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Treated Wastewater Recharges Aquifer

The El Paso area, including adjacent Ciudad Juarez, Mexico, depends upon the Hueco Bolson aquifer for 65% of its water. Demand is overdrafting the Bolson, whose levels are dropping almost 2 feet annually, and water use projections indicate an upward trend in pumpage will continue.

As it stands, withdrawal of groundwater has created a large cone of depression in the water table centered under the El Paso-Ciudad Juarez area, which has a population of more than 1.5 million.

About 60% of the advanced tertiary treated wastewater processed by the Fred Hervey Water Reclamation Plant is injected into the bottom of Hueco Bolson Aquifer, a process known as aquifer storage and recovery. The balance of the water is sold to the El Paso Electric Company Newman Power Plant for cooling tower makeup water and to the Painted Dunes Golf Course and the Bowen cattle ranch for irrigation, said Plant Manager Javier Hernandez.

(The term "bolson" refers to the sediment-filled basin bounded by the Franklin Mountains on the West, and lower divides and valleys on its remaining boundaries.)

Built in 1985, the 10-million gallon/day (mgd) Fred Hervey Water Reclamation Plant treats wastewater from the northeast side of El Paso to Environmental Protection Agency (EPA) drinking water standards, then conveys the water to the three end users.

Within the aquifer, reclaimed wastewater mixes with groundwater, shoring up aquifer reserves. About 15 percent of El Paso's water needs are met by reclaimed water.

Aside from bolstering groundwater supplies, aquifer injection has also stemmed intrusion of saline water from the Rio Grande alluvium, a shallow aquifer overlying the Hueco

Bolson. The freshwater zone of the aquifer ranges in depth from 200 feet to 700 feet. Treated wastewater is injected from below to allow mixing with existing groundwater. The Hueco Bolson Recharge Project was designed so that the residence time of the water injected into the aquifer would be at least two years.

Operations Manager Mike Fontaine checks one of 10 injection wells situated west of the Fred Hervey Water Reclamation Plant. Tertiary treated wastewater is injected beneath the Hueco Bolson aquifer at a depth of between 300 and 760 feet. This is one of the deepest polyvinyl chloride pipe wells in the United States.

Owing to the fact that the Fred Hervey plant must provide a relatively constant supply of wastewater to its irrigation and industrial customers, it loses the luxury of operating like a regular wastewater treatment plant, Mike Fontaine, plant operations manager said. Instead of treating wastewater upon demand without much attention to output, the plant must maintain a steady stream of effluent. One 5-million gallon equalization basin acts as a buffer, holding primary treated wastewater collected during periods of high flows in preparation for treatment during times of low flows.

Four features distinguish the wastewater treatment and disposal at Fred Hervey from conventional wastewater treatment plants, according to Fontaine: a powdered activated carbon treatment, high-lime treatment, ozone disinfection, and subsequent injection into the aquifer. First, the plant uses a powdered activated carbon treatment in which dissolved pollutants, ammonia, and minute traces of organic contaminants are absorbed. Then the pollutant-laden carbon and bacteria are injected with air, heated, and pressurized, converting them to ash. The carbon not burned into ash is then renewed and reused.

The high-lime treatment first raises pH to kill viruses, mitigate hardness, remove phosphorus and precipitate out heavy metals in the form of hydroxides. Carbon dioxide is added later to lower pH.

The last unique features are the 10 injections wells, adding between 16 and 44 million gallons of treated wastewater per month into the aquifer. Before actual injection, the polished water is detained 8 hours in 3.3-million gallon clear wells, where a battery of tests ensures that it meets or exceeds EPA standards.

Three large ponds which stored primary treated wastewater are being removed from service, due to the risk that storage of untreated wastewater in the unlined ponds has the potential of degrading water in the Hueco Bolson with nitrates as it percolates downward.

Unlined holding ponds which stored primary treated wastewater are being removed from service to protect the aquifer from possible nitrate contamination.

Fred Hervey was the El Paso mayor who created the El Paso Public Service Board, which oversees the city's water utilities, and encouraged the city to plan for future water needs.

Javier Hernandez, (915) 594-5721, is manager of the Fred Hervey Water Reclamation plant.

MUD forges partnerships, improves service

Storage capacity of one-half millon gallons is represented by new ground and elevated storage tanks. These replaced collections of dilapidated tanks scattered throughout Homestead's service area

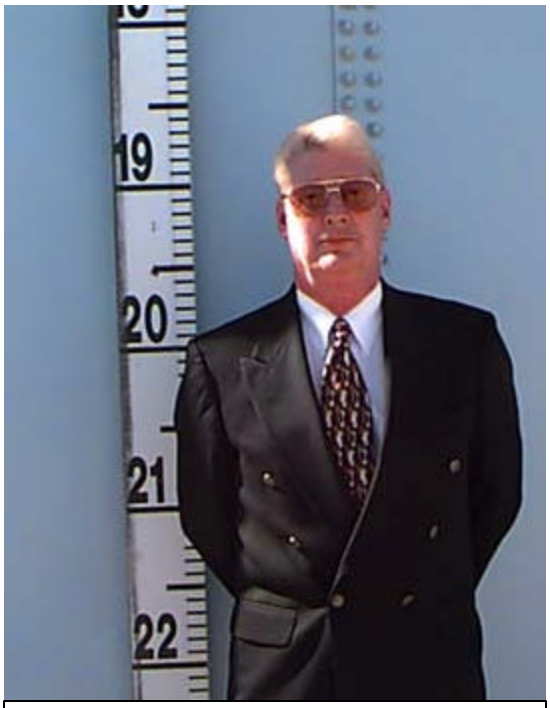
Talk about turning a problem into an opportunity.

