CONGRESSIONAL BUDGET OFFICE
U.S. Congress
Washington, DC 20515

Dan L. Crippen, Director

May 24, 2002

Honorable Paul E. Gillmor,
Chairman
Honorable Frank Pallone Jr.,
Ranking Member
Honorable Sherrod Brown
Subcommittee on Environment
and Hazardous Materials
Committee on Energy and Commerce
U.S. House of Representatives

Honorable Michael Bilirakis
Committee on Energy and Commerce
U.S. House of Representatives

Honorable John J. Duncan Jr.,
Chairman
Honorable Peter A. DeFazio,
Ranking Member
Honorable Sherwood Boehlert
Honorable Robert Borski
Subcommittee on Water Resources
and Environment
Committee on Transportation
and Infrastructure
U.S. House of Representatives

Dear Gentlemen:

Experts from the Environmental Protection Agency and various nonfederal groups report that the nation's drinking water and wastewater systems face increasing challenges over the next several decades in maintaining and replacing their pipes, treatment plants, and other infrastructure. But there is neither consensus on the size and timing of future investment costs nor agreement on the impact of those costs on household and other water ratepayers.

Pursuant to a joint request at the end of the 106th Congress from the Chairmen and Ranking Members of the Subcommittee on Water Resources and Environment and what is now the Subcommittee on Environment and Hazardous Materials, the Congressional Budget Office (CBO) has analyzed those issues. According to the agreement with committee staff, CBO is now issuing a summary of its results, attached to this letter. The attachment presents estimates of future costs for water infrastructure under two scenarios—a low-cost case and a high-cost case—and briefly discusses major federal policy options. The full study, which will follow, will report in greater detail on the nation's water systems, the methods and assumptions used in CBO's analysis, and the arguments for and against various policy responses.

The attachment was written by Perry Beider and Natalie Tawil of CBO's Microeconomic and Financial Studies Division, under the supervision of David Moore and Roger Hitchner. The authors received valuable assistance and comments from Tracy Foertsch, Susanne Mehlman, John Peterson, and Dennis Zimmerman, all of CBO, and from Steve Allbee, George Ames, Janice Beecher, Claudia Copeland, Randall Lutter, Alan Manning, George Raftelis, Kenneth Rubin, Jon Schellpfeffer, David Travers, and many others.

Leah Mazade edited the attachment, and Christine Bogusz proofread it. Rae Wiseman typed early versions of the tables, and Kathryn Winstead and Christian Spoor prepared the report for publication. Annette Kalicki prepared the electronic versions for CBO's Web site (www.cbo.gov).

I hope the attached report will be useful to you. Please call me if you have any questions, or have your staff contact the authors directly at 226-2940.

Sincerely,

Dan L. Crippen

Attachment

SUMMARY

CBO

REPORT

Future Investment in Drinking Water and Wastewater Infrastructure

May 2002

The Congress of the United States ■ Congressional Budget Office

Notes

Unless otherwise stated, all costs in this report are in 2001 dollars.

Numbers in the text and tables may not add up to totals because of rounding.

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Future Investment in Drinking Water and Wastewater Infrastructure

Water-system authorities believe that maintaining the nation's high-quality drinking water and wastewater services will require a substantial increase in spending over the next two decades. They point to many types of evidence of the problems with existing water infrastructure, including the damages caused by collapsed storm sewers in various cities, the yearly 1.2 trillion gallons of stormwater overflows from combined sewer systems that carry untreated sewage into water bodies, and the estimated 20 percent loss from leakage in many urban drinking water systems. Future investment spending is expected to be devoted primarily to the replacement of pipes, which represent most of the value of both drinking water and wastewater assets, but investment will also address aging equipment at treatment plants and water quality.

The amount of money needed for future investment in water infrastructure is a matter of some debate, and various estimates have been developed. The "needs surveys" of wastewater and drinking water systems conducted periodically by the Environmental Protection Agency (EPA) provide one measure of potential investment costs. Others are offered by groups such as the Water Infrastructure Network and the American Water Works Association. The Congressional Budget Office (CBO) has also analyzed future costs for water infrastructure and presents its estimates here as high-cost and low-cost scenarios that span the range of what CBO considers to be the most likely possibilities. CBO's two sets of projections illustrate the large amount of uncertainty surrounding estimates of those future costs.

In the debate about future water-system investment, not only the amount of money that will be needed but also the source of those funds is at issue. Advocates of more federal spending have argued that estimates of the difference between future costs and some measure of recent investment spending—the "funding gap"—justify increased federal support. However, higher future costs could be funded from many sources and are not necessarily a federal responsibility.

The federal government currently supports water-system investment through several programs. They include the clean water and drinking water state revolving funds (SRFs), which receive capitalization grants through appropriations to EPA; loan and grant programs of the Department of Agriculture's Rural Utilities Service; and the Community Development Block Grants administered by the Department of Housing and Urban Development.[1] Notwithstanding those and various smaller programs, the vast majority of the funding for drinking water and wastewater services in the United States today comes from local ratepayers and local taxpayers. (For example, in 1999, federal and state grants provided just 2 percent of the revenues reported by 102 medium-sized and large wastewater systems in a survey by the Association of Metropolitan Sewerage Agencies.)[2]

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1. For an overview, see the General Accounting Office, *Water Infrastructure: Information on Federal and State Financial Assistance*, GAO-02-134 (November 2001). The federal government also supports water infrastructure through tax preferences on municipal debt and "qualified private activity bonds" (discussed later).

2. Association of Metropolitan Sewerage Agencies, *The AMSA Financial Survey, 1999* (Washington, D.C.: AMSA). Comparable data for small and rural systems, which rely more heavily on external aid, are not readily available.

Ultimately, society as a whole pays 100 percent of the costs of water services, whether through ratepayers' bills or through federal, state, or local taxes. Federal subsidies for investment in water infrastructure can redistribute the burden of water costs from some households to others. However, subsidies run the risk of undermining the incentives that managers and consumers have to take cost-effective actions, thereby retarding change in the water industry and raising total costs to the nation as a whole.

