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Urban Water Resources Management: The 21st Water For Texas Conference

By RIC JENSEN Information Specialist, TWRI

The era of large-scale development of water resources is over. This recurring message was directed to water resource professionals from across the state when they gathered this fall for the Texas Water Resources Institute's 21st "Water for Texas" Conference.

Furthermore, the emphasis on water resources must now be shifted from building dams and reservoirs to managing water resources more efficiently and protecting water quality.

That was the consensus of 19 prominent leaders in the field who addressed the conference theme, "Urban Water Resources Management," at Texas A&M University October 2-3.

The tone for the conference was set in the keynote address, delivered by Harvey O. Banks, a consulting engineer from Belmont, California. Banks said that now, more than ever, efficient management of water resources was necessary because of increased costs and difficulties of obtaining new supplies.

Both Banks and Jean O. Wlliams, a consultant from Wimberly, Texas, stressed the importance of water conservation programs as a valuable component of water resources management. Through conservation, loads to wastewater systems can be reduced, giving facilities a longer lifespan; expansion of supply and treatment facilities can be delayed and water supplies can be stretched to their optimum uses.

However, Banks and Williams both noted that in many cases, utilities implementing water conservation programs don't have a firm idea of the cost-effectiveness of the components of such programs. Are public education programs more cost-effective than water audits? Will landscape incentives generate more benefits for a utility than distributing water-use efficient shower heads?

Banks cited a recent study performed for the East Bay Municipal Utility District (East Bay MUD) in the Oakland, California, area that attempted to quantify benefit-cost (B/C) data on separate components of water conservation programs (Table 1). The results, which projected costs and benefits to the year 2005 for 1.15 million customers, indicated that residential water audits, distribution of water-saving devices, and incentives for installing water-saving fixtures in new buildings were the most B/C-effective components of a conservation program.

Other benefits and costs identified by Wlliams include political liabilities of unacceptable programs, effects of imposed changes in lifestyle, and public doubt resulting from hazily defined benefits. She noted that quantifying impacts of specific conservation measures was essential, because many programs with high B/C ratios may be acceptable in crisis events but unacceptable in extended programs. Although the East Bay MUD study identified direct costs and benefits, Wlliams believes a strong effort must be placed on quantifying indirect costs and benefits that are more difficult to measure, such as changes in the quality of life and benefits of education programs. She recommended as a priority research area the development of analytical models to measure such direct and indirect impacts.

WATER DEMAND MANAGEMENT

Water demand management is defined as those conservation measures that improve water use efficiency, increase water use and recycling, and minimize water waste, according to Mike Personett, now the water efficiency manager for the Lower Colorado River Authority. Personett equated reducing water use through effective demand management with increasing supplies.

He suggested that demand management planning should incorporate these elements: 1) gathering information about existing and future supplies, 2) identifying water-related problems and issues, 3) profiling water demands by user groups, and 4) detailing current and projected water demand and wastewater flow from each user group. Once these elements are secured, the feasibility, benefits, and costs of demand management measures should be evaluated. The most effective components of the program may then be selected and implemented.

As part of another TWRI-sponsored research project, a computer model that will allow city utilities to more accurately predict water demand has been developed by David Maidment, a professor in the Department of Civil Engineering at the University of Texas at Austin. The "Water Use Forecasting Model" (WATFORE) is currently used by the City of Austin and the Edwards Underground Water District to assist officials in making water policy decisions.

The model provides a preview of expected water consumption that can range from as little as two days to as much as two months in advance. The program requires daily data on water pumpage, daily rainfall, maximum air temperature, and expected weather conditions.

WATFORE is most frequently used to anticipate water use in the near future and to estimate the chance that extreme use may occur. For example, the City of Austin has a water conservation ordinance that requires mandatory water conservation if water use goes beyond a specified level for several consecutive days. The city uses WATFORE to estimate the chance this will occur within a two-week period.

The model is also helpful in scheduling water deliveries and studying the impact of demand management programs. Figure 1 shows water demand levels predicted by WATFORE versus actual water use in the Corpus Christi area during 1984, a drought year. The large blue area represents the impacts of that city's water conservation program in reducing demands.

More efficient water use in lawn and garden areas is necessary and can be realized, according to Gary Robinette, the president of AGORA, a landscape architecture firm in Plano. Landscapes can be designed to hold rainfall onsite, reduce runoff, and curtail the need for irrigation, Robinette said. The concept of xeriscaping (water conservation through creative landscaping) in combination with appropriate irrigation systems, use of mulches, and close placing of plants with similar water requirements can all improve water use efficiency, he said. Many of these approaches were expressed in a task force report, Water Conservation in Urban Landscapes, that was recently published by TWRI. Free copies are available from the Institute.
H. W. (Bill) Hoffman, head of the Municipal and Commercial Conservation Unit of the Texas Water Development Board (TWDB), identified elements of new state programs that mandate conservation. For example, plans for water conservation are now required from most entities applying for TWDB loans. The water conservation plans can include public information and education programs, tightened plumbing codes, leak detection and repair programs, drought contingency planning, water-saving landscaping, water recycling, and reuse and rate structures that encourage conservation.

