Southwest Florida
Water Management District

An Equal Opportunity Employer

2379 Broad Street, Brooksville, Florida 34604-6899
(352) 796-7211 or 1-800-423-1476 (FL only)
SUNCOM 628-4150 TDD only 1-800-231-6103 (FL only)
On the Internet at: WaterMatters.org

Tampa Service Office
7601 Highway 301 North
Tampa, Florida 33637-6759
(813) 985-7481 or
1-800-836-0797 (FL only)
SUNCOM 578-2070

Bartow Service Office
170 Century Boulevard
Bartow, Florida 33830-7700
(863) 534-1448 or
1-800-492-7862 (FL only)
SUNCOM 572-6200

Sarasota Service Office
6750 Fruitville Road
Sarasota, Florida 34240-9711
(941) 377-3722 or
1-800-320-3503 (FL only)
SUNCOM 531-6900

Lecanto Service Office
3600 West Sovereign Path
Suite 226
Lecanto, Florida 34461-8070
(352) 527-8131
SUNCOM 667-3271

ORIGINAL

November 5, 2001

VIA UPS EXPRESS MAIL

Ms. Blanca S. Bayó, Director
Division of the Commission Clerk
and Administrative Services
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, Florida 32399-0870

Subject: Docket No. 010503-WU

Dear Ms. Bayó:

Enclosed are an original and seven copies of the Southwest Florida Water Management District's Exhibits and Direct Testimony for Jay Yingling and John Parker and Direct Testimony for Lois Sorensen.

Thank you for your attention to this matter. Please contact me at the District's Brooksville headquarters, at extension 4660, if you have any questions about this matter.

14017-01 thru 14019-01

Sincerely,

Margaret M. Lytle

Margaret M. Lytle
Assistant General Counsel

MML
Enclosures

cc: Ralph Jaeger, Esquire
F. Marshall Deterding, Esquire
Stephen C. Burgess, Esquire
Mr. Edward Wood

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Protecting Your Water Resources

DOCKET NO. 010503-WU

ALOHA UTILITIES, INC.

DIRECT TESTIMONY OF JAY W. YINGLING

MARGARET M. LYTLE, APPEARING ON BEHALF OF

INTERVENOR, SOUTHWEST FLORIDA WATER

MANAGEMENT DISTRICT

DATE FILED: NOVEMBER 5, 2001

DIRECT TESTIMONY OF JAY W. YINGLING

Q. Please state your name and professional address.

A. Jay W. Yingling, 2379 Broad Street, Brooksville, Florida, 34604-6899.

Q. Where are you employed?

A. The Southwest Florida Water Management District.

Q. What is your position with the District?

A. Senior Economist.

Q. Please describe your duties in this position.

A. My duties include economic analytic work in support of key District research, planning, programmatic and regulatory functions. More specifically, I participate in rulemaking activities, evaluate proposed rules, prepare or supervise the preparation of Statements of Estimated Regulatory Costs (SERCs), prepare or supervise the preparation economic analyses of water and land issues concerning the District and existing, proposed, and potential District programs. Since the development of the Memorandum of Understanding (MOU) between the Florida Public Service Commission (Commission) and the five water management districts (1991), I have acted as a liaison to Commission staff on issues of mutual interest addressed in the MOU. This duty has included working with Commission and utility staff on water use permittee related rate structure and conservation issues, attending and presenting at utility customer meetings, and providing testimony in rate hearings.

Q. Please describe your training and experience.

A. I received both B.S. (1982) and M.S. (1984) degrees in Food and Resource Economics from the University of Florida. My academic training included courses on both economic theory (supply and demand) and applied quantitative analysis (econometrics and statistics). Since March of 1987, I have been employed by the SWFWMD, first as an economist and then as Sr. Economist since June 1991. Prior to working for the SWFWMD, I worked as a Staff Rules Analyst for the St. Johns River Water Management District. I have prepared or supervised the preparation of dozens of SERCs, numerous articles, presentations and reports on water resource economic issues. Perhaps most relevant, I was the District's project manager for the development of the Water Price Elasticity Study completed in 1993 and for the development of the Waterate Model. As stated before, I have also coordinated with Commission staff on rate structure and conservation issues since before 1991. I have testified both on the behalf of the Commission and utilities in rate hearings. My current resume is attached as Exhibit 1.

Q. Why does the District promote the use of water conservation oriented rate structures?

A. For the benefit of all water customers within its jurisdiction, the District promotes the efficient use of water. The longer that we can maintain demand within the limits of available high quality water sources, the longer we can avoid the higher costs of having to develop lower quality sources. For water to be used efficiently, it must be priced in a manner that provides incentives for efficient use.

Over the years, water price elasticity studies have shown that water utility customers are responsive to changes in water price. Extensive statistical studies of utility water demand show that when the price of water increases, demand for water decreases, when all other factors are equal (such as weather). Economic theory indicates that persons respond to marginal price, the price of the next unit of a good purchased. The marginal price is, therefore, the appropriate incentive for efficient use. In much of the SWFWMD, potable quality water is at least a seasonally scarce resource. Water conservation oriented rate structures reinforce the concept of scarcity and the need to conserve through the marginal price of water. If there is no marginal cost for additional water use or the marginal cost of water declines as more water is used, the scarcity of high quality potable water sources is not adequately reflected and behavioral changes and the adoption of water conserving technologies will be less likely to occur.

Q. What is the purpose of a water conservation oriented rate structure?

A. From the District's perspective, the purpose of a water conservation oriented rate structure is to provide economic incentives to reduce per capita water use to, or maintain it at, a given level. The primary goal is not to change or generate additional revenues for a utility. The intent is to provide incentives for conservation within the rate structure itself through manipulation of fixed and variable charges and the level or location of marginal prices. It is one of a number of tools that can be used to reduce or maintain per capita use, and it is required in Water Use Caution Areas (WUCAs).

Q. How is a water conservation oriented rate structure determined?

A. From a permitting perspective, the District has used the same guidelines on water conservation oriented rate structure since 1993. These guidelines are called "Interim Guidelines for Water Conserving Rate Structures", and are attached as Exhibit 2. In essence, the guidelines prohibit the use of two rate structure forms based on the marginal price signal. Flat rates, in which there is a single fixed charge for water use and no gallonage charge, has a marginal price of zero. There is no additional charge for additional gallons used. This structure does not reflect scarcity and provides no disincentive to profligate use. Declining block rate structures are also not acceptable because the marginal price declines as more water is used. Such a structure does not reflect the scarce nature of the resource because the marginal cost of water to the consumer declines as more water is used.

In the literature, many types of rate structures are considered water conserving The most common among these are inclining block, seasonal, uniform with a seasonal surcharge, ratchet, and excess use charge. All involve some form of higher marginal price for water use based on usage or season. Uniform rates, with a constant marginal price, are sometimes also considered a water conserving rate structure. To minimize costs to regulated utilities, the District will accept a uniform rate structure when the utility is in compliance with per capita requirements. If it is not in compliance, then a more aggressive rate structure, such as those mentioned where the marginal prices increases based on usage or season must be implemented.

Q. What water use permittees are required by rule to implement a water conserving rate structure?

A. Public water supply utilities with permitted quantities of 100,000 gallons or more that are located in the Highlands Ridge, Eastern Tampa Bay, and Northern Tampa Bay WUCAs. The requirement for utilities in the Northern Tampa Bay WUCA is found in Section 7.3.1.2 of the Basis of Reveiw, in the Water Use Permit Information Manual, Part B, which is incorporated by reference as a rule of SWFWMD in Rule 40D-2.091, Florida Administrative Code. The authority to require the use water conserving rate structures and the District's flexible approach to the implementation of the requirement as outlined in the "Interim Minimum Guidelines for Water Conserving Rate Structures" were evaluated and approved in the Division of Administrative Hearings Case No. 94-5742RP commonly referred to as the "SWUCA rule challenge." The hearing officer recognized that "the general concepts as to what constitutes a water conserving rate structure are well recognized in the industry" (Final Order, p. 799). The District's Guidelines were found to be consistent with those general concepts.

In addition to the conditions contained in the Guidelines, there may be other occasions when the District may encourage or require the implementation of a water conserving rate structure or the implementation of a more aggressive water conserving rate structure. One of these occasions would be when the utility is violating the water quantity limits of its permit and may cause or contribute to harm to water resources. Water conserving rate structures are recognized as one of a number of reasonable tools that may be necessary to bring a permittee into compliance when water resources are potentially being harmed.