When Ron Rodenhaver became general manager of Homestead Municipal Utility District (MUD) in April 1993, he found a crumbling infrastructure, disorganized records, undocumented connections, a large amount of unaccounted for water, accounts more than a year overdue, substandard water quality, a debt problem, and credit so poor that contractors refused to take on repair work. The system was in such disarray that Texas Natural Resource Conservation Commission (TNRCC) had placed a moratorium on new connections.

Fast-forward to 1997. Homestead has erased its debt, lowered the rate of levied taxes, constructed two storage tanks totaling half a million gallons capacity with federal funding and is replacing all water lines in its services

area while installing fire hydrants. Old wells yielding substandard water and storage tanks have been deeded to El Paso County for future parks and other construction.

Governing magazine named Rodenhaver one of its 10 Public Officials of the Year in 1996 for his achievement in turning around the MUD, for coordinating improvements with all levels of governmental entities, and for taking over a "debt-ridden, environmentally unsound, bureaucratically wasteful organization and delivering to its customers the first decent water and fair prices many of them had ever seen."



Ron Rodenhaver, Homestead's general manager, was named one of Governing *magazines Public Officials of the Year for 1996*.

Located in an unincorporated community northeast of El Paso between El Paso city limits and the slope of the Hueco Mountains, the area now served by Homestead had been supplied by two small private water systems straining to keep up with haphazard land development with rusting storage tanks, mismatched pumps, and deteriorating pipes.

In 1990, the two small private systems serving these *colonias* east of El Paso combined to form Homestead MUD. (*Colonias* are rural, economically depressed subdivisions lacking adequate infrastructure.) In the previous decade, new connections had been added with little regard for water quality and system integrity. Then in July 1992, the 822-connection system failed, and TNRCC filed action with the Attorney General to declare a moratorium on new customers. The same action also stipulated that Homestead MUD hire a professional manager.

Resident Lorenz Barrios, alarmed at the failure, set about guiding the district by serving on the Board of Directors, which he now chairs. Rodenhaver credits Barrios with guiding the MUD's Board of Directors in improvement of the district.

Rodenhaver, for 20 years general manager at Horizon City Water District 15 miles to the east, was brought in. He first set about gaining control of the budget and reducing overhead. Credit was so poor that in some cases he had to rely on the strength of his good reputation and his own credit card to effect repairs.

The Homestead MUD Board of Directors signed a resolution to do whatever it took to get this district in shape.

Rodenhaver opened the lines of communication with Texas Water Development Board (TWDB). With a grant from the Farmer's Home Administration (FmHA), small collections of leaking 10,000-gallon storage tanks were replaced with a 248,000-gallon ground storage tank, a 250,000-gallon elevated storage tank, and three booster pumps.

Northeast El Paso's Homestead MUD has deeded these leaking, graffitti-covered storage tanks to the City of El Paso for parks and other construction. In the background is the 250,000 gallon elevated storage tank, built with a grant from FmHA, which now serves Homestead's customers.

The moratorium on new customers will be lifted once a 24-inch line from El Paso Public Service Board is completed. This new main is funded by the Economically Distressed Areas Program (EDAP) funds of TWDB and by FmHA.

Now Homestead MUD is implementing a four-phase improvement plan. In Phase 1, a $5 million grant from EDAP is being used to install a new water distribution system and fire hydrants.

With Homestead well on its way to a turnaround, federal and state water agencies turned their sights on a patchwork of private water suppliers in the east El Paso area. TWDB, TNRCC, and FmHA proposed that all water systems in the area should be publicly held to qualify for loans to fund improvements.

Somewhat reluctantly, El Paso County agreed to purchase 8 of 11 private water companies serving a population of more than 5,000 with the understanding that Homestead would operate them under contract. El Paso Public Service Board, a city entity, will wholesale water to Homestead, which will in turn wholesale the water to the other water suppliers. Part of the improvement will bring water to unserved homes, which are now forced to fill tanks and drums at neighbor's homes or pay to have water hauled in.

Part of the district's problem in the past has been haphazard land development. Rodenhaver feels developers, which he calls land salesmen, irresponsibly plat out and sell land in subdivisions without services, straining the existing water system. The Texas Attorney General apparently agreed. In action filed along with the connection moratorium, the settlement declared that land developers should not serve on the Homestead's Board of Directors.

In addition to other improvements, a low-pressure 85,000-gallon/day reverse osmosis pilot desalinization plant, to be overseen by the civil engineering department of University of Texas at El Paso, is under construction on land donated by Homestead. The plant was funded jointly by the U.S. Bureau of Reclamation and the U.S. Environmental Protection Agency. The plant will provide potable water and serve as a research site for brine utilization.

Now that Homestead MUD is debt-free, its customers are enjoying an average 20 percent cut in water bills, and property taxes assessed by the MUD have been decreased 40 percent. Rodenhaver now looks forward to hooking up the backlog of 400 families upon lifting of the moratorium.

Rodenhaver can be reached at (915) 847-1051.

High Plains introduces Water Wise *program*

by Carmon McCain
High Plains Underground Water Conservation District No. 1

About 385 fifth and sixth grade students in four school districts within the High Plains Underground Water Conservation District have successfully completed the water conservation education program *Learning to be Water Wise & Energy Efficient*, sponsored by the District during the 1996-97 school year. Data collected from participating students will be used to determine overall success of the program.

The program has been approved for the upcoming school year and will be expanded into two more school districts. The District funded purchase of each $28 student kit.

The *Learning to be Water Wise & Energy Efficient* program was introduced with measurable success in The Harris-Galveston Coastal Subsidence District (*Texas Water Savers*, Fall 1995 and Spring 1997).