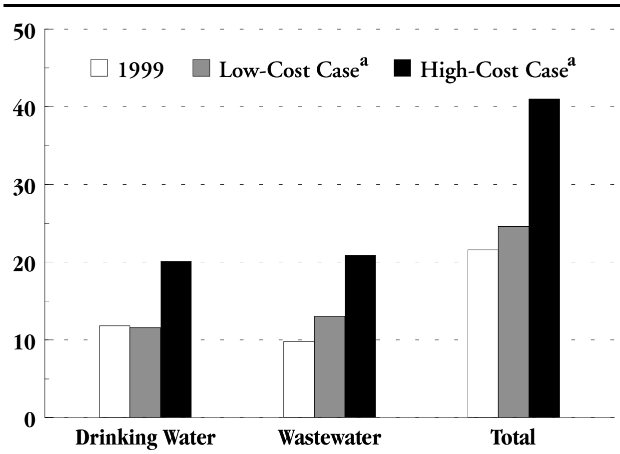
CBO's Estimates of Future Costs for Water Infrastructure

CBO estimates that for the years 2000 to 2019, annual costs for investment in the nation's water systems will average between $11.6 billion and $20.1 billion for drinking water systems and between $13.0 billion and $20.9 billion for wastewater systems (see Figure 1).

Figure 1.

CBO's Estimates of Water Investment Costs

Billions of 2001 Dollars



SOURCE: Congressional Budget Office.

a. Average annual costs for the 2000-2019 period.

CBO also projects that annual costs over the period for operations and maintenance (O&M), which are not eligible for aid under current federal programs, will average between $25.7 billion and $31.8 billion for drinking water and between $21.4 billion and $25.2 billion for wastewater. (Unless otherwise noted, all costs in this paper are in 2001 dollars.) CBO estimated costs for the 2000-2019 period to simplify comparisons with earlier estimates developed by the Water Infrastructure Network (WIN), a coalition of groups representing water-service providers, elected officials, engineers, construction companies, and environmentalists. Data on actual spending in 2000 and 2001 are not yet available.

CBO estimated future investment and O&M spending under two different scenarios—a low-cost case and a high-cost case—that were intended to span the most likely possibilities within the full set. The range of estimates reflects the limited information available at the national level about existing water infrastructure. For example, there is no accessible inventory of the age and condition of pipes, even for the relative handful of large systems that serve most of the country's households. That lack of adequate system-specific data compounds the uncertainty inherent in projecting costs two decades into the future. Indeed, given the limitations of the data and the uncertainty about how future technological, regulatory, and economic factors might affect water systems, CBO does not rule out the possibility that the actual level of investment required could lie outside the range it has estimated.

Under each scenario, the estimates are intended to represent the minimum amount that water systems must spend (given the scenario's specific assumptions) to maintain desired levels of service to customers, meet standards for water quality, and maintain and replace their assets cost-effectively. That definition of the estimating target recognizes that a water system's investment requirements depend on the standards of service that it chooses and specifically focuses on the minimum amount of spending necessary to achieve service and quality goals. Other estimators have used similar definitions to characterize investment "needs." For example, EPA's survey of drinking water needs covers investments that reflect "the inherent costs of being a water system which involves the nearly continual need to install, upgrade, and replace the basic infrastructure that is required to deliver safe drinking water to customers" and any others that are "required to protect the public health."[3]

CBO excluded certain categories of investment in developing its estimates, in part because of data limitations. Water systems are still in the early stages of developing estimates of the costs for increasing system security in the wake of the September 11th attacks; however, preliminary reports suggest that security costs will be relatively small compared with the other costs for infrastructure investment. Also excluded from the estimates is drinking water investment to serve new or future customers. Such projects are not eligible for assistance from the SRFs, and hence are not covered in EPA's needs survey, unless they respond to a public health problem (for example, a project to hook up users of contaminated wells) or are components of projects triggered by existing customers' needs (for example, replacing a deteriorated water main with a larger-sized one that allows for expected growth).

CBO's estimates measure investment spending in costs-as-financed rather than in current resource costs, the yardstick that economists typically use. Costs-as-financed comprise the full capital costs of investments made out of funds on hand—that is, on a pay-as-you-go basis—during the time period being analyzed and the debt service (principal and interest) paid in those years on new and prior investments that were financed through borrowing. In contrast, current resource costs include the investments' capital costs, regardless of how they are paid for, and exclude payments on past investments. Current resource costs are more suitable than other measures of investment volume for analyzing whether society is allocating resources efficiently—for example, in assessing the costs and benefits of water-quality regulations. But CBO's present analysis takes water-quality and service goals as a given and focuses on the financial impact of meeting those goals. For that purpose, measuring costs-as-financed is more useful than measuring current resource costs because it better indicates the burden facing water systems and their ratepayers at a given time.

3. Environmental Protection Agency, *Drinking Water Infrastructure Needs Survey: Second Report to Congress* (February 2001), p. 12.

How CBO Derived Its Estimates

CBO derived its estimates of investment for both the low-cost and high-cost cases following the basic approach—including the major sources of data and supplementary models—used by WIN, which projected costs for both physical capital and interest on loans and bonds. Within that approach, CBO's two cases differ in the values for six assumptions about physical capital requirements and for three assumptions about financing costs (see Table 1). The assumptions most responsible for the difference in the two scenarios' estimated costs are those about the rate at which drinking water pipes are replaced, the savings associated with improved efficiency, the costs of controlling combined sewer overflows (CSOs), and the borrowing term.[4] (Box 1 discusses how CBO derived its estimates of O&M costs and compares them with WIN's estimates.)

To estimate physical capital requirements for drinking water and wastewater systems, CBO started with data collected by EPA in its needs surveys, supplementing

4. A "combined" sewer system is one that commingles stormwater with household and industrial wastewater. About 5 percent of publicly owned wastewater systems have combined sewers; the rest have separate "sanitary" sewers. Both types of systems can overflow, particularly during a period of heavy rainfall, discharging the excess flow directly into receiving waters; wastewater systems face significant expenditures to address both CSOs and sanitary sewer overflows.