Q. What other guidance is there on the development of water conserving rate structures?

A. There are other features of a water conserving rate structure for which the District does not have specific guidelines. However, the District has made available additional recommendations to permittees and the Commission, including "Recommendations for Defining Water Conserving Rate Structures", by John B. Whitcomb, prepared for the Southwest

Florida Water Management District, August 1999, which is attached as Exhibit 3. Additionally, the literature is rich with recommendations for developing water conserving rate structures. (American Water Works Association, 1992; California Department of Water Resources, 1988; Californian Urban Water Council, 1997). A bibliography of these references is attached as Exhibit 4.

For example, the fixed charge portion of the bill should be kept to the minimum commensurate with the need for revenue stability. However revenue stability can be enhanced with the establishment of a revenue stabilization fund while keeping the fixed charges reasonably low. A low fixed charge increases the revenue required from gallonage charges and therefore higher gallonage charges. This provides more of a disincentive to wasteful use and more of a reward to the customer for reducing use. A utility that purchases all of its water does not need to be as concerned about revenue stability as does a utility with its own withdrawals financed by revenue bonds which must be paid regardless of the demand for water.

The marginal price change(s) for an inclining block rate structure should be large enough to give the customer an incentive to reduce usage to the previous block. The higher or last block(s) thresholds(s) should be low enough to cover a significant portion of the customer base or the structure will only have a significant impact on a small portion of the customer base and not have the water conserving effect desired. Similar types of considerations should also be made in the development of other types of water conserving rate structures.

Q. How effective are water conserving rate structures?

A. This is a difficult question to answer - but difficult to answer for a number of good reasons. However, theoretical considerations, their relatively common use, and common sense would indicate that well designed water conserving rate structures are effective. The authors of the Guidebook on Conservation-Oriented Water Rates (California Department of Water Resources, 1988), describe the dilemma quite well.

> "First, DWR knows of no city that has adopted conservation-oriented water rates without at the same time enacting a general water rate increase. Therefore, it is not possible to tell how much of the subsequent drop in per capita water consumption was due to a revised rate structure and how much was due to higher water costs.
>
> However, the experiences of Washington, D.C., and Tucson, Arizona, which switched to conservation-oriented water rates in the late 1970's, show significant water savings can result from conservation-oriented water rates. Refer to the excerpts from DWR Bulletin 198-84 (in the back pocket of this guidebook) for more information.

When a city adopts conservation-oriented water rates, some customers will get lower water bills, others will face higher water costs, and some residential customers might see no difference in their annual water costs.

The incentive to conserve will come from several factors. First, most users will experience increased summer water bills and lower winter water costs. This is desirable, for conservation is more valuable during the peak summer months.

Second, large water users will tend to get higher bills under the revised rate schedule, which would provide them with incentives to reduce use.

Third, large residential users, with above-average outdoor use, will tend to get higher water bills under conservation-oriented water rates. Because outdoor use has been found to be more responsive to price than outdoor use, the drop in exterior water use by large users should outweigh any increase in water use by apartment dwellers, most of whom will face lower water bills.

A fourth factor in conservation-oriented water rates that leads to reduced water consumption over time is the fact that everyone now knows if a household gets careless and increases its water use, its water bill will increase more under the revised rate schedule than it would have under the old rate schedule.

The final factor explaining the use of pricing incentives to encourage conservation is the concept of marginal cost. Marginal cost is the cost of purchasing one more unit of a good or service. Although switching to conservation-oriented water rates will mean that some users will face lower average costs, virtually everyone should face significantly higher marginal water costs (if the new rates are truly conservation-oriented).

Economic studies often indicate that consumers make purchase decisions based more on marginal costs than average costs.

So although it is not possible to quantify the above five factors for each city to determine exactly how much water would be saved by switching to conservation-oriented water rates, DWR believes that a city with typical water rates (a conservation index number of approximately 0.7) switching to these conservation rates (an index number of 1.0) would be equivalent to the effect of raising the average price of water by 10 to 20 percent, while keeping the old rate structure.

This would mean that if the above typical city (with a winter PED[1] of -0.25 and a summer PED of -0.35) were to adopt these conservation rates, it could expect a decline in per capita

[1] PED is the price elasticity of demand.

residential winter water use of 2.5 to 5 percent and a decline in summer per capita residential water use of 3.5 to 7 percent. Commercial, industrial, and public-authority water use could also be expected to decline if conservation-oriented water rates are applied to those user classes."

As noted in this authority, it is quite difficult to find a utility that has adopted a water conserving rate structure that has not also included an increase in revenues. Further, to isolate the effects of the structure change from other water demand variables, it may be necessary to perform complex and expensive statistical analyses. Utilities are not inclined to perform such analyses. There is, however, some anecdotal evidence of the effectiveness of the water conserving rate structures.

In 1995, the Homosassa Special Water District implemented a revenue neutral water conserving rate structure. The rate structure was designed using the District's Waterate model. Although no formal statistical analysis of the effect of the rate structure has been performed, in a recent telephone conversation between myself and utility superintendent Dave Purnell, Mr. Purnell was quite firm in his conviction that the water conserving rate structure (inclining block) played a significant role in reducing per capita water use in the service area (October 23, 2001).

In 1993, Sarasota County changed their inclining block rate structure to a more aggressive inclining block rate structure. Again, the change was designed to be revenue neutral. Per capita use declined significantly in the years following the structure change. No other significant conservation programs were implemented in the during the same period. Although no formal statistical analysis of the effect of the rate structure has been performed, David Cook, Manager of Finance and Administrative Services for Environmental Services, is confident that the rate structure change played a significant role in the decline in per capita water use in Sarasota County's service area (telephone conversation on October 25, 2001).

In 1991, the Spalding County Water Authority (Georgia) changed from a declining block rate structure to an increasing block rate structure. As a result, the average customer's bill increase by $1.99 per month. The estimated price elasticity for the rate change was -.33. In 1993, the average bill was increased by $2.13 per month without a change in rate structure. The estimated price elasticity for the 1993 rate change was only -.07. A simple test was conducted to determine if weather was significantly different between the two periods. It was not. In addition, no other conservation programs were implemented during either period of time. The author concludes that the change in rate structure was a significant contributing factor to the larger response to the rate change in 1991 (Jordan, 1994).

Another study in Georgia in 1992 indicated that the daily water use for systems using declining block rate structures was 503 gallons per connection, 428 gallons for systems using uniform rate structures, and 352 for systems using inclining block rate structures (Jordan and Elnagheeb, 1993).

Q. Do Aloha Seven Springs' existing and proposed rate structures comply with the District's water conserving rate structure requirement?

A. While both the existing and proposed rate structures comply with the rate structure requirements as defined in the Guidelines with respect to per capita usage, the utility is not in compliance with its permit quantity limitations and the utility's withdrawals are located in an area where water resources are stressed. Furthermore, recent and potential additions to the utility's service area are characterized by high per capita use. Given these factors, a more aggressive water conserving rate structure than exists, such as an inclining block structure, is appropriate.

Assuming a residential average use of about 8,000 gallons per month[2] for single family residential use, a simple analysis indicates that the maximum mix of fixed and gallonage-related rate revenues under the

[2]Actual is 8,584 gallons per month (Schedule E-14).

proposed rate structure (approximately 34% fixed)[3] is a significant improvement from the existing rate structure (approximately 53%). Concerning the first price block threshold (10,000 gallons per month) under the proposed residential structure, approximately 27% of all bills and 32% of water use would be affected by the second block price. This is not insignificant. A lower threshold would send a stronger conservation message to a larger number of customers. However, it could also lower the price differential between blocks unless the fixed charge could be lowered without significantly affecting revenue stability. The placement of the threshold is not inconsistent with the objectives of an inclining block rate structure.

The price differential between the proposed blocks is approximately 25%. Such a differential is not insignificant and is consistent with the objectives of an inclining block rate structure.

The proposed general service rate structure appears to continue to be a minimum gallonage charge uniform rate structure. An inclining block rate structure could be developed for general service customers that would be provide an additional conservation incentive for this customer class. However, given the increase in the uniform rate, there will

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[3]Aloha reported in its response to Citizen's First Set of Interrogatories No. 42 that the portion of proposed rate revenues coming from fixed charges would be 38%.

likely be a significant incentive to conserve for this customer class. In summary, the proposed rate structures provide a stronger conservation incentive than the previous rate structure. Any shortcomings of the rate structures will likely be made up for by the general increase in rate levels.

