BROWN AND CALDWELL

Quarterly

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INSIDE:

Annacis Island treatment plant's massive upgrade

Fuel cells to power wastewater facilities

Infrastructure planning in Lincoln, Nebraska

Featured this issue—RSC's state-of-the-art environmental management program

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Colleen Holman, corporate environmental manager of Rental Service Corp. (RSC), and Eric Mears, client service manager at Brown and Caldwell, in a personnel lift at one of RSC's Phoenix stores.

PHOTO BY TOM STORY

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C O N T E N T S • S U M M E R • 1 9 9 8

Quarternotes

Tom Jacobs

BC Office News

Brown and Caldwell opened an office in Salt Lake City, Utah, this past spring. Vice President Tom Jacobs is managing it. Contact the staff at 165 South West Temple, Suite 300A, Salt Lake City, Utah, 84101, (801) 933-5122 by phone and (801) 579-0612 by fax…The North Carolina office has moved to 200 Providence Road, Suite 204, Charlotte, N.C., 28207. The telephone number is (704) 358-7204; faxes go to (704) 358-7205. Jim Hawkins and Rick Carrier (see "Joining BC") jointly manage the office.

Top Honors for Arizona Wastewater Treatment Plant

The upgrade and expansion of the City of Phoenix's 23rd Avenue wastewater treatment plant was recognized for engineering excellence by the American Civil Engineering Council, which named it one of six recipients of its 1997 Grand Award. The plant is the largest water reclamation facility in Arizona and achieves the most advanced use for reclaimed water — agricultural irrigation — in the southwestern United States.

As a major partner with Malcolm Pirnie, Brown and Caldwell provided engineering design and construction services for the 57-million-gallon-per-day facility. Using an innovative direct filtration process, with declining-rate, mono-media filters, the plant is achieving effluent turbidities of less than 1 turbidity unit (NTU). The reclaimed wastewater, discharged to the Roosevelt Irrigation District canal, is ultimately used to irrigate edible food crops. Key Brown and Caldwell staff responsible for the successes of this project include Sam Edmondson, Kerry Brough, and Peter Tymkiw.

The plant also earned the American Academy of Environmental Engineers' 1996 Honor Award for design; the City of Phoenix's 1996 Mayor's Grand Award; and the 1996 Operations Award from the Association of Metropolitan Sewerage Authorities.

Treated wastewater being discharged to a Phoenix canal.

Continued on page 6

Looking for Real Performance Improvement? Set Your Sights on Training.

Mike Cherniak discusses the links between training, technical services, and increased productivity.

Few would disagree that environmental training — typically spoken of in apple-pie-and-motherhood terms — is a "win-win." Job efficiency is improved, careers are enhanced, technical skills are upgraded, etc. Yet despite environmental training's popularity, conventional wisdom has dictated that when budgets tighten, it is among the very first line items to be trimmed.

So, as a professional trainer, I am heartened by new research showing that managers of municipal water and wastewater utilities are looking to training to boost the competitiveness of their operations. The results of a Brown and Caldwell-commissioned study by the BTI Consulting Group strongly suggest that managers today are going well beyond paying lip service to training. What action do managers believe will most improve their competitive performance? Work force training came out on top. In fact, when managers were asked to describe their greatest unmet need, "equipping staff with new skills" was just behind that perennial want, "capital." What actions do managers feel are critical to success in three to five years? You got it — improving the work force.

Operating costs *will* be lowered by improving productivity — but money must be spent to cross-train the work force. Managers who have trimmed their training budgets to bare existence to save money should look to industry colleagues and consider whether they've cut activities that are a major avenue to real savings.

Brown and Caldwell's efforts to help clients become more competitive involve ensuring that they understand how to properly operate, monitor, and maintain the custom systems we design. While all agree up front that these services are important, many still leave the planning table viewing them merely as a punch list task at the end of the design phase. Under these circumstances, operations specialists are expected to deliver a quality product and services with an inadequate slate of goals, budget, and/or schedule.

In the face of this challenge, Brown and Caldwell defines a pathway for training and support services that will meet client objectives *and* realize potential returns in process savings and increased productivity. Here are some features:

- Make sure that your operations specialists have reviewed the scope, budget, and scheduling of project training and are involved in pre-planning for start-up activities. All stakeholders have needs that impact costs, scheduling, and the ultimate product, and success requires their "thumbs up."
- Clearly identify your immediate needs for staff capabilities and the target audience for training. Consider the organization's perception of training and the organization's future direction. Success will have been achieved if staff understand the goals of the training and leave each session with newfound knowledge that can be immediately applied in their jobs.
- Insist that client and consultant staff review and agree upon all aspects of service delivery. Coordinating vendors, client staff, and Brown and Caldwell start-up personnel is critical. The logistics of who will do what, when, and how, should be broached months before start-up. Success is directly related to the ability of all involved parties to articulate their respective roles and responsibilities during start-up.
- Define now how service delivery will be evaluated and measured. Make sure to incorporate staff opinions and supervisor observations into objectives-setting as well as measurement. Success means that outcomes match objectives.
- Institutionalize an effective cross-training program. Training *systems* merely respond to individual training requests; proactive *programs* provide training within the context of meeting increased productivity objectives. A cross-training program requires leadership and vision. An internal coordination committee staffed by members of operations, maintenance, and management can accomplish this. Perform a simple needs assessment to develop objectives. Then, assign an internal training coordinator to handle the logistics of opportunity identification, communication, and delivery. Brown and Caldwell helps clients design and implement such programs.