Table 1.

Assumptions Used in CBO's Low-Cost and High-Cost Cases

	Low-Cost Case	High-Cost Case
Capital Factors		
Savings from efficiency in wastewater and drinking water investment (Percent)	15.0	5.0
Wastewater		
Annual percentage depreciation	2.7	3.3
Replacement share from Wastewater Needs Survey[a] (Percent)	25.0	15.0
Annual cost of CSO abatement (Billions of 2001 dollars)	2.6	5.5
Drinking water		
Annual percentage replacement of pipes	0.6	1.0
Annual cost of regulations not yet proposed (Billions of 2001 dollars)	0	0.53
Financing Factors		
Real (inflation-adjusted) interest rate (Percent)	3.0	4.0
Repayment period	30 years	25 years
Pay-as-you-go share of total investment (Percent)	15.0	30.0

SOURCE: Congressional Budget Office.

NOTE: CSO = combined sewer overflow.

a. The share of the needs reported in the survey that represents replacement of existing capital.

them with estimates derived from simple models. The supplementary estimates were necessary, CBO believes, because the surveys reportedly do not identify investment requirements over the full 20-year period. According to EPA, many wastewater systems plan their investments over a shorter time span, such as five or 10 years, and many drinking water systems have responded to the surveys on the basis of planning documents covering just one to five years.[5]

The methods CBO used to supplement EPA's survey data differed for drinking water and wastewater.[6] For drinking water, CBO replaced the survey data on investments in pipe networks with estimates based on a study by Stratus Consulting for the American Water Works Association (AWWA). The Stratus study estimated the need for pipe replacement on the basis of some national-level data and assumptions about the number of drinking water systems nationwide (classified by size and region), the miles of pipe per system, the distribution of pipe mileage by pipe size, the replacement cost of pipes of each size, and the pipe replacement rate.

In analyzing capital costs for wastewater systems, CBO distinguished between projects to replace existing infrastructure and other investments. It estimated replacement investment for each year of the 2000-2019 period

5. Environmental Protection Agency, *1996 Clean Water Needs Survey: Report to Congress* (September 1997), p. 7, and *Drinking Water Infrastructure Needs Survey*, p. 43.

6. Consequently, the two sets of estimates are not strictly comparable. That is, the estimates of the difference in future investment costs between wastewater and drinking water systems may partly reflect the differences in estimating methods.

Box 1.

Estimates of Costs for Water Systems' Future Operations and Maintenance

The Congressional Budget Office (CBO) used relatively simple methods to estimate water systems' future spending on operations and maintenance (O&M). For both drinking water and wastewater O&M in the high-cost case, CBO extrapolated a linear trend from real (inflation-adjusted) spending on O&M over the 1980-1998 period. For the low-cost case, it started with the same linear trend but adjusted it downward to reflect savings from improved efficiency; the savings were phased in over 10 years, beginning at 2 percent in 1995 and reaching 20 percent by 2004.

Thus, only one factor distinguishes the estimates under the two scenarios—which, as a result, probably do not capture as much of the uncertainty surrounding future O&M costs as do CBO's more-detailed models of capital investment.

Estimates of annual O&M costs by the Water Infrastructure Network (WIN)—$29 billion for drinking water and $24 billion for wastewater—are roughly in the middle of the ranges spanned by CBO's two cases. Because CBO and WIN used the same basic approach of extrapolating a future trend from existing data on O&M spending, and both WIN's analysis and CBO's low-cost case assume savings of 20 percent from efficiency gains, one might expect the two sets of estimates to be similar. However, WIN used different spans of data for extrapolation than CBO did (from 1985 to 1994 for drinking water and from 1972 to 1996 for wastewater); converted the data from nominal to real dollars with a construction cost index (which might not correspond well to the types of expenditures associated with O&M) instead of the more general GDP price index that CBO used; and phased in the efficiency savings two years later. Moreover, for wastewater, WIN extrapolated its trend not from data on O&M spending itself but rather from data on O&M spending per dollar of net capital stock. Although a water system's capital stock is plausibly related to its O&M costs, there is no clear reason for associating each additional dollar of capital stock with an increasing (rather than a steady) amount of additional O&M spending.

by multiplying the estimated net capital stock in that year by a constant rate of depreciation. Other investment in each year was assumed to equal the average annual amount reported in relevant categories of EPA's needs survey, with two adjustments. One adjustment substituted a later EPA estimate of the costs of correcting sanitary sewer overflows (SSOs) for the survey's reported needs relating to repair and replacement of existing sewers. The second adjustment was made because some of the needs reported in the survey and in the later analysis of SSO costs represented amounts to replace existing infrastructure. CBO thus reduced the sum of those needs by a certain percentage to avoid double-counting.

CBO calculated interest costs for investments made during the 2000-2019 period using assumptions about interest rates, borrowing terms, and the share of investments paid for through borrowing rather than on a pay-as-you-go basis. However, much of the principal and interest on investments financed during the period will not be paid until after 2019. To measure investments from 2000 through 2019 in costs-as-financed, CBO focused only on the debt service paid during the period, whether on newly built projects or on those built before 2000. (As discussed later, that approach differs from WIN's.)

Within the basic approach, CBO selected contrasting assumptions for its low-cost and high-cost cases (shown in Table 1 on page 4) by examining earlier analyses by other estimators and consulting with industry experts. For example, the assumptions used for the cost of CSO control reflect views from EPA and the CSO Partnership, a coalition of CSO communities and firms expert in designing such controls. In particular, the low-cost case uses EPA's estimate of the cost of controlling 85 percent of wet weather flows, whereas the high-cost case reflects the CSO Partnership's belief that costs will be roughly twice as high unless states pursue their options for revising water-quality standards to make control less expensive.[7] Similarly, the values assumed in the two scenarios for the pay-as-you-go share of investment are based on CBO's expectation that systems will increase their use of borrowing as they try to control rates in the face of rising investment costs; but they reflect different views among experts about how much and how quickly the use of pay-as-you-go financing will decline.

