# Minnesota's Aging Infrastructure

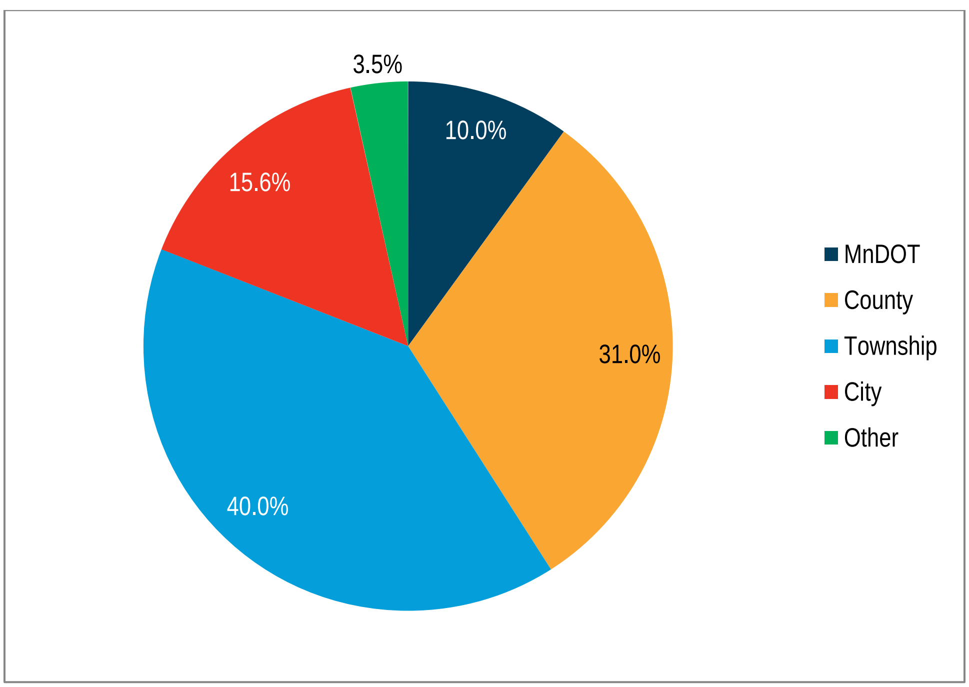
## INTRODUCTION & CONTEXT

Minnesota's public infrastructure is aging; bodies of government from small towns to state agencies are facing long lists of needed fixes with too few resources to address them. The United States' roads, bridges, water and sewer lines, levees, and other infrastructure components were rapidly constructed to meet the needs of a growing population, resulting in an expansive system that has suffered from a lack of maintenance since it was put into place. According to the American Society of Civil Engineers, the United States will face a $1.6 trillion gap between current revenues and investment needs from 2012 through 2020.[1] The longer maintenance needs go un-addressed, the more expensive the overall bill will become. As such, addressing aging infrastructure in the United States and Minnesota must be a high priority.

Minnesota's story is not unlike the rest of the United States. Aging infrastructure, a lack of preventative maintenance, and insufficient replacement of assets in poor condition has resulted in leaky pipes, pothole-ridden streets, and the inefficient delivery of services, largely due to more investment needs competing for limited funds. In Minnesota it is estimated that poor road quality costs the average driver $282 per year in extra operations and maintenance costs.[2] While this report focuses mostly on MnDOT's aging transportation infrastructure, it is important to consider infrastructure owned by other government bodies for transportation and non-transportation purposes. Even underground utility systems like water and sewer infrastructure can have impacts on the transportation system if not properly maintained.

Ownership of transportation infrastructure in Minnesota is divided between a number of different government jurisdictions. This can lead to confusion regarding who is responsible for maintenance and what funding sources are available. Figure 1 shows the breakdown in jurisdiction by lane-mile in Minnesota. When appropriate, MnDOT pursues jurisdictional alignments to make sure that Minnesota's roads are owned and operated by the right body of government. Jurisdictional transfers between government agencies often involve costly improvements to make sure that roads are in good condition at the time of the transfer but can lead to cost savings and efficiencies in the long run.

Figure 1: Ownership of the roadway system by lane-mile




[1] ASCE, 2013
[2] Ingraham, 2015

# Minnesota's Highway System

## HISTORICAL GROWTH AND ONGOING MAINTENANCE

As is the case with many other aging public assets, the timing of when Minnesota's network of roads and bridges was built has significant impacts on maintenance costs experienced today.

