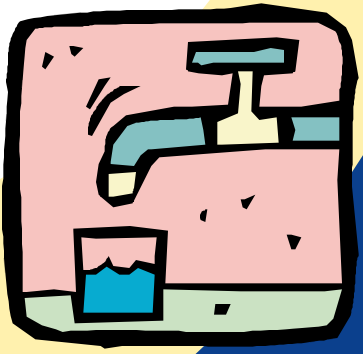
ASCE

American Society of Civil Engineers

Renewing America's Infrastructure

A Citizen's Guide



"A crumbling infrastructure can't support a healthy economy. If we want budget surpluses in future years, we must invest in infrastructure renewal to make that possible."

Robert W. Bein, P.E.

2001 President,

American Society of Civil Engineers

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Message from ASCE

Dear Friend,

Every day America's vast infrastructure directly affects your life—from the schools your children attend to the roads you travel. When it functions as intended, infrastructure works in harmony with the environment to help us live efficiently and safely.

Civil engineers build and maintain our infrastructure, affecting our lives in small, yet significant ways. They keep the mechanisms of our country working so that, as a nation, we can take for granted that our lights will turn on, that our roads and bridges won't crumble beneath us, and that we'll have clean, safe water when we're thirsty. But they cannot do this job alone.

You probably picked up *Renewing America's Infrastructure: A Citizen's Guide* because your daily commute has become unbearable, your local lake is unsafe for fishing or swimming, or your child's classroom is a trailer. The fact is America's roads, bridges, water systems, and other public works are straining under the demands of modern life. They require constant maintenance and renewal, which necessitates responsible choices.

As an active citizen, you can help shape those choices.

Please use this guide as a primer to set you on your course to help rebuild our nation's infrastructure. If we work together to build the best environment possible, the result will be a better quality of life for all Americans and a stronger role in the global economy.

Sincerely,

James E. Davis, P.E.
Executive Director
American Society of Civil Engineers

Introduction

America's Infrastructure—A Legacy in Peril

What happens when Americans do not pay attention to, and invest in, our infrastructure? Rolling blackouts in California. Public beaches along Michigan and California closed. Classes in Kansas City held in a former boys' restroom.

In March, ASCE released its *2001 Report Card for America's Infrastructure*. The nation's critically important foundation for economic prosperity received a cumulative grade of D+. Shortfalls in federal and state funding and changing population patterns have placed a tremendous burden on our aging power plants, water systems, airports, bridges, highways, and school facilities. In life, you get what you pay for, and America has not been paying for its infrastructure for decades. This report card reflects that.

The reasons for such a dismal grade are numerous: explosive population growth and school enrollment that outpace the rate and impact of current investment and maintenance efforts; local political opposition and red tape that stymie development of effective solutions; and the growing obsolescence of an aging system—most recently evident in the breakdown of California's electrical generation system.

To remedy our infrastructure problem, America needs to invest $1.3 trillion over the next five years.

Who Pays for Infrastructure?

Our public works are public assets. We all have a stake in their upkeep and operation, and we all share in the expense of construction and maintenance.

Sometimes, those who actually use the infrastructure most must pay for it through tolls; utility bills; or special taxes on gas, airline tickets, and other items. But because infrastructure improvements

affect us all by supporting our economy and providing fundamental community services, the public usually bears a portion of the cost through general tax revenues.

For years, the federal government has played a large role in collecting and distributing funds for infrastructure improvements. However, this responsibility is shared by state and local governments, who may finance infrastructure projects through bonds, sales taxes or general tax revenues. This places responsibility for infrastructure renewal and development squarely with individual voters, who must approve bond issues and elect political leaders who will make our infrastructure needs a priority.

Renewing America

Whether your community has existed for 150 years or just 10, citizens and civil engineers worked together to plan and build the water, sewer, and transportation systems we depend on every day. The decisions they made still determine the ease and efficiency with which your community operates and the way its built environment affects you.

Today, you have an opportunity to respond to growth and the need for change in your community. This guide will help you identify ways to encourage maintenance and repair of the infrastructure, and help you recognize the critical need to invest in the design of new systems. You can help make the case for renewing America right where you live.

Grading Our Public Works

The American Society of Civil Engineers assigned letter grades to 12 categories of public works in its *2001 Report Card for America's Infrastructure*.

The grade point average was a D+. The *Report Card*, reprinted on pages 6 and 7, shows how our roads, bridges, water and energy systems, and school facilities measure up.

According to the report, school buildings are literally crumbling, more than half of our roadways are in substandard condition, and our airports face gridlock by the year 2004.

Based on recent federal government reports and input from a group of civil engineering experts, ASCE estimates that bringing the infrastructure up to acceptable levels will take almost $1.3 trillion in capital investment over the next five years.

Subject	Grade
Roads	D+
Bridges	C
Transit	C-
Aviation	D
Schools	D-
Drinking Water	D
Waste Water	D
Dams	D
Solid Waste	C+
Hazardous Waste	D+
Navigable Waterways	D+
Energy	D+
Infrastructure G.P.A.	D+

A = Exceptional
B = Good
C = Mediocre
D = Poor
F = Inadequate

Each category was evaluated on the basis of condition and performance, capacity vs. need, and funding vs. need.