Comparing Future Costs and Current Spending

As noted earlier, part of the policy debate on investment in water infrastructure has focused on the difference between future costs and current spending for such investment and on how that difference could affect household ratepayers. However, the available data on current spending, collected for the Census Bureau's Survey of State and Local Government Finances, shed limited light on the issue because they do not measure spending in costs-as-financed. The census data identify the current interest payments only of drinking water systems and not of wastewater systems (because the survey classifies the latter as municipal departments rather than utilities and does not itemize the interest attributable to different departments).[8] Further, the data include the capital costs of all investment in a given year—whether the burden of those projects falls on ratepayers in that year or is being deferred through borrowing—and exclude the principal being repaid on previous borrowing.

For 1999, the latest year for which information is available, CBO's best estimates of investment spending are \$11.8 billion for drinking water and \$9.8 billion for wastewater, measured in costs-as-financed. To develop those estimates, CBO had to make many assumptions —for example, about the extent to which water systems had borrowed to finance investments over the previous 20 years. Different assumptions could have increased or decreased the results, perhaps by 20 percent.

The difference between those estimates of 1999 investment spending and projected average annual investment from 2000 through 2019 under the low-cost case is close to zero for drinking water and is \$3.2 billion for wastewater. Together, the future costs for both types of systems represent growth of 14 percent from the 1999 levels. That result contradicts the conventional wisdom that the nation's water systems will soon be straining to fund a large increase in investment. Nevertheless, CBO considers that result reasonable, given the uncertainty about the condition of the existing infrastructure, the prospects for cost savings from improved efficiency, and the possibility that water systems will fund more of their investment through borrowing and will borrow for longer terms. Under the high-cost case, the estimated increases average \$8.3 billion per year for drinking water

7. Under federal Clean Water Act regulations, states are allowed to modify the designated uses and quality standards of their water bodies if they demonstrate that meeting the existing standards is either technically infeasible or would have "substantial and widespread economic and social impacts."

8. The survey data also do not cover privately owned systems. Using WIN's approach, CBO addressed that omission by scaling up the data on drinking water expenditures by 15 percent, which reflects rough estimates of the share of households served by private systems. Private wastewater systems serve relatively few households, and CBO did not adjust the data to take them into account.

and $11.1 billion for wastewater, together representing growth of about 90 percent over the estimated levels for 1999.

Comparing CBO's Estimates with Those of Others

When measured in comparable terms, WIN's estimates are similar to those of CBO's high-cost case. In contrast, estimates obtained from "bottom-up" studies (those that derive national totals from data on individual systems) are even lower than the ones CBO projected in its low-cost case.

Comparing CBO's and WIN's Estimates

CBO's estimates of future investment in water infrastructure are not directly comparable with those of the coalition because the latter are not measured in costs-as-financed. WIN's published estimates comprise total capital costs associated with all investments—whether funded on a pay-as-you-go basis or through debt—during the 2000-2019 period and all interest paid over time on those investments. Thus, they differ from costs-as-financed estimates because they include debt service (principal and interest) paid after 2019 on "in-period" investments instead of debt service paid during the period on pre-2000 investments. That difference is important because the cohorts of investment that were financed yearly from 1980 through 1999, and that continue to be paid off from 2000 to 2019, are smaller than the new cohorts that the analyses project will be financed during the second period.

An additional factor complicates comparing CBO's and WIN's estimates of the increase over current spending that future investment costs represent. WIN's measure of future costs differs from its measure of current spending (which relies on the census data discussed above), so its estimates of the increased needs are inconsistent. In particular, WIN's measure of current spending includes the interest paid in the current year on past drinking water investments (rather than future interest payments on that year's investments) and does not include interest on wastewater investments.

Using more-detailed results provided by WIN's analysts, CBO found that measuring future investment in costs-as-financed reduces WIN's estimates of average annual needs from $26.3 billion to $21.4 billion for drinking water and from $24.2 billion to $18.9 billion for wastewater—an overall reduction of 20 percent (see Table 2).[9] CBO also recalculated the coalition's estimates of the difference between average annual future needs and current spending—the so-called funding gap—in costs-as-financed. (To do so, however, CBO had to approximate WIN's estimate of current debt service, a key component of current spending in costs-as-financed terms, since not enough information was available to calculate it directly.)[10] Again, the revised estimates are lower—$9.4 billion instead of $12.2 billion for drinking water and $9.2 billion instead of $13.5 billion for wastewater, for a combined reduction of 25 percent.

The reductions that result from measuring investment volume in costs-as-financed bring WIN's estimates close to those of CBO's high-cost case: the coalition's figures are somewhat higher for drinking water and a little lower for wastewater. The similarity in the two sets of esti-

9. Those comparisons express all costs in 2001 dollars. As originally published, WIN's annual estimates of future needs were in 1997 dollars and totaled $24 billion for drinking water and $22 billion for wastewater.

10. CBO approximated 1999 spending in costs-as-financed as it would have been calculated in WIN's analysis by multiplying WIN's estimate of average 2000-2019 costs for annual debt service on pre-2000 investments by a scaling factor that it obtained from a mock re-creation of the coalition's model. The resulting estimate was $12.0 billion, very close to the estimate of $11.8 billion used in CBO's own scenarios. Thus, any flaws in the approximation do not play a major role in explaining contrasts between WIN's and CBO's costs-as-financed estimates of the difference between future costs and current spending.

Table 2.