Beginning in about 1945, all miles on the state highway system were classified as surfaced, which included everything from improved gravel roads to modern pavements.[3] Today, almost all of the state highway system has been paved, with the exception of 14 lane-miles on Minnesota Highway 74 near Weaver, Minnesota in the southeast part of the state. The majority of gravel highways were paved during the 1950s and 1960s (50-60 years ago) which helps explain the magnitude of maintenance and preservation need on the highway system today; the typical life expectancy of a roadway is 40 to 70 years before major repairs are necessary. MnDOT will need to invest $2.9 billion between now and 2023 to meet the targets set through the agency's Transportation Asset Management Plan for pavement quality across the system.[4] From 2024 to 2033, MnDOT plans to invest $5.41 billion to maintain ride quality primarily on the state's interstate highways, while ride quality on other trunk highways is projected to worsen significantly.[5]

## HIGHWAYS

The bulk of Minnesota's pavements were originally constructed between 40 and 70 years ago. The Federal Aid Highway Act of 1956 provided funding mechanisms for freeways and expressways to be built throughout the country, which is a primary reason for the substantial spike in the number of lane-miles between 40-70 years old. Given the number of highways that were built and rapid system expansion that occurred in the years following, it makes sense that many roadways in the US are now in need of significant maintenance or reconstruction. Generally speaking, roads are reconstructed in full about every 50 years. The age at which a reconstruction is needed varies greatly from roadway to roadway and is due to environmental factors, type of use, traffic levels, use by heavy commercial freight traffic, type of pavement, amount of maintenance received, and more. Figure 2 shows the age of pavements on the state highway system based on the date of their original construction, not when they were most recently resurfaced or overlaid.

[3] FHWA Publications Archive, 2015

[4] MnDOT Transportation Asset Management Plan, 2014

[5] Minnesota State Highway Investment Plan, 2013

Figure 2: Age of pavement on the State Highway System as of 2014[6]

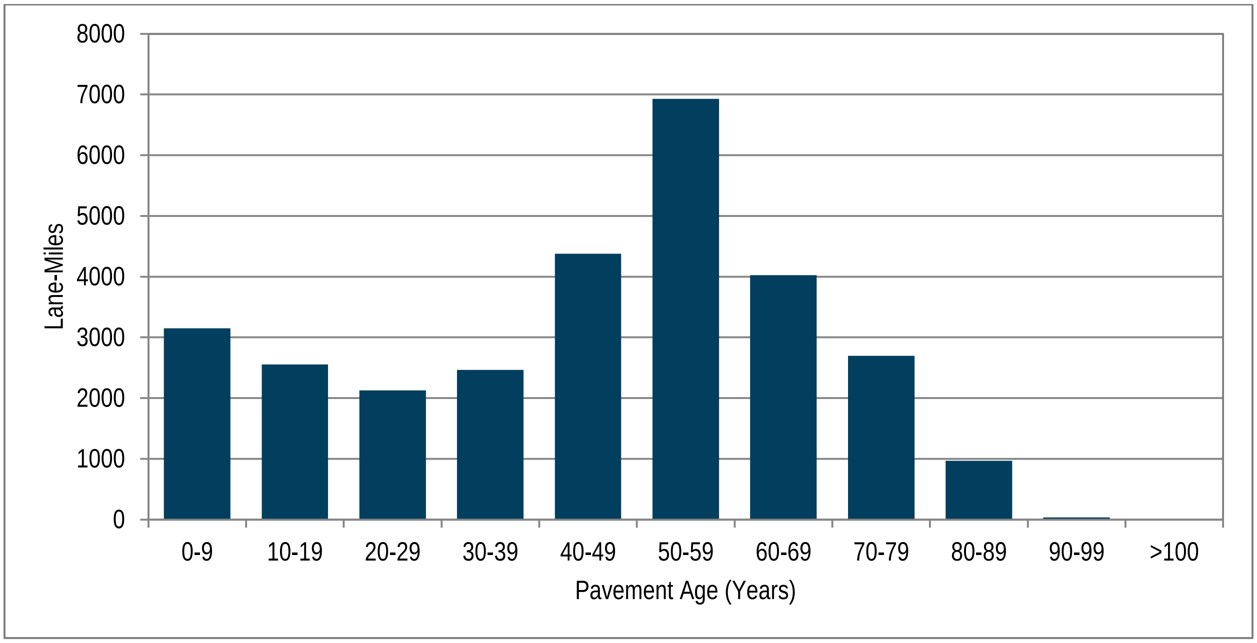



Figure 3: Approximation of “typical” maintenance expenditures during pavement lifespan

