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THE COST OF WATER SUPPLY AND WATER UTILITY MANAGEMENT

Volume II

by

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FOREWORD

The Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and welfare of the American people. Noxious air, foul water, and spoiled land are tragic testimonies to the deterioration of our natural environment. The complexity of that environment and the interplay among its components require a concentrated and integrated attack on the problem.

Research and development is that first step in problem solution, and it involves defining the problem, measuring its impact, and searching for solutions. The Municipal Environmental Research Laboratory develops new and improved technology and systems (1) to prevent, treat, and manage wastewater, solid and hazardous waste, and pollutant discharges from municipal and community sources, (2) to preserve and treat public drinking water supplies, and (3) to minimize the adverse economic, social, health, and aesthetic effects of pollution. This publication is a product of that research and is a most vital communications link between the researcher and user community.

The Safe Drinking Water Act of 1974 establishes primary, health-related standards and secondary, aesthetic-related but nonenforceable guidelines for drinking water supplies. These standards will bring about fundamental changes in the way water is handled before it is delivered to the consumer. Many of these changes will have an economic impact on the affected water utilities. This report provides detailed information on the current costs of water supply for 12 selected water utilities. In addition to providing information on the individual supplies, data are aggregated to provide projections of the relative impact of various strategies that might be undertaken to satisfy the Act's requirements. These data and associated analyses are presented in two volumes. Volume I is a summary of selected data from the study together with its analysis. Volume II contains detailed, in-depth information for each utility studied.

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ABSTRACT

A study of 12 selected water utilities was undertaken to determine the economics of water delivery. Data were collected from at least one Class A water utility (revenues greater than $500,00O/year) in each of the U. S. Environmental Protection Agency's 10 regions. Volume I provides summary information and in-depth analyses of five of the utilities studied. All the utilities are analyzed in aggregate, and factors affecting the cost of water supply are examined. Also provided is an evaluation of the hypothetical impact of the Safe Drinking Water Act in 1980.

Volume II contains the basic data from each of the 12 utilities studied. Services of each utility were divided into three functional areas common to all water supply delivery systems--acquisition, treatment or purification, and distribution. These areas provided a common basis for collecting and comparing data. Costs were categorized either as operating or as capital expenditures.

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ABBREVIATIONS AND DEFINITIONS

cost	-- expense of water production
CPI	-- Consumer price index
Maximum day/ maximum hour	-- maximum day flow for the year in MGD/maximum hour flow for the year in MGD
Mil gal	-- million gallons
MGD	-- million gallons per day
Price	-- amount charged user
Retail service area	-- area in which water is retailed by the utility
Revenue-producing water (RPW)	-- the water measured as metered consumption and paid for by wholesale and retail customers within the service area
Treated water	-- the amount of water treated through the water department's treatment plant
SMSA	-- standard metropolitan statistical area
Source water	-- raw water from ground or surface supply

METRIC CONVERSION TABLE

English Units	Metric Equivalents
1 foot	0.305 meters
1 mile	1.61 kilometers
1 sq mi	2.5~ sq kilometers
1 mil gal	3.79 thou cu meters
1 $/mil gal	0.26 $/thou cu meters

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SECTION I

EXECUTIVE SUMMARY

A two-year study of 12 selected water utilities was undertaken to determine the economics of water delivery. Data were collected from at least one class A water utility (revenues greater than $500,000/year) in each of U. S. Environmental Protection Agency's (EPA) 10 regions. The finished water from all utilities selected meets the 1962 Public Health Service Drinking Water Standards, Volume I of this report provides in-depth analyses for five of the 12 utilities studied: Cincinnati, Ohio; Kansas City, Missouri; Fairfax County Water Authority in Fairfax, Virginia; Dallas, Texas; and the Elizabethtown Water Company in Elizabeth, New Jersey. Aggregate analysis of data from all the utilities is also provided in Volume I, along with an evaluation of factors affecting the cost of water supply and a consideration of the impact of technologies that might be used to satisfy requirements of the Safe Drinking Water Act.

Volume II contains the basic data from each of the 12 utilities studied. They represent many institutional arrangements, physically different water supply systems, and different conditions faced by water utilities across the United States. For example, Cincinnati and Kansas City are single-source utilities distributing water to far-flung distribution areas. Others, such as the Dallas Water Utility and the Fairfax County Water Authority, are in rapidly growing areas with capital costs distributed over a fast growing, revenue-producing base that keeps water costs low. Two investor-owned utilities, Elizabethtown Water Company and New Haven Water Company, were included in the sample to demonstrate problems associated with investor-owned utilities. The San Diego and Phoenix utilities operate in water-short areas. Pueblo and Kenton County were the smallest utilities studied. Seattle has made extensive investments in controlled source protection, and Orlando uses groundwater from a deep aquifer.

