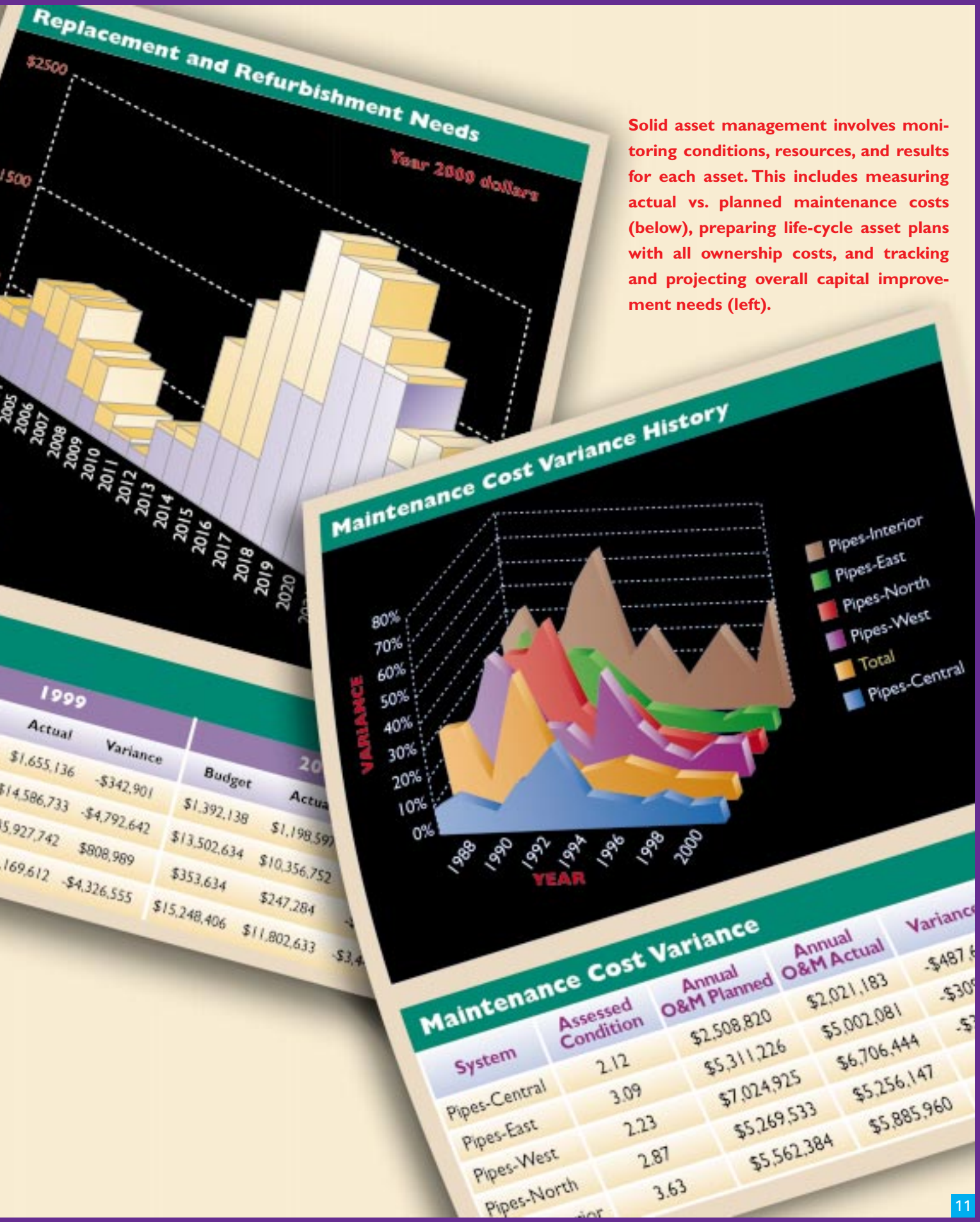

Solid asset management involves monitoring conditions, resources, and results for each asset. This includes measuring actual vs. planned maintenance costs (below), preparing life-cycle asset plans with all ownership costs, and tracking and projecting overall capital improvement needs (left).

Asset Management

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The Kansas City, Mo., Water Services Department's recent competitiveness review included assessing its asset management practices and systems.

