CBO TESTIMONY

Statement of
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Estimates of Needs for Investment in Drinking Water Infrastructure

before the
Subcommittee on Environment and Hazardous Materials
Committee on Energy and Commerce
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SUMMARY

The existing estimates of how much investment in drinking water infrastructure will be needed over the next 20 years are very uncertain and may be too large. The lion's share of the investment will be used to rehabilitate or replace water pipes, but there is no national inventory of pipes' ages and conditions on which to base estimates of investment needs. In the absence of such an inventory, analysts have to rely on rough national assumptions, which add significantly to the uncertainty inherent in any 20-year projection. Moreover, notwithstanding claims that the existing estimates are, if anything, likely to underestimate the needs, CBO has identified some factors suggesting that those estimates may be too large. Thus, policymakers should not give undue credence to the estimates of future needs or the associated "funding gaps."

Moreover, the very concept of an investment "need" is a fuzzy one. The amount of money that water systems must spend in order to provide the necessary services can vary dramatically depending on how efficiently the systems operate and invest. Therefore, from the standpoint of economic efficiency, it is important that any federal support for water infrastructure be provided in a way that gives system operators and water users the appropriate incentives to keep costs and usage down.

Mr. Chairman and Members of the Subcommittee, thank you for inviting me to testify. The Congressional Budget Office (CBO) appreciates this opportunity to contribute to your review of the needs for investment in drinking water infrastructure. My testimony today reflects some initial findings from an ongoing CBO study requested by this Subcommittee and your colleagues on the Transportation and Infrastructure Committee.

Safe drinking water is essential to the economy and to human health. But how much and how to invest in order to maintain an adequate drinking water infrastructure are difficult issues. I hope to shed some light on those issues today.

In particular, I want to impart two main points:

- First, the existing estimates of how much investment will be needed over the next 20 years are very uncertain and may be too large. The lion's share of the investment will be used to rehabilitate or replace water pipes, but there is no national inventory of pipes' ages and conditions on which to base estimates of investment needs. In the absence of such an inventory, analysts have to rely on rough national assumptions, which add significantly to the uncertainty inherent in any 20-year projection. Moreover, notwithstanding claims that the existing estimates are, if anything, likely to underestimate the needs, CBO has identified some factors suggesting that those estimates may be too large. Thus, policymakers should not give undue credence to the estimates of future needs or the associated "funding gaps."

- Second, the very concept of an investment "need" is a fuzzy one. The amount of money that water systems must spend in order to provide the necessary services can vary dramatically depending on how efficiently the systems operate and invest. Therefore, from the standpoint of economic efficiency, it is important that any federal support for water infrastructure be provided in a way that gives system operators and water users the appropriate incentives to keep costs and usage down.

THE EXISTING ESTIMATES OF DRINKING WATER NEEDS

Projecting 20 years into the future is always difficult. Even the best 20-year estimate is only an extrapolation of what would happen under current and currently anticipated trends. In the case of projecting the needs for investment in water infrastructure, the difficulty is compounded by a shortage of data. The Environmental Protection Agency's (EPA's) quadrennial Drinking Water Infrastructure Needs Survey provides relevant data collected from systems around the country. However, EPA's reports based on the survey note that it underestimates infrastructure needs over its 20-year horizon because many systems are not able to identify and document all of their needs for the full period.[1] According to EPA staff, follow-up visits to some systems after the first drinking water survey yielded revised estimates that averaged 55 percent above those initially reported.

Prompted in part by the incompleteness of EPA's survey, a consortium called the Water Infrastructure Network (WIN) has developed more comprehensive estimates of 20-year infrastructure needs, supplementing the data from the survey with assumptions based on professional judgments. According to WIN's estimates, shown in Table 1,

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1. For example, see Environmental Protection Agency, *Drinking Water Infrastructure Needs Survey: First Report to Congress* (January 1997), p. 1. EPA recently released a report on a second survey of drinking water needs but has not yet incorporated the results of that survey into its analysis of the infrastructure funding gap.

