

### Connecticut Society of Civil Engineers INFRASTRUCTUREREPORTCARD.ORG/CONNECTICUT www.csce.org



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# **EXECUTIVE SUMMARY**

Today, more than ever, the people of Connecticut are concerned about the State's economy and are trying to find solutions that will make Connecticut more attractive to businesses and future residents. A key component of any economy is its infrastructure. This includes transportation networks, energy and clean water distribution systems, and wastewater collection. Infrastructure is the glue that holds our modern-day cities and towns together. Businesses rely on the transportation systems to move goods and people, power and water for industry, and communications to reach customers and conduct business transactions. The better these infrastructure systems are, the greater the opportunities for prosperity.

The Connecticut Society of Civil Engineers, in conjunction with the American Society of Civil Engineers, looked at five important infrastructure networks: roads, bridges, rail transportation, drinking water systems and wastewater systems. Grades ranged from a D+ to a B, with an average grade of a C-. Age is a reoccurring challenge across many of the categories. Much of Connecticut's infrastructure is over 50 years old, meaning it is beyond its intended life. While our roadways, bridges and more are still functioning and safe, they are worn out, less reliable, and more congested. Investing in infrastructure will foster opportunities for our economy to grow in a sustainable fashion and support ongoing prosperity.

This report looks at the five categories of infrastructure, highlighting the significant problems and identifying several solutions.



# **GRADING METHODOLOGY**

The 2018 Report Card for Connecticut's Infrastructure was written by a committee of 11 civil engineers from Connecticut who volunteered their time to collect and analyze data, prepare and review their findings. The committee worked with staff from ASCE National and ASCE's Committee on America's Infrastructure to provide a snapshot of our infrastructure, as it relates to us at home, and on a national basis.

The Report Card Sections are graded based on the following eight criteria:

CAPACITY Does the infrastructure's capacity meet current and future demands?

**CONDITION** What is the infrastructure's existing and near-future physical condition?

FUNDING What is the current level of funding from all levels of government for the infrastructure category as compared to the estimated funding need?

FUTURE NEED What is the cost to improve the infrastructure? Will future funding prospects address the need?

**OPERATION AND MAINTENANCE** What is the owners' ability to operate and maintain the infrastructure properly? Is the infrastructure in compliance with government regulations? PUBLIC SAFETY To what extent is the public's safety jeopardized by the condition of the infrastructure and what could be the consequences of failure?

**RESILIENCE** What is the infrastructure system's capability to prevent or protect against significant multihazard threats and incidents? How able is it to quickly recover and reconstitute critical services with minimum consequences for public safety and health, the economy, and national security?

INNOVATION What new and innovative techniques, materials, technologies, and delivery methods are being implemented to improve the infrastructure?



# **GRADING SCALE**



#### **EXCEPTIONAL: FIT FOR THE FUTURE**

The infrastructure in the system or network is generally in excellent condition, typically new or recently rehabilitated, and meets capacity needs for the future. A few elements show signs of general deterioration that require attention. Facilities meet modern standards for functionality and are resilient to withstand most disasters and severe weather events.



### GOOD: ADEQUATE FOR NOW

The infrastructure in the system or network is in good to excellent condition; some elements show signs of general deterioration that require attention. A few elements exhibit significant deficiencies. Safe and reliable with minimal capacity issues and minimal risk.



#### **MEDIOCRE: REQUIRES ATTENTION**

The infrastructure in the system or network is in fair to good condition; it shows general signs of deterioration and requires attention. Some elements exhibit significant deficiencies in conditions and functionality, with increasing vulnerability to risk.



#### POOR: AT RISK

The infrastructure is in poor to fair condition and mostly below standard, with many elements approaching the end of their service life. A large portion of the system exhibits significant deterioration. Condition and capacity are of significant concern with strong risk of failure.



#### FAILING/CRITICAL: UNFIT FOR PURPOSE

The infrastructure in the system is in unacceptable condition with widespread advanced signs of deterioration. Many of the components of the system exhibit signs of imminent failure.



# LIST OF AUTHORS

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### **RECOMMENDATIONS TO RAISE THE GRADE**

If Connecticut is ready to improve our infrastructure, the Connecticut Society of Civil Engineers (CSCE) has some suggestions to start raising the grade:

- 1. Connecticut should continue to prioritize investment in infrastructure during challenging budget cycles. In a recent poll, 42% of businesses and industry associations indicated that high traffic volumes and congestions on roads hamper or limit the growth of their markets, and approximately 15% have considered relocating due to these concerns. We need robust and sustainable investment in our infrastructure to incentivize businesses to relocate or stay in Connecticut, which in turn will strengthen our economy, lessen the impact of challenging budget cycles, and improve our overall quality of life.
- 2. Connecticut must ready itself for increasingly severe storms by modernizing its infrastructure. Wastewater and drinking water networks, roadways, bridges and our key infrastructure systems must be resilient against the consequences of climate change. Our infrastructure should not only be able to withstand increasingly severe storms, but support emergency response and facilitate a return to regular order as efficiently as possible.
- 3. THE state and localities should increase investment in infrastructure to help reduce costs for residents down the road. Drivers in the state pay up to an average of \$2,378 each year in congestion-related delays and vehicle operating costs. Robust investment in our infrastructure not only decreases the amount of money drivers pay on vehicle repairs, but it improves access to better employment, and strengthens our quality of life.



### 2018 REPORT CARD FOR CONNECTICUT'S INFRASTRUCTURE





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## BRIDGES

#### **EXECUTIVE SUMMARY**

In Connecticut, there are 79 million bridge crossings each day and 7.8% of bridges in the state are structurally deficient, compared with 8.9% nationwide. Some of the state's largest and most heavily traveled bridges are those with the structurally deficient (otherwise known as a "poor" condition) rating, meaning significant funding will be needed to bring these bridges back to a state of good repair. While the percentage of structurally deficient bridges is small, 62.6% of bridges are in fair condition, which puts them at risk for slipping into the structurally deficient category. Fortunately, funding has been allocated to continue the initial phases of Governor Malloy's \$100 billion, 30-year Let's Go CT! transportation plan through 2020, bolstered by \$250 million in General Obligation Bonds. However, 59% of bridges in the state are over 50 years old and beyond their design life, which will require new sources of funding to ensure our bridge network is built for the future is properly maintained and improved to meet the future needs of the traveling public.

#### BACKGROUND

There are 4,238 bridges in Connecticut that are included in the Federal Highway Administration (FHWA) National Bridge Inventory (NBI). 1,785 of these bridges are on the National Highway System (NHS), while 2,453 are considered non-NHS. Connecticut's bridges are owned by a variety of entities. Roughly two thirds of NBI bridges-2,837-are owned by the state, while 1,257-or just under one third-are owned by towns or cities. The remaining bridges have unknown or private owners. This chapter relies on data from the 2017 FHWA NBI.

#### **CAPACITY AND CONDITION**

According to a 2018 report by TRIP, a national transportation research group, approximately 59% of Connecticut bridges are more than 50 years old, the average design lifespan of bridges designed in the twentieth century. Though bridges are now reaching their design lifespan, if a bridge is maintained properly, its lifespan could be well beyond 50 years. However, such maintenance requires continuous adequate funding.

According to the 2017 FHWA bridge data, the overall condition of all NBI (NHS and Non-NHS) bridges in the state are rated to be 29.6% in good condition (rating of 7 or higher out of a 0 to 9 scale), 62.6% in fair condition (rating of 5 or 6), and 7.8% in poor condition (rating of 4 or lower). Although the majority of the bridges are in fair condition, exposure to natural elements inevitably will lead these bridges to be in poor condition if proper maintenance and rehabilitation are not performed regularly. A poor condition rating is roughly equivalent to the term structurally deficient (SD). 7.8% of all NBI (NHS and Non-NHS) bridges in Connecticut are structurally deficient (SD), which is less than the national average of 8.9%. When a bridge is identified as structurally deficient it is an indicator that a bridge needs maintenance, rehabilitation, or sometimes replacement. A structurally deficient rating implies that significant work needs to be done, but as long as traffic is permitted to use the bridge, the bridge is deemed safe. The percentage of structurally deficient NBI bridges by number and by deck area for the State, New England and the National average is presented in the table below.