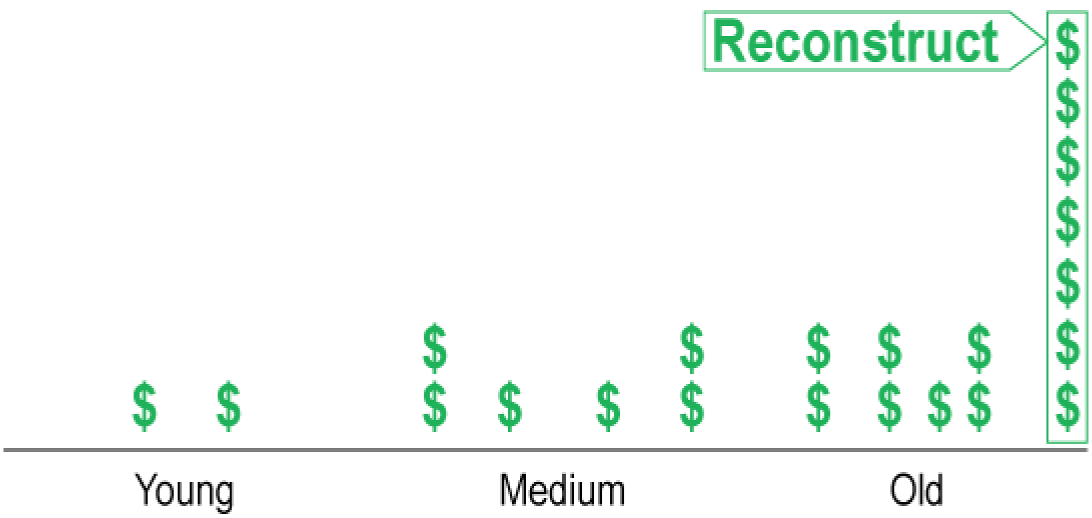



Figure 3 represents the relative cost of maintenance activities during a pavement's lifespan in Minnesota. It should be noted that costs can vary considerably depending on environmental factors at the construction site. Though full reconstructions typically average about $700,000 per lane-mile, they can range anywhere from $210,000 per lane-mile in near-perfect building conditions to over $3,000,000 per lane-mile in complex situations. If best management practices for maintenance are not followed and implemented in a timely manner, future fixes become more expensive as pavement quality decreases and more substantial repairs are needed.

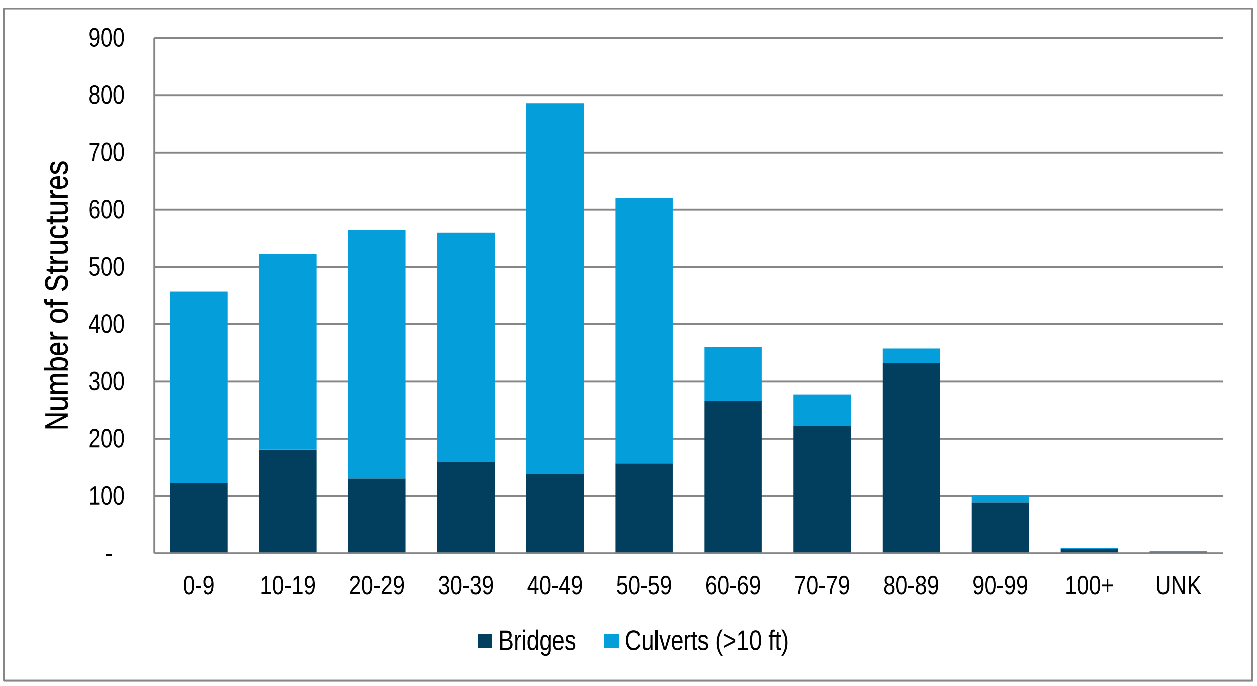
[6] MnDOT Transportation Asset Management Plan, 2014