TABLE 1. SUMMARY OF THE WATER INFRASTRUCTURE NETWORK'S ESTIMATE OF THE ANNUAL FUNDING GAP (In billions of 1997 dollars)

	Drinking Water
Capital Investment	19
Financing	5
Total Capital	24
Less 1996 Capital Funding[a]	-13
Estimated Funding Gap	11
Memorandum:	
Operation and Maintenance	27

SOURCE: Congressional Budget Office based on Water Infrastructure Network, "Clean & Safe Water for the 21st Century: A Renewed National Commitment to Water and Wastewater Infrastructure" (undated), available from the American Water Works Association (www.awwa.org/govtaff/win/finalreport.pdf).

a. From all sources, including ratepayers and federal and state aid.

investment needs for drinking water will average about $24 billion per year through 2019 (expressed in 1997 dollars and including financing costs). WIN estimates that capital spending in 1996 from all sources—primarily local funds from ratepayers but also federal and state aid—was roughly half of the estimated future needs; thus, relative to the 1996 investment level, future needs for drinking water infrastructure represent an average annual funding gap of $11 billion.[2] (The table also shows WIN's estimates of average annual spending for operation and maintenance [O&M]. Because little

2. Water Infrastructure Network, "Clean & Safe Water for the 21st Century: A Renewed National Commitment to Water and Wastewater Infrastructure" (undated), available from the American Water Works Association (www.awwa.org/govtaff/win/finalreport.pdf), pp. 3-1 and 3-3.

outside funding is available for O&M, ratepayers cover almost all of those costs as well as a portion of capital costs; thus, the O&M estimates bear on the question of total costs facing future ratepayers.) EPA is also conducting a similar "gap analysis" but has not yet published its results.

Uncertainty of the Estimates

The assumptions and judgments required in the absence of detailed data increase the uncertainty surrounding the estimates. The analysis underlying WIN's estimate illustrates that uncertainty. Part of that analysis comes from a 1998 report done for the American Water Works Association (AWWA), which focused only on investments in transmission and distribution systems and only on capital costs, not financing or O&M.[3]

The 1998 report estimated needs of $325.1 billion over 20 years (an average of $16.3 billion per year), including $101.4 billion for large systems, $198.0 billion for medium-sized systems, and $25.7 billion for small systems.[4] The analysis took the figure for small systems directly from EPA's 1995 needs survey and estimated the other figures using probability distributions to reflect uncertainty in four factors: the annual rate of pipes' replacement, the miles of pipe per water system, the distribution of pipes by size, and the cost per foot of replacing pipes of each size. To reflect the uncertainty about systems' replacement of pipes, for example, the analysis randomly selected replacement rates between 0.5 percent and 1.5 percent per year.

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3. Stratus Consulting Inc., "Infrastructure Needs for the Public Water Supply Sector: Final Report" (unpublished paper prepared for the American Water Works Association, Boulder, Colo., December 22, 1998).

4. Ibid., p. 3-11. CBO has been unable to learn exactly how WIN's consultants adapted the AWWA's estimate. Presumably, investments in treatment facilities and equipment account for at least some of the difference between the AWWA's annual average of $16.3 billion and WIN's figure of $19 billion (for capital costs).

The resulting distributions of estimated needs were wide (see Table 2). For medium-sized systems, the analysis found that the "80 percent confidence interval" around the mean estimate of $198 billion spanned $116 billion to $272 billion—leaving a 10 percent chance that the need was less than $116 billion and another 10 percent chance that it exceeded $272 billion. For large systems, the 80 percent confidence interval spanned $19 billion to $193 billion—or from 82 percent below the mean to 91 percent above it.