The Learning to be Water Wise & Energy Efficient *kit consists of low-flow faucet aerators and showerhead, as well as a flow bag, toilet dye tablets, a toilet flow restrictor, and a water calculator.*

During the two- to three-week unit, students asked their parents to help install free low-flow kitchen and bathroom faucet aerators and low-flow showerheads in their homes.

Classroom activities also emphasized the importance of water conservation with

activities that included checking showerhead flow rates; determining the application efficiency of a lawn watering system; calculating the amount of water used each day by the shower, toilet, and bathroom sink; and conducting an energy and water use audit.

All instructors agreed that the classroom activities helped both students and parents discover ways to conserve water in their daily routines.

"The program was a terrific idea," said Friona Elementary School teacher Sheryl Taylor. "It gets parents involved in the learning process with their children, and it benefits the entire community. The program is very `real life,' it is relevant to the community, and it teaches students responsibility with our resources.

Instructors Leann Boyd and Janice Moser of the Lubbock-Cooper Independent School District agreed.

Canyon Junior High School instructor Pat Holcomb said the *Water Wise* unit fit in well with other curricula.

"Our social studies instructor taught about the Ogallala Aquifer and the hydrologic cycle," said Holcomb. "Our math teacher used the water facts in math problems, and our English instructor conducted a survey of other towns to determine if they had ever been forced to ration water," she said.

Several spin-off activities resulted from the *Water Wise* program. Students at Friona Elementary School created water conservation posters and booklets that they shared with students in the lower grade levels and people around town.

Canyon Junior High School students set up a table at their local hardware store to inform the public about water and water conservation. Other students made a water conservation exhibit for the junior high school's library display case.

The program reinforces the District's philosophy that water conservation is best accomplished through public education.

Carole Baker, public information director of the Harris-Galveston Coastal Subsidence District, is working with the Texas Natural Resource Conservation Commission to introduce *Learning to be Water Wise & Energy Efficient* in school districts statewide.

For more information, contact Carmon McCain at (806) 762-1834 or Carole Baker at The Subsidence District at (281) 486-1105.

Meetings and Conferences

American Water Works Association (AWWA)/Environmental Protection Agency Workshop on Water Conservation Guidelines, Sept. 22, Denver, Colo. Contact Rudd Coffey at (617) 894-9830 or rcoffey@ziplink.net.

Reaching Globally--Acting Locally: Solutions, Innovations, and Support, sponsored by the Water Reuse Association of California, Oct. 15-17 in San Diego, Calif. for persons involved in the design or operation of water recycling facilities. This year's event will feature global and local perspectives in agricultural, rural, and small community innovations, avenues of support and economic developments, solutions for operators, and serving golf course customers. For more information, call Terri Taylor-Solorio at (916) 422-2746.

American Rainwater Catchment Systems Association meeting**,** Oct. 31, in conjunction with the Austin Green Builders Convention. Call Kate Houser, (512) 326-4636.

Integrated Resources Planning Workshop, Nov. 13, Austin. Morning session will focus on "nuts-and-bolts" issues , and afternoon sessions will outline case studies. Texas Water Development Board Executive Administrator Craig Pedersen will review Senate Bill 1 regional planning requirements. Call Mamie Larson, AWWA, (303) 347-6204 for more information. Fee is $100.

The **7th Annual Conference on Texas Water Law,** Nov. 13-14, Austin. Sessions will include: effects of Senate Bill 1, water rights permitting, water marketing, reuse of wastewater, and border water law issues. To register, call CLE International, (800) 873-7130. (CLE will offer a video and audio cassette of the conference, as well as course materials for those unable to attend the conference.)

AWWA Conservation Division Mid-Winter Meeting and Water Shortage Planning Workshop, Feb. 7-9, Austin. For information, contact Susan Miller at (303) 347-6181 or smiller@awwa.org.

AWWA Annual Conference and Exposition, June 21-25, Dallas, TX. Contact David Rossiter at (303) 347-6209 or rossiter@awwa.org.

To volunteer to act as a host, moderator, or helper at the annual conference, call Janell Mirochna, Dallas Water Utilities, (214) 670-4297.

Conservation rates affect demand management

By Jan Gerston
Texas Water Resources Institute More than 100 demand studies have determined that water pricing, in the form of increasing block rates, is a powerful conservation tool at the disposal of water utilities.

Utilities conventionally use one of three types of conservation rates. Most common is an increasing-block structure (also called inverted block) with tiered rates at set usage levels. One seasonal method sets two different rate structures, one for winter and one for summer. The other method sets a baseline according to a customer's winter use, and imposes a surcharge in the summer for any use over this baseline. Either way, economists say that the first low-cost block must be large enough to encompass the entire usage of some customers, or the overall conservation message is defeated.

In a study published in the *Conserv 96* Proceedings, University of North Texas economist Michael Nieswiadomy found that 30% of Texas water utilities use increasing block rates, 62% use flat rates, and 8% use decreasing rates. Overall, 25% of Texas utilities have adopted the increasing step rates, as shown in the table on page 6. Curiously, 26% of utilities in both the wettest and most arid regions, more than 40 inches annual and less than 20 inches annually, respectively, use conservation rates structures. Utilities with more than 25,000 customers are more likely (49%) than the smallest providers with fewer than 500 customers (11%) to have adopted this incentive.

San Antonio, the largest city in the country relying entirely on groundwater, had to adopt an aggressive water conservation plan to meet mandated pumping limits imposed to protect endangered species upstream at Comal and San Marcos springs.

Serving more than 250,000 customers and a population of 938,000, San Antonio Water System (SAWS) had implemented a three-tiered increasing block structure, but found the conservation message was not strong enough. SAWS customer base is 63% residential with seasonal variations in water use due to heavy summertime irrigation. SAWS adopted a policy treating conservation as a new water source, with a goal of reducing regional water demand by the year 2000.

