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Community Water System Survey

Volume I: Overview

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Acknowledgements

Many dedicated owners, operators, and managers of community water systems made this survey possible. We would like to thank the almost 2,000 water systems that devoted valuable time to searching through records and completing questionnaires.

The Community Water System Survey was managed by Mr. Brian C. Rourke of EPA's Office of Ground Water and Drinking Water (OGWDW). He was assisted by Mr. Benjamin P. Smith, also of OGWDW.

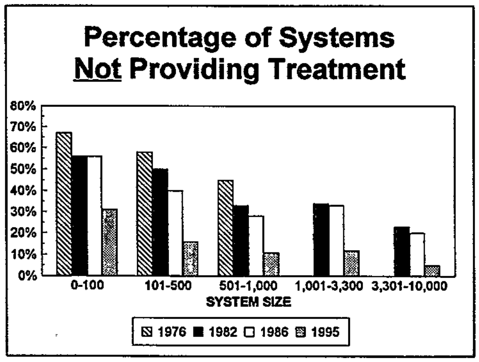
The Cadmus Group, Inc. served as prime contractor for this project. Westat, Inc., a subcontractor, was responsible for survey design, data collection and database development.

Executive Summary

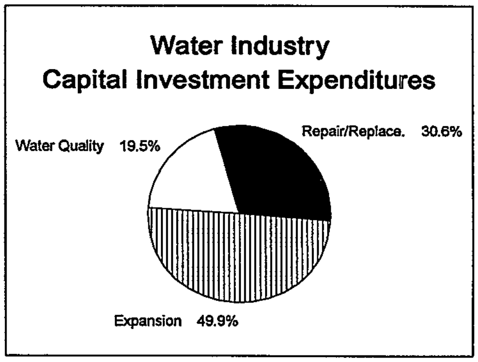
Trends and Key Findings

The U.S. Environmental Protection Agency (EPA) conducted the 1995 Community Water System (CWS) Survey to obtain data to support its development and evaluation of drinking water regulations. Most of the operating characteristics of community water systems are unchanged from 1976, when the first CWS Survey was conducted. The vast majority of systems are small and privately owned, but most people are customers of large publicly owned systems. Nevertheless, there have been some important changes since the first CWS Survey. Trends and key findings from the survey include:

- **The percentage of systems that do not treat their water steadily declined from 1976 to 1995.** This is consistent with the emphasis on water quality monitoring and treatment since the Safe Drinking Water Act (SDWA) was first passed in 1974. For more information on this trend, see section 3.1.1 of Chapter 3.



- **In spite of this decrease in systems not providing treatment, only 19.5 percent of the capital investment made by community water systems is for water quality improvements.** Community water systems reported spending $32.6 billion in the 8 years following SDWA reauthorization in 1986. The largest category of capital investment was expansion (49.9 percent of the total), followed by repair and replacement of infrastructure (30.6 percent). This is discussed more fully in section 3.1.2.



- **Standard financial ratios indicate that many small community water systems are, on average, not financially healthy.** The operating ratio is calculated by dividing total operating revenues by operation and maintenance (O&M) expenses. If the ratio is 1.0, a system can cover its daily expenses, but little else. A higher ratio means that funds are available for non-operating functions, such as servicing debt or establishing a capital reserve fund. As shown in the following table, over 30 percent of all small systems serving fewer than 500 people have operating ratios of less than 1.0.

Distribution of Operating Ratio (Percentage of Systems)				
	System Size			
	<500	501-3,300	3,301-50,000	>50,000
Public Water Systems				
<1	34.8	19.0	14.4	8.3
1 to 1.2	17.8	23.6	10.8	9.5
>1.2	47.4	57.4	74.8	82.2
Private Water Systems				
<1	32.3	17.2	6.0	6.4
1 to 1.2	19.6	18.7	16.8	5.1
>1.2	48.1	64.1	77.2	88.5

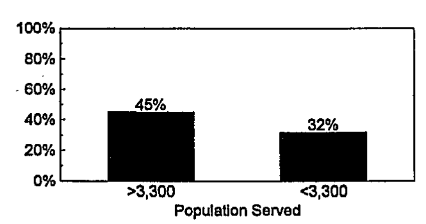
Another measure of financial condition is the debt service coverage ratio. It gauges the ability of the system to cover debt service after all other "cash" expenses have been paid. The numerator of this ratio is the annual net revenue available to pay debt service costs, and the denominator is the amount of debt to be retired plus associated interest on that debt. Generally, this ratio should exceed 1.0. The table below shows that approximately half of the systems in the smallest size category have ratios of less than 1.0.

Distribution of Debt Service Coverage Ratio (Percentage of Systems)				
	System Size			
	<500	501-3,300	3,301-50,000	>50,000
Public Water Systems				
<1.0	52.1	41.5	25.7	15.7
1.0 to 1.5	19.3	16.5	21.0	21.2
>1.5	28.6	42.0	53.3	63.1
Private Water Systems				
<1.0	46.7	28.5	15.4	7.7
1.0 to 1.5	12.6	11.4	14.8	3.1
>1.5	40.7	60.1	69.8	89.2

When assessing this financial information about water systems, please note the survey results represent only one year of financial performance. Using only this "snapshot" of the industry in 1995, EPA's ability to derive conclusions about the overall financial health of the water industry is limited. For a more detailed interpretation of this financial data, see section 3.1.2.

- **Over one-third of all community water systems participate in some type of source water protection effort.** These efforts can be a low-cost method of preventing contamination of water sources. Systems serving populations greater than 3,300 reported a higher rate of participation in source water protection efforts (45 percent) than did systems that serve fewer than 3,300 people (32 percent).

Percentage of Systems Participating in Source Water Protection



The 1996 SDWA Amendments made source water protection a national priority. The survey results show that a substantial portion of community water systems already participate in some type of contamination prevention efforts. These efforts may or may not meet requirements under state source water protection programs. For more information on source water protection, see section 3.1.1.

Survey Methodology

EPA surveyed community water systems in 1976, 1982, and 1986. Consistent with the previous surveys, the 1995 CWS Survey collected information on the most important operational and financial characteristics of community water systems.

EPA started the 1995 CWS Survey in the fall of 1994. During Phase I, EPA developed a preliminary survey instrument and sampling plan, then conducted a pretest with nine water systems to gauge respondents' reactions to the draft questionnaire. Next, EPA conducted a full-scale pilot test of the questionnaire. The Agency used a computer-assisted telephone interview questionnaire to identify eligible systems and appropriate respondents for the pilot test and for the mail questionnaire.

In Phase II, EPA revised the survey instrument and sampling plan based on results of the pilot test. The Agency mailed the questionnaire to 3,700 eligible community water systems in June 1995 and maintained a toll-free helpline to answer questions from respondents. EPA continued to receive completed questionnaires until February 1996, at which time approximately 54 percent of the eligible participants had completed questionnaires.

A more complete discussion of the survey methodology can be found in Chapter 1 of Volume I and in Volume II, Part 3 (Methodology Report).

Intended Uses of CWS Survey Data

EPA developed the CWS Survey database to provide critical data to support regulatory development and implementation. The Agency plans to use the data to support the types of analyses discussed below.

Regulatory Development Analyses. Before new regulations are established under the SDWA, the Agency must satisfy the requirements of various statutes and regulations including: Executive Order 12866, the Paperwork Reduction Act, the Regulatory Flexibility Act, the Small Business Regulatory Enforcement Fairness Act, and the Unfunded Mandates Reform Act. Data from the CWS Survey provide baseline information that is critical to the preparation of these analyses.

Policy Development Analyses. The diversity of water systems in the CWS Survey database provides sufficient financial and operational data to support a variety of Agency initiatives to develop policies and guidance documents for states and public water systems concerning the implementation and enforcement of drinking water regulations. The Agency also receives periodic requests from Congressional staff and committees, other federal agencies, and the public for information on the water supply industry. The 1995 CWS Survey provides current information on the water industry to satisfy these requests.

Regulatory Implementation Analyses. A critical issue for EPA to address under the 1996 SDWA Amendments is whether the drinking water industry, and small systems in particular, have the technical and financial capacity to comply with SDWA regulations over a sustained period. Congress has provided money to assist the states and EPA in building additional capacity through State Revolving Loan Funds for public water systems. CWS Survey data, in conjunction with data from the Drinking Water Infrastructure Needs Survey, may be used to assess the financial ability of the water industry to finance infrastructure investment.

Compliance Analyses. EPA will use the CWS Survey database in developing profiles of operational and financial characteristics for different types of water systems that can be statistically correlated with the Agency's database of compliance records contained in the Safe Drinking Water Information System (SDWIS). The objective of this analysis is to identify those operational and financial characteristics that may lead to future compliance problems.

1. Introduction

To support its regulatory development initiatives, the U.S. Environmental Protection Agency (EPA) periodically collects information on the financial and operating characteristics of the public water supply industry. EPA conducted the 1995 Community Water System (CWS) Survey as part of this effort. EPA uses the information from this survey to prepare regulatory impact analyses (RIAs) in support of regulatory development and to analyze economic and operating factors that affect national drinking water quality. A complete discussion of the uses of the survey data will be found in Chapter 4 of this volume.

This report presents the information collected from the 1995 CWS Survey in two volumes. Volume I, the Overview, provides perspective on these details by extrapolating from the survey data to present a national picture of water systems. It does this by grouping systems into fewer categories than in Volume II in order to observe patterns that characterize the industry, and by comparing the 1995 data to similar data from previous CWS Surveys (1986, 1982, and 1976). Volume II, the Detailed Report, presents the survey findings in a series of tables that break out water systems according to detailed size, ownership, and water source categories. Volume II also provides a detailed methodology.

1.1 Background

EPA began the 1995 CWS Survey in the fall of 1994. The survey effort proceeded in two phases. In Phase I, EPA developed a preliminary survey instrument and sampling plan, and then conducted a pretest of nine water systems to gauge respondents' reactions to the draft questionnaire.

Following the pretest, EPA conducted a full-scale pilot test using three versions of the survey instrument: one for publicly owned systems, one for privately owned systems, and one for ancillary systems (a system where water supply is ancillary to its primary business—e.g., mobile home park). (The three versions of the questionnaire varied only slightly to reflect minor variations in methods of accounting and financial data.) The goal of the pilot test was to evaluate the design and procedures for the full study. In order to identify eligible systems and appropriate respondents for the mail questionnaire, the survey used a computer-assisted telephone interview (CATI) questionnaire to conduct a preliminary screening. The CATI survey identified over 4,700 eligible water systems, of which EPA selected 62 for the pilot test. Twenty-one systems returned completed questionnaires.

In Phase II, EPA prepared a revised sampling plan and questionnaires based on the results of the pilot test. In June 1995, the surveys were distributed to a stratified random sample of 3,700 water systems nationwide. As shown in the table on the following page, the revised questionnaire comprised 24 operational questions and 13 financial questions. Three questions related to general information also were asked. Most questions requested several line items of information.

Community water system respondents had until February 1996 to return completed questionnaires. Slightly more than 54 percent of the systems that received questionnaires responded to the survey. From June 1995 to

Summary of 1995 CWS Survey Questionnaire	
Question Number	**Summary of Question**
General Information	
1	Contact information (e.g., name and telephone number of persons filling out questionnaire).
2	Year for which operating and financial information are provided.
3	Source of regulatory information, operator training, and technical assistance.
Part I - Operating Characteristics	
4	Number of gallons produced in the last year and number of intake points with disinfection.
5	Peak daily production and maximum daily treatment design capacity.
6	Factors determining maximum design capacity.
7	Presence of treated water storage.
8	Treated water storage (e.g., type of storage, number of tanks, and storage capacity).
9	Distribution system (e.g., type and length of existing pipe, pipe replacement, main repairs, and months between flushes).
10	Length of pipe for expansion in last five years.
11	People served and active connections currently and five years ago.
12	ZIP codes covered by service area.
13	Presence of drinking water operators.
14	Number, employment status, and training level of operators.
15	Presence of system interconnection for emergency purposes (e.g., hot summers).
16	Solutions in case of permanent contamination of water source.
17	Indication and identification of connection to long term alternate water source.
18	Treatment facility information (e.g., name, location, number of wells, average and potential flows, and treatment provided).
19	Indication of points in distribution system where disinfectant residuals are boosted.
20	Sources not receiving treatment (e.g., name, type, location, and average and potential flows).
21	Indication of source water or wellhead protection program.
22	Indication of source water or wellhead protection measure applied.
23	Indication of source water or wellhead protection management (e.g., local government).
24	Indication of how management area is delineated.
25	Indication of presence and type of contaminants located within 2 miles of water intakes.
26	Identification of laboratory analysis provider.
27	Laboratory analysis payment method.
Part II - Financial Information	
28	Indication of application of Generally Accepted Accounting Principles for financial reports.
29	Water sales revenues and deliveries by customer category (e.g., residential, commerical, etc.).
30	Water related revenue sources (e.g., connection fees, general fund revenues, etc.).
31	Billing structure (e.g., customer category rate increase information, and active connections).
32	Uncompensated usage (e.g., free service to municipal buildings, uncollected bills, leaks, etc.).
33	Expense summary (e.g., operating, debt service, and other).
34	Assets, liabilities, and total debt outstanding.
35	Indication of payment for capital improvements, repairs, or expansion since 1987.
36	Source of funds for capital improvements, repairs, or expansion since 1987.
37	Cancellation of plans for capital improvements, repairs or expansion due to borrowing limits.
38	Indication of whether bonds have been rated by a rating service.
39	Summary of bond rating and type of bond last issued.
40	Additional comments.