When talk turns to training, technical services, and increased productivity, all involved should embrace the dialogue. When the training phase of a project commences, don't take it as a sign of completion or a signal to start relaxing. Consider this: start-up, training, and operations efforts can be viewed either as the home stretch of a project, or as the on-ramp to an effective cross-training program owned enthusiastically by the staff. I say, opt for the latter.

Mike Cherniak

Rental Service Corp. Commits to Excellence in Environmental Management

In less than a year, a service business in the throes of rapid expansion creates a nationwide environmental management program rivaling that of any U.S. company.

With more than 200 stores in 26 states, Rental Service Corp. (RSC) provides rental equipment — from aerial lifts to backhoes, hand tools to electric tools — to industrial, petrochemical, and construction companies as well as contractors and homeowners. The growth of those industries, along with effective business strategies, has led to the company's astounding expansion: doubling of the number of store locations over two years, and a leap in annual revenues from $128 million in 1996 to $500 million today. RSC expects 1999 revenues to exceed $1 billion.

Initially hired to perform a Phase I environmental site assessment for one acquisition in 1997, Brown and Caldwell went on to perform more than 60 for RSC. Soon the two firms were working closely together to develop a nationwide, state-of-the-art environmental program. It includes RSC's environmental management program, extensive employee training, and a customized environmental management information system (EMIS). In addition, Brown and Caldwell has begun the design and construction of "mini-wastewater treatment plants" for equipment washing operations at various locations.

"After Brown and Caldwell began working with us, we had a consultant who translated environmental terminology into language we could understand and apply to the rental industry," says Colleen Holman, corporate environmental manager. "And we wanted to be on the cutting edge and environmentally friendly. So we said, help us develop an effective environmental program."

David Harrington, RSC's senior vice president of human resources, and Colleen Holman, the company's environmental manager.

PHOTOS BY TOM STORY

Rapid growth and environmental consistency

Most of RSC's growth occurs through acquisitions of smaller rental store networks and "cold starts" on leased property. The acquisitions spawned the need for Phase I environmental site assessments to manage the potential liabilities associated with these industrial properties. Unlike many businesses, RSC decided that *every* potential acquisition would include a detailed environmental as well as financial due-diligence evaluation.

"We worked towards a national contract with Brown and Caldwell to achieve consistency in every location," says David Harrington, RSC senior vice president of human resources, who oversees the environmental program directed by Holman. "Now our corporate development people negotiate on a more informed and accurate basis." The increased knowledge about each property's environmental issues has dramatically reduced acquisitions costs, Harrington notes, as well as helping RSC to be an excellent steward of the environment. "We want to protect the company's assets today," adds Holman, "so we don't have a problem five years from now."

Environmental management information system

RSC's acquisitions — and its daily operations — are greatly aided by the customized EMIS installed and operated for the company by Brown and Caldwell, including an extensive database on all of RSC's properties.

"It was the database that really clinched the partnership between the two companies," says Holman. "Greg Cameron [the Brown and Caldwell geologist who designed the application] took us from an antiquated paperwork filing system to a state-of-the-art system. Before we worked with Brown and Caldwell, it took over a month just to get a report after all the Phase I field work had been done. Now there's no need for Fed Ex, mail, drafts back and forth, or faxes. We get electronic reports in a couple of days."

"The system also helps us post-acquisition, because we know the current status of permitting, maintenance, and action items for every store," notes Harrington. "It's great. We can respond to federal, state, and city requirements for any location."

Eric Mears, Brown and Caldwell's client service manager for RSC, guaranteed EMIS performance. "If it didn't meet specified criteria — schedule, accuracy, user-friendliness, and our responsiveness to any problems that came up after installation — half of our fee was at risk," he says. "We're proud that we performed well and met our client's expectations."

Beyond the basics

RSC's environmental management naturally began to extend from acquisitions to operations issues. One reason is top management's view of the environmental program as an extension of the company's safety program, which is widely acknowledged as an industry leader. "Although we want to comply with all regulations, the driving force behind our environmental program is that we care about our employees," says Holman, who founded the safety program five years before taking on the environmental program. Harrington confirms this. "The program fits in with our philosophy that employees are No. 1 and customers are No. 2."

RSC's commitment to environmental management also flows from its focus on proactiveness and partnership. "We're not looking just for the basics," says Harrington. "We want to know about regulatory changes on the horizon. We ask Brown and Caldwell about trends we need to be aware of, whether in a specific industry, such as construction, or in general commercial business."