To meet future demand, SAWS decided several years ago to modify the existing block structure. At the same the, the utility set goals of recovering an equivalent amount of revenues for operations, reducing discretionary use, and funding conservation programs, wrote Tom Fox, former director of water resources, in the a paper entitled, "Analysis, Design, and Implementation of a Conservation Rate Structure" published in the *Conserv `96* proceedings.

SAWS considered and rejected basing blocks on winter averages, because wastewater fees are low enough that there was no disincentive to the customer not to over-use water during the winter averaging period to increase their allotment for the irrigation system.

The first block covers the system-wide winter average of 7,500 gallons per month. This block encompasses 50% of residential customers. The second block applies to consumption up to 12,000 gallons per month and takes in 80% of SAWS' customers. The third block step is nearly equivalent to the first two, and covers about 90% of the customers. The big jump occurs at the fourth block, use in excess of 17,200 gallons. (Blocks 2 and 4 are adjusted upward in the summer.) For their incremental usage, these high volume customers pay more than three times as much as first tier customers and twice as much for their extra consumption as their third tier neighbors.

El Paso Water Utilities has also implemented seasonal rates. Block 2 and 3 rates, 85% and 131% higher, respectively, than block 1 rates in the summer, discourage the heavy-volume irrigation customer.

Conservation rates are especially effective to the extent that water demand is elastic. Price elasticity is a measure of the sensitivity of demand to changes in price of a good or

service. In quantitative terms, price elasticity of demand is defined as the percent change in water use divided by the percent change in price. The larger the change in water demand in response to rate increases, the more elastic the demand.

The experience of most municipalities has shown demand to be slightly inelastic--an increase in rates does not result in an equivalent decrease in usage. But even price elasticities of less than one can be significant, for example, a 10% rate increase resulting in a 7% demand decrease can mean significant water savings.

Studies by Nieswiadomy, Janice Beecher of the National Regulatory Research Institute at Ohio State University, the Environmental Defense Fund, and others have found that the increasing rates tend to be inelastic in the short-run, but elastic in the long-run.

Long-term water consumption is more responsive to price changes than short-term consumption, Nieswiadomy wrote, presumably due to the time required to install water-saving appliances or to modify landscapes. Long-term responsiveness may also be due to modification of customers' water demand as they become accustomed to the inverted-block rate structure.

To determine the effectiveness of conservation water rates, the City of Austin recently awarded a contract to Hagler and Bailly of Boulder, Colorado to study price elasticity of demand on water utilities in four Texas cities that have adopted increasing block rates: Austin, San Antonio, Dallas, and Corpus Christi.

Economists find the most efficient rate structure to be based on marginal cost rather than average cost. Marginal cost is defined as the cost of supplying the next unit of water to be added to the total water supply. In other words, the two components of marginal cost are the change in operating costs caused by change in the usage of existing capacity and the cost of expanding capacity (both capital and operating costs). Marginal cost-based pricing reflects both the scarcity of water and the true cost of producing that water.

Figuring marginal cost involves projecting capacity and operating costs. If the benefit of such an analysis does not compensate for its cost, often average price is used as a substitute.

In a departure from the conventional block and seasonal rates, economist Robert Collinge of the University of Texas at San Antonio, proposes a market-based, revenue-neutral pricing system. Collinge adopted the term "feebate" for the combination of offsetting fees and rebates.

Instead of an inclining block structure, Collinge proposes setting a conservation baseline for each customer, then granting rebates for customers consuming less than the baseline and charging a fee for usage in excess of that entitlement. Excess usage fees fund the rebates, making the plan revenue-neutral, Collinge said in an article, "Conservation Feebates," *(Journal of the American Water Works Association*, January 1996).

The sum of all individual baseline entitlements equals the anticipated water supply or pumpage target; therefore, there would be neither a surplus nor shortage of water. The conservation baseline, therefore, would be determined by available water supply rather than customer's historic usage. Feebates change monthly to achieve the target water supply.

Feebates offer a conservation incentive not inherent in the inclining block structure. While the block structure would deter customers from crossing the threshold into the next block, there is little incentive for further conservation within the each block. Feebates, on the other hand, reward the most frugal customers while levying a penalty fee on those who place a higher value on heavy water use. High-volume users who so wish to, pay the true costs for supplying that extra increment of water.

Collinge argues that a rate structure modeled after an efficiently functioning water market will generate the most value from water resources in a manner that is fair to water customers. Low-income customers could reap the benefits of the rebates, while more affluent customers could pay the penalty fees for their more extravagant irrigation and lifestyle choices.

Traditionally, utilities focused on managing supply, but as developable water sources become more scarce and avoided capital costs assume more important, demand-side managment emerges as the water utilities' most accessible instrument of water consevation.

Nieswiadomy can be reached at (817) 565-2244 or mike@econ.unt.edu. Collinge can be reached at (210) 458-5312.

SAWS lauds commercial conservation

by Chris Brown and Craig Rose

San Antonio Water System The San Antonio Water System established the Best Practices Water Conservation Award Program to recognize businesses which have voluntarily initiated sound water conservation practices and to provide a platform to share resourceful and creative approaches with the community.

Entries from businesses, organizations, and industries were judged on basic water conservation practices, design innovation, and transferability to similar industries. In addition to the 10 winners, a second group of success stories were recognized with Watersaver Too Awards.

Between the two groups recognized, more than 324 million gallons of water have been saved through their innovation.

A special Pioneer Award was presented to City Public Service (CPS), San Antonio's gas and electric utility, for being one of the first users of recycled water in San Antonio. Since 1966, CPS has used reclaimed wastewater for cooling tower evaporative makeup.