OWNER	NBI BRIDGES			NBI BRIDGES		
	NUMBER OF BRIDGES (EA.)	STRUCTURALLY DEFICIENT		BRIDGE AREA (SQ. M)	STRUCTURALLY DEFICIENT	
CONNECTICUT	4,238	332	7.8%	3,322,219	456,487	13.7%
NEW ENGLAND	17,917	1736	9.7%	11,398,502	1,520,348	13.3%
UNITED STATES	615,002	54560	8.9%	374,362,285	23,358,957	6.2%

The graph below specifically compares the NHS-NBI Bridges in poor condition in Connecticut to other states in New England and to the national average. This comparison includes the percent of poor bridges by number of bridges, and also by deck area.

#### COMPARISON OF NHS-NBI BRIDGES IN POOR CONDITION



While Connecticut's percentage of structurally deficient bridges by number of bridges is lower than the national average, the state is far worse when looking at structural deficiency by bridge deck area. According to the FHWA, Connecticut has the third largest percentage of bridges in poor condition by deck area in the country. This is attributed to the fact that Connecticut's largest bridges (deck area) are NHS-NBI bridges in poor condition.

Another factor for a bridge to be in a "state of good repair" is the bridge's capacity to safely carry live loads in its current condition. There are 58 (1.4%) of NBI bridges "posted" for having a load carrying capacity below current standard loading.

The Department is currently projecting that if current funding and staffing levels are maintained, completion of currently scheduled projects will result in Connecticut being compliant with the FAST Act metric (less than 10% of NHS-NBI bridges, measured by deck area) by the start of Federal Fiscal Year 2020. Many of the structurally deficient NHS-NBI bridges have the largest deck areas in the state, all of which are currently in design projects.

#### CAPACITY

Approximately one in four NBI structures may not have an adequate number of lanes, lane widths, shoulder widths on or under the bridge, or vertical clearances under the bridge to serve current traffic demand, which could result in increased congestion. These bridges would require significant modification or reconstruction. These bridges would require significant modification or reconstruction, and during a design project the removal of the functional obsolescence is always considered.

#### **OPERATION & MAINTENANCE**

The Connecticut Department of Transportation (CTDOT) owns and maintains 2,827 NBI bridges. The remainder are maintained by towns, private agencies, Metro-North and/or Connecticut Department of Energy and Environmental Protection (ConnDEEP). Bridges are inspected at regular intervals, at least once every two years. Some are inspected more frequently due to conditions such as fracture critical or fatigue prone details. Upon completion of the bridge inspection process, a maintenance work item may be prepared that identifies any deficiencies and areas of deterioration. The repair would then be scheduled based on criticality. Maintenance contracts consist of on-call contractors and CTDOT's staff.

#### FUNDING AND FUTURE NEED

The CTDOT has begun the implementation of the Governor's Let's GO CT! initiative, a 30-year funding plan for transportation projects. For Federal Fiscal Year (FFY) 2015, the plan included an initial \$2.8 billion in bond authorizations. For FFY 2016, and 2017, respectively, additional \$275 million and \$520 million in bonding was provided. The Department assumes that as the 5-year Ramp-Up fund ends in FFY 2020, the State's Regular Bond Program will increase by approximately \$700 million in FFY 2021 to reflect the transition to an increased regular program.

The FFY 2016 Let's GO CT! funds have made it possible to begin large-scale projects such as an engineering review of the I-95 corridor, the preliminary design process for I-84 Exits 3 through 8 in Danbury; and initiated planning for the replacement of the I-84 / Route 8 interchange in Waterbury.

For FFY 2017, the State had approximately \$1.5 billion to fund highway and bridge (NBI and Non-NBI bridges) projects. Approximately 43% of this budget was from Federal Funds, 39% from State funding, and 18% from Ramp Up State Funding.

Over the next 30 years, it is estimated that the CTDOT needs approximately \$18.7 billion to bring and keep the balance of the State's bridges (NBI and Non-NBI bridges) in a state of good repair. Up to \$6 billion more will be needed for bridge work (NBI and Non-NBI bridges) if the capacity improvements projects are not completed, which would require doubling the existing bridge (NBI and Non-NBI bridges) program to \$800 million per year.

#### **RESILIENCE AND PUBLIC SAFETY**

Hurricanes are major natural hazard in the Connecticut area. The State of Connecticut does not have a specific program dedicated to overhaul bridges for resiliency against significant storm events. Project implementation is reactive based on the significant storm event that occurs. However, CTDOT has been proactively identifying/addressing such resiliency concerns via it's routine and underwater bridge inspections, thereby creating work items for the Department's maintenance forces to address or prompting the initiation of a project. In the past ten years, five bridges have been identified for repairs due to significant storm events that occurred. Repairs for two of the bridges were federally funded with Housing and Urban Development (HUD) federal funds and the remaining three were funded via the State's Emergency Declaration state funding program.

Another public safety concern for the state is bridge railing systems that are not up to the current standard. Approximately 56.3% of NBI bridges in the State have bridge railing systems not up to the current standard. This is due to rail systems that do not meet the current crash testing standards or barrier heights not conforming to current national safety standards.

#### **INNOVATION**

While there is not a system in place to actively integrate innovative products into every project, CTDOT has experience with using innovative products and practices. These include high performance concrete, high performance steel, link slabs, prefabricated bridge units (PBU's), geosynthetic reinforced soil-integrated bridge systems (GRS-IBS) and sensor monitoring.

In terms of project delivery, CTDOT completed their first Design-Build bridge project (four bridges) in the summer of 2016, and currently is in construction with another Design-Build bridge project (four bridges). Also, CTDOT actively implements Accelerated Bridge Construction (ABC). Since 2012, 21 projects have been completed, seven others are in construction, and another eight are in design. In the past few years, the State has developed an ABC matrix to determine which project is suitable to use ABC techniques based on criteria such as Average Daily Traffic (ADT), user impact, bridge location, work zone geometry, cost, environmental impacts, water handling, and waterway limitations.



BRIDGES

- Legislature should ensure that CTDOT funding remains at the same level of \$800 million per year in order to reduce the number of NBI and NHS bridges that are structurally deficient to bring the percent by deck area below 10%.
- Increase funding for local bridges in order to reduce the number of structurally deficient bridges or these structures will become an even weaker link in our State's overall transportation infrastructure, regardless of adequate funding to CTDOT.
- Legislature should support raising the gas tax to provide additional funding for transportation projects.
- Legislature should support incorporate tolling system on interstate highways to provide additional funding for transportation projects.
- Establish a transportation funding lockbox that will eliminate the use of funds on spending/projects not related to our transportation infrastructure.
- Continue to investigate innovative successful practices used in other states to efficiently repair the most deficient bridges.
- Increase funding for bridge maintenance in order to reduce deferred maintenance backlog.



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## **DRINKING WATER**

#### **EXECUTIVE SUMMARY**

Connecticut has high-quality drinking water and generally well-maintained water systems, but these systems are aging and in need of major repair and rehabilitation, estimated at over \$4 billion through 2034. Drinking water system operations, including infrastructure improvements, are funded primarily through a rate-based system. The average Connecticut household pays an average of approximately \$500 per year for clean, potable drinking water. Additional asset management planning will be needed to ensure the limited amount of available funding is used where it is needed most. In addition, as the effects of climate change are increasingly being felt, water systems will need to evaluate their vulnerability and take steps to mitigate the impact while maintaining service to their customers.

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#### BACKGROUND

Approximately 2,500 public water systems (PWS) in Connecticut provide drinking water to over 2.7 million people, or about 78% of the state's total population. Over 500 are community water systems (CWS), more than 500 are non-transient non-community systems (NTNC), and the remaining are transient non-community systems. These PWS have over 4,400 high-quality drinking water sources, including 150 reservoir systems. Over 60% (330) of the 500 CWS are small systems. There are also approximately 332,500 private water supply wells.

The Department of Public Health (DPH) oversees public drinking water for Connecticut. Their responsibilities include regular sanitary survey inspections of each PWS, review of each project involving a water system facility or source, monitoring of water quality samples, and enforcement of a range of laws, including source water protection and the certification of water system operators.