Mears recalls the beginnings of the program: "During our first Phase I assessments, questions came up. We asked, 'What are your policies regarding underground storage tanks, discharge of wash water, oil disposal and recycling?' We thought about how they could standardize operations, manage liability, and save money. Colleen wanted the company to have comprehensive answers. It was exciting — the chance to help them give birth to a program."

Brown and Caldwell conceived of the environmental management program as a pyramid. The top third of the pyramid is the environmental mission statement, or the guiding principles. The middle third is environmental policies, or the rules of operation. The pyramid base is best management practices and procedures, which are communicated throughout the whole organization. RSC's environmental management team is completing the formulation of the policies, practices, and procedures, which then will be incorporated into the EMIS.

The best management practices and procedures are already being disseminated through RSC's unique training program, the Rental Service University. Environmental management is taught in tandem with instruction on how to run a profitable rental business and address human resources, safety, and legal issues. This kind of in-depth training is unmatched in the rental industry.

Designing new wash racks

RSC's environmental leadership in its field is illustrated by its request of Brown and Caldwell to design and build new wash racks for the company. "RSC was saying, 'We are going to do the right thing even if local environmental regulations aren't addressing the issue,' " says Mears.

Historically, returned rental equipment is washed on concrete pads, with water discharged to bare ground or the local drainage ditch. Some states regulate this water as process water, although many do not. RSC's new wash racks, generally 40-foot-wide by 70-foot-long sloped concrete pads, contain a packaged water collection and treatment system that Mears calls a mini-wastewater treatment plant. The water is either recycled through a closed-loop system or treated and discharged to the sanitary sewer. Pilot testing at five RSC sites is underway, which will help streamline design and construction. After any needed design modifications, the racks will be constructed at every store that doesn't meet RSC's wash rack policies or best management practices.

Many types of environmentally sensitive liquids require special handling, disposal, and recycling. Brown and Caldwell is helping RSC to develop consistent, cost-effective environmental procedures and practices for doing so.

"We tried to buy a universal treatment system, but it didn't exist," says Holman. "Brown and Caldwell drew on their expertise with big, complicated wastewater treatment plants to deliver exactly the simple system we needed."

"And we know it can be harder to achieve top quality on a small scale than on a large one," Holman adds. "The rental industry is still a small network, and we know none of our competitors have comparable safety or environmental programs. We're still working to improve. We aim to be the best no matter what the scale."

For more information on the development of RSC's environmental management program, contact Eric Mears at (602) 222-4444.

The equipment washing shown here generates wastewater that is regulated in many states. Brown and Caldwell is designing a wash rack for RSC that includes the concrete pad shown, plus a packaged water collection system that functions like a mini-wastewater treatment plant. The equipment wash water is either recycled through a closed-loop system or treated and discharged to the sanitary sewer.

An Enormous Upgrade for the Annacis Island Treatment Plant

Construction of the largest and most technically innovative wastewater treatment plant of its kind nears completion.

After seven years of planning, design, and construction, the Annacis Island wastewater treatment facility's conversion to secondary treatment will be completed in the summer of 1998. Located near Vancouver, British Columbia, it will be the largest and most technically advanced trickling filter/solids contact facility in the world, serving about one million people.

The conversion is part of a $650 million program of the Greater Vancouver Sewerage and Drainage District to upgrade the plants at Annacis and Lulu Islands, which have provided primary treatment for more than half the region's population since the early 1970s. Treated effluent is discharged into the Fraser River, home of the largest salmon runs in the world. Concerns over the degraded quality of the river spurred the Province of British Columbia to mandate the upgrade to secondary treatment.

Four trickling filters, part of the world's largest trickling filter/solids contact system, are shown during construction.

The District hired ABR Consultants to plan, design, and manage the project, train operators, and help commission the facilities. ABR is a joint venture led by Brown and Caldwell that includes two major Canadian partner firms — Associated Engineering (B.C.), Ltd., and Reid Crowther and Partners, Ltd.

A large-scale illustration of innovation

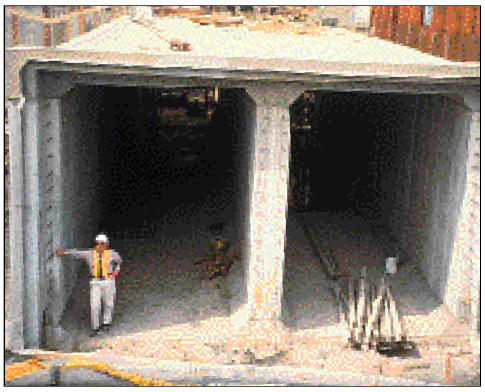
"The sheer size of the program alone makes it unique," says Brown and Caldwell/ABR project manager Steve Krugel. "But what also makes it unusual is its high level of technical innovation."