The **Southwest Car Wash Association-San Antonio Committee** was recognized for its initiative and partnership efforts confronting industry-specific issues related to the drought. Through this effort, the Vehicle Wash Conservation Certification program was established. Components of the program include installation of water-efficient equipment and a requirement to host a minimum of three charity events per facility per year. Qualifying facilities display Vehicle Wash Conservation Certification signage designating their compliance with all aspects of certification.

United Services Automobile Association (USAA) implemented a centralized computer-controlled irrigation system with a weather station and moisture sensors, resulting in a 60% reduction in summer irrigation water use. All plumbing fixtures were replaced with low-flow models, and waterless urinals were installed. Upgrades and modifications to cooling towers and food service areas have been implemented. USAA's water savings is 47 million gallons annually.

La Quinta Inns and Suites is replacing all faucets and showerheads in 1,600 rooms in San Antonio with low-flow types. In addition, a hand-watering landscape policy was set in place during the summer months of 1996. These efforts reduced La Quinta's 1996 local water consumption by more than 6,000,000 gallons, a 10% reduction in total water consumption.

The Great Northwest Community Improvement Association, Inc. used $53,000 of homeowner funds to improve water use efficiency at their community center and residences, including installing a fiberglass liner in their swimming pools to prevent leaks, replacing inefficient fixtures, designing a water-thrifty landscape, and water conservation education in monthly newsletters.

JLS Dairy Queen replaced once-through water-cooled ice machines with recirculating models, reducing water use from 70,000 to 26,000 gallons per month.

Lone Star Radiator Company installed a closed-loop wastewater recycling system. The process removes oils, metals, and other wastes, which drop out of solution into a sludge. The dried sludge is shipped to a facility for recovery of the metals. This system allows Lone Star to completely eliminate its discharge of wastewater into the public treatment system and to reduce monthly freshwater use by 32,000 gallons.

The **South Texas Blood and Tissue Center** headquarters was designed to recover rainwater from drain locations over its 6,200-square foot roof area. The captured water is stored in cisterns and used to irrigate landscaping, saving potable water.

Dentists **Samuel P. Alfano and Dennis H. Salinas** installed a dry vacuum to replace one that required continuous flow of water, cutting usage from an average 50,000 to 15,000 gallons per month.

Misty Oaks Homeowners Association has in place procedures performed by maintenance and pool personnel to insure maximum water use efficiency. In addition,

they have initiated a number of water-saving measures, including repairs and upgrades to their community pool and installation of a water-efficient irrigation system.

Measures taken by **Northern Hills County Village Owners Association** include installation of a pressure-reduction valve to reduce water waste, monitoring and maintenance of water use programs for the community, and installation of a separate meter for future access to SAWS recycled water.

Brown, SAWS water conservation manager, can be reached at (210) 704-7528.

Northwest El Paso reclaimed water project to supply residential, commercial irrigation

On August 5, with a shovelful of dirt, El Paso entered a new era in water reclamation.

On that day, Eluid Martinez, Commissioner of the U.S. Bureau of Reclamation (USBR) broke ground for the Northwest Reclaimed Water Project, which, by the year 2005, could meet a demand of 1,500 million gallons per year (mg/yr) from large-volume customers in the northwest lobe of the city.

El Paso is thus far the only Texas city to benefit from the USBR's water recycling initiative, authorized by the Reclamation Recycling and Water Conservation Act of 1996 (*Texas Water Savers*, Spring 1997). Sixteen other projects in California, Utah, Nevada, and New Mexico will be funded by this legislation.

The northwest area of El Paso now draws a large share of its water from the Mesilla Bolson. Irrigating large turf areas with reclaimed wastewater will help preserve the groundwater supply from this aquifer. The Hueco Bolson to the east of the Mesilla Bolson and a collection of small surface water rights for irrigation from the Rio Grande supply the balance of the area's water needs. Design resembles potable distribution infrastructure Improvements underway at the Northwest Wastewater Treatment Plant will enable the wastewater effluent to meet U.S. Environmental Protection Agency river discharge standards and quality standards for irrigation and for some industrial uses. The existing plant has a capacity of 17.5 million gallons per day.

"This reclamation project is one of the first in the country to be designed to resemble a potable water distribution system--but in reverse," said Carl Norris, regional project manager for the Rio Grande/Permian Basin region for Texas Water Development Board (TWDB). "It achieves distribution through an intricate pressurized system with piping and storage reservoirs. Only in this case, a wastewater treatment plant, rather than a potable water treatment plant, is the water source. The system supplies water to multiple sites for irrigation and industrial use."

Traditional reuse systems rely upon gravity-fed, rather than pressurized distribution, and usually serve just one customer, Norris said.

Plans for the four-phase Northwest Reclaimed Water Project call for the construction of an infrastructure of pipelines, pump stations, and reservoirs to convey tertiary treated wastewater from the Northwest Wastewater Treatment Plant to golf courses, large industrial users, school yards, parks and athletic fields. After large-volume users have been served, residential landscapes could be supplied with reclaimed water on a separate meter network. Reclaimed water for industry and irrigation Planners are also considering the use of dual distribution systems in new developments and industrial parks.

El Paso Public Service Board has established standardized user agreements for purchase of reclaimed water to enable fair and uniform expansion of water recycling.

The Northwest Area planning team, composed of representatives from El Paso Public Service Board and engineering firm CH2M Hill, projected demand from existing large-volume customers at 644 mg/yr and demand from area yard meters at an additional 235 mg/yr. By the year 2005, demand of new and existing users will total almost 1,500 mg/yr.