Connecticut has finalized a State Water Plan that will address all water uses: drinking water, industry, environmental health, agriculture, energy, and recreation.

#### CAPACITY

Under normal conditions, the large CWS can meet current demand. Some of these systems, however, may experience shortages during times of drought, as these systems have sources that can be vulnerable during dry conditions. Many CWS of all sizes have emergency interconnections. Connecticut is looking for more sustainable ways to reduce sensitivity to drought.

Growth and increased demand is generally expected with the larger systems, whether through development of new properties or interconnections with small systems. This will force the search for increased supply and potentially additional treatment and storage facilities. Several large systems have identified additional potential interconnections that address both future demand and the need for an emergency supply. Small systems typically serve a specific area and do not have the capacity to expand. New small systems are constructed when development occurs in an area without access to another water system with the capacity to provide service.

#### CONDITION

DPH staff inspect each CWS every three years and non-community system every five years. These sanitary survey inspections mainly focus on the sources of supply, treatment, and water storage facilities, along with the operation of the system. In addition, PWS are required to routinely sample for a variety of possible contaminants. As of June 30, 2017, 98.3% of the population served by CWS were provided drinking water that meets all applicable health standards -- well above the national target of 92%. This percentage has been consistent since 2011. From 2014-2016, 75% of the CWS inspected had no significant deficiencies. Of those CWS that did have a significant deficiency, 77% of the deficiencies were corrected. Overall, CWSs are kept in functioning condition, however as discussed below, there are significant needs that must be addressed soon.

The water mains that make up distribution systems are aging and increasingly in need of rehabilitation or replacement. According to the State Water Plan, the vast majority of large water systems have indicated that distribution system upgrades have been planned or identified.

Small systems are less likely to be well-maintained, as they usually do not have the institutional knowledge of what is necessary to maintain a well-run water system. They also tend to charge customers less than what is required to operate the system, resulting in insufficient funds when repairs are needed.

#### **FUTURE NEEDS**

According to the Environmental Protection Agency's (EPA) 2011 Drinking Water Infrastructure Needs Survey and Assessment ("DW Needs Survey"), Connecticut needs over \$3.5 billion to maintain existing infrastructure over the 20-year period (2011-2030). This survey has some limitations, as it does not consider the infrastructure need for growth or fire protection.

The 2015 Drinking Water Needs Survey report for the period 2015-2034 was released in March 2018. Given the age of typical larger water systems in the northeast, the need, as expected, increased to over \$4 billion. In addition, the infrastructure in many small water systems, which was constructed for individual homeowner associations 40 to 50 or more years ago, is reaching the end of its useful life and in need of major rehabilitation or complete replacement. These systems do not have the customer base to raise the needed capital to maintain the infrastructure. They are generally run by volunteers, who are asking their neighbors to pay upwards of tens of thousands of dollars per household for each improvement.

#### **FUNDING**

Drinking water system operations, including infrastructure improvements, is funded primarily through a rate-based system. These rates can vary widely across the state. In their 2016 Connecticut Water Rates Survey, the engineering firm Tighe & Bond found the average annualized water costs of the rate structures reported was \$509, with the median at \$500, a low of \$173 and high of \$932. Only 12% of respondents had increased rates since the previous survey in 2013.

Projects can be financed with support from the Drinking Water State Revolving Fund (DWSRF) Program, which makes low-interest loans to PWS. The results of the EPA Drinking Water Needs Survey are used to determine the amount of annual federal funding that the State is eligible to receive through the DWSRF. Since its inception in 1997, Connecticut has received over \$144 million in funds for projects. Additional State funding has resulted in a total of \$359 million available for drinking water infrastructure projects through June 30, 2017. Included this amount is \$20 million in grant funding appropriated by the Legislature under a new Public Water System Improvement Program created in 2014. This is only approximately 9% of the total need demonstrated in the DW Needs Survey. While this funding is greatly needed, the strict requirements of the DWSRF program deter some systems from applying for this assistance.

More funding is needed to meet the needs for infrastructure rehabilitation and replacement. Water systems historically tend to charge less than what is necessary to maintain their system in the long-term. As the infrastructure is getting older and the need to undergo major rehabilitation or replacement is increasing, many systems are finding it difficult to obtain the required funds. Asset management can help systems understand the full cost of the service and what their rates should be.

#### **OPERATION AND MAINTENANCE**

The Operator Certification requirements mandate each CWS and NTNC have a certified operator in charge of the system, covering the vast majority of the State's population. State regulations require all CWS serving over 1,000 people to have a Water Supply Plan, which includes asset management planning and a capital improvement plan. Most systems are well operated and maintained; however, as these water systems age and maintenance is deferred due to funding constraints, maintaining the water system is increasingly difficult and costly for many systems.

Many small water systems do not undertake asset management planning and are not prepared when repairs or improvements become necessary. However, over the past few years, the DWSRF program, coupled with federal requirements, have required small systems to have or develop an asset management plan as a condition of receiving funding. A contractor specializing in helping small systems has been providing assistance free of charge to develop these plans.

#### **PUBLIC SAFETY**

The health of Connecticut's residents and visitors depends greatly on the capability of the PWS and private wells to provide safe, potable drinking water. State law mandates that only the highest-quality water sources may be used for drinking water; it is the only State in the country that prohibits wastewater discharges into drinking water sources. For example, rivers that receive treated wastewater discharges, like the Connecticut River, cannot be used as a source of drinking water. This requires the source water to be the best quality available and reduces the extent of treatment necessary to deliver potable water.

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Only the larger water systems typically have the capacity to provide fire hydrants, which leaves the majority of rural areas without pressurized fire protection.

Over the past few years as State and federal budgets have become tighter, adequate staffing at the DPH to oversee public drinking water is increasingly becoming a concern. Since the development of the Safe Drinking Water Act (SDWA) in 1974, the requirements for PWS have increased, resulting in the need for additional regulatory oversight in an effort to protect public health. In November 2016, the Association of State Drinking Water Administrators produced a report highlighting the need for increased regulatory oversight in Connecticut, as a follow-up to their 2013 National Report. Since 1996, the same year the SDWA was most recently amended, Connecticut has seen a 20% reduction in the number of staff for the State's drinking water program. At the same time, the funding to maintain even the current level is decreasing.

#### RESILIENCE

There are several state laws in place that aim to improve the resiliency of water system facilities. All facilities must be located where the facility is not likely to be subject to fires or other man-made or natural disasters, and above the 100-year flood elevation. While this has been the accepted standard elevation for more severe storms, the effect of climate change has seen the 100-year flood areas expand along with sea level rise. Those facilities that are located in close proximity to this elevation, and those near the ocean, will become more vulnerable in the future. As a result, the locations of new facilities are being evaluated against the 500-yr flood elevation.

The increasing severity of storms has also identified the need for systems to have emergency power capabilities and back-up sources of supply. In 2011 and 2012, Connecticut was hit with three extreme weather events that collectively affected the entire state. These highlighted the discrepancy between large and small CWSs. A significant number of small systems lost power and were put on boil water advisories due to service interruptions, some for all three storms. Conversely, because of emergency power capabilities, most large systems maintained water service even without street power, some for as long as nine days. Only one large water system does not have generator power.

These events led to the development of regulations that require all CWSs to have back-up power provisions in place by December 2018; large systems are also required to have Emergency Contingency Plans. In 2012, the DWSRF implemented the Emergency Power Generator Program to assist small systems to purchase and install generators.

#### INNOVATION

Modern life comes with conveniences, such as non-stick pans, water repellants, flame retardants, and fabric stain repellants, however the chemicals associated with these technologies are now being detected throughout the environment. Innovative treatment techniques will be needed to remove these contaminants should they appear in drinking water sources. Connecticut's Source Protection and Drinking Water Source Laws will limit the impact. Another recent concern has been harmful algal blooms appearing in drinking water reservoirs, which can lead to the presence of cyanotoxins. This has required several large water systems to provide increased water treatment for surface supplies and to reevaluate and improve their surface water treatment processes.

The repair and rehabilitation of water mains, as opposed to full replacement, is also becoming more common, as these techniques have improved. Budget constraints have forced water systems to explore less costly options that will still provide a long-term solution.

