FAILURE TO ACT

THE ECONOMIC IMPACT OF CURRENT INVESTMENT TRENDS IN WATER AND WASTEWATER TREATMENT INFRASTRUCTURE ★★★★

EXECUTIVE SUMMARY

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

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Of all the infrastructure types, water is the most fundamental to life, and is irreplaceable for drinking, cooking, and bathing. Farms in many regions cannot grow crops without irrigation. Government offices, hospitals, restaurants, hotels, and other commercial establishments cannot operate without clean water. Moreover, many industries—food and chemical manufacturing and power plants, for example—could not operate without the clean water that is a component of finished products or that is used for industrial processes or cooling. Drinking-water systems collect source water from rivers and lakes, remove pollutants, and distribute safe water. Wastewater systems collect used water and sewage, remove contaminants, and discharge clean water back into the nation's rivers and lakes for future use. Wet weather investments, such as sanitary sewer overflows, prevent various types of pollutants like sewage, heavy metals, or fertilizer from lawns from ever reaching the waterways.

However, the delivery of water in the United States is decentralized and strained. Nearly 170,000 public drinking-water systems are located across the U.S. Of these systems, 54,000 are community water systems that collectively serve more than 264 million people. The remaining 114,000 are non-community water systems, such as those for campgrounds and schools. Significantly, more than half of public drinking-water systems serve fewer than 500 people.

As the U.S. population has increased, the percentage served by public water systems has also increased. Each year new water lines are constructed to connect more distant dwellers to centralized systems, continuing to add users to aging systems. Although new pipes are being added to expand service areas, drinking-water systems degrade over time, with the useful life of component parts ranging from 15 to 95 years.

Particularly in the country's older cities, much of the drinking-water infrastructure is old and in need of replacement. Failures in drinking-water infrastructure can result in water disruptions, impediments to emergency response, and damage to other types of essential infrastructure. In extreme situations caused by failing infrastructure or drought, water shortages may result in unsanitary conditions, increasing the likelihood of public health issues.

The United States has far fewer public wastewater systems than drinking-water systems—approximately 14,780 wastewater treatment facilities and 19,739 wastewater pipe systems as of 2008.[1] In 2002, 98 percent of publicly owned treatment systems were municipally owned.[2] Although access to centralized treatment systems is widespread, the condition of many of these systems is also poor, with aging pipes and inadequate capacity leading to the discharge of an estimated 900 billion gallons of untreated sewage each year.[3]

The EPA estimated the cost of the capital investment that is required to maintain and upgrade drinking-water and wastewater treatment systems across the U.S. in 2010 as $91 billion. However, only $36 billion of this $91 billion needed was funded, leaving a capital funding gap of nearly $55 billion.

Water infrastructure in the United States is clearly aging, and investment is not able to keep up with the need. This study's findings indicate that investment needs will continue to escalate. As shown in table 1, if current trends persist, the investment required will amount to $126 billion by 2020, and the anticipated capital funding gap will be $84 billion. Moreover, by 2040, the needs for capital investment will amount to $195 billion and the funding gap will have escalated to $144 billion, unless strategies to address the gap are implemented in the intervening years to alter these trends.

Effects on Expenses

Even with increased conservation and cost-effective development of other efficiency methods, the growing gap between capital needs to maintain drinking-water and wastewater treatment infrastructure and investments to meet those needs will likely result in unreliable water service and inadequate wastewater treatment.

Because capital spending has not been keeping pace with needs, the resulting gap will only widen through 2040. As a result, pipes will leak, the construction of the new facilities required to meet stringent environmental standards will be delayed, addressing the gap will become increasingly more expensive, and waters will be polluted.

This analysis assumes that the mounting costs to businesses and households will take the form of:

- ★ Doing nothing and living with water shortages, and higher rates (rationing through price increases); major outlays by businesses and households, including expenditures incurred by moving to where infrastructure is still reliable; purchasing and installing equipment to conserve water or recycle water; and increasing reliance on self-supplied water and/or wastewater treatment (i.e., installing individual wells and septic waste systems when municipal facilities and services are not available options); and

- ★ Incurring increased medical costs to address increases in water-borne illnesses due to unreliable delivery and wastewater treatment services.