Two major users already identified are the golf course at Coronado Country Club and ASARCO's copper smelter. Reclaimed water better for the bottom line In fact, the Coronado Country Club, slated to receive reclaimed water in Phase I of the project by 1998, is the only nonmilitary El Paso golf course still irrigated by potable water.

Total cost of the project is estimated at $18 million. The USBR authorization was $2.8 million for initial construction. The Texas Water Development Board contributed a $750,000 grant for project design from the State Revolving Fund. Once El Paso Public Service Board approved the project, this TWDB grant allowed design work to start immediately. A low-interest loan from TWDB supports a major part of the construction. El Paso Public Service Board supplied the major balance of the funding.

This reclaimed water turns out to be a good business proposition for Coronado Country Club. Built in the early 1970s, the golf course's irrigation system of thin-walled polyvinyl chloride (PVC) pipe was in need of upgrading. Anticipating the availability of lower-priced water, the country club will be in a better position to secure and repay financing for the irrigation upgrade, according to John Balliew, compliance engineer for El Paso Water Utilities.

El Paso's potable rates are set up to bill heavy irrigation customers at the block 2 rate of $1.48 per hundred cubic feet or the block 3 rate of $1.85 in the summer. Reclaimed water will be sold to large-volume users at $0.48 per hundred cubic feet (CCF), an amount which is 32% and 26%, respectively, of the block 2 and block 3 rates. Wastewater reuse enjoys long history in El Paso El Paso has a history of wastewater reuse for golf course irrigation going back to 1958 at the Ascarate Golf Course in the southern part of the city (205 mg/yr). In 1985, the Painted Dunes Golf Course started irrigation (121 mg/yr) with reclaimed water. A third golf course has a permit to draw irrigation water from the Rio Grande.

Balliew, a chemical engineer, has studied the water quality requirements of golf course irrigation water. The reclaimed water has twice to three times the total dissolved solids of groundwater (1,300 milligrams/liter versus 500 milligrams/liter in groundwater). Researchers at the Texas A&M Research Center in El Paso have found that the use of a wetting agent helps the wastewater percolate through the soil, preventing salt build up, and other additives prevent flocculation.

A steering committee comprising industrial and commercial interests, developers, civic groups, school districts, the Texas A&M Research Center, and the City of El Paso participated in guiding this project.

Norris can be reached at (512) 463-8049, Balliew at (915) 594-5595.

Austin to foster horizontal-axis water market

The City of Austin has signed on as the first local partner in a Department of Energy (DOE)-sponsored volume purchase of high-performance clothes washers. Austin is the first city in the country to participate in the Energy Star Partnerships Municipal Utility Consortium.

It's not your mother's Maytag. Maytag is betting on the horizontal-axis machine as its flagship product for the next century's clothes washer market. The Department of Energy is promoting a partnership to pull these water-conserving appliances into the consumer marketplace.

The request for proposal (RFP) now in the works will call for a manufacturer to supply truckload quantities of horizontal-axis clothes washers and for a retailer to furnish and deliver them to City of Austin utility customers. The City of Austin, while not taking possession of the clothes washers, will promote the appliances to customers through bill stuffers, billboards, and the print and broadcast media, according to Tony Gregg, manager of Austin's Planning, Environmental and Conservation Services Department. A prebid conference on July 15 in Austin was attended by seven retailers.

The City of Austin is the consortium's first municipal partner. Pacific Northwest National Laboratory (PNNL) is actively recruiting additional municipal utility partners to join this procurement and to take advantage of volume pricing. Municipal partners receive the water-saving benefit of this cost-effective conservation measure. Utility customers can save between $22 and $85 per year in combined electric or natural gas and water cost savings.

The mission of the Energy Star Partnerships is to accelerate the penetration of new high-efficiency appliances into the marketplace. "The consortium hopes to effect market transformation through volume purchase," said Sandi Edgemon, a research engineer with PNNL. "We hope to pull new and emerging technologies into the marketplace." Edgemon addressed the August 7 meeting of the Conservation and Reuse Division, Texas Section, American Water Works Association.

Utility partners agree to promote the use of horizontal-axis clothes washers and refer customers exclusively to the winning bidder. DOE has developed performance specifications and is developing an RFP for volume delivery to future partners.

Although utilities are not obliged by the program to offer a credit or rebate, the City of Austin has proposed offering credit on utility bills--$50 for water, $50 for natural gas, and $150 for electricity--to customers purchasing the new machines. About 80 machines are sold monthly in Austin to residential customers, and Gregg estimates a target market of 1,000 customers.

Horizontal-axis clothes washers use about 25 gallons per load versus 45 gallons per load for vertical-axis machines. In fact, in a residence equipped with 1.6-gallons per flush toilets and low-flow showerheads and faucet aerators, the conventional vertical-axis clothes washer is the largest single water user. If 100,000 residential customers used high-performance clothes washers, water savings would be between half a billion and a billion gallons annually.

Horizontal-axis clothes washers manage the job with less water by tumbling clothing through water, rather than filling a tub with water.

The U.S.-manufactured horizontal-axis clothes washer tub volumes range between 2.0 and 2.9 cubic feet. The average tub volume for a standard clothes washer is 2.9 cubic feet. The Energy Star program also addresses electricity and natural gas. The Municipal Utility Consortium is an opportunity for water, wastewater, electric, and natural gas utilities to work together for conserving all resources.

The new-generation clothes washers are more expensive--about $800--versus about $400 for those of vertical-axis design. However, savings on utility bills can yield a payback as short as 3 to 4 years for residential customers with electric water heaters. (Most advanced machines also use a faster spin cycles to pull more moisture from the clothes, allowing shorter drying cycles and further energy savings.) Savings based upon utility rates in Austin would yield the average residential customer $30 per year savings on the water bill, $9 per year in natural gas, and $41 in electricity.