Data were collected for 10 years in five operating cost categories and two capital cost categories. The operating cost categories are support services, acquisition, treatment, power and pumping, and transmission and distribution. Capital costs were dived into interest and depreciation. Each operating cost category was examined as to total expenditures, unit costs, and percent of total cost. Revenue-producing water was used for all unit cost calculations because it represents the basis on which utilities obtain their operating revenues. The impact of operating expenditures, increasing labor costs, and increasing labor productivity on total water production costs were examined.

A systems evaluation was made for each utility in which the service area was divided into its components. Schematic diagrams of the system components have been developed for each of the utilities studied. For some utilities, these diagrams are very detailed, and for others, because of the complexity of the system, the diagram is somewhat superficial. By using the systems diagram and the previous cost categorizations, it was possible to evaluate the costs associated with delivering water to various subsections of the distribution system and to make some estimates as to how the costs of water vary throughout the distribution area.

Individual and comparative analyses reveal certain trends. Labor cost is a significant part of the annual operating costs for all utilities and has nearly doubled in some cases over the period of analysis. More and more dollars are being shifted into support service activities. Examination of water delivery costs shows that they increase with the distance from the treatment plant; thus there are definite limits to the efficient size of water utility service areas.

Mathematical models have been developed that relate labor cost ($/man-hour), productivity (man-hours/million gallons (mil gal)), and production (revenue-producing water) to annual operating costs. Another model has been developed for annual capital costs incorporating revenue-producing water and depreciation.

Extrapolations have been made with historical data for future water costs. Estimates for meeting the Safe Drinking Water Act's organic standards have been superimposed on these costs. Between 1974 and 1980, it is estimated that the price of water will have increased by 36% as a result of normal inflation and increased demands. For those few utilities required, under the Safe Drinking Water Act, to install the most expensive control technology (granular activated carbon), costs will increase an additional 24% above the expected 1980 level.

Total costs for each of the 12 utilities during the latest year of data collection are shown in Table 1. Taxes for the investor-owned utilities are reported separately. This analysis provides a mechanism for comparing utilities.

We hope these data will provide useful information on water supply costs from various utility systems and an example of the means by which data can be collected from water supplies to provide comparative information. With the advent of the Safe Drinking Water Act, regulatory agencies, utility managers, and the public should be able to isolate and understand various cost impacts on utilities of inflation and expansion demand versus regulatory impacts. The approach suggested here will allow the utility manager to pinpoint areas where costs are spiraling out of control and allow him to take corrective action. Table 2 summarizes some of the expected cost increases resulting from inflation and demand, as well as the effects of add-on technologies.

TABLE 1. COST ANALYSIS SUMMARY FOR LATEST YEAR OF RECORD (1974)

Utility	Revenue-producing water (mil gal)	Cost categories ($/mil gal)					
		Support services	Acquisition	Treatment	Distribution	Interest	Total
Kansas City	26,855	$ 145	$ 15	$ 82	$ 138	$ 50	$ 430
Dallas	63,030	83	25	52	120	58	338
San Diego	47,192	96	277	28	106	7	514
New Haven	17,714	113	29	15	106	117	560"
Fairfax Co.	19,232	88	35	56	134	209	522
Phoenix	63,661	91	17	47	112	53	320
Kenton Co.	2,259	82	12	103	124	73	394
Orlando	12,522	110	42	22	135	85	394
Elizabeth	38,256	89	67	33	144	113	492+
Pueblo	6,793	99	38	84	232	164	617
Seattle	45,967	109	37	13	77	27	263
Cincinnati	38,104	85	17	36	139	18	295

* Includes $179 taxes.

+ Includes $76 taxes.

TABLE 2. EXPECTED INCREASE IN COSTS FOR 1980

Item	cost in 1975	Expected cost in 1980	1980 costs with add-on technologies		
			GAC - contractors	GAC - media replacement	Chlorine dioxide
Treatment operating cost ($/yr in millions)	1.10	1.50	2.97	4.17	2.17
Treatment capital cost ($/yr in millions)	0.48	0.60	3.34	1.33	0.73
Total operating cost ($/yr in millions)	8.85	12.40	13.07	15.07	13.07
Total capital cost ($/yr in millions)	3.80	4.95	7.69	5.68	5.08
Total production cost ($/yr in millions	12.75	17.35	21.56	20.75	18.25
Total unit cost ($/mil gal)	412.00	480.00	596.47	574.06	504.90

SECTION 2

INTRODUCTION

The Safe Drinking Water Act of 1974 will bring about fundamental changes in the way drinking water is handled before it is delivered to consumers. The Act establishes primary health-related standards and secondary or aesthetic-related but nonenforceable guidelines for drinking water supplies. Throughout the Act, emphasis is placed on the need to consider the economics of water delivery.