Report Card for America's Infrastructure

D+	**Roads** One-third of the nation's major roads are in poor or mediocre condition, costing American drivers an estimated $5.8 billion a year. Road conditions contribute to as many as 13,800 highway fatalities annually. Nearly one-third of America's urban freeways—which account for more than half of all miles driven—are congested.
C	**Bridges** As of 1998, 29 percent of the nation's bridges were structurally deficient or functionally obsolete, an improvement from 31 percent in 1996. It is estimated that it will cost $10.6 billion a year for 20 years to eliminate all bridge deficiencies.
C-	**Transit** Transit ridership has increased 15 percent since 1995—faster than airline or highway transportation. Capital spending must increase 41 percent just to maintain the system in its present condition.
D	**Aviation** Airport congestion delayed nearly 50,000 flights in just one month in 2000. Congestion also jeopardizes safety—there were 429 near misses on runways reported in 2000, up 25 percent from 1999.
D-	**Schools** Due to either aging or outdated facilities, or severe overcrowding, 75 percent of our nation's school buildings are inadequate to meet the needs of school children. The average cost of capital investment needed is $3,800 per student, more than half the average cost to educate that student for one year. Since 1998, the total need has increased from $112 billion to $127 billion.
D	**Drinking Water** The nation's 54,000 drinking water systems face an annual shortfall of $11 billion needed to replace facilities that are nearing the end of their useful life and to comply with federal water regulations. Non-point source pollution remains the most significant threat to water quality.
D	**Wastewater** The nation's 16,000 wastewater systems face enormous needs. Some sewer systems are 100 years old. Currently, there is a $12 billion annual shortfall in funding for infrastructure needs in this category; however, federal funding has remained flat for a decade. More than one-third of U.S. surface waters do not meet water quality standards.
D	**Dams** There are more than 2,100 unsafe dams in the United States. There were 61 reported dam failures in 1999 and 2000. The number of "high-hazard potential dams"—those whose failure would cause loss of life—increased from 9,281 in 1998 to 9,921 in 2001.
C+	**Solid Waste** The amount of solid waste sent to landfills has declined 13 percent since 1990, while the amount of waste recovered through recycling has nearly doubled. Most states have ten years' worth of landfill capacity and waste-to-energy plants now manage 17 percent of the nation's trash.
D+	**Hazardous Waste** Effective regulation and enforcement have largely halted practices that contaminate. Aided by the best clean-up technology in the world, the rate of Superfund clean-ups has quickened—though not enough to keep pace with the number of new sites placed on the National Priorities List as the backlog of potential sites are assessed.
D+	**Navigable Waterways** The U.S. Army Corps of Engineers has a backlog of $38 billion in active authorized projects. On the inland waterways system, 44 percent of all the lock chambers have already exceeded their 50-year design lives. Key deep-draft channels are inadequate for the mega-container ships, which are the world standard for international trade; and intermodal connectors to ports are in poor condition. Transportation demand on waterways is expected to double by 2020, and serious performance problems are likely if current levels of investment continue.
D+	**Energy** Since 1990, actual capacity has increased only about 7,000 megawatts (MW) per year, an annual shortfall of 30 percent. More than 10,000 MW of capacity will have to be added each year until 2008 to keep up with the 1.8 percent annual growth in demand. The U.S. energy transmission infrastructure relies on older technology, raising questions of long-term reliability.

Understanding Infrastructure Issues

Now that you have seen America's infrastructure report card, you may be asking how you can help raise our grade-point average.

Infrastructure is a complex network of public works, which includes roads, bridges, airports, dams, school facilities, and utilities. The rules governing its planning, financing, construction, and upkeep are equally complex. Whether your goal is to shorten your daily commute, attract new business to your community, or protect the environment for your children, gaining a better understanding of these issues is the first step toward becoming an advocate for infrastructure renewal in your community.

As you read through this *Citizen's Guide*, think about the following:

Be an informed citizen. In order to educate public officials about infrastructure needs in your community, you must understand what those needs are. Consider ASCE's *Report Card*. How does your community measure up?

Demand continuous and timely maintenance. If roads and bridges, subways and waterways, and other infrastructure facilities are not kept in sound condition, they cannot support the level of service they are designed to handle. Regular maintenance prolongs use and minimizes the need for costly repairs. The money saved can be used to fund other community priorities. Unfortunately, federal policies often encourage new construction at the expense of maintenance.

Think long-term. Renewing America's infrastructure is an ambitious goal. It cannot be achieved overnight. Furthermore, the roads, bridges, water treatment plants, and other facilities built today must serve for decades to come. Comprehensive planning and long-term investment are key to sound decisions about infrastructure.

Consider all the factors influencing infrastructure decisions. Building a new highway has implications beyond the immediate highway corridor. For example, concern that a new highway may displace wetlands must be balanced against the reduction in air pollution that will result from decreased traffic congestion.

Do more with less. Clearly, money alone will not solve our infrastructure problems. Solutions to urban problems such as traffic congestion and contaminated water require new technologies and approaches. Research can help identify more efficient designs and longer lasting, maintenance-free materials. And, we can change our behavior—through recycling, telecommuting, or using mass transit, for example—to reduce the demand on our infrastructure.

Preserve the environment. To use the nation's resources most effectively, we must balance environmental and economic goals. Land use and transportation patterns designed to foster economic growth and personal mobility can be developed in harmony with environmental benefits.

Look at the big picture. Remember that beyond the immediate, individual benefits you gain from infrastructure improvements, there are broader community benefits. For example, even though you may not use the new mass transit system, its construction will reduce traffic congestion on local roads and increase nearby property values.

Transportation

Between commuting to work, going to the grocery store, and picking the kids up from soccer practice, you spend a lot time in your car. If you are like many Americans stuck in traffic, you may feel like you spend your whole life in your car.

The roads in your community cannot handle the increased capacity resulting from local population growth. You would take the commuter train if it traveled between suburbs, and you would fly out of the local airport if it could accommodate commercial jets.

Americans are losing more productive work hours due to traffic congestion—impacting their wallets, their quality of life, and the national economy.

There are many solutions to ease the increasing demands on our transportation infrastructure and improve highway conditions, capacity, and safety—these do not always include building more roads. We must increase transportation investment at all levels of government, make use of the latest technologies, and decrease our dependence on automobiles if we want to ease this burden.

Roads

How good are the roads in your community? Chances are, they are not as good as you might expect. According to the Department of Transportation:

- 58 percent of America's urban and rural roadways are in poor, mediocre, or fair condition. Although this is a slight improvement from previous years, it is not good enough.

The Federal Highway Administration's Rankings for America's Roads

Poor	In need of immediate improvement
Mediocre	In need of improvements in the near future to preserve usability
Fair	Will likely need improvement
Good	In decent condition and will not require improvement in the near future
Very Good	Have new or almost new pavement

- 30 percent of all fatal highway accidents involve outdated and substandard road and bridge design, pavement conditions, and safety features.
- More than 70 percent of peak-hour traffic occurs on congested roads. The cost to the economy—in wasted time and fuel—in just the 10 most congested urban areas is $34 billion each year.
- From 1980 to 1998, travel increased 72 percent while miles of public roads increased only 1 percent, according to the Federal Highway Administration's *Highway Statistics.*
- The average length of peak time congestion increased from two to three hours in 1982, to five or six hours in 1999 according to a Texas Transportation Institute study. This is no longer just a phenomenon of the big city—the figure tripled for small urban areas between 1982 and 1999.