Q. What is the history of the Waterate model?

A. In 1991 the District was developing the WUCA rules which included the requirement for water conserving rate structures to be used as a demand management tool. At the time there were no large sample estimates of water price elasticities for that included a wide range of prices in the sample and there is a wide range of water prices in the District due to source water of varying quality. It was deemed desirable to conduct such a price elasticity study to assist utilities in the District in estimating reductions in demand due to rate structure and price level changes. The consulting firm of Brown and Caldwell, in association with Dr. John Whitcomb, were engaged to conduct the study. The price elasticity study, the most comprehensive ever known to be conducted in the State of Florida, was completed in 1993. The study demonstrated that single family residential water price elasticity changes over a large range of prices. While the study provided more accurate estimates over a range of prices, the application of the varying levels of price elasticity required a more complex set of calculations than a single price elasticity. To facilitate the use of the more discrete price elasticity estimates, the same consultants were engaged to develop a rate model that would automate the numerous calculations of changes in water use and revenues for levels of consumption at various price ranges. The model is simply a tool to perform a larger number of more discrete calculations - but the same types of calculations that would be performed by a rate consultant. The model was also completed in 1993. Since that time, the District has provided the model at no cost to utilities in the District, conducted no-cost workshops on its use, and has provided a toll-free user help line.

Over the years Dr. Whitcomb has made several revisions to: a) make the model single family residential elasticity estimates more accurate, b) make the model run time faster, and c) to add desirable features. In spite of changes to the single family estimation equation, the price elasticities have remained quite stable in relevant price ranges and within the ranges of other single family residential price elasticities. The latest version of the model was released in 2001 and runs in Microsoft Excel, a very commonly used spreadsheet model which allows the direct input of utility financial spreadsheets.

Q. Are the proposed rates affordable?

A. A measure of water bill affordability that the District has used in the past is whether the total annual water bill exceeds 2% of median household income and is derived from the EPA's "rule of thumb" measure of affordability.[4] Interim and proposed rate annual water bills were estimated at thousand gallon increments from 5,000 to 10,000 gallons per month and were compared to estimated Pasco County median household income ($28,202) and the low end of the 90% confidence interval for the estimate ($25,313)[5]. The annual estimated water bill at each monthly increment of use was below 2% of both the median household income estimate and the lower value of the 90% confidence interval for the estimate. The highest estimated percent was 1.5% at the low interval for the estimate. According to this measure of affordability, the proposed rates should generally be affordable.

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[4]Federal Register /Vol. 56, No. 20/ January 30, 1991/Rules and Regulations. P. 3570.
[5]County Estimates for Median Household Income for Florida: 1997. Http://www.census.gov/hhes/www/saipe/stcty/c97_12.htm October 16, 2001.

CERTIFICATE OF SERVICE

I certify that a true copy of the foregoing was sent by U.S. Mail to the following persons on this 5 day of November 2001:

Ralph Jaeger, Esquire
Division of Legal Services
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, FL 32399-0850

F. Marshall Deterding, Esquire
Rose, Sundstrom & Bentley, LLP
2548 Blairstone Pines Drive
Tallahassee, FL 32301

Stephen C. Burgess
Deputy Public Counsel
Office of Public Counsel
111 West Main Street, Room 812
Tallahassee, FL 32399-1400

Mr. Edward Wood
1043 Daleside Drive
New Port Richey, Florida 34655-4293

Margaret M. Lytle

Margaret M. Lytle

RESUME

RECEIVED
NOV 01 2001
OFFICE OF
GENERAL COUNSEL

Jay W. Yingling
1315 East Norfolk Street
Tampa, Florida 33604

Daytime Phone
352-796-7211 ext. 4406

EDUCATION

M.S. Food and Resource Economics, University of Florida (1984)

Field of Specialization: Natural Resource and Environmental Economics
Thesis: Urbanization and the Change in Central Florida Citrus Acreage

B.S. (Honors) Food and Resource Economics, University of Florida (1982)

Field of Specialization: Natural Resource and Environmental Economics

A.A. (Honors), St. Petersburg Junior College

Relevant Academic Training:

Natural Resource and Environmental Economics:
Graduate - Natural Resource Economics, Agricultural Land Decisions (special topics seminar)
Undergraduate - Land and Water Economics, Economics of Environmental Quality

General Economic Theory:
Graduate - Intermediate Agricultural Production Economics, Consumption Economics and Markets, Macroeconomics
Undergraduate - Microeconomics (2), Macroeconomics (2), Agricultural Production Economics

Quantitative:
Graduate - Econometrics, Activity Analysis for Economic Decisions (linear programs)
Undergraduate - Calculus, Statistics, Quantitative Analysis in Food and Resource Economics

Finance and Management:
Graduate - Agricultural Finance
Undergraduate - Public Finance, Farm Firm Management

Public Policy:
Graduate - Agricultural Policies and Programs
Undergraduate - Public Policy in Agriculture

EXPERIENCE

RESEARCH

Research Assistant, to Dr. J. Walter Milon,, University of Florida, October 1983 to July 1986. Nature of research: Investigate the relationship between levels of exotic aquatic weeds and the economic value of recreational fishing on a freshwater lake ecosystem.

Thesis Research, involved econometric modeling of urban influenced land use decisions of citrus producers using linear regression.

Research Assistant, to Dr. Rodney Clouser, University of Florida, August 1982 to October 1983. Nature of research: Community and rural development.

APPLIED ECONOMIC AND POLICY ANALYSIS

Senior Economist, Southwest Florida Water Management District, Brooksville, Florida, March 1987 to current.

Staff Rules Analyst, St. Johns River Water Management District, Palatka, Florida, July 1986 to March 1987.

ADMINISTRATIVE

Inventory Controller - Purchasing Agent, CE Morgan Building Products, Largo, Florida, July 1978 to October 1980.

Storekeeper, U.S. Coast Guard, June 1971 to June 1975. Duties: Clothing Stores Manager for Seventh Coast Guard District (Florida, Georgia, South Carolina and Greater Antilles); Bid processing and accounts ledger maintenance for Base Ketchikan, Alaska; Base Exchange Operator, Base Ketchikan, Alaska.

HONORS

ACADEMIC

"Presidential Recognition of Outstanding Student Contribution to the University of Florida" certificate, April, 1983.

First Place, American Agricultural Economics Association. (AAEA) Undergraduate Essay and Public Speaking Session, AAEA Summer Meetings, Logan, Utah 1982; Paper entitled "Beach Zone Use in Florida: Public Goods, 'Non-Market Failure', and Property Rights".

IFAS SHARE General Scholarship, 1981 - 1982.

MILITARY

Coast Guard Achievement Medal for "Outstanding Achievement and Superior Performance of Duty from 19 January 1974 to 1 June 1975."

PUBLICATIONS

STATEMENTS OF ESTIMATED REGULATORY COSTS AUTHORED

Minimum Flows for the Lower Hillsborough River, Chapters 40D-8 and 40D-80, F.A.C., March 1999, Revised June 1999

Year-Round Water Conservation Measures, Chapter 40D-22, F.A.C., July 1991

Schedule of Levels for Lakes and Other Impoundments; Establishment of Water Levels for Lakes Altahama, Bonnie, Cooper (Worth), Crystal, North Lake Wales, Serena, Twin Lakes, Wales, Warren, and Weader (Weaver), Chapter 40D-8, F.A.C., June 1991

Schedule of Levels for Lakes and Other Impoundments; Establishment of Water Levels for Spring Lake, Chapter 40D-8, F.A.C., June 1991

Proposed Revisions to General Well Regulation Rules, Chapter 40D-3, F.A.C., March 1991

Proposed Revisions to the Basis of Review Concerning Denial of Impacts to Wetlands Deemed to be Environmentally Sensitive Areas, and Minimum Mitigation Requirements, Chapters 40D-4 & 40, F.A.C., February 1991

Schedule of Levels for Lakes and Other Impoundments; Establishment of Water Levels for Lakes Alfred, Blue, Cummings, Echo, Eva, George, Griffin, Medora, Pansy, and Sanitary (Mariana), Chapter 40D-8, F.A.C., November 1990

Permit Processing Fees, Chapter 40D-0, F.A.C., November, 1990

Surface Water Management for the Mining of Materials Other than Phosphate; Proposed Revisions to Water Quality Monitoring, Allowable Wetland Impacts, and Wetland Impact Compensation Provisions, Chapter 40D-45, F.A.C., August 1990

Procedural Rules, Contract Bidding - Resolution of Protests, Chapter 40D-1, F.A.C., March 1990

Surface Water Management; The Proposed Deletion of the Non-Phosphate Mining Exemption from Chapter 40D-4, F.A.C. and the Creation of a Rule and Basis of Review for the Permitting of the Mining of Materials Other than Phosphate, Chapters 40D-4 and 40D-45, F.A.C., November 1989