February 1996, EPA maintained a toll-free helpline to answer questions and provide guidance to water systems participating in the survey.

To enhance the quality of the data provided in the completed questionnaires, EPA conducted a manual quality assurance (QA) review beginning in December 1995. This QA review focused on the eight survey questions that EPA considered to be the most critical to supporting its regulatory initiatives. These critical questions addressed:

1. Annual water production by water source—ground water, surface water, and purchased water. (Question 4)

2. Service population and active connections. (Question 11)

3. Characteristics of treatment facilities—location, average and potential daily flows, and treatments provided. (Question 18)

4. Characteristics of untreated sources—name, location, and average and potential daily flows. (Question 20)

5. Water sales revenues and deliveries by customer category. (Question 29)

6. Water-related revenues—connection fees, inspection fees, interest earnings, etc. (Question 30)

7. Water system expenses—operating expenses, debt service expenditures, and other expenses. (Question 33)

8. Water system assets, liabilities, and debt. (Question 34)

The first step of the QA review process was to determine if responses to any of the eight critical questions appeared inconsistent with information provided in other survey questions, or with expert knowledge of the water industry. In cases where respondents made obvious mistakes and solutions were apparent (e.g., reporting thousands of gallons instead of millions of gallons), responses were corrected. In cases where mistakes were suspected, but solutions were not apparent, the water systems in question were contacted. Reviewers used both approaches to obtain answers for blank or incomplete critical questions.

EPA identified mistakes or inconsistencies in responses to critical questions on about half of the completed questionnaires—approximately 1,000 questionnaires. EPA telephoned approximately 500 water systems to clarify the mistakes or inconsistencies. Ultimately, all identified mistakes and inconsistencies were corrected.

Because approximately half of the systems responding to the survey provided inconsistent responses to at least one of the eight critical questions, EPA was concerned that inconsistencies may be present in the 32 noncritical questions that did not undergo manual QA review. EPA conducted automated data validation checks on most of the noncritical questions to identify and remove data anomalies and outliers, but it was not within EPA's budget or the scope of this project to conduct detailed QA reviews of the noncritical questions.

To ensure high data quality, EPA relied on expert peer review and on the assistance of known experts in all phases of the CWS Survey project. A complete discussion of the peer review process and of the quality assurance efforts can be found in the methodology chapter of Volume II.

1.2 Data Presentation

Volumes I and II of the CWS Survey Report present tabulations of the data collected in the CWS Survey. In Volume I, the data are generally presented according to four service population categories:

- **Very Small**—From 25 to 500 served
- **Small**—501 to 3,300 served
- **Medium**—3,301 to 50,000 served
- **Large**—More than 50,000 served

In Volume II, results are presented according to eight service population categories:

- From 25 to 100 served
- 101 to 500 served
- 501 to 1,000 served
- 1,001 to 3,300 served
- 3,301 to 10,000 served
- 10,001 to 50,000 served
- 50,001 to 100,000 served
- More than 100,000 served

These different size categories support the different analytic purposes mentioned earlier.

Data tabulations also are presented according to ownership (e.g., public, private, or ancillary) and primary water source (e.g., primarily ground water, primarily surface water, and primarily purchased water). The most detailed level of data disaggregation presented in this report is by ownership and primary water source (e.g., the number of publicly owned systems with primarily surface water sources).

1.3 Organization of the Report

This report comprises two volumes:

Volume I: The Overview. Volume I presents the most important and interesting findings of the survey. It is composed of an Executive Summary, which summarizes the key findings and highlights of the survey results, and four chapters:

- **Chapter 1. Introduction.** Chapter 1 describes the background, purpose, survey methodology, and the organization of the overall report.
- **Chapter 2. National Projection Summary.** Chapter 2 provides an aggregate perspective on basic water industry demographics and operational and financial characteristics of the industry. It presents a national profile of water systems, their customers, and their operating and financial characteristics.
- **Chapter 3. Key Trends and Survey Findings.** This chapter provides a discussion, supported by graphics, of the principal findings of the CWS Survey. Chapter 3 provides a summary of operational and financial survey findings, as well as a comparison of findings in the 1995 survey to those of the 1986, 1982, and 1976 surveys.
- **Chapter 4. Uses of Data.** This chapter describes the intended uses of the CWS Survey data. It shows how the survey questions relate to the data requirements of drinking water RIAs and Regulatory Flexibility Analyses (RFAs).

Volume II: Detailed Survey Result Tables and Methodology Report. Volume II presents a detailed summary of data collected in the CWS Survey. There are no narrative descriptions accompanying these tabulations. The results are divided between operating and financial characteristics. The order of presentation generally corresponds to the order and organization of the survey questionnaire.

Volume II also provides a detailed description of the survey methodology. It provides information on sample design and weighting, the telephone screener survey, the mail survey, and quality assurance. Copies of the survey questionnaires are supplied as appendices.

2. National Projections Summary

The 1995 CWS Survey database contains financial and operational data for a wide variety of public water supplies. As an introduction to the database, this section of the report describes the current operating and financial characteristics of the water industry. The data are presented, in general, as industry totals based on projections from the survey sample statistics. The objective of this presentation is to establish the preliminary themes and patterns in the CWS Survey results that are more fully explored in Chapter 3.

A Note on the Data

Because not every respondent answered every survey question, some variables discussed in Chapters 2 and 3 may have more or fewer available observations than other variables. This can reduce consistency across variables, since different groups of systems may be represented in different calculations. For example, the survey estimated water produced, water delivered, and water losses due to unaccounted for use. In theory, one might assume that water produced minus water delivered would equal water loss. In fact, if the respondents are different for each variable, this simple calculation does not work. EPA and CWS Survey analysts decided that the increased accuracy for each variable (e.g., water produced) outweighed any reduction in consistency. When inconsistency seems significant, we explain it in a footnote, or a note in the relevant table.

2.1 Water System Profiles

Altogether, there are more than 180 thousand water systems in the United States serving over 250 million people. Included in this estimate of systems are community water systems, transient noncommunity water systems, and nontransient noncommunity water systems.

Number of Public Water Systems

System Type	Number	% of Total
Community Water Systems in Survey (1, 2)	50,289	28%
Nontransient Noncommunity Water Systems (3)	23,639	13%
Transient Noncommunity Systems (3)	106,436	59%

(1) Certain types of community water systems were excluded from the estimate. See Volume II for more information.

(2) The number of community water systems is an estimate from the CWS Survey.

(3) Data on the number of noncommunity systems come from "The National Public Water System Supervision Program" (EPA-812-R-95-001, July 1995), which relies on a national inventory of public water systems.

The vast majority of the U.S. population served by water systems are served by community systems. While people also drink water from noncommunity systems, community water systems provide the most exposure to risks from contaminants. Therefore, they are the focus of this report.

Population Served by Types of Public Water Systems

System Type	Population (Millions)	% of Total
Community Water Systems in Survey	243.0	93%
Nontransient Noncommunity Water Systems	6.0	2%
Transient Noncommunity Systems	13.6	5%

Data on the population served by types of public water systems come from "The National Public Water System Supervision Program" (EPA-812-R-95-001, July 1995).

2.1.1 Source and Ownership

The water industry consists of a diverse group of water suppliers. They range from large municipal systems that use primarily surface water sources and serve several million persons, to mobile home parks, schools, and institutions that use primarily ground water sources and serve fixed populations of as few as 25 persons at least 6 months of the year. The results of the 1995 CWS Survey confirm this diversity. Almost 80 percent of community water systems use primarily ground water (i.e., ground water makes up the largest portion of the system's total production). Less than 10 percent of systems surveyed primarily use surface water sources, and systems that primarily use purchased water, either raw or finished, account for approximately 11 percent of the national total.

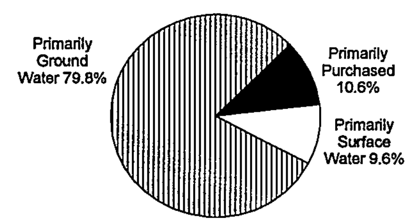
In the table below, we show community water systems by source of water and by ownership type (publicly owned, privately owned, or ancillary[1]). While systems that use primarily ground water are rather evenly divided by source, publicly owned systems are predominant in both primarily surface and primarily purchased sources. (See Volume II, Table 1-3, for more detailed data on this subject.)

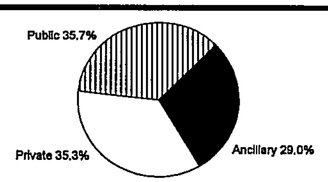
Source water characteristics are incorporated into EPA's regulatory analyses to account for operational configurations, regulatory requirements, and costs that are associated with different types of water quality conditions. For example, approximately 21 percent of systems use mixed sources (i.e., they do not rely 100 percent on any single source).

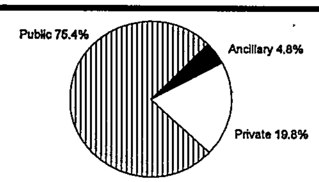
In EPA regulatory analyses, water systems are categorized based on the size of their service populations to account for differences in operational characteristics such as production requirements, treatment processes in-place, operators' skills and experience, as well as technical and financial capability. Water production typically demonstrates economies of scale (i.e., declining average costs of production as volume increases) because of the large capital investments required. Water system size is an increasingly

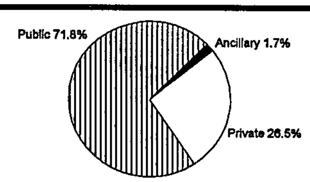
Community Water Systems By Source and Ownership Type

Total Drinking Water Systems		
Primarily Ground Water	40,123	79.8%
Primarily Surface Water	4,832	9.6%
Primarily Purchased	5,334	10.6%
Primarily Ground Water		
Public	14,321	35.7%
Private	14,168	35.3%
Ancillary	11,634	29.0%
Primarily Surface Water		
Public	3,641	75.4%
Private	957	19.8%
Ancillary	234	4.8%
Primarily Purchased		
Public	3,827	71.8%
Private	1,415	26.5%
Ancillary	92	1.7%







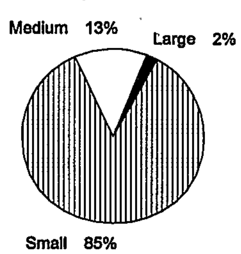


[1]In an "ancillary" system, providing potable water is not the entity's primary business. Instead, these systems provide water as an ancillary function of their principal business or enterprise. Examples include mobile home parks, schools, hospitals, prisons, and commercial businesses.

important characteristic of the industry for the Agency to consider in its development of regulations.

Recognizing differences among systems based on size, Congress, in the reauthorized Safe Drinking Water Act (SDWA), directed the Agency to provide regulatory flexibility to "small" community water systems, i.e., those serving populations of 3,300 or fewer persons. Eighty-five percent of community water systems fit this small system designation. Only 2 percent of community water systems are considered large systems, i.e., serving populations of more than 50,000 persons.