1999 Congestion Costs (in millions)

City	*Delay*	*Fuel*	*Total*
Los Angeles	$10,880	$ 1,690	$12,570
New York	$ 8,720	$ 1,025	$ 9,745
Chicago	$ 4,135	$ 470	$ 4,605
San Francisco / Oakland	$ 2,635	$ 420	$ 3,055
Detroit	$ 2,530	$ 280	$ 2,810
Washington DC, MD, VA	$ 2,460	$ 270	$ 2,730
Houston	$ 2,410	$ 255	$ 2,665
Atlanta	$ 2,385	$ 235	$ 2,620
Boston	$ 1,940	$ 215	$ 2,155
Philadelphia	$ 1,795	$ 195	$ 1,990

Source: *2001 Urban Mobility Report, Texas Transportation Institute*

1999 Congestion Cost Per Driver

City	*Cost*
Los Angeles	$1,000
Seattle-Everett	$ 930
Atlanta	$ 915
Houston	$ 850
Austin	$ 785
Washington, DC	$ 780
Dallas	$ 780
San Francisco-Oakland	$ 760
Denver	$ 760
San Jose	$ 750

Source: *2001 Urban Mobility Report, Texas Transportation Institute*

Cities with the Most Congested Roadways

1. Los Angeles, CA
2. San Francisco / Oakland, CA
3. Seattle-Everett, WA
4. Washington, DC-MD-VA
5. Chicago, IL / Northwestern, IN
6. San Diego, CA
7. Boston, MA
8. Portland / Vancouver, OR-WA
9. Atlanta, GA
10. Las Vegas, NV

Source: *2001 Urban Mobility Report, Texas Transportation Institute*

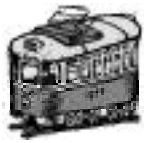
Public Policy Considerations

There is some good news. The Transportation Equity Act for the 21st Century (TEA-21) provides $218 billion for highway construction and maintenance and other surface transportation projects through Fiscal Year 2003—$173 billion for highway projects and $42 billion for transit projects, and $2 billion for highway safety projects.

Total highway expenditures by all levels of government increased from $93.5 billion in 1995 to $111.9 billion in 1999, and federal funding for roadway projects almost doubled, from $8.6 billion to $16.3 billion—making an impact on road projects in all 50 states. The miles of federal-aid roadway projects underway has also increased dramatically from 16,654 miles to 29,030; another good measure of the increased attention to our nation's highways.

But it isn't enough. Even with TEA-21's commitment, we must increase annual investment by $27 billion at all levels to improve conditions and performance adequately, according the Federal Highway Administration.

Mass Transit



Mass transit clearly has a role to play in easing congestion—in 2000 Americans took more than nine billion trips on mass transit. Also in 2000:

- Transit ridership increased by 4.5 percent over 1998 numbers. This continues a trend that marks the fourth straight year of ridership increases, and amounts to 15 percent increase since 1995.
- States spent up to $1.6 billion in Federal Highway Administration program funds on transit, and passed a number of ballot initiatives on transit, such as the effort to extend San Francisco's BART to San Jose.

The result is that well-established commuter rail systems continue to experience record growth, while new systems are being planned in other metropolitan areas to improve access to the urban core from fast growing suburbs.

But what happens when our mass transit system can no longer handle increases in rider volume?

New commuter patterns exist that were not anticipated when systems such as BART and Washington DC's Metro were first designed, resulting in situations where trains are full for a good part of the peak hour and where commuters have to wait for one or two trains to pass to get on. In addition, in many instances suburb-to-suburb commutes are not served—30 percent of the nation's suburbs have no mass transit service at all.

Even with increased interest in public transportation, many people cannot take advantage of it. The Federal Transit Administration reports that 25 percent of the nation's urban population does not live within walking distance of mass transit.

Public Policy Considerations

Transit funding is growing, but at a slow pace. The federal government invests $7.66 billion annually in mass transit capital improvements. However, according to the Federal Transit Administration, an additional $10.8 billion is needed to maintain current conditions—an increase of 41 percent—and another $16 billion is needed to upgrade aging systems and make other improvements.

Bridges

Bridges are considered one of the greatest engineering achievements. They majestically span vast waterways, a visible tribute to what we can accomplish. Yet, in 1998, the Federal Highway Administration rated 29 percent of the nation's bridges structurally deficient or functionally obsolete.

A structurally deficient bridge is closed or restricted to light vehicles because its structural components have deteriorated. While not necessarily unsafe, these bridges must have limits for speed and weight. A functionally obsolete bridge has older design features, and while it is not unsafe for all vehicles, it cannot safely accommodate current traffic volumes, and vehicle sizes and weights.

While this number remains high, it is a slight improvement over previous years. In fact, over the last ten years, the number of bridge deficiencies has steadily declined from 34.6 percent in 1992 to 29 percent in 1998. The Federal Highway Administration's strategic plan states that by 2008 less than 25 percent of the nation's bridges should be classified as deficient. With thousands of bridges in the U.S., is that number good enough?

Public Policy Considerations

Recent increases in federal and local funding to address decaying bridges are helping ensure the safety of our nation's bridges. Funding for bridge repairs and replacement will continue to increase. But with $80 billion in needs, this funding is still inadequate.

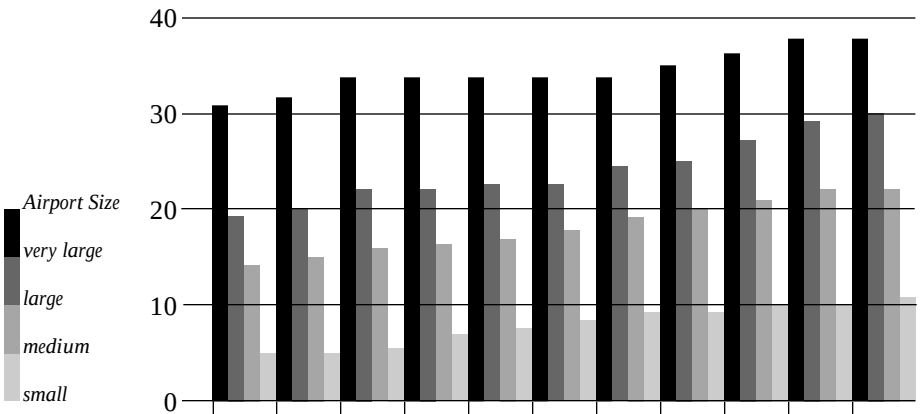
Aviation

In the past ten years, air traffic has increased 37 percent, while the capacity to handle it increased only 1 percent. Our aviation infrastructure—airports, air traffic control system, and other components—is not keeping up.

Flights are delayed or rerouted, causing travelers to miss connections—or miss family members who've come to greet them at the airport. Airport gridlock—typically, the queues of airplanes awaiting permission to arrive or depart—has become common. Even if these airport traffic jams are relatively short-lived, they can cause delays that persist throughout the day.

In 1999, 659.9 million people flew. According to the Federal Aviation Administration, that number could increase to 1 billion by 2011. Combined with the impact of enhanced security measures, this overcrowding means travelers will continue to pay more, while waiting longer to get where they are going.