In 2015 the Governor established permanent council of state agencies focusing on the State's resiliency in extreme weather events, covering infrastructure of all types. This group will identify factors to consider for various state planning efforts.



### **RECOMMENDATIONS TO RAISE THE GRADE**

- Identify drinking water sources that are vulnerable to drought or dry conditions and identify measures to ensure that those water systems can maintain continuous service to their customers.
- Identify opportunities for small water systems to be offered assistance that provide information on the technical, managerial, and financial capacities necessary to own and operate a water system, including appropriately charging for water.
- Implement full cost of service rate structures to help public water systems address needed repairs, rehabilitations, or replacements before the infrastructure fails.
- Maintain the strict source protection laws for drinking water in an effort to minimize the treatment necessary to remove contaminants and maintain a higher level of public health protection.
- Maintain sufficient DPH staffing for providing regulatory oversight and assistance to public water systems
- Maintain a knowledgeable and well-trained drinking water treatment plant operator workforce by promoting these jobs and expanding training opportunities
- Identify drinking water facilities that are vulnerable to extreme weather events and identify measures to ensure that those water systems can maintain continuous service to their customers
- Ensure research continues to identify potentially harmful contaminants in drinking water and the means to remove them.
- Use Asset Management to better maintain existing infrastructure and do proactive and preventative maintenance.



### **DEFINITIONS**

PUBIC WATER SYSTEM (PWS) - A public water system provides water for human consumption through pipes or other constructed conveyances to at least 15 service connections or serves an average of at least 25 people for at least 60 days a year. A public water system may be publicly or privately owned.

COMMUNITY WATER SYSTEM (CWS) – A public water system that supplies water to the same population year-round.

NON-TRANSIENT NON-COMMUNITY WATER SYSTEM (NTNC) – A public water system that regularly supplies water to at least 25 of the same people at least six months per year. Some examples are schools, factories, office buildings, and hospitals that have their own water systems.

TRANSIENT NON-COMMUNITY WATER SYSTEM (TNC) – A public water system that provides water in a place such as a gas station or campground where people do not remain for long periods of time.

SMALL WATER SYSTEM – a community water system serving 10,000 or fewer people.

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- Connecticut Department of Public Health Harmful Algal Blooms (www.ct.gov/ dph/cwp/view.asp?a=3139&q=438906)
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## RAIL

#### **EXECUTIVE SUMMARY**

Connecticut has a significant passenger and freight railroad system that provides service within the state and commerce between the major metropolitan areas of Boston and New York. Over 3.6 million tons of freight are moved annually on 10 freight railroads. Over 3.5 million intercity passengers are served on Amtrak's Northeast Corridor (NEC). The current Metro-North Railroad system serves approximately 41 million passengers annually and is the busiest railroad line in the country. The Connecticut Department of Transportation has invested nearly \$780 million in the New Haven-Hartford-Springfield Line. While the existing rail and track infrastructure is in generally good condition, there is still a continuing need to invest in rail system modernization and replacement across both the freight and passenger network. Rail is key to sustaining economic development and competitiveness with a focus on increasing the capacity of the rail system to accommodate increased ridership and freight tonnage.

### CAPACITY

The entire Connecticut rail system consists of 628.5 route miles of railroad owned by private freight carriers, Amtrak and the state. The Connecticut Department of Transportation (CTDOT) owns 106 route miles of track maintained by MTA-Metro North Railroad. 51 route miles are owned and maintained by Amtrak. These rail lines are also used to move freight within the state.

#### Metro-North Railroad (MNR) System (owned by the CTDOT)

- New Haven Main Line
- New Canaan Branch
- Danbury Branch
- Waterbury Branch

The New Haven Main Line, also part of Amtrak's Northeast Corridor, is the busiest line in Connecticut, serving approximately 40.7 million passengers annually. This is the highest rail line ridership in the U.S. In 2016, the on-time performance of the Metro-North Railroad System was 96.8% for the New Haven Main Line and branches. Performances ranges from the highest of 98.3% for the New Canaan branch to the lowest performance of 95.5% for the Danbury branch. The average ridership has remained steady in the three years from 2014 through 2016 with a small dip in 2015.

#### **Other Passenger Rail Corridors**

- Shore Line East (SLE) (operates for approximately 51 miles along the Amtrak owned Northeast Corridor)
- New Haven-Hartford-Springfield (NHHS) Line added expanded rail service on the Amtrak-owned corridor after extensive double tracking, passing siding and interlocking improvements funded by CTDOT.

Ridership on Shoreline East is approximately 600,000 passenger trips a year. The increase in capacity and the addition of expanded service and improved customer service features on the NHHS Line is expected to result in a significant increase in ridership. Early ridership projections put the total passenger trips per year for weekday service at approximately 800,000.

#### Freight Rail Network

The freight rail network in the state is predominately designed to link local shippers and industries to major Class 1 railroads and the major port facilities in New York and New Jersey by providing last mile service while also, to a lesser extent, supporting local haulage. Ten privately owned carriers operate over a 377.8 mile network with 131.1 miles owned by the state (including two miles owned by the city of Bristol) and leased to the freight railroads and 246.7 miles are owned by the freight railroads. The network includes 17 specific branches or lines with different track ownership and conditions. Except for two branches—the Palmer Line (55.8 miles) and Plainfield Secondary (53.2 miles) that operate as class 3 tracks (40 mph) — all of the remaining freight track (206.8 miles) operates at class 2 (25 mph) or of class1/ excepted (10 mph) standards. CSX and P&W have freight operating rights over portions of the passenger network and can operate at class or 5 speeds (60 and 80 mph, respectively)

The ten freight railroads include:

- Branford Steam Railroad.
- Central New England Railroad
- CSX
- Housatonic Railroad Company
- Naugatuck Railroad Company (primarily a tourist railroad)

- Pan Am Southern Railway
- Providence and Worcester (P&W) Railway
- Rail America operating two subsidiaries: Connecticut
  Southern Railway and New England Central
- Valley Railroad Company (primarily a tourist railroad)

#### CONDITION

Rail plays a vital role in the state's economy and multi-modal transportation system in the region. The CTDOT Office of Rail developed a 10-year Connecticut State Rail Plan in 2012 that states, "the vision for rail transportation in Connecticut is a system that provides high-speed, intercity, regional commuter and freight services that will be a catalyst for smart growth, encourage greater mobility, promote the state and regional competitive advantage in the global economy, decrease highway and aviation congestion, reduce energy use, and improve air quality." The State Rail Plan has the goal of bringing the entire network to a state-of-good repair through a cyclical replacement of infrastructure elements. Some of the specific goals include repairing or replacing existing movable bridges, the electrification of the branches, and numerous other future goals. The State Rail Plan also addresses the existing conditions, analyzes the economic impact, and establishes long-term goals for the state's passenger and freight railroad system.

To achieve improved service and accomplish State Rail Plan goals, several infrastructure assets are in need of upgrade or replacement. Rolling stock (train cars and engines) have been added in past five years with new M-8's for the MNR NH line. However, the SLE and other branch lines still have older rolling stock that is over 30 years old.

Much of existing rail and track infrastructure is in good condition with the state abiding by all Federal requirements for inspections and condition analysis. The bridges, track structure, signal systems and electrical systems on the Shoreline East track, owned by Amtrak, are inspected annually by Amtrak. CTDOT inspects all bridges that they own and are used by either freight railroads or MNR. The bridge infrastructure for the Metro-North line and the branches has an average rating of 5.2, which is considered fair. However, several bridges (five in total) are over 100 years old and in need of urgent upgrades, including the Walk Bridge which is 120 years old. Due to the condition of such bridges on MNR-NH line, a speed restriction of 30 mph is in place for passenger rail trains which reduces the overall capacity of the line. The Walk Bridge is under design and to be replaced in the near future.

The NHHS line has just been completed and is open for service. Significant ridership was demonstrated at the onset of the line with over 21,000 riders during opening weekend. This improvement program includes approximately 62 miles between New Haven and Springfield, MA. The construction cost was approximately \$780 million.

Freight railroads would be able to carry increased tonnage of materials and reduce highway use and maintenance if a targeted program of track improvements were undertaken to increase operating speeds, buy upgrading track class, improving load carrying capacity to an industry standard 286,000 pound car limit and make selective clearance improvements that would allow double stack freight operations.