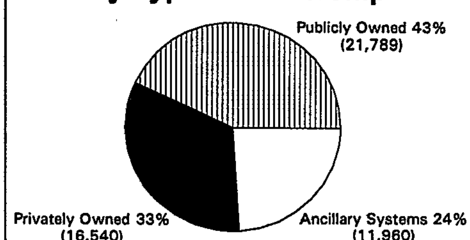
Community Water Systems by Size



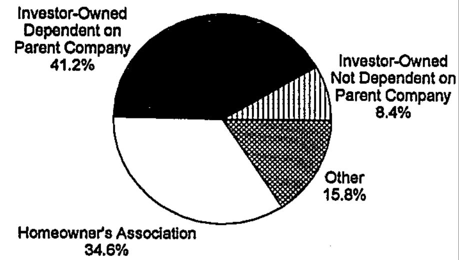
In addition to size, issues related to how water system ownership is structured are important when EPA estimates the financial impact that drinking water regulations may have on the water industry. Publicly and privately owned systems differ in rate structures, accounting practices, and their ability to raise capital.

The results of the CWS Survey indicate that 43 percent of community water systems are publicly owned. This group comprises water systems that are owned by municipalities, townships, counties, water districts, and water authorities. The survey also shows that 33 percent of all community water systems are privately owned. Private ownership encompasses a broad range of owners, from homeowners associations to investor-owned water companies.

Number & Percentage of Systems by Type of Ownership



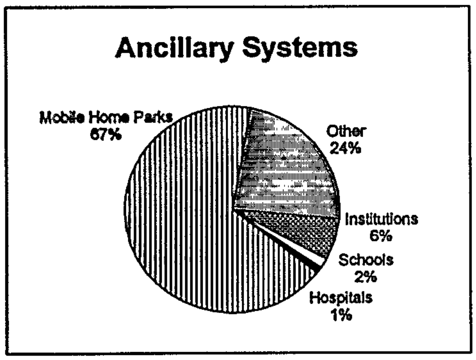
Privately Owned Systems



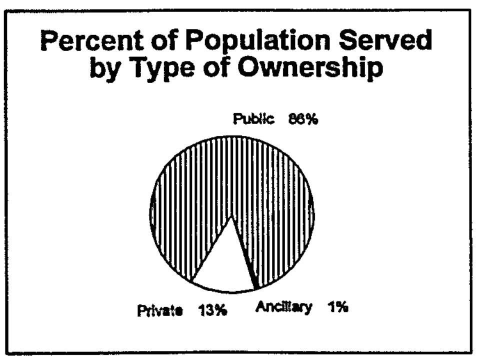
The remaining 24 percent of community water systems are classified by EPA as ancillary[2] systems, all of which serve populations of 3,300 or fewer persons. These systems, as explained above, are not typical water utilities; they provide water as an ancillary function of their principal business or enterprise. Often they provide water as a convenience to their patrons, employees, or residents. Compared to publicly and privately owned systems, ancillary systems serve smaller populations, produce smaller flows, have limited operator capability (i.e., no full-time, certified operators), and do not bill customers or users directly for the water service.

[2]In EPA's data system on public water systems, ancillary systems are a sub-set of privately owned systems. For purposes of this report, we have defined them as a separate category.

The largest category of ancillary systems is mobile home parks.

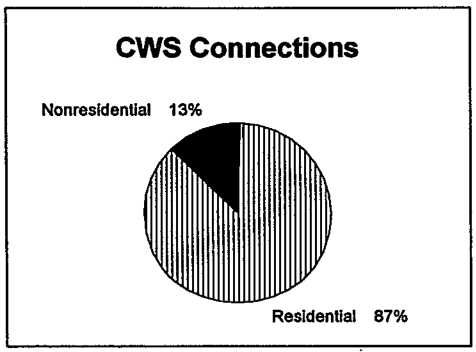


The vast majority of water system customers—about 86 percent—get their water from publicly owned systems.



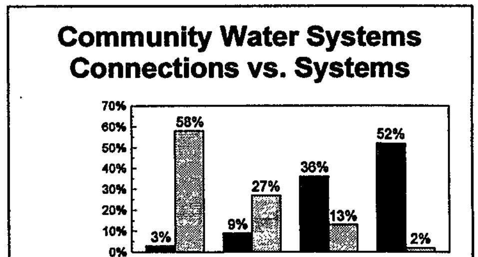
2.2 Customer Profile

Community water systems serve more than 75 million customer connections, representing a service population of approximately 245 million persons. Residential connections comprise 87 percent of total connections (of those systems that were classified by type of connection in the survey).



The remaining 13 percent of connections are classified as nonresidential—primarily commercial and industrial (including multi-family dwellings and apartment complexes), governmental, wholesale, and agricultural customers.[3]

Large systems (primarily publicly owned) provide potable water to over half of all customers served by community water systems. In fact, the 1995 CWS Survey confirms previous industry surveys' conclusions that large systems account for a tiny percentage of systems, but more than 50 percent of the connections served.



	Very Small	Small	Medium	Large
Connections	1,978,385	6,990,445	27,717,830	40,507,346
Systems	29,217	13,505	6,702	865

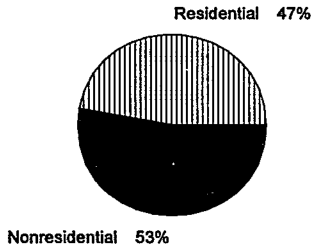
Conversely, small and very small systems account for roughly 85 percent of systems, but only 12 percent of customer connections served.

Total water consumption (i.e., deliveries) in community water systems is estimated to be approximately 37 billion gallons per day.[4] Deliveries to residential and nonresidential customers represent 47 percent and 53 percent, respectively, of total consumption.

[3]Nonresidential customers, for this summary, also include some residential connections since some respondents were not able to provide detail on connections by customer class.

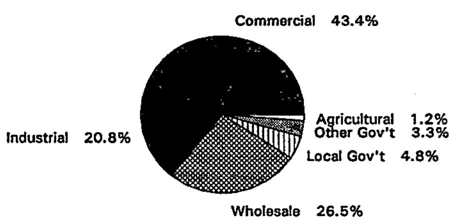
[4]This may under-estimate total national deliveries because of item nonresponse on this survey question.

Water Deliveries by Customer Type



Of the nonresidential deliveries where respondents could specify the type of customer, the largest customer category was commercial (43.4 percent), followed by wholesale (26.5 percent), and industrial (20.8 percent), as shown in the pie chart below. Wholesale customers often are other water systems that may supply residential customers.

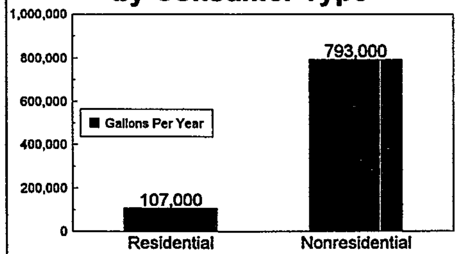
Water Deliveries to Nonresidential Customers (Excluding Other)



Deliveries per connection for all community water systems totaled approximately 547 gallons per day (approximately 200 thousand gallons annually). Residential deliveries per connection totaled 295 gallons per day, compared to 2,174 gallons per day to nonresidential connections. Even though the gallons delivered to each residential connection are fewer than the gallons delivered to nonresidential connection, residential connections make up the majority of all connections.

Residential consumption per connection translates to 107 thousand gallons annually, which confirms assumptions in EPA RIAs that the average household consumes approximately 100 thousand gallons per year. Annual consumption per nonresidential connection totaled 793 thousand gallons. (See Volume II, Table 1-14, for more detailed data on this subject.)

Average Annual Water Use by Consumer Type



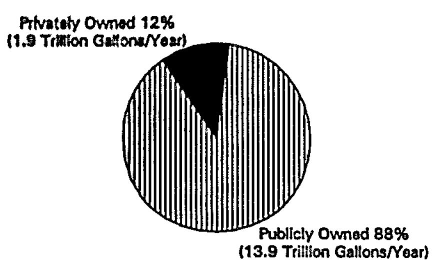
2.3 Operational Summary

The 1995 CWS Survey database enables the Agency to identify differences in operational conditions among water systems and to develop an up-to-date characterization of baseline conditions at water treatment facilities throughout the industry. In particular, data were collected on facility operational parameters such as sources/intakes, treatment processes in-place, production capacity, storage and distribution composition, and operator skills and training. Specification of these operational conditions provides the Agency with a baseline from which to estimate the incremental impact of facility compliance with SDWA regulations. A brief summary of operational characteristics is provided below.

2.3.1 *Industry Production*

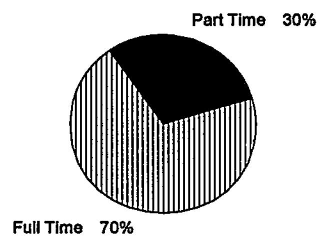
Total water production from all community water system facilities averaged 43 billion gallons per day. Systems using primarily surface water sources accounted for 48 percent of industry production, or, about 21 billion gallons per day. Publicly owned systems accounted for the majority of water production (88 percent); most large surface water systems are publicly owned.

Water Production by Ownership



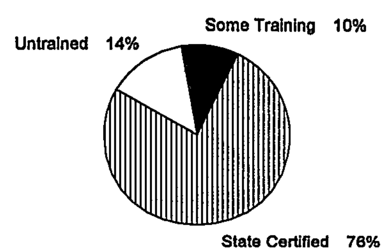
To process these volumes of water, community water systems employed an estimated 91,944 operators, approximately 70 percent of whom were employed full time by water systems. Thirty-eight percent of systems employed at least one full-time operator. (See Volume II, Table 1-15, for more detailed data on this subject.)

Drinking Water System Operators



Seventy-six percent of all operators were state certified in water system operations, and an additional 10 percent had received some formal training through a national or state program, but were not fully state certified. Seventy percent of part-time operators were employed in small systems. (See Volume II, Table 1-16, for more detailed data on this subject.)

System Operator Background



Total industry production per employed operator (full and part time) was 484 thousand gallons per day for all community water systems. Production per operator per day by very small systems (i.e., serving fewer than 500 persons) totaled 23 thousand gallons, compared to 2.4 million gallons per operator per day for large systems.

2.3.2 *Treatment and Distribution*

Eighty-one percent of community water systems reported performing some treatment on all or a portion of their water sources. To put this result in perspective, the survey estimates that over 99 percent of systems using surface water sources performed some treatment of their source water. Of those systems reporting no treatment, 80 percent rely on ground water as their only source.

The types of treatments applied vary according to type of water source. For example, of systems that answered the survey questions on types of treatment, more than twice as many exclusively ground water systems apply iron and manganese removal and aeration as do exclusively surface water systems. The exclusively surface water systems that replied to the questionnaire apply flocculation/coagulation and filtration more than twice as often as do the ground water only systems.

The reader should use caution in interpreting some of the percentages in the following table. It shows the percentage of systems reporting each type of treatment at any treatment facility. If one looked at these data by facility, instead of by system, the percentages would be lower.

Percentage of Systems Applying Various Treatments at One or More Treatment Facilities

	100% Ground Water	100% Surface Water
Aeration	33%	12%
Disinfection/ Oxidation	92%	99%
Iron and Manganese Removal	34%	14%
Flocculation/ Coagulation	33%	84%
Filtration	39%	89%
Organics Removal	27%	23%
Corrosion Control	36%	62%
Other	28%	12%

In addition to the SDWA source water treatment requirements, water systems are confronting increasing costs for replacement and repair of existing infrastructure, such as storage facilities and distribution systems. For many water systems, distribution system replacement and repair are long overdue. In other systems, repairs are being accelerated in conjunction with treatment installations or upgrades. In either situation, as the cost of providing high-quality water increases, water systems and customers may be more concerned about the significant portion of production lost or adversely affected by poor distribution systems.

To achieve greater insight into the condition of distribution systems, the 1995 CWS Survey collected detailed information on the current size and composition of distribution piping and maintenance. Community water systems maintain approximately 29 million miles of pipe. (See Volume II, Tables 1-10, 1-11, and 1-12, for more detailed data on this subject.)

Community water systems reported expanding their distribution systems by less than 1 percent (113,265 miles) from 1990 through 1994. Community water systems also replaced 1.0 million miles of pipe and performed over 360 thousand main repairs.