Proposed Revisions to General Well Regulation Rules, Chapter 40D-3, F.A.C., and the Incorporation of Chapters 17-524, 1,531, 17532, and 17-555, F.A.C., March 1989

Revisions to Water Use Permitting Rules and Adoption of the Basis of Review for Water Use Permit Applications Within the Southwest Florida Water Management District, Chapters 40D-2 & 20, F.A.C., February 1989

Surface Water Management; Definition of Terms, "Project Area", Chapter 40D-4, F.A.C., June 1988

Surface Water Management; Off-Site Storm Water Treatment Criteria, Chapter 40D-4, F.A.C., June 1988

General Consumptive Use Permits Within the Coastal Zone, Chapter 40D-20, F.A.C., June 1988

Surface Water Management; Conditions for Issuance of General Permits and Editorial Changes to Threshold Language, Chapter 40D-40, F.A.C., June 1988

Surface Water Management; Revision of Construction and Noticed General Permit Application Forms, Adoption of Conceptual Permit Application Form, Chapter 40D-4, F.A.C., May 1988

Surface Water Management; Modification of Letters of Conceptual Approval, Chapter 40D-4, F.A.C., May 1988

General Permit Processing Fees, Chapter 40D-0, F.A.C., May, 1988

Procedural Rules & General Permits, Chapters 40D-1, 20 & 40, F.A.C., February, 1988

Addition of Isolated Wetlands Criteria, Chapter 40D-4, F.A.C., October 1987 (Addendum)

Surface Water Management; Incorporation of Stormwater Regulation and Adoption of the Basis of Review for Surface Water Management Permit Applications within the Southwest Florida Water Management District, Chapters 40D-4 & 40, F.A.C., July 1987

Management and Storage of Surface Water; Addition of Wekiva River Basin Criteria, Chapters 40C-4 & 41, F.A.C., October 1986 (rule withdrawn)

Management and Storage of Surface Waters; Addition of Isolated Wetlands and Wetlands Mitigation Criteria to the Applicant's Handbook, Chapter 40C-4, F.A.C., 1986

STATEMENTS OF ESTIMATED REGULATORY COSTS SUPERVISED

Statement of Estimated Regulatory Costs for Revisions to Florida Administrative Code Regarding Minimum Flows and Levels in the Northern Tampa Bay Area, Chapters 40D-2, 40D-4, 40D-8 and 40D-80, F.A.C., November 1998

Economic Impact Statement for Revisions to Chapter 40D-2, F.A.C., Water Use Permitting, and Chapter 40D-8, F.A.C., Water Levels and Rates of Flow, Including Rules Specific to the Southern Water Use Caution Area, Prepared by Hazen and Sawyer in Association with Resource Economics Consultants and HSW Engineering, August 25, 1994

Northern Tampa Bay Water Use Caution Area, Chapter 40D-2, F.A.C., Prepared by CH2M Hill, January 1991

Eastern Tampa Bay Water Use Caution Area, Chapter 40D-2, F.A.C., Prepared by CH2M Hill, August 1990

Highlands Ridge Water Use Caution Area, Chapter 40D-2, F.A.C., Prepared by CH2M Hill, May 1990

MISCELLANEOUS PUBLICATIONS

Estimated 1997 Water and Wastewater Charges in the Southwest Florida Water Management District. with David C. Carter, Jodi Hopkins, and Don Rome. Southwest Florida Water Management District. Brooksville, Florida. June 1999

Water Economics and Finance. with William Hutchinson, Grace M. Johns, Richard A. March, and C. Donald Rome, Jr. Water Resources Atlas of Florida. Editors Edward A. Fernald and Elizabeth D. Purdum. Institute of Science and Public Affairs. Florida State University. Tallahassee, Florida. 1998

Minimizing the Cost of Achieving Pollutant Load Reduction Goals: Nonpoint Source Control in the Peace River Watershed. with David Carter. June 1998 in The Optimal Best Management Practice Configuration Model: Design Document, User Guide and Case Study. David W. Carter. Prepared for the Southwest Florida Water Management District. Brooksville, Florida. August 1999.

Economic Incentives for Agricultural Water Conservation in Southwest Florida. with Grace Johns, Ron Cohen, and Peter Thompson. Proceedings of the Conserv '96 Conference, Orlando, Florida. January 1996

Land Conservation Economic Impact Literature Review and Research Recommendations. Prepared for the Land Acquisition, Planning and Management Subcommittee of the Water Management District Review Commission. November 1995

Can a Regional Economy Survive Limits on Withdrawals to Protect an Important Aquifer? Use of Economic Analysis in Revising Florida Administrative Code. with Grace Johns. Proceedings of Water Environment Federation's 68th Annual Conference and Exposition (WEFTEC '95), Miami Beach, Florida. October 1995

Alternative Methods of Land Acquisition. with Rand Frahm *et al*. Southwest Florida Water Management District. Brooksville, Florida. July 1995

Residential Water Price Elasticities in Southwest Florida. with John B. Whitcomb and Marvin Winer. Proceedings of the Conserv '93 Conference, Las Vegas, Nevada. December 1993

Proceedings of a Workshop on Water Allocation Strategies. Edited with Richard S. Owen for the Governing Board of the Southwest Florida Water Management District. Tampa, Florida. March 1993

Economic Values. Ch 9. in Indian River Lagoon Joint Reconnaissance Report. Florida Department of Environmental Regulation and Office of Coastal Resources Management, National Oceanic and Atmospheric Administration. 1987

Determinants of Land Prices and Acreage in Florida's Citrus Producing Region. with Dr. Rodney Clouser. Proceedings of the Southern Agricultural Economics Assn. meetings. Biloxi, Mississippi. February 1985.

Factors Affecting Agricultural Land Use: A Study of Citrus Acreage in Florida. with Dr. Rodney Clouser. Proceedings of the Southern Agricultural Economics Assn.(SAEA) meetings, Nashville, Tennessee. February 1984

PROFESSIONAL AFFILIATIONS

American Water Resources Association, Florida Section

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SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

INTERIM MINIMUM REQUIREMENTS FOR WATER CONSERVING RATE STRUCTURES

DECEMBER 1991

The District requires that public supply water utilities in the three Water Use Caution Areas adopt water conserving rate structures by January 1, 1993. Until a major study on the subject of water conserving rate structure guidelines is completed in late 1992, this document will serve as the interim requirements guidelines.

In determining whether a structure complies with WUCA requirements, the major concern is the form of the structure. It is, however, in the interest of those utilities whose compliance per capita usage exceeds 150 gallons per capita daily to design a structure that will be an effective tool in reducing wasteful water usage. Documentable deductions and credits that may be useful in determining whether the compliance per capita level can be achieved at current rates are addressed in sub-sections I.A. of Sections 7.1, 7.2 and 7.3 of the Water Use Permit Information Manual.

<u>Structure Form</u>

The form should reinforce the concept that potable water is at least a seasonally scarce resource by providing economic incentives for conservation. Typically this would require that the customer face a non-zero, increasing marginal cost for water as water use increases. The marginal cost of water is the additional amount of money that the customer would have to pay for an additional unit of water use. For example, a structure may have a base charge of $6 per month and a usage charge of $1 per thousand gallons up to 15,000 gallons per month and $1.50 per thousand gallons above 15,000 gallons. A customer using 12,000 gallons per month would therefore face a marginal cost of $1 per thousand while, a customer using 15,000 gallons per month would face a marginal cost of $1.50 per thousand. Note that the base charge does not affect marginal cost, only average cost, since the base charge does not change with usage.

A "flat" rate, wherein the customer pays only a single quantity charge (e.g., $15 per month), regardless of the amount used would not be considered a water conserving rate structure since there is no economic incentive to reduce usage. The customer's marginal cost of water under such a structure is zero and does not reinforce the concept of potable water as a scarce resource.

A "declining block" rate, wherein the customer pays successively lower per unit charges as usage increases would also not be considered a water conserving rate structure. An example would be where the cost decreases from $1.00 per thousand for the first 10,000 gallons to $.85 per thousand for the next 10,000 gallons. The customer's marginal cost of water decreases as water use increases and does not reinforce the concept of potable water as a scarce resource.

Any rate structure in which a significant percentage of a customer class's water use is paid for under a minimum charge would not be considered a water conserving rate structure. The American Water Works Association (AWWA) suggests that a maximum range of from 5 to 15% of a customer class's usage be covered under a minimum charge. The District may require the permittee to justify the revenue need for more than 15% minimum charge coverage of a customer class's usage. The customer's marginal cost of water for quantities up to the limit covered by the minimum charge is zero and does not reinforce the concept of potable water as a scarce resource for smaller quantity users.