These responses to failing public infrastructure will vary by location, household characteristics, and size and type of business. Expenditures due to moving, or from installing and operating new capital equipment for "self-supply," are estimated for households, commercial establishments, and manufacturers. These costs are estimated at $35,000 per household and $500,000 to $1 million for businesses, depending on size and water requirement, and are amortized over 20 years. Although these expenditures are based on the costs associated with self-supply, the costs are used to represent outlays by some households and businesses in response to unreliable water delivery and wastewater treatment services. This study does not assume that companies or households move outside of the multistate region where they are now located. However, movement across regional boundaries and relocation of businesses outside of the U.S. is certainly a response that may be triggered by decreasing reliability of public water and sewer systems. Households and businesses that do not self-supply are assumed to absorb the higher costs that are a consequence of disruptions in water delivery and wastewater treatment due to worsening infrastructure. The assumption for this category is that these households and businesses will pay the $84 billion associated with the 2020 capital gap ($144 billion by 2040) in terms of higher rate costs over and above the baseline projected rates for water and wastewater treatment.

TABLE 1 ★ Annual Capital Gap for Water Infrastructure in 2010, 2020, and 2040 *(billions of 2010 dollars)*

YEAR	SPENDING	NEED	GAP
2010	36.4	91.2	54.8
2020	41.5	125.9	84.4
2040	51.7	195.4	143.7

SOURCES Needs calculated from EPA (1997a, 1997b, 2001, 2003, 2005, 2008, 2009, 2010). Spending calculated from CBO (2010) and USCB (2011a, 2011b).

TABLE 2 ★ Estimated Costs for U.S. Households and Businesses due to Unreliable Water and Wastewater Infrastructure *(billions of 2010 dollars)*

SECTOR	COSTS, 2011–20		COSTS, 2021–40		COSTS, 2011–40	
	CUMULATIVE	ANNUAL	CUMULATIVE	ANNUAL	CUMULATIVE	ANNUAL
Households	$59	$6	$557	$28	$616	$21
Businesses	$147	$15	$1,487	$74	$1,634	$54
TOTALS	**$206**	**$21**	**$2,044**	**$102**	**$2,250**	**$75**

NOTE Numbers may not add due to rounding.

SOURCES EDR Group based on interviews, establishment counts, and sizes by sector from *County Business Patterns*, population forecasts of the U.S. Census, and forecasts of establishments and households provided by the INFORUM Group of the University of Maryland.

Water-borne illnesses will exact a price in additional household medical expenditures and labor productivity due to sick time used. The EPA and the Centers for Disease Control and Prevention have tracked the 30-year incidence of water-borne illnesses across the U.S., categorized the type of illnesses, and developed a monetary burden for those cases. That burden is distributed partially to households (29 percent), as out-of-pocket fees for doctor or emergency room visits, and other illness-related expenses leaving less for a household to spend on other purchases, and mainly to employers (71 percent), due to lost labor productivity resulting from absenteeism. The monetary burden from contamination affecting the public-provision systems over the historical interval was $255 million.

Overall summary of costs. The sum of estimated expenses to households and businesses due to unreliable water delivery and wastewater treatment is shown in table 2. By 2020, the total costs to businesses due to unreliable infrastructure will be $147 billion while that number will be $59 billion for households. The total impact of increased costs and drop in income will reduce the standard of living for families by almost $900 per year by 2020.

Effects on the National Economy

By 2020, the predicted deficit for sustaining water delivery and wastewater treatment infrastructure will be $84 billion. This may lead to $206 billion in increased costs for businesses and households between now and 2020. In a worst case scenario, the U.S. will lose nearly 700,000 jobs by 2020. Unless the infrastructure deficit is addressed by 2040, 1.4 million jobs will be at risk in addition to what is otherwise anticipated for that year.