## BRIDGES

Bridges have historically been constructed with a theoretical design life of 50 years, though newly constructed bridges are expected to remain functional for 75-100 years or more due to recent materials and engineering improvements.[7] Properly maintaining bridges during their lifespan is an important step to achieve the full useful life of a structure. If preventative maintenance is skipped, fixes down the road become more expensive due to deterioration that worsens more quickly as it is allowed to continue.[8] Given tight budgets and the decline in buying power of existing transportation funds, ensuring that a bridge's full useful life is captured is a key part of getting the most out of investments in the transportation system. An investment of $20.5 billion each year would be needed to eliminate the backlog of deficient bridges nationally by 2028 – currently only $12.8 billion per year is invested across the United States.[9]

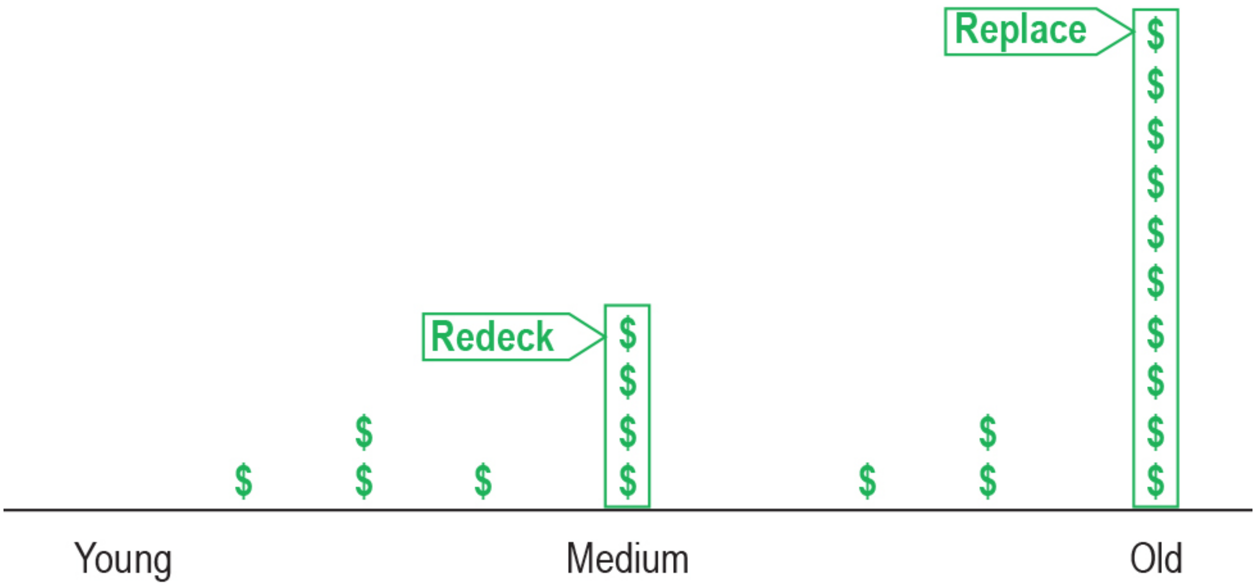
As of 2015, 5.3% of structurally deficient or functionally obsolete bridges in the state were found on Minnesota's Interstate highways and 7.0% on the remainder of the trunk highway system.[10] Functionally obsolete bridges feature designs that are no longer adequate for their task, including too few lanes to accommodate traffic, no space for emergency shoulders, or drawbridges on a congested highway. A structurally deficient bridge has one or more defects that require attention, and can range from relatively minor issues to severe problems. County, township, and city owned facilities make up nearly 88% of structurally deficient or functionally obsolete bridges.[11] Accounting for these pressing needs often takes up resources that could otherwise be used to maintain sound bridges that are in need of minor, preventative maintenance. This can result in the establishment of a "worst-first" maintenance strategy that is more expensive to carry out in the long term. Figure 4 shows the age of bridges and culverts greater than 10 feet in length on the state highway system.[12] Figure 5 shows an abstraction of when investments in bridges are typically made along with the relative magnitude of investments.