"Uniform" rates feature a constant per unit charge (e.g., $1.00 per thousand gallons), regardless of quantity used. The customer's marginal cost of water is constant throughout the usage range and does not reinforce the concept of increasing marginal costs for scarce resources. Such structures will be evaluated on a case by case basis, primarily based upon the ability of the utility to meet compliance per capita standards. A uniform rate with a substantial seasonal surcharge would, however, reinforce the concept of potable water as a seasonally scarce resource and would be an acceptable structure form.

In terms of form, the District believes the structure that most reinforces the concept of potable water as a scarce resource is an inclining block rate structure. Under such a structure, customers who use amounts higher than a predetermined threshold or thresholds would pay a higher per unit charge (inclining block rates may contain more than one price block). Ideally, one threshold for residential customers would be set at the upper limit of conservative indoor and outdoor residential use for a typical household in the service area. For example, assuming a water conserving indoor use of 60 gallons per capita daily indoor use (Maddaus), 2.8 persons per household and Tampa's average annual net irrigation requirement of 32.39 inches on 5,000 square feet of irrigated turf (Augustin), the water conserving threshold for the first block would be about 15,000 gallons per month. Beyond this threshold, there would be a substantial increase in the per unit price to discourage waste. A seasonal alternative may be to have a lower threshold for months of low net irrigation requirements and a higher threshold for high net irrigation requirement months.

Inclining block rates are not suggested for commercial or industrial classes unless a method of determining block size based on efficient use for the size and type of customer is developed.

Seasonal rates or surcharges applied to either uniform or inclining block structures for excessive use during the dry spring months would also be acceptable forms of a water conserving rate structure. At a minimum, seasonal rates or surcharges would be applied in the months of May and June with at least one other month at the discretion of the utility.

Effectiveness

The District does not currently require a particular "percentage" reduction in water use resulting from the adoption of a water conserving rate structure. The District views such structures as one among many tools that a permittee may use to achieve any required per capita water use rates.

Most discussions of the effectiveness of water rate structures refer to the concept of price elasticity of demand. Price elasticity of demand is an economist's term for the responsiveness of consumers' demand for a product, in this case water, when the price of the product is changed. More technically, it is the proportional change in quantity demanded for a change in price. The equation for price elasticity is:

$$E = \frac{(Q_2 - Q_1)}{(P_2 - P_1)} * \frac{P_1}{Q_1}$$

where:

- E is the price elasticity of demand for water,
- Q_1 is the old quantity of water used before the price change,
- Q_2 is the new quantity of water used after the price change,
- P_1 is the old price of water, and
- P_2 is the new price of water.

To determine the percentage change in quantity used if the elasticity is already known, the equation is rearranged and solved for $(Q2-Q_1)/Q_1$:

$$\frac{(Q_2 - Q_1)}{Q_1} = E * \frac{(P_2 - P_1)}{P_1}$$

For example, if the price elasticity for water in a given community is -.50, a 10 percent increase in the price of water will decrease the quantity of water consumed by approximately 5 percent (-.50 X 10 = -5.0). Note that price elasticities are almost always negative and the larger the absolute value of the elasticity, the larger the change in demand. Estimates vary widely among studies conducted over time and among different communities and user groups (Maddaus) but in the long term, and over a wide spectrum of users, overall water price elasticity estimates tend towards the range of -.20 to -.50 (Cuthbert),(Williams and Suh). The factors influencing the variation in estimated elasticities are many but generally are related to the beginning price range of water, the income of the user group, and the amount of discretionary water use (generally outdoor irrigation). These and other factors influence price elasticity in combination. This is why multiple regression models are generally used in estimating price elasticities so that these other influences can be filtered out and only the demand changes resulting from price changes can be isolated. The Cuthbert, South Florida Water Management District (SFWMD) and Weber references in the Bibliography provide very good discussions of elasticities, variables affecting water demand and water conserving rate structures.

Studies have also been conducted to estimate elasticities for specific types of water use such as single family residential indoor and outdoor, multi-family, commercial and industrial (Maddaus, SFWMD, and Williams and Suh). Elasticities estimated for these use classes vary widely depending on the nature of use. Such disaggregated elasticity studies provide more accurate estimates of how price changes will affect the demands of various customer classes.

The District is currently initiating a study of elasticities for various classes of water use at representative utilities in the District. The results of this study will allow utilities to better develop, and the District to better evaluate, water conserving rate structures. Until this study is completed, the District will provide the best available data to assist utilities in developing effective water conserving rate structures.

If it has been some time since rates have been changed, the effectiveness of a proposed structure should be evaluated using real (deflated) dollar rates. Studies have shown that consumers respond to real (deflated) price changes as well as nominal (current dollar) price changes (Cuthbert). Determination of real price changes should be based on the Consumer Price Index for residential and commercial class rates and the Producer Price Index for industrial class rates.

If any structure is submitted and per capita evaluation results do not indicate substantial progress towards meeting per capita water use requirements, the marginal cost for quantity ranges in excess of water conserving indoor and outdoor residential uses may be compared to other utilities whose per capita use rate are within compliance ranges. Rates with significantly lower than average marginal costs in non-conserving usage ranges may not be considered water conserving rate structures.

The acceptability of submitted structures will not be finally determined until after the January 1, 1993 submission date.

<u>Other Important Considerations in Changing Rate Structures</u>
While increasing block rates, seasonal rates and surcharges have been shown to be effective in reducing demand, changes in rate structures raise several concerns. A poorly planned change in rate structures has the potential to: 1) raise excess revenues, yet be relatively ineffective in conserving water, 2) be extremely effective in conserving water but reduce revenues below desirable levels, 3) raise rates beyond the ability of low income groups to pay, or 4) cause consumers to seek alternative sources of supply that could be harmful to local water resources. If changes in rate structures are being considered and the price increase is expected to be substantial, price elasticities for the local area should be estimated or, at a minimum, elasticities which have been estimated for similar communities should be reviewed.

One concern often expressed about raising rates is that the utility may experience difficulty in having a rate structure adopted that could generate excess revenues. When calculating revenue requirements, the permittee should explicitly take into account the costs of programs that may be necessary to comply with all applicable permit conditions. For example, a utility with unaccounted water use in excess of 12 percent may have to make significant investments in periodically replacing meters, auditing, measuring unmetered uses, or repairing leaks. Utilities may also have to invest in more sophisticated data processing systems in order to efficiently comply with overall and residential per capita reporting requirements. Costs may also be incurred for retrofit and public conservation education programs. All of these potential costs should be considered in the development of revenue requirements before deciding that an increase in revenues is not needed or that excess revenues may be generated. Utilities may wish to pursue regulatory rather than price measures if the customer base has a very low price elasticity for water. In such a case, a large price increase could generate excess revenues.

Another concern often expressed is that a water conserving rate structure could reduce revenues below requirements. Almost all studies have shown the price elasticity of water for indoor residential use to be less than the absolute value of 1, or inelastic. This means that revenues will increase due to higher per-unit price faster than they will decrease due to reduced sales, yielding an overall increase in revenue. Most studies have shown outdoor use to also have an elasticity of less than 1 or just slightly greater than 1. Except for a few commercial and industrial uses, most other customer classes also have elasticities with an absolute value of less than one. The more detailed the customer class usage data submitted, the more accurately a model will predict usage changes and the ability to determine whether revenue requirements will be met. This is where knowledge of the customer base can be very valuable.

Another major consideration is equity. If water rates are increased enough to substantially affect the consumption of large users (generally higher income groups), water costs may rise to an unaffordable level for low income groups. This potential problem can be overcome through the use of a "lifeline" rate. In this version of a block rate, the first block per unit price is low and the block encompasses the minimum quantity necessary for personal and household needs and perhaps for the maintenance of a small lawn. Beyond the low minimum quantity, rates rise substantially to discourage excessive use. While some do not agree that the lifeline rate is the most equitable and economically efficient (Renshaw), such a structure is perceived to be fair to low income groups and may reduce customer resistance to rate increases, especially among fixed income groups.

The last consideration is the possibility of source substitution. If rates are increased substantially, the installation of domestic irrigation wells may become an attractive alternative for utility customers. If the aquifer being tapped by the domestic wells is the same as the potable source, any existing supply or environmental problems may be exacerbated. Regulatory measures to control such wells may become necessary.

Although these are major considerations, they generally do not present any obstacles that cannot be overcome in designing water conserving rate structures. An excellent summary of successful design criteria may be found in Grisham and Fleming (p. 38).