The impacts of these infrastructure-related job losses will be spread throughout the economy in low-wage, middle-wage and high-wage jobs. In 2020, more than 500,000 jobs will be threatened in sectors that have been traditional employers of people without extensive formal educations or entry-level workers.[4] Conversely, in generally accepted high-end sectors of the economy, 184,000 jobs will be at risk.[5]

The impacts on jobs are a result of costs to businesses and households managing unreliable water delivery and wastewater treatment services. As shown in Table 3, between now and 2020, the cumulative loss in business sales will be $734 billion and the cumulative loss to the nation's economy will be $416 billion in GDP. Impacts are expected to continue to worsen. In the year 2040 alone, the impact will be $481 billion in lost business sales and $252 billion in lost GDP.[6] Moreover, the situation is expected to worsen as the gap between needs and investment continues to grow over time. Average annual losses in GDP are estimated to be $42 billion from 2011 to 2020 and $185 million from 2021 to 2040.

The Role of Sustainable Practices

In all likelihood, businesses and households will be forced to adjust to unreliable water delivery and wastewater treatment service by strengthening sustainable practices employed in production and daily water use. The solutions already being put forward and implemented in the United States and abroad include voluntary limitations or imposed regulations governing the demand for water, as well as technologies that recycle water for industrial and residential purposes (e.g., using recycled shower water for watering lawns). These types of policies have reduced the demand for water and wastewater, and, therefore have lessened the impacts on existing infrastructure. The most recent Clean Watersheds Needs Survey (EPA 2010) incorporates new technologies and approaches highlighted for wastewater and stormwater: advanced treatment, reclaimed wastewater, and green infrastructure. In contrast, the most recent Drinking Water Needs Survey (EPA 2009) does not include new technologies and approaches, such as separate potable and nonpotable water and increasing efficiencies.

TABLE 3 ★ Effects on Total U.S. Business Sales and GDP due to Declining Water Delivery and Wastewater Treatment Infrastructure Systems, 2011–40

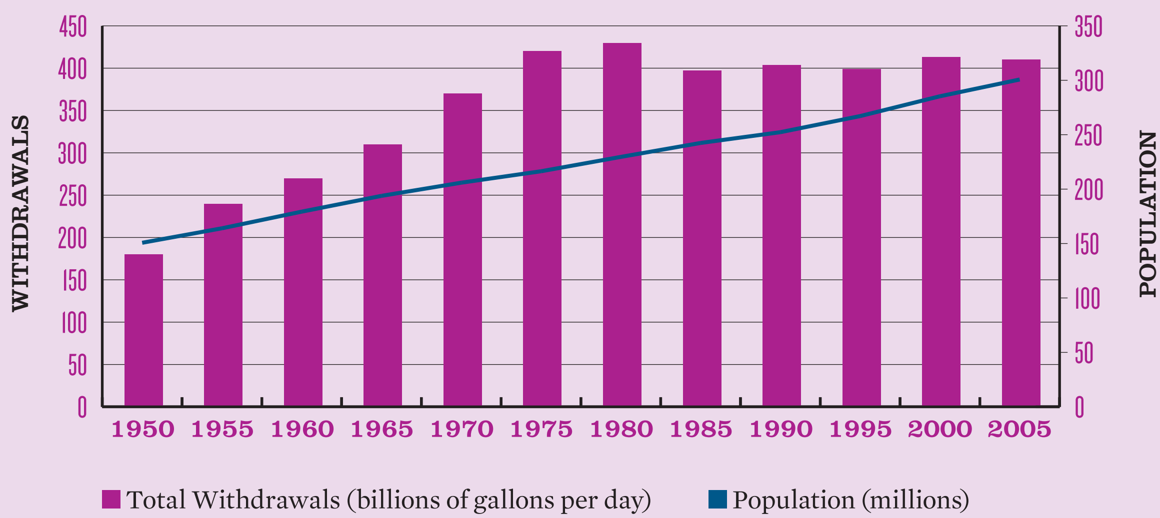
(billions of 2010 dollars unless noted)