#### **OPERATIONS AND MAINTENANCE**

Continuous funding is required for maintaining and replacing existing infrastructure. The MNR schedules repair and rehabilitation of existing infrastructure yearly. The upcoming MTA five-year plan includes the replacement of 20,000 to 30,000 railroad ties yearly, approximately 30 miles of rail resurfacing, improvements to switches and crossings at 20 locations, and at-grade crossings lighting upgrades.

The relatively new "New Haven Maintenance Facility" allows for the maintenance of the rolling vehicle stock. It also allows for the ease of inspection, repair and cleaning of the vehicles. With investments in new rolling stock, CTDOT is also investing in upgrades to the maintenance facilities. The new component change-out shop and the wheel truing facility have been completed. CTDOT continues their investment in the New Haven Rail Yard to serve the new generation of rail cars. The improvements also include new mail line connections, upgraded yard signal system, new diesel shop / CSR heavy repair shop, and a new car wash facility. The improvements are expected to be completed in 2023.

#### FUNDING AND FUTURE NEED

The Transportation Capital Infrastructure Program Annual Capital Plan Report 2017, published by CTDOT, shows the programmed amount of capital investment for all public transportation (including other entities, e.g. bus transportation) at \$750 to \$950 million dollars per year for the next five years as part of the State Let's Go CT! program which started in 2016. While additional capital is being allocated to Connecticut's passenger rail program, an additional \$4 - \$5 billion is still required.

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#### PUBLIC TRANSPORTATION (YEAR OVER YEAR)

#### Available Funding:

Federal Funding	\$310,701,946	\$364,390,458	\$178,282,747	\$181,313,553	\$181,313,553
State Funding (other than Ramp Up)	\$317,810,382	\$284,996,851	\$239,122,500	\$239,659,001	\$569,536,671
Ramp Up State Funding	\$421,000,000	\$224,600,000	\$410,000,000	\$534,000,000	\$-
Total Funding					
Less Fundie - fan Deserversenstin	\$1,049,512,328	\$873,987,309	\$827,405,247	\$954,972,554	\$750,850,224
Less Funding for Programs not in Capital Plan	\$(2,702,044)	\$(2,745,277)	\$(2,799,084)	\$(2,846,669)	\$(2,846,669)
Less Anticipated Carryforward to	\$(113,308,036)	\$-	\$-	\$(7,004,171)	\$(21,841)
next year					
Total Funding Anticipate Utilizing	\$933,502,248	\$871,242,032	\$824,606,163	\$945,121,714	\$747,981,714
Programmed Amount (in Capital Plan)	\$933,502,248	\$871,242,031	\$824,606,163	\$945,121,714	\$747,981,714

#### AN EXAMPLE OF THE PROGRAMMING OF CAPITAL FUNDS IS SHOWN IN THIS FIGURE.

Capital Category	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	Total
Rail	\$190,250,000	\$430,000,000	\$188,000,000	\$410,000,000	\$527,000,000	\$1,745,250,000
NHL Bridge Interim Repairs						
Rail Fleet						
NHHS Line Expansion/NHHS Stations						
SLE Improvements						
New Haven Station and Parking						
NHL- Danbury Branch Dock Yard						
Plan to Upgrade NHL Capacity and Speed						
Real Time Audio and Video System NHL						
Waterbury Branch Signal System						

The Northeast Corridor Commission (NECC) Capital Investment Plan identified five bridges in Connecticut with major funding challenges. Their projected cost to upkeep and maintain are listed below.

\$660,000,000
\$1,500,000,000
\$400,000,000
\$1,170,000,000
\$1,000,000,000
\$4,730,000,000

While significant funding has been put in place for the Connecticut passenger rail system from Amtrak, CTDOT and the NY MTA, significant funding for capital replacement/state of good repair is still needed and hasn't been identified.

Freight railroads have traditionally been supported by the states with abandoned rights of way acquired and 'banked' for potential future use. The state's ownership of 35% of the freight railroad infrastructure with leasing to freight operators is a significant financial support mechanism. In addition, freight railroads are allowed to substitute capital investments in lieu of income taxes.

#### SAFETY

After a turbulent safety record in 2013 for Metro-North Railroad Right-of-Way, many improvements have been made. A Federal Rail Agency conducted a "Deep Dive," of the safety record and identified a number of improvements that were needed. Two major items that from this report included the need to: (1) enforce speed limits (e.g. positive rail control) and (2) increase training and the testing of the rail infrastructure. MTA (MNR's parent entity) has continued to make safety a priority in the wake of this report. Efforts include implement-ing automatic speed control devices, installing new speed signs and upgrading the infrastructure testing equipment.

The first phase of signal system upgrade has been completed with the second phase to be upgraded within the next 10 years. The New Canaan branch and Danbury branch signals systems have been completed. The Waterbury branch signal system is targeted to be completed in 2020.

A number of at-grade crossings are still in place within the branch lines and the new Hartford Line corridor. Current practices include separating at-grade crossing and installing signal systems (signal gates) for vehicular traffic. From 2002 to 2011 there have been an increase in at-grade crossing accidents from 1 to 12 per year (Statewide including non-commuter traffic). A number of at-grade crossings are being upgraded with new signal gates on the Hartford Line. Operation lifesaver is implemented in Connecticut to reduce injury and fatalities through free education.

#### **RESILIENCE & INNOVATION**

Several items have been implemented in order to improve the resiliency of the State's rail. Power upgrades have occurred at the New Haven Rail Yard and the Walk Bridge in order to maximize resiliency. New projects must meet flood standard requirements.

Multiple projects have been undertaken in order to provide innovative solutions to the needs of the railroad. The New Haven Rail Yard has a new state of the art CCO (Component Change-Out Shop) facility for maintenance of the rolling stock. CTDOT has implemented improved project delivery methods including Construction Manager at Risk/Construction Manager General Contractor (CMGC). Other delivery innovations include 3-D engineering modeling, e-construction as well as design-build project delivery. One example of utilizing alternative delivery is the use of CMGC on the Walk Bridge replacement project which is expected to provide better oversight of costs for the duration of the project through design and construction. This procedure is designed to reduce risk to the Department and improve project delivery.



### **RECOMMENDATIONS TO RAISE THE GRADE**

The recommendations to further improve rail services and accomplish the goals include:

- Fund the major backlog bridge projects on the NEC.
- Increase funding for small bridges and track repair as noted by the NEC Reports.
- Adequately fund grade crossing safety improvement programs
- Continue the use of Alternative Delivery methods including CMGC.
- Consider alternative funding mechanisms including infrastructure bank, increased parking lots with ticketing, and/or Public Private Partnerships.
- Investigate ways to reduce costs including the electric costs of the catenary system
- Continue to support infrastructure modernization of freight railroads.



RAIL

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## ROADS

#### **EXECUTIVE SUMMARY**

Connecticut has over 20,000 miles of public roadways that form an important link, crucial for residents of the state and for connecting important commercial and industrial centers to

the east, west and north. However, more than half of the network is more than 55 years old and a majority of the roads are either in poor or fair condition. The condition of the road network is anticipated to further deteriorate if it does not receive significant investment. The combination of poorly maintained roads and congestion costs Connecticut road users approximately \$2.4 billion annually. It is anticipated that approximately \$30 billion will be needed to provide roadway facilities that would meet expectations of roadway users within 30 years. While some funding through bonds has been provided in support of the Let's Go CT plan, more is needed



to maintain the long-term solvency of the Special Transportation Fund, bolster the state's economic competitiveness, and improve the resdients' quality of life.

#### CAPACITY

Connecticut has the third busiest road network in the country. Congestion on the I-95 corridor from Stamford to Bridgeport, the I-91/ I-84 area of Hartford, as well as I-84 in Waterbury, are well known to residents. Congestion on Connecticut roads cost motorist an estimated \$2.4 billion in fuel, congestion and increased accidents due to deficient roadways. Commuters in the urban centers lose an average of 42.7 hours a year due to congestion. The average cost to individual motorists across the entire state is \$2,308 per year. The vehicle traveled miles (VMT) continue to increase. There was a 4% increase in VMT from 2000 to 2016; the



total VMT in 2016 was 32 billion. Fortunately, there are ongoing initiatives to improve commuter rail and bus ridership across the State.