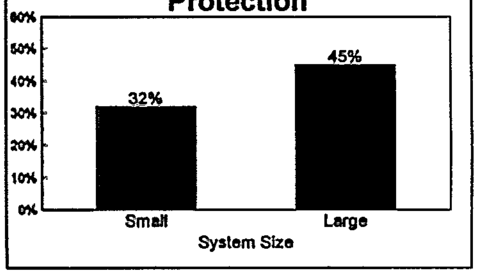
2.3.3 Source Water Protection

Source water protection efforts can be a low-cost option for many water systems to protect sources from contamination. Water systems whose sources are vulnerable to contamination can reduce future capital expenditures for treatment plants and equipment by adopting "best management practices" and land use controls to prevent or reduce the probability of contamination.

Survey results indicate that over one-third of all community water systems participate in some type of source water protection effort. The three primary methods of source protection identified by these respondents were zoning or land use controls, best management practices, and education on land use impacts.

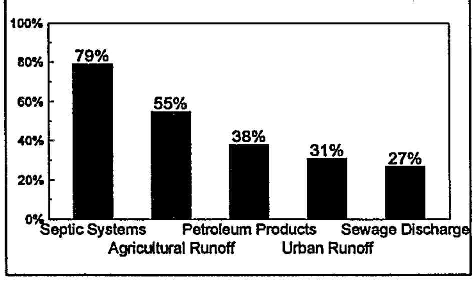
About 80 percent of the systems that participated in source water protection efforts reported using these three methods. These efforts, however, may or may not meet the requirements for state source water protection programs. A greater proportion of large systems (45 percent) reported participation in source protection programs than did small systems (32 percent). Source and ownership appear to be less significant in determining participation in source water protection efforts. An equal percentage of systems also participate in source water protection efforts managed by a local or state governmental agency, but small systems report greater involvement with source water protection efforts managed by a state agency. (See Volume II, Table 1-24, for more detailed data on this subject.)

Percentage of Systems Participating in Source Water Protection



Water systems were asked to identify potential sources of contamination within 2 miles of their water supply intakes or wells. Overall, the most frequently identified sources of contamination were septic systems (cited by 79 percent of systems) and agricultural runoff (reported by 55 percent of systems). Other potential sources of contamination that were identified included petroleum products (e.g., fuel and heating oil tanks) in 38 percent of systems; urban runoff in 31 percent of systems; and sewage discharge in 27 percent of systems. (See Volume II, Table 1-28, for more detailed data on this subject.)

Percentage of Systems Citing Water Contamination Sources



Water systems were asked to indicate their laboratory analysis provider. Overall, approximately 40 to 50 percent of systems identified the state or a private firm as their primary laboratory analysis provider. A higher percentage of large water systems reported using in-house laboratory services to analyze water for metals, inorganic chemicals, and microbial contaminants.

2.4 Financial Summary

Water systems were asked to provide basic financial information from their income statements and balance sheets. EPA requires an accurate baseline of the financial characteristics of community water systems to forecast the ability of these systems to make the technical and capital investments required for sustainable water operations.

The summary below provides an aggregate profile of the water industry in 1995. Given that the survey results represent only one year of financial performance, EPA's ability to derive conclusions about the financial health of the water industry is limited. Instead, the data are presented as a "snapshot" of the industry in 1995. A variety of financial characteristics must be examined over time to fully assess the ability of water systems to sustain an adequate and safe supply of water.

2.4.1 Summary of Revenues and Expenses

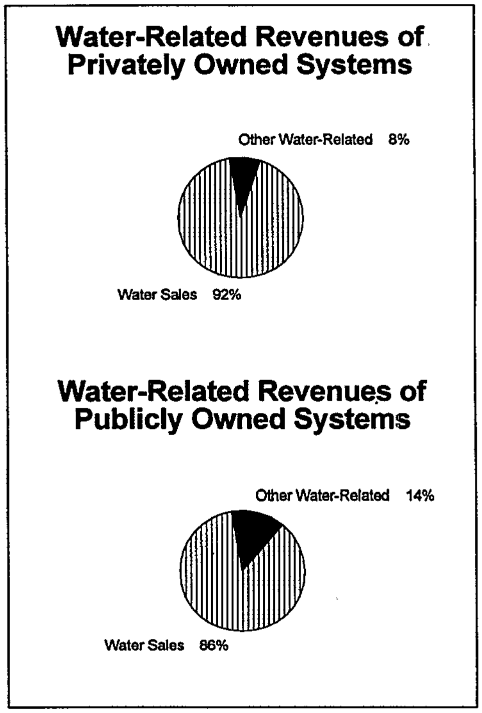
Most water industry revenues are generated directly through the sale of water. Water rates are the primary mechanism by which customers are charged for service. Systems may also generate revenues from fees (e.g., connection or inspection fees), fines and penalties, and other non-consumption-based charges. Publicly owned water systems may receive contributions from a municipal general fund.

Water industry revenues from all sources for publicly and privately owned systems were estimated to total $25.9 billion, most of which was derived from water sales. Publicly owned systems accounted for 86 percent ($22.2 billion) of total industry revenues, compared to 14 percent ($3.7 billion) for privately owned systems.

Water System Annual Revenues and Expenses

	Annual Revenue ($Billion)	Annual Expenses ($Billion)
Publicly Owned Water Systems	22.2	19.0
Privately Owned Water Systems	3.7	3.1
Total	25.9	22.1

The vast majority of water-related revenues come directly from water sales. As shown in the pie charts that follow, this is particularly true for privately owned systems, which derive 92 percent of their revenues from water sales. Publicly owned systems, obtain 86 percent of their revenues from water sales. The remainder consists of other types of water-related revenues (e.g., connection fees, inspection fees, and interest earnings). (See Volume II, Table 1-35, for more detailed data on this subject.)



Across all system size categories, sales to residential customers accounted for 54.8 percent of total water sales. Revenues from water sales to commercial and industrial customers totaled 18.3 percent of total water sales, while wholesale customers and other customer categories accounted for 4.1 percent and 22.8 percent respectively. The percentage of water sales revenues from residential customers is highest in small systems, as shown in the table below. The category "other" included governmental customers,

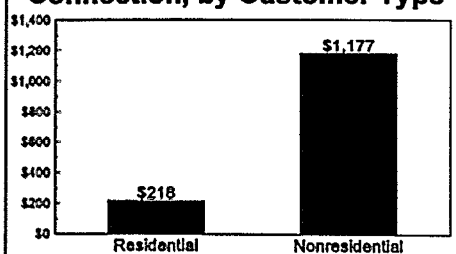
Sources of System Water Sales Revenue by Type of Customer (Excluding Ancillary Systems)

Customer Type	System Size			
	<500	501-3,300	3,301-50,000	>50,000
Residential	70.5%	61.7%	52.4%	54.5%
Commercial/Industrial	8.1%	12.3%	19.9%	20.2%
Wholesale	5.4%	1.8%	3.0%	5.4%
Other	16.0%	24.2%	24.7%	19.9%
Total	100.0%	100.0%	100.0%	100.0%

agricultural customers, categories not defined in the survey, and total sales revenues for systems that did not disaggregate by customer type.

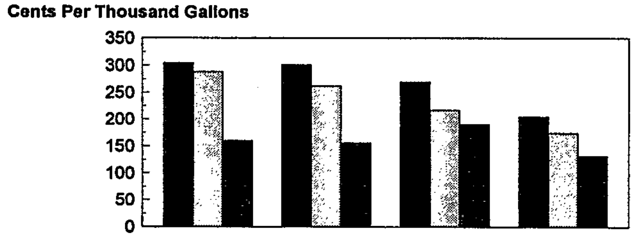
Nonresidential connections generated about 5 times more revenue per connection, but delivered 7 times more water than did residential connections. (See the graph, "Average Annual Water Use by Consumer Type," on page 9.) Specifically, nonresidential water sales per connection totalled $1,177, compared to sales revenues per residential connection of $218.

Annual Water Sales per Connection, by Customer Type



Residential customers pay a higher rate, however, $2.94 per thousand gallons, compared with $2.51 for commercial customers and $1.70 for wholesale customers.[5] Rates generally are higher for all customer categories in small systems, as shown in the chart "Water Sales Revenue by Customer Type."

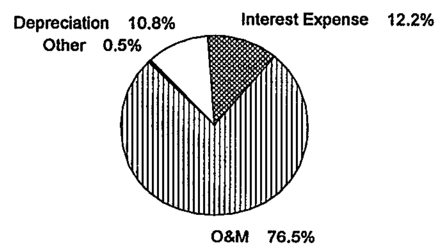
Water Sales Revenue by Customer Type



	Very Small	Small	Medium	Large
Residential	305	301	270	205
Comm/Ind	289	262	217	174
Wholesale	160	156	190	132

Total expenses for all community water systems were $22.1 billion. (See the table "Water System Annual Revenues and Expenses" on page 13.) Operations and maintenance (O&M) expenses, which include all direct costs of production such as labor, materials, chemicals, electricity, taxes and payments in lieu of taxes, accounted for $16.9 billion, or 76.5 percent of total industry expenses. Of the water industry's remaining operating expenses, depreciation expenses were $2.4 billion, interest expenses were $2.7 billion, and "other" expenses were $0.1 billion.

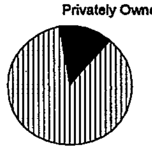
Water Industry Expenses



[5] To calculate the residential customer rate from the preceding paragraph, one cannot simply divide the national estimate of average annual water sales per residential connection by the national estimate of residential consumption per connection. While data for all three variables came from the first line of survey question 29, each was calculated independently to provide the greatest precision in each estimate. The estimate of average annual water sales came from all respondents who provided "water sales revenue" data on line 1 of question 29. The estimate of residential consumption came from respondents who provided "gallons delivered" on line 1 of question 29. The average residential customer rate is derived from information provided by all respondents who provided both "water sales revenue" and "gallons delivered."

As shown in the graph below, expenses for publicly owned systems totaled $19 billion, (86 percent of total industry expenses). Private system expenses totaled $3.1 billion (14 percent).

Water System Expenses by Type of Ownership



As previously mentioned, water rates are the method by which most water systems attempt to recover operating expenses. Meters allow water systems to monitor customer demand and to establish charges based on usage. The CWS Survey estimates that 95 percent of residential and 98 percent of nonresidential connections were metered industry-wide.

Metered Connections by Customer Type	
Residential Connections	95%
Nonresidential Connections	98%

Of all the rate structures that water systems use for their residential customers, the uniform block rate is the most common (49 percent). Declining block rates and separate flat fees are next (16 percent and 15 percent, respectively). Note that rate structures other than those explicitly included in the CWS survey accounted for about 8 percent of all the rate structures applied. (See Volume II, Table 1-43, for more detailed data on this subject.)

Percentage Use of Various Residential Rate Structures	
Uniform Rate	49.0%
Declining Block	16.0%
Increasing Block	11.0%
Peak Period	0.9%
Separate Flat Fee	15.3%
Combined Flat Fee	10.0%
Other	8.2%

Note: The percentages in this table do not total 100 percent because some systems used more than one rate structure.

2.4.2 *Industry Balance Sheet*

Community water systems reported assets totaling approximately $132 billion in 1995. Total liabilities were $62 billion. Survey respondents were not asked to provide detail on assets by major system component (e.g., treatment plant or distribution systems).

Water System Annual Revenues and Expenses

	Assets ($Billion)	Liabilities ($Billion)
Publicly Owned Water Systems	117.8	56.2
Privately Owned Water Systems	14.1	5.7
Total	131.9	61.9

Consistent with previous surveys of water systems, the water industry can be characterized as very capital intensive. The results of the 1995 survey indicate that water systems overall maintain about $5 of gross assets for every $1 of revenue. This ratio is highest in the smallest system size category. (See Volume II, Tables 1-56, 1-57, 1-58, and 1-59, for more detailed data on this subject.)

Asset-to-Revenue Ratio (Excluding Ancillary Systems)	
System Size Category	**Ratio**
<500	6.3
501-3,300	4.5
3,301-50,000	4.9
>50,000	5.3

This high asset-to-revenue ratio reflects, among other things, the high capital investment of water utilities. The asset-to-revenue ratio for investor-owned electric utilities and gas utilities, by comparison, was about $3 to $1 in 1994, according to the Energy Information Administration and American Gas Association.

3. Trends and Key Findings

This chapter summarizes the most important trends and findings from the responses to the 1995 CWS Survey. The chapter is organized into two parts. The first part covers a few trends derived from comparing this survey with previous surveys. The second part of this chapter describes key findings. In both parts, we present the operational characteristics first, followed by financial characteristics.