Change in Percentage of Congested Daily Traffic



Source: *Federal Aviation Administration 2000 Aviation Capacity Enhancement Plan*

The Federal Aviation Administration is taking measures to address airport capacity:

- In June 2000, the Federal Aviation Administration prepared a national action plan to address those airports or air space where congestion is particularly bad, and expects to complete the entire initiative by the end of Fiscal Year 2002. The first step was re-routing propeller aircraft and arrivals from Virginia's Dulles International Airport and at airports in the New York / New Jersey metropolitan area, thereby reducing congestion and complexity in this airspace.
- Runway expansions, additional terminals, and operational improvements are all considerations at airports where substantial growth is expected, such as the Portland International Airport, which is forecast to have a 37.9 percent increase in operations by 2011 and the Baltimore-Washington International Airport, expected to increase by 36 percent by 2011.

Another solution is to modify air traffic control systems. Because the Federal Aviation Administration's air traffic control system operates continuously, most changes, from the installation of new equipment to the implementation of new procedures, will take place while aircraft are using the system—maintaining the system's level of safety under these conditions requires careful planning and execution.

In order to address security concerns, we will likely see changes in the way the air transport system operates. As airports and airlines implement new safety procedures, we are likely to experience even longer delays. Clearly, expanded airport capacity, modernizing the air traffic control systems, finding a more logical and sustainable system of scheduling flights, and other efficiency improvements will help balance the impact of increasing safety measures. Fixing the problems will require time, money, and cooperation among all parties involved.

Public Policy Considerations

In April 2000, Congress passed the Wendell H. Ford Aviation and Reform Act for the 21st Century, known as AIR-21. This legislation provides the Federal Aviation Administration with a $10 billion increase in funding over the next three years, with most of the additional funding going toward radar modernization and airport construction projects.

Navigable Waterways

We often think of trucks delivering goods to our communities, but many of the items we use every day come to us via ship or barge. Last year, over two billion tons of cargo moved through U.S. ports.

Navigable waterways encompass the nation's ports; harbor channels; and inland, intracoastal, and coastal waterways. In the past 30 years, capital investment for public water resources has decreased 70 percent. The U.S. Army Corps of Engineers has a $38 billion backlog of authorized projects, which would take 25 years to complete at current funding levels.

Marine transportation is an essential component of both our nation's and the world's transportation systems:

- Annually, more than 95 percent of all U.S.–foreign trade, by volume, is transported by ship. Current forecasts project that domestic and international waterborne trade will double by 2020.
- People are increasingly using ferries to commute and companies are using short-sea freight service to ease freight congestion on our overcrowded rail lines and highways.
- More than 78 million Americans use our nation's waterways for recreational boating activities per year.

As our nation's cities revitalize their communities there is a renewed interest in urban waterfront areas. Fifty-three percent of our population lives along the coast, even though coastal communities represent only 17 percent of the nation's landmass—significantly impacting land use and maritime interests.

The primary focus of waterfront redevelopment is on residential, commercial, recreational, and tourist-related uses, contributing to potential waterway congestion. This type of development can lead to increased congestion in and around marine terminals and other marine activities, community conflicts caused by compatibility issues, and limited future expansion opportunities for traditional industrial and maritime uses.

Public Policy Considerations

The Harbor Maintenance Trust Fund and Inland Waterway Infrastructure Trust Fund both had surpluses as of 2000—meaning we are not efficiently addressing the infrastructure needs of our waterways. A way to start to fixing this problem is to provide adequate funding on an on-going basis to address the $38 billion backlog of the Army Corps' authorized projects.

Schools

"It's inexcusable that during a decade of unprecedented economic growth in this country, students were left behind. What does that say about the real value we place on education?" said National Education Association (NEA) President Bob Chase during the Fiscal Year 2002 budget hearings.

If children are our most precious resource, why are we educating them in converted bathrooms?

The estimated cost of repairing our schools is $3,800 per student. While local governments have increased spending on school construction and maintenance, problems continue to linger as enrollment outpaces construction in many communities. Consequently, the cost to fix the problem has risen from $112 billion in 1998 to a minimum of $127 billion. In 1998, school-aged children were 18.8 percent of the U.S. population. With three-quarters of all school buildings failing to provide an effective environment for learning, due either to outdated facilities or overcrowding, the situation could get much worse before it gets better.

In August of 1999, the Department of Education released a back-to-school special report on the baby boom echo entitled *No End in Sight*. Its findings included:

- 53.2 million children are enrolled in elementary and secondary schools today. This number will reach 54.2 million by 2009.
- The number of births is projected to increase slowly for the next 10 years—the U.S. Bureau of the Census indicates the number of births will continue to rise to 4.2 million in 2009.

Despite a growing economy and burgeoning student enrollment, investment in U.S. public schools has remained stagnant, according to the NEA report *Rankings & Estimates: Rankings of the States 2000 and Estimates of School Statistics 2001*. The report also shows school-aged children are one of the fastest-growing segments of the population. Where will these children be educated?

Example of Projected Needs for America's Schools

	Alabama	*California*	*Texas*
Percent of schools reporting a need to upgrade or repair building to good overall condition	84	87	76
Percent of schools reporting at least one inadequate building feature (e.g. roof, plumbing, electrical, windows, HVAC)	59	71	46
Percent of schools reporting at least one unsatisfactory environmental factor (e.g. air quality, ventilation, acoustics heating, lighting)	63	87	60
Number of students per computer	17	21	11
Amount paid in 1999–2000 in interest on school debt	$ 132.4 *million*	$ 677.2 *million*	$ 991.4 *million*
Current estimates for school			
■ modernization	$ 2.3 *billion*	$ 32.9 *billion*	$ 13.7 *billion*
■ infrastructure	$ 1.5 *billion*	$ 22.0 *billion*	$ 9.5 *billion*
■ technology	$ 792.0 *million*	$ 10.9 *billion*	$ 4.2 *billion*
Enrollment over the last decade increased	+3.9 %	+21.7%	+19%

Source: *NEA State-By-State Modernization Facts*, www.nea.org / lac / modfacts

Case Study

Huntington Beach Union High School District in California presents a case study for what many school districts and students face:

Aging schools: Some of the schools in this district are at least 75 years old. Major problems include deteriorated sewer systems, broken pipes, termite infestation, dry rot, and worn-out electrical systems, all due to the extreme use and age.

Lack of safety compliance: Many of the schools do not meet California earthquake standards or city building codes.

Leaking roofs: Flooding has caused extensive damage to computers and other equipment. Also, floors in portable classrooms are rotted due to water damage from leaky roofs.

Sinking buildings: Many of the schools are in need of major repairs or replacement because the buildings are actually sinking into the ground.

Faulty electrical connections: Fire alarms and public address systems often do not work in emergency situations. This lack of electrical power sometimes makes it impossible to run classroom computers.

Source: *Huntington Beach School District web site*

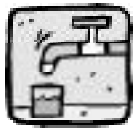
Public Policy Considerations

Efforts to repair, rehabilitate, or modernize the nation's schools face numerous hurdles. The complex relationships between local school districts and state and federal governments are constantly evolving. Coupled with other serious problems faced by the nation's school systems, school infrastructure must compete for both attention and money.