Approximately 10% of State routes are over capacity and it is projected that in less than 20 years, 20% will be over capacity if the status quo is maintained. As stated in the Connecticut Department of Transportation in its Let's go CT! report, the "transportation system is at the brink of breaking, [and] aging infrastructure, traffic congestion, and long-delayed planning have placed the Connecticut economy and quality of life at risk..."

#### CONDITION

About 80% of Connecticut's major locally and state-maintained roads are in either poor (57%) or mediocre (22%) condition. 10% and 11% of the roads are in fair and good condition, respectively. The numbers are slightly different when urban and rural roads are considered separately. Rural roads are in a slightly better condition due to lesser traffic. In 2013, the higher-functional-class roads (Interstates and expressway) were in somewhat better condition (good or better condition) for approximately 70% of the length, while the secondary (non-NHS) routes were in fair or poor condition for approximately 57% of the length.

81% of the over 20,000 miles of public roads are maintained by cities and towns. CTDOT resurfaces about 250 miles of pavement annually and the State has increased road resurfacing funding over the past few years. Fortunately, as a result of this increased funding towards road resurfacing, pavement ride quality on state-maintained roads specifically have improved over the past six years; approximately 77% of the state-maintained roads had acceptable or better ride quality in 2016. The state-maintained network includes both NHS (National Highway System) and the state-maintained network. The distribution of pavement conditions along the roadway network within the three-major urban cites is almost consistent. Only 10% of roads in Bridgeport/Stamford, Hartford and New Haven urban areas are in good condition as shown in the adjacent figure.



More than half of the road network in Connecticut is over 55 years old. If the appropriate maintenance is not performed as roads continue to age, the overall condition of the network will deteriorate and will cost more to repair. The extreme variability in Connecticut's weather is one of the largest contributing factors to pavement deterioration. Traveling on rough roads cost Connecticut motorists \$2.2 billion annually (\$864 per motorist) in additional vehicle operating cost including tire wear, accelerated depreciation, repair cost and increased fuel consumption.

#### FUNDING AND FUTURE NEED

Connecticut roads are largely paid for by those who use them. The state assesses a gas tax of \$0.25 per gallon of gasoline and \$0.41 per gallon of diesel. In FY 2017, Connecticut collected \$484.5 million in taxes from motor vehicle fuels revenue. The gasoline tax has not been raised since 2000, while the diesel rate has not been raised since 2008. State fuel taxes are combined with federal and local funding to support projects across the state.

Funding will continue to be the Connecticut Department of Transportation's (CTDOT) most significant issue, especially considering the recent budget crisis and the anticipated future budgetary shortfalls. Historically, funds raised from transportation user fees have been allocated to the general fund, leading to chronic funding shortfalls for transportation projects. A constitutional amendment to prevent such practices is before voters in the November 2018 election.

As per the CTDOT Transportation Ramp-up Dashboard, historically, federal monies accounted for a significant portion of Connecticut's total capital transportation program. However, federal funds have been inadequate to maintain Connecticut's infrastructure in a state of good repair or to allow the state to do enhancement projects. These federal funds include various requirements, restrictions and processes that somewhat limits the State's ability to deliver projects easily and quickly.

The Governor has also proposed a 30-year \$100 billion plan, Let's Go CT! that outlines a plan to fund and improve Connecticut transportation infrastructure including roads, bridges, rail, etc. The estimated highway cost within this plan (not including bridges) is about \$30 billion. This 30-year plan includes a five year, \$2.8 billion "ramp-up" plan that focuses on improving the most critical infrastructure first. The ramp-up plan has been approved and enacted. Meanwhile, there have been modest increases in funding to invest in Connecticut's roads from the federal government, but the overall funds fall far short of what is needed. The following chart shows the funding trend through year 2020 for roadways and it also shows that role played by the ramp-up program. The proposed funding mechanisms include gas tax and tolls.



Connecticut's vehicle miles traveled (VMT) have grown 4% from 2000 to 2016 with a total of 32 billion vehicle travel miles in 2016. In addition, major private investments in Stamford and Bridgeport are attracting residents, as well as private investment for distribution centers in Connecticut. These investments will likely cause traffic to rise, increasing the impact of limited roadway capacity. A significant number of businesses and industry associations (42%) indicated that high traffic volumes and congestions on state roads hamper or limit growth of their market. Approximately 15% have considered relocating due to these concerns.

An optimization study conducted by CTDOT indicated that approximately \$5.5 billion (pavement cost and not total project costs) will be required to maintain the state of good repair and eliminate the percentage of roadway in poor condition over 30 years on all state-main-tained roadways. An additional \$8.6 billion will be required to improve and maintain ancillary asset such as guiderails, signs and signals.

#### **OPERATION AND MAINTENANCE (O&M)**

The Department has in recent years updated much of its fleet through a coordinated budget program. Generally, it is the Department's practice to not divert funds from new projects towards O&M needs. However, further updating of fleet and equipment is essential to adequately maintain the network and build capacity to meet future needs.

The condition of the network is a direct consequence of the amount of funding available. The state has increased funding for roadway maintenance over the past 10 to 12 years. An average of \$54.5 million was spent annually on resurfacing from 2005 to 2015.

During snow storms it is the Department's goal to have lanes cleared within four hours on limited access highways and within six hours on secondary roads. The state is currently challenged by staffing and equipment shortfalls and, more recently, budget cuts.

#### **PUBLIC SAFETY**

Connecticut can be proud of its relatively low fatality rate compared to the national average. Connecticut is ranked 9th lowest nationally, with a 2016 fatality rate of 0.98 fatalities per 100 million vehicle miles driven; the national average is 1.13. However, the fatality rate on Connecticut's non-interstate rural roads was 1.45 fatalities per 100 million vehicle miles. Thus, Connecticut's rural roads are more dangerous than the interstates, despite the latter's congestion.

The chart shows annual fatalities on Connecticut roads for last five years. It is estimated that roadway safety features are a contributing factor for approximately 33% of fatalities in Connecticut. "Traffic crashes in which roadway features were likely a contributing factor imposed \$1.5 billion in economic costs in 2015."



In order to manage traffic disruptions due to incidents, the CTDOT operates the State Farm Safety Patrol on major routes from 5:30 a.m. to 7:00 p.m. This free service offers assistance to drivers in need. The 2017 statewide seatbelt usage has reached an all-time high of 90.3%. The rate has increased from 89.4% in 2016.

The overall condition of signs on State expressways ranges from brand new to those approaching their service life as they are regularly updated and replaced before they exceed their service life. However, traffic signs on non-expressways could go unchanged for several years, exceed their service life and therefore provide poor reflectivity. This may be a contributing factor to the higher fatalities on non-interstate roads.

#### RESILIENCE

Connecticut is committed to addressing the threats that climate change and large storms pose after the devastating impacts of Tropical Storm Irene (Aug. 2011), the Halloween Storm (Oct. 2011) and Superstorm Sandy, (Oct. 2012) by making resiliency inherent in some of the design practices.

For instance, coastal and river-front communities were severely impacted by Superstorm Sandy in 2012. In response, the State of Connecticut established State Agencies Fostering Resilience (SAFR) who's charge included collaboration on a "Statewide Resilience Roadmap" and State policy on Disaster Resilience. SAFR has worked with impacted communities to prepare an application to the Department of Housing and Urban Development under the National Disaster Resilience Competition. Connecticut received \$57 million to be divided between a pilot project to provide innovative flood protection to a section of Bridgeport (\$50 million) and \$7 million available to other impacted communities to address local needs.

In addition, Connecticut has established the Connecticut Institute for Resilience and Climate Adaptation (CIRCA). CIRCA is a partnership between the UConn and CT DEEP, with a mission "to increase the resilience and sustainability of vulnerable communities along Connecticut's coast and inland waterways to the growing impacts of climate change on the natural, built, and human environment." Some of the proposed initiatives include "Resilient Transit Oriented Development" and "Resilient Corridors." There are ongoing efforts to ensure that Connecticut's major roadways are passable after extreme weather event such as a snow storm or a hurricane. Some of the steps taken by the CTDOT include:

- Extensive tree trimming and removal along major highways to reduce the possibility of trees falling onto the roadway and thereby delaying a return to normal traffic.
- Inspection of major drainage systems statewide and initiating projects as needed to mitigate substandard systems.
- Utilize NOAA Atlas 14 rainfall intensities for the design of storm sewer system
- Purchase of additional equipment to expedite clean up after a storm event.
- Maintain adequate shoulders on the roads for snow plowing.