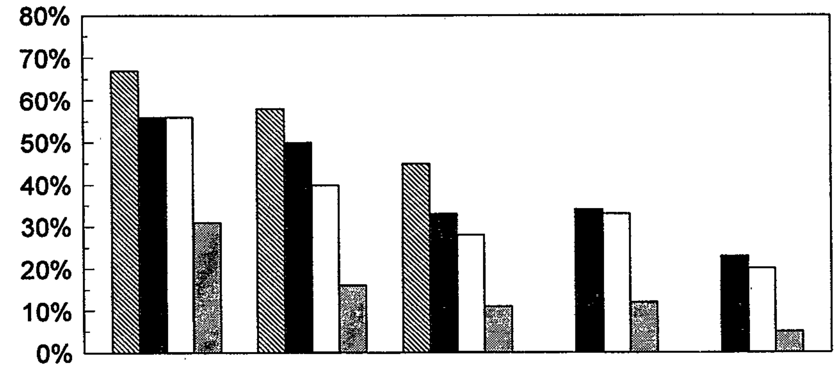
There were three previous CWS surveys (1976, 1982, and 1986), providing almost 20 years of experience for comparative purposes. We are particularly interested in changes since the 1986 survey because results from that survey are used as baseline characteristics in EPA's cost models.

3.1 Trends

3.1.1 Operating Characteristics

As Chapter 2 showed, most of the operating characteristics of community water systems are the same as those in 1976. Most systems are small. Most small systems are privately owned or ancillary systems. Most people, however, are customers of large publicly owned systems. Nevertheless, there has been one important change.

Percentage of Systems Not Providing Treatment



SYSTEM SIZE	0-100	101-500	501-1,000	1,001-3,300	3,301-10,000
1976	67%	58%	45%		
1982	56%	50%	33%	34%	23%
1986	56%	40%	28%	33%	20%
1995	31%	16%	11%	12%	5%

The percentage of systems that do not treat their water has steadily declined from 1976 to 1995. Differences in questionnaires preclude trend analysis for all size categories, but we have comparable data for the five smallest sizes. These categories are of interest, however, because most large systems provide some treatment. As shown in the graph above, the percentage of small and medium systems not providing treatment has fallen steadily since the SDWA was enacted in 1974. This is consistent with the SDWA's emphasis on water quality monitoring and treatment.

The importance of this change is that treatment in place is a significant variable in calculating the cost of compliance for RIAs. In the models used to estimate compliance costs, systems with treatment in place do not need to invest in additional treatment (provided, of course, that the treatment in place is capable of meeting regulatory objectives). (See Volume II, Table 1-18, for more detailed data on this subject.)

3.1.2 Financial Characteristics

Water sales revenues have increased since 1986 (in constant dollars) for systems in most size categories. These increases reflect increased investment in fixed assets and increased costs of operation and maintenance (O&M). (See the table "Trends in Water Sales Revenues.") Although we cannot do a one-to-one comparison of the larger size categories, it is clear that there have been significant increases in all systems serving more than 50,000 people.[1] For example, water sales revenues for systems serving 50,001 to 100,000 people are 220 cents per thousand gallons of water delivered, significantly higher than the two corresponding size categories in the 1986 survey. Similarly, systems serving more than 100,000 people in 1995 posted higher water sales revenues than did all comparable size categories for 1986. (See Volume II, Table 1-39, for more detailed data on this subject.)

Trends in Water Sales Revenues (Cents per 1,000 Gallons Sold)

System Size	1995	Percentage Change from 1986 (in 1995$)
<100	345	25.09%
101-500	342	1.30%
501-1,000	356	38.95%
1,001-3,300	295	3.87%
3,301-10,000	293	40.87%
10,001-50,000	240	17.33%
50,001-100,000	220	49.25%
>100,000	189	31.80%

During the past decade, water rates have increased faster than the Consumer Price Index (CPI). The CWS Survey examined rate increases by system size. These data show that large systems increase rates more frequently than do small systems. This is a well-established pattern in the literature on the water industry. Large systems have substantial resources to plan and implement regular rate increases. Small systems tend to wait longer between increases, but seek larger increases when they do so.

The lag between rate increases may be an important factor explaining the weaknesses in many small systems' financial conditions, as measured by financial ratios. For any given year, the financial health of many small systems may not be good because these systems have not yet increased rates.

The table below shows the size of the most recent rate increases for systems in the survey. Rate increases were annualized by dividing the size of the increase by the number of years between increases. The data show annual increases ranging from 4.9 percent to 14.8 percent. This rate of increase is larger than the CPI's, which has been approximately 3 percent for the past several years. (See Volume II, Table 1-44, for more detailed data on this subject.)

Residential Rate Increase Profile

System Size	Annualized Percentage Increase
<100	14.80%
101-500	5.79%
501-1,000	8.62%
1,001-3,300	7.37%
3,301-10,000	4.85%
10,001-50,000	5.52%
50,001-100,000	7.22%
>100,000	7.50%

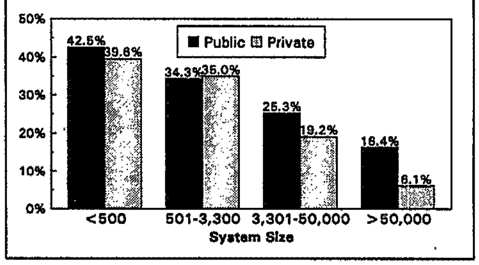
[1] In the size categories where we could not do a one-to-one comparison, the percent change for a given size category in the 1995 survey was calculated by comparing the 1995 value with the mean value of the corresponding two or three categories from the 1986 survey.

The CWS Survey results are consistent with analyses conducted by Professor Janice A. Beecher of Indiana University on the pattern of rate increases for water and sewer systems over the past 20 years.

The graph below, prepared by Professor Beecher, shows that increases in water and sewer prices were slightly below the increase in the CPI from 1970 to 1984, but then began to steadily outstrip the CPI increase. These increases are even more significant when compared with those of other utilities (telephone, piped gas, electricity) which had substantially lower rates of increase.

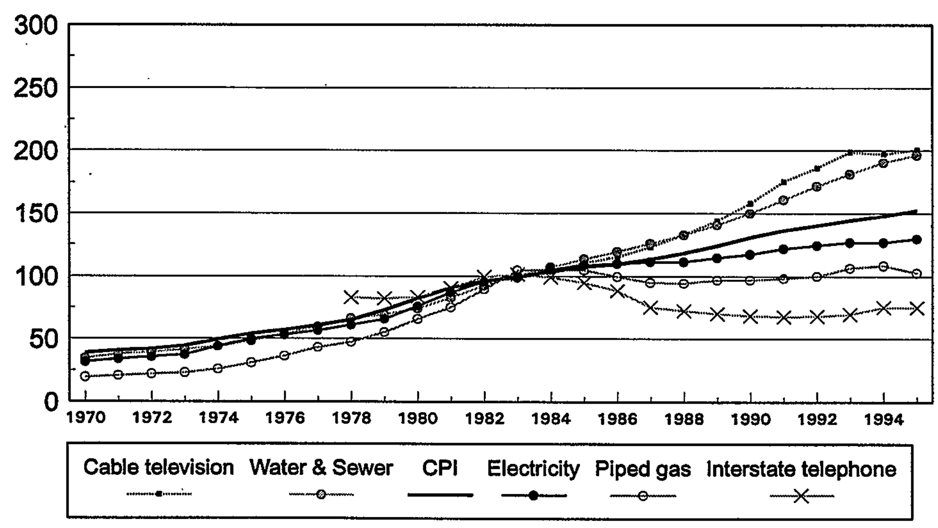
In spite of substantial rate increases, it appears that many water systems in all size categories still are not raising enough revenue. Indeed, the 1995 CWS Survey confirms the findings of the three previous surveys: many systems have costs that exceed revenues. A substantial percentage of systems participating in the 1995 CWS Survey reported a revenue deficit (if publicly owned) or a loss (if privately owned).

Percentage of Systems With Deficit (Loss)



As shown above, the percentage of systems in the survey reporting deficits (or losses) decreases with system size. The overall percentage is about the same as it was in the 1976 survey (the last time this characteristic was measured). The percentage of systems with deficits (or losses) was highest in the smallest system size categories, where it was approximately 40 percent. But the percentage of systems with deficits (or losses) declined as the system size increased. A higher percentage of publicly owned systems had deficits than privately owned systems had losses.

Consumer Price Indexes for Utilities 1970 to 1995
(1982-1984=100)



In theory, privately owned systems with repeated losses cannot stay in business, and both publicly owned systems with deficits and privately owned systems with losses should have more difficulty in securing capital for infrastructure investments. Additional information on the financial health of water systems, including their ability to borrow, is presented in section 3.2.2.

Before drawing any conclusions from these data about the overall financial health of the industry, we offer some caveats:

- The survey's estimates of deficit or surplus come from a single year's financial data. As noted above, water utilities often face temporary deficits while waiting for the implementation of higher rates. During the QA process on the survey, analysts telephoned all large systems showing a deficit.[2] All data were confirmed, and several respondents indicated that lagging rate increases accounted for the temporary deficit. Other respondents said that the current year's loss (or deficit) reflected the need to reduce large reserve fund balances.

- Combined systems (e.g., water and sewer) may have had difficulty disaggregating their operating expenses. Many combined utilities track sales revenue for each operation separately, but combine operating expenses. Telephone queries to survey respondents indicated that many used simple decision rules to disaggregate their operating expenses (e.g., applying the proportion of total sales represented by water sales to operating expenditures). Other respondents indicated that they disaggregated "big ticket" items, but did not remove non-water expenditures from less significant line items. The cumulative effect of these factors likely may be to overestimate the percentage of systems in deficit.

- Our questionnaire asked respondents to identify "water sales" and "water-related" revenues. The second category was defined broadly, but some systems may not have reported revenues that should have been classified as "water related." If reported, these revenues would have improved their financial position.

- The comparatively small percentage of large, privately owned systems with losses may reflect the reliance of these systems on equity capital. Profits are needed to pay dividends to stake holders.

- It is important to note that some systems, particularly small systems, are technically insolvent. This is consistent with the findings of other studies of such systems.[3] For very small systems, there is a thin line between solvency and insolvency. In a homeowners association serving 100 people, for example, temporary insolvency can be resolved by a small assessment on all customers.

- Observers have noted that water systems may have negative net income on their income statements, but positive cash flow. Depreciation

[2] Analysts telephoned all publicly owned systems serving more than 50,000 persons and all privately owned systems serving more than 10,000 persons to confirm survey responses.

[3] See, e.g., Dreese, G. R. and Beecher, J.A. "Financial Distress Models for Small Water Utilities," Proceedings of the Eighth NARUC Biennial Regulatory Information Conference, IV: 175-95 (Columbus, OH 1992). See also Cromwell, J. E. and Rubin, S. J., "Development of Benchmark Measures for Viability Assessment," Report for the Pennsylvania Department of Environmental Protection, 1996.

is counted as an expense but requires no cash outlay.[4]

3.2 Key Findings

3.2.1 *Operating Characteristics*

Production and distribution of drinking water are essential functions of most community water systems. As with all characteristics of water systems, of course, there is much diversity in both production and distribution. Some systems purchase finished water and have little or no production function. Other systems produce finished water and act solely as wholesale distributors with few (if any) retail customers. A summary of production and storage data from the 1995 survey appears on this page.

One interesting item in this table is the ratio of maximum daily treatment to peak daily production. For both ground water and surface water systems, the ratio declines with system size. Previous CWS Surveys have concluded that this trend is related exclusively to system size—large systems have more efficient operations. **The data show, however, that the ratio of maximum daily treatment to peak daily production is related not only to system size, but also to the source of unfinished water. Size matters, but so does source.**

The ratio of maximum daily treatment to peak daily production appears to reflect the treatment and storage conditions associated with different sources of water. Ground water systems generally rely on, and can afford, additional pumping and treatment capacity to meet peak demands. Surface water systems, in contrast, generally use more capital-intensive treatment techniques and tend to rely on storage facilities to meet peak momentary and hourly demands.

As expected, the ratios for ground water systems and surface water systems tend to converge as system size increases. The smallest ground water systems often use hydro-pneumatic tanks which, practically speaking, are designed to meet momentary and hourly demands through source pumping rather than storage. Large ground water systems, however, tend to have more sophisticated and capital-intensive treatment processes. Like their surface water counterparts, they rely more on storage to meet peak demands.