YEAR	BUSINESS SALES	GDP
Losses in the Year 2020	-$140	-$81
Losses in the Year 2040	-$481	-$252
Average Annual Losses 2011–2020	-$73	-$42
Average Annual Losses 2011–2040	-$251	-$137
Cumulative Losses 2011–2020	-$734	-$416
Cumulative Losses 2011–2040	-$7.5 Trillion	-$4.1 Trillion

NOTE Losses in business sales and GDP reflect impacts in a given year against total national business sales and GDP in that year. These measures do not indicate declines from 2010 levels.

SOURCES EDR Group and LIFT model, University of Maryland, INFORUM Group, 2011

FIGURE 1 ★ Water Use and Population in the United States, 1950–2005



SOURCE U.S. Geological Survey.

American businesses and households have been using water more efficiently, and they can continue to improve their efficiency during the coming decades. As shown in figure 1, though the U.S. population has continued to grow steadily since the mid-1970s, total water use has been level. Overall, U.S. per capita water use peaked in the mid-1970s, with current levels being the lowest since the 1950s. This trend is due to increases in the efficiency of industrial and agricultural water use and is reflected in an increase in the economic productivity of water.[7] These trends in industrial water use can be explained by a number of factors. For example, several water-intensive industries, such as primary metal manufacturing and paper manufacturing, have declined in the U.S., thereby reducing water withdrawals. Other industries have faced more stringent water quality standards under the Clean Water Act, which may have led to the implementation of technologies or practices that save water.[8]

Nationally, water use in the home has remained stable since the 1980s. Efficiency and conservation efforts have reduced per capita household consumption in some states and regions. Domestic water use has become more efficient through the use of new technologies such as water-efficient toilets that use one-third of the water of older toilets. In addition, new technologies and approaches may reduce future water infrastructure needs. For example, many cities have recently adopted green infrastructure approaches to wet weather overflow management. Green roofs, grassy swales, and rain gardens, for example, are used to capture and reuse rain to mimic natural water systems. Such techniques often provide financial savings to communities.

Nevertheless, demand management and sustainable practices cannot solve the problem alone. These efforts are countered by increasing populations in hot and arid regions of the country—including the Southwest, Rocky Mountains, and Far West—where there is greater domestic demand for outdoor water use.[9]

In this study, a second scenario was run, which assumed that there would be a general adjustment by businesses and households as the capital gap worsened. In this scenario, negative economic impacts mount for about 25 years—roughly 2011–35, though at a slower pace than the earlier scenario—and then abate as increasing numbers of households and businesses adjust to the reality of deficient infrastructure, including net losses of 538,000 jobs by 2020 and 615,000 jobs by 2040. In this scenario, job losses peak at 800,000 to 830,000 in the years 2030–32.

In addition, GDP would be expected to fall by $65 billion in 2020 and $115 billion in 2040. The lowest points in the decline in GDP would be in 2029–38, when losses would exceed $120 billion annually. After-tax personal income losses under this scenario are $87 billion in 2020 and $141 billion in 2040, which represents a rebound from $156 billion to $160 billion in annual losses in the years 2030–34.

The Objectives and Limits of This Study

The purpose of this study is limited to presenting the economic consequences of the continuing underinvestment in America's water, wastewater, and wet weather management systems. It does not address the availability or shortages of water as a natural resource or the cost of developing and harnessing new water supplies. Joining water delivery and wastewater treatment infrastructure with the costs of developing new water supplies is an appropriate and important subject for a more extensive follow-up study. This report assumes that the current regulatory environment will remain in place and no changes to current regulations will occur. Finally, this work is not intended to propose or imply prescriptive policy changes. However, many organizations and interest groups, including ASCE, continue to engage with policy makers at all levels of government to seek solutions to the nation's infrastructure problems.