In response to this need, a 2-year study of selected water utilities was undertaken in which data were collected from at least one Class A water utility (revenues greater than $500,000/year) in each of the U. S. Environmental Protection Agency's 10 regions. Figure 1 shows the location of the utilities studied. Twelve utilities were selected for investigation--one in regions I, II, III, V, VI, VII, VIII, and X and two in regions IV and IX. The study, which ran from 1974 through 1976, was conducted in two phases with a special study in Cincinnati, Ohio. Data were collected so that costs could be easily compared among utilities.

Each utility's services were divided into the functional areas of acquisition, treatment or purification, and distribution. These functional areas or subsystems are common to all water supply delivery systems and can therefore provide a common basis for data collection. Another category common to all water utilities is the management or administrative function which completes the framework of the institution for insuring an adequate supply of safe drinking water. This institution is most commonly called a water supply utility.

Costs were categorized as either operating or capital expenditures. Operating costs have been assigned to the following functional areas: acquisition, treatment, power and pumping, transmission and distribution (including storage),and support services. The first four functional areas are related to the physical delivery of water, and the fifth, support services, is related to the overall integrative responsibility of utility management. Operating costs include operating labor, maintenance, and materials. For example, if the utility has a treatment division, laboratory personnel costs are included in the treatment cost category, but management costs for the division are included in the support services category. Support services include, therefore, all of the administrative and customer services that are required to manage the water utility and collect revenues but that are not directly related to the physical process of delivering water.