Notwithstanding those results, CBO does not believe that the existing estimates of total needs for drinking water investment are likely to be off by as much as 80 percent or 90 percent.[5] However, the results do illustrate the point that the use of assumptions in the absence of hard data inevitably increases the imprecision of a future projection. CBO further notes that the range of uncertainty around the needs does not have to be plus or minus 80 percent to have a dramatic impact on the potential scope of the policy problem that the needs represent. Because the estimated funding gap for capital investment—that is, the amount above recent funding levels—is roughly half of the total projected investment needs (according to WIN's numbers), an error of, for example, 30 percent or 40 percent in the projected needs translates to an error of 60 percent or 80 percent in the funding gap. According to rough calculations by CBO,

5. The analysts who developed the AWWA's estimate may have inadvertently overstated its uncertainty by using simple flat probability distributions for most of the uncertain factors. They probably would have been justified in giving greater weight to outcomes near the center of the range of possible values, which would have required using more complex peaked or bell-shaped distributions. Moreover, confidence intervals tend to get smaller in percentage terms as individual components of an estimate (for example, the needs of large systems and medium-sized systems) are added together, allowing random errors to offset one another.

TABLE 2. THE AMERICAN WATER WORKS ASSOCIATION'S ESTIMATE OF 20-YEAR INVESTMENT NEEDS FOR DRINKING WATER TRANSMISSION AND DISTRIBUTION SYSTEMS (In billions of 1998 dollars)

Size of System	Mean Estimate	80 Percent Confidence Interval
Small	25.7	N.A.
Medium	198.0	115.6 to 271.6
Large	101.4	18.6 to 193.2
Total	325.1	N.A.
Memorandum:		
Estimated Needs per Year	16.3	
WIN's Estimate of Total Capital Investment per Year (Including for treatment and storage)	19	

SOURCE: Congressional Budget Office based on Stratus Consulting Inc., "Infrastructure Needs for the Public Water Supply Sector: Final Report" (unpublished paper prepared for the American Water Works Association, Boulder, Colo., December 22, 1998)," and Water Infrastructure Network, "Clean & Safe Water for the 21st Century: A Renewed National Commitment to Water and Wastewater Infrastructure" (undated), available from the American Water Works Association (www.awwa.org/govtaff/win/finalreport.pdf).

NOTE: N.A. = not available.

an error of 30 percent or 40 percent just in the assumptions about the necessary rate of replacing pipes, which CBO believes is quite possible, could imply an error of 20 percent or 30 percent in the funding gap.[6]

6. The probability distribution of replacement rates for pipes assumed in the AWWA's analysis of drinking water infrastructure ranged from 0.5 percent to 1.5 percent per year, as noted in the text, and averaged 1.0 percent per year. That analysis also discussed an alternative approach, which assumed that pipe footage was laid in proportion to nationwide population growth. Under that alternative, the replacement rate between 2000 and 2019 would be about 0.6 percent per year, 40 percent less than under the selected approach.

Pipes represent roughly three-quarters of total capital assets of drinking water systems, and—at least in the wastewater analysis—replacement of existing assets represents about half of total investment needs. Therefore, an error of 40 percent in the assumed rate of pipes' replacement could imply an error of 15 percent in total investment needs and, hence, of 30 percent in the funding gap.

Similar estimates derived independently can raise one's confidence in those estimates. Contrary to the common perception, however, the current, preliminary version of EPA's "gap analysis" does not reach the same conclusion as the WIN report. Although both analyses present estimated gaps of $23 billion per year for drinking water and wastewater combined, that figure means different things in the two cases: in the WIN analysis, it is the 20-year average of a gap that grows year by year, whereas in EPA's preliminary analysis, it is the gap at the end of the 20-year period.[7] The differences are concentrated on the drinking water needs; for wastewater, the two estimates of needs are indeed very similar, if not identical—but that is because they were derived using the same methodology from the same consultants. In short, the two drinking water estimates are independent but not similar, and the two wastewater estimates are similar but not independent.