3 Assess your available tools and, where needed, improve them.

Examples:

- For the Northeast Ohio Regional Sewer District, development of a comprehensive inspection and condition assessment program yielded the Infrastructure Information Management System. This system contains detailed data on mapping, inventory, and conditions, and it generates prioritized rehabilitation recommendations for all pipes and manholes. The system is accessed throughout the agency in either a browser-based viewer application or a desktop maintenance application. The District's business processes were considered during the system's development to ensure that the data were not only accessible, but useful.
- The King County, Wash., Department of Environmental Services is using historical data from its existing maintenance management system to analyze equipment performance. The results are helping it determine more accurate replacement and refurbishment timing.
- The City of Atlanta Wastewater Department's web-based Integrated Management Systems meet all CMOM requirements. Through a single window, city wastewater managers can access information on operations and maintenance, engineering, training, safety, laboratory information, process control, and financial and risk management. Key indicators from each division come directly to a dashboard desktop, allowing managers to avoid compliance issues and respond to problems quickly, as well as to reduce operating costs through better resource management.

For these utilities, the time to initiate part or all of an asset management program was now. What about your utility? For more information, contact me at kharlow@brwncald.com, or (949) 260-6152.

— KEN HARLOW

QUARTERNOTES

Solutions-Oriented Expert in Utility Management, O&M Joins Brown and Caldwell

Widely respected utility expert **Rick Arbour** has joined Brown and Caldwell as a company vice president. "The company's integrity, client focus, and commitment to utility asset management were major factors in my decision," Arbour told us. We're honored.

Formerly president of his own one-person consulting firm for more than 11 years, Arbour specializes in the operation, maintenance, and management of water and wastewater utilities. Before launching his own firm, he held technical and management positions with the Minneapolis-St. Paul regional wastewater agency, Metropolitan Council Environmental Services. Since then, he's deployed his tremendous expertise for agencies across the U.S., Canada, Mexico, and South America, focusing on best practices, training, and the timely issue of capacity, management, operation, and maintenance (CMOM) programs.

Arbour also advises the USEPA on sanitary sewer overflows and system O&M, and he chairs the Water Environment Federation's (WEF's) Collection System CMOM subcommittee. He's a contributing author to WEF's national publications and manuals of practice.

Already working together on Sacramento's broad-ranging CMOM program (see the article on page 17) Arbour and Brown and Caldwell are poised to bring practical, experience-based, and effective solutions to many other utilities across the country.

— CRAIG GOEHRING, P.E., CEO

Sophisticated Off-Line Wastewater Storage Going Strong 20 Years Later

More than two decades ago, the City of Sacramento, Calif., built the aptly named Pioneer Reservoir as part of its pioneering efforts to control combined sewer overflows (CSOs) to the Sacramento River. This sophisticated off-line storage facility, which has prevented hundreds of overflows, remains a key element in the city's wastewater management program.

In an era of the big, single-chamber storage tank, Brown and Caldwell designed Pioneer Reservoir with three separate chambers that overflow from one to the next. It also has an automated washdown system of wall sprays, floor sprays, and water cannons, as well as odor control and ventilation. The reinforced-concrete, pile-supported reservoir—with a capacity of 23 million gallons, including 3 million gallons of storage in the 120-inch-diameter pipeline—unobtrusively covers 3 1/2 acres near the junction of two major freeways. Computer-controlled valves route excess combined sewage flows from two pumping stations either to storage in the reservoir or to the wet-weather treatment plant, regional wastewater treatment plant, or Sacramento River, depending on flow and storage conditions.

Part of a broader program to rehabilitate the city's combined sewer system, Pioneer Reservoir began operation in 1980. The program reduced the number of annual overflows from 36 to four. In the mid-1990s, to be prepared in case of overflows, the reservoir "evolved from a simple storage basin into a primary treatment plant," says the reservoir's Supervising Plant Operator **Dave Phillips**. "Because of the design, there was very little we had to do to convert it. All we had to do was add diffusers for chemical dosing at the beginning of each of the three basins and a fourth diffuser before flow goes to the river."