The Fiscal Year 2001 Omnibus Appropriations Act provides $1.2 billion for grants to local educational agencies for urgent school renovation, activities authorized under part B of the Individuals with Disabilities Education Act (IDEA), technology activities related to school renovation, and charter school facility financing.

Bipartisan legislation has been introduced in the Senate and House of Representatives that would help states and local schools meet repair, renovation, and construction needs by providing tax credits to pay the interest on school modernization bonds.

Water



Water is necessary for our survival. It is also the most abundant resource on the planet. We have become masters at finding sources of pure water, containing it, and distributing it. Now we must face the challenge of ensuring that the water we consume is clean and safe.

In April 2000, the Water Infrastructure Network (WIN) released the report *Clean & Safe Water for the 21st Century (*www.win-water.org). WIN reported significant improvements in water quality and public health associated with America's investments in water and wastewater infrastructure.

But, the report also documented an unprecedented financial problem: over the next 20 years, we will need to invest $23 billion a year more than we are now in America's water and wastewater systems to meet the national environmental and public health priorities in the Clean Water Act and Safe Drinking Water Act and to replace aging and failing infrastructure.

There is compelling evidence that water and wastewater needs exceed current investment levels. If we do nothing, the nation can expect increased threats to public health, environmental degradation, and real economic losses.

The nation's water utilities, already facing costly new drinking water safety standards, may have to spend tens of billions of dollars more just to keep that water flowing. The American Water Works Association predicts required spending of more than $250 billion over the next 30 years just to replace aging pipes and other basic infrastructure.

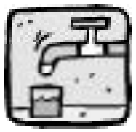
Cost to Replace Infrastructure

City	*Assets to be Replaced*	*Estimated Replacement Cost (in millions)*
Austin, TX	Water mains	$2,348
Boston, MA	Water mains	$ 694
Bridgeport, CT	Water mains, supply plant	$1,663
Charleston, WV	Water mains, supply plant	$ 650
Cincinnati, OH	Water mains, supply plant	$2,042
Columbus, GA	Water mains, supply plant	$ 648
Denver, CO	Water mains, supply plant	$5,583
Des Moines, IA	Water mains, supply plant	$ 524
Oakland, CA	Water mains, supply plant	$8,110
Gloucester, MA	Water mains, supply plant	$ 116
Honolulu, HI	Water mains, supply plant	$1,272
Louisville, KY	Water mains	$1,343
New Rochelle, NY	Water mains	$ 325
Philadelphia, PA	Water mains	$2,438
Portland, OR	Water mains	$1,257
St. Paul, MN	Water mains, supply plant	$1,005
Seattle, WA	Water mains	$1,713
Tacoma, WA	Water mains, supply plant	$1,100
Tucson, AZ	Water mains, supply plant	$1,852
Wausau, WI	Water mains, supply plant	$ 84

Source: *American Water Works Association*

In addition to the challenge of keeping the water flowing, we must address another threat to our water supplies: polluted runoff. According to the 1998 National Water Quality Inventory, states report that polluted runoff is the leading cause of water quality problems nationwide. Runoff occurs during rainstorms or snowmelt when billions of pounds of dirt, fertilizer, chemicals, grease from city streets, and other pollutants are carried into the nation's waters. When our sewer systems cannot handle this runoff, we are faced with serious water quality problems, including beach closings, shellfish bed closures, and threats to groundwater and drinking water supplies.

Combined sewer systems—where the sewer system collects both storm water runoff and sanitary sewage in the same pipe—are one of the largest contributors to problems with water runoff. These systems are located primarily in older cities. During rainfall or snowmelt, the volume in the combined sewer system can exceed capacity. As a result, the runoff may directly discharge to streams, rivers, lakes, or estuaries rather than reaching the treatment plant. Although some programs are in place to control sewer overflows and stormwater runoff, the Environmental Protection Agency is exploring ways to control the environmental and public health threats posed by this source of pollution.



Drinking Water

Approximately 54,000 community drinking-water systems provide drinking water to more than 250 million Americans. To keep our communities healthy, it is imperative that we keep water supplies free of contaminants that cause disease.

These drinking water systems face staggering infrastructure funding needs over the next 20 years—$138.4 billion. Although America spends billions on infrastructure each year, drinking water face an annual shortfall of at least $11 billion to replace aging facilities that are near the end of their useful life and to comply with existing and future federal water regulations. The shortfall does not account for any growth in the demand for drinking water over the next 20 years.

Although regulations governing clean water protect our nation, they are very costly to address. For example, the Environmental Protection Agency has proposed a new standard for arsenic levels in drinking water. As proposed, the national costs of treatment, monitoring, reporting, record keeping, and administration under the new standard will be approximately $181 million annually, and the total treatment cost will be another $177 million per year. Annual monitoring and administrative costs will be about $2.7 million and states' costs will be about $1 million. And that is only to address arsenic—it does not take into account other contaminants.

Public Policy Considerations

Although the Safe Drinking Water Act Amendments of 1996 authorized EPA to spend $1 billion annually to construct and repair drinking-water facilities, Congress has failed to appropriate the full amount. In Fiscal Year 2001, the appropriated amount was $825 million—82.5 percent of the authorized total.

The question is not whether the federal government should take more responsibility for drinking water and drinking water improvements, but how. Possible solutions include grants, trust funds, loans, and incentives for private investment. In addition, many publicly owned and operated utilities have demonstrated they can reduce operating costs 20 to 25 percent or more within a three- to five-year period by adopting more efficient organizational structures, work practices, and new technologies. Those savings could be invested in the infrastructure.

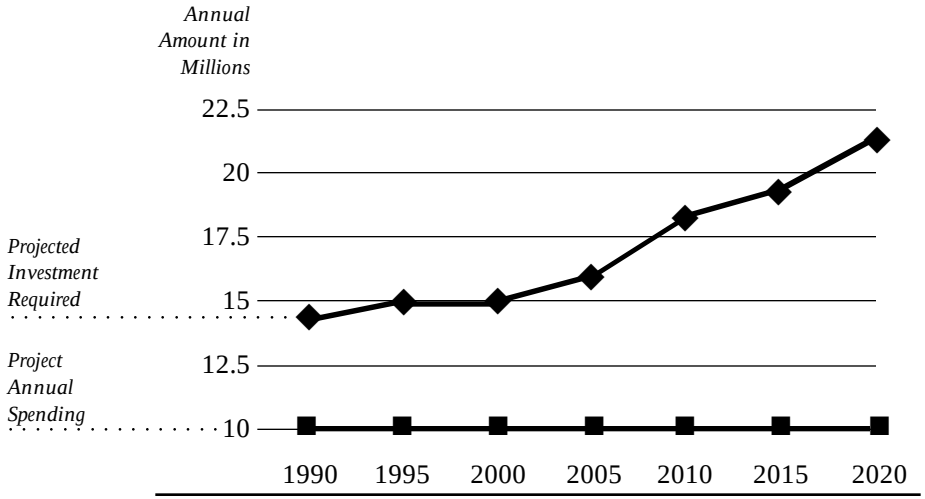
Wastewater

Wastewater treatment plants prevent billions of tons of pollutants each year from reaching America's rivers, lakes, and coastlines—making our waters safe for fishing and swimming; and preserving natural treasures such as the Chesapeake Bay, the Great Lakes, and the Colorado River.