Not only does the upgrade's design employ many new processes and systems, it adapts previously existing processes and systems to work better, on a bigger scale, in groundbreaking ways. Some examples:

An advanced trickling filter/solids contact (TF/SC) process to provide secondary treatment. Effluent criteria for the Annacis Island plant are considerably more stringent than secondary-treatment effluent criteria within the U.S. While American criteria are based on monthly averages, British Columbia standards are based on daily maximum values, demanding optimal performance every day.

Using a sophisticated procedure to select a secondary treatment process, the team evaluated 17 alternative methods. The TF/SC process ranked highest considering cost, reliability, flexibility, ease of operation and maintenance, and robustness, that is, its ability to handle fluctuating and "shock" loads. (The process must handle varying loads from industrial wastewater sources and a combined sewer system tributary to the plant.)

In the team's advanced TF/SC design, trickling filters remove part of the soluble, carbonaceous biochemical oxygen demand (BOD) from the effluent using biofilm attached to the filter media. The biofilm in the trickling filters sloughs off and passes to four solids contact tanks. There the remaining soluble BOD from the trickling filter effluent is removed and the biomass is biochemically prepared for flocculation (agglomeration) in the center wells of the clarifiers.



Brown and Caldwell/ABR project manager Steve Krugel stands in the Annacis Island facility's secondary effluent conduit, now completely operational beneath the ground surface.

The design can accommodate different loading conditions, process configurations, and seasons. Special features include the world's largest vertical turbine solids-handling pumps, and an innovative system to handle a nuisance: snails. The system entails an aerated snail-removal chamber and heavily sloping contact-tank floors to ease removal of shells.

The world's first extended thermophilic anaerobic digestion process. The District determined that the facility should produce Class A biosolids, which can be distributed without restriction to a multitude of beneficial-

use markets. Annacis Island had been using on-site lagoons to store digested primary sludge for more than 20 years. The lagoons had to be removed to make room for the new construction. In addition, British Columbia had imposed strict new biosolids criteria (equivalent to those of the U.S. EPA); the volume of solids to be treated had doubled; and the plant had to provide ultimate disposal of the solids for the first time.

In evaluating ways to produce Class A biosolids, the design team considered several methods, including pasteurization of sludge before digestion and several modes of thermophilic (high-heat) digestion. The team then developed a new concept: extended (multi-tank) thermophilic anaerobic digestion. One of its advantages is the use of continuous-flow tanks in series, ensuring that pathogens do not break through to the effluent as a result of "short-circuiting" through a single tank. Lab-scale experiments using the method showed superior pathogen die-off rates. Then mathematical modeling and a full-scale, long-term demonstration at another District plant revealed that the method was reliable and the most cost-effective.

Cost-saving methane gas use. Plant energy costs were halved by the use of methane gas from the digesters to fuel clean-burning Jenbacher cogeneration engines, to produce power and provide process heat.

Multi-method odor control. The plant's extensive odor-control system was developed using odor modeling and a cost evaluation of different ways to achieve a specified odor level at the plant's fenceline. The system employs containment, scrubbing, submerged launderers, and several large biofilters containing bacterial cultures to treat odorous gases.

Fully integrated data acquisition and control. A new process control and information management system distributes data among six area control centers throughout the plant, any one of which can, in turn, operate the entire facility. The system was selected and completely programmed by ABR. It communicates with more than 4,000 instruments, 700 motors, 12 high-performance programmable logic controllers, 50 electrical distribution system power monitors, 50 feeder protection relays, and 100 variable-frequency drives.

A hinged-joint raft foundation for earthquake protection. After a risk analysis identified the probability of subsurface liquefaction at Annacis Island in the event of an earthquake, the designers developed a foundation system to protect against structural damage. It uses an innovative hinge joint that structurally ties together more than 20 tank foundations, eliminating the risk of tank separation and minimizing differential settlement, while allowing flexural movement.

Massive, on schedule, and under budget

The program was divided into two phases for funding purposes. In September 1991, construction at Annacis Island began with a $4 million contract for sand preloading of the 127-acre site. Annacis's Phase 1 construction was completed on time in April 1997; it entailed four new digesters, a heat recovery building, dissolved air-flotation thickeners, four solids contact tanks, and 12 secondary clarifiers. The Phase 1 facilities, temporarily using the solids contact tanks for activated sludge treatment, now treat approximately one half of the projected average dry-weather flow — 128 million gallons per day — to secondary levels.

The design has proven to be an unqualified success. The secondary effluent contains BOD and suspended solids of less than 15 parts per million (ppm), well below the daily maximum of 45 ppm. "…[I]t's great news," says Don Littleford, the District's project manager for the upgrade. "Phase 1 far exceeds the initial design parameters."

Phase 2 facilities, to start operation this summer, include four 52-meter-diameter trickling filters, a new influent pumping station, cogeneration, and a new operation and maintenance building. (The 5000-cubic-meter concrete pour for the trickling filters' common-raft foundation, completed in 1996, was the largest single pour for a reinforced concrete structure in British Columbia history.) Program components still in design include a new dewatering building and dewatered sludge storage building for Annacis, and disinfection upgrades for both Annacis and Lulu Islands. The Lulu Island plant, about one-seventh the size of the Annacis plant, also will start up this year. The upgrade program is $65 million under budget as it enters the home stretch.