Photo by John Goodwin

Eckenfelder Scholarship Applications To Be Accepted in Fall

Brown and Caldwell will begin accepting applications in September for the 2002-03 Dr. W. Wesley Eckenfelder Jr. Scholarship. Winners are awarded $3,000 to help defray the costs of pursuing a degree in the environmental professions.

The company established the scholarship to honor **Dr. W. Wesley Eckenfelder** and his 50-year environmental career. Now a senior technical director with Brown and Caldwell, Eckenfelder has trained thousands in industrial wastewater treatment. In December 1999, Eckenfelder was one of three people named "20th-Century Pollution Control Pioneer" by Environmental Protection magazine. He has consulted for more than 150 corporations and has authored or edited 32 books, including "Industrial Water Pollution Control, Third Edition," and "Activated Sludge Treatment of Industrial Wastewater."

Mickal Witwer and **Joseph Brown** were awarded Brown and Caldwell's first Dr. W. Wesley Eckenfelder Jr. Scholarship Award in February. Witwer attends the University of Florida and was graduated in May with a master's degree in engineering. He plans to pursue his doctorate. Brown is pursuing a double major at the University of Alabama; he will be graduated in December with bachelor's degrees in civil engineering and French.

Candidates for the scholarship program should be a U.S. citizen or permanent resident; a full-time undergraduate or graduate student enrolled at an accredited college; a

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Eckenfelder Scholarship

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declared major in civil, chemical, or environmental engineering or one of the environmental sciences; and possessor of a cumulative grade point average of 3.0 or higher on a 4.0 scale, or the 5.0 scale equivalent.

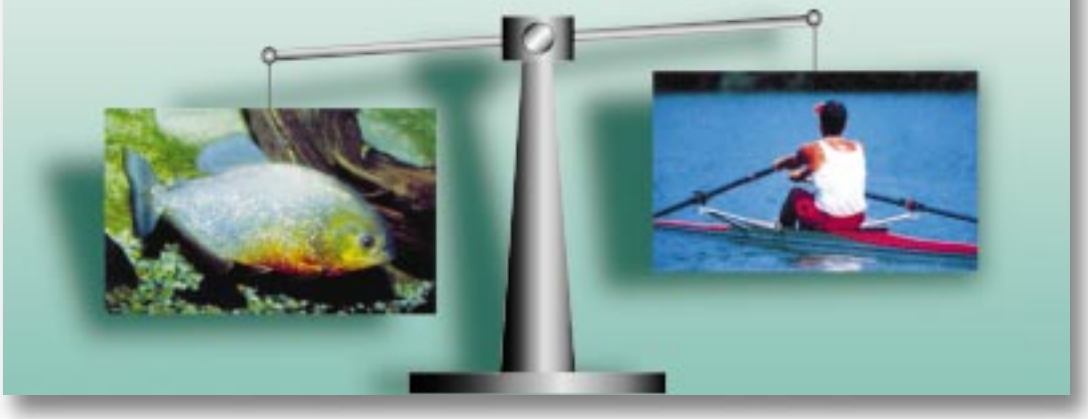
With their completed application forms, candidates should each submit a 250-word essay describing why they chose to major in one of the environmental sciences; two written recommendations, with one from a university official; the academic advisor name, phone number, and e-mail address; and an official academic transcript.

Applications should arrive by November 30, 2001, at HR/Scholarship Programs, Brown and Caldwell, P.O. Box 8045, Walnut Creek, California 94596-1220.

Joseph Brown

Mickal Witwer

Weighing the Risks and Benefits of Wet-Weather Disinfection Technologies



As municipalities across the nation enact programs to control combined sewer overflows (CSOs), sanitary sewer overflows (SSOs), and stormwater runoff, disinfection of these wet-weather flows is becoming more prevalent—and so are the environmental impacts of disinfectants used to purify them.

The Water Environment Research Foundation (WERF) saw the need to evaluate the benefits and risks of disinfecting wet-weather flows. WERF selected Moffa & Associates (now a part of Brown and Caldwell) to perform the USEPA-funded project.

The results will help guide municipal officials, regulatory policy-makers, and wastewater professionals who are developing CSO or SSO disinfection policies and selecting disinfection technologies.