Estimates of Average Annual Water-System Costs, Capital Plus Financing, 2000-2019

In Billions of 2001 Dollars

	Drinking Water	Wastewater	Total
Investment Needs			
CBO[a]	11.6 to 20.1	13.0 to 20.9	24.6 to 41.0
Water Infrastructure Network			
As published	26.3	24.2	50.5
In costs-as-financed	21.4	18.9	40.3
Increase in Investment Above Recent Level			
CBO (Using a 1999 baseline)[a]	-0.2 to 8.3	3.2 to 11.1	3.0 to 19.4
Water Infrastructure Network			
As published[b]	12.2	13.5	25.7
In costs-as-financed[c]	9.4	9.2	18.6

SOURCES: Congressional Budget Office based in part on Water Infrastructure Network, *Clean and Safe Water for the 21st Century: A Renewed National Commitment to Water and Wastewater Infrastructure* (Washington, D.C.: WIN, April 2000).

a. Ranges are defined by CBO's low-cost and high-cost scenarios.

b. Relative to a 1996 baseline.

c. CBO's approximation of WIN's results using a 1999 baseline.

mates is not surprising, given that CBO and WIN used the same basic modeling approach and that the specific assumptions used in CBO's high-cost scenario either duplicate those in WIN's analysis—both assume that 1 percent of drinking water pipes and 3.3 percent of wastewater capital will be replaced annually—or differ in ways that tend to offset each other. (Specifically, CBO's high-cost case assumes higher costs than WIN does for CSO controls, nonreplacement projects in EPA's wastewater needs survey, and future drinking water regulations, as well as a higher interest rate on borrowed funds and a larger share of pay-as-you-go investment—but it also assumes a longer borrowing term, some savings from efficiencies in capital investment, and lower debt service on pre-2000 investments.)[11] Thus, CBO's high-cost case does not provide independent support for WIN's estimates but instead suggests that to obtain estimates of that magnitude requires making relatively pessimistic assumptions.

11. In contrast, CBO's low-cost case incorporates three assumptions that are the same as their counterparts in WIN's analysis and seven that are "lower," in the sense that they help to lower estimated costs. One of the seven, the estimated average cost over the period of debt service on pre-2000 investments, is not shown in Table 1 because it is the same in both of CBO's cases —$8.7 billion per year for drinking water and wastewater combined. The corresponding figure in WIN's analysis is $9.5 billion.

Table 3.

Estimates of Average Annual Water-System Costs Measured as Capital Resource Costs, 2000-2019

In Billions of 2001 Dollars

	Drinking Water	Wastewater	Total
CBO[a]	12.0 to 20.5	14.9 to 22.3	26.9 to 42.7
Water Infrastructure Network	20.9	19.2	40.1
Environmental Protection Agency			
Clean Water Needs Survey[b]			
As published	n.a.	7.3	n.a.
Adjusted for estimated sanitary sewer overflow needs	n.a.	11.4	n.a.
Drinking Water Infrastructure Needs Survey[c]			
As published	8.0	n.a.	n.a.
Adjusted for underreporting	11.1	n.a.	n.a.
American Water Works Association[d]	8.5	n.a.	n.a.

SOURCES: Congressional Budget Office based in part on Environmental Protection Agency, *1996 Clean Water Needs Survey: Report to Congress* (September 1997); Environmental Protection Agency, *Drinking Water Infrastructure Needs Survey: Second Report to Congress* (February 2001); American Water Works Association, *Reinvesting in Drinking Water Infrastructure: Dawn of the Replacement Era* (May 2001); Water Infrastructure Network, *Clean and Safe Water for the 21st Century: A Renewed National Commitment to Water and Wastewater Infrastructure* (Washington, D.C.: WIN, April 2000).

NOTE: n.a. = not applicable.

a. Ranges are defined by CBO's low-cost and high-cost scenarios.

b. Estimate for 1996 through 2015.

c. Estimate for 1999 through 2018.

d. Estimate for 2000 through 2029.

Comparing CBO's Estimates and Estimates from Bottom-Up Studies

Support for lower estimates of investment costs comes from bottom-up studies by EPA and the AWWA. Those studies measure investment in current resource costs—again, total capital costs regardless of financing but without including interest costs. Thus, comparing their estimates with CBO's and WIN's projections requires that those projections also be expressed in terms of resource costs.

Measured comparably, the estimates from CBO's low-cost case are above those from the EPA and AWWA studies, even after some (perhaps incomplete) adjustments to EPA's estimates to try to correct for the surveys' limitations in capturing investments over the full 20-year horizon (see Table 3).

- EPA's latest available wastewater survey was conducted in 1996 and published in 1997; estimated average annual needs were $7.3 billion per year. Substituting EPA's later projection of costs for SSO control raises the estimate to $11.4 billion.

- For drinking water, EPA's 1999 needs survey (published in 2001) estimated average annual needs of $8.0 billion; if the amount of underreporting in that survey equals the amount that EPA found in follow-up visits to 200 medium-sized and large systems after the initial 1995 needs survey, then the estimate of $8.0 billion can be scaled up to $11.1 billion.

- The AWWA conducted a detailed engineering analysis of the needs of 20 medium-sized and large drinking water systems; extrapolating from that admittedly small base to national totals, the association estimated that average annual needs equal $8.5 billion.

In short, estimates of investment needs from studies of individual drinking water and wastewater systems have been lower than those in CBO's low-cost case.

Water Costs in Household Budgets

How might future costs for water infrastructure investment, operations, and maintenance affect household budgets? CBO estimates that in the late 1990s, average bills for drinking water and wastewater services combined represented 0.5 percent of average household income. By 2019, CBO projects, average household water bills will account for 0.6 percent of average household income under the low-cost scenario and 0.9 percent under the high-cost scenario. According to the best available international data, such shares would not be high compared with the income shares devoted to household water bills in many other industrialized countries.[12]

CBO's estimates assume steady levels of taxpayer-financed support and constant shares of water costs paid by household and nonhousehold ratepayers. Any changes in those levels or shares would shift the form of the impact on household budgets but would not change the average impact nationwide, since households ultimately pay 100 percent of water costs, whether through water bills, taxes, or the costs of other goods and services produced using water.