Summary of Production and Storage

	System Size			
	<500	501-3,300	3,301-50,000	>50,000
Primarily Ground Water				
Average Daily Production (Gallons)	17,148	198,011	1,892,761	25,238,287
Peak Daily Production (Gallons)	46,320	403,979	3,597,039	47,813,370
Maximum Daily Treatment Capacity (Gallons)	152,383	880,078	5,560,389	58,971,239
Ratio of Maximum Daily Treatment to Peak Daily Production	4.66	2.59	1.62	1.40
Storage Capacity (Million Gallons)	0.03	0.26	2.62	20.92
Average Daily Deliveries (Gallons)	15,170	164,804	1,525,106	21,123,817
Ratio of Average Daily Deliveries to Average Daily Production	0.97	0.89	0.87	0.89
Primarily Surface Water				
Average Daily Production (Gallons)	45,963	278,479	2,677,060	38,099,428
Peak Daily Production (Gallons)	160,758	624,576	4,389,824	56,606,417
Maximum Daily Treatment Capacity (Gallons)	304,872	1,527,963	6,409,019	79,023,967
Ratio of Maximum Daily Treatment to Peak Daily Production	2.28	1.83	1.57	1.38
Storage Capacity (Million Gallons)	0.23	0.60	4.00	149.83
Average Daily Deliveries (Gallons)	18,871	229,110	2,228,237	32,402,153
Ratio of Average Daily Deliveries to Average Daily Production	0.91	0.86	0.87	0.87

Readers should note that the ratios in this table—the ratio of maximum daily treatment to peak daily production and the ratio of average daily deliveries to average daily production—cannot be computed from other data in the table. For example, dividing maximum daily treatment (as shown in the table) by peak daily production (as shown in the table) will not yield the ratio shown in the table. Each mean value in the table was calculated independently to provide the greatest precision in each estimate. The mean maximum daily treatment comes from all respondents who answered that question; the peak daily production comes from all respondents who answered that question; and the ratio is derived from information provided by all respondents who answered both questions.

[4] This issue is discussed in a recent article by Professor Jeffrey L. Jordan, using data from financial statements of all Georgia water utilities. See "Do You Use Your Depreciation Funds Wisely," Opflow, Vol. 21, No. 12 (December 1995), p. 1.

Notwithstanding the relationship between these ratios and source, the table also shows that the ratios for both surface water and ground water systems are inversely related to system size. This suggests that, to some extent, large systems have a more sophisticated understanding of the fluctuations in demand and have sized production and storage facilities to account for them.

The other ratio in the table "Summary of Production and Storage" compares average daily deliveries with average daily production. It shows that approximately 10 percent of the water produced does not get delivered and therefore results in "uncompensated usage." There are many reasons for this phenomenon, but one of the most important is losses from the distribution system because of leaks. (For more information on production and storage, see Volume II, Tables 1-2, 1-4, and 1-8.)

The relationship between size and production efficiency is examined again in the table "Ratio of Peak Daily Production to Average Daily Production." This table compares the average ratio of peak daily production to average daily production, and shows that the ratios are inversely related to system size.

Ratio of Peak Daily Production to Average Daily Production, by Ownership

	Publicly Owned Systems		Privately Owned Systems	
System Size	Mean	Median	Mean	Median
<100	2.36	1.59	3.55	1.44
101-500	2.47	1.82	2.17	1.72
501-1,000	3.18	1.89	1.69	1.55
1,001-3,300	1.98	1.61	2.34	1.57
3,301-10,000	2.33	1.64	1.90	1.62
10,001-50,000	1.66	1.53	1.74	1.48
50,001-100,000	1.69	1.56	1.47	1.44
>100,000	1.60	1.51	1.51	1.54

Small systems, on average, have a higher ratio of peak daily production to average daily production. This may reflect the comparatively large fluctuations in demand that occur in small systems. In a small system, changes in consumption by a few households can have a significant impact on demand. In large systems, with larger and more predictable commercial and industrial customers, there may be less variance in demand. (See Volume II, Tables 1-6 and 1-7, for more detailed data on this subject.)

Residential Deliveries as a Percentage of Total Deliveries, by Ownership

	Publicly Owned Systems		Privately Owned Systems	
System Size	Mean	Median	Mean	Median
<100	97%	100%	99%	100%
101-500	87%	98%	95%	100%
501-1,000	83%	90%	92%	100%
1,001-3,300	71%	75%	89%	98%
3,301-10,000	70%	69%	82%	92%
10,001-50,000	61%	63%	69%	66%
50,001-100,000	61%	60%	50%	48%
>100,000	53%	55%	55%	55%

The table above shows that the smallest systems typically serve primarily residential customers. For example, the median values show that at least half of all privately owned systems serving fewer than 1,000 people serve residential customers exclusively. As system size increases, other customers become more significant. These include commercial, industrial, governmental, wholesale, and agricultural customers. The ratio of residential deliveries to total deliveries is highest for systems serving fewer than 100 persons (almost 100 percent), and it declines to almost 50 percent for systems serving more than 100,000 persons. (See Volume II, Table 1-14, for more detailed data on this subject.)

Residential Sales as a Percentage of Total Sales, by Ownership

System Size	Publicly Owned Systems		Privately Owned Systems	
	Mean	Median	Mean	Median
<100	95%	100%	99%	100%
101-500	68%	91%	93%	100%
501-1,000	84%	89%	92%	100%
1,001-3,300	75%	79%	88%	96%
3,301-10,000	73%	75%	84%	91%
10,001-50,000	65%	67%	74%	71%
50,001-100,000	67%	67%	59%	61%
>100,000	59%	59%	60%	62%

When residential sales are compared with total sales, the same general pattern emerges. As shown in the table above, the percentage of total sales that are residential declines as the size of system increases. When we compare sales with deliveries, a slightly different pattern emerges. In the smallest systems, residential sales are a lower percentage of total sales than residential deliveries are a percentage of total deliveries. At the largest size categories, however, this pattern is reversed. For public systems serving more than 100,000 people, residential sales account for 59 percent of total sales, but residential deliveries account for only 53 percent of total deliveries, suggesting a small subsidy in the other direction. (See Volume II, Table 1-36, for more detailed data on this subject.)

Average Annual Water Delivered per Connection (Thousand Gallons)

System Size	Customer Category				
	Residential	Commerical/ Industrial	Wholesale	Governmental	Agricultural
Publicly Owned Systems					
<100	81	48	0	90	195
101-500	93	229	7,703	112	101
501-1,000	97	383	9,919	391	298
1,001-3,300	82	1,061	22,483	2,675	1,096
3,301-10,000	87	855	45,575	1,493	797
10,001-50,000	108	602	95,185	16,442	531
50,001-100,000	122	962	126,889	34,482	3,117
>100,000	127	1,052	632,135	24,566	3,030
Privately Owned Systems					
<100	92	0	0	0	0
101-500	110	534	25,413	95	83
501-1,000	88	583	8,021	180	879
1,001-3,300	102	836	9,264	7,015	474
3,301-10,000	124	1,488	31,140	832	262
10,001-50,000	110	493	50,674	1,479	1,113
50,001-100,000	96	8,114	343,625	2,026	8,500
>100,000	114	729	194,286	1,763	0

The table titled "Average Annual Water Delivered per Connection (Thousands of Gallons)" shows the annual distribution of water delivered per connection. The range for residential connections is from 81,000 gallons to 127,000 gallons. This is consistent with the traditional assumption of 100,000 gallons per year per connection. The largest deliveries, as one might expect, are to nonresidential users. Average annual deliveries to commercial and industrial users average as high as 8.1 million gallons. While water use among many commercial and industrial customers is similar to that of residential users, there are others (e.g., laundries and some manufacturing operations) where water use is very high. The average annual deliveries to governmental customers are even larger, as high as 34 million gallons for publicly owned systems serving 50,001 to 100,000 persons. These may reflect large public entities, some of which (e.g., hospitals) are intensive users of water. The largest category is wholesale customers. Many large utilities sell finished water to other water systems, and the average deliveries can be substantial—632 million gallons annually for the largest category of publicly owned systems. (See Volume II, Table 1-14, for more detailed data on this subject.)

Miles of Pipe Replaced as a Percentage of Total Miles of Existing Pipe, by Ownership

System Size	Publicly Owned Systems		Privately Owned Systems	
	Mean	Median	Mean	Median
<100	0.61%	0.50%	1.26%	0.25%
101-500	6.27%	0.61%	4.59%	1.21%
501-1,000	3.93%	0.63%	2.94%	2.36%
1,001-3,300	3.09%	0.70%	0.77%	0.19%
3,301-10,000	3.12%	1.14%	1.33%	0.28%
10,001-50,000	1.62%	0.67%	0.52%	0.36%
50,001-100,000	0.87%	0.41%	0.38%	0.18%
>100,000	1.16%	0.34%	0.34%	0.11%

The table above shows the percentage of distribution piping replaced per year as a percent of the total miles of pipe in the system. The mean values show substantial variance, particularly for small systems. The median values generally show an inverse relationship between the percentage of pipe replaced and system size. The data for systems serving more than 10,000 people are consistent with results from the 1992 survey by the American Water Works Association (AWWA).[5] (See Volume II, Tables 1-10 and 1-11, for more detailed data on this subject.)

Another characteristic of distribution systems is the percentage of new pipe installed each year for expansion. This is calculated by dividing the miles of new pipe installed by the total miles of pipe already in place. The table below shows that the mean values generally are between 1 and 2 percent, consistent with the 1992 AWWA survey.[6]

Miles of New Pipe for Expansion as a Percentage of Total Miles of Existing Pipe, by Ownership

	Publicly Owned Systems		Privately Owned Systems	
System Size	Mean	Median	Mean	Median
<100	2.33%	0.00%	0.71%	0.00%
101-500	1.46%	0.00%	2.13%	0.00%
501-1,000	2.28%	0.44%	1.33%	0.19%
1,001-3,300	2.18%	1.25%	1.86%	0.58%
3,301-10,000	1.86%	1.07%	1.50%	0.84%
10,001-50,000	1.69%	1.08%	6.01%	0.68%
50,001-100,000	1.25%	0.80%	1.35%	1.09%
>100,000	1.70%	0.85%	1.16%	1.01%

[5]American Water Works Association, *Water Industry Data Base*, 1992, p. 91.

[6]*Ibid.*, page 92.

A final statistic on distribution systems is the population served per mile of existing pipe. The data are presented in the next table. Both the mean and median values show that the largest systems have substantially higher populations per mile of pipe than smaller systems. This is consistent with the fact that large systems, particularly publicly owned systems, are in densely populated areas.

Population Served per Mile of Existing Pipe, by Ownership

	Publicly Owned Systems		Privately Owned Systems	
System Size	Mean	Median	Mean	Median
<100	100	36	151	72
101-500	117	70	160	52
501-1,000	172	116	101	59
1,001-3,300	122	96	102	40
3,301-10,000	161	136	97	56
10,001-50,000	255	189	229	178
50,001-100,000	246	237	187	177
>100,000	905	288	317	280

As we explained during the discussion of trends in section 3.1, the percentage of systems providing no additional treatment has decreased steadily since 1976. The table on the next page shows the percentage of systems applying various treatments at one or more treatment facilities, by water source, and by system size. (We have limited the analysis to 100-percent ground water systems and 100-percent surface water systems to explore the effects of source as well as size. Using data from primarily ground water systems, for example, could represent a mixture of surface and ground sources.)

The data show that treatment configurations become more complex as size of system increases. In part, this reflects the fact that very small systems usually cannot afford the capital investment or maintenance costs associated with complex treatment processes.

For systems with 100 percent ground water, for example, the most common treatment was simple disinfection. For large ground water systems, however, there is a high percentage of systems that also install filtration for treatments such as iron and manganese removal or softening of hard water using the lime-soda ash process. Large ground water systems also have more sources, and only a few of these may have water quality problems. For example, the table shows that 77 percent of these systems have organics removal, but this may require only one treatment facility and may serve one (or a few) wells.