The Annacis Island wastewater treatment facility, scheduled for start-up this summer, will be the largest and most technically advanced trickling filter/solids contact plant in the world. Shown (clockwise from lower left) are four new thermophilic digesters; 12 secondary clarifiers; four solids contact tanks and four trickling filters; 13 primary sedimentation tanks, three gravity thickeners, four digesters, and chlorine contact tanks from the original plant; new influent pumping station and operations and maintenance buildings under construction (upper right); the new cogeneration building (lower right); the heat recovery building; and four dissolved air flotation thickeners.

Contact Brown and Caldwell/ABR project manager Steve Krugel at (604) 451-6100 for more information on the Annacis and Lulu Islands project.

Continued from inside front cover

Efficient Sewer Replacement Wins Certificate of Recognition

A Brown and Caldwell-designed sewer project — entailing more than 6,000 linear feet of pipeline under one of the busiest streets in the Bay Area city of Fremont, Calif. — was recently installed a full month ahead of schedule and under budget. The use of microtunneling was key to the project's efficient completion.

The client, the Union Sanitary District, awarded a special certificate of recognition to the company "for your outstanding efforts in making this project a great success. Your firm demonstrated a commitment to the principles of partnering and team work…[and] prepared an excellent design, which resulted in minimal impact to those along the alignment. We appreciate your quick response and cooperative attitude."

The District had determined that growth projections required replacement of the 12-inch-diameter sewer main running along a congested arterial street with 21-inch-diameter pipe. Brown and Caldwell was hired to provide the preliminary and final designs.

During the preliminary design, Brown and Caldwell project engineer John Goodwin and the design team uncovered challenging considerations. First, poor soil conditions would require extensive dewatering, along with sheeting and shoring, if conventional open-cut construction were used. Second, soil and groundwater were contaminated at two locations along the pipeline alignment. And third, the disruptive impact of open-cut construction on traffic and the surrounding community would be extensive.

To address these challenges, Brown and Caldwell recommended microtunneling, a trenchless pipeline-construction method in which the company holds special expertise [see sidebar]. Microtunneling reduced the need for expensive sheeting and shoring, minimized the handling of contaminated soil and groundwater, and lessened the impact of construction on traffic and adjacent businesses. More than 5,000 feet of the 21-inch pipe was installed by microtunneling, 300 feet of it through an existing 15-inch-diameter sewer. Traditional open-cut methods were used to install 1,100 feet of smaller collector sewer pipe.

Excellent communication and coordination were crucial to project success. Because of close partnering among Brown and Caldwell, the general contractor, the microtunneling subcontractor, and the Union Sanitary District, the project was completed early and construction costs were significantly lower than the original $3.75 million bid. In addition, city officials, along with nearby residents and businesses, were kept informed of the project status and provided input throughout initial planning and design. Detailed traffic control plans and extended working hours both minimized public impact and maximized efficiency.

"In terms of making everyone happy — from the owner, contractor, and city to the members of the community — this was the most successful microtunneling project we've worked on," says Goodwin. "Everything clicked."

When Should Microtunneling Be Used?

Microtunneling is a technique to install underground pipe without trenching. A remote-controlled, computer-operated tunnel-boring machine extracts soil and discharges it to the surface, while right behind it, in a linked unit, a hydraulic jack pushes the pipeline into place. Surface disruption is minimized, and pipe can be routed without the constraints imposed by trenching or conventional excavation.

Microtunneling should be considered under the following circumstances:

- Difficult or poor soil conditions
- High groundwater table
- Contaminated soils or groundwater along pipe alignment
- Deep pipeline
- The need to avoid extensive traffic impact
- Unacceptability of community disruption.
- Limited available work area

To install more than 5,000 feet of new sewer main along a busy street in Fremont, Calif., Brown and Caldwell recommended microtunneling. Shown are the tunnel-boring machine and the pipeline before installation.

Olfactory Abilities Put To Work

Every job has its benefits. At Brown and Caldwell's Pleasant Hill, Calif., office, the perquisites include the opportunity to serve as an odor panelist. Never mind where the foul air samples came from in the first place; once they've been diluted 100:1 or 1000:1, they take on a character all their own. You could liken being an odor panelist to the olfactory part of professional wine tasting, except wastewater treatment plant odors offer hints beyond the traditional berry, spice, or oak of a good Chardonnay.

Odor panels are just a part of the company's odor control services for wastewater treatment plants and collection systems. These services include identifying odor sources; measuring odor intensity; estimating odor emission rates; modeling atmospheric odor dispersion; evaluating the performance of existing foul-air treatment systems; developing and evaluating odor-control alternatives; and preparing odor-control master plans. The methods Brown and Caldwell may recommend to control odor are operational changes, process modifications, chemical addition, atmospheric dispersion improvements, and cover-vent-and-treat strategies.