Average shares, however, can obscure important differences among households; thus, they shed only limited light on the argument, made by advocates of boosting federal aid for water infrastructure investment, that water bills will otherwise become "unaffordable" for many households. Accordingly, CBO went beyond national averages to examine the current distribution of household water costs relative to income and to project the distributions that would occur if CBO's low-cost and high-cost estimates of future spending were accommodated through a uniform percentage increase in customers' water bills (see Figure 2).[13]

Specifically, CBO analyzed the current distribution using a national sample of annualized water bills reported by approximately 2,800 individual households; those households were participants in the quarterly Consumer Expenditure Interview Survey during the period beginning with the third quarter of 1997 and ending with the first quarter of 1999. CBO's analysis of the data included imputing expenditures for the 39 percent of respondents who did not report their own bills by using data from households with comparable incomes.[14] To

12. However, those data are limited to average direct billing costs for typical levels of water use and exclude household costs associated with tax-financed subsidies for water systems. See Organisation for Economic Co-operation and Development, Environment Directorate, Environment Policy Committee, *Household Water Pricing in OECD Countries*, ENV/EPOC/GEEI(98)12/FINAL (Paris: OECD, May 1999).

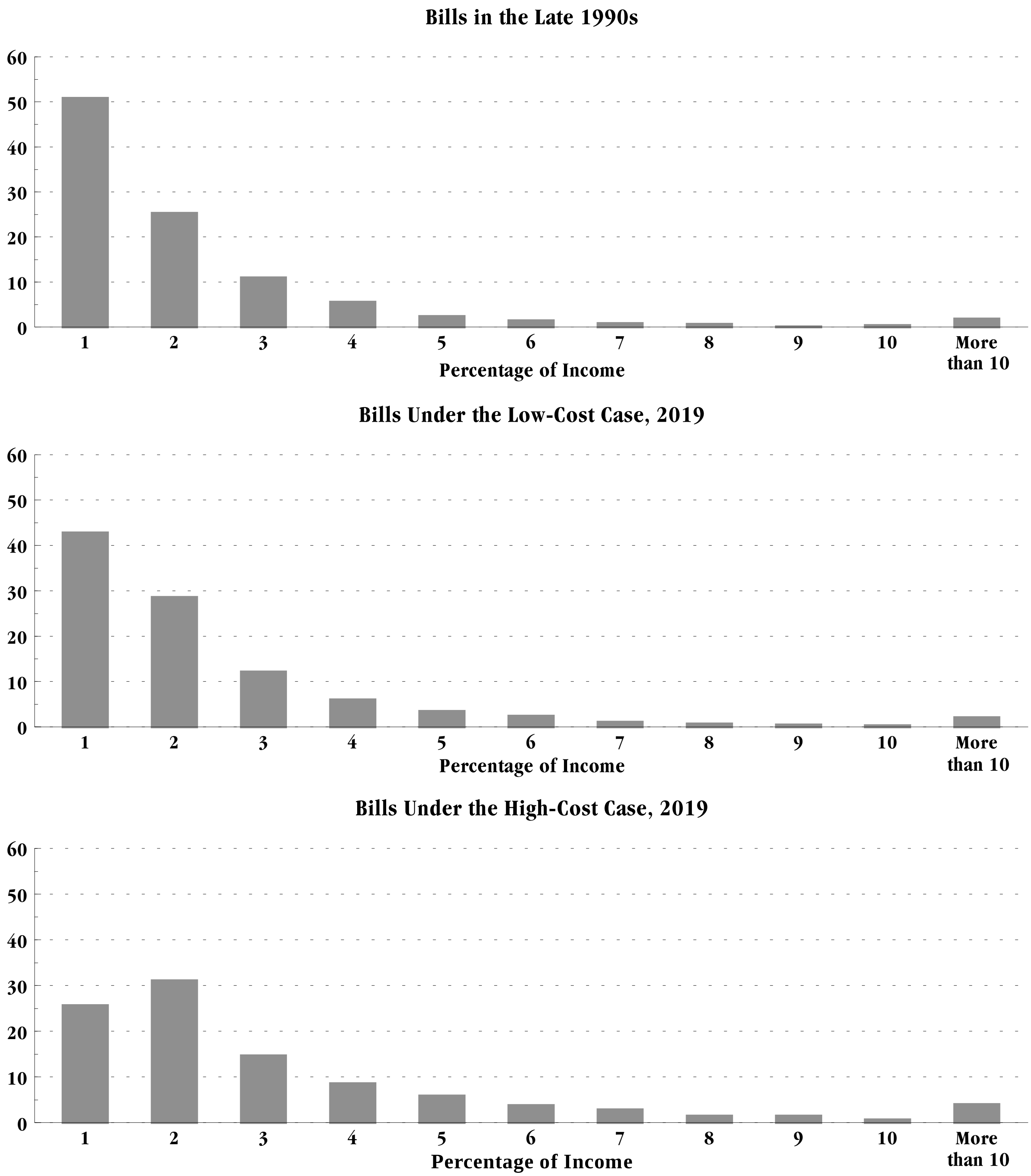
13. Of course, the fact that investment and O&M requirements vary among systems ensures that all customers in all classes (residential, commercial, industrial, and so forth) will not experience uniform percentage increases in water bills.

14. That imputation may overstate water costs since most nonreporting households are likely to be apartment dwellers (who do not receive separate water bills) and water use per capita is generally lower in multifamily units than in single-family homes. CBO also weighted the data to adjust for the fact that not all surveyed households participated for a full year.

Figure 2.

CBO's Estimates of Water Bills as a Share of Household Income

Percentage of U.S. Households



SOURCE: Congressional Budget Office.

project the distributions forward to 2019, CBO scaled up the individual water bills to reflect estimated costs in the two scenarios and extrapolated future household income to reflect growth in real income and population.

The results of CBO's analysis can be characterized in several ways, with different measures highlighting different features of the distributions shown in Figure 2. One summary measure that has received significant attention in discussions of future water costs is the fraction of households whose water bills exceed 4 percent of their income. But there is nothing unique about that particular measure; 4 percent has no economic significance as the point at which household water bills become "unaffordable."

