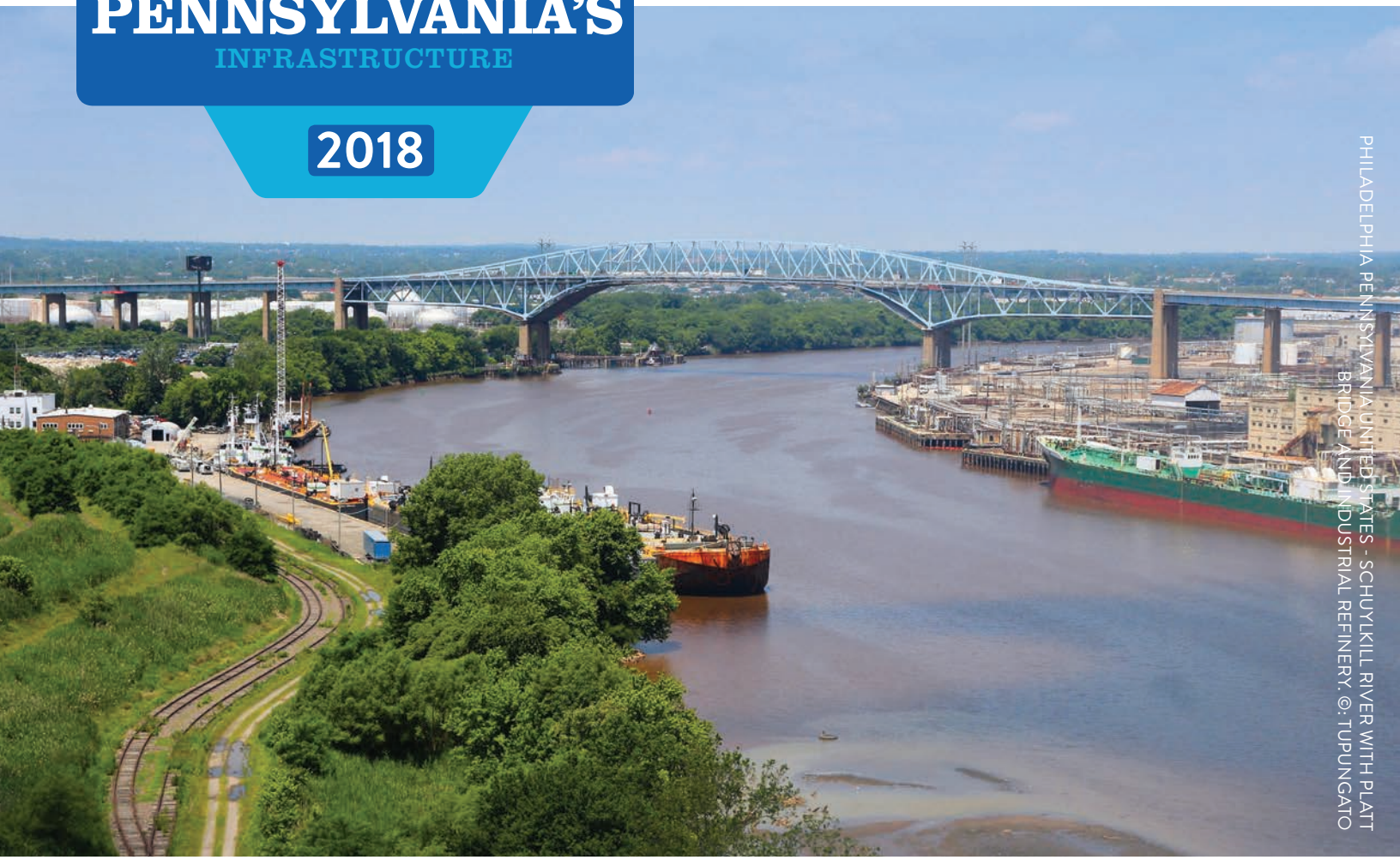
REPORT CARD FOR PENNSYLVANIA'S INFRASTRUCTURE

2018



PHILADELPHIA PENNSYLVANIA UNITED STATES - SCHUYLKILL RIVER WITH PLATT BRIDGE AND INDUSTRIAL REFINERY. ©: TUPUNGATO

Pennsylvania State Council of the American Society of Civil Engineers

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EXECUTIVE SUMMARY

The Pennsylvania State Council representing the Central Pennsylvania, Lehigh Valley, Philadelphia and Pittsburgh Sections of the American Society of Civil Engineers (ASCE) present the *2018 Report Card for Pennsylvania's Infrastructure*. Civil engineers hold paramount the safety, health and welfare of the public. To help serve the public, the Pennsylvania Council has created this report card to help educate Pennsylvanians of the status of the state's infrastructure so that the public, in conjunction with elected officials, can make educated decisions on how to prioritize funding to meet current and future needs of the Commonwealth. This report card also makes recommendations to infrastructure owners and civil engineers on how improve our state's infrastructure.

In the past four years since the *2014 Report Card for Pennsylvania's Infrastructure*, legislative support for infrastructure, public agency planning and a thriving economy have had tangible improvements in the status of several pieces of infrastructure in Pennsylvania. Examples of these improvements since 2014 include but are not limited to:

- The advancement of 2,600 transportation projects into construction as a result of Act 89 funding improving Roads to a D+;
- The construction of two new levee systems with 12 new systems/rehabilitations under design as a result of increased funding moving levees to a solid C; and
- The implementation of a program to replace 558 bridges in poor condition through the use of a public-private partnership which showed great effort towards addressing the state's numerous bridges in poor condition.

These improvements demonstrate the impact that increased funding, the right leadership, and strategic planning can have on our infrastructure. However, despite three categories' letter grades improving since the 2014 Report Card, 11 categories' letter grades have remained unchanged and two grades have declined with the following opportunities for improvement:

- As the state with the most combined sewer overflows, billions of gallons of untreated sewage enter into our streams every year and is reflected through Stormwater's downgraded letter grade and Wastewater's D- grade.
- Pennsylvania's aging drinking water mains saw an over 40% increase in breaks contributing to a D grade.
- Extended age and lack of consistent funding have allowed the condition of inland waterways to deteriorate to the point that watercraft locks and dams have become severely impeded, upwards of 220 hours of delay for a for single vessel, downgrading Inland Waterways grade to a D.

The *2018 Report Card for Pennsylvania's Infrastructure* gives the Commonwealth an overall grade of C-, which reflects that Pennsylvania has some of the oldest infrastructure in the country, and improvements continue to be needed. Unfortunately the 2018 overall grade of a C- reflects the same letter grade as the *2014 Report Card for Pennsylvania's Infrastructure*, indicating that while some aspects of our state's infrastructure have improved, others have degraded. Much of Pennsylvania's infrastructure continues to serve well beyond its intended lifespan and has deteriorated. All Pennsylvanians—citizens, agencies, and policy makers—need to decide if they value the personal and economic benefits of a robust infrastructure network. If the answer is "yes", they need to make infrastructure improvement a top priority. Solid infrastructure keeps Pennsylvanians safe and prosperous.

For more information on the *2018 Report Card for Pennsylvania's Infrastructure* visit www.pareportcard.org, www.infrastructurereportcard.org/Pennsylvania or email reportcard@asce.org.

2018 REPORT CARD FOR PENNSYLVANIA'S INFRASTRUCTURE

GRADING METHODOLOGY

The *2018 Report Card for Pennsylvania's Infrastructure* was written by a committee of over 75 civil engineers from Pennsylvania 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?

A BRIDGE OVER THE SUSQUEHANNA RIVER IN HARRISBURG PENNSYLVANIA. ©: CEW

GRADING SCALE

A — 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.

B — 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.

C — 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.

D — 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.

F — 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.

RECOMMENDATIONS TO RAISE THE GRADE

As Pennsylvania residents, agencies and policymakers work to improve our infrastructure, ASCE Pennsylvania offers suggestions to start raising the grade. Each category graded in this Report Card gives specific recommendations for achieving a higher grade. In general, each of those recommendations can be summarized into the following priority actions:

- Act 89 provided meaningful funding for our transportation infrastructure and we are beginning to see results. However, our needs are enormous. **ASCE encourages all of Pennsylvania's 67 Counties to take advantage of the Act 89 provision empowering revenue collection at the local level.** Counties across the Commonwealth must join with their state counterparts and bring new revenue to the table to support our transportation infrastructure across multiple modes of transportation. The backlog of deferred maintenance is particularly pressing our transit and passenger rail systems, and counties have an obligation to provide part of the necessary funds to bring those systems back to a state of good repair.
- Unlike many of our bridges, roads and ports, our water systems are owned and operated by local authorities and agencies. These entities must prioritize the maintenance and replacement of our aging water systems. Our drinking water, wastewater, and stormwater grades were among the lowest in the 2018 Report Card. In some places, pipes are over 125 years old, recreational facilities are closed due to contamination from combined sewer overflows, and we're facing enormous stormwater management needs to meet increasingly stringent regulatory requirements and mitigate decades of harm to our receiving waters. Building, replacing, and updating water infrastructure will require leadership to plan new approaches and improve upon the existing conditions. This will take significant capital, but finding sufficient funding is critical to protecting our public health. **We should encourage and support the passage of legislation to encourage localities to align user fees with the true cost of treating, delivering and managing water and wastewater.** Relief for these rate increases should be provided to low income populations whenever possible.
- Those responsible for building, maintaining, and improving Pennsylvania's infrastructure should take a strategic approach to planning for the future. We must be flexible as demographics shift and ensure cities have the resources to accommodate growing populations. Rural communities must have sufficient support to ensure public health and safety. We need to approach existing problems in new ways, such as public private partnerships (P3s), to pay for additional highway lanes, or connected and autonomous vehicles to increase capacity. Preparing for the future must also involve collaboration and partnership during the migration of new technologies to the infrastructure networks. **Lawmakers should provide funding for research, development and deployment; engineers should continue to ensure the safety of the traveling public; and private industry should have a seat at the table as decision makers explore the ramifications of new technology.**

2018 REPORT CARD FOR PENNSYLVANIA'S INFRASTRUCTURE

Aviation **C+**	Bridges **D+**	Dams **C**	Drinking Water **D**
Energy **C**	Freight Rail **B**	Hazardous Waste **B-**	Inland Waterways **D**
Levees **C**	Parks & Recreation **B-**	Passenger Rail **C-**	Ports **C+**
Roads **D+**	Schools **C-**	Solid Waste **C+**	Stormwater **D**
Transit **D**	Wastewater **D-**	GPA **C-**	

AVIATION

C+

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AVIATION

EXECUTIVE SUMMARY

Airports in Pennsylvania are a critical element of the overall transportation network in the region. Generating over $10 billion in annual payroll and over $28 billion in output, aviation serves as a key economic generator, crucial to maintaining Pennsylvania's global competitiveness, and a safety and security asset for its citizens. With a good history of funding, Pennsylvania is developing a modern and safe aviation network, and multi-billion dollar investments are underway in Philadelphia and Pittsburgh that will benefit 90% of enplaned passengers in the state. Both challenges and opportunities remain, particularly with resiliency improvements, the need for consistent funding, and opportunities to develop both hangar and air cargo facility capacity to support growth and a changing economy.

BACKGROUND

Pennsylvania ranks 11th in the country in the number of public-use aviation facilities with 128 airports, heliports and seaplane bases with an annual economic impact of $23.6 billion to the Commonwealth. Of these 128 facilities, 113 are considered general aviation without scheduled airline service, typically servicing private and corporate aircraft. The aviation industry also supports more than 300,000 jobs making it one of the largest employment sectors in Pennsylvania.

In 2016, about 40 million passengers used Pennsylvania's 15 commercial service airports, accounting for 5% of all domestic traffic, with Philadelphia International Airport (PHL) serving over 30 million passengers.

Pennsylvania moved over half-a-million metric tons of air cargo in 2016, representing less than 2% of the overall domestic market. Two Pennsylvania airports, Philadelphia (PHL) and Pittsburgh International Airport (PIT) rank in the Top 50 cargo airports in North America by tonnage. The Pennsylvania Bureau of Aviation is a funding and regulatory agency only; they do not own the airports. As a result, there is little asset management data collected across the state.

CONDITION & CAPACITY

Airport infrastructure within the Commonwealth can be covered primarily in the following categories: buildings and airside pavement.

Building Condition

For the commercial service facilities in Pennsylvania, terminal facilities are generally in good condition. Currently, there are numerous airports where new terminal buildings have been constructed within the past 20 years, or where major improvements have been made in the past 10 years. Both PHL and PIT have major terminal modernization programs underway including PHL's program that in 2017 authorized nearly $370 million to building facilities.

However, there is a major shortage of hangars in the surrounding metropolitan areas, and many of the existing hangars are in poor condition. At both commercial service and general aviation smaller airports, new building codes and local share match requirements can make new construction onerous, resulting in deferred new construction. There is a major need for new hangar construction or for hangar improvements throughout the Commonwealth.

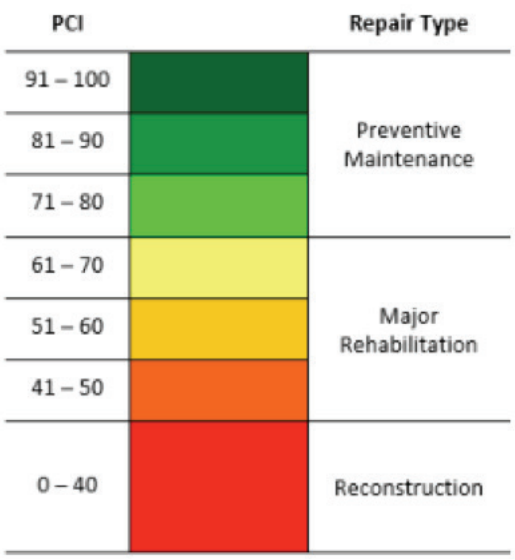
Airside Pavement Condition

In 2016, the PennDOT Bureau of Aviation completed an update to their Statewide Pavement Management System Plan. As a part of this project, their consultant team looked at Airfield Pavements on all public use facilities. The condition of airfield pavements was rated based on the Pavement Condition Index (PCI) and suggested repair types shown in Figure 1. A lower rating generally requires more extensive, and costly, repairs.

The Study found the following conclusions:

- Runway pavement surfaces have an average age of 16 years. Taxiway pavements had an average age of 19 years, and apron pavements had an average age of 23 years. The typical life cycle of an asphalt pavement is 20 years, and for a concrete pavement is 30 years.
- Generally, commercial service airports require a moderate amount of major pavement rehabilitation (PCIs ranging from 56-83 with the majority in the 60s).

FIGURE 1: SUGGESTED AIRFIELD REPAIR TYPES BASED ON PAVEMENT CONDITION INDEX



- Smaller general aviation airports were slightly better (PCIs ranging from 60-85 with the majority in the 70s) and generally require preventative maintenance measures to extend pavement service life.
- The pavement condition of both commercial service and general aviation airports has decreased slightly between 2008 and 2016. This trend will need to be reversed in order to prevent significant service interruptions and extensive repairs in the future.
- Most airports have a pavement maintenance program in place, capable to perform less complex maintenance efforts.

There has been a focus on obstruction removal and mitigation. This activity identifies and removes or otherwise mitigates physical penetrations of protected airspace (such as buildings and trees), an important, but costly, safety initiative.

Since 2014 although there has been fluctuation of enplanements, or passenger boardings, at public airports throughout the state, overall the number has maintained as shown in Figure 2.

FIGURE 2. COMPARISON OF ENPLANEMENTS.

City	Airport Name	CY 17 Enplanements	CY 14 Enplanements	% Change
Philadelphia	Philadelphia International	14,271,232	14,792,339	-3.52%
Pittsburgh	Pittsburgh International	4,327,431	3,827,860	13.05%
Harrisburg	Harrisburg International	582,287	644,048	-9.59%
Allentown	Lehigh Valley International	328,912	298,306	10.26%
Avoca	Wilkes-Barre/Scranton International	261,572	214,805	21.77%
Latrobe	Arnold Palmer Regional	151,207	128,415	17.75%
State College	University Park	138,423	142,551	-2.90%
Erie	Erie International/Tom Ridge Field	85,628	97,063	-11.78%
Williamsport	Williamsport Regional	18,321	24,686	-25.78%
Bradford	Bradford Regional	3,897	2,019	93.02%
Brookville	Dubois Regional	3,888	4,081	-4.73%
Johnstown	John Murtha Johnstown-Cambria County	3,594	4,856	-25.99%
	Summary	20,176,392	20,181,029	-0.02%

Only PHL currently exhibits persistent airfield capacity constraints, particularly during inclement weather. PIT exhibits sporadic parking, security and other landside function constraints. Both airports have announced and are in the process of delivering large capital programs to address these constraints. No other airports in Pennsylvania are known to exhibit any capacity constraints, including airspace, runway or terminal capacity.

FUNDING

For commercial service airports willing to take on debt, various forms of municipal bonds are available to fund certain capital improvements. For all other airports, Federal, state and local sources of revenue and financing are used to maintain, improve and operate airports in Pennsylvania. Airports currently are able to raise funds by charging passenger facility charges (PFCs) up to the current Federal cap of $4.50 per passenger. These fees can be used to make facility improvements but have a restrictive limit on funding commercial service airports.

Another source of infrastructure funding comes from the Federal Aviation Administration (FAA) and their Airport Improvement Program (AIP) including:

- Entitlement Funding – Commercial Service Airports with greater than 10,000 annual enplaned passengers receive a minimum of $1,000,000 annually. Commercial Service Airports with less than 10,000 enplaned passengers and all general aviation airports receive $150,000 annually.
- State Apportionment Funding – Each State receives a certain amount of funding from the AIP that the FAA can use to fund projects in that State based on each State's population and area.
- Discretionary Funding – All public airports compete for Discretionary Funding.

The past five years of AIP Funding for Pennsylvania has ranged from $59 million to $83 million.

PennDOT's Bureau of Aviation has three additional sources for aviation funding:

- Aviation Development Grant Funding – Derived from the aviation fuel tax
- Capital Budget Grant Funding - Authorized by the state Legislature from the General Fund.
- Multi-Modal Funding – Via Act 89 of 2013, a minimum of $6 million is annually set aside for Aviation.

Challenges to funding derive primarily from the delays in Federal transportation funding, relying on congressionally-authorized continuing resolutions in lieu of multi-year AIP reauthorizations, and lack of local or state match to encumber Federal funding.

Due to budgeting disagreements with the Pennsylvania State Legislature in 2017, no Capital Budget Grant Funding was released. This $10 million shortfall especially impacts the funding of General Aviation hangar development.

The growth of air cargo in the region has also created a demand for updated and expanded facilities across the state. Several airports have planned air cargo expansions but lack the funding to develop this infrastructure, impacting a region's competitiveness in the growing logistics and air cargo industry.

FUTURE NEED

The PHL Capacity Enhancement Program and the PIT Terminal Modernization Program address short-term future needs via large, multi-year capital investments. Through the realization of these programs, the capacity and safety needs of the two largest airports in Pennsylvania will be addressed.

A number of the other commercial service airports have recently invested in terminal replacements and expansions as well as safety and capacity projects to address airfield shortfalls. These projects are in various stages of completion, from planning and environmental approvals to complete and activated.

Beyond the identified demand for hangars and cargo facilities, and normally programmed safety and maintenance funding, including airfield pavement maintenance programs, no other funding needs have been identified.

PUBLIC SAFETY

In the past several years, the FAA has focused on obstruction removal and, as a result, many airports have lost their nighttime approaches until obstruction mitigation is achieved. Pennsylvania has made good progress in improving air space safety through obstruction mitigation, but funding for other infrastructure improvements to airfield pavements, hangars and small general aviation facilities have lower priority and delayed implementation.

Recently, the sole supplier of Engineered Material Arresting Systems (EMAS), the system of collapsible concrete structures that safely stop aircraft that run off the end of runways, announced that they are no longer going to make new or replacement blocks for EMAS. There are two EMAS installations in Pennsylvania. If something should happen to either one of those installations, there is currently not a plan in place as to how the installation could be repaired.

Pennsylvania airports have an excellent safety record. While there have been accidents, some of which have resulted in fatalities, none have been as a result of an unsafe infrastructure condition at the Airport. Safety improvement funding has the highest priority for both FAA and State Funding, and there has been a focus on improving safety at all Pennsylvania Airports.

RESILIENCE

The need for resilient airports will continue to increase as these facilities serve a critical relief mission during inclement weather, as well as natural and man-made disasters. Many Pennsylvania airports are used by first responders for police, fire and medical units in emergencies.

A large number of commercial and general aviation airports in Pennsylvania are susceptible to the development of sinkholes where limestone geology is prevalent. When these occur, damage to facilities can render airports inoperable. For many general aviation airports, securing funding and completing the repairs in a timely manner is very challenging. In addition to safety concerns, this can impact a locality's economy and businesses' ability to meet commitments.

Frequent flooding and other naturally occurring events have similar impacts to many Pennsylvania commercial and general aviation airports. The ability to access emergency funding or rapid low- or no-interest loans would improve the resiliency of Pennsylvania's airports.

INNOVATION

There are many new technologies that will impact aviation in the immediate and near future. Changes to air traffic control, including the implementation of the Next Generation Air Traffic Control System (NextGen), will open the skies to additional capacity but will require additional investment. Advancements in security screening of passengers and cargo will speed travel and delivery once infrastructure can accommodate these new technologies. Automated and connected vehicles will alter the way many passengers use commercial service airports, changing landside facility capacity demands and parking revenue streams.

These technology disrupters can and will drive improvements to aviation including service, resiliency, safety and security, and operational costs. Like many advancements, the cost and timing of adoption will be a challenge within current regulatory and funding structures.

RECOMMENDATIONS TO RAISE THE GRADE

- Increase the number of hangars for general aviation activity near metropolitan areas.
- Remove the federally-imposed cap on Passenger Facility Charges (PFCs) to allow airports a tool to prioritize and invest in their own facilities.
- Explore third-party funding such as privatization, public-private partnerships and other alternative funding mechanisms to help increase the amount of funding available for the state's vital aviation assets. This could be particularly useful to meet the demand for hangars and air cargo facilities in the state.
- Consider benchmarking the aviation fuels tax to inflation, the consumer price index or other appropriate economic factors.
- General Aviation funding from the State Legislature, through Capital Budget Grant Funding or other means, should be secured in a more consistent and predictable manner to improve funding at these facilities.
- Identify a replacement product for EMAS to protect air operations at facilities employing this technology.

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BRIDGES

D+

DOWNTOWN RIVER WATERFRONT AND YELLOW BRIDGES CROSSING THE ALLEGHENY RIVER IN PITTSBURGH, PENNSYLVANIA. ©: TREKANDSHOOT

BRIDGES

EXECUTIVE SUMMARY

Of Pennsylvania's more than 22,779 highway bridges – the ninth largest inventory in the nation – 18.3% (4,173 bridges) are classified as being in poor condition, down from 24.4% in 2014. On average, Pennsylvania's bridges are 15 years older than the national average and continue to be in need of repair and modernization. The additional funding from Act 89 passed in November 2013 has brought much needed investment to the transportation system, but more work needs to be done. While there have been many improvements over the past four years, Pennsylvania's bridge asset managers still face several challenges, and Pennsylvania has more than double the national average of bridges rated in "poor" condition.

BACKGROUND

In the Commonwealth of Pennsylvania, over 8 million drivers travel across our bridges every day. There are numerous bridge owners, with the majority of Pennsylvania's bridges owned by PennDOT. The remainder are owned by County, Township, and City Highway Agencies as well as the PA Turnpike Commission and authorities like the Delaware River Port Authority in Philadelphia who own signature bridges such as the Benjamin Franklin Bridge and the Walt Whitman Bridge. The National Bridge Inspection database was used as the basis for the bridge condition statistics discussed in the Bridge category. It should be noted that bridges that only carry rail traffic are not included in the Bridge category; however, bridges that carry both highway and rail traffic are considered.

CAPACITY AND CONDITION

Pennsylvania has 22,779 highway bridges currently in its inventory, ranking ninth in the nation; this includes state, local, city, commission and authority-owned bridges. Based on the 2017 National Bridge Inventory data, 18.3% (4,173 bridge) of Pennsylvania's bridges are classified as being in poor condition, more than double the national average. This percentage represents a significant decrease from the *2014 Report Card for Pennsylvania's Infrastructure*,, in which 24.4% (5,539 bridges) of Pennsylvania's bridges were classified as being in poor condition (see Figure 1). Since January 2015, 2,086 state-maintained bridges have been restored to good condition, for a net total of 819 more state-maintained bridges in good condition since Act 89 passed. The number of statewide bridges in poor condition has dropped by 1,044. However, this does not include the 245 bridges that are currently closed statewide.

While Pennsylvania has made significant gains over the past four years, bridges across the state were in worse condition than much of the rest of the nation before Act 89, and we are still playing catch up. The state ranks second based on the number of poor bridges and fifth based on the percentage. Bridge age continues to be a major concern as well. Much of Pennsylvania's infrastructure was built prior to the 1960s, resulting in an average bridge age of 58 years, compared to the national average of 43 years. When looking only at bridges in poor condition, the average bridge age increases to almost 80 years, well beyond the intended service life.

FIGURE 1:
PERCENTAGE OF BRIDGES CLASSIFIED AS POOR CONDITION

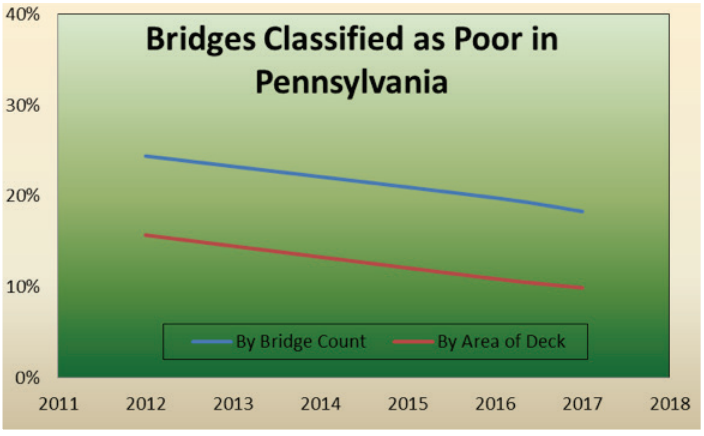
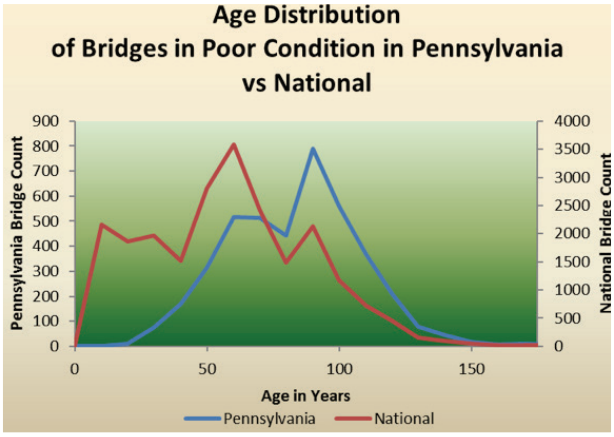


FIGURE 2: DISTRIBUTION OF BRIDGES IN POOR CONDITION COMPARED TO AGE (PENNSYLVANIA COMPARED TO NATION)



The Commonwealth's bridges are inspected a minimum of every other year and assigned numerical condition ratings based on the observed condition of the bridge's components such as beams, deck slab, abutments, and piers to define their physical condition. If the bridge components exhibit high levels of deterioration, the bridge is classified as poor condition. While not unsafe, without extensive maintenance, these bridges need to be inspected more frequently and may ultimately require costly rehabilitation or even replacement.

FUNDING AND FUTURE NEED

Funding for bridges comes from a variety of federal, state, local and private sources.

The Commonwealth collects funds to supplement federal spending on transportation. The state legislature passed Act 89 in November 2013 that increased the tax on fuel to counteract decades of infrastructure underinvestment (See Figure 3). Act 89 enhances collections from the Commonwealth's primary funding source, the Motor License Fund (MLF), via liquid fuel taxation, vehicle registration and driver's license fees, and traffic fines. Meanwhile, the Pennsylvania Turnpike, Delaware River Port Authority and the Delaware River Joint Toll Bridge Commission use tolling revenue for infrastructure needs. Locally, one-third of counties have imposed an additional $5 fee on vehicle registrations that directly supports local road and bridge projects. The additional revenue has been helpful to these counties and consideration should be given to expanding upon this with a regionally based approach to help fund transportation infrastructure. The remaining counties in the state should consider taking advantage of this opportunity to create an additional funding revenue stream for its infrastructure.

To stretch infrastructure funding, alternative project delivery methods are effective, including Contractor Design/Build and Public Private Partnerships (P3). Pennsylvania's Rapid Bridge Replacement (RBR) Project, an $889 million Design/Build P3 to replace and maintain 558 bridges statewide, has received national recognition as the first multi-asset bridge bundling package of this magnitude. Lessons can be learned from RBR regarding contracting, administration, and the delivery of the project. Anticipated life cycle cost savings exceeds $300 million while significantly reducing construction duration versus conventional project delivery methods. Counties have also implemented bridge bundling techniques for economy of scale through design efficiencies and lower construction costs.

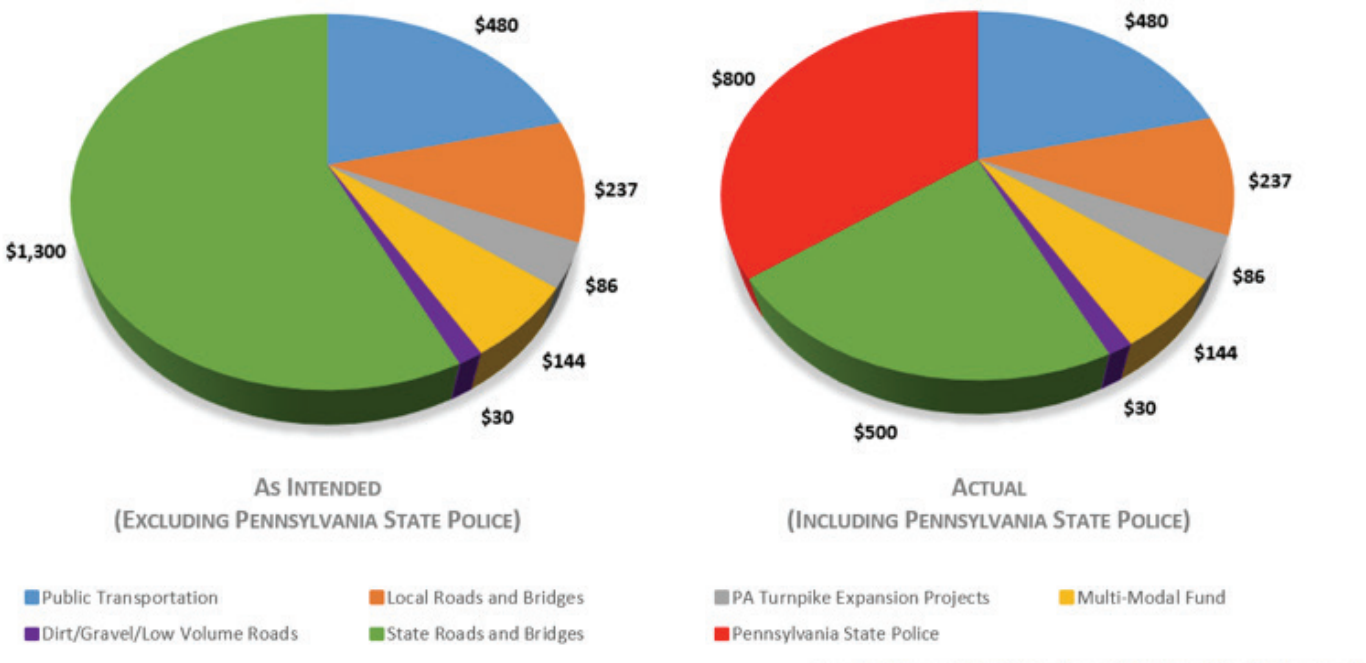
Act 89's original intent was to generate infrastructure funding, however the Pennsylvania State Police (PSP) receives over $800 million annually from the state bridges sector of the MLF. A 2017 study concluded PSP highway patrol services equate to only $533 million, implying the PSP utilize $267 million for non-transportation services.

In 2016, to increase the amount of funding available for transportation efforts, administrative action was proposed to cap the expenditures from the Motor License Fund going toward the PSP budget. Action on this has not yet been taken and is still being discussed. If the expenditures can be capped, it would direct more resources toward Act 89's Decade of Investment projects to be completed by 2028.

In 2018, the Commonwealth estimated $7.7 billion in bridge repairs. This total "needs" number has decreased by $1.9 billion from 2014. Excluding the RBR Program which accounted for 25% of total bridges replaced between 2015 and 2017, Pennsylvania reduces the number of poor condition bridges on average by 150 annually. Under current funding, it would take 13 years to reach the national average of poor condition bridges. If the annual PSP appropriations were to be reduced to $533 million, then Pennsylvania would achieve the national average of poor condition bridges twice as fast in only seven years.

With respect to maintenance, PennDOT and the Pennsylvania Turnpike Commission have both funded budgets dedicated to routine maintenance, though neither specifically distinguish between general highway and bridge maintenance. Local bridge maintenance remains underfunded, and routine maintenance items are often deferred until bridges are weight restricted, closed, or emergency repairs are made. In 2017, Governor Wolf's administration announced the $2 billion Road Maintenance and Preservation (Road MaP) program, which focuses investment on maintenance projects. Since 2014, PennDOT has increased focus on local bridges with a portion of their annual budget dedicated to local bridge projects.

FIGURE 3. ACT 89 MOTOR LICENSE FUND APPROPRIATIONS (MILLIONS)



Source: http://www.penndot/gov/about-us/Documents/Final_Trans_Funding_Plan_Summary.pdf

PUBLIC SAFETY

The Federal government requires that all new bridges conform to their Bridge Design Specifications, which are supplemented by PennDOT's Design Specifications. These specifications have been developed to ensure that all bridges meet a minimum level of safety and reliability. To ensure continued bridge safety, PennDOT has implemented a robust inspection program which exceeds the Federal government's minimum requirements. Additionally, a sample of bridges are independently re-inspected and compared to the original inspection to ensure the consistency of condition evaluation of the bridges. Although Pennsylvania ranks 46th out of 50 states in terms of percentage of bridges in poor condition, this does not directly impact public safety since these bridges are routinely inspected and are weight restricted when necessary. Nevertheless, this is an indication of an aging system where potential safety problems must be closely monitored.

With respect to bridge inspection, PennDOT and the Pennsylvania Turnpike Commission typically meet national safety standards and have more rigorous standards than other states. Both agencies have reliable inventory systems for tracking bridge condition and maintenance items. Local bridge owners such as cities, municipalities, and counties, however, are less reliable in meeting routine inspection requirements and maintaining their bridge inventory.

RESILIENCE

Resilience is the ability of transportation infrastructure to resist natural and manmade hazardous events and recover the ability to provide critical services following these events. For bridges, hazards include flooding, vehicle fires, and earthquakes, among others. Many bridges have attributes or vulnerabilities that make them susceptible to hazards which can result in a loss of functionality. The September 2016 Liberty Bridge fire in Pittsburgh and the January 2017 fracture on the Delaware River Steel Truss Bridge illustrate the consequences resulting from a transportation network unable to cope with the temporary closure of two important bridges.

Regarding the effects of climate change, in April 2017, PennDOT released a report detailing results of a study examining the vulnerability of Pennsylvania's bridges to extreme weather events. This report presents several strategies that can be used to study and plan for the impacts of extreme weather and provides a list of recommendations to improve resiliency. Pennsylvania has reduced the number of bridges that have fracture critical details or are susceptible to flooding through targeted bridge repair and replacement efforts. By reducing the number of bridges susceptible to natural and manmade hazards, the overall resilience of Pennsylvania's transportation network is improving.

INNOVATION

Accelerated Bridge Construction (ABC) methods have become increasingly common in Pennsylvania and are an innovative way for contractors to get in, get out, and get traffic moving again quicker than traditional methods of construction. The most common method involves the use of prefabricated bridge elements, illustrated in Figure 4, which can be constructed off site and erected on site.

The use of high performance concrete mixes for concrete beam bridges is now permitted in design and construction. This innovation results in the reduction of beam size, allows for longer span lengths between supports, and is more durable than traditional concrete which leads to increased service life.

In October 2014, PennDOT hosted a 3D modeling workshop. 3D modeling involves development of a bridge model to produce a "real world" assessment of the project in a virtual environment. This method offers numerous advantages to both design and construction with one being identification of detailing conflicts before the bridge is ever fabricated.

An emerging technology which will have a positive impact to bridge inspection is the use of unmanned drones. Advantages of this technology would be increased safety for inspectors and the travelling public, increased efficiency of inspections, and cost reductions through the minimization of equipment use and traffic control.

FIGURE 4.
PREFABRICATED CONCRETE ABUTMENT

PHOTO COURTESY OF ALFRED BENESCH & COMPANY

RECOMMENDATIONS TO RAISE THE GRADE

- Accelerate efforts to reduce the number of bridges in poor condition with a goal of having fewer bridges in poor condition than the national average.
- Decrease the number of bridges being added to the poor condition list by applying bridge preservation best practices, which includes an increased use of better materials such as high performance concrete.
- Continue to advocate state elected officials against disproportionate PSP appropriations from the MLF. Proper PSP appropriations could double the annual elimination of bridges in poor condition and at the same time reduce the number being added through increased maintenance and rehabilitation.
- Support the motor fuels tax and pursue for the long-term a usage-based funding system dependent on alternatives such as vehicle miles traveled. In the interim, pursue a tax on hybrid/electric vehicles to fund transportation improvements.
- Continue to collect and analyze data regarding bridge assets, through asset management systems or other means, to better understand the hazards and vulnerabilities impacting the resilience of the transportation network. Detailed datasets will help facilitate studies to evaluate transportation network vulnerabilities in specific locations.
- Continue to promote and use innovative methods such as Accelerated Bridge Construction and 3D modeling to gain further efficiencies in bridge design and construction to stretch infrastructure dollars.

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DAMS

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THE WEHR DAM IN SOUTH WHITEHALL TOWNSHIP IN PENNSYLVANIA
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DAMS

EXECUTIVE SUMMARY

There are 3,380 state-regulated dams in Pennsylvania that provide for the drinking water, irrigation, flood control, hydropower, recreation and industrial water needs of the state. While dams provide many needed services, if they are not properly invested in and maintained, they can pose a risk to life and property within the state. This is particularly true of high hazard potential dams; should these fail, there is probable loss of human life and substantial property damage. There are 803 high hazard potential dams in Pennsylvania, 743 of which are state-regulated. Of the state-regulated high hazard dams, 44% are considered deficient, a reduction from 67% in 2014. While this is encouraging, approximately 33% of the deficient dams are still considered unsafe, meaning they do not meet current Pennsylvania Department of Environmental Protection standards. Estimates show $1.1 billion is needed to repair deficient and unsafe dams in Pennsylvania.

BACKGROUND

Historic dam failures in Pennsylvania spurred the state to become a national leader in dam safety. In 1889, more than 2,200 lives were lost when the South Fork Dam near Johnstown failed, and in 1977 heavy rainfall near Johnstown caused six local dams to fail, claiming 41 additional lives. Pennsylvania became the first state to pass dam safety legislation following the 1911 failure of the Austin Dam in Potter County. Pennsylvania's tragic history of dam failures should continue to motivate investment in the aging infrastructure that dots the state. Although 57% of the dams in Pennsylvania are privately owned, both public and private dam owners lack the funding needed to repair and maintain their dams. As populations increase and development expands in both urban and rural areas, dams pose a growing safety hazard to Pennsylvanians living throughout the state through deteriorating infrastructure and construction downstream of dams that were not built to current design standards.

CONDITION & CAPACITY

Dams are inventoried and their condition is tracked in the National Inventory of Dams (NID). The NID only includes all high and significant hazard potential classification dams, as well as low hazard potential dams that meet specific height and reservoir storage requirements. Some of the smaller, low hazard potential dams that are managed by the Pennsylvania Department of Environmental Protection (PADEP) Division of Dam Safety are excluded from the NID.

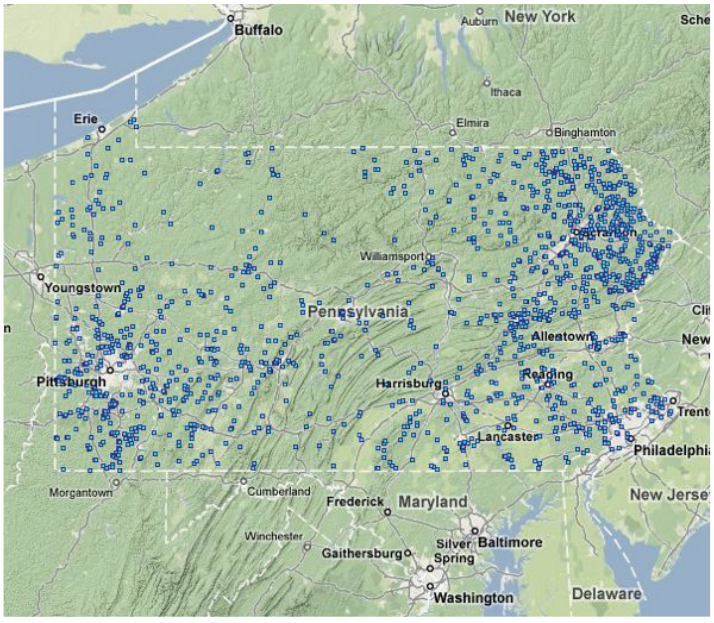
Dam hazard ratings refer strictly to the potential for downstream impacts and do not reflect the condition of the dam. High hazard potential dams are those whose failure would cause probable loss of human life and substantial property damage. Significant hazard potential dams are those whose failure would result in no probable loss of human life but would likely cause economic loss. The current NID, published in 2016, lists 1,525 dams in Pennsylvania. As of 2016, over 1.6% of the dams in the United States were located in Pennsylvania, but over 5% of the high hazard potential dams were in the state.

There are 3,380 state-regulated dams located in Pennsylvania, including 743 high hazard potential dams (22%); 289 significant hazard potential dams (9%); and 2,348 low hazard potential dams (69%).

Deficient dams are estimated using the NID rating methodology whereby all dams not meeting the 'Satisfactory' or 'Fair - General Lack of Maintenance' ratings are considered deficient. Of these deficient dams, a portion have deficiencies that, if not corrected, could result in the partial or complete failure of the dam or any associated structure or facility with subsequent loss of life or substantial property damage. Of the 743 high hazard potential state-regulated dams in Pennsylvania, 329 (44%) are considered "deficient", which is an improvement over the 67% of high hazard potential dams reported "deficient" in 2014. Currently, one third (103 of 329) of the deficient dams are still considered unsafe. Unsafe dams do not meet PADEP's current standards, such as inadequate stability and spillway capacity to safely pass high flood events and active deficiencies (seepage, movement or cracking) which require active monitoring or repairs in order to maintain the stability of the structure.

Pennsylvania is continually adding new dams to its database and reclassifying others as downstream conditions and development change. New dams are added to account for recently constructed dams, as well as older dams that were not previously included in the state's database. Figure 1 illustrates the location of Pennsylvania dams included in the NID.

FIGURE 1. NID STATE MAP OF DAMS IN PENNSYLVANIA



Source: www.nid.usace.army.mil

The average design life of a dam is generally considered to be 50 years, at which point the structure is anticipated to require significant maintenance or upgrades. Based on the NID database, 858 (approximately 56%) of the dams in Pennsylvania are at least 50 years old, meaning substantial continued maintenance can be expected. One alternative to continued maintenance is dam removal, which occurred at 51 dams in Pennsylvania from 2014 through 2017, including 11 high hazard dams. Pennsylvania is a leader in dam removals, due in part to the streamlined permitting process created by PADEP. In cases of dam removal, the dam is often obsolete, and although there would be capacity to rebuild a dam at that location, the economics and environmental benefits of dam removal outweigh the need for replacement of the dam.

In the past four years, two events have occurred in the U.S. that have driven increased review and evaluation of dam safety. The first was the October 2015 record rainfall (estimated at a 1,000-year flood event) in South Carolina that caused at least 51 dams to breach or fail (SCDHEC, 2018). This event brought increased awareness of the need for dam safety and emergency preparedness in advance of an extreme event. The second event that caused increased interest in dam safety was the 2017 near-complete-failure of the Oroville Spillway in California. This event caused the evacuation of over 100,000 people and brought about the recognition of the need for adequate inspections and early action to prevent future failures. Although these events occurred in other states, they are good reminders of why Pennsylvania needs a robust maintenance and inspection program that incorporates the best engineering and science practices into protecting the state's residents.

FUNDING & FUTURE NEED

Repair costs can vary significantly based upon many factors. The PADEP Division of Dam Safety estimates average repair costs can often range from $75,000 to $4 million per dam, generally increasing with increased hazard potential. The total cost for upgrading Pennsylvania's 1,091 deficient dams is estimated at $1.1 billion.

There are several programs to help fund and finance dam projects in Pennsylvania. The Pennsylvania General Assembly passed Act 13 in 2012, overhauling the state's oil and gas laws. Act 13 established the Marcellus Legacy Fund which allocates funds for initiatives including statewide flood mitigation projects. Individual projects can receive up to $500,000. Additionally, the Pennsylvania Infrastructure Investment Authority (PENNVEST) provides low-interest loans for water projects throughout the state, including dam projects. The H2O PA Act, passed in 2008, provided funding to assist with infrastructure for drinking water projects. To date, 24 major dams received funding through the H2O PA Act; however, the program closed in 2018, and future funding will be limited, if it exists at all. Finally, in 2013 the PADEP's safety fee package was increased, generating new funding to cover approximately one third of the Division of Dam Safety Program operational costs.

More recently, House Bill 431 (formerly House Bill 1712) was incorporated into the fiscal code as part of the budget passed by the state in June 2018. This bill will establish the Private Dam Financial Assurance Program (Program) and the Private Dam Financial Assurance Fund (Fund). The Program will provide a revolving loan for private dam owners to meet their requirements under the 1978 Dam Safety and Encroachments Act, which requires proof of financial responsibility by dam owners. Additionally, the bill will establish a Fund in the state treasury, where money and accrued interest will be available for the PADEP's use should it need to remove, repair, or otherwise take corrective measures in the event a dam owner fails to comply with regulatory requirements.

In Washington, the Water Infrastructure Improvements for the Nation (WIIN) Act of 2016 authorized the High Hazard Potential Dam Rehabilitation Program to provide federal grant assistance for the rehabilitation, repair, or removal of non-federal high hazard potential dams. This program stands to benefit Pennsylvania dams by allowing communities to make preemptive investments into aging infrastructure, and in the process, make the downstream communities safer. Unfortunately, this program has yet to receive any funding through the appropriations process; therefore, most dam repair funding is currently provided by the dam owner or state funds; or in the case of dam removal, combined state and non-governmental organization (NGO) funding.

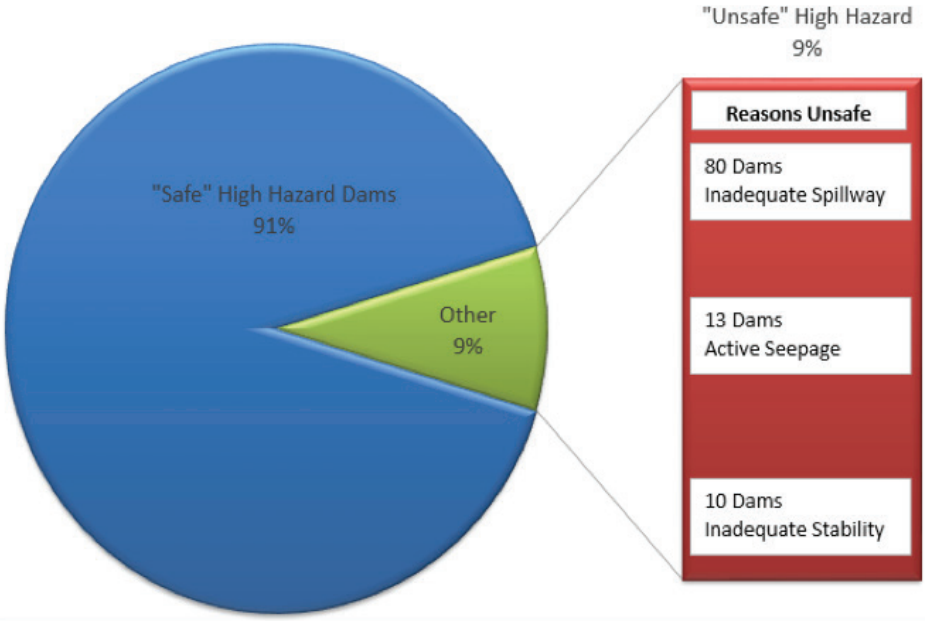
PUBLIC SAFETY & RESILIENCE

Each of the dams within Pennsylvania are classified based on the potential risk to the public and loss to the state's economy. Each dam is assigned a category based on size (dam height and storage capacity) and hazard potential (life and economic loss). The purpose of classification is to determine the design and operation requirements for each dam based on consequences that may occur in the event of an operational or structural failure.

PADEP has an extensive inspection program for both public and private dams. The purpose of the inspections is to verify the condition and proper maintenance/operation of the dam. Based on the inspection observations, the PADEP determines if the dam is "safe" for continued operation. The goal is to discover and remediate any deterioration/issues before a potential failure. Early remediation potentially lowers the repair cost and risk to the public.

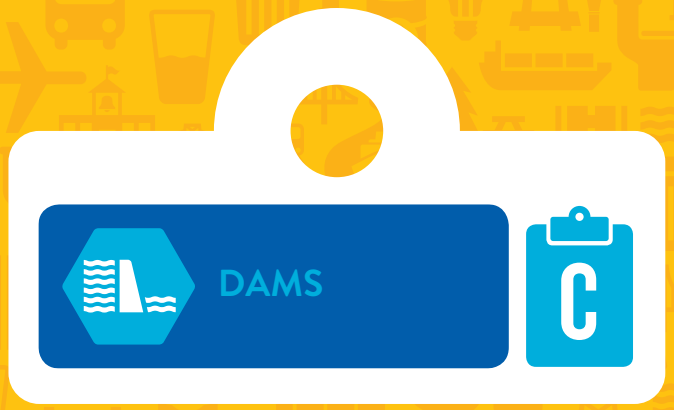
A list of "unsafe" high and significant hazard dams that do not meet their design requirements is maintained by PADEP. As illustrated in Figure 2, currently 9% (or 73 dams) of Pennsylvania's 809 high hazard dams (includes 66 non-state-regulated and the 743 state regulated high-hazard dams) are considered "unsafe." Based on the Pennsylvania State Code, an "unsafe" dam is defined as: "A dam with deficiencies of such a nature that if not corrected could result in the failure of the dam with subsequent loss of lives or subsequent property damage." The main reasons dams in Pennsylvania are considered "unsafe" include: inadequate spillway capacity to safely pass the design flood, inadequate stability under the recommended loading conditions, and active seepage through the dam. Until these "unsafe" dams are repaired, they pose an increased risk to public safety and economic loss. There is overlap between the "deficient" and "unsafe" dam rankings, with "unsafe" dams generally being a subset within the "deficient" ranked dams.

FIGURE 2. CURRENT CONDITION OF PENNSYLVANIA HIGH HAZARD DAMS



PADEP commissioned a state-specific study, currently underway, on the Probable Maximum Precipitation (PMP) to more accurately predict storm inflows for dams. When completed, the study will replace outdated federal guidelines with Pennsylvania-specific data that is expected to provide improved estimations of runoff amounts that will aid in accurately determining and designing for spillway overflow capacity.

PADEP requires dam owners to develop and maintain an Emergency Action Plan (EAP) for significant and high hazard dams. To date, PADEP has an EAP for over 50% of these dams in Pennsylvania; however 95% of the high-hazard dams have an EAP in place. These EAPs alert emergency personnel and the public of emergencies that may lead to failure of the dam and outline appropriate responses. Pennsylvania began electronic filing of EAPs in 2014. The electronic formatting of EAPs provides better access to this critical document during an emergency. Pennsylvania expects to have all EAPs filed electronically by 2023.



RECOMMENDATIONS TO RAISE THE GRADE

- **Perform incremental dam break analyses for "unsafe" dams to limit the potential of catastrophic cascading failures. In 2011, PADEP updated their regulations to require high hazard dams to consider incremental dam break analysis. This type of analysis accounts for the effects of the flows from an upstream dam failure on downstream dams.**
- **Develop EAPs for all high and significant hazard dams to increase public safety and acknowledgement of the potential risk.**
- **Evaluate unsafe and deficient dams using the updated PMP guidelines, once they are available.**
- **Continue appropriations of public funding to assist financially burdened, high-hazard and significant-hazard dam owners with rehabilitation and maintenance projects that benefit public safety.**

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DRINKING WATER

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DRINKING WATER

EXECUTIVE SUMMARY

Pennsylvania's drinking water infrastructure is aging. In Philadelphia, half of the city's water mains were installed prior to 1930 and nearly 30% were installed before 1900. Cast iron, which makes up a majority of Pennsylvania's water mains, saw break rates of nearly 35 per 100 miles per year, a 43% increase since 2012. Smaller community water systems, meanwhile, are struggling to fund projects to meet new regulations. Many public water system (PWS) billing rates have not kept up with rising costs. Over the next ten years, Pennsylvania's PWSs are projected to have a $10.2 billion funding gap. To meet this gap, these systems will likely need to adopt full-cost pricing and find new technologies to reduce consumption and waste. Otherwise, the public could face increased health risks, environmental impacts, and financial losses.

BACKGROUND

In Pennsylvania a PWS is a system which provides water to the public for human consumption which has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. The second PWS in America was installed in Bethlehem, PA, in 1761. Since that time Pennsylvania's population has grown to 12.8 million. Under the Federal Safe Drinking Water Act, Pennsylvania Department of Environmental Protection's (PADEP's) Bureau of Safe Drinking Water regulates nearly 8,500 PWSs; an estimated 89% of the state's population relies on PWSs for their clean water. The rest of Pennsylvania's drinking water is obtained from more than a million domestic water wells. Well drilling is regulated through the Pennsylvania Department of Conservation and Natural Resources (DCNR) by the Water Well Drillers License Act. Quality of well water in PWSs is regulated, but individual well water quality is the responsibility of the homeowner and not currently regulated.

CONDITION AND CAPACITY

Ninety three percent of PWSs depend on ground water as the source. However, 78% of Pennsylvania's population, including those that reside in the state's large metropolitan areas, are served by surface water. With its abundance of ground and surface water, Pennsylvania faces challenges that differ from fast- growing states in the South or drought-prone states in the West. Pennsylvania's major dilemma is aging infrastructure.

A nationwide study conducted in 2018 found that water main breaks have increased 27% since 2012. Various reports put the average rate of water main breaks between 14-27 breaks per 100 miles of water main per year. Cast iron, which makes up a majority of Pennsylvania's water mains, saw break rates of nearly 35 per 100 miles per year, a 43% increase since 2012.

To put water main age into perspective, half of Philadelphia's water mains were installed prior to 1930. Nearly 30% were installed before 1900. On average, the city experiences around 750 water main breaks per year – a little more than two a day. Recently, Evans City, PA experienced a water main break which affected 1,700 residents, leaving them without water for a day and requiring a boil water advisory for two days.

The American Water Works Association has announced that the replacement era of water systems is upon us. While the average age of failing water mains is approximately 50 years old, the average rate of pipe replacement is 125 years. Postponing investment in replacement substantially increases the overall costs and puts public health at risk.

The increasing average age of the workforce in water treatment operators is another growing concern. A PADEP report on the Operator Certification Program revealed that most drinking water operators are in the 50-59 age bracket, creating the potential retirement of a large portion of the drinking water operators. This may lead to a void in trained professionals qualified to operate the Commonwealth's water treatment systems.

FUNDING AND FUTURE NEED

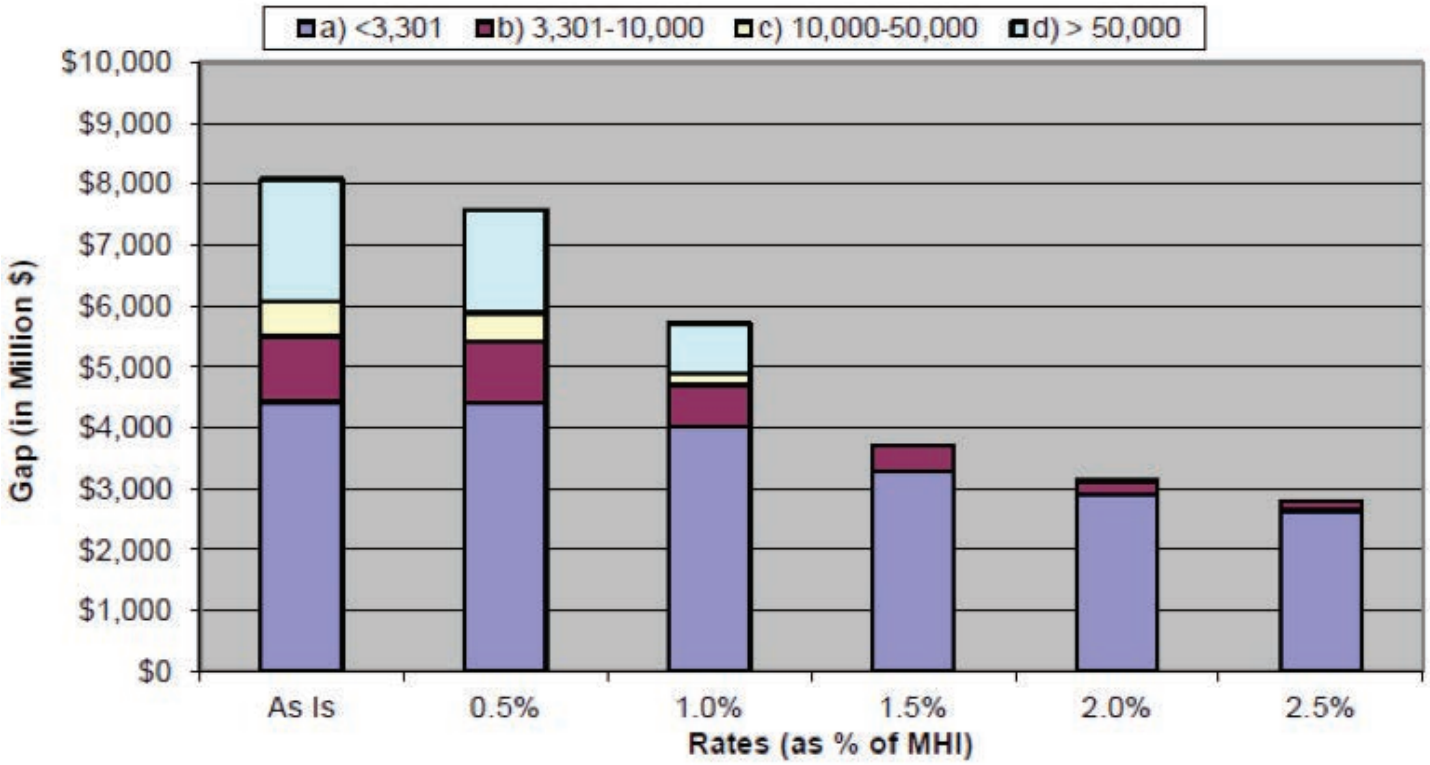
PWSs depend on a combination of federal and state funding, as well as user fees, to meet demands from aging drinking water infrastructure, a growing population, and new regulatory requirements. Beyond user fees, the main supplemental funding source is the Federal Drinking Water State Revolving Fund (DWSRF), which is managed by the Pennsylvania Infrastructure Investment Authority (PENNVEST). According to DEP's 2015 Water and Wastewater Gap Study, PENNVEST is expected to provide $800 million over the next 10 years in grants and loans for public and private water and wastewater systems. Total available subsidy value increases to $900 million when including other funding sources (U.S. Dept. of Agriculture Loans & Grants, U.S. Dept. of Housing and Urban Development Community Development Block Grants (HUD CDBG), and Appalachian Region Commission Grants).

The drinking water gap over the next 10 years in Pennsylvania is $10.2 billion. Most rates paid by consumers today do not reflect the long-term costs of maintaining and repairing the infrastructure; often they are just a reflection of short-term construction and service costs. Figure 1 below demonstrates that if rates, on a statewide average basis were allowed to rise to 1.5% of median household income (MHI), the funding gap could be met by many of the PWSs. However, Pennsylvania has more than 2,200 community drinking water

systems, many of which are small water systems serving fewer than 3,300 consumers. Addressing the gap is most difficult for small systems, due to high cost and low MHI. Many small systems will not be able to meet their needs through increasing user rates without state and federal funding assistance.

FIGURE 1. DRINKING WATER FACILITIES – GAP VS RATES

Total Gap for Facilities Serving Populations



Some PWSs are turning to partnerships with private or public entities to alleviate debt crises. In 2013 Allentown leased its drinking water and sewer systems for 50 years to Lehigh County Authority. This deal included an agreement to controls on rates, an annual payment of $500,000 to Allentown, payoff of $30 million in debt plus $160 million unfunded pension liability. The deal also doubled the customer base for Lehigh County Authority.

Pittsburgh Water and Sewer Authority (PWSA) is experiencing a financial crisis with a debt of $750 million. Despite Mayor Peduto's pursuit in 2017 of a partnership venture, the PWSA came under the jurisdiction of the Pennsylvania Public Utility Commission (PUC) on April 1, 2018.

PUBLIC SAFETY

An anticipated public safety improvement is the proposed increase to the disinfection requirements rule that is scheduled to take effect in 2018. The proposed amendment under this rule is to increase the available free chlorine at all points in the distribution system by an order of magnitude from 0.02 ppm to 0.2 ppm with weekly monitoring requirements. This increase is proposed to protect public health against microbial and other biological contamination that can take place within the distribution system.

Under the Lead and Copper Rule, DEP is working with water systems to reduce lead levels that may be caused by the distribution system and household plumbing fixtures by requiring treatment to address the corrosiveness of the water. Currently 91.4% of the population served by community water systems and 86.6% of all children at day-care and school facilities that have their own water supply are protected by optimized corrosion control. Unfortunately, events such as the PWSA exceeding the Lead Action Level in December 2017 are still occurring and has highlighted the importance of the replacement of Lead service lines and further corrosion control measures.

RESILIENCY AND INNOVATION

Through federal legislation in 2002, PWSs serving a population greater than 3,300 were required to complete vulnerability assessments and emergency response plans. These plans determine what threats exist and what mitigation measures are available or desired for implementation. A 2017 Governor's report discusses the formation of emergency response plans but does not include a discussion on capital improvements required. Additional sources of funding for construction of these measures (Emergency Standby Power Generators, Emergency Interconnects between PWSs, etc.) should be considered by the State legislature.

PWSs through Chapter 110 of the state code are required to annually report their source of supply, consumptive uses, and water losses including unaccounted for water loss. Unaccounted for water loss can result from small fractures in pipes – breaks that are not large enough to cause a major drop in pressure and may not be visible above ground. State regulators have been active in requiring water authorities to reduce their unaccounted for water to acceptable levels in an effort to improve the efficiency of source of supply, treatment, and distribution systems. PWSs across the state are utilizing newer technologies ranging from more accurate radio read customer meters, to employing leak detection sensors in the distribution system. The improved accuracy of the upgraded meters results in an increase of revenue capture and can allow a PWS to check water meter consumption on a more frequent basis with greatly reduced staffing requirements.

The state in recent budget legislation included a provision to give a PWS the authority to replace customers' water mains to their homes (though these pipes are the responsibility of the property owner they are often old and can contain lead). This was previously not permitted and was cost prohibitive for customers to complete the replacement themselves. This change in legislation was innovative in allowing water utilities that exceed the lead action level to now have legislation in place that permits them to replace lead service lines. PWSA has committed to replace over 2,000 full lead service lines at no cost to customers in 2018. This $44 million project will target replacements in neighborhoods shown to have the presence of young children who are most at-risk for lead exposure. Funding such as HUD's CDBG program appear to provide a grant mechanism for replacement of lead service lines; however, the available funding in this program is limited.

RECOMMENDATIONS TO RAISE THE GRADE

- Educate consumers about the complexity and costs of providing water services, to embrace the idea of water as a valuable commodity.
- Advocate for increased federal and state funding in addition to maintaining the current funding levels.
- Raising the rates to 1.5% of MHI, to ensure all repair and replacement costs are accounted for in current water rates.
- Roll out programs to help low-income customers and ensure affordability.
- Institute training and scholarship programs to establish a skilled labor force.
- Increase the use of public-private partnerships.
- Improve efficiency, productivity, and explore technological innovation.
- Extend grant funding, tax credits, or a reimbursement mechanism for the replacement of lead service lines in homes.
- Lower the population threshold requirement below 3,300 so that vulnerabilities of all of Pennsylvania's PWSs can be reviewed. This can be accomplished with actions such as offering operator certification credits for small PWSs to develop a vulnerability assessment.
- While some townships have water well construction standards for domestic wells, it should be a standard requirement for all domestic wells across the Commonwealth, to protect ground water from potential contamination.

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ENERGY

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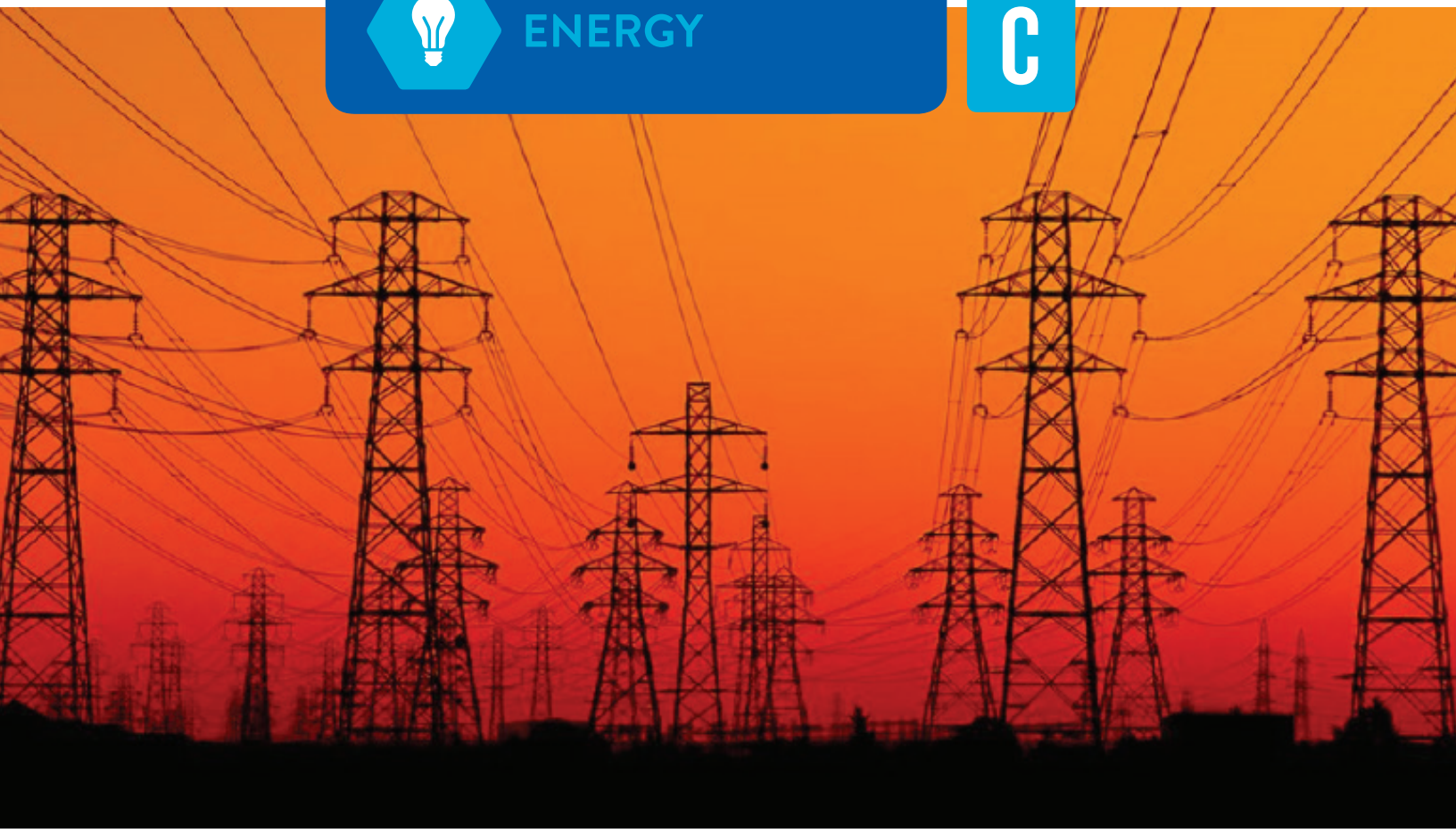


ENERGY

EXECUTIVE SUMMARY

Pennsylvania benefits from having diverse, reliable and affordable energy resources, and utilizes those resources to rank third in the country in terms of total energy production. The state has a solid foundation of energy generation, transmission, and distribution infrastructure that is continuing to transform and react to market forces. However, Pennsylvania must also contend with increasing energy dependence and reliability requirements, aging infrastructure, and physical and cyber threats. While a portion of Pennsylvania's Electric Distribution Companies have been challenged with meeting reliability standards in recent years, the infrastructure appears to meet the current needs. It is clear that collaborative involvement among utilities, electric generation companies, regulators, and policymakers will be required to ensure investments and proposed projects address future system needs, such as renewables and evolving industry trends, while considering the impacts to affordability.

BACKGROUND

The Commonwealth of Pennsylvania is rich in energy resources, with vast supplies of coal and natural gas, as well as geography and topography that allows for solar, wind, and hydroelectric generating potential. The electrical generation market within Pennsylvania is deregulated, and therefore driven by market forces. The PJM Interconnection, a regional transmission organization (RTO), centrally dispatches generation and coordinates movement of wholesale electricity within Pennsylvania, as well as manages the reliability of the transmission grid. Utilities in Pennsylvania, regulated by the Pennsylvania Public Utilities Commission (PUC), are comprised of privately and publicly owned utilities that generate, transmit, distribute and/or sell energy for use by the public. Figure 1 below provides an overview of the electric power grid.

FIGURE 1. ELECTRIC POWER GRID

Source: Department of Energy

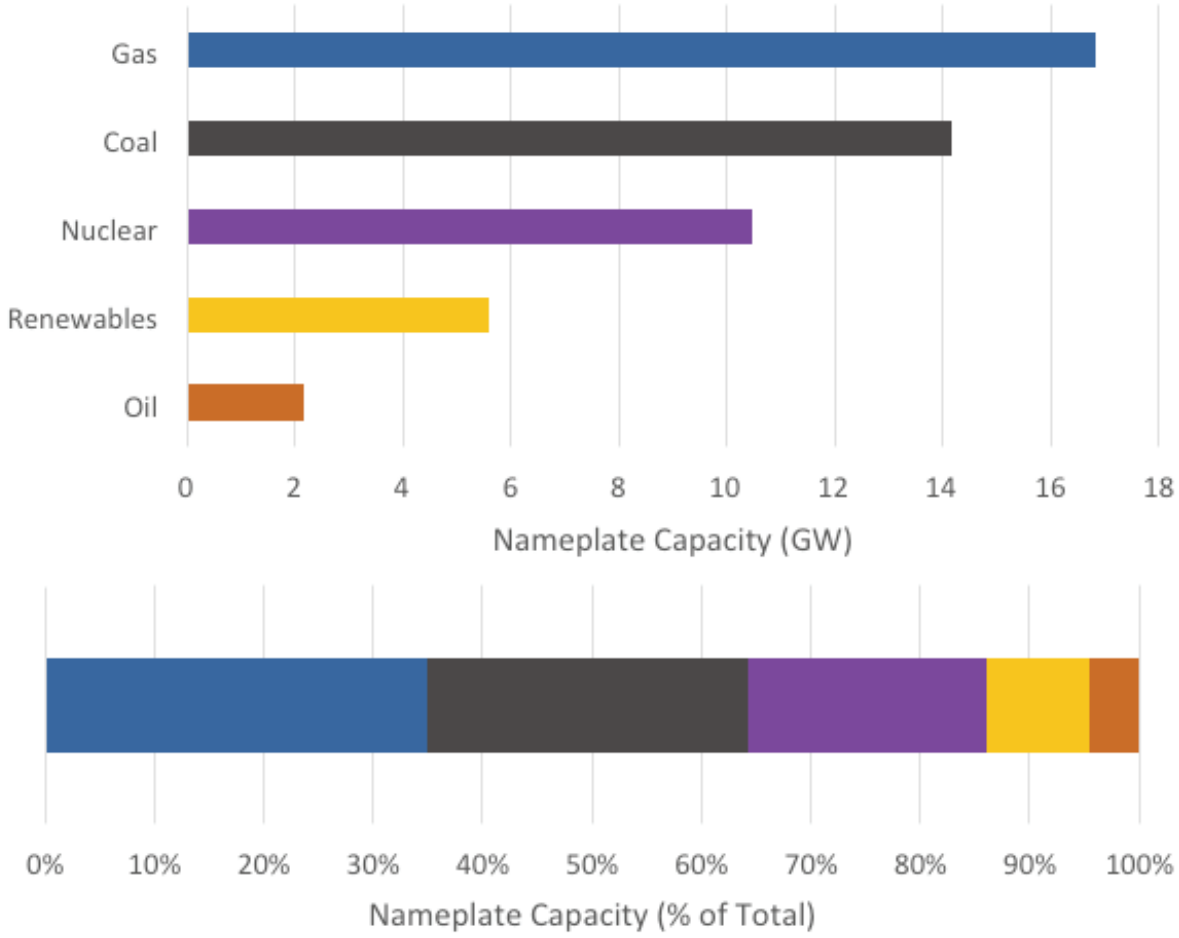
Pennsylvania has more than 12,000 miles of large diameter pipelines. Current estimates project the miles of gathering lines alone will at least quadruple by 2030 due to continued development in the Marcellus Shale. Pennsylvania is second only to Texas in estimated natural gas reserves, with Pennsylvania's natural gas production increasing by more than nine times from 2010 to 2016 (2016 production exceeded 5.2 trillion cubic feet). Once dependent on interstate pipelines from the Gulf Coast to supply natural gas, Pennsylvania is able to meet its own natural gas demand due to Marcellus Shale production.

CONDITION & CAPACITY

Pennsylvania benefits from a diverse mix of generation sources that include nuclear, coal, gas, hydroelectric, and renewable sources. Generation plant capacity is an average of 34 years old, but the average age is declining due to the retirement of older plants and the construction of new plants. Coal and nuclear plants, which have provided approximately half of the state's generation capacity, face stiff competition from newer gas plants in a competitive wholesale market that has experienced a substantial increase in reported gas generating capacity since the 2014 Pennsylvania Report Card.

Based on the latest U.S. Energy Information Administration data from 2016, and as shown in Figure 2, in-state electric generation plant nameplate (installed) capacity is approximately 48,000 Megawatts. Utility-scale renewables in the Commonwealth include hydroelectric, solar, wind, biomass, and pumped storage. Prosumers, customers who both consume and produce energy (most commonly through rooftop solar), are growing in the energy space in the U.S. Although energy generated by prosumers do not currently impact Pennsylvania's generation profile, it is expected that in the future, when Pennsylvania utilities can accommodate customer generated energy into the grid, this will cause a shift in the generation profile and increase renewables generation. While gas plants provide more capacity than any other type, Pennsylvania's actual generation mix is often led by nuclear. This generation mix is expected to change, as two of the state's five nuclear plants are scheduled for shut down by 2021, with plant owners citing the inability to compete with lower prices resulting from natural gas.

FIGURE 2. PENNSYLVANIA GENERATION CAPACITY BY FUEL TYPE



Source: EIA Data, 2016

The state's generation capacity is significantly greater than its consumption, and with current plants in planning and construction, Pennsylvania will have sufficient capacity to meet its needs for the foreseeable future. However, the state will increasingly rely on natural gas for generation; distributed and renewable generation are not yet a major part of in-state capacity. While the Pennsylvania Alternative Energy Portfolio Standards Act of 2004 (AEPS) requires 18% of electricity to be from renewable sources by 2021, the state's renewable production only equates to approximately 4%. Additionally, suppliers currently purchase a majority of the credits to meet program targets from out-of-state sources.

Development in Marcellus Shale has led to natural gas production in the state that has outpaced the existing infrastructure's ability to transport it out of the region. To alleviate these constraints, several pipeline projects have been initiated and completed in recent years. Half of the transmission pipeline miles in Pennsylvania are at least 45 years old, and as pipelines age, failure due to corrosion and fatigue are a growing concern.

Pennsylvania's electric delivery relies on a complex system of power generation and transmission and distribution (T&D) grids managed and operated by investor-owned utilities, cooperatives and municipal utilities. Much of the T&D infrastructure was constructed in the 1950s and 1960s, with some power lines in Pennsylvania dating back to the 1920s. This aging energy infrastructure was not engineered to meet modern system demands or designed to withstand more recent severe weather events. While many utilities have been recently addressing aging energy infrastructure by making investments to strengthen the delivery system and improve reliability, continued investment and development will be required to provide the increased flexibility and enhanced operational capabilities needed to enable a modern, resilient electric system required to meet future demands.

The PUC monitors the reliability of the state's 11 electric distribution companies (EDCs) through the assessment of reliability performance metrics. These metrics, reported by the EDCs on a rolling 12-month average and 3-year average, are considered the minimum level of reliabil-

ity performance. The PUC reported the following 3-year average performance compliance data for Pennsylvania's 11 EDCs in 2017, which has demonstrated a regression in performance:

- 4 EDCs failed to meet the rolling 3-year CAIDI (Customer Average Interruption Duration) performance standard
- 4 EDCs failed to meet the rolling 3-year SAIFI (System Average Interruption Frequency) performance standard
- 3 EDCs failed to meet the rolling 3-year SAIDI (System Average Interruption Duration) performance standard

Per the PUC's analysis, reliability and resilience of the electric distribution system to meet performance standards appears to be challenged in years where there is increased storm activity. This data emphasizes the importance for hardened energy infrastructure that is designed and constructed to withstand the increasingly frequent severe weather events. Additionally, during this 3-year period, all 11 EDCs reported challenges with trees causing a substantial amount of power outages, noting the greatest challenge coming from trees outside of right-of-way boundaries where utilities have limited to no trimming/removal rights.

The electric grid continues to be challenged by several existing and evolving factors, including cyber threats, severe weather events, integration of both renewable / distributed energy resources, as well as the evolving need for utilities to have increased grid monitoring and control functionality to enable grid-edge technologies.

FUNDING AND FUTURE NEED

In Pennsylvania's deregulated electrical generation market, private equity investment is driving a shift in the ownership and operation of Pennsylvania's generating plants to a more diverse group of companies, compared to the independent power producers that have owned and operated most of the state's generation for the past 20 years. The state's economical and abundant natural gas supply has attracted significant international capital investment. It is not clear how long the current spike in new development will continue, as assets are bought and sold more frequently in an increasingly crowded market with little forecast growth in demand.

According to a 2017 Eaton Report, Pennsylvania has been in the top seven states in the last three years for number of power outages, with over 58% of the reported outages caused by weather, falling trees, and faulty equipment or error. While investments to improve the reliability and resilience of Pennsylvania's electric grid have been made in recent years, continued and increased investment is needed to address aging system infrastructure, as well as the need for hardened energy infrastructure that is designed and constructed to withstand high-impact severe weather events. With Pennsylvania's current electricity rates relatively low (ranking 19th nationally at 10.19 centers/kWh), well-planned investments and collaborative involvement among utilities, regulators, and policymakers will be required to ensure investments and proposed projects address the need to balance the electric grid's reliability and flexibility, while considering the impacts to affordability.

PUBLIC SAFETY, RESILIENCE, INNOVATION

With the increase of natural gas generation in the state, newly-constructed generation plants in Pennsylvania include state-of-the-art technology for efficiency and control, and both operational reliability and safety of gas plants has not been a major concern. However, continued evaluation is necessary, for example, to ensure sufficient fuel availability during extremely cold weather, when gas demand peaks due to the combination of electricity generation and heating needs.

Extensive and disruptive changes are transforming the energy industry in Pennsylvania and the US – this is resulting in a shifting generation mix, a growing need for T&D field devices to enable innovative advanced control and monitoring capabilities and integration of both utility-owned and customer-owned renewable generation sources. The aging T&D infrastructure system continues to be challenged by severe weather events and cyber and physical security threats. If this need is not met, public safety could be in jeopardy due to prolonged power outages. Continued renewal and hardening of aging infrastructure, as well as integration and use of smart grid systems and devices is needed to reduce outages and the associated economic impacts to customers. Collaboration and innovative thinking among regulators, policymakers, and electric infrastructure owners will be essential to ensure the evolution of a modern, resilient energy system that meets customer and affordability needs.

RECOMMENDATIONS TO RAISE THE GRADE

- **Adopt a current, holistic statewide energy policy that continuously assesses required changes and evolving needs, such as the emerging role of prosumers, to provide clear direction for meeting current and future demands.**
- **Create proper incentives to catalyze investment in transmission and distribution upgrades, as well as investments that diversify the state's energy generation sources.**
- **Provide for improvements that address the emerging needs in critical infrastructure and cyber security protection.**
- **Implement energy infrastructure hardening and resiliency initiatives, including aggressive vegetation management programs, to proactively prepare the grid to withstand the increasing frequency of severe weather events.**

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FREIGHT RAIL

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FREIGHT RAIL

EXECUTIVE SUMMARY

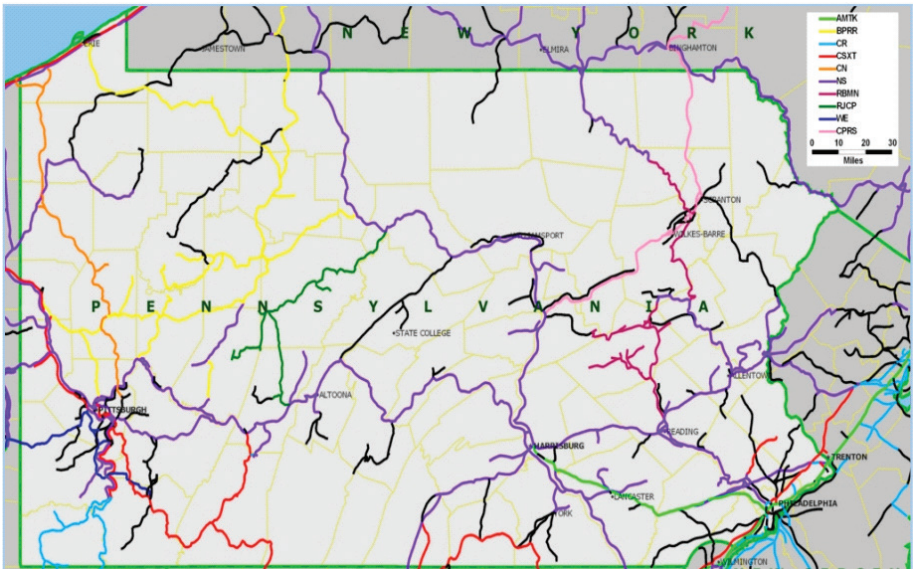
Pennsylvania's 64 freight railroads operate on 5,604 miles of track across the state, ranking it the fifth largest rail network by mileage in the U.S. By 2035, 246 million tons of freight is expected to pass through the Commonwealth of Pennsylvania, an increase of 22% over 2007 levels. Pennsylvania's railroad freight demand continues to exceed current infrastructure. Improvements such as double stacking or parallel tracks and larger transfer facilities would help improve capacity. Despite competing interests , the Pennsylvania Department of Transportation's Freight Rail Bureau has continued to procure impressive levels of freight infrastructure funding, which directly or indirectly supports multi modal transportation projects throughout the Commonwealth. This public funding is in addition to all private support committed. It has further produced the most comprehensive state rail plan to date, with a strong emphasis on understanding stakeholders and their needs.

BACKGROUND

Since the mid-1800s, rail transportation has been a key transportation mode supporting industrial production and energy movement. Higher utilization of rail provides congestion mitigation benefits, air quality improvement, and enhancement of transportation safety, as a result of reducing truck traffic on highways. Pennsylvania has the 5th largest rail system in the United States and is one of the nation's leaders in freight assessment, planning, and investment spurring from the Commonwealth's industrial heritage. Today, most railroads are privately owned. The state network is made up of approximately 5,604 route-miles of freight railroad operated (Figure 1), and sixty-four freight railroads, more than any other state. They are summarized as follows:

- Three Class I Railroads: CSX, Norfolk Southern (NS), and Canadian National
- Two Class II Railroads: Buffalo and Pittsburgh Railroad, and Wheeling and Lake Erie Railroad
- Thirty-two Class III Railroads, also known as short line or local line haul railroads
- Twenty-seven local switching and terminal railroads.

FIGURE 1. FREIGHT RAIL LINES IN PENNSYLVANIA



Source: Federal Railroad Administration, 2006

CONDITION

The majority of Pennsylvania freight rail lines are privately owned, and publicly available information is limited. However, it is known that approximately 60% of the short line and regional railroad physical infrastructure is in need of extensive rehabilitation, including 170 bridges. Some lines, such as NS's Crescent Corridor could benefit from the straightening of curves to allow for faster travel speeds, addition of passing tracks, improving signal systems and building new terminals. Additionally, excluding the Bessemer & Lake Erie (CN) and Delaware & Hudson Railroads (CP Rail), each of which has heavy load infrastructures, the short line and regional railroads are capable of handling the heavier 286,000 pound loads on only 70% of their infrastructure.

CAPACITY

Pennsylvania's core or strategic rail lines include some of the highest volume routes in the nation, such as the NS (former Pennsylvania Railroad) main line connecting Philadelphia, Harrisburg and Pittsburgh, and extending ultimately to Chicago. This line carries over 120 million gross tons (MGT) annually. Other highly-trafficked rail lines in the Keystone State include CSX's east-west line through Erie, at 113 MGT; CSX's line through Connellsville, Pittsburgh and New Castle, 100 MGT; NS's Reading-Bethlehem-Easton-New Jersey line, 100 MGT; NS's Hagerstown, MD-Harrisburg line; and CSX's line from Chester to Yardley.

In Pennsylvania, double stacking (freight containers that are stacked two high on rail cars) is used along with the retrofitting of more lines to address capacity needs. Notable existing double stacked lines include NS's Central Corridor that runs the width of the state and the NS/CSX's Erie Corridor around Lake Erie. There are lines identified where double stacking could support improved and competitive service including: the National Gateway Project (including the J&L Tunnel near Pittsburgh), expanding the length of double stacked lines along CSX's I-95 Corridor in Southeastern Pennsylvania, and CSX's Southwest corridor (Cumberland, MD through Pittsburgh to Ohio).

Issues where capacity impairs demand growth are generally within private yards or terminals. There are approximately forty-five rail traffic choke points throughout the state including Norfolk Southern's Port Perry Branch and its Lemoyne Connector (linking NS's Lurgan Branch with its Port Road / Enola Branch at Lemoyne).

An increase in capacity could also be used where passenger and freight lines share common trackage such as NS and Amtrak which share a portion of the NS-owned New York - Pittsburgh main route between Pittsburgh and Harrisburg. As a result of capacity constraints and heavy freight traffic only two services are provided in a day by Amtrak.

There are a number of rail lines in Pennsylvania considered at risk of abandonment because of low traffic density. With annual traffic less than 5 MGT, 124 Pennsylvania rail lines are considered somewhat at risk of abandonment. Ninety six rail lines are considered especially at risk with less than 1 MGT. To increase the amount of traffic, marketing the existing rail lines to area industries as an efficient for of transportation could be done.

FUNDING & FUTURE NEED

It is anticipated that between 2010 and 2035, the state rail volume and state through rail freight will grow at 1.2% and 1.5% annually.

In addition to anticipated volume growth, there is continued desire to grow the economy. Figure 2 shows the number of jobs that have been created as a result of PennDOT grants over the past four years that have been applied towards freight rail projects, typically for Class II and III rail lines.

FIGURE 2. BENEFITS OF INVESTMENT IN FREIGHT RAIL

FISCAL YEAR	GRANT TYPE	STATE INVESTMENT	TOTAL PROJECT COST	NUMBER OF PROJECTS FUNDED	NUMBER OF JOBS CREATED
2014	RFAP	$12,379,314	$17,684,739	38	17,260
2014	CB	$23,301,962	$33,288,517	13	24,632
2014	Act 13	$951,299	$1,358,999	5	2,386
TOTAL		$36,632,575	$52,332,255	56	44,278
2015	RFAP	$4,475,100	$6,393,000	7	1,977
2015	CB	$29,999,999	$42,857,140	15	44,313
2015	Act 13	$1,417,420	$2,024,886	4	840
TOTAL		$35,892,519	$51,275,026	26	47,130
2016	RFAP	$8,698,145	$12,435,926	22	181
2016	CB	$30,000,000	$42,857,147	9	127
2016	Act 13	$1,583,374	$2,261,964	3	37
TOTAL		$40,281,519	$57,555,037	34	345
2017	RFAP	$5,479,870	$7,828,389	13	158
2017	CB	$24,520,130	$35,028,758	9	273
2017	Act 13	$2,146,734	$3,066,763	5	20
TOTAL		**$32,146,7**	**$45,923,910**	**27**	**451**

Key: Capital Budget (CB) - Portion Specifically for Rail Freight

Source: PA Freight Rail Bureau

PennDOT grants include the Rail Freight Assistance Program (RFAP) Capital Budget Grants. Since the passing of Act 89 in 2013, PennDOT has provided a consistent funding source for future RFAP projects. In addition to Act 89, Act 13 from 2012 appropriates $1 million annually for rail projects located in the Marcellus Shale Regions.

RFAP grants have ranged in size from $250,000 to nearly $4 million. These grants have been used for new construction of private facilities to spur economic development to improving capacity. See below for a few examples:

- HAZLETON SHAFT CORPORATION - $250,000 to construct a rail spur for access to an existing and proposed anthracite coal thermal drying and processing facility.
- CSX - $3 million for construction of a new lead track in McKees Rocks to serve a new intermodal rail facility.
- D HOLDINGS - $700,000 to rehabilitate about 3,200' of track and five turnouts and pave a 16,000-square foot existing dock at a Blair County transload facility.
- SHELL CHEMICAL APPALACHIA LLC - $3.8 million to construct 10 miles of track to be used for the inbound transport of construction materials for Shell's plant and for the shipment of outbound product from the completed plant.

PennDOT has also established the Pennsylvania Infrastructure Bank (PIB) to provide low-interest loans to railroads and shippers for rail freight projects to help spur economic development. PennDOT is also beginning to utilize other funding programs to complement their RFAP and capital budget programs, including Congestion Mitigation Air Quality (CMAQ), TIGER funding and various grants through the Federal Railroad Administration (FRA). Additionally, Pennsylvania's Department of Community and Economic Development (PADCED) administers economic development loan and grant programs that assist rail infrastructure expansions.

The larger Class I railroads are more able to cover their capital funding needs both for state of good repair/replacement projects and capacity expansion projects. Smaller railroads are not as affluent and need the most assistance. State funding is particularly useful to preserve and support competitive rail access to local sites that have local economic impacts.

PUBLIC SAFETY & RESILIENCY

There are 75 oil trains and numerous chemical trains that pass through the Commonwealth every week. Derailments and collisions at grade crossings are of the greatest concern. Train travel times of day, as well as speed through urbanized areas are carefully coordinated and controlled. In general, private railroads do not provide public information regarding train "consists" (a makeup or arrangement of cars contents).

In the event of a major incident, various agencies respond similarly to a plane crash. If it is an accident involving chemicals or oil, efforts to contain the material will be carried out by specialty contractors and by railroad personnel. Track upgrades and armored communications could help existing facilities be brought back online more quickly after an incident.

INNOVATION

LED light fixtures on the tracks signals are being upgraded to save energy and to be more visible to both railroad personnel and to the general public. GPS technology has been used and continues to be more fully integrated with complex logic computer tracking systems to monitor train operations. Grade crossings are being eliminated whenever possible to reduce the risk of collision accidents. Trains are becoming more and more automated such that in the future, only one human will be needed to safely operate the train. Advanced safety braking systems such as Electronically Controlled Pneumatic brakes may also be applied to freight trains, though industry acceptance of this technology is lagging. PTC has been mandated by the FRA to be implemented to all railroads meeting specific requirements as a safety standard. Although innovative, it is not a cost saving measure based on efficiency. Instead, the costs saved are in accident reduction. PTC is of particular value in heavy freight traffic locations or where passenger and freight trains share the track.

RECOMMENDATIONS TO RAISE THE GRADE

- Improve capacity to keep up with the anticipated increase of freight expected to pass through PA.
- Implement recommended changes that result from the suggested passenger rail study when it relates to shared common tracks.
- Seek to continuously increase the resiliency of the state rail network. Identify weak points and fund projects to systematically address these weaknesses.
- Support more double-stack intermodal clearance projects.
- Modernize and/or remove at-grade crossings.
- Support innovative, public-private financing agreements for freight projects.
- Seek new, innovative sources of federal and state funding for rail freight investment to specifically reduce highway congestion and improve the overall level of transportation safety in the Commonwealth and to fund larger projects supported over multiple contract years.
- Inventory and aggressively market freight connections in land packages to prospective business owners looking to bring business to Pennsylvania.

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HAZARDOUS WASTE

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HAZARDOUS WASTE

EXECUTIVE SUMMARY

Pennsylvania has made notable progress in reducing the amount of EPA-regulated hazardous waste generated and in cleaning up and redeveloping abandoned contaminated sites. From 2005 to 2015, the amount of hazardous waste generated in the Commonwealth annually decreased by 18.5%, for a total decrease of 26.1% since the inception of biennial reporting in 2001. Since 2014, the Commonwealth has been the benefactor of over 1,800 brownfield cleanup sites under the Act 2 Land Recycling Program. Funding for environmental protection within the Commonwealth remains an issue. Although available revenue has modestly increased since 2013, the PADEP general fund still remains approximately 40% lower than it was 15 years ago in 2003. Without action, the environmental values expressed in the Pennsylvania Constitution and the progress noted above will be jeopardized.

BACKGROUND

The Pennsylvania Department of Environmental Protection's (PADEP's) mission is to protect Pennsylvania's air, land, and water from pollution and to provide for the health and safety of its citizens through a cleaner environment.

PADEP is responsible for numerous programs including hazardous waste management and brownfield redevelopment (remediation and reutilization of blighted properties). Funding from both the Commonwealth General Fund and the Federal government is provided to ensure resources are in place to keep the programs afloat and to provide staffing to support the mission put forth by PADEP.

CONDITION AND CAPACITY

The current condition and capacity of Pennsylvania's hazardous waste infrastructure is generally on par with the rest of the nation. The condition of hazardous waste infrastructure can be measured by evaluating the number of federally recognized contaminated sites (Superfund sites), quantifying the success of the Commonwealth's voluntary cleanup program (Act 2), and assessing the trend of hazardous waste management and handling in recent years. Each of these are discussed in more detail below.

National Priority Listing (Superfund Sites)

The U.S. Environmental Protection Agency's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) program, commonly referred to as Superfund, is designed to address highly-contaminated abandoned sites. Pennsylvania currently has 94 Federal National Priority List (NPL) sites, the third highest number in the nation behind New Jersey and California. The high number of NPL sites is largely an artifact of the Commonwealth's rich industrial history. NPL sites are addressed through a sequential process of site studies to determine the extent of contamination and options, implementing remedial actions, and removal from the NPL list (also known as "delisting").

Act 2 Land Recycling (Voluntary Cleanup) Program

Pennsylvania's award-winning Land Recycling Program (Voluntary Cleanup) aims to reduce land consumption and encourages the transformation of abandoned, idle properties into economic opportunities. Since its inception in 1995, the program has resulted in 5,665 site cleanups, with another 1,301 site cleanups in progress. $535 million in grants have been awarded to facilitate cleanups through the Department of Community and Economic Development (DCED), PADEP and Pennsylvania Infrastructure Investment Authority (PENNVEST) programs. Roughly 100,000 jobs have been created or retained because of the economic opportunities that have been provided by Pennsylvania's abandoned, idle properties. Pennsylvania continues to be considered a leader in brownfield redevelopment (remediation and reutilization of blighted properties) due to this program, Pennsylvania's Statewide Comprehensive Outdoor Recreation Plan 2014-2019 recommends that the Commonwealth restore and repurpose brownfields, abandoned mine lands, and other damaged lands for recreation and conservation purposes through at least five pilot projects. The plan notes that brownfield sites are a way to preserve history and reuse structures in new ways, such as restaurants, gathering places, education centers and for recreational purposes, such as ATV trails, bicycle trails, and fishing and riverfront access.

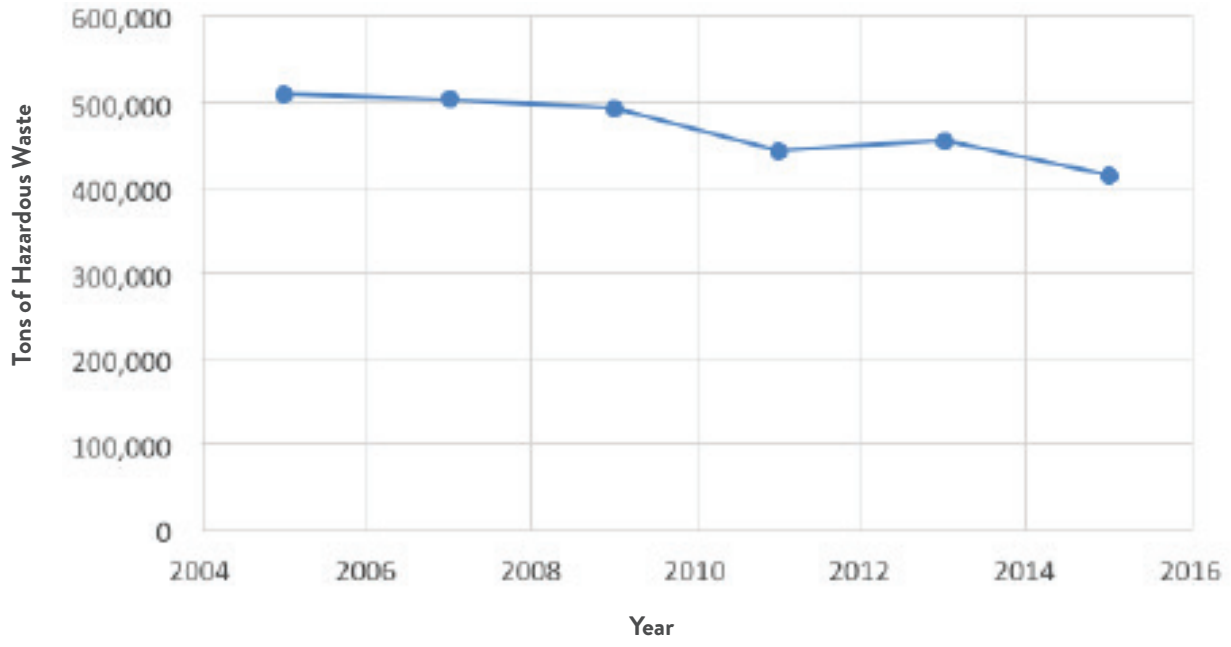
Hazardous Waste Generation/Management

As indicated in Figure 1, the annual quantity of hazardous waste generated in Pennsylvania has declined by approximately 18.5% over the past 10 years (2005-2015). The 2017 biennial report is due out later in 2018. The PADEP attributes this decline to a number of factors: technology, reducing potential future liability, maturity of regulations, growing commitment to environmental protection, and negative economic conditions impacting the chemical manufacturing and primary metals industries.

Hazardous waste that is not recycled or reused must eventually be treated and disposed, a process that occurs at treatment, storage and disposal facilities (TSDFs). The Commonwealth's environmental performance can be assessed in terms of the volumes managed at these permitted TSDFs and also how much hazardous waste is imported from other states or exported into the Commonwealth. Over the past

decade, an annual average of 470,000 tons of hazardous waste was managed in Pennsylvania TSDFs. Pennsylvania exported 264,000 tons of hazardous waste and imported 390,000 tons of waste for management in 2015, which is a slight reduction from the 2013 reporting year.

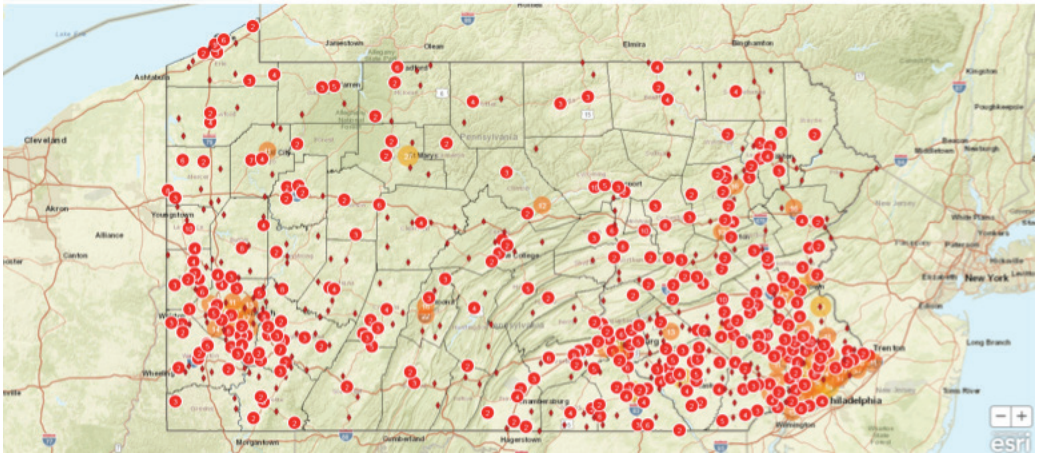
FIGURE 1. GENERATED TONS OF HAZARDOUS WASTE



Cleanup Sites

When sites in Pennsylvania contain regulated substances that do not allow for the unrestricted use the property, the PADEP keeps track of these locations using the Pennsylvania Activity and Use Limitations (AUL) Registry. In Pennsylvania, AULs are filed for voluntary cleanup sites (Act 2) and storage tank release sites that are remediated/mitigated via a standard other than the Statewide Health Standard. There are 2,801 AULs that have been recorded by the PADEP, as shown in Figure 2. Each AUL lists specific requirements for periodic monitoring and reporting; some are for annual reporting, while others allow reporting every three years, or no reporting at all. While the UECA requires recordation, there is no requirement or current mechanism to track the status of monitoring and reporting compliance.

FIGURE 2. CONTAMINATED STE ACTIVITY USE AND LIMITATIONS ACROSS THE COMMONWEALTH



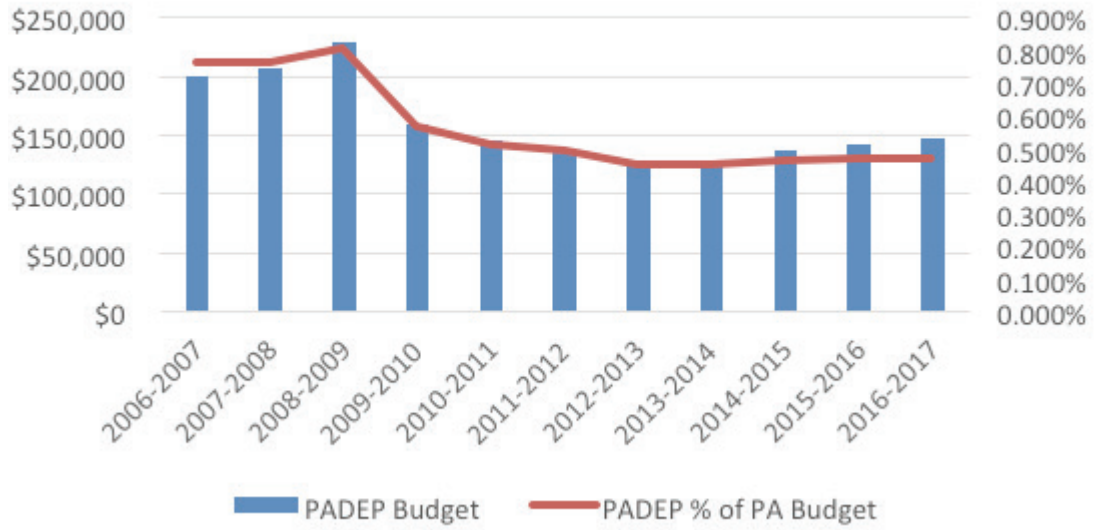
Source: http://www.depgis.state.pa.us/pa-aul/AulMap.html

FUNDING AND FUTURE NEED

Commonwealth PADEP Budget

Since 2014, the funding of PADEP from the General Fund has been on the rise and has slightly gained market of how money is allocated from the General Fund, as shown in Figure 3.

FIGURE 3. PADEP BUDGET (IN $1,000S) AND PERCENT OF PA BUDGET



The proposed fiscal year 2018-2019 budget for the PADEP includes $154.5 million from the General Fund and a total spending authorization of $722.4 million. This represents a 5.6% increase over the 2017-2018 budget. The proposal includes $229.1 million in special fund authorizations as well as $219.6 million in Federal spending authority.

A major focus of the budget is to increase staffing levels to meet Governor Wolf's commitment to reduce permit backlogs, modernize permitting processes, and utilize technology to improve permit reviews. The 2018-2019 budget request includes to increase the overall PADEP staff by 33 positions to 2,482 employees.

While it is a positive sign that the PADEP budget has increased over the past four budget years, the budget ($148 million in 2016-2017) still remains 40% below what it was 14 years ago ($245 million in 2003).

Contaminated Site Funding Opportunities

The Commonwealth provides various funding programs and other incentives with the mission to assist business, communities, and municipalities with environmental cleanups of contaminated sites. The table below summarizes these State programs:

- **Industrial Site Reuse Program (ISRP)** –Grants and loans up to $200,000 for environmental assessments; grants and loans up to $1 million for remediation.
- **Pennsylvania First Program (PA First)** - Comprehensive funding tool to facilitate increased investment and job creation within the Commonwealth. Funding can be used for infrastructure; land and building improvements; environmental assessment/remediation.
- **Business in Our Sites Grants/Loans (BOS)** – Funding covers site development activities required to make a site shovel-ready.

The Federal government also offers funding opportunities for entities (typically municipalities and not for profit organizations) to re-develop brownfields within the Commonwealth. In April 2018, the EPA awarded $2.7 million worth of grants to support seven brownfields projects in Pennsylvania for environmental assessment, revolving loan funds (RLF), and cleanups, as shown in Table 1.

The Superfund Program involves a state and federal partnership. The EPA has primary responsibility. EPA is obligated to consider and apply laws, standards and technical comments, and community concerns when making cleanup decisions. Pennsylvania finances 10% of a funded remedial action with the federal government contributing the remaining 90%. The commonwealth is responsible for 100%of the operation and maintenance costs after the remedial action is complete.

TABLE 1. EPA BROWNFIELD GRANTS AWARDED TO PA (APRIL 2018)

Lycoming County	$800,000	This funding will support the City of Williamsport and Muncy Borough, both of which have supported industry since the early 19th century due to their proximity to rail lines.
Butler County	$600,000	Assessments will focus on the City of Butler and Petrolia Borough. Funds will also support community outreach activities.
Clearfield County Economic Development Corp.	$300,000	Assessments will focus on mine-scarred properties in DuBois and Clearfield Boroughs.
Greene County Industrial Development Authority	$300,000	Assessments will target the municipalities of Monongahela, Waynesburg, and Cumberland.
Norristown	$300,000	Site assessments on properties that could be contaminated with petroleum or hazardous substances, and determine the feasibility for cleanup and redevelopment.
Earth Conservancy	$200,000	Cleanup of a 400-foot segment of Espy Run that runs through the City of Nanticoke and Hanover Township. Espy Run travels through mine-scarred lands once used for anthracite mining. The stream is impacted by sedimentation and acid mine drainage.
Lawrence County	$200,000	Assessment activities will target the City of New Castle's gateway corridors.

PUBLIC SAFETY, INNOVATION AND RESILIENCE

Pennsylvania has some of the most scenic and serene rivers and waterbodies, including the Susquehanna, Delaware, Schuylkill, Allegheny, Ohio, and Monongahela Rivers. Former industrial areas along these riverbanks and other water features are often home to brownfields. Revitalizing waterfront brownfield areas can provide people of the Commonwealth with safe access to greenspace and recreation opportunities. These areas can also play an important role in bolstering local resilience to increased flooding or temperatures from a changing climate.

In 2015, the Pennsylvania Climate Change Action Plan was updated from its original 2009 version. PADEP provides a report on the potential impact of climate change on human health, the economy and the management of economic risk, forests, wildlife, fisheries, recreation, agriculture and tourism in Pennsylvania. While this report does include a section on *Land Use: Brownfield Redevelopment (Chapter 5)*, the discussion focuses on the benefits of brownfields with regard to carbon sequestration via reuse of existing infrastructure and decrease use of greenfields (undeveloped open space). The report lacks a discussion on the need to incorporate climate resilient innovative features into redevelopment of these "climate vulnerable" properties. These resilient features can be resource intensive and may increase development costs; therefore, careful consideration of long-term goals, best practices, and financing opportunities to meet both a community's revitalization plans and its resiliency requirements is necessary.

RECOMMENDATIONS TO RAISE THE GRADE

- **Assess overall PADEP funding to determine if current environmental protection appropriations are preventing the PADEP from achieving its intended mission objectives (i.e. reduced hazardous waste generation, increased number of site cleanups).**
- **Add discussion in the PADEP Climate Change Action Plan to address long-term goals, best practices, and financing opportunities associated with brownfields and/or contaminated sites that are in "climate vulnerable" areas.**
- **Provide a mechanism to track the status of AULs and revise PADEP's AUL database to require the status of the monitoring/reporting with auditing verification to provide confidence in the continuing obligations.**

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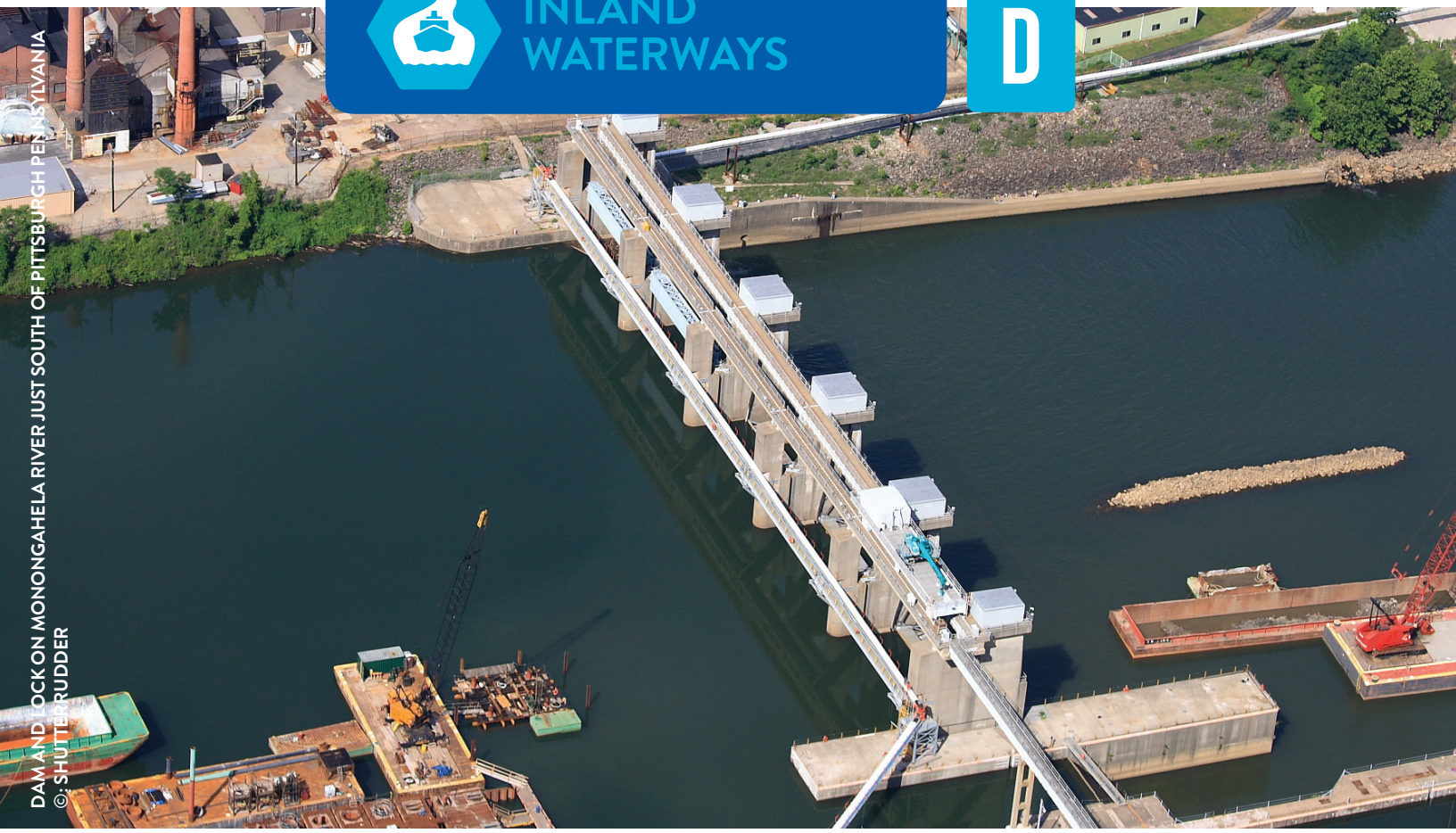


DAM AND LOCK ON MONONGAHELA RIVER JUST SOUTH OF PITTSBURGH PENNSYLVANIA
©: SHUTTERRUDDER

INLAND WATERWAYS

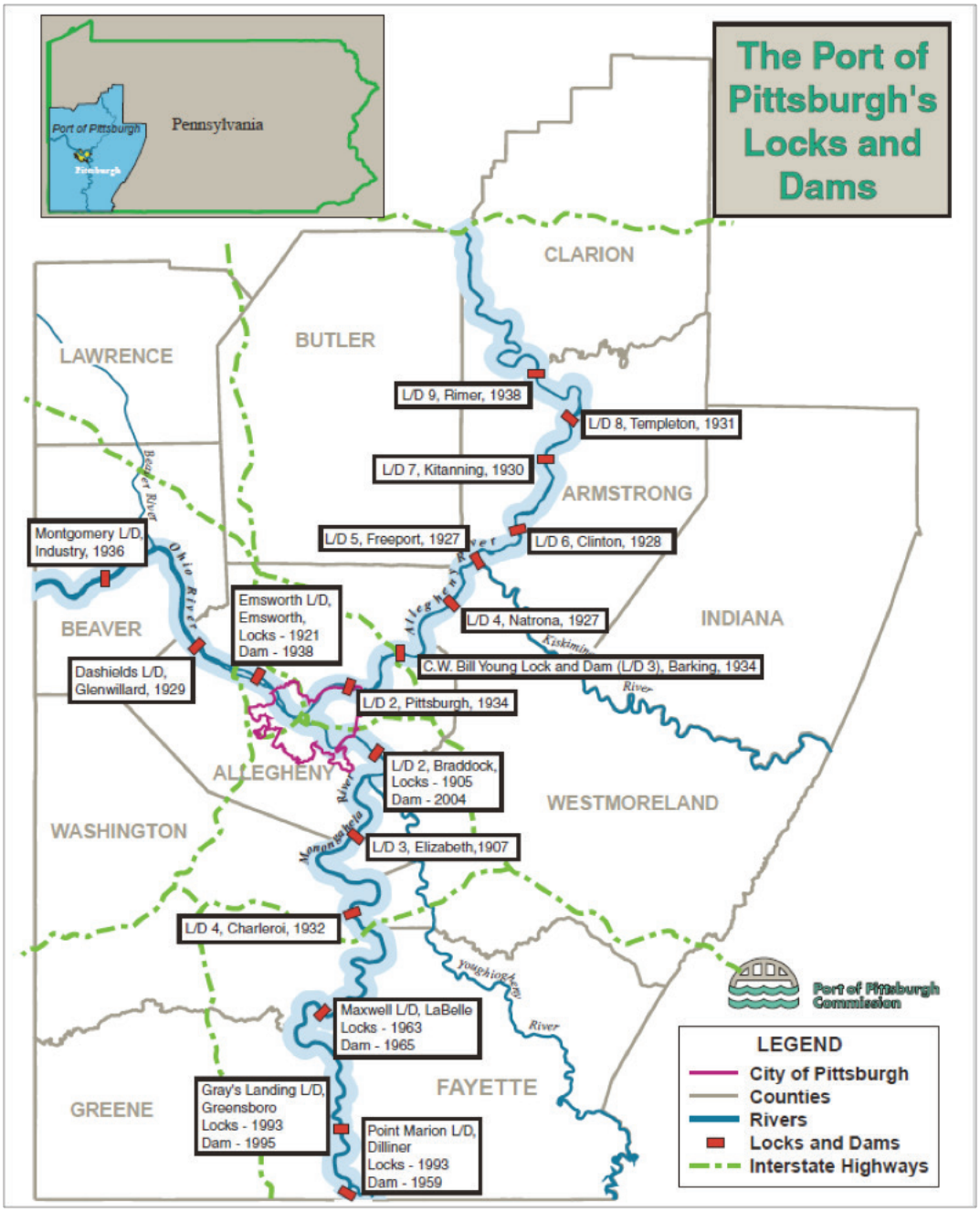
EXECUTIVE SUMMARY

The Port of Pittsburgh's Inland Waterways Navigation System consists of 17 locks and dams on the three major rivers that connect in Pittsburgh. Much of the infrastructure is 70 to 80 years old. Extended age and lack of consistent funding have allowed the condition of this system to deteriorate to the point that watercraft lockages have become severely impeded. Reduced hours of operation are in effect for several locks and dams along the Allegheny and Monongahela Rivers. While an increase in funding for the Olmstead project on the Ohio River is helpful, it has limited available funding for the remainder of the infrastructure. Meanwhile, inconsistent funding has caused project costs to increase from the original 1992 estimate of $750 million to the current estimate of $1.2 billion. Continued lack of sufficient funding could lead to a major lock and dam failure and loss of navigation for an extended period.

BACKGROUND

The Port of Pittsburgh inland navigation system serves twelve counties in Pennsylvania through 200 miles of navigable waterways and 17 locks and dams. Eight of these locks and dams are located on the Allegheny River, six on the Monongahela River, and three on the Ohio River. These are the only rivers considered to be inland waterways in Pennsylvania. There are 200 river terminals and barge industry suppliers, including privately owned terminals that depend on this navigation system. Advocacy for the region's waterways is provided by The Port of Pittsburgh Commission as designated by the Commonwealth of Pennsylvania. Ownership, as well as operation and maintenance of this navigation system, is the responsibility of the US Army Corps of Engineers (USACE), Pittsburgh District. Figure 1 shows the extent of the Port of Pittsburgh's Locks and Dams in Pennsylvania.

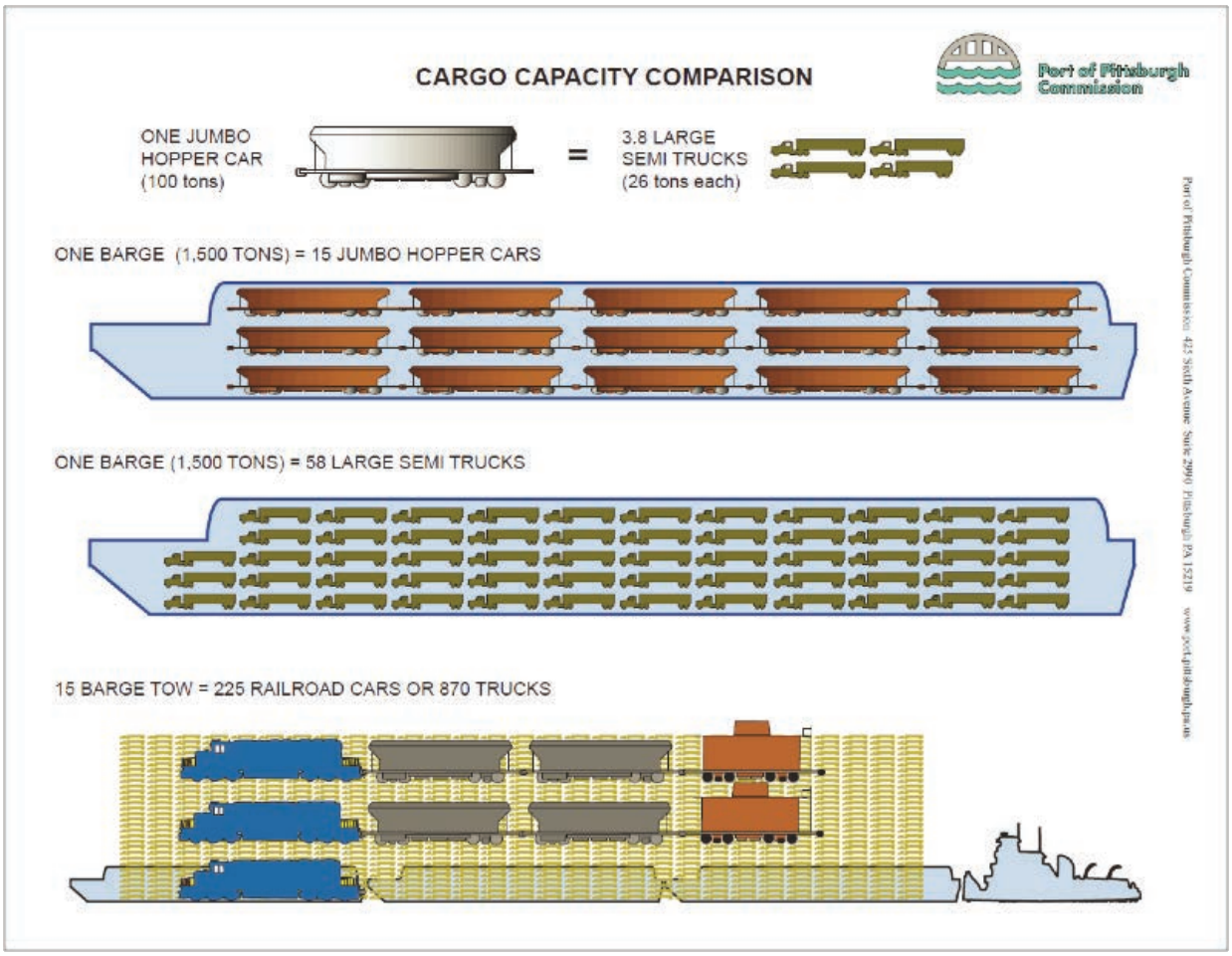
FIGURE 1. PORT OF PITTSBURGH'S LOCKS AND DAMS



CAPACITY

The Pittsburgh District initiated a feasibility study in 2017 to seek alternatives for future commercial use of navigation facilities on the Upper Allegheny and Monongahela Rivers. Figure 2 provides a cargo capacity comparison for rail, truck and barges. This study indicated that there had been a steady decrease in commercial river traffic as well as limited federal funding to support these systems. At the same time, operations and maintenance costs have increased as these structures age. Several locks and dams in the state are 70 to 80 years old, with the oldest exceeding 110 years. These assets continue to need extensive maintenance to function. Reduced hours of operation are in effect for Locks and Dams 5 thru 9 on the Allegheny River, and for the Morgantown, Hildebrand and Opekiska Locks and Dams on the Monongahela River. On the Ohio River, impediments to navigation continue due to the delay of repairs to the Montgomery Locks and Dam.

FIGURE 2. CARGO CAPACITY COMPARISON



CONDITION

The Upper Ohio Navigation System is facing critical problems due to the advanced age of its locks and dams. The Emsworth and Dashields Locks and Dams will have their primary lock chambers closed in spring 2018 for critical maintenance activities. Further impediments to navigation will continue well into the future as work progresses on lift gates at the Montgomery Lock and Dam. A failure of these gates could result in loss of the Pittsburgh Navigation Pool between Montgomery and Dashields Locks and Dams, and severely impact all navigation throughout the Pittsburgh navigation system.

Information reported in the Lock Performance Monitoring System (LMPS), Summary by River Basin for 2016, Table 1, shows that several locks and dams have experienced significant delays in locking vessels during that period.

TABLE 1. PA LOCK AND DAM DELAY STATISTICS

LOCK PERFORMANCE MONITORING SYSTEM SUMMARY BY RIVER BASIN - JANUARY - DECEMBER 2016							
Allegheny River							
Lock and Dam	**Loads / Year**	**K Ton / Year**	**Percentage of Delays / Vessels**	**Delays / Vessel (Hours)**	**Percentage of Delays / Ton**	**Delays / Ton (Hours)**	**# Closures**
L&D #2	3,402	1,259	4%	18.3	18%	2.3	5
C.W. Bill Young	2,460	1,252	18%	18.7	15%	4.2	0
L&D #4	1,777	194	9%	72.9	16%	22.3	2
L&D #5	1,313	79	5%	62.0	4%	61.0	1
	8,952	**2,784**		**171.9**		**89.8**	**8**
Monongahela River							
Lock and Dam	**Loads / Year**	**K Ton / Year**	**Percentage of Delays / Vessels**	**Delays / Vessel (Hours)**	**Percentage of Delays / Ton**	**Delays / Ton (Hours)**	**# Closures**
L&D #2	2,634	10,958	27%	38.0	28%	1.4	7
L&D #3	4,057	9,906	30%	220.0	30%	5.0	1
L&D #4	4,623	8,039	29%	71.0	31%	1.4	11
Maxwell	2,353	4,819	12%	8.0	15%	0.4	27
Grays Landing	1,677	3,752	7%	5.0	6%	1.0	1
Point Marion	1,533	3,771	10%	2.0	9%	0.4	1
	16,877	**41,245**		**344.0**		**9.6**	**48**
Ohio River							
Lock and Dam	**Loads / Year**	**K Ton / Year**	**Percentage of Delays / Vessels**	**Delays / Vessel (Hours)**	**Percentage of Delays / Ton**	**Delays / Ton (Hours)**	**# Closures**
Emsworth	2,804	12,110	22%	177.0	37%	2.7	16
Dashields	2,901	11,840	33%	99.0	33%	3.1	9
Montgomery	3,510	11,478	68%	190.0	70%	2.0	91
	9,215	**35,428**		**466.0**		**7.8**	**116**

Construction work and condition at the Maxwell and the Montgomery Locks and Dam facilities are quite dramatic in terms of both closures and delays per ton. Even at the remaining locks, there are extensive delays that are caused by the dam closures. See Figure 1 for a geographical representation of the Port of Pittsburgh Locks and Dams.

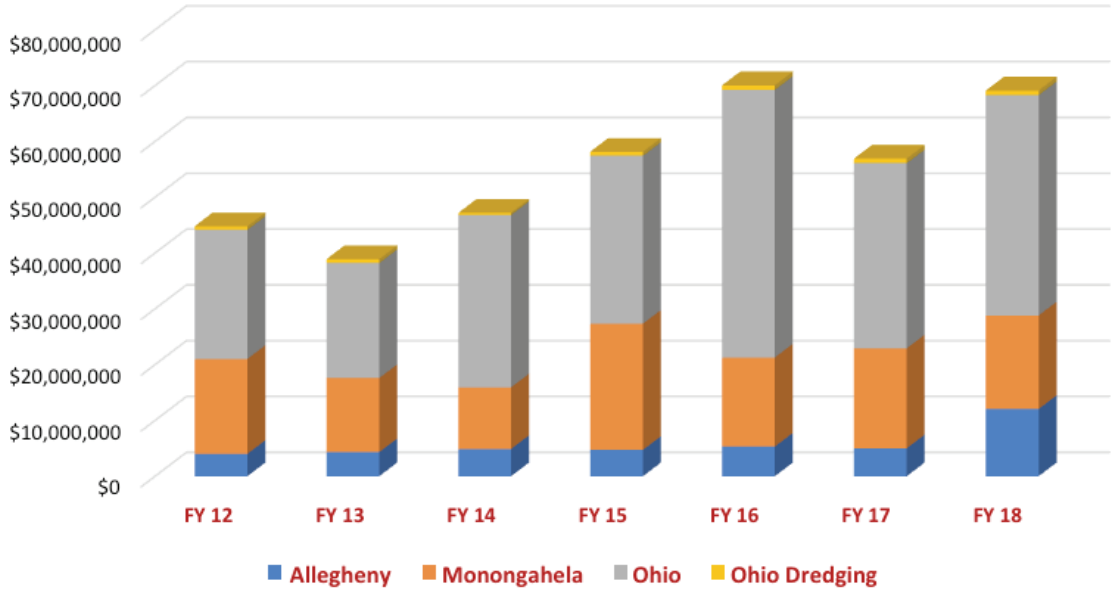
The Lower Mon Project is currently in multiple phases including planning, design, construction and completion. The project is driven by the conditions of the facilities. Work currently under construction consists of replacing Lock and Dam #2 at Braddock, replacing the locks at Lock and Dam #4 in Charleroi, and removing the 110 year old Lock and Dam #3 in Elizabeth. Lock and Dam #2 was replaced, and the new Braddock Dam was put into operation in 2004 as part of the Lower Mon Project.

The remainder of the project includes completing the river chamber at Charleroi, dredging between Elizabeth and Charleroi, and removal of Lock and Dam #3. The Project also includes a new land chamber at Charleroi which at this time is planned to be deferred into the future (25-50 years out) unless traffic warrants construction sooner. Improvements consist of removing Lock and Dam #3 which eliminates a lockage and creates a longer pool from Braddock to Charleroi, larger 84' x 720' chambers at Charleroi, and newer facilities. Once complete the river levels will rise a nominal 5' above Braddock and drop 3.2' from Elizabeth to Charleroi. The long-term benefits of these changes will result in a 30-mile unimpeded navigation pool between Braddock and Charleroi.

FUNDING