List of References

American Water Works Association, "Water Rates" AWWA Manual M1. 4th ed. Denver: AWWA, 1991, p. 34.

Augustin, Bruce J., "Water Requirements of Florida Turfgrasses", Florida Cooperative Extension Service Bulletin 200, (Gainesville: University of Florida, 1984).

Cuthbert, Richard W., "Effectiveness of Conservation-Oriented Water Rates in Tucson" Journal AWWA, March 1989, p. 65-73.

Grisham, Alice and William M. Fleming, "Long-Term Options for Municipal Water Conservation" Journal AWWA, March 1989, p. 33-42.

Maddaus, William O., Water Conservation, American Water Works Association, p. 66.

Renshaw, Edward F., "Conserving Water through Pricing" Journal AWWA, p. 2-5.

South Florida Water Management District, Empirical Water Demand Study, by Brown and Caldwell Consultants and John J. Boland, 1990.

Weber, Jack A., "Forecasting Demand and Measuring Price Elasticity" Journal AWWA, May 1989, p. 57-65.

Williams, Martin and Byung Suh, "The Demand for Urban Water by Customer Class" Applied Economics, 1986, vol. 18, p. 1275-1289.

SOUTHWEST FLORIDA
WATER MANAGEMENT DISTRICT

RECOMMENDATIONS FOR DEFINING WATER CONSERVING RATE STRUCTURES

AUGUST 1999

REPORT SUBMITTED BY:

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1-800-800-9519

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ABBREVIATIONS

SWFWMD	Southwest Florida Water Management District
TG	Thousand gallons

1 INTRODUCTION

The SWFWMD is one of five water management districts responsible for overseeing and protecting water resources in Florida. As part of this responsibility, the SWFWMD has at times and for certain areas imposed rules on its water supply permittees regarding the design of water rate structures. Specifically, in some cases its permittees have been required to adopt water conserving rate structures (e.g., those in the Eastern, Northern Tampa Bay and Highlands Ridge Water Use Caution Areas).

1.1 Defining a Water Conserving Rate Structure

Defining a "water conserving rate structure" is not a simple, non-subjective task. The SWFWMD created a document defining interim minimum requirements for water conserving rate structures in 1991.[1] This document focused on rate structure form only. It stated that flat rates (no variable charges based on water use) and declining block rates (unit price decreases with increasing increments of water use during a billing period) are not water conserving rate structures. It instead encouraged the use of increasing block rates (unit price increases with increasing increments of water use during a billing period) and seasonal surcharges.

In 1993, Brown and Caldwell Consultants submitted a report to SWFWMD regarding the definition of water conservation promoting rates.[2] This report defined water conserving rates in a much more comprehensive fashion. It used criteria related to rate structure form, cost allocation between fixed and variable charges, rate level, and bill communication with customers.

Subsequent to this report, Brown and Caldwell Consultants in association with John B. Whitcomb conducted a large empirical study measuring how water prices can influence customers' water use consumption.[3] In 1995, John B. Whitcomb worked with Florida Water Services (formerly Southern States Utilities) in defining water conserving rate structures.[4] Recently, SWFWMD completed a 1997 census of the water rate structures used by its permittees.[5] The results of these projects offer new information and guidance for improving the 1993 Brown and Caldwell definition.

The objective of this report is to make recommendations on how SWFWMD might define "water conserving rate structures" as relevant to its policy making, funding, or

[1] Southwest Water Management District, *Interim Minimum Requirements for Water Conserving Rate Structures*, December 1991.
[2] Brown and Caldwell Consultants, *Definition of Water Conservation Promoting Rates*, Prepared for SWFWMD, February 1993.
[3] Brown and Caldwell Consultants and John B. Whitcomb, *Water Price Elasticity Study*, Prepared for SWFWMD, August 1993 and updated in 1999.
[4] John B. Whitcomb, *Financial Risk and Water Conserving Rate Structures*, Prepared for Southern States Utilities, April 1995.
[5] Southwest Florida Water Management District, *Estimated 1997 Water and Wastewater Charges in the Southwest Florida Water Management District*, June 1999.

regulatory activities. With respect to the 1993 Brown and Caldwell definition, the major changes are:

1. Scaleability. The threshold distinguishing between what is and is not a water conserving rate structure can be scaled depending on local water supply and demand conditions. In times and places of water shortages, more stringent definitions can be employed as necessary. This report does not create a binary definition (as the 1993 Brown and Caldwell did), but instead identifies a range of definitions.
2. Criteria Simplification. This report does not include rate level or wastewater charges in assessing water rate structures. Rate level refers to the revenue requirements collected via water rates. Ideally, revenue requirements should include all direct costs associated with providing water service and should not be subsidized from revenues from other sources (e.g., transfers from general funds, improper use of connection fee receipts, or tax revenues). This is not typically a major issue in Florida and is often difficult to assess if it is an issue. Including wastewater charges as part of the definition of water conserving rates is conceptually appealing in that wastewater charges are often linked in some fashion to water consumption. However, water and wastewater agencies commonly do not serve the same set of customers. In addition, wastewater agencies have different financial constraints and rate structure approaches (e.g., capping water use to reflect wastewater flows). Hence, excluding rate level and wastewater charges greatly simplifies the criteria is assessing the conservation potential of water rate structures.
3. Assessment Simplification. The 1993 Brown and Caldwell definition used both a go/no go format and a weighting format in assessing if a water rate structure is water conserving. It is possible for a rate structure to pass one format, but not the other leading to some inconsistencies. This report presents a simple go/no go format to simplify the assessment process.
4. Flexibility in Means to Achieve the Same Ends. The definition of water conserving rates employed here allows water utilities to adopt a variety of rate structures to comply. The overall constraint is that the rate structure options selected must send a water pricing signal to customers that is at least as great as an identified standard. This provides a consistent level of water conservation, while allowing maximum flexibility to permittees to design water rates.

1.2 Rate Making Objectives

A water utility must consider a number of rate-making objectives in designing water rates. These can include:

- Revenue Sufficiency. Rates should recover revenues equal to the costs incurred in providing water service to customers (revenue requirements).
- Cost-of-Service and Social Equity. Cost-of-service equity concerns the allocation of cost recovery among customer classes and customers. It is maximized when each customer's water bill equals, as close as possible, the cost borne by the utility in

providing that service. Social equity concerns providing low-income customers with affordable water service.

- Practicality. Water rates should be relatively easy for the utility to administer and for the customers to understand.
- Water Conservation. Rates should create a beneficial reduction in water use or water losses.

Theoretically, water conservation is maximized when a utility designs its rate structure so that marginal water prices equal the marginal private and social costs associated with providing water service.[6] Practically, it is difficult to measure social costs associated with water resources (e.g., environmental costs). In addition, maximizing the water conservation objective often conflicts with the other rate-making objectives.

Most notably, water conserving rate structures tend to decrease the probability of revenue sufficiency. Because future costs and water consumption are not known with certainty, rates cannot be set to be perfectly revenue sufficient; sometimes revenues will be too high and sometimes too low. In most cases, however, revenue stability tends to decline with water conserving rate structures as changes in water consumption patterns (e.g., from changes in weather or business activity) cause a greater financial swing.[7] Although revenue stability concerns can be mitigated by increasing financial reserves and/or changing water rates more frequently (to more adequately reflect changing costs and water use), it is an important objective to all utilities.

Because of practical limitations and because of competing rate objectives, the definition of a water conserving rate structure set forth here is in relative terms. The report focuses on how one rate structure can be more water conserving than another. It does not seek to identify or imply the use of a rate structure that maximizes water conservation in a theoretical economic context.

1.3 Report Outline

Chapter 2 provides a discussion of three criteria used to assess the water conserving nature of rate structures. Chapter 3 presents an equivalency table showing the recommended definition of water conserving rate structures at different levels of water curtailment. Chapter 4 illustrates the process using data from a hypothetical water utility.

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[6] A beneficial reduction is when the net benefits of conserving water exceed the net costs. See Baumann, Duane D., John J. Boland, and John Sims, *Water Conservation: A Struggle Over Definition*, Water Resources Research, pp. 428-434, April 1998.

[7] John B. Whitcomb, *Financial Risk and Water Conserving Rate Structures*, Prepared for Southern States Utilities, April 1995.

2 WATER CONSERVING RATE CRITERIA

Three criteria are recommended to assess the conserving nature of a water rate structure. They include:

1. cost allocation between fixed and variable charges
2. rate structure form
3. bill communication

This chapter describes each of these criteria. In the next chapter, these criteria are used to define water conserving rate structures.