#### INNOVATION

CTDOT continues to test new technologies, such as intelligent compaction, Class 14 asphalt concrete (which allows roadways to drain better in storms), use of polymer modified asphalt (that are more resistant to rutting), precast concrete pavement and develop improved paving details. CTDOT is participating in several Federal Highway Administration research and pooled fund studies. CTDOT is also testing new contracting methods such as design-build and construction manager at risk. Through the implementation of Smart Work Zones (SWZ), the CTDOT is aiming to improve safety of roadway users and work zone personnel, increase mobility in work zones and work zone traffic incidents. The CTDOT has implemented the smart work zone technology on some recent projects such as Charter Oak Bridge in Hartford, Arrigoni Bridge in Middletown, and I-84/Route 8 Bridge Rehabilitation in Waterbury.

CTDOT is in partnership with the University of Connecticut's, Connecticut Advanced Pavement Laboratory (CAP Lab), to perform state planning and research for the Department. One such project is the "Development of a Quality Management Plan for Pavement Condition Data in Connecticut." The objective is to develop a plan that will cover required quality assurance activities before, during, and after pavement condition data collection and processing. This plan will promote acquiring reliable, accurate, and complete pavement condition data and will address steps in dealing with data quality issues. Having pavement condition data that accurately represents the condition of the pavement network will improve CTDOT's ability to provide reasonable, timely, and reliable preservation and rehabilitation recommendations.



### **RECOMMENDATIONS TO RAISE THE GRADE**

- Implement innovative funding sources such as tolls or mileage taxes to generate additional funds that will be solely designated to transportation improvements.
- Establish a transportation funding lockbox that will eliminate the use of funds on spending/projects not related to our transportation infrastructure.
- Implement additional road use taxes for hybrid and electric vehicles.
- Implement a timely and consistent pavement preservation program.
- Implement congestion management techniques and transit/rail alternatives to extend the efficacy of the existing facilities
- Greater focus on resurfacing of rural roads will help improve the overall pavement condition ranking
- Focus on the overall system instead of a single project to ensure that the entire network is improved, and the needs of the entire system are met.
- Invite or promote private investment for upgrading the infrastructure
- Promote an effective asset management program
- Encourage performance-based investment strategies to ensure the highest return on investment.
- Implement the "Let's Go CT" program to increase safety, capacity and efficiency in the network.

Disclaimer: The CTDOT published its first Highway Transportation Asset Management Plan (TAMP) in July 2018. The information included in the TAMP report will be reviewed and considered for future version of the Connecticut State Report Card.



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## WASTEWATER

#### **EXECUTIVE SUMMARY**

Most of Connecticut is served by sanitary sewer systems; however, Connecticut has a wide variety of wastewater infrastructure. This infrastructure is aging and needs major repairs and rehabilitation. These improvements will require a \$4.6 billion investment eliminate sanitary sewer overflows. Robust planning is necessary to ensure that limited funds are used where needed most. Also of significant concern is the impact of increasingly severe storms on the state's wastewater infrastructure. Connecticut is home to almost 50 sewage plants that have been identified as at "high-risk" for flooding during major storms. Due to the tangible effects of climate change, wastewater facilities will need to be more resilient and take steps to address the impacts of increased flooding to maintain operation during extreme events.

### BACKGROUND

Connecticut is home to a wide array of both public and private wastewater infrastructure. This includes several types of collection and treatment facilities such as:

- sanitary sewer systems in both small and very large systems;
- combined sewer systems found in older cities;
- municipally-owned wastewater treatment plants (WWTP), which treat the waste collected from the sanitary sewer and combined sewer systems;
- private wastewater facilities;
- reclaimed water facilities, which utilize treated wastewater for non-potable uses;
- large, regulated sub-surface sewage treatment systems;
- several alternative treatment systems;
- and hundreds of thousands of private septic systems.

Regulatory oversight of wastewater facilities depends on the size and type of the facility. The Department of Energy and Environmental Protection (DEEP) regulates all facilities except sub-surface systems that produce less than 7,500 gallons per day (gpd); the Department of Public Health (DPH) oversees sub-surface systems between 2,000 and 7,500 gpd; and local health departments are responsible for those under 2,000 gpd.

#### **CONDITION AND CAPACITY**

The majority of Connecticut's population (66% in 2007) are served by sanitary sewers that carry wastewater to a WWTP. However, some of the larger older systems also collect stormwater runoff. These "combined sewer systems" were designed during a time when there was no treatment. It was considered economical to combine the wastewater and stormwater flows and discharge directly into a body of water to mix and dilute the flows. Combined sewer overflow (CSO) structures are located throughout the system to discharge to these local water bodies, and prevent back-ups of untreated wastewater into buildings or street flooding during heavy rains. These CSO's remained even as treatment was added, for emergency situations or due to a lack of adequate sewer pipeline capacity during rain events. Untreated wastewater can contain pathogens, chemicals, and high nutrients and are a public health and environmental concern.

Over time, these combined systems have become less able to handle sanitary flow during even small rain events, as system expansion and more impervious surfaces, such as parking lots, have increased the volume of runoff. These overflows happen more often. Over the years, Connecticut has made a concerted effort to control these overflows in most parts of the State. However, these projects tend to be expensive and complex. There are six remaining large sewer systems with CSOs in Connecticut and agencies are actively working to reduce and/or eliminate these flows where possible.

Raw sewage may also reach a body of water when the flows from the sewer system bypass to the WWTP. This may occur when the plant cannot handle the higher volume, such as from heavy rains, or due to equipment failure. Additional flow from rain or groundwater, called inflow and infiltration (I/I), can enter through cracks or defects in aging sewer pipes or from public and private inflow sources such as roof leaders and sump pumps. The result is a discharge of raw or partially treated sewage to a nearby water body, in the forms of CSO releases, sanitary sewer overflows (SSOs), and WWTP bypasses. The additional flow can also reduce the effectiveness of the treatment, which can contribute to increased levels of nitrogen and phosphorous in receiving waters and other water quality concerns.

Municipal systems are not the only ones adversely affected by high rain events and I/I. Sub-surface sewage treatment systems are generally not designed to handle these rain events. Higher groundwater levels during extreme wet weather may cause these systems to become flooded and untreated sewage to mix with groundwater and runoff on the surface. Moreover, a lack of maintenance of these sub-surface sewage treatment systems leads to failures.

#### **FUTURE NEED**

Many WWTPs have been in use for over 50 years and are either currently being upgraded or will soon need significant upgrades.

Many upgrades will be needed for further water quality improvements, such as nitrogen and phosphorous reduction, in addition to the continued work to reduce or eliminate SSOs and CSOs. The Environmental Protection Agency's 2012 Clean Watersheds Needs Survey ("CW Needs Survey") found that Connecticut will require over \$4.6 billion to maintain existing infrastructure over the 20-year period (2012-2031). By far the largest need is for improvements in CSOs communities at over \$2.9 billion. This survey has some limitations, as it does not consider privately owned wastewater facilities. The actual monetary need may be markedly higher.

#### **FUNDING**

As wastewater infrastructure is getting older and the need to undergo major rehabilitation is rising, it is increasingly difficult to find the needed money for these capital improvements. The Clean Water State Revolving Fund (CWSRF) program is by far the greatest source of financing for municipalities with its low-interest loans and grants. Since its inception in 1987, State and Federal funding for the CWSRF has made over \$3.6 billion available for municipal wastewater infrastructure projects through June 30, 2017.

Connecticut is home to almost 50 sewage plants that have been identified as at "high-risk" for flooding during major storms. This is a challenge that state lawmakers have taken seriously. For example, in 2015, legislators approved \$378 million in low-interest loans and grants for municipalities looking to harden their wastewater infrastructure against major storms. Lawmakers approved an additional \$20 million for projects to preserve wetlands and dunes along the shoreline, to better protect wastewater and other infrastructure.