From its analysis, CBO estimates that in the late 1990s, 7 percent of U.S. households spent more than 4 percent of their income on water services; an additional 16 percent had expenditures greater than 2 percent of their income. Twenty-five percent of U.S. households were spending less than 2 percent but more than 1 percent, and 51 percent were spending no more than 1 percent. If the additional burdens associated with CBO's low-cost and high-cost estimates led to uniform percentage increases in ratepayers' bills, 10 percent to 20 percent of U.S. households might be spending more than 4 percent of their income on water bills in 2019 for the services they now use; an additional 19 percent to 23 percent might be spending more than 2 percent.

In the WIN coalition's estimates, water bills account for a much larger share of household budgets, both now and in the future. In 1997, WIN estimates, 18 percent of households spent more than 4 percent of their income on water services; it foresees 22 percent of households having bills at that level by 2009 (halfway through the 2000-2019 period) and "a third or more of the population" experiencing such costs as rates continue to adjust.[15]

Apparently, the primary source of the discrepancy between WIN's estimate of 18 percent for 1997 and CBO's estimate of 7 percent for the late 1990s is that WIN did not examine actual bills based on water use by individual households, as CBO did; instead, it calculated household water bills using data on charges in 1997 among systems in Ohio for the equivalent of 250 gallons per day. The rationale for using those Ohio charges is that data from the 1990 census show drinking water expenditures relative to income for Ohio households matching well with those for the United States as a whole. (The 1990 census did not have data on household wastewater expenditures.) However, if national household water bills cannot be accurately characterized on the basis of Ohio system charges for 250 gallons per day, then WIN's results may not be representative. If, for example, low-income households tend to use less than 250 gallons per day, then, other things being equal, WIN's estimates overstate the number of households with water bills claiming more than 4 percent of their income.

Rationales for Federal Involvement in Water Services

Economic principles suggest that federal intervention in drinking water and wastewater markets may be able to increase the net benefits of water services when other entities do not have adequate incentives to account for their decisions' "spillover" effects on third parties. Partly

15. Water Infrastructure Network, *Clean and Safe Water for the 21st Century: A Renewed National Commitment to Water and Wastewater Infrastructure* (Washington, D.C.: WIN, April 2000), pp. 3-4 to 3-5.

on that basis, the federal government has taken the lead in establishing water quality standards under the Clean Water and Safe Drinking Water Acts. Whether current standards are consistent with the economically efficient use of society's resources is an important question but one that is outside the scope of this report.

There may also be an opportunity for federal action to improve the cost-effectiveness of water services by supporting research and development (R&D). Nonfederal entities measure potential R&D expenditures only against the cost savings that they themselves could realize, ignoring benefits that might accrue to others. Without federal involvement, therefore, funding for the development of new water-system technologies is likely to be lower than is optimal. Nonetheless, determining the right level of federal support in practice is a challenge. It depends on the returns to investment in R&D, which are typically difficult to predict, and the extent to which nonfederal entities reduce their R&D expenditures in response to federal funding.[16]

An economic case might also be made in favor of federal support for disseminating "best-management practices." The argument is not simply that such practices can help water systems reduce their costs, although that appears to be true. (Based on 136 assessments of water systems since 1997, the consulting firm EMA Associates finds that adherence to industry best practices could reduce operational costs by an average of 18 percent.) Rather, the crux of the argument is the possibility that federal costs for gathering and disseminating information about widely applicable practices would be lower than the total costs that individual system managers would incur in seeking out relevant information. If so, then taxpayer-funded support might yield cost savings.

However, other types of federal support for water services, such as the current spending programs and tax preferences that help fund investment, distort prices and thus undermine incentives for cost-effective actions by water systems and ratepayers. Eliminating those distortions could lower total national costs: for example, system managers might reduce investment costs by undertaking more preventive maintenance and improving the design of their pipe networks, and households might cut water use by fixing leaks and watering lawns less often.

A different argument for subsidizing investment in water infrastructure is to achieve certain distributional purposes, such as shifting the costs of water services from ratepayers served by high-cost systems to those served by low-cost systems or from low-income to high-income households. (Most federal support goes to publicly owned systems, but some goes to privately owned ones; see Box 2.) In evaluating the case for subsidizing water services, it is important to recognize that both the distributional effects and the extent to which support undermines incentives for cost-effective action depend on the level and form of the subsidies. To preserve those incentives for both water systems and users, the Congress could pursue policies that redistribute income rather than those that distort the price of water.

Implications of Increased Federal Support for Infrastructure Investment

Federal support for water-system investment can have unintended consequences. For example, an analysis of the federal wastewater construction grants program under the Clean Water Act concluded that it reduced other contributions to wastewater capital spending by 67 cents

16. In addition, federal funds for R&D may not yield the expected returns if political factors influence their allocation.

Box 2.

Federal Aid for Private Water Systems

Nearly half of all community drinking water systems in the United States are privately owned, as are roughly 20 percent of wastewater systems that treat household sewage. However, those systems serve only a small share of households: private drinking water systems reach only about 15 percent of households—excluding those using individual wells—and private wastewater systems only about 3 percent of sewered households. (The latter figure is an industry estimate; precise data are not readily available.)

Giving private systems access to federal funds on an equal footing with public systems may have positive consequences for cost-effectiveness in addition to the negative ones associated with increasing investment aid generally. If private ownership can reduce a system's costs in some cases and local decision-makers can correctly identify those cases, then balanced treatment could result in cost savings.

To help private systems pay for future investment in infrastructure, the federal government could make them equally eligible for the support it offers to public systems. On the spending side, that would involve privately owned wastewater systems gaining access to loans from the state revolving funds (SRFs).[1] On the tax preference side, it would involve altering policies related to tax-exempt private activity bonds (PABs). Specifically, the Congress could:

- Exempt bonds issued for water systems from the federal limits on the amount of PABs issued in each state;

- Exempt interest earned on those PABs from the individual alternative minimum tax (AMT) and partially exempt it from the corporate AMT;

- Increase opportunities for PAB issuers to benefit from arbitrage profits—those earned by investing PAB proceeds at a rate above the bond's own yield—by allowing issuers a full two years to spend their bond proceeds; and

- Allow one-time refinancing of PAB issues with new tax-exempt bonds up to 90 days before redemption of the original debt.