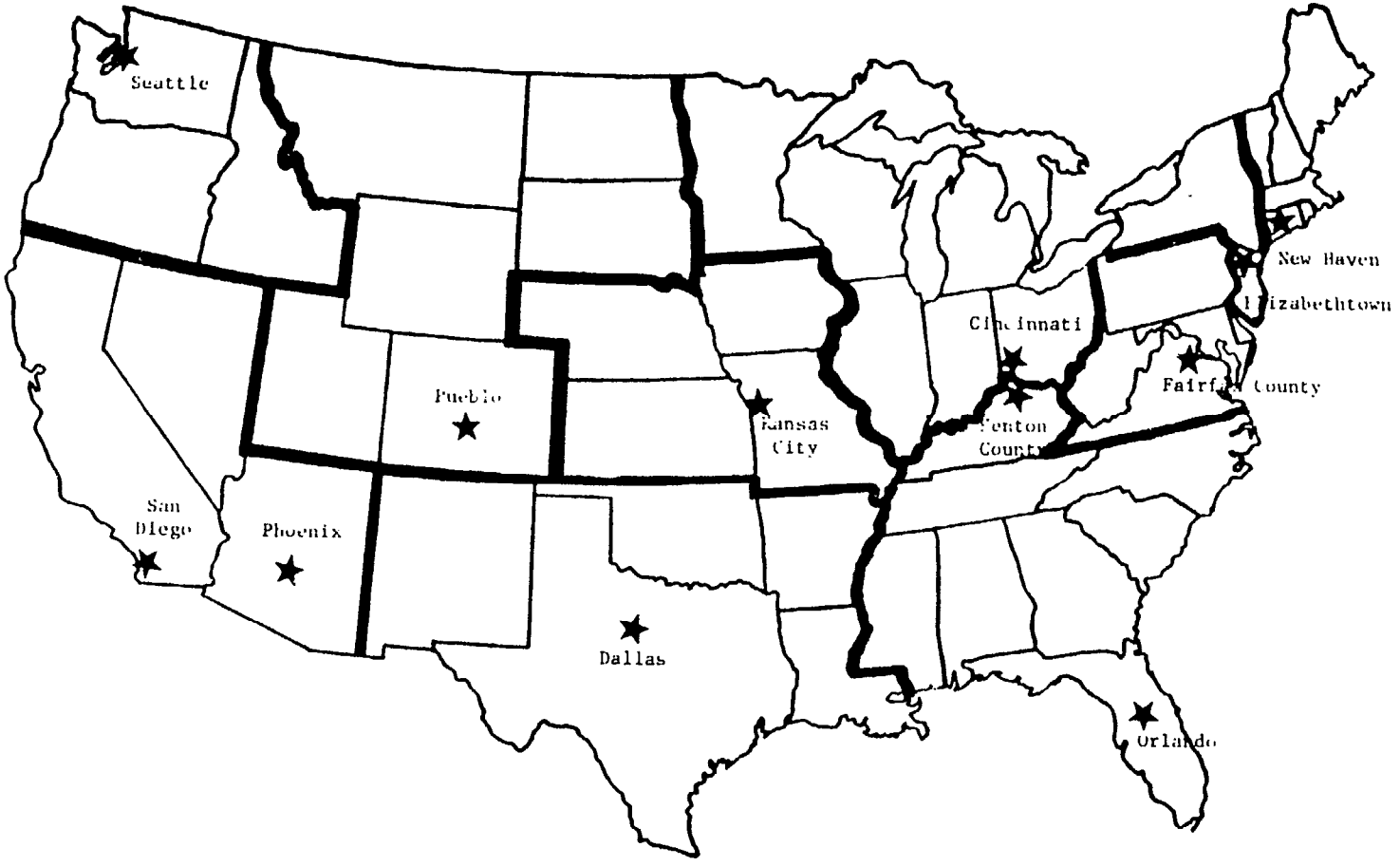

Figure 1. Location of water utilities studied.

Capital costs are assumed as depreciation and interest for the plant-in-service. Depreciation is based on the historic cost of the facility divided by its useful life, and not on the costs required to reproduce the facility. Lower costs will therefore be associated with older utilities. Most of the utilities analyzed constructed the major portion of their facilities in the 1930's and 40's. Interest costs are the dollars the utilities must pay for their bonds or other money raising mechanisms.

Revenues were not considered in this report. All of the data reported are strictly related to the cost of water supply and do not include some of the broader aspects of elasticity of demand and optimal pricing policies of water supply. All costs reported are based on revenue-producing water (RPW) pumped by the utilities for a 10-year period from 1965 through 1974.

The report has been prepared in two volumes. Volume I contains summary information and an analysis of the factors that affect the cost of water supply,and Volume II contains the basic data from each of the selected utilities.

SECTION 3

CONCLUSIONS

Data from the 12 utilities studied here are representative of many utilities in the United States. Distributed across the country, the 12 utilities studied reflect differences in wage rates and costs for various items throughout the United States. The cost of water supply has been continually increasing as a result of increased capital and labor costs, labor wage rates, costs of chemicals and other supplies, and increased demand for water. However, a decrease in the number of man-hours required to supply 1 million gallons (mil gal) of water has moderated these cost increases. In many cases, when the unit cost of water is modified by the Consumer Price Index (CPI), costs have actually decreased with time.

Equations developed in Volume 1 show that when water conservation measures are adopted, increasing wage rates and other inflationary effects will increase the cost of water in accordance with other cost increases in the economy. Such increases are inevitable and should be anticipated.

The methodology used for collecting these data can be applied to water utilities not included in this study. Such an application would provide for a comparative and standardized analysis of water supply costs for all utilities. This effort is intended as a model for other related data collection efforts.

SECTION 4

OVERVIEW AND AGGREGATE DATA ANALYSIS

Revenue-producing water from all 12 utilities increased by approximately 50% over the 10-year period studied (1965-74) (Figure 2).

Average costs for the five major operating cost categories all showed substantial increases over time (Table 3). Support services increased from an average of slightly over $1 million/year to more than $3 million/year, or by nearly 200%. The other categories increased by slightly more than 1002, with the exception of transmission and distribution, which increased by approximately 73%.

Unit costs had considerably smaller increases or remained stable during the 10-year period (Table 4). Support services unit cost increased nearly 63%, transmission and distribution stayed nearly the same, and total expendutires increased by less than 50%.

The five operating cost categories varied as a percent of total operating cost (Table 5). Support services increased from 26% to slightly over 31%, and treatment, power and pumping, and transmission and distribution decreased as percents of total operating cost.

Average operating and capital costs for all 12 utilities more than doubled during the 10-year period (Table 6). Operating expenditures increased by 127%, and capital expenditures increased by 78%. Unit costs increased by only 25%.

Average operating and capital expenditures ratios for the 12 utilities studied are shown in Table 7. Operating expenses increased as a percent of total cost from 64.5% in the first year of analysis to nearly 70% by the last year, whereas capital cost dropped from 35.5% in the first year of analysis to just over 30% in the last year.