Although the federal government has spent more than $71 billion on wastewater treatment programs since 1973, the nation's 16,000 wastewater systems still face enormous infrastructure funding needs. In the next 20 years, the systems face a shortfall of at least $12 billion annually to replace aging facilities and comply with existing and future federal water regulations. As with drinking water needs, this total does not account for any growth in demand from new systems.

Funding for wastewater infrastructure has remained flat for a decade.

Projected Annual Wastewater Treatment Spending Versus Projected Annual Investment



Source: *EPA Municipal Support Division Strategic Plan, August 2001.*

In Fiscal Year 2001, Congress appropriated $1.35 billion for wastewater infrastructure, which represents about 11 percent of the annual need nationally. Few states and localities can make up the difference.

Communities that must upgrade existing facilities, or build new ones, will need $126 billion by 2016, according to the most recent estimate by the Environmental Protection Agency.

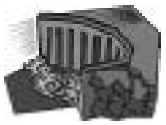
- $45 billion is for projects to control combined sewer overflows.
- $27 billion is for new or improved secondary treatment (the basic statutory requirement of the Clean Water Act).

States also need an additional $34 billion for projects that are not subject to EPA reporting requirements but, nevertheless, represent a potential demand on state resources.

Public Policy Considerations

On this issue there is little disagreement—investments in wastewater infrastructure are necessary to protect public health, the environment, and the economy. Congress needs to earmark $11 to $12 billion annually for immediate wastewater infrastructure system improvements.

In order to be able to meet these needs, cities and local governments will need help in the form of innovative grants, revolving loan funds, and other financing mechanisms. This, with the creation of a water trust fund used to finance the national shortfall in infrastructure funding, will be necessary to address growing issues in wastewater treatment.



Dams

Is your idea of a perfect summer day to go to a beautiful lake to boat, ski, or fish? Then you probably have visited a man-made dam. Dams not only provide a beautiful recreational resource, they serve many useful functions, making them an extremely important part of this nation's infrastructure—equal in importance to bridges, roads, and airports.

Most people are not aware of the dams in their neighborhoods. In fact, some developers and zoning officials are completely unaware of dams within their communities, and build in areas susceptible to damage should a dam fail. In the past two years there have been 61 reported dam failures, and the number of "high-hazard potential dams"—those whose failure would cause loss of life—increased from 9,281 to 9,921 in 1998. Currently, there are about 2,100 unsafe dams in the U.S.—some in almost every state. (An unsafe dam is one that has been found to have deficiencies that leave it more susceptible to failure.)

The lack of funding for dam upgrades has become a serious national problem. Unfortunately, operation, maintenance, and rehabilitation of dams can range in cost from the low thousands to the low millions. Owners are responsible for these expenses. With 58 percent of dams in the U.S. privately owned, many owners cannot afford these costs. Funding assistance, through government or private sources, is minimal at best.

Primary Purposes for Dams In the U.S. *(some have multiple uses)*

Recreation	31.3 percent
Fire and Farm Ponds	17.0 percent
Flood Control	14.6 percent
Irrigation	13.7 percent
Water Supply	9.8 percent
Mine Waste Retention	8.1 percent
Hydroelectric	2.9 percent
Undetermined	2.3 percent
Navigation	0.2 percent
Tailings and Other	0.1 percent

Source: *The Association of State Dam Safety Officials*

Dams age like any man-made structure. Approximately 30 percent of dams are 50 years old—a dam's expected design life span. In the year 2020, 80 percent of dams will reach the half-century mark.

Although most states have legislative authority to carry out comprehensive dam safety programs, they do not do so. Some states are unable, by specific language in their laws, to regulate certain types of dams, allowing these structures to fall between the regulatory cracks. Other states have limited ability to enforce the law. In some states, officials have no recourse if dam owners do not carry out safety repairs ordered by the state.

State budgets for dam safety range from $0 to $6 million; but, the average annual state dam safety budget is about $375,000. The average number of regulated dams per state is approximately 1,500. The average number of dam inspectors per state is six; this means that each dam inspector is responsible for overseeing the safety of about 250 existing dams, in addition to overseeing new construction.

Public Policy Considerations

There is an alarming lack of public support and education about the need for proper dam maintenance and repair. Even though dam safety impacts thousands of people, unless a dam fails, it is not usually in the public view. There are some things we can do:

- Establish comprehensive and fully funded dam safety programs in all 50 states, especially Alabama and Delaware—the only states without authorized dam-safety programs.
- Create federal and state revolving loan funds to assist public and private dam owners in rehabilitating their dams.
- Fully fund and expand the Small Watershed Rehabilitation Act, and reauthorize the National Dam Safety Program Act.

Waste Disposal

Fresh Kills Landfill, located on the western shore of Staten Island, has four mounds ranging in height from 90 feet to approximately 225 feet—the result of more than 50 years of landfilling. This landfill stands as a monument to the amount of waste we generate in this country.

In 2000, U.S. residents, businesses, and institutions produced more than 221 million tons of municipal solid waste—approximately 4.5 pounds of waste per person per day. We are sending less of that waste to landfills—down 13 percent from the 1990 total—and recycling more. However, at the rate our population is growing, we need to find even more innovative ways to address waste disposal.

Solid Waste

We have made monumental strides in our sanitary landfilling practices in the United States in the last 20 years—moving from open dumps with little or no control to facilities using sophisticated containment systems, environmental monitoring, and improved operational practices. At the same time, stringent regulations have caused landfill capacity to decline: between 1986 and 1996, the total number of landfills in the U.S. fell from 7,683 facilities to 3,581—a capacity reduction of more than 50 percent.

Even with lower capacity, most states still have more than 10 years' landfill capacity remaining. However, many states in the Northeast have less than five years' capacity on average and will soon need to find alternative ways to dispose of their waste. Land on which to site a landfill is a finite resource. We must find innovative ways to address waste.