Providing equal access would have distributional consequences. Customers of private and public water systems would be equally eligible for federal benefits. However, privately owned water systems would be uniquely exempted from the PAB limits, since all privately run enterprises that are exempt from those limits under current law, such as airports and solid-waste facilities, must be publicly owned.

1. Private drinking water systems are already eligible for SRF assistance under federal law, although state constitutional provisions may prohibit some states from funding such systems. See Environmental Protection Agency, Environmental Financial Advisory Board, *Funding Privately Owned Water Providers Through the Safe Drinking Water Act State Revolving Fund* (July 1998).

on the dollar.[17] Thus, federal support does not necessarily increase investment in water infrastructure but may prompt cuts in state and local spending or its diversion to other uses.

Federal support for investment projects also undermines the cost-effective provision of water services by distorting the price signals that systems face and thus affecting managers' choices in many areas, such as preventive maintenance, construction methods, treatment technology, pipe materials, and excess capacity. The resulting losses can be significant, particularly if subsidies are large. For example, a statistical analysis done for a 1985 CBO study of the wastewater construction grants program indicated that the original federal cost share of 75 percent led to higher costs for plant construction.[18] In particular, the study projected that a cut in the federal share of investment funding from 75 percent to 55 percent (which occurred later under the program) would reduce average capital costs by 30 percent.[19] (Costs would be reduced, assuming that the states did not replace the lowered federal funding with their own subsidies, because system managers would exercise more care in choosing treatment technologies and reserve capacity and in monitoring the pace of construction.)

One way to reduce the distorting effects of federal subsidies might be to target increased aid to fewer systems—those judged most deserving, whether because of high costs associated with declining customer bases, federal regulations, or simply high levels of anticipated investment (or investment and O&M) in general. It may be difficult, however, to define the target group in a way that does not reward systems for poor management and past underinvestment. Targeting could even undermine cost-effective action if it encouraged system managers to let infrastructure deteriorate in hopes of qualifying for aid in the future.

A variety of spending mechanisms—grants, loan subsidies, and credit assistance—are available to deliver and annually readjust a desired level and pattern of aid for water systems, but the design of such programs would strongly influence total costs. For example, federal support such as partial grants, partial loans, or credit assistance would leave investment projects relying on private funds as well, and thus could help keep costs down by subjecting water systems to more market discipline from lenders and ratepayers. Another approach to help system and state authorities make cost-effective choices would be to allow them more flexibility in using the SRFs. That strategy might include eliminating floors and ceilings on funding for eligible activities in the drinking water program, easing restrictions on transferring federal money between drinking water and wastewater revolving funds, and broadening the funds' range of uses to address issues such as nonpoint source pollution.

17. James Jondrow and Robert A. Levy, "The Displacement of Local Spending for Pollution Control by Federal Construction Grants," *American Economic Review*, vol. 74, no. 2 (May 1984), pp. 174-178. The displacement of state and local spending per dollar of federal funds might have been less had the federal share been smaller than 75 percent, its statutory level during the period the authors studied.

18. Congressional Budget Office, *Efficient Investments in Wastewater Treatment Plants* (June 1985).

19. According to that estimate, the federal contribution for a given number of projects would have to be almost twice as high with a support rate of 75 percent as it would have to be with a rate of 55 percent, and more than four-fifths of the difference would go to higher costs. For example, a treatment plant that cost $10 million to build with a federal subsidy of 75 percent would have a federal share of $7.5 million and a local share of $2.5 million. In contrast, a plant that cost 30 percent less and had a subsidy of 55 percent would yield federal and local costs of $3.85 million and $3.15 million, respectively. The higher subsidy rate thus raises federal spending by $3.65 million but reduces local spending by only $0.65 million, one-fifth of the increase in federal expenditures.

The federal government can also use tax preferences to aid water systems, but doing so limits its discretion in delivering certain levels and patterns of aid. Public water systems and the interest paid on municipal bonds issued on their behalf are generally exempt from federal taxes. Options for enhancing the tax preferences already accorded to municipal bonds include relaxing the requirement that issuers rebate arbitrage profits (earned by investing the proceeds from a bond at a rate above the bond's own yield) to the Treasury and eliminating the partial taxation of interest earned on municipal bonds held by corporations that pay the alternative minimum tax. Such enhancements would aid medium-sized and large water systems but would be less helpful to small systems, many of which do not have access to the municipal bond market.[20] The Congress's ability to review and adjust tax preferences is limited in comparison with its ability to adjust spending programs through the annual appropriation process, but the greater year-to-year stability of the preferences would make planning easier for water-system managers.

20. Since SRFs would benefit from the changes, small systems that received SRF funding would benefit indirectly. Changing tax rules for water systems but not for other issuers of municipal bonds would make the tax code more complex and alter the current distribution of tax benefits.

Implications of Direct Federal Support for Ratepayers

An alternative to subsidizing investment by water systems would be to assist low-income households facing high or greatly increased water bills. No federal program exists for transferring income to help households with their water bills, but there are precedents for that type of federal aid.[21]

A well-designed program to support households might address distributional objectives more precisely and at the same time avoid price distortions that would undermine incentives for cost-effective action by water systems and their customers. Unlike programs to subsidize investment, a program to subsidize households would not affect the choices confronting water-system managers; nor would it reduce the water prices faced by households that were not receiving the direct subsidies. Even for subsidized households, the program could limit the costs associated with distorting water prices by defraying the expense of their basic water use (for example, by paying a fixed amount per month based on household size) instead of paying benefits as a percentage of each household's water bill (which would effectively lower the price per gallon used). Such a program would provide support without encouraging overuse of water services.

21. Federal programs designed to provide household-level assistance with utilites include the Low Income Home Energy Assistance Program and the Low Income Program of the Universal Service Fund for telecommunications. The two programs generally distribute about $1 billion and $600 million per year, respectively.