Figure 4: Age of bridges and culverts (>10 ft) on the state highway system[13]




[7] FHWA Bridge Preservation Guide
[8] Ibid.
[9] American Society of Civil Engineers
[10] MnDOT, 2015
[11] MnDOT, 2015
[12] MnDOT Bridge Office, 2015. Note: there are more than 47,000 culverts that are less than 10 feet in length on the state system. Age information is not available for these culverts.
[13] MnDOT Bridge Office

Figure 5: Approximation of "typical" maintenance expenditures for bridges




## Local Infrastructure

Local bodies of government are often responsible for maintaining their respective public infrastructure systems, including streets, bridges, water systems, and more. Larger cities in Minnesota (over 5,000 people) are leading the way in terms of asset management – more than 70% of survey respondents to a recent survey sponsored by the non-profit group MN 2050 have either considered, are working on, or have completed an asset management plan.[14] Counties engage in asset management planning nearly as frequently as large cities, while under half of small cities (under 5,000) use asset management practices or planning.[15] Each jurisdictional category viewed their effectiveness differently. Small cities saw their current efforts as being less effective than counties, while large cities saw their efforts as being the most effective.[16] Asset management is especially important for local jurisdictions as funding for infrastructure often comes from property tax receipts. Paying for infrastructure improvements and maintenance may not be an issue in cities and towns with strong tax bases, but for towns with struggling tax bases maintenance can be a significant issue.

There are a variety of ways to facilitate asset management activities, including mapping and database establishment. Roads, airports, and bridges are most commonly documented through mapping applications.[17] This is perhaps unsurprising given the important role that mapping of these assets plays in society for wayfinding purposes. Buildings, solid waste facilities, natural gas networks, and traffic fixtures were the least frequently mapped assets that were consistently found across jurisdictions.[18] Tracking the location and quality of assets allows local governments to develop estimates of the total value of assets, though few local municipalities have completed value assessments. MN 2050 sent their asset management survey to 264 jurisdictions across Minnesota (out of just fewer than 3,000 total) and received value calculations from jurisdictions for roads, bridges, water supply and distribution systems, and waste water collection and treatment systems. The total value for these infrastructure components is shown in Table 1. Given the limited number of responses, the data below are intended only to illustrate a portion of the asset value that exists on public systems in Minnesota. Much further research must be conducted to understand the total value of publicly-owned assets in the state.

[14] MN 2050 Preliminary Draft Survey Responses
[15] Ibid.
[16] Ibid.
[17] Ibid.
[18] Ibid.

Table 1: Reported value based on responses to MN2050 Asset Management Survey[19]

| Asset | Number of Responses | Total Value |
|---|---|---|
| Roads | 33 | $33,772,624,842 |
| Bridges | 15 | $6,795,864,702 |
| Water Supply & Distribution | 17 | $366,134,294 |
| Waste Water Collection & Treatment | 14 | $7,114,500,140 |

### CASE STUDY: DULUTH-SUPERIOR METROPOLITAN INTERSTATE COUNCIL

The Duluth-Superior Metropolitan Interstate Council included a focus on asset management strategies in their update of the Connections 2040 Long-Range Transportation Plan. Based on data collected from roadway stewards in the region, the MIC found that 49% of pavements were of good quality, while 24% were fair and 27% were poor.[20] On the whole, the region has taken steps forward from previous levels in 2009 by engaging in sound asset management practices. Most pavements that are in poor condition are found on the local and county systems.[21] Continued maintenance of the local bridge network will be critically important – research by the MIC found that 63% of bridges and 76% of bridge miles in the region are between 25 and 50 years old and are likely approaching periods in which they will require large maintenance investments.[22]

## Airports

MnDOT's State Aviation System Plan includes an overview of estimated maintenance costs at Minnesota's airports, broken in to common funding categories. In total, Minnesota's airports, not including MSP International, had a projected maintenance bill of $2.46 billion between 2012 and 2030, of which 40.26% was billed for general improvements.[23] Infrastructure needs at airports include building maintenance, taxiways, and property management challenges. Projected funding levels for Minnesota's public airports do not come close to meeting this level of need. Anticipated funding for airports from 2012 to 2030 is anticipated to top out at $855 million – roughly one-third of the total needed to meet the wide variety of infrastructure needs at airports in Greater Minnesota. The Metropolitan Airports Commission 2030 Long Term Comprehensive Plan for MSP International estimates a total of $2.4 billion in facility improvement needs between 2010 and 2030 to maintain high-quality levels of service.[24]