The Forced-Choice Triangle Olfactometry methodology (ASTM method E679) requires that panelists have a normal sense of smell — for which Brown and Caldwell screens potential panelists — and that they be volunteers, non-smokers, and not wearing heavy perfumes or deodorants on the day of the test. Odor panelists gain a unique experience, memorable peer reactions, and the satisfying knowledge that they've helped push the nebulous and subjective aspects of odor perception into the quantitative realm.

Odor panels are called on during the early phases of Brown and Caldwell's odor control projects. While some panels are composed of employee volunteers, others are filled with enthusiastic members of the community served by the wastewater treatment plant, as in a recent project for the City of San Francisco. For some projects, odor panel services are provided by an outside laboratory.

Using an olfactometer, Brown and Caldwell employee and volunteer odor panelist Sharon Parmalee tries to distinguish a diluted foul-air sample from samples of odor-free air.

A Week's Analysis Yields Infrastructure Planning Solutions

When population growth exploded beyond the bounds set by planning efforts, the city of Lincoln, Neb., called in Brown and Caldwell for a fresh perspective.

Like many Midwestern cities, Lincoln's population grew steadily throughout the 1990s. The city has a comprehensive process for general planning that includes wastewater facility planning, and it had set boundaries for urban growth. But development was spreading beyond the fringes of urban boundaries, and the city hadn't planned for infrastructure in these areas — or developed a way to pay for it. Yet it wanted to allow targeted development in the "urban boundary fringe" because such growth would provide beneficial economic development.

For a number of years, city officials responded to the challenges of fringe area development by strictly enforcing sewer service policies applying outside city limits. Finally, a team of senior Brown and Caldwell municipal facility planners was called in to provide planning solutions — especially in the Stevens Creek basin just east of the city, where the situation was the most critical.

Brown and Caldwell's team of Tom Jacobs, Sam Edmondson, and Jack Warburton, with assistance from Kirk Petrik, brought a collective 85 years of experience to the planning process. They spent a week in Lincoln reviewing the situation; analyzing current policies, practices, and financing methods; and developing a number of recommendations to manage fringe area development while maintaining the personality of the community.

By week's end, the team met with a group of about 30 city staff members, including Mayor Mike Johanns, three members of the City Council, two members of the Lancaster County Board, and several senior members of various municipal departments. The team's presentation included the following insights and recommendations:

- A clear description of the city's current practices
- Recommendations for new policies, engineering practices, and funding methods
- A process for implementing the recommendations
- An example of how this process would work on a portion of the Stevens Creek basin

"The approach was well-conceived and will pay dividends," says Dick Erixson, Lincoln's public works director. A member of the City Council called the workshop the most successful effort to deal with the fringe growth issue since she had joined the council in 1979.

During the week-long session, the Brown and Caldwell team completed the entire evaluation, held the workshop, and presented a document to the city including all the results and recommendations. Tom Jacobs sums up Brown and Caldwell's contribution: "The city wanted a fresh look at the situation, and they got it."

Improved Design Cuts Cost of Pioneering Fuel-Cell Technology

Brown and Caldwell has completed design improvements for the application of new, highly flexible fuel-cell technology to produce power for wastewater treatment plants. The improvements will cut fuel pretreatment costs in half. The new fuel cell — only the third of its kind to use digester gas — will be installed at the Portland, Ore., Columbia Boulevard Wastewater Treatment Plant, which is maintained by the city's Bureau of Environmental Services (BES).

"We're using technology developed for the space age," says BES principal engineer Eugene Appel, "and carrying it into accepted utility practices for the 21st century."

The Columbia Boulevard plant purchased the 200-kilowatt fuel cell and gas pretreatment unit from ONSI Corporation, a division of International Fuel. The BES hired Brown and Caldwell to help specify and facilitate the development of the gas pretreatment unit to make it more economical than the two previous units in both initial and operating costs. Developing the gas pretreatment unit was a cooperative effort also involving the Oregon Department of Energy and Calgon Carbon Corporation. In addition, Brown and Caldwell designed a heat recovery system, which uses the low-grade heat produced by the fuel cell to help heat the anaerobic digesters.

Fuel-cell technology, developed for the U.S. space program, only recently was applied to provide electrical power at wastewater treatment plants. The two previous applications, at the Yonkers, N.Y., and Boston (Deer Island) wastewater treatment plants (profiled in the January 1998 issue of Water Environment & Technology magazine) demonstrated the fuel cell's ability to work with treated digester gas.

The fuel cell converts waste gas generated by the anaerobic digestion process into electrical power and heat energy. First, the digester gas is processed by the gas pretreatment unit, which removes hydrogen sulfide and other compounds. Next, the digester gas enters the fuel cell. A fuel processor inside the cell uses the digester gas to produce hydrogen-rich gas. Then the hydrogen-rich gas and air are passed through a fuel stack, which, much like a battery, consists of graphite plates with electrolyte sandwiched between them. In this part of the process, an electrical charge is developed on the plates. This direct (DC) current is then converted to alternating current (AC) for use in the plant. The process also generates heat. Water, used as a coolant, carries this heat away to the heat recovery system.