Percentage of Systems Applying Various Treatments at One or More Treatment Facilities	<500	501-3,300	3,301-50,000	>50,000
100% Ground Water				
Mean Number of Treatment Facilities	1.2	1.6	2.7	6.2
Percent of Systems Not Providing Treatment	26%	13%	5%	0%
Treatment Categories				
Aeration	15%	48%	74%	87%
Disinfection/Oxidation	89%	95%	99%	99%
Iron and Manganese Removal	21%	45%	68%	74%
Flocculation/Coagulation	20%	41%	72%	92%
Filtration	25%	48%	82%	95%
Organics Removal	14%	35%	62%	77%
Corrosion Control	20%	46%	77%	91%
Other	15%	38%	60%	86%
100% Surface Water				
Mean Number of Treatment Facilities	1	1	1.1	1.8
Percent of Systems Not Providing Treatment	2%	0%	0%	0%
Treatment Categories				
Aeration	1%	10%	11%	59%
Disinfection/Oxidation	98%	100%	97%	100%
Iron and Manganese Removal	1%	10%	15%	63%
Flocculation/Coagulation	48%	85%	99%	100%
Filtration	75%	82%	93%	96%
Organics Removal	3%	10%	37%	79%
Corrosion Control	23%	49%	70%	87%
Other	4%	9%	12%	62%

Note: The percentage of systems not providing treatment in this table is slightly different from the percentages reported in the table on page 17. This table reports only on systems that are either 100 percent ground water or 100 percent surface water. The table on page 17 reports on all systems, regardless of source.

The percentage of surface water systems disinfecting should be 100 percent, at least for all systems serving more than 501 people. Failure to include disinfection appears to have been an error on the part of a few respondents.

For surface water systems, a similar pattern emerges. Small surface water systems use simple disinfection and filtration. In large surface water systems, other types of treatment (e.g., organics removal) become more common.

The reader should note the constraints we imposed on this analysis. The table shows the percentage of systems reporting each type of treatment at any treatment facility. Thus, if a ground water system had eight facilities, and only one reported filtration, this still was counted as a report of filtration at that system. If one looked at these data by facility, instead of by system, the percentages would be lower.

3.2.2 *Financial Characteristics*

As the previous section demonstrated, size of system matters for several of the most important operating characteristics. **Size of system is even more important for financial characteristics. There are economies of scale in the water industry.** The industry is characterized by substantial investment in fixed assets. This investment can be spread across a broader customer base in large systems, leading to lower per capita costs and lower per capita revenues. Also, large systems can afford professional management. As we demonstrate in the following section, using several financial ratios, some small systems do not appear to be financially healthy.

The following financial ratios group systems into three or four categories based on commonly applied thresholds. In general, these thresholds indicate a level of financial health. For example, an operating ratio of less than 1 generally indicates a weak financial condition. A ratio of 1 to 1.2 represents marginal to acceptable performance, and a ratio greater than 1.2 represents a generally strong financial condition. While the ratio thresholds are intended to characterize the financial condition of CWSs in general, they do not characterize the financial position of a particular water system. For example, it is entirely possibly, even likely, that some public water systems have operating ratios of less than 1.0 for reasons that are consistent with good planning and management (e.g., because they are drawing down large reserves). Such water systems would not accurately be characterized as financially weak, even though they have a low operating ratio.

One final note of caution about interpretation of these financial ratios. As explained in Section 5.8 of Volume II, financial data are recorded and reported in different ways by privately owned and publicly owned systems. Furthermore, within the category of publicly owned systems, some use enterprise fund accounting, and others do not. Comparing these data involved making assumptions about and adjustments to the data as they were initially reported in the questionnaires. The objective of these adjustments was to define various revenue and expense items as consistently as possible in order to provide comparable measures of financial condition. Section 5.8 of Volume II provides details on how the ratios were calculated and guidelines to their interpretation.

The operating ratio is defined as the ratio of operating revenues to O&M expense.[7] The ratio is calculated by dividing total operating revenues by O&M expenses. Items such as depreciation charges, interest, or other debt service payments are excluded from expenses when creating the ratio.

If the ratio is less than 1.0, the system is either running an operating deficit (or loss) that year, or is relying on non-operating revenues to finance its operations. A higher ratio means that funds are available from operations for non-operating functions such as servicing debt.

Distribution of Operating Ratio (Percentage of Systems)

	System Size			
	<500	501-3,300	3,301-50,000	>50,000
Public Water Systems				
<1	34.8	19.0	14.4	8.3
1 to 1.2	17.8	23.6	10.8	9.5
>1.2	47.4	57.4	74.8	82.2
Private Water Systems				
<1	32.3	17.2	6.0	6.4
1 to 1.2	19.6	18.7	16.8	5.1
>1.2	48.1	64.1	77.2	88.5

The table above shows the distribution of operating ratios by size of system. Notably, over 30 percent of all small systems (serving 500 or fewer people) have operating ratios of less than 1.0. Furthermore, less than half of systems in this size category have ratios of more than 1.2, a standard of good financial health. As system size increases, the ratios get better. In the largest size category, more than 80 percent of systems (almost 90 percent of privately owned systems) have ratios greater than 1.2.

Another indication of a water system's financial health is the ratio of total debt to total annual revenue. This ratio provides a measure of a water system's ability to incur new debt. The lower the ratio, the better. As shown in the following table, there is a slight downward trend in both means and medians as system size increases.

Total Debt as a Ratio of Total Revenue

	Publicly Owned Systems		Privately Owned Systems	
System Size	Mean	Median	Mean	Median
<100	3.21	3.34	3.18	2.23
101-500	2.98	2.38	2.54	1.76
501-1,000	2.63	1.82	2.70	1.94
1,001-3,300	2.84	2.47	2.43	1.89
3,301-10,000	2.62	2.02	3.93	1.85
10,001-50,000	2.08	1.85	1.48	1.32
50,001-100,000	3.09	1.59	1.55	1.60
>100,000	2.64	1.94	1.22	1.26

Closely related to total debt is the debt service coverage ratio. This measures the ability of water systems to cover their debt service after all operating expenses (excluding depreciation, interest, and other debt service) have been paid. Debt service coverage is computed by dividing net available revenue by annual principal and interest (i.e., debt service) charges. Net available revenue is the cash

[7] The use of the term "operating ratio" here is an accounting measure used by analysts to assess the financial condition of water utilities. It should not be confused with the operating ratio as used by public utility commissions to calculate a rate base.

available to pay debt service expenses after current O&M expenses have been paid. It is calculated by subtracting only O&M expenses (excluding interest, other debt service payments, and any depreciation charges) from gross revenues (i.e., operating plus non-operating revenues).

The numerator in the debt service coverage ratio represents annual net revenues available to pay debt service, and the denominator is the amount of debt to be retired and the interest on that debt for one year. It is a critical ratio used by lenders and bond rating services. This ratio should exceed 1.0, and analysts consider a range of 1.0 to 1.5 as acceptable. The debt service coverage ratio may be the subject of bond issue requirements for purposes of setting rates and for meeting tests before additional bonds may be issued.

Distribution of Debt Service Coverage Ratio (Percentage of Systems)

	System Size			
	<500	501-3,300	3,301-50,000	>50,000
Public Water Systems				
<1.0	52.1	41.5	25.7	15.7
1.0 to 1.5	19.3	16.5	21.0	21.2
>1.5	28.6	42.0	53.3	63.1
Private Water Systems				
<1.0	46.7	28.5	15.4	7.7
1.0 to 1.5	12.6	11.4	14.8	3.1
>1.5	40.7	60.1	69.8	89.2

The table above shows that approximately half of the systems in the smallest size category have ratios of less than 1.0. Privately owned systems are somewhat better in all size categories. For the largest systems, over 80 percent of publicly owned systems, and over 90 percent of privately owned systems, have ratios greater than 1.0.

Another characteristic, called the net takedown ratio, is an indicator of water system profitability (or surplus). It is determined by dividing net available revenue (defined above) by total gross revenue. Total gross revenues are the sum of both operating and non-operating revenues.

Distribution of Net Takedown Ratio (Percentage of Systems)

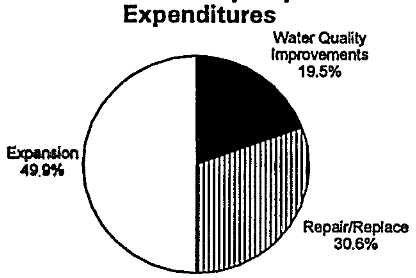
	System Size			
	<500	501-3,300	3,301-50,000	>50,000
Public Water Systems				
<0%	29.6	13.0	10.0	8.0
0% to 20%	11.2	22.9	13.5	8.0
>20% to 40%	26.8	28.2	35.5	32.2
>40%	32.4	35.9	41.0	51.8
Private Water Systems				
<0%	19.7	10.2	5.6	7.7
0% to 20%	9.6	18.6	14.0	3.0
>20% to 40%	32.2	31.0	42.0	78.5
>40%	38.5	40.2	38.4	10.8

As a general rule, lenders like to see a net takedown ratio greater than 20 percent. The data in the table above show that about 40 percent of the smallest publicly owned systems and about 30 percent of the smallest privately owned systems fall below the 20 percent threshold. As with all of the financial ratios, the larger systems look much better. Over 80 percent of the publicly owned systems and almost 90 percent of the privately owned systems have debt service coverage ratios of more than 20 percent.

As a final comment on financial ratios, we note that publicly owned systems frequently appeared to have financial ratios that were slightly worse than those of privately owned systems in most size categories. This is due in part to the ratios chosen for analysis, most of which emphasize net revenues. Privately owned systems often raise capital through sales of equity, reducing their reliance on debt capital. To pay dividends to their shareholders, privately owned systems would need to generate higher net revenues than publicly owned systems.

The general theme of this section—that larger systems have financial characteristics that are different from small systems—also appears to be true when one examines capital expenditures. Across all size categories, the largest category of investment was system expansion, followed by repair/ replacement and water quality improvements.

Water Industry Capital Expenditures



Large systems, however, generally invest a slightly greater percentage of their capital investment budgets in water quality improvements than do small systems. (See Volume II, Table 1-66, for more detailed data on this subject.)

Percentage of Capital Expenditures by Purpose, by Ownership

	System Size			
Publicly Owned Systems	<500	501-3,300	3,301-50,000	>50,000
Water Quality Improvements	17	20.2	19.6	20.4
Repair/Replace	30	32.6	19.3	34.8
Expansion	53	47.2	61.1	44.8
Privately Owned Systems				
Water Quality Improvements	14.3	15.7	7.6	21.3
Repair/Replace	50.2	43.1	38.3	33.2
Expansion	35.5	41.2	54.1	45.5

Community water systems reported capital investment expenditures totaling $32.6 billion over the 8-year period following SDWA reauthorization in 1986. Approximately 50 percent of the capital investment during this period was made by large publicly owned water systems. Interestingly, almost half of capital investment expenditures were for system expansion. Only the smallest two categories of privately owned systems reported spending more for replacement and major repairs than for expansion.

The principal source of funds for these capital investments was debt financing (e.g., bonds or loans). A higher proportion of large systems chose debt financing; small systems reported capital investment funds coming from "all other sources" (most likely, current operating revenues or reserve accounts).

Of those systems issuing bonds, a majority of systems serving populations greater than 50,000 were rated "A" or better, as shown in the following table. The table illustrates that the percentage rated "A" or better increases as system size increases.

Percentage of Systems with Bonds Rated "A" or Better of Systems Issuing Bonds

	System Size			
	<500	501-3,300	3,301-50,000	>50,000
Publicly Owned	6	6	35	83
Privately Owned	None	6	20	36

Six percent or less of systems in the smallest two size categories were rated "A" or better, but 83 percent of the largest publicly owned systems were rated "A" or better. The data also show that publicly owned systems generally have a higher percentage of systems rated "A" or better. This reflects the fact that most publicly owned systems serving more than 10,000 people have bonds that are rated; the majority of privately owned systems are not rated. Also, most small system bonds are not rated. (See Volume II, Table 1-69, for more detailed data on this subject.)

4. Intended Uses of CWSS Data

The 1995 CWS Survey database was developed primarily to provide the Agency with critical data to support its regulatory development and implementation efforts. The Agency last undertook this effort in 1986, to coincide with the 1986 Amendments to the SDWA.

Since 1986, the Agency has developed regulations covering 84 contaminants in public drinking water supplies, the filtration of surface water supplies, the use of lead plumbing, and the control of underground injection of wastes. EPA undertook the 1995 CWS Survey to determine a current baseline of operational and financial characteristics of the water supply industry. By comparing the results of this survey with the 1986 CWS Survey, changes in water industry operations and expenses resulting from the 1986 SDWA Amendments—and from customer demands for improvements in water quality and service—can be measured.