2.1 Cost Allocation Between Fixed And Variable Charges

Almost all water utilities use a combination of fixed and variable charges to recover costs from customers. A fixed charge is assessed each billing period regardless of how much water is used (e.g., $5.00 per month for a ¾" meter). Fixed charges tend to increase with meter size. A variable charge is associated with the number of water units (e.g., TG) a customer consumes during a billing period. The more water a customer uses, the greater the variable charge for that customer.

The decision of the split between revenues collected via fixed and variable charges is an important one. Professional guidelines exist to assist in this decision based upon cost-of-service principles.[8] Nevertheless, there is often much judgement required in allocating costs between the fixed and variable components. Hence, a great variation in the industry is seen. Table 2-1 shows that the percentage of revenues collected via the fixed charge varies greatly with water utilities within the SWFWMD.

[8] American Water Works Association, *Water Rates Manual M1* (1991) and *Water Rates and Related Charges Manual M26* (1986).

Table 2-1. Fixed Charges As Percent of Water Bill

Fixed Charges Percent of Bill	Number of Utilities	Percent of Utilities
1 to 10%	1	1%
11 to 20%	7	5%
21 to 30%	16	13%
31 to 40%	34	27%
41 to 50%	24	19%
51 to 60%	21	16%
61 to 70%	13	10%
71 to 80%	3	2%
81 to 90%	5	4%
91 to 100%	4	3%
Total	128	100%

Source: Estimated 1997 Water and Wastewater Charges in the Southwest Florida Water Management District, June 1999. Based on 8 TG/month water use assumption for single family homes.

The decision on the cost allocation between fixed and variable charges has major significance regarding water conservation. Lower fixed charges result in higher variable charges, that in turn lead to lower water consumption. Table 2-2 shows long-run water consumption could be reduced by as much as 50 percent by going from a 50/50 to a 0/100 split of fixed/variable charges respectively. To the extent that water utilities have discretion in setting their fixed/variable split, they have the ability to greatly impact water consumption.

Table 2-2. Fixed/Variable Charge Tradeoff

% of Revenues From		Example Rates		Estimated Long-Run
Fixed	Variable	Fixed $/Month	Variable $/TG	Water Change
60%	40%	$18.00	$1.28	25.0%
55%	45%	$16.50	$1.62	11.1%
50%	50%	$15.00	$2.00	0.0%
45%	55%	$13.50	$2.42	-9.1%
40%	60%	$12.00	$2.88	-16.7%
35%	65%	$10.50	$3.38	-23.1%
30%	70%	$9.00	$3.92	-28.6%
25%	75%	$7.50	$4.50	-33.3%
20%	80%	$6.00	$5.12	-37.5%
15%	85%	$4.50	$5.78	-41.2%
10%	90%	$3.00	$6.48	-44.4%
5%	95%	$1.50	$7.22	-47.4%
0%	100%	$0.00	$8.00	-50.0%

Notes: Long-run water change measured from baseline of 50/50 fixed/variable charge split. Example rates designed to be revenue neutral and calculated using Waterate software model. Analysis assumes customers respond to marginal price and have a long-run price elasticity of -0.5. In the *Water Price Elasticity Study* conducted by Brown and Caldwell and John B. Whitcomb (1999), long-run price elasticity is –0.39 in the $0 to $1.81/TG price range, -0.69 in the $1.82 to $3.62/TG price range, and –0.24 for prices over $3.62/TG (1999 dollars).

2.2 Rate Structure Form

Another major policy variable controlled by water utilities is the variable charge. There are three general types of variable water rates as described below:

- Uniform Rate. Variable charge is the same for all units of water sold to a customer (e.g., $2.00 per TG).
- Decreasing Block Rate. Variable charge decreases with increasing increments of water use during a billing period (e.g., $3.00 per TG for first 10 TG and $1.00 per TG for all TG over 10).
- Increasing Block Rate. Variable charge increases with increasing increments of water use during a billing period (e.g., $1.00 per TG for first 10 TG and $3.00 per TG for all TG over 10).

In addition, variable charges may change by season using any of the general rate types listed above.

Table 2-3 shows the percentage of utilities employing each type of variable charge. The most frequent type of variable charge is the uniform charge (56%). Increasing block rate charges are used by 30%. Only one utility used a decreasing block rate and 13% used some type of flat rate (all revenues from fixed charges).

Table 2-3. SWFWMD Variable Charges

Variable Charge	Number of Utilities	Percent of Utilities
Uniform	66	56%
Decreasing Block	1	1%
Increasing Block	35	30%
None (e.g., Flat Rate or no separate charge)	15	13%
Total	117	100%

Source: Estimated 1997 Water and Wastewater Charges in the Southwest Florida Water Management District, June 1999.

As shown in the next chapter, the rate structure used for the recommended standard of comparison is the uniform. Water utilities, however, should get credit for adopting increasing block rate structures to the extent that they can increase marginal water prices above average water prices. Utilities with decreasing block rates or flat rates are not defined to be water conserving under any circumstances.

2.3 Bill Communication

In order for water customers to make informed, rational economic decisions regarding their water consumption, they must understand the water rate structure and their water use patterns. A convenient and logical way to convey this information is on the customer water bill.

All water bills serve the basic accounting function of notifying the customer of the bottom line dollar amount owed the utility for providing water service. As shown in Table 2-4, however, few water bills contain detailed pricing (19%) and historic water use information (19%). The motivated customer can obtain pricing information by directly contacting the utility and historic water use information by monitoring past water bills. However, this increases the time and effort required by the customer to compile such information. Increasing the cost of information will deter some customers from gathering and utilizing such information. Hence, including such information on the water bill can minimize such barriers.

Table 2-4. Customer Information on Water Bill

Bill Information	Percent of Utilities
Water Rate Structure	19%
Current Water Use	99%
Historic Water Use (last 12 months)	19%

Source: Estimated 1997 Water and Wastewater Charges in the Southwest Florida Water Management District, June 1999. Based on 104 utilities submitting copies of water bills.

3 WATER CONSERVING RATE STRUCTURES DEFINED

This chapter presents the recommended conditions required to define a rate structure as water conserving based on the criteria set forth in Chapter 2. A graduated scale is developed allowing for progressively more stringent definitions of water conserving. In addition, for each scale a water utility has flexibility in adopting different rate structure forms and/or including information on the water bill to comply.

3.1 Basic Definition

The basic recommended definition of a water conserving rate structure is based on:

- a minimum percentage of revenues collected via variable charges
- a uniform variable rate
- no requirements on the information contained on the water bill

The decision variable for the SWFWMD is what level to set the minimum percentage of revenues collected via the variable charge. As shown previously in Table 2-2, increasing this percentage can significantly reduce water consumption in the long run.

The 1993 Brown and Caldwell definition suggested a 75 percent minimum percentage of revenues from variable charges. Given that less than 19% of SWFWMD utilities comply with this requirement (based on Table 2-1), enforcing this threshold would lead to dramatic water savings. SWFWMD may want to relax the threshold to a lower percentage (e.g., 50 percent) to make it easier for utilities to comply. Or, if conditions warrant (i.e., severe water shortages), SWFWMD may want to use a more strict standard (e.g., 90 percent). Because water shortages can change over time and place, SWFWMD may also want to change its minimum percentage requirements over time and place.

3.2 Credit for Rate Structure Form

Increasing block rates and seasonal surcharges can increase the conservation price signal sent to customers relative to using a uniform rate. A water conserving rate structure definition should factor in this impact. Because increasing block rates are typically only designed for residential customers, this situation focuses on this customer group.

The approach taken here is to credit utilities with increasing block rates or seasonal surcharges by lowering their basic threshold with respect to the minimum percentage of revenues collected via variable charges. If the basic threshold is set at 75 percent, for example, then utilities with increasing block rates may only need to comply with a 70 or 65 percent threshold. This gives utilities the flexibility to design and adopt alternative rate structures so long as they provide the desired results.

The magnitude of the credit can be set to equalize the overall price signal sent to customers in relation to the uniform rate structure. To quantify the credit, utilities would need to calculate the following ratio:

Price Ratio = Weighted Marginal Water Price / Average Water Price

Average water price equals revenues from all variables charges divided by number of water units sold. For example, if annual variable charge revenues are $1,000,000 and the total TG sold to customers are 1,000,000, then the average price would be $1.00 per TG. Changing rate structure form has little impact on average water price.