In the 1980s and 1990s many land-disposal facilities were replaced by waste-to-energy plants, which increased their capacity to manage waste tenfold. These plants now manage 17 percent of the nation's municipal solid waste. However, the growth of waste-to-energy has itself stalled due to increased costs and environmental concerns. In the last 10 years, recycling and composting have been the fastest growing methods of waste management—accounting for 28 percent of waste management in 1997; up from 10 percent in 1986.

One new idea to address solid waste is the bioreactor landfill, a sanitary landfill that uses microbiology to transform and stabilize decomposable organic waste within five to ten years. This type of landfill significantly increases the extent and speed of organic waste decomposition, making them more effective than traditional landfills.

Public Policy Considerations

The current debate surrounding municipal solid waste focuses on the interstate shipment of waste. Whether state and local governments should be allowed to restrict the growing volume of out-of-state solid waste has been on the national environmental policy agenda for more than a decade. A related issue, whether state or local jurisdictions may designate where locally generated waste must be disposed, is also controversial. Congress has been unable to resolve either issue since the debate began in 1987.

The continued use of landfills is a viable option for managing municipal solid waste. In addition, integrated management of municipal solid waste could alleviate some of the space problems. Other solutions are:

- Continue development of improved landfill design and operating technology.
- Increase federal funding of research into waste-to-energy programs.
- Address the problem of over-consumption, with the goal of reducing the production and consumption of unnecessary goods, packaging and throwaways.
- Minimize toxic materials used in products and packaging and produced as byproducts during production processes.

Hazardous Waste

For years, we as a nation did not know the impact of putting oil, chemicals, and other substances into the ground. We now know that these things contaminate the land and water that we rely on. In 1980, the U.S. Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act (commonly known as Superfund) to clean up highly contaminated hazardous waste sites.

Although nearly 800 high-priority hazardous-waste sites were cleaned up between 1980 and 2000 and more than $14 billion was spent, the U.S. General Accounting Office estimates that the Superfund program has yet to complete cleanups for 42 percent of the nation's most severely contaminated hazardous waste sites. Today more than 1,200 sites remain to be addressed, and another 3,000 sites still need to be assessed for possible action under Superfund. Cleanup will be completed by the end of calendar year 2008 at 85 percent of the sites.

Most people think of Superfund sites as old manufacturing plants or oil refineries. What they do not know is that the gas station or photo finishing shop down the street could be a hazardous waste site as well. While some of these "mom and pop" operations become Superfund sites, many are considered brownfields—vacant or underutilized land that may be contaminated, but that also has potential for economic redevelopment.

According to the U.S. Conference of Mayors, 180 cities have 19,236 brownfields sites. The U.S. Congress has not passed legislation to specifically address brownfields, instead keeping this initiative under Superfund authority.

The Environmental Protection Agency's current brownfields program began in 1993 under the Superfund program. The program has expanded to include 307 brownfields assessment grants (most for $200,000 over two years) totaling more than $57 million; 24 revolving loan fund grants of $350,000 each to help finance the actual cleanups; and 16 Brownfields Showcase Communities, where technical and financial assistance from 15 participating federal agencies is coordinated with state, local, and non-governmental efforts.

Between 1995 and 2000, the Environmental Protection Agency provided $246.9 million in brownfields grants for state and local revolving loan funds. Fiscal Year 1997 was the first year brownfields became a separate budgetary line item within the EPA budget. In the Fiscal Year 2000 budget, the administration requested and was appropriated $91.7 million.

Public Policy Considerations

There is, on average, a 12-year span between identifying and cleaning up Superfund sites. There are two primary reasons for this: the first is that many cleanup technologies take time to work properly, and the second is that overlapping federal and state requirements and responsibilities can slow the process down.

Use of innovative technologies, voluntary cleanup agreements that lessen liability, and land use controls that limit future uses so that sites do not need to be returned to pristine condition can all help reduce the time needed to address contamination, help foster economic development, and protect human health and the environment.

Energy

Throughout the winter and spring of 2001 people nationwide watched California to see how that state would handle its energy crisis. Prices soared, and Californians experienced rolling blackouts. The economic impact was tremendous. People began to ask how to avert this crisis in their own state.

Energy generation and transmission are increasingly unable to meet the population's demand for power. Although growth in electricity demand through 2020 is expected to be slower than in the past, 393 gigawatts of new generating capacity (excluding cogenerators) is needed by 2020 to meet growing demand and to replace retiring units.

If we cannot generate the power, then we need to rethink how design and construction industries do business to meet the demands of the 21st century for both economic competitiveness and quality of life. The industry must rethink the infrastructure from the ground up because this determines how energy is produced and consumed.

By 2020, 27 percent of current nuclear capacity and 8 percent of current fossil-fuel capacity will be retired. More than 10,000 megawatts of capacity nationally will have to be added each year between now and 2008 to keep up with the projected 1.8-percent annual growth rate, but since 1990 we have been averaging only about 7,000 megawatts additional capacity—an annual shortfall of 30 percent. Of the 162 gigawatts of new capacity expected after 2010, 16 percent will replace retired nuclear capacity. About 1,300 new power plants could be needed by 2020, according to the Energy Information Administration.

Where will we get our energy?

The demand for natural gas is growing sharply—annual U.S. gas consumption could increase by 60 percent over the next 20 years. The current estimate of the natural gas resource base in the 48 states is equivalent to at least 65 to 70 years of supply at the current level of consumption, according to the American Gas Association.

Coal-fired power plants are expected to remain the key source of electricity through 2020. In 1999, coal accounted for 1,880 billion kilowatt-hours, or 51 percent, of total generation. Although coal-fired generation is projected to increase to 2,350 billion kilowatt-hours in 2020, increases in gas-fired generation may reduce coal's share to 44 percent. By 2020, it is projected that 11 gigawatts of coal-fired capacity will be retrofitted with scrubbers to meet the requirements of the Clean Air Act Amendments of 1990.

Public Policy Considerations

As demand grows, we must look toward renewable energy resources to meet our needs. We need to expand total federal spending on such energy supply programs as renewable energy resources, fossil energy research, and energy conservation. The only energy-supply program of importance to see an increase is the clean-coal technology program, which is slated to receive a boost from $9 million to $82 million in Fiscal Year 2002.

We need continued economical, reliable, and environmentally responsible energy development and production in the United States. This is critical to industrial and commercial expansion, economic growth and stability, and to minimize dependence on foreign energy sources.

What You Can Do

This guide offers solid proof that the nation's public works challenges are enormous and complex, and will not solve themselves. It is now up to concerned citizens, like you, who understand the economic and environmental benefits of a healthy infrastructure, to push for action.

You have seen the big picture. You are beginning to find ways that you may be able to influence infrastructure decisions in your own community. And you are beginning to ask the right questions: How do decisions made by a neighboring community or another state impact you? How will your decisions affect them?