Disinfection of wet-weather flows is nothing new; the benefits, in terms of pathogen destruction, have been consistently demonstrated by the EPA for more than 30 years. The EPA also has proven disinfectants can react with organic matter in wet-weather flows to form substances known as disinfection by-products (DBPs).

But most of what is known about DBPs was learned from analysis of drinking water subjected to chlorine disinfection. Chlorine, the most widely used and least expensive drinking water and wastewater disinfectant, can cause the formation of trihalomethanes, which are suspected carcinogens.

According to Moffa Project Manager **John LaGorga**, a large part of the project involves finding a balance between human and environmental risks from the addition of chemicals to stormwater runoff or CSOs containing fecal coliform bacteria (e.g., E. coli).

"We need to balance the benefits of reducing pathogens with the risks of environmental degradation and toxicity from DBPs," explains LaGorga. "And this balance needs to be evaluated on a site-specific basis. For example, the human exposure to pathogens discharged from a particular wet-weather outlet may be low because of the outlet's location or receiving-water characteristics, yet the disinfection by-products may pose real environmental threats. For each wet-weather outfall considered for disinfection, we should ask, What are the benefits, what are the risks, and can we find a reasonable way to balance them?"

The project is divided into three phases. In the first phase, Moffa & Associates will gather and analyze existing literature regarding wet-weather disinfection techniques, by-products, and potential risks to aquatic and human life. In the second phase, bench-scale testing will evaluate the effectiveness of available disinfection technologies and identify their environmental impacts. In phase three, the findings will be communicated to both stakeholders and the public.

Then the project results will be applied to a case study in New York's Onondaga Lake watershed. The team will work with the Onondaga County Department of Drainage and Sanitation to implement a decision-making process—including input from stakeholders, the general public, city officials, and industry professionals—that will be an example of how to select appropriate disinfection technologies. A final report will be available at the end of 2003.

Facility Atlas Solves Data Management Needs at OCSD

By implementing its cutting-edge data management tool Facility Atlas, the Orange County, Calif., Sanitation District (OCSD) is expected to save more than $1 million annually and to improve productivity.

The Facility Atlas will gain a big chunk of these savings by reducing construction change orders and minimizing contractor extended overhead costs, OCSD Director of Engineering **Dave Ludwin, P.E.,** says. "We estimate that we will save hundreds of thousands of dollars per year in extended overhead costs associated with unforeseen conditions, while substantially improving facility productivity and quality."

A 1994 needs assessment determined that asset data management was critical at OCSD; finding information had become a project in itself. With a history of more than 50 years of operation, 300 construction projects at its two treatment plants (240 million gallons per day average flow), and 650 miles of trunk sewers, OCSD needed a tool to efficiently and accurately keep track of data.

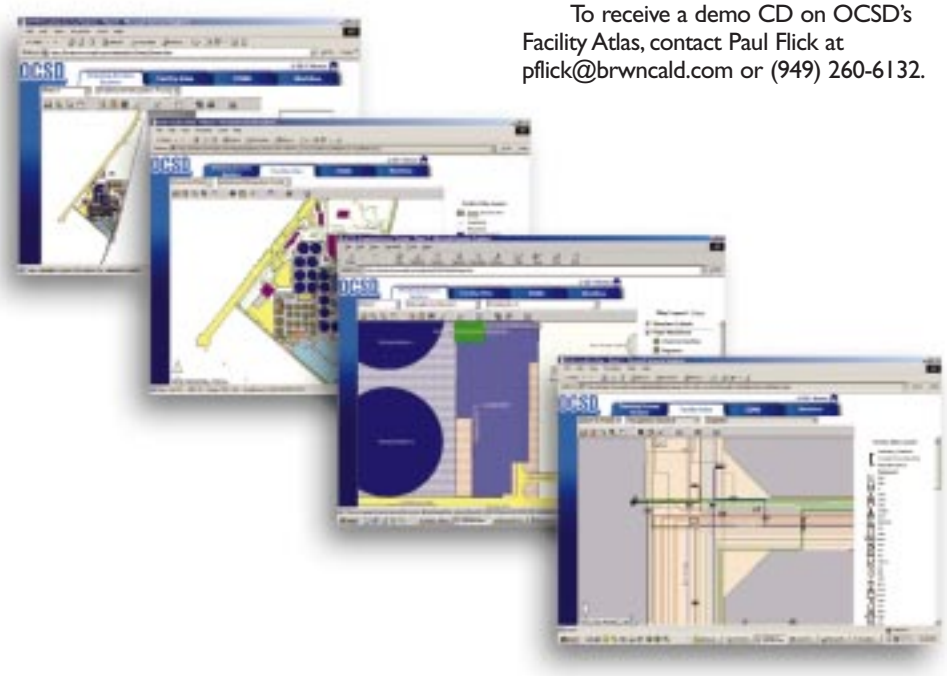
As it was spending between $50 million and $100 million on capital improvements annually, OCSD also needed to provide for management of future assets. So it called on Brown and Caldwell to create the innovative tool.