Water reuse is a feasible and attractive option for regions of Texas where supplies are limited or are of poor quality, or where they are expensive to develop. Ashok Varma, vice president of Camp, Dresser 8 McKee in Dallas, detailed two Texas reuse projects_one in Odessa and another at the Las Colinas development near Dallas.

In Odessa, wastewater is treated and reused for agricultural production of nonfood-chain crops, for industrial use, and for irrigation of country clubs, cemeteries, and a university campus. In the future, treated effluent may be blended with local raw water supplies to produce potable water.

At Las Colinas, the reuse of wastewater will ensure a guaranteed supply of water and will promote the growth of turfgrasses in golf courses and recreation areas by supplying nutrients present in the wastewater. In addition, the water will supplement lakes in the development without creating any odor or aesthetic problems.

Varma also compared state water quality standards for reuse of wastewater in parklands. He noted that although California, Arizona, and Florida currently approve irrigation of parklands with wastewater reuse, Texas does not.

WATER SUPPLY MANAGEMENT

Water supply management involves the development and allocation of diverse sources such as surface water, groundwater, and reclaimed wastewater. Innovative approaches such as conjunctive management may also increase yields. A key component of supply management is accurate planning to determine the extent to which new sources will have to be developed.

Management of three Houston area reservoirs (Lake Conroe, Lake Houston, and Lake Livingston) as a water resources system could increase yields by as much as 8 percent, while conjunctive management of those sources with groundwater could increase yields to 15 percent, according to Dan Sheer, a water resources consultant from Maryland. Conventionally, the combined independent yield from these reservoirs has always been expressed as the sum of the storage capacities of the three lakes (Table 2).

Sheer's premise is that reservoirs with the least volume of storage per square mile of drainage area (S/D area) are likely to fill and spill first. By drawing water first from the lake with the smallest S/D area (Lake Houston), then taking water from the lake with the intermediate S/D area (Lake Livingston) and finally from the reservoir with the largest S/D area (Lake Conroe), water yields are maximized. Yields could be increased by an additional 200 thousand acre-feet per year if excess water from the Brazos River during high flow periods (skimming) were incorporated into this conjunctive management system.

El Paso augments existing supplies through an innovative plant that recharges groundwater in the Hueco Bolson Aquifer with treated waste water. This proposal was relatively cost-effective against other alternatives for developing additional potable water, such as importing groundwater and desalinization. Because the project was innovative, the U.S. Environmental Protection Agency (EPA) funded 65 percent of the construction costs.

The wastewater, treated with both conventional and high-tech processes, is stored for at least eight hours to monitor its quality before being injected. Ten injection wells are used in the project, and it takes a minimum of two years before water flows from the injection wells to the production wells. Since the project became operational in May 1985, six million gallons per day are produced with operating costs that average about $1.1 0 per 1,000 gallons.

Conference participants also heard about a research project funded by TWRI that may assist planners in more accurately predicting the need for future water supply projects. Dr. Steve Murdock, head of the Rural Sociology Department at Texas A&M University, discussed the scope of this research, which attempts to determine if underlying social and demographic factors influence the amount of water Texans consume.

State water agencies currently use 153 gallons per day as the standard figure for per capita water usage, without considering demographic factors. If certain population groups that consume more or less water can be identified, this information can help to make future planning efforts more accurate, thus avoiding construction or premature expansion of water development and treatment facilities.

In the TWRI research, data were analyzed and interviews were conducted at El Paso, Sonora, Rock Springs, Mathis, Alice, Waco, Hearne, and Longview. Preliminary results suggest that variables such as ethnic composition, age of the housing and number of units, proportions and sizes of households, percentage of the regional population living in rural and urban areas, and income levels clearly affect water usage and should be factored into models that predict water demands.

WATER QUALITY MANAGEMENT

Water quality management includes prevention of water pollution incidents, cleanup of degraded waters, and policies and practices that preserve, enhance, and restore water purity.

The EPA's water quality programs for the region that includes Texas were identified by Bruce Elliott, chief of the Water Quality Management branch in the Dallas office. EPA considers the major water quality issues in this region to be toxins, groundwater quality, and demands made by growth. He elaborated on EPA's National Pollution Discharge Elimination System (NPDES), which regulates and permits toxic substances, and stated that a coordinated federal-state effort is underway to identify stream segments in Texas where toxins are a problem.