Commercial customers would be eligible for the same benefits. Coin-operated and on-premise (multifamily dwelling) laundry facilities could install horizontal-axis machines meeting the PNNL specifications to take advantage of the utilities savings as well as any billing credit.

Four manufacturers in the United States now produce horizontal-axis machines, although such appliances are common in Europe. In fact, Leonard Hadley, Maytag chairman and chief executive, said, "I look at this new technology as the ticket to expand Maytag laundry superiority into the next century." Neptune, the company's horizontal-axis model, is featured prominently, nearly to the exclusion of conventional models, on the Maytag's web site, http://www.maytag.com. The company has spent tens of millions of dollars in research and development costs for the Neptune.

"DOE has not before worked exclusively with water utilities to promote water savings, so the Municipal Utility Consortium is charting new territory," Edgemon said. DOE, however, does sponsor several partnerships to promote energy savings, such as the Green Light program for compact fluorescent lighting and the Water Alliance for Voluntary Efficiency, promoting water conservation in the private sector. For more information, contact Edgemon at (509) 372-4583.

Water parks: maximum fun, minimum water

In the dog days of summer, nothing compares to the refreshment and fun offered by water parks. But in this water-scarce state, water fun is serious business to park operators.

And Texas owns bragging rights to several world superlatives. Schlitterbahn, New Braunfels' mega-park, was voted Best U.S. Waterpark three years in a row by the readers of *Inside Track*, the magazine for amusement park fans. It is the nation's most popular seasonal water park, playing host to more than 700,000 fun-seekers last year, an attendance which is topped only by year-round pools.

Schlitterbahn Waterparks' German castle with four slides was the first attraction built at the New Braunfels park in 1979. Now, 15 years later, Schlitterbahn offers 30 attractions, one lasting as long as 45 minutes.

In case it's been a while since you've been to a water park, the relatively tame flume rides are just the beginning. Today's modern water parks boast inner tube chutes, wave pools, artificial rapids, free-falls, water slides (including enclosed, dark ones), uphill water coasters, kiddie water playgrounds, body slides, lagoons, paddleboats, hot tubs, and a something called a soda straw.

Schlitterbahn draws its water from two sources--the Comal River and municipal water from the City of New Braunfels, whose primary source of water is Canyon Lake. New Braunfels is the only city underlain by the Edwards Aquifer with a water treatment plant using surface water.

The newer Surfenburg and Blastenhoff sections use highly efficient closed-loop systems which recycle all water, adding water just for evaporative and splash-out losses.

State-of-the-art diatomaceous earth filters virtually eliminate the need for backwashing, saving even more water.

Some of the attractions in the original 40-acre park are fed from the original channel of the spring-fed Comal River. Schlitterbahn has a permit to pump water from the Comal River, from where it circulated, without the addition of chemicals, through the main park. The spring water flows continuously through Schlitterbahn's rides and back into the Comal River. The system is completely drained each night.

Amarillo's Wonderland Park, which purchases water from the City of Amarillo, also recirculates water from its five rides, cleansing it each time by passing it through sand filters. The total water capacity of Wonderland Park is 100,000 gallons, but the park uses only 350,000 gallons annually, according to president and general manager Paul Borkart. One of the park's tube rides is completely enclosed, keeping evaporation down to almost nil.

San Antonio's Splashtown, with its more than 40 attractions, among them the thrilling eight-story Texas Freefall and the awesome Hydra, is serious about water. All water within the park is recirculated through a sand filter. Evaporative make-up comes both from the park's own well and from the San Antonio Water System. Even "splash-out" is routed to the recirculating pits via a series of drains, according to Splashtown president Keith Kinney. In slightly cooler weather, the park turns off sprayers and misters, which keep patrons cool while lounging, to curtail evaporation.

Both Splashtown and Schlitterbahn carefully plan landscaping to be water-thrifty. "We use same the water conservation measures as the homeowner," Kinney said.

Over the years, Schlitterbahn has replaced water-thirsty plants with native trees, and shrubs and annual plants with hearty perennials. During the drought, the park stopped watering grassy areas to conserve water.

Both Splashtown and Schlitterbahn continually replace faucets and showerheads with low flow models. Splashtown uses spring-loaded handleless showers.

NRH2O in Dallas, with a total water capacity of 650,000 gallons, emphasizes its niche as a family park.

"We give maximum enjoyment from a minimum amount of water," said park manager Chris Swartz. Last year the park hosted 223,986 visitors, Swartz said. For example, the park's wave pool is 6 feet deep, as opposed to the traditional 8-foot deep pools. The shallow depth affords both safety for children and a considerable water savings.

Now in the planning stages, NRH2O is considering the storage of swimming pool backwash for landscape irrigation, Swartz said.

The four Six Flags amusement parks: Six Flags Waterworld, Six Flags Astroworld, Six Flags Dallas, and Six Flags Fiesta Texas all filter, chlorinate, and recirculate water, as well as equipping toilets, showerheads, and faucets with low-flow devices.

So, is the Senate Bill 1 regional water plan troubling you? Is groundwater pumping causing you heartburn? Maybe a turn on an uphill water coaster or being jetted out of fiberglass chute is just the tonic to get you back in touch with your element.

Other Texas aquifer storage and recovery projects

Two other Texas aquifers are recharged by well injection. In the High Plains, rainfall and runoff accumulating in the region's characteristic playas is pumped back into the Ogallala Aquifer. The Hill Country city of Kerrville injects treated surface water from the Guadalupe River into the Lower Trinity Aquifer.

In the High Plains, the Agricultural Research Service of the U.S. Department of Agriculture determined that storage in the regional aquifer was a good way to conserve runoff impounded in the playas.