The Facility Atlas is a smart map of OCSD's surface and underground facilities. Combining web-based geographical information system (GIS) software, a document management system, and OCSD's existing maintenance and instrumentation databases, the Atlas stores information on process piping, 85 types of equipment, surface features, and structures. The information can be sorted, filtered, and queried using different search tools. Each facility object can be queried to return a list of attributes, ranging from construction material to project contract number and name.

By using the tree-view legend on the web browser and choosing equipment and system layers on the smart map, OCSD staff can select facility information to view. Should employees decide to view a specific process system, they simply remove all other systems from the smart map and a list of system attributes is returned. Tunnel cross sections are "hot linked" to the Engineering Document Management System, providing the user with instant access to drawings and documents used to install or upgrade that section.

Brown and Caldwell employed a variety of innovative data capture methods to create highly accurate databases for OCSD's buried utilities and pipe tunnels. Legacy data on buried utilities, for example, were converted to the database from more than 2,000 paper maps. Advanced field computers and automated data capture tools ensured an accurate and efficient database for OCSD's more than 20,000 linear feet of pipe.

To receive a demo CD on OCSD's Facility Atlas, contact Paul Flick at pflick@brwncald.com or (949) 260-6132.



Orange County, Calif., Approves Landmark Groundwater Replenishment Project

The Orange County, Calif., Sanitation and Water Districts have approved an ambitious plan to replenish the Orange County groundwater aquifer with treated wastewater. The Districts hired a team including Camp Dresser & McKee and Brown and Caldwell to design and construct the first phase of the project, which will cost $352 million and take about four years to complete. The team won the job after having performed predesign services for the project [*Quarterly*, Fall 1999].

"This is the largest and most visible such project in the nation," explains Project Manager **Bob Finn, P.E.** The effort will add 70,000 acre-feet of water annually to the aquifer—enough to serve 200,000 households.

The project will pump 70 million gallons per day of water to either injection wells that control seawater intrusion or to spreading basins for recharge. It includes a 60- to 78-inch-diameter pipeline to convey treated water 14 miles up the Santa Ana River to the recharge area.

New Software Tool Targets and Ranks Needed Sewer Inspections

A new software tool will soon be available to help communities prioritize sewer inspection and repair.

In an era of more stringent overflow controls and tougher operating requirements, the tool will help target the critical areas of a sewer system — and where to spend infrastructure dollars, which are especially precious to small and medium-sized agencies.

Integrating a broad range of expert knowledge on the probabilities and consequences of pipeline failure, the Sewer Cataloging, Retrieval, and Prioritization System (SCRAPS) is being developed by a Water Environment Research Foundation (WERF)-funded team of scientists and engineers from Brown and Caldwell and the University of Washington.

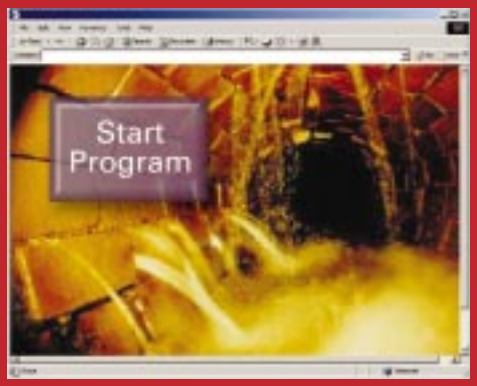
Relying on an expert knowledge system

Sewer failure can endanger public health and safety, wreak havoc on city streets and buildings, and require expensive emergency repairs. But many municipalities have limited resources for preventive inspections. So WERF called for development of a predictive tool to help focus inspections on the most critical sewers.