The EPA is also working with municipalities to prevent the spread of toxic materials. Many municipalities in Texas will soon be required to develop plans for pretreating 126 pollutants. In addition, EPA is developing groundwater programs to protect the quality of drinking water; currently underway are a wellhead protection program and a sole-source aquifer demonstration project intended to safeguard the Edwards Aquifer. EPA is also considering a ban on deep well injection of hazardous wastes, Elliott said.

How good are Texas' water quality standards and are they good enough? This was the issue addressed by Ken Kramer, Austin representative of the Lone Star Chapter of the Sierra Club. Kramer presented details of a lawsuit brought by the Sierra Club and others against the EPA in January 1986. The suit contends that EPA violated requirements of the national Clean Water Act by approving Texas' surface water quality standards, because the standards may not meet goals of the act.

Specifically, Kramer indicated that goals of the Clean Water Act were to obtain "fishable and swimmable" streams by 1983 and zero discharge of pollutants by 1985. However, he stated that roughly 10 percent of the designated stream segments in Texas still do not meet fishable and swimmable standards, including more than 350 stream miles in both the Trinity River Basin and in the Houston-Galveston area.

Kramer also questioned the lack of standards for intermittent streams, the use of averaging water quality data that may not show specific instances in which streams are noncompliant, and the absence of more detailed regulations for toxic materials in streambeds.

Dr. T. Rick Irvin discussed water quality problems that may be associated with new industries and technologies that may prevent or clean up the resulting pollution. Irvin, an assistant professor in the Department of Veterinary Anatomy at Texas ABM University, recounted incidents in California's Silicon Valley in the early 1980s where birth defects, skin disorders, and cancer allegedly resulted from groundwater contamination caused by computer manufacturing firms. Follow-up studies in California indicated that 70 percent of the monitored sites suffered from contamination of drinking water supplies.

Irvin stressed that most of these environmental problems could have been avoided if a proper systems analysis of potential pollution problems had been conducted before the plants were constructed. Since the technology is now available to anticipate potential problems before they occur, this capability should allow expansion and diversification of the Texas economy without environmental degradation, he said.

Sam Brush, an environmental planner with the North Central Texas Council of Governments (NCTCOG), detailed efforts of that organization to improve water quality in the Trinity River and to lessen the risk of massive fish kills there. Brush said that NCTCOG has been involved in establishing a continuous, automated monitoring system to gather data on water quality in the Trinity. The council has also been instrumental in regional water quality planning and in replacing municipal and private wastewater treatment plants with regional facilities. Since 1970, 35 municipal and private plants have been phased out, and regional systems now treat more than 95 percent of the wastewater in NCTCOG's jurisdiction. Brush noted that biological oxygen demand (BOD) concentrations have declined from highs of 30-50 milligrams per liter (mg/L) in the early 1970s to values in the 11 mg/L range in 1984-86, even though the volume of treated wastewater has almost doubled during that time.

He added that NCTCOG is now directing its attention to preventing dissolved oxygen depressions, which many researchers believe are responsible for fish kills. Possible remedies include increased flows from current and planned reservoirs, treatment of nonpoint sources of pollution and sludge beds, and reaeration of the river.

Using aquatic plants to improve water quality was the topic of Thomas A. DeBusk, an environmental associate with the Reedy Creek Utilities Company at Lake Buena Vista, Florida. DeBusk said that water hyacinths and cattails, in particular, can remove nutrients when part of a wastewater treatment system. This system may also be able to remove a spectrum of contaminants including organic compounds, heavy metals, and toxins from wastewaters.

Advantages of this treatment system include lower construction and operating costs. DeBusk said that optimal strategies for managing these systems, as well as markets for utilizing the harvested plant materials, need to be researched and developed.

INDUSTRIAL WATER NEEDS

Which industry in Austin uses more water than the University of Texas, Bergstom Air Force Base, or the state office building complex? Surprisingly, it is Motorola's manufacturing facility, which employs just 5,000 persons.

Rich Weigand, Motorola's environmental manager, says the Austin plant utilizes an average of 1.7 million gallons of water per day in the manufacture of semiconductors. He emphasized that, to be successful, areas trying to recruit high-tech industries need large amounts of consistently high quality water that can easily be used to produce ultrapure water. He added that utilities need to create a favorable economic climate for industries with special water needs.

Although Motorola's water usage is currently high, Weigand said the company is looking at reuse and water conservation to become more water-use efficient. Much of the water in the plant, used as rinse water to cleanse computer chips, is not currently recycled. Plant officials are looking into rinsewater reuse as one means to contain operating costs.