While the State has demonstrated a commitment to improving wastewater systems and water quality, funding will still be needed well into the future. Most recently, the 2018-2019 state budget has provided significantly less funding than requested for through the CWSRF program. This will have a major impact on the progress in addressing sewer overflows, water quality concerns, and aging infrastructure.

Municipalities rely on sewer rates and/or fees to fund and finance necessary improvements to wastewater infrastructure. These rates can vary widely across the state. In their 2016 Connecticut Sewer Rates Survey, the engineering firm Tighe & Bond found the average annualized sewer costs of the rate structures reported was \$472, with the median at \$401, a low of \$130 and high of \$1,469. Only 14% of respondents had increased rates since the previous survey in 2013. In some cases, voter approval was needed for increased rates due to the high costs of the infrastructure improvements. Asset management planning can help systems understand the full cost of the service and help in the evaluation if they need to increase their rates.

#### **OPERATIONS AND MAINTENANCE**

Connecticut has several regulations to address Operations and Maintenance. The Operator Certification requirements mandate each WWTP to have certified operators in charge of the plant. Recent Federal law now requires that projects funded by the CWSRF be evaluated for cost effectiveness; maximize the potential for efficient water use and energy conservation in the design; and consider the costs of construction, operation and maintenance, and future replacement. Funding recipients must also develop and implement a fiscal sustainability plan (FSP). The FSP must inventory critical assets and their condition and performance. In addition, the plan must include a strategy for maintaining the assets and future needs of WWTP facilities and funding for these needs, similar to an asset management plan.

#### **PUBLIC SAFETY**

The greatest risk to public safety associated with wastewater is the risk to public health when a wastewater treatment system releases untreated sewage, either through an overflow, a back-up into a home or business, or bypass of a WWTP. These bypass flows can be

significant enough to close access for beach and boating if the water quality is tested and found to have high bacteria levels.

Nutrients such as nitrogen or phosphorous in wastewater can also cause harm to the environment. Excess nitrogen from human activities has been identified as the primary pollutant causing hypoxia in Long Island Sound. For many years, Connecticut has actively worked to reduce the total maximum daily amount that ends up in the Sound, with the help of funding from the CWSRF. Signs of improvement in hypoxia are evident, but more reduction in nitrogen is still needed to attain a healthy Long Island Sound.

Excessive amounts of phosphorous negatively affect both aquatic life and recreational uses in water resources and may originate from WWTP discharges as well as urban and agricultural runoff. Polluted water can lead to noxious algae blooms, cyanobacteria, habitat alteration, and aquatic life impairments. A Connecticut State law required the development of a state-wide strategy to reduce phosphorous loading in inland non-tidal waters; the final report with recommendations was released in February 2017. National Discharge Elimination System (NPDES) permits limit the levels of phosphorous that can be discharged from WWTPs. A number of WWTP are actively working on upgrade projects to reduce phosphorous discharges. Pollution prevention along with education and outreach efforts will also help.

#### RESILIENCE

The increasing severity of storms and extreme weather conditions have reinforced the need for consideration of climate adaptation. Many WWTPs are located at lower elevations since they maximize the use of gravity to bring the wastewater through the sewer system to the plant, as well as to use gravity to treat the wastewater.

This was evident during Superstorm Sandy, when the storm surge caused two treatment facilities in Bridgeport to release more than 19.5 million gallons of partially treated sewage into the Long Island Sound. Overall, the October storm resulted in overflows from 17 wastewater treatment plants and sewer systems along the shore.

In order to mitigate impacts of major storms, future state-funded projects must follow minimum flood protection levels, and all new or rehabilitated wastewater infrastructure must be designed to provide uninterrupted operation and be protected from physical damage during a 100-year storm. Certain critical activities may need to consider the 500-year flood elevation. The Federal Emergency Management Agency (FEMA) has recently updated the 100 and 500-year flood elevations and facilities need to be upgraded to meet the updated elevations.

Since 2013, state law requires the CWSRF consider the necessity and feasibility to implement measures designed to mitigate the impact of a rise in sea level over the projected life span of a facility. In 2015, the Governor established a permanent Council of State Agencies focusing on the State's resiliency in extreme weather events, covering all types of infrastructure. This group will identify factors to consider for various State planning efforts.

The CWSRF also requires WWTPs to conduct energy audits and assess the risk to existing infrastructure from climate change and evaluation of alternatives for corrective actions.

#### INNOVATION

As additional pollutants are identified as harmful to humans and the environment, new or enhanced treatment processes or other mitigation measures will be needed to address them. These include stricter effluent limits for metals, control of pharmaceuticals and personal care products, and adaptations to address climate change and sea level rise.

Improvements to existing treatment techniques will always be explored through the increased investigation of cost-effective options. In addition, the CWSRF program encourages "green" infrastructure, which uses vegetation, soils, and natural processes to manage stormwater. Innovative approaches can be effective in addressing the water quality impacts of wet weather events by reducing polluted stormwater discharges and sewer overflows.



### **RECOMMENDATIONS TO RAISE THE GRADE**

- Increase funding to help wastewater systems address needed repairs, rehabilitations, or replacements before the infrastructure fails.
- Increase funding to complete the mitigation of combined sewer overflows and elimination of sanitary sewer overflows.
- Increase funding to continue to address water quality concerns and maintain progress in reducing levels of nitrogen and phosphorous in the effort to improve water quality and the environment.
- Implement full cost of service rate structures to help wastewater systems address needed repairs, rehabilitations, or replacements before the infrastructure fails.
- Maintain a knowledgeable and well-trained wastewater treatment plant operator workforce by promoting these jobs and expanding training opportunities.
- Identify wastewater facilities that are vulnerable to extreme weather events and identify measures to ensure that those facilities can maintain continuous operation.
- Ensure research continues to identify potentially harmful contaminants in wastewater and the means to remove them.
- Increase funding to complete infiltration and inflow investigations within the sewer collection system.
- Use Asset Management to better maintain existing infrastructure and do proactive and preventative maintenance.



WASTEWATER

BYPASS – the diversion of wastes from any portion of the wastewater collection or treatment facilities.

SANITARY SEWERS – pipes that carry wastewater from homes and businesses (i.e. wastewater from toilets, laundry, bathing, dishwashing).

STORM SEWERS - pipes that carry rainwater or melted snow from storms.

COMBINED SEWERS - pipes that are designed to carry both sanitary and stormwater flow.

STORMWATER – rain or melted snow that washes off streets, parking lots and other surfaces.

HYPOXIA – a condition of low dissolved oxygen concentrations in the waters of Long Island Sound that impacts up to half of the Long Island Sound's waters each summer.

WASTEWATER TREATMENT PLANT (WWTP) - a facility that receives wastewater (and sometimes stormwater) from domestic and/or industrial sources, and by a combination of physical, chemical, and biological processes, removes contaminants from the wastewater.

INFILTRATION – groundwater that seeps, trickles, or flows into old or leaky sewer collection pipes and manholes from the surrounding soil.

INFLOW – stormwater that flows into sewer collection systems from sources such as catch basins, manhole covers or private residences with stormwater drains, sump pumps and/or roof leaders connected to the sewer system.



### SOURCES

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- Environmental Protection Agency Clean Watersheds Needs Survey (www. epa.gov/cwns)
- Tighe & Bond 2016 Connecticut Sewer Rates Survey (https://www.tighebond. com/category/rate-surveys/)



The Connecticut Society of Civil Engineers is a professional society dating back to 1884. We are the local branch of the American Society of Civil Engineers. Members are civil engineers working in many different capacities, including designers, contractors, facility managers, town and state engineers, and in many different disciplines, including structural, geotechnical, hydraulic, environmental, survey engineering. We all share a common passion for designing, building and maintaining the structures and systems that allow our society to function. At monthly meetings we discuss topics that cover the gamut of civil engineering. We host day-long seminars to allow members to learn new methods and industry trends. We support the student chapters at the civil engineering schools in the state. We close out our year's activities by honoring the individuals who have distinguished themselves in their profession and firms who have completed projects that have enhanced our state and advanced our profession.