## Railroads

Minnesota's railroads, while not owned by the state, also contribute to the growing body of aging infrastructure that must be maintained. Typically, the state is responsible for maintaining the safety equipment at railroad-highway at-grade crossings. In total there are more than 1,400 active rail crossing warning devices in operation across the state – 270 of these (21 percent) are more than 30 years old. The typical design life for a crossing warning system is between 20 and 25 years.[25] Public awareness regarding the importance of crossing infrastructure has increased in recent years, given high profile incidents involving trains that carry crude oil from North Dakota's Bakken oil fields. These incidents are discussed in further detail in the paper on Minnesota's Freight Rail system. A study of at-grade crossings along the rail routes used to ship Bakken crude revealed $244 million in needed maintenance and improvements to improve safety for trains and those crossing the tracks.[26]

[19] MN 2050 Preliminary Draft Survey Responses
[20] Duluth-Superior Metropolitan Interstate Council, 2014
[21] Ibid.
[22] Ibid.
[23] MnDOT State Aviation System Plan, 2012
[24] Metropolitan Airports Commission, 2010 – the 2015 plan update is currently under development
[25] MnDOT State Rail Plan, 2015
[26] Ibid.

## Ports & Waterways

Minnesota's ports and commercial waterways face a similar plight when compared to other components of the transportation system – a large list of sorely needed maintenance work and few funds to draw from. Commercial waterways in Minnesota are used extensively to ship bulk goods both to and from the state. MnDOT offers support to public ports through the Port Development Assistance Program – the four ports (out of nine) in Minnesota who currently most recently sought funds from the PDAP had project needs in excess of $34 million.[27] Dredging needed to maintain predictable shipping passageways for barges and ships are one of the key expenses on Minnesota's waterways. The US Army Corp of Engineers spent $9.3 million for dredging on the Saint Paul District's section of the Mississippi River in 2012, and $5.0 million in Minnesota's Lake Superior ports.[28] Maintaining locks and dams is also critically important. While the Corp spent $9.2 million in 2012 on lock and dam maintenance, there is a total need of more than $110 million on the St. Paul District's lock and damn system (which includes Minneapolis through Guttenberg, IA).[29]

## Other Infrastructure

Other infrastructure systems like water delivery and sewer face similar issues to transportation infrastructure. Given that many local roadway systems rely on general revenue sources like property taxes, these systems often end up competing for limited funding. Additionally, they are frequently co-located with transportation infrastructure. Finding ways to coordinate maintenance activities on transportation, water, and sewer infrastructure systems is key to minimizing disruptions and maximizing efficiencies.

### WATER DELIVERY SYSTEMS

Public assets in need of maintenance extend beyond only transportation infrastructure. Investment needs for buried drinking water infrastructure across the country for the next 25 years total more than $1 trillion.[30] The lifespan of water pipes tends to be longer than most transportation assets, though the importance of preventative maintenance at appropriate times remains important. Maintaining consistent preventative maintenance schedules is a challenge, considering that systems across the United States experience 240,000 water main breaks each year. [31] Pipes built in the late 19th and early 20th centuries are just now reaching the point where they need to be replaced.[32] Public water utilities often run into funding challenges due to seemingly plentiful supplies of drinking water in the United States. Funding maintenance activities is difficult as water rates have been held at levels that do not accurately depict the true cost of treating and delivering water to the public.[33] A combined strategy of rate hikes for water service and creative financing solutions will be needed to address maintenance needs.

### WASTEWATER SYSTEMS

Wastewater systems in the United States are also in need of increased levels of investment in the years to come. Approximately $298 billion are needed to maintain wastewater and stormwater systems in the United States over the next 20 years.[34] Work has already begun on updating antiquated wastewater systems across the country. Requirements under the Clean Water Act have led to new investment in pipes, plants, and equipment to eliminate the occurrence of combined sewer overflow events.[35]

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[27] MnDOT Statewide Ports & Waterways Plan, 2013
[28] Ibid.
[29] Ibid.
[30] American Water Works Association
[31] American Society of Civil Engineers
[32] American Water Works Association
[33] American Society of Civil Engineers
[34] American Society of Civil Engineers
[35] Ibid.