Here are some steps you can take to do your part in renewing America's infrastructure:

- Learn all you can about the infrastructure problems in your area.
- Contact your state transportation department, your city water board, or other sources to learn about plans for ensuring adequate roads, bridges and water systems.
- Regularly attend meetings held in your community about pressing infrastructure problems.
- When you see a problem, find out what level of government has jurisdiction over it. At first, your search may seem confusing, but don't be discouraged. Sometimes various levels of government deal with different aspects of the same problem.
- Search the Internet. Agencies at all levels of government now have Web sites that list laws and regulations that pertain to your problem. Your member of Congress or state representative probably has a site, too, and that may link you to other government and advocacy group sources. If you know of an interest group that deals with the area you're interested in, visit its site. Search for magazine and newspaper articles that will tell you how other communities faced problems similar to yours.
- Ask business groups, such as your Chamber of Commerce or Board of Trade, to examine the infrastructure in your area and its affect on local business, employment, and the economy.
- Express your concerns to public officials such as your mayor. Ask them how they plan to solve these problems. Urge other citizens to support your cause.
- Write letters-to-the-editor of your newspaper, your governor, and your members of Congress, expressing your concerns and opinions on infrastructure.
- Volunteer for—or organize—citizen advisory committees dealing with your community's infrastructure issues.
- Support local, state, and federal officials who understand and are committed to infrastructure renewal. Ask them to make infrastructure an election issue, just as they would education, crime, or health care.
- Work to help pass local bond issues to repair, replace, and expand your roads, bridges, water systems, and schools.
- Talk to civil engineers in your area about solutions and needs.

For more information, including state-by-state statistics, visit the ASCE web site at www.asce.org/reportcard.

Glossary

Appropriation: The annual funding Congress approves for a federal agency or program. The amount appropriated may be less than the amount authorized.

Authorization: An act of Congress that creates a federal program and determines its activities and the maximum funding level that may be appropriated.

Bond: A method of borrowing money to purchase, build, or improve public property, such as a bridge, park, or school. Money is borrowed from investors and paid back, with interest, over a specified period.

Brownfields: Underutilized or abandoned industrial sites with either real or perceived contamination. Typically located in urban areas, brownfields must be assessed and cleaned up before they can be adapted for new purposes.

Capital Budget: An accounting technique that separates capital investments (for long-lived assets such as roads or airports) from operating expenses. The cost of capital investment is spread out over the life of the asset. Many state and local governments use capital budgets to plan and finance infrastructure improvements, but the federal government counts the entire cost of a capital investment in the year in which it is constructed.

Environmental Impact Statement: A report that predicts the environmental impact of proposed legislation, regulation, or other major federal actions, including federal construction projects. Required before a project (even partly funded with federal funds) can be built, an acceptable environmental impact statement must recommend the alternative that best balances the environmental impacts and the benefits.

Fiscal Year: A 12-month period used for accounting purposes. The fiscal year for the federal government begins October 1 and ends September 30 of the following year.

Hazardous Waste: Chemical or nuclear waste that can pose a threat to health or the environment if improperly managed.

Highway Trust Fund: Established in 1956 to finance the federal highway program, the Highway Trust Fund is financed entirely by taxes on gasoline and other fuels. Revenues are used on a "pay-as-you-go" basis. That is, improvements are made only when there are sufficient funds generated by user fees to pay for them. The trust fund contains two accounts, one for highways and one for mass transit. Though the original legislation earmarked the trust fund exclusively for transportation purposes, it has been a part of the unified federal budget since 1968, allowing the government to use trust fund revenue to partially offset the annual budget deficit.

Off-Budget: Money collected or paid by the federal government that, for accounting purposes, is not counted as part of the federal budget. This prevents those funds from being used to offset deficit spending in other areas of the budget. Examples include the Social Security trust funds and the Postal Service.

Solid Waste: Garbage, refuse, sludge, and other discarded materials (including liquids and contained gases) resulting from industrial, commercial, mining, and agricultural operations and from personal activities. Does not include sewage, industrial wastewater discharges, and certain radioactive materials.

State Revolving Funds: Federal grants that are used to help finance construction projects to clean up the nation's water. States use the grants to make zero-interest or low-interest loans to local communities; as loans are repaid, the fund is replenished, and additional loans can be made. State revolving funds programs were created as part of the Clean Water and Safe Drinking Water acts.

Superfund: The informal name of the trust fund used by the government to pay for hazardous waste cleanups. Revenues come mainly from taxes on petroleum and feedstock chemicals, a broad-based tax on corporate income, and general revenues.

Trust Fund: Funds collected and used by the government to carry out specific purposes or programs according to the terms of a trust agreement or statute. Trust funds are not available for the general purposes of the government.

User Fees: Fees or taxes collected from users of public facilities, rather than from the general population. Examples include tolls for public roads, harbors or waterways; gas or airline ticket taxes; or admission charged for parks and other public lands.

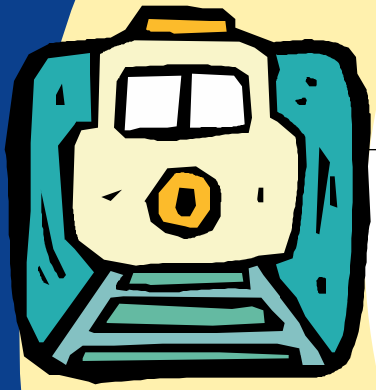
Wetlands: Lands that are inundated or saturated by surface or groundwater long enough to support growth of vegetation typically suited to saturated soil conditions. Generally includes such habitats as tidal marshes, swamps, and prairie potholes.

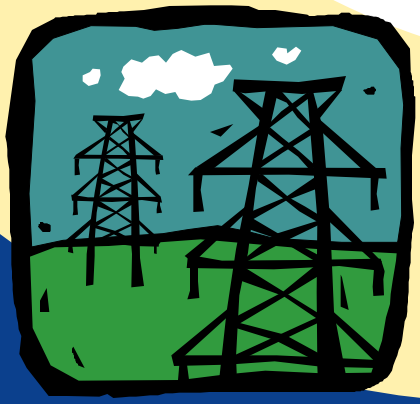
About ASCE

The American Society of Civil Engineers enhances the welfare of humanity by advancing the science and profession of engineering.

The Society offers continuing education courses and technical specialty conferences; develops technical codes and standards for safer buildings, water systems, and other civil engineering works; publishes technical and professional journals, manuals, and a variety of books; works closely with Congress, the White House, and federal agencies to build sound national policy on infrastructure and engineering issues; and supports research of new civil engineering technology and materials.

Founded in 1852, ASCE has more than 123,000 members worldwide and is America's oldest national engineering society. The Society will celebrate its 150th anniversary in 2002.





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