Possible Biases in the Estimates

Given that the estimates of needs are surrounded by significant uncertainty, the question arises as to whether that uncertainty is roughly balanced—that is, whether the estimates are about equally likely to prove too low as too high, or to lie primarily on one side or the other. WIN and EPA analysts argue that they have deliberately erred on the low side in their assumptions on capital and O&M spending and, therefore, that their estimates probably understate future needs. In particular, they point to their assumptions that 25 percent of the investment is financed without borrowing, that the rest is financed at a real interest rate of 3 percent, and that increased efficiency reduces O&M costs by 20 percent to 25 percent.

7. Personal communication, Steve Allbee, Environmental Protection Agency.

Those assumptions are reasonably conservative. But CBO has identified other factors that could tend to overstate the estimated costs for capital investment, financing, and O&M:

- First, in estimating needed capital investment, the existing analyses do not assume any savings from improved efficiency. Although the data to support such savings are sparser than they are for O&M, evidence from a growing number of case studies suggests savings from methods such as design/build contracting, preventive maintenance, and demand management (discussed below). Incorporating efficiencies in capital investment would also reduce the estimates for financing and O&M costs, because each dollar not invested cuts 75 cents from the debt to be financed and reduces the capital stock to be operated and maintained.[8]

- Second, the financing costs in the WIN report may be overstated. They appear to be the lifetime debt-service payments associated with the average annual capital investment over the period of 2000 to 2019. However, debt payments on investments made late in the period will primarily occur after 2019 and therefore have little influence on the average payment for debt service within the period. Conversely, the amount of debt paid in much of the first decade will primarily reflect the level of investment made before 2000, which is significantly lower than the level the report recommends from 2000 on. According to CBO's rough calculations, under WIN's assumptions the average annual debt service paid within the period would be roughly 25 percent below the reported $5 billion.

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8. Of course, some methods used to reduce investment needs require more O&M spending rather than less. As noted later in the text, the existing analyses do not reflect a detailed model of the relationship between capital spending and O&M spending.

- Third, the assumed reductions in O&M costs resulting from increased efficiency are relative to a baseline that may be too high for wastewater and perhaps for drinking water as well. CBO does not have specific information on the methods used to calculate O&M costs for drinking water systems, but the wastewater analysis used in both the WIN report and EPA's preliminary study assumes that the baseline ratio of O&M to capital stock rises steadily throughout the 20-year period, extrapolating from a general trend in data from 1972 to 1996. Although additional capital stock is typically associated with additional costs for O&M, it is not obvious that the *ratio* of O&M to capital would continue rising indefinitely in the absence of efficiency gains. Increases in that ratio during the 1970s and 1980s may reflect unique causes, such as the initial introduction of many secondary treatment facilities and biosolids disposal programs. Going forward, some investments, such as those to replace deteriorated pipes or install automated sensing and measurement equipment, could reduce the O&M required per unit of capital stock.

In short, there is much about future investment needs in drinking water infrastructure that is unknown, and assumptions based on even the best professional judgments can be significant sources of error.

EFFICIENCY, EQUITY, AND THE DEFINITION OF "NEED"

Although considerable uncertainty surrounds the available estimates, CBO accepts the judgment of industry professionals that drinking water systems will require large investments over the next few decades. But future "needs" are not a predetermined reality; they are partly the result of many federal, state, local, and private choices yet to be made. The amount of investment needed to maintain services and meet water quality requirements under current industry practices and current government policy is likely to differ from the amount needed under evolving industry practices, under alternative government policies, or under a least-cost approach.

In particular, a broad increase in federal funding intended to help keep water rates affordable could reduce the pressure on systems to operate more efficiently and on customers to economize on their use of water services and thereby keep total investment needs higher than they would be otherwise. That is another example of the familiar trade-off between equity and efficiency.