EPA plans to use the 1995 CWS Survey data to support the following types of analyses:

- Regulatory development analyses
- Policy development
- Regulatory implementation
- Compliance analyses

The CWS Survey data elements that can be used as inputs to each of these types of analyses are described below.

4.1 Regulatory Development Analyses

The 1996 Amendments to the SDWA extend EPA's mandate to establish regulations (i.e., set maximum contaminant levels) for contaminants in public drinking water supplies including arsenic, sulfate, and at least five additional contaminants every 5 years. Before any new regulations are established, however, the Agency must satisfy the analytic requirements of various statutes and regulations including:

- Executive Order 12866.
- Paperwork Reduction Act.
- Regulatory Flexibility Act.
- Small Business Regulatory Enforcement Fairness Act.
- Unfunded Mandates Reform Act.

The 1996 Amendments reinforce EPA's current SDWA requirement to specify best available technologies (BATs) for the removal of drinking water contaminants to consider those technologies that are affordable to different classes (i.e., sizes) of water systems. The Agency traditionally has conducted analyses of affordability in the context of implementing the SDWA's provisions regarding variances and exemptions. The 1996 Amendments to the SDWA add a new section, "Small System Variances," which provides new procedures for variances for small systems. This section also directs the Agency to publish information to assist states in developing affordability criteria. Data from the CWS survey will be useful when implementing these requirements.

In addition, the 1996 SDWA Amendments formalize the cost-benefit analysis requirements of Executive Order 12866. Under this order, the Agency must prepare Regulatory

Impact Analyses (RIAs) that detail the national costs and benefits of all proposed regulatory actions and alternatives under consideration. The RIAs are reviewed by the Office of Management and Budget to determine whether a proposed regulation can be justified from an economic perspective (i.e., whether the public health and other benefits achieved are sufficient to justify the costs imposed on the nation).

The RIAs prepared in support of proposed drinking water regulations estimate the economic and financial impacts of these regulations on the nation as a whole, on individual water utilities, and on individual households. The national-level economic impact analyses focus on estimating the net benefits of each regulatory alternative under consideration. The financial analyses examine the impact of additional capital requirements on water utility operating expenses and revenues. They also estimate how capital and O&M expenditures that are necessary to achieve compliance will affect household water rates and expenses. These effects are also known as distributional impacts.

As shown in the table on the next page, a drinking water RIA is a compilation of separate analyses and data collection efforts that provide data for the Agency's national cost and benefit estimation models. One example is the Office of Ground Water and Drinking Water's "Safe-Water" Model, which is an updated version of the old "What-If" Model. These analyses include:

- *System Characterization (Source, Size, Ownership):* Describe the type, size, and number of water treatment processes public water systems would have to construct or install to remove the regulated contaminant.
- *Contaminant Occurrence Analysis:* Estimate the current levels of a particular contaminant in drinking water supplies and the number of water utilities that potentially exceed various regulatory alternatives (i.e., Maximum Contaminant Levels) in violation of the proposed standard.
- *Exposure/Health Effects:* Describe the potential health risks associated with particular drinking water contaminants and assess the number of persons at risk from exposure.
- *Decision Trees/Treatment Profiles:* Describe the current treatment profile (i.e., treatment in-place) of community water systems and forecast the likelihood that they will select one of EPA's proposed BATs.
- *Entry Points, Distribution of Treatment Facilities:* Examine entry points into the distribution system, their average and potential flows, extent to which they are treated, and the types of treatments applied.
- *Unit Engineering Costs:* Examine in detail the capital and O&M requirements of a particular treatment technology that has been demonstrated to be effective in removing the specific contaminant.
- *Economic and Financial Input Estimates:* Evaluate baseline economic and financial conditions in the water industry and estimate the impact of new regulations on financial condition.

The table on the next page compares RIA and Information Collection

Comparison of RIA and ICR Data Requirements to CWS Survey Data Elements

	RIA Data Requirements							ICR
Survey Question Number	System Characterization (Source, Size, Ownership)	Contaminant Occurence Analysis	Exposure/ Health Effects	Decision Trees/ Treatment Profiles	Entry Points, Distribution of Treatment Facilities	Unit Engineering Costs	Economic and Financial Impact Estimates	Compliance Monitoring Burden
Q1: Contact Information								
Q2: Year Data								
Q3: Information Source								
Q4: Source Detail	■	■	■	■	■	■		■
Q5: Peak/Maximum Designs	■				■	■		
Q6: Design Factors				■	■	■		
Q7/8: Finished Storage		■	■			■		■
Q9: Pipe Detail		■	■			■		■
Q10: New Pipe Length						■		
Q11: Population/Connections	■	■	■	■	■	■		■
Q12: Zip Codes		■						
Q13/14: Operators				■		■		
Q15: Interconnections		■		■				
Q16: Contaminant Options		■		■				
Q17: Distance to Alternative Source		■						
Q18: Treatment Facilities		■		■	■	■		■
Q19: Disinfection Residuals		■		■		■		
Q20: Untreated Facilities		■		■	■	■		■
Q21-24: Surface/Wellhead Protection		■						
Q25: Contaminant Sources		■						
Q26: Lab Analysis Provider								■
Q27: Lab Payment Method								■
Q28: Generally Accepted Accounting Principles								
Q29: Revenues From Water	■						■	
Q30: Other Revenues							■	
Q31: Rates/Meters	■						■	
Q32: Uncompensated Usage						■	■	
Q33: Expenses							■	
Q34: Balance Sheet							■	
Q35-37: Capital Improvement Detail							■	
Q38/39: Bond Ratings							■	
Q40: Comments								

Request (ICR) data requirements to CWS Survey data elements. In general, the CWS Survey data elements provide baseline information that is critical to the preparation of the analyses discussed above. Without an accurate baseline, changes imposed by regulations cannot be measured accurately. For example, basic data to characterize the industry, such as the number of water systems categorized by their type of source, ownership, population served, and production volume are collected in response to CWS Survey questions 4, 5, and 11.

Contaminant occurrence analyses and exposure assessments use such industry characterization data; they also rely on information about source and facility characteristics that is provided in response to questions 18 and 20.

Analyses such as these support EPA's estimates of the cost of complying with new regulations. The cost of compliance includes installing or upgrading treatment facilities; increases in O&M expenses (mainly labor, chemicals, and power) associated with new treatment processes; and the cost of collecting and analyzing drinking water samples to monitor compliance.

The Paperwork Reduction Act requires the Agency to identify the reporting and recordkeeping burden imposed on regulated industries and on federal and state governmental agencies that manage the public water supply supervision program and the compliance monitoring program specified in SDWA regulations. The estimated burden of these recordkeeping and reporting requirements is detailed in ICRs. The preceding table also shows the CWS Survey data elements that support the development of SDWA burden estimates for use in ICRs.

The Regulatory Flexibility Act (RFA) and the newly authorized Small Business Regulatory Enforcement Fairness Act (SBREFA) require the Agency to demonstrate that SDWA regulations do not impose an unreasonable economic and financial burden on small businesses or governments. The analyses required by the RFA and SBREFA can be supported by many of the same CWS Survey data elements as the RIA and ICR analyses. The table on the opposite page compares RFA data requirements and CWS Survey data elements. The financial section of the CWS Survey database provides a number of critical data elements for input into EPA's small business impact analyses.

4.2 Policy Development Analyses

The diversity of water systems contained in the CWS Survey database provides the Agency with a sufficient set of financial and operational data that can be used to support a variety of Agency initiatives to develop policies and guidance to states and public water systems concerning the implementation and enforcement of drinking water regulations. These policy initiatives can involve, for example, defining financial affordability criteria for granting variances and assessing community-level affordability (i.e., ability to pay). Issues of affordability can then be examined by merging CWS Survey data with current population Census tract data to compare financial and operational performance measures to median income levels in service areas. Further, the source water protection and operator training and certification data contained in the CWS Survey can be used by EPA and the states to refine guidance for state programs.

The Agency is continually engaged in efforts to provide summary information and reports on the status of regulatory development, implementation, and enforcement activities. For example, the Agency has periodically prepared comprehensive drinking water program-level studies that describe the total cost and benefits of

Regulatory Flexibility/Small System Impact Analysis						
				Determine Small Entity's Ability to Absorb/Pass on Cost Increase		
Survey Question Number	Defining Small Entities (Source, Size, Ownership, etc.)	Determine Health Risk Posed by Small Entities	Determine Reporting, Recordkeeping, Requirements (Monitoring)	Financial Analysis	Socio-Economic Analysis	Alternatives to Regulation
Q1: Contact Information	■					
Q2: Year Data				■	■	
Q3: Information Source						■
Q4: Source Detail	■	■	■	■	■	■
Q5: Peak/Maximum Design	■				■	■
Q6: Design Factors		■		■	■	■
Q7/8: Finished Storage		■	■			■
Q9: Pipe Detail		■	■			■
Q10: New Pipe Length	■					
Q11: Population/Connections	■	■	■	■	■	■
Q12: Zip Codes	■	■			■	■
Q13/14: Operators	■	■	■	■		■
Q15: Interconnections		■				■
Q16: Contaminant Options		■				■
Q17: Distance to Alternative Source		■				■
Q18: Treatment Facilities		■	■	■	■	■
Q19: Disinfection Residuals		■				■
Q20: Untreated Facilities		■	■	■	■	■
Q21-24: Source/Wellhead Protection		■				■
Q25: Contaminant Sources		■	■			■
Q26: Lab Analysis Provider		■	■	■		
Q27: Lab Payment Method			■	■		
Q28: Generally Accepted Accounting Principles				■		
Q29: Revenues From Water	■			■	■	
Q30: Other Revenues	■			■		
Q31: Rates/Meters				■	■	■
Q32: Uncompensated Usage				■		
Q33: Expenses	■			■		
Q34: Balance Sheet	■			■		
Q35-37: Capital Improvement Detail		■		■		■
Q38/39: Bond Ratings				■		
Q40: Comments	■	■	■	■	■	■

all SDWA regulations. Most recently, the Agency was required by Congress to prepare an overall assessment of the capacity of states and public water suppliers to meet the technical and financial requirements of SDWA regulations. Data from previous CWS Surveys were used extensively in these reports. Further, the Agency is required periodically to prepare a program-level ICR to document the burden imposed on states, the water industry, and federal agencies to implement SDWA regulations. The Agency also receives periodic requests from Congressional staff and committees, other federal agencies, and the public for information on the water supply industry. The 1995 CWS Survey provides current information on the water industry to satisfy these requests.

Finally, data from the CWS Survey can be used in conjunction with data from prospective drinking water RIAs to develop estimates or profiles of the net needs of public water systems. Specifically, the CWS Survey database contains information on the current treatment and distribution configuration of water systems that can be used as a baseline for projecting future capital and O&M requirements for water systems.

4.3 Regulatory Implementation Analyses

A critical issue for EPA to address under the 1996 SDWA Amendments is whether the drinking water industry, and small systems in particular, have the technical and financial capacity to comply with SDWA regulations over a sustained period. In addition to the financial problems faced by small water systems, larger systems have potentially serious financial concerns as the combined effects of regulatory compliance and infrastructure repair and replacement drive operating costs higher. As a result, the Agency is engaged in efforts to assist states and water suppliers in building the necessary technical and financial capacity. Congress has provided money to assist the states and EPA in building additional capacity through State Revolving Loan Funds for public water systems. CWS Survey data, in conjunction with data from the Drinking Water Infrastructure Needs Survey, may be used to assess the ability of the water industry to finance infrastructure investment.

Another potential use of the CWS Survey database is for the development of operational and financial performance measures for individual water systems to gauge their relative technical and financial performance. Data on specific CWS Survey variables or ratios of variables can be expressed as industry mean or median values for comparison by individual utilities against their particular operational situation. The data can also be used in statistical (e.g., regression analysis) models to develop relationships between variables for use in predicting potential operational or financial problems. Water system analysts could use these models to identify systems in need of additional technical and financial assistance before critical problems develop.

4.4 Compliance Analyses

The Agency is engaged in several efforts to upgrade and expand its water industry databases. One intended use of the CWS Survey database is to support the development of profiles of operational and financial characteristics for different types of water systems that can be statistically correlated with the Agency's database of compliance records contained in the Safe Drinking Water Information System (SDWIS). The objective of this analysis is to identify those operational and financial characteristics that can potentially result in future compliance problems. EPA can then develop guidance to target systems that may exhibit these characteristics.