Early aquifer storage and recovery efforts used dual-purpose wells which were recharged for the majority of a 24-hour period, then pumped for a short time to redevelop the well.Water from the playas was turbid, and the clay was found to clog the porous media of the aquifer.

Recharging turbid water into the wells ruined or permanently damaged the wells; therefore, recharging turbid water into wells is not recommended.

The Agricultureal Research Service then explored ways to clarify water by treatment with a combination of a cationic polyelectrolyte and aluminum sulfate. This system reduced the suspended solids from 200 milligrams/liter (mg/l) to 20 mg/l.

Later tests conducted on two types of wells demonstrated that either could successfully be used for groundwater recharge. One was a properly designed 16-inch-diameter irrigation well. The second was a low-cost 6-inch-diameter steel casing well.

Another, even less-costly, recharge vehicle is a shaft, a well-like opening which terminates above the water table. Shafts, however, lack mechanical filters, so they must be recharged only with clean water.

In the Kerrville demonstration project, treated drinking water from the Upper Guadalupe River Authority is injected into the Hosston-Sligo Formation of the Lower Trinity Aquifer at a variable rate of between 200 and 1,0000 gallons per minute.

Water has been recovered from this well only for tests conducted for an American Water Works Association Research Foundation study. Samples taken over a 5-week storage period indicated increased mixing of recharged water with groundwater.

Houston, others to sponsor water use workshop for hospitality industry

A "virtual tour" of hotels, a hands-on introduction to the latest water conservation hardware and software, and a first-hand account of conservation measures at a large hotel are slated for the City of Houston's Hotel Water Use Workshop October 22 at the Houston-Galveston Area Council (HGAC) building.

John Flowers, manager of the Environmental Protection Agency's (EPA's) Water Alliances for Voluntary Efficiency (*Texas Water Savers*, Winter 1996) will demonstrate WAVE-Saver, a PC-based software tool created specifically for hotels. EPA provides WAVE-Saver free-of-charge to hotels and other commercial businesses who join EPA's nonregulatory WAVE partnership.

John Sutton of Texas Water Development Board (TWDB) will take participants on a virtual tour of actual water-saving equipment and technology at hotels and motels. Sutton has conducted water-efficiency workshops throughout the state.

Mike Sejman, chief engineer of the Hyatt Regency-Houston Downtown will give a first-hand account of the conservation measures practiced by the Hyatt.

Sponsored by the City of Houston Water Conservation Branch, the EPA, the HGAC and the TWDB, the half-day workshop will integrate state-of-the-art technologies to demonstrate how to reduce a facility's water consumption while increasing efficiency and profitability.

For more information, call Jan Kelso, Water Conservation Branch Community Liaison, (713) 880-2444.

Reuse hinges on public perception

"What we throw into the bay.
They drink for lunch in San Jose."
Tom Lehrer

Songwriter Tom Lehrer's intent was humorous satire, but public opinion about water reuse is no laughing matter. Community perception of water reuse, both potable and nonpotable, is the major hurdle water managers must clear before adopting reuse as a water supply strategy.

As Texas A&M graduate student Michele Foss and the Lower Colorado River Authority (LCRA) found in two separate studies, public acceptance is critical to the success of a reuse project.

Concerns about health impacts and mistrust of the reliability of treatment, testing, and distribution were uppermost in the minds of the San Antonio community in a survey conducted by Foss, a graduate student in water resources. San Antonio was selected as the survey population due its need for water supplies other than the Edwards Aquifer.

Understandably, low-contact nonpotable reuse (irrigation, road construction, and industrial purposes) garnered the most support, more than 90%. Previous studies into water reuse have found that "[p]ublic support erodes as the risk of contact with reclaimed water increases. Despite this decline in acceptance, approximately 48% to 62% of respondents indicated a willingness to use reclaimed water for potable purposes," Foss found.

Studies conducted by W. H. Bruvold on public attitudes toward reuse of reclaimed water indicate that the public is more apt to accept reuse when belief in water scarcity, pollution of existing supplies, economic benefit, and water purification exists, Foss said.

Both short- and long-term health impacts were the most often cited issue regarding reuse. For potable reuse, respondents cited short-term waterborne illnesses caused by waterborne pathogens as primary concerns. But apprehension about long-term health risks from solvents, pesticides, and other chemicals were also indicated.

Closely related to health impacts are concerns about the reliability of wastewater treatment and water quality.

Many felt testing procedures were inadequate. Overall, these issues indicate feelings of mistrust for the municipal water supplier as a whole.

The flip side of this issue, perhaps, is the public's concern with the desire to be informed about aspects of any implemented reuse system, as well as to be involved in the decision-making process.

A larger reuse survey conducted in 1994 and 1995 of more the 600 Lakeway area residents in the Lake Travis area in Austin by the LCRA revealed that some 80% would be willing to used reclaimed wastewater for landscape irrigation, so long as the price was right.

In addition, 77% of the Lakeway area study respondents said they believed that using reclaimed water for irrigation purposes would help to protect the quality of Lake Travis, and 83% agreed that wastewater produced in the Lakeway area should be reclaimed for irrigation use.

That survey, funded by the Texas Water Development Board, also acknowledged that public acceptance hinges on--

1. public awareness of local water supply problems and perception of reuse as part of a possible solution;

2. public understanding of the quality of reuse water and how it would be used;

3. confidence in local public utilities; and

4. assurance that reuse applications would involve minimal risk of accidental personal exposure.

For more information on the San Antonio study, Foss can be reached at mgarteis@rpts.tamu.edu. To learn more about the Lakeway study, contact Cheri Vogel at LCRA, (512) 473-3200, extension 7586. Health issues top reuse concerns