Instead of relying on a schedule of inspection based only on asset age, SCRAPS uses whatever records a utility might have, including those on age and systematic inspections, along with anecdotal observations. SCRAPS assesses the information according to "rules" generated from a knowledge base, gleaned by University of Washington researchers from a wide range of public and private sources. This expert-system assessment involves a mathematical construct known as Bayesian probability theory, which assigns probabilities on the basis of observations and experience.

"The use of expert systems is a fledgling science within our industry," explains Brown and Caldwell Project Manager **Steve Merrill, P. E.**

"To use a simple example, if most observers believe that large trees directly over a shallow sewer with questionable joint construction are likely to result in blockages due to root intrusion, then we can assign a high risk, or conditional probability, for failure given the simultaneous occurrence of these factors. SCRAPS integrates a belief-based network of such conditional failure mechanisms into an expert system."



Updated rankings of failure likelihood and consequences

Given general information about particular sewers, SCRAPS identifies problem areas and ranks sewers for inspection according to the likelihood and consequences of failure.

Failure likelihood is based on operational defects, structural defects, interior corrosion, exterior corrosion, erosion, and infiltration. The ranking is based on the potential for structural deterioration and operational defects (such as blockages), along with consequences such as impacts on the local economy, environmental and health effects, and the cost of replacement after failure.

With the click of a button, the user can view, catalogue, and store prioritization results as well as pipeline information. Also, input and output can be easily imported and exported: utilities with a great deal of existing data can rapidly populate the SCRAPS database and begin prioritization; and utilities with GIS capabilities can produce maps of investigation hot spots to show prioritized field activities.

Further, SCRAPS is a tool for ongoing use: its Bayesian basis yields improved predictions as more information is compiled.

Validated performance

A beta version of the SCRAPS tool has been validated using case histories of pipeline failures. The case histories were separately analyzed by the agencies at which the failures occurred, by a group of independent sewer utility experts, and by SCRAPS. SCRAPS performed significantly better than the independent experts in providing rankings that matched those of the agencies. This result indicates that SCRAPS provides better and quicker assessments than independent experts lacking detailed inspection records.

Further, SCRAPS can provide such high-quality assessments in quantity, ensuring consistency. "Basically, SCRAPS takes the human error out of the subjective evaluations an expert would be prone to if he or she had to rate and rank hundreds of pipes over a period of time," says **Andy Lukas, P. E.,** Brown and Caldwell's co-principal investigator for the project.

After the tool is finalized in fall 2001, WERF will offer it for sale to municipalities. For more information on how to use SCRAPS, contact Steve Merrill at (206) 749-2293 or Andy Lukas

ACEC Awards Littleton/Englewood WWTP Expansion

The American Consulting Engineers Council of Colorado has recognized Brown and Caldwell for its Littleton/Englewood Wastewater Treatment Plant expansion design. The highly original, complex design earned the ACEC-CO Engineering Excellence Award in the Water and Wastewater category.

The design for the Phase 1B expansion, which includes new digester covers, a dewatering facility, and a cogeneration system, has already saved the cities of Littleton and Englewood millions in operating and capital costs. It also increases the plant's treatment capacity to 36 million gallons per day to accommodate the area's booming population.

A new, low-emission cogeneration system saves the treatment plant $350,000 annually in operating costs by producing more than half the energy needed to power the plant — four times more energy than the plant's old system. It also provides backup power, which improves system reliability and reduces the chance of sending untreated wastewater into the South Platte River.

The new dewatering facility design saved more than $2 million in capital costs: a unique pumping scheme saved more than $400,000, modifications to existing centrifuges spared another $1.2 million, and modifications to the plant's polymer equipment another $400,000.

Sacramento Sets the Bar for CMOM

In Sacramento, Calif., County Sanitation District 1 (CSD-1) has kicked off one of the first capacity, management, operations, and maintenance (CMOM) programs in the country.

The program is also the most thorough CMOM effort to be undertaken so far. It encompasses not just CSD-1's collection system practices and programs, but also its business plan, current concerns, and asset management issues.