Weighted marginal water price equals the marginal price each customer faces averaged over all customers. The average is weighted by the amount of water each customer uses. For example, if one customer uses 10 TG and faces a $1.00 per TG marginal price and another customer uses 20 TG and faces a $3.00 per TG marginal price, then the weighted marginal price would be $1.00*10/30 + $3*20/30 or $2.33 per TG. Changing rate structure form can dramatically impact weighted marginal price. With increasing block rates and seasonal surcharges, weighted marginal price is larger than average water price. In general, larger water price differentials among the blocks and seasons lead to larger price ratios.

Details of how weighted marginal price is calculated are described in Chapter 4.

Once the price ratio is calculated, utilities can use Table 3-1 to see the credit provided in terms of lowering the percentage of revenues that would need to be collected via the quantity charge. Given a 75 percent minimum threshold and a 1.56 price ratio, for example, a utility would only need to collect 60 percent of its revenues from variable charges.

Table 3-1. Rate Structure Form Price Ratio Equivalency:
Minimum Ratio of Weighted Marginal Price to Average Price

Min % of Revenues from Quantity Charges (SWFWMD Policy Variable)	Actual % of Revenues from Quantity Charges												
	40%	**45%**	**50%**	**55%**	**60%**	**65%**	**70%**	**75%**	**80%**	**85%**	**90%**	**95%**	**100%**
40%	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45%	1.27	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50%	1.56	1.23	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
55%	1.89	1.49	1.21	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60%	2.25	1.78	1.44	1.19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
65%	2.64	2.09	1.69	1.40	1.17	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70%	3.06	2.42	1.96	1.62	1.36	1.16	1.00	1.00	1.00	1.00	1.00	1.00	1.00
75%	3.52	2.78	2.25	1.86	1.56	1.33	1.15	1.00	1.00	1.00	1.00	1.00	1.00
80%	4.00	3.16	2.56	2.12	1.78	1.51	1.31	1.14	1.00	1.00	1.00	1.00	1.00
85%	4.52	3.57	2.89	2.39	2.01	1.71	1.47	1.28	1.13	1.00	1.00	1.00	1.00
90%	5.06	4.00	3.24	2.68	2.25	1.92	1.65	1.44	1.27	1.12	1.00	1.00	1.00
95%	5.64	4.46	3.61	2.98	2.51	2.14	1.84	1.60	1.41	1.25	1.11	1.00	1.00
100%	6.25	4.94	4.00	3.31	2.78	2.37	2.04	1.78	1.56	1.38	1.23	1.11	1.00

Notes: The values shown in the table equal the minimum ratio defined as weighted marginal water price divided over average price for a base year for single family homes. Ratio equals 1.00 with uniform variable charge. Increasing block rates create ratio greater than 1.00. Minimum ratios are set so as to create the same water savings as the uniform rate structure with a higher percentage of revenues collected via the quantity charge. For example, an increasing block rate structure with a price ratio of 1.15 and 70% of revenues from variable charges is equivalent to a uniform variable rate with 75% of revenues from variable charges. The price ratios are determined assuming a long-run price elasticity assumption of -0.5 and using the Waterate software model. Analysis does not include impacts from wastewater charges.

3.3 Credit for Bill Information

The basic definition of a water conserving rate structure makes no recommended requirements on the information contained on the water bill. However, including complete rate structure information may encourage a customer to make alterations to their water use to avoid higher cost block charges or penalties for excessive use. In addition, providing historical water use data can help customers track the effectiveness of their own water conservation efforts, monitor water use patterns, and help uncover unusual water use that indicate leaks or other problems.

Unlike the rate structure form credit, no empirical evidence exists to assist in quantifying the size of the credit to offer regarding bill information. Because economic theory suggests that rational decision making depends on consumers understanding the details of pricing and water uses, however, the credit should be non-trivial.

In the definition proposed in this report, utilities are granted a credit equivalent to a 5 percent reduction in the minimum percentage of revenues to be collected via variable charges for including both rate structure information and historic water use. In addition, the SWFWMD could offer additional credit for utilities that include customer class water use statistics on their bills and read meters and bill customers on a frequent basis (e.g., monthly).

4 CASE STUDY ILLUSTRATION

This chapter provides an illustration of how to calculate the price ratio for a utility using an increasing block rate for single family customers. This price ratio can be used with Table 3-1 to determine the credit allowed in lowering the threshold of the percentage of revenues coming from variable charges.

The first step for the utility is to create a bill frequency analysis table such as that shown in Table 4-1 over a recent 12-month period.

The second step for the utility is to calculate the weighted marginal price associated with the rate structure. This is calculated by multiplying the water prices associated with each block by the percent of marginal water use associated with each block as shown in Table 4-2. In this example, a two-block rate structure is used with the price in the first block (0 to 6 TG per billing period) equaling $1.00 per TG and the price in the second block (greater than 6 TG per billing period) equaling $2.00 per TG.

The third step for the utility is to calculate average price. This is calculated by multiplying the water prices associated with each block by the percentage of water sold in each block. Table 4-2 also shows this tabulation.

Lastly, the price ratio is obtained by dividing weighted marginal water price by average water price. In the illustration shown in Table 4-2, the price ratio is 1.25.

Assuming a water conserving rate structure is defined and scaled to have a basic threshold of 75 percent of its revenues derived from variable charges, a utility with a 1.25 price ratio only needs to recover 70 percent using Table 3-1. If a price ratio of 1.33 could be obtained, the minimum percentage required would drop to 65 percent. Higher price ratios can be achieved by increasing water prices in the upper blocks and/or by changing the amount of water defined in each block.

In addition, if the utility used a water bill that included complete rate structure information and historic water use over a 12-month period, the minimum actual percentage of revenues collected via quantity charges would drop by an additional 5 percent.

Table 4-1. Bill Frequency Analysis

TG/Month	Bill Count	Water Use (TG)	Cumulative Water Use (TG)	Water Use > 6 TG
1	675	675		0
2	2851	5702		0
3	4272	12816		0
4	4291	17164		0
5	4497	22485		0
6	4474	26844	85686	0
7	3434	24038		3434
8	2931	23448		5862
9	2510	22590		7530
10	1915	19150		7660
11	1430	15730		7150
12	1304	15648		7824
13	1008	13104		7056
14	825	11550		6600
15	730	10945		6567
16	601	9614		6009
17	515	8756		5665
18	515	9271		6180
19	429	8155		5580
20	429	8584		6009
21	343	7211		5150
22	258	5665		4120
23	258	5923		4378
24	258	6180		4635
25	386	9657		7339
26	129	3348		2575
27	215	5794		4507
28	172	4807		3777
29	129	3734		2961
30	172	5150		4120
31	86	2661		2146
32	86	2747		2232
33	86	2833		2318
34	86	2919		2404
35	86	3004		2489
36	86	3090		2575
37	43	1588		1331
38	43	1631		1373
39	43	1674		1416
40	43	1717		1459
Total	42640	367601		152433

Notes: Bill frequency based on a 10 utility average over a 12- month period.

Table 4-2. Price Ratio Calculation

Description	0 to 6 TG/Month	Over 6 TG/Month	Total
Marginal Water Use TG	85,686	281,915	367,601
Marginal Water Use %	23%	77%	100%
Marginal Water Price $/TG	$1.00	$2.00	
Weighted Marginal Water Price $/TG			$1.77
Water Use Sold TG	215,168	152,433	367,601
Water Use Sold %	59%	41%	100%
Marginal Water Price $/TG	$1.00	$2.00	
Average Water Price $/TG			$1.41
Weighted Marginal/Average Price Ratio			1.25

Notes: Marginal water use equals sum of all water use in third column of Table 4-1 within applicable blocks (1 to 6 and 7 to 40 TG). Weighted marginal water price equals 23%*$1.00 + 77%*$2.00 or $1.77. Water use sold in the 2nd block equals the sum of all water use in the 5th column of Table 4-1. Water use sold in the 1st block equals all remaining water use (367,601-152,433=215,168). Average water price equals 59%*$1.00 + 41%*$2.00 or $1.41.

Bibilography

References

American Water Works Association. Alternative Rates. AWWA M34. 1992.

California Department of Water Resources. Water Conservation Guidebook No. 9: Guidebook on Conservation - Oriented Water Rates. October 1988.

California Urban Water Conservation Council. Designing, Evaluating, and Implementing Conservation Rate Structures. July 1997

Jordan, J. L. and A. H. Elnagheeb. "Water Pricing in Georgia". In Proceedings of the 1993 Georgia Water Resources Conference. University of Georgia, Athens, Georgia. 1993.

Jordan, Jeffrey L. "The Effectiveness of Pricing as a Stand-Alone Water Conservation Program." Water Resources Bulletin. Vol. 30, No. 5. October 1994.