The impact of labor and operating costs for water supply are shown in Table 8. Labor costs accounted for 42% of the utilities' operating costs in the first year of analysis and 42% in the last year. The average cost/man-hour increased 82%, but the ratio of man-hours/mil gal of RPW decreased by 16%. Table 8 shows a steady decrease in capital/labor cost ratio. Although economies of scale were in effect with respect to the number of man-hours used to produce water, this cost reduction was nullified by wage increases. Labor is therefore a very important factor in what is typically presumed to be a capital intensive industry.

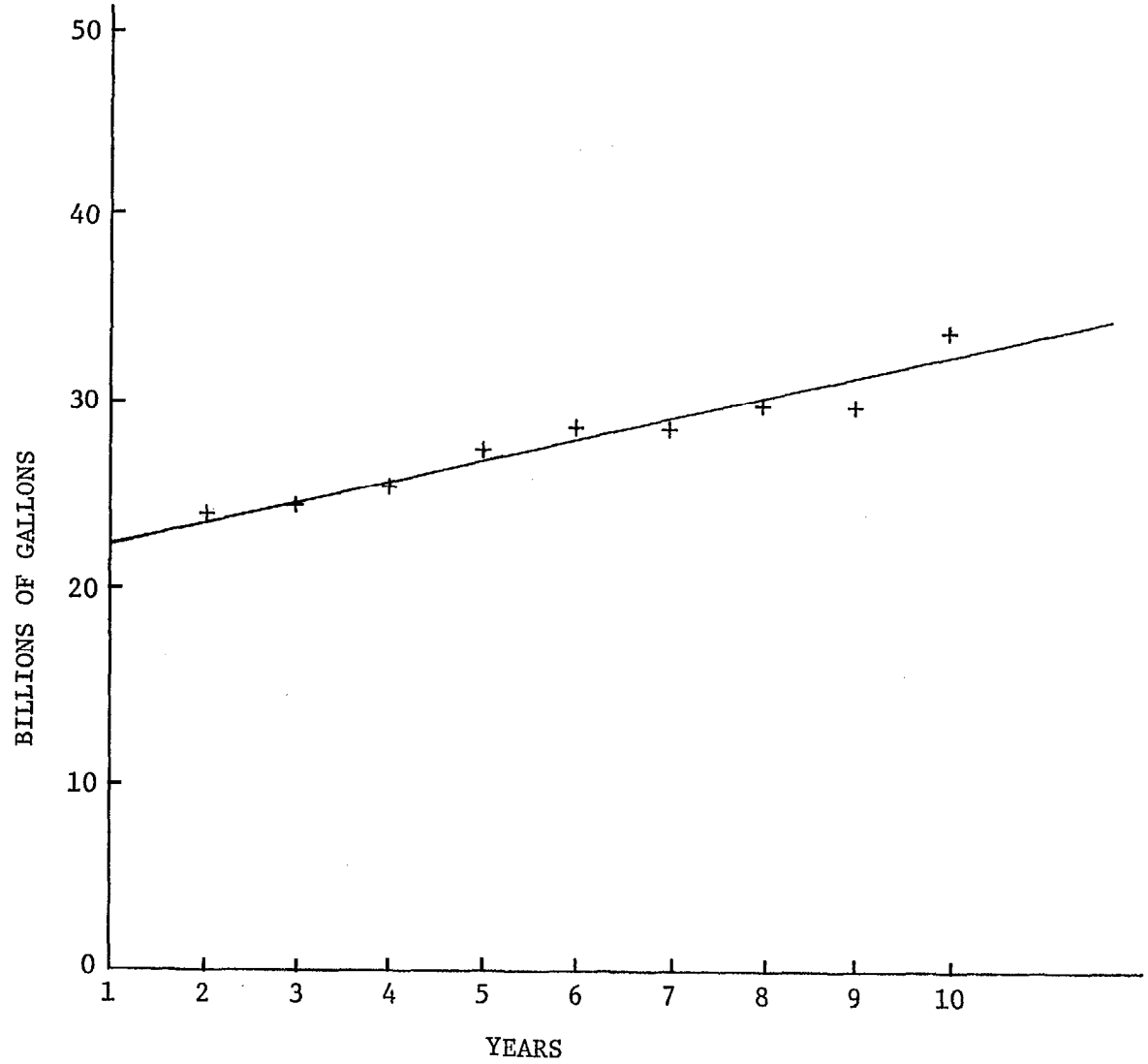

Figure 2. Average annual revenue-producing water for all 12 utilities.