"A good CMOM will help you prevent overflows and will likely help you provide a defense in case an overflow does occur," explains Brown and Caldwell Project Manager **Pete Bellows, P.E.** "But nobody knows what 'a good CMOM' is. The County wants to set the bar instead of someone else doing it for them."

An opportunity for improvement

At the heart of the USEPA's draft policy on sanitary sewer overflows (SSOs) is CMOM, which requires agencies to enact programs to eliminate SSOs and achieve long-term management of their collection systems.

The whole range of operations—maintenance, engineering, training, inventory, finances, and information management—is covered. Agencies must outline the goals for each component of its organization, who's responsible for meeting them, and who's measuring them.

Some agencies see CMOM as just a paperwork exercise. Not CSD-1. "The CMOM project is an exciting opportunity to support our continuous improvement efforts, by focusing on best practices in all aspects of our utility," explains the District's Special Projects Manager **Patrick Hassey**.

Allocating resources to cut overall risk

Like many agencies, Sacramento's CSD-1 had to meet growing demands for new sewer service over the past two decades. More recently, it has undertaken a major rehabilitation program. The new CMOM undertaking will integrate these and other efforts into a plan for maintaining the whole collection system.

"For collection systems, an SSO is the signal of failure, whether caused by maintenance issues (grease, roots), capacity problems (infiltration/inflow, growth), or structural conditions (corrosion, cracks, washouts)," explains Bellows. "A holistic assessment is needed because it determines the individual risks from each failure mechanism, then the overall risk, so the agency can allocate the proper maintenance resources, capital projects, and enforcement actions."

Four steps to CMOM

First, the Brown and Caldwell/Montgomery Watson team will create a model CMOM and a program framework, specifying format, content, required information, metrics for evaluating goals, and other parameters. In the second task, it will audit current practices and identify any areas for improvement. Third, the team will prioritize areas for improvement and develop strategies to address them. Finally, the CMOM will be drafted; simultaneously, the team will embark on specific improvement projects.

"The interesting part is how to determine if your program is effective," adds Bellows. "Do you use benchmarking? Stakeholders' interests? Best practices?" The answer is a combination of all of these, to be determined by CSD-1 and the team for each aspect of CMOM. To implement the improvement projects, the team recommended adapting the balanced scorecard technique, widely used in the private sector, to correctly weigh short- and long-term objectives, financial and non-financial measures, and external and internal perspectives on performance.

The program will be wrapped up in 2003.

The new dewatering building's innovative pumping scheme saved more than $400,000 in capital costs and $75,000 in O&M costs.

The design reduced the operating shift from 33 manhours to fewer than 10 manhours; the truck loadout time for biosolids now takes 15 minutes with the new system, instead of the former 16 hours. These and other improvements reduced annual operations and maintenance costs by $75,000.

The innovative submerged digester covers and the mixing system increase digester capacity using the existing tank, as well as boosting methane production in the cogeneration system.

Brown and Caldwell also provided construction management services from the pre-bid phase to completion. These services, combined with a well-coordinated design, resulted in change orders totaling less than $30,000, all in all saving $1 million that Littleton and Englewood had earmarked for contingency fees. The operator-friendly facility was completed at $2 million below budget.

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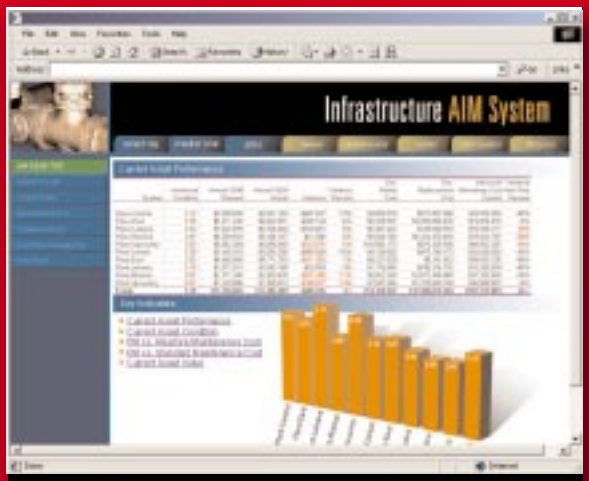

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