In recent years, both drinking water and wastewater systems around the country have taken steps to become more efficient. The results are illustrated by data from a survey conducted periodically by the Association of Metropolitan Sewerage Agencies. For example, the average sum of O&M costs and administrative costs per million gallons declined from $1,108 in the 1996 survey to $987 in the 1999 survey.[9] One method used to reduce costs has been more efficient use of employees: among 45 municipal wastewater agencies that responded in both 1996 and 1999, full-time-equivalent staffing per 10,000 people in the served area declined from 5.0 to 4.7.[10]

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9. CBO's calculations, using data from Association of Metropolitan Sewerage Agencies, *The AMSA Financial Survey, 1999: A National Survey of Municipal Wastewater Management Financing and Trends* (Washington, D.C.: AMSA, 1999) and its 1996 counterpart. The averages cover 84 responding wastewater systems in the 1999 report and 97 systems in 1996. CBO recalculated the 1996 average shown in the reports to exclude five high-cost systems that did not respond to the later survey. Also, the 1999 average that CBO obtained using available data for 84 systems differs slightly from AMSA's average of $930 for 87 systems.

10. Ibid., p. 67. Both the opinions of industry experts and more detailed data on the nature of the reductions in staffing and operational costs indicate that those savings primarily reflect true gains in efficiency, rather than reductions in necessary maintenance or other vital services.

Experts in the water industry see room for further cost savings, not only in operational costs but also in capital costs. Promising methods include the following:

- Consolidation of systems to achieve economies of scale. Reportedly, 50 percent of small drinking water systems lie within a standard metropolitan statistical area.

- Asset management, which involves analyzing local data on assets' age, performance, and condition in order to identify a maintenance and replacement strategy that minimizes long-run costs.

- Demand management, including the use of pricing strategies to reduce peak use.[11]

- Innovative contracting for new construction, such as the use of contracts covering both design and construction, or even design, construction, and operation.[12]

But those potential future savings could go unrealized if federal policy inadvertently undermines the forces pushing for efficiency. The savings observed to date have occurred primarily because of pressures from two sources. One source has been competition from private firms seeking contracts to operate municipal systems. The actual or potential threat of such competition has led to significant increases in efficiency in systems that remain publicly operated as well as in those contracted out to private operators. The second source of pressure has been resistance from customers

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11. See Allan Dietemann, "A Peek at the Peak: Reducing Seattle's Peak Water Demand" (Seattle Public Utilities, Resource Conservation Section, February 9, 1998).

12. For a well-documented example involving wastewater, see David Higgens and Frank Mangravite, "Comparison of Design-Build-Operate and Conventional Procurements on Washington Borough, N.J., Wastewater Treatment Plant," *International Supplement to RCC's Public Works Financing* (July-August 1999), pp. 1-7.

and oversight bodies to large rate increases. That pressure too has led system operators to reexamine their management practices and find many ways to reduce costs without sacrificing quality of service.

Whether federal aid would undermine or reverse the progress in water systems' efficiency would depend on how much aid the government provided and in what form. Clearly, if the federal government issued blank checks for infrastructure, local systems would lose any incentive to keep capital costs down. But the issue is also relevant in less extreme cases: a 1985 CBO analysis found that high federal cost shares in the original construction grant program for wastewater treatment raised capital costs by more than 30 percent.[13] Unfortunately, CBO cannot describe the precise relationship between federal support and total nationwide costs.

But if it is not clear "how much is too much" federal aid from the standpoint of efficiency, it is also not clear "how little is too little" for equity purposes—that is, to address the affordability and fairness issues. A large, broad program would probably benefit not only the neediest water users but also well-off users, with little additional gain in equity. CBO is analyzing the affordability issues associated with water infrastructure needs and expects to provide additional information on them in a report to be issued later this year.

In summary, CBO's analysis of the existing estimates of investment needs for drinking water infrastructure leads the agency to conclude that those estimates are accompanied by significant uncertainty and may be too high. Moreover, how big the needs turn out

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

to be will be influenced by who pays to meet them; in particular, proposals intended to address the equity problem of keeping rates affordable may adversely affect efficiency by raising total national costs.