Conclusion

Well-maintained public drinking water and wastewater infrastructure is critical for public health, strong businesses, and clean rivers and aquifers. Up to this moment American households and businesses have never had to contemplate how much they are willing to pay for water if it becomes hard to obtain.

This report documents that capital spending has not been keeping pace with needs for water infrastructure, and if these trends continue, the resulting gap will only widen through 2040. As a result, pipes will leak, new facilities required to meet stringent environmental goals will be delayed, O&M will become more expensive, and waters will be polluted.

There are multiple ways to partially offset these negative consequences. Possible preventive measures include spending more on existing technologies, investing to develop new technologies and then implementing them, and changing patterns in where and how we live. All these solutions involve costs. Separately or in combination, these solutions will require actions on national, regional, or private levels, and will not occur automatically.

★ ENDNOTES

1. EPA 2010.

2. EPA 2002.

3. EPA 2004, as cited by ASCE 2009.

4. Agriculture and food products, restaurants, bars and hotels, transportation services, retail trade; wholesale trade, utilities, construction, mining, and refining, other services and entertainment, and other manufacturing.

5. Transportation equipment manufacturing, knowledge sector services, medical services, and technology and instrument manufacturing.

6. "Business sales" is being used to represent economic output, which is gross economic activity, including businesses sales, production added to inventory or destroyed, and budget expenditures for nonprofit and public sector organizations. "GDP" or "value added," are the economic activities that occur in the U.S. and is a better indication of domestic productivity. For example, a car assembled and sold in the U.S. might include parts manufactured in Europe or Asia. In this example, the cost of foreign made parts and the transportation costs to transport those parts to the U.S. are part of the price of the car and would be included in the sale price of the car (business sales). However, GDP includes only the domestic assembly, whatever parts are manufactured in the U.S., transportation costs that originate in the U.S., and activities associated with the sale (or consignment to inventory/demolition) of the car.

7. Pacific Institute (2009).

8. Kenny et al. (2009).

9. Pacific Institute (2009); USCB (2000, 2010).

ABOUT EDR GROUP

Economic Development Research Group, Inc. (EDR Group), is a consulting firm focusing specifically on applying state-of-the-art tools and techniques for evaluating economic development performance, impacts, and opportunities. The firm was started in 1996 by a core group of economists and planners who are specialists in evaluating the impacts of transportation infrastructure, services, and technology on economic development opportunities. Glen Weisbrod, the president of EDR Group, was appointed by the National Academies to chair the TRB Committee on Transportation and Economic Development.

EDR Group provides both consulting advisory services and full-scale research projects for public and private agencies throughout North America as well as in Europe, Asia, and Africa. Its work focuses on three issues:

- ★ economic impact analysis
- ★ benefit/cost analysis
- ★ market/strategy analysis

The transportation work of EDR Group includes studies of the economic impacts of road, air, sea, and railroad modes of travel, including economic benefits, development impacts, and benefit/cost relationships. The firm's work is organized into three areas: (1) general research on investment benefit and productivity implications; (2) planning studies, including impact, opportunities, and benefit/cost assessments; and (3) evaluation, including cost-effectiveness implications.

Senior staff at EDR Group have conducted studies from coast to coast in both the U.S. and Canada, as well as in Japan, England, Scotland, Finland, the Netherlands, India, and South Africa. EDR Group is also nationally recognized for state-of-the-art analysis products, including the Transportation Economic Development Impact System (TREDIS).

ABOUT DOWNSTREAM STRATEGIES

Downstream Strategies offers environmental consulting services that combine sound interdisciplinary skills with a core belief in the importance of protecting the environment and linking economic development with natural resource stewardship. The company builds capacity for sustainability through projects in three main subject areas—water, energy, and land—via its unique toolkit, which includes geographic information systems and stakeholder involvement and participation. Within the water program, the company performs economic and policy analyses, provides expert testimony and litigation support, and conducts field monitoring. Its scientific and policy reports equip its clients with the technical expertise needed to improve and protect water resources.

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