The advantages of the technology are impressive. Without moving parts or combustion, the fuel cell can create power with as much as twice the efficiency of indirect conversion methods such as steam or internal combustion engines — without environmentally harmful emissions or noise. And it does so with one of the few renewable fuels that is widely available: digester gas.

The catch, up until now, has been cost per kilowatt — two to three times the cost of other facility fuel systems. The reduction in pretreatment costs and mass production of the fuel cells promise to make fuel cells competitive for digester gas applications in the future.

Brown and Caldwell engineer Bill Meloy observed and reviewed the two existing fuel cell installations. Then he made recommendations to the Columbia Boulevard plant and ONSI regarding design of the gas pretreatment and gas handling systems. The design recommendations significantly reduce start-up costs as well as operating costs.

Brown and Caldwell's design of a heat recovery system is presently under construction. It makes use of about 40 percent of otherwise wasted digester-gas energy. The design is unique — and money-saving — in the way it interfaces with existing plant thermal processes to recover heat, which is then used to heat the digesters. The plant's existing digester heat exchangers will now perform double duty, taking heat from either the fuel cell or the boiler-fired heating system.

Meloy explains that the heat-recovery aspect of the project was particularly challenging, because "as you add more fuel cells in the future, it becomes more difficult to utilize the low-grade waste heat." But he relished the opportunity to help solve the relatively new technical problems. "Using fuel cells on digester gas is still in its infancy," Meloy notes, "and we had a chance to help shape the approach."

The fuel cell that was part of a demonstration project at the Deer Island wastewater treatment plant in Boston. Eugene Appel, principal engineer for the Portland, Ore., Bureau of Environmental Services, is among the group at left examining the fuel cell.

The new designs are a step toward making the fuel cell competitive with gas engine cogeneration units in both overall energy recovery and cost. Fuel cells have the potential to produce a significant portion of the power and heating energy needed for wastewater plants in the future.

The clean power produced by fuel cells makes it ideal for computer facilities, and the fuel cell at the Columbia Boulevard plant will be a standby power source for the plant communications and control system. Appel says that the fuel cell not only "meets our need to provide reliable power for the communication center," it also allows the plant "to further utilize digester gas, and to protect the airshed."

To Simplify, Build Trust

Simplify your business life in four easy steps. Doesn't that sound good, feel soothing, and take a load off for a few seconds? Simplify.

More and more we are seeing prescriptions on how to simplify, to make things easier. They are aimed mostly at our personal lives, and at balancing all of life's complexities. Surprise, surprise: we need these same prescriptions in everyday business — in particular, the environmental business. Why? Because our customers are asking for it. And they are asking for something else underneath: trust.

Admittedly, the request for the simplicity of trust is coming through in typical business terminology that can hardly be called simple, such as the expressed need for "collaborative relationships," "value-based partnerships," and "alliances." But under the terminology is a plain truth: The expected returns from these business models don't happen without — simply — trust.

Yes, this message has always been a part of successful business. And through the cycles of business change, trust has had different degrees of perceived importance. Today, Brown and Caldwell is selected to do work for our customers in many ways, from a 1,000-point scoring matrix after four months of proposal and presentation effort, to a single phone call "to get started." Although it's not always overt, the desire to trust is embedded in the continuum of consultant selection methods.

In its annual industry review, "The Strategic Review and Outlook for the U.S. Environmental Services Industry 1998," the BTI Consulting Group of Boston found what they termed a "mind boggling" trend: "67 percent of all industrial companies finally want to develop collaborative value-based relationships with their consultants. Supply chain analysis and reengineering in the rest of the company are showing that collaborative relationships bring more value than bid and propose."

That's a compelling statistic coming from customer research into over 6,000 environmental buyers.

Always wanting confirmation closer to home, we asked our customers about their views of the industry and their needs. Here's what they told us: in-house environmental staffs are smaller; accountability for compliance and profitability is greater; concern over consultant conflicts is growing; and yet there is no shortage of challenging problems to solve. Our customers want a partner, a collaborative team, proactive thinking and doing, and reliable communication (read "no surprises").

Think about doing business in the ways our customers want in the absence of real trust. It doesn't work — at least not to the level expected.

Here are four steps to get to trust.

Make and Keep Commitments

- No fuzzy commitments.
- Make only agreements you can keep.
- If you can't keep a commitment, speak up immediately.
- Clean up broken commitments.

Commitment is the foundation of trust. An agreement is made between at least two parties, a willing customer and willing consultant. Real communication is defined here and tested.

Build Credibility

- Meet your obligations (commitments).
- Demonstrate staying power.
- Promote truthfulness and candor.

As credibility is built, mutual respect and fair play follow. In this step, the business relationship becomes sturdier. With multiple repetitions of credibility-building actions, the relationship is strengthened more and more.

Practice Openness

- Treat mistakes as learning experiences, not exit events.
- Allow intense exchanges, in which real issues are addressed.
- Become more comfortable with give and take.
- Encourage proactive and provocative thinking.

With openness, all parties in the business relationship begin to derive gain. The groundwork is lain for visionary and effective thinking.

Enjoy Trust

- The gains are unlimited.

Now, let's collaborate, brainstorm, innovate, be proactive, and solve tough problems. With trust, it seems so much easier.

CRAIG GOEHRING

Craig Goehring

Joining Brown and Caldwell…

Joining the staff of the Charlotte, N.C., office as a client service manager is **Rick Carrier, P.E.**, who has 14 years of design, construction management, and operations experience with many water and wastewater treatment and conveyance facilities. A longtime resident of North Carolina, Carrier earned his master's in environmental engineering and bachelor's in civil engineering… **Daniel Clayton, P.E.**, a new project manager in the Denver office's water/wastewater group, has nearly a decade of environmental engineering and related experience. His designs include wastewater treatment improvements, including odor control; systems to monitor continuous emissions; and hazardous and municipal solid waste disposal facilities. Clayton has supervised testing and helped clients achieve regulatory compliance with biosolids incinerators and other point sources. He holds a bachelor's in forest engineering and a master's of engineering degree.

Cheryl Lee is the company's new director of finance, heading the financial planning and analysis departments. Lee holds a master's degree in business administration and a certificate in project management. She comes to Brown and Caldwell with 10 years of experience in the banking, construction, and software industries… **Ron Appleton, P.E.**, has joined the wastewater group in the company's Pleasant Hill, Calif., office. Appleton's experience, spanning 10 states and the District of Columbia, includes process evaluations, pilot testing, and design for municipal and industrial wastewater treatment. His expertise is in physicochemical and biological advanced wastewater treatment and water recycling. He earned bachelor's and master's degrees in civil engineering from Stanford University.

Project Engineer **Angela Berry**, a new member of the West Palm Beach, Calif., office, has over seven years of field-oriented construction and operations experience. Berry has been responsible for planning, research, construction submittals, purchasing, piping and equipment layout, technical review, and scheduling for wastewater treatment and water storage facilities. She has a bachelor's degree in oceanic science and a master's in environmental engineering… **Andy Lukas, P.E.**, has transferred from Brown and Caldwell's Seattle office to the company's Twin Cities office, to expand the company's Midwestern services in water resources, pipeline infrastructure, and information technology. He has master's and bachelor's degrees in civil engineering.

Technical Papers and Back Issues of *Quarterly*

The technical papers and back issues of *Quarterly* listed below are available to readers. For copies, please write, call, or e-mail Andrea Atkins, Brown and Caldwell, 3480 Buskirk Avenue, Pleasant Hill, Calif., 94523; (925) 210-2464; aatkins@brwncald.com. Technical papers also can be accessed via the internet at www.brownandcaldwell.com.

Technical Papers

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"Better Information Systems Are Built on Business Fundamentals" No. 667

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"Water Reuse by Drip Irrigation of Pineapple Process Water" No. 668

SCHAFER, P.L.
"Odor Control Systems from an Engineering Firm's Viewpoint" No. 669

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"Operational Criteria as an Alternative Approach to Compliance withWastewater Disinfection Treatment Standards" No. 673

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Winter '98 - Groundbreaking assessment of Atlanta's water and wastewater operations; innovative water-well designs that overcome water quality problems; Taiwan's state-of-the-art industrial wastewater reclamation system; responding to the EPA's new chemical risk management program; tailored software for managing your company's environmental data.

Fall '97 - Lake Washington's restoration through restructuring of Seattle's wastewater system; utility business-model evaluations that recommend information technology plans to achieve goals; spotlight on the Water Environment Research Foundation; accessing O&M manuals online; the McDonald method to calculate effluent dilution; proving low-tech production of Class A biosolids.

Summer '97 - An integrated storm water treatment program and public landscape artwork at King County, Wash.'s wastewater treatment plant; how to prepare for a successful site decommissioning; optimization instead of rebuilding at a Wisconsin Tissue paper mill.

Fall '96 - Treatment process upgrades and planning to achieve cost-effective compliance at a Cleveland wastewater treatment plant; optimization of utility collection, plant, and distribution systems; site-specific water quality studies for Lincoln, Neb.; diagnosis and rehabilitation of aging pipeline infrastructure.

Fall '95 - A St. Paul, Minn., wastewater treatment plant's use of collaborative program management; creation of the world's largest storm water wetland treatment system in the Florida Everglades, including overview map; unprecedented use of oxygenation to improve reservoir water quality.

Summer '95 - Tripling water plant capacity using high-rate filtration; integrated watershed management plans; demonstration of the reliability of bioremediation.

Fall '94 - Addressing sanitary sewer overflows; easy diagnostic tests to pinpoint the causes of dispersed suspended solids and flocculated suspended solids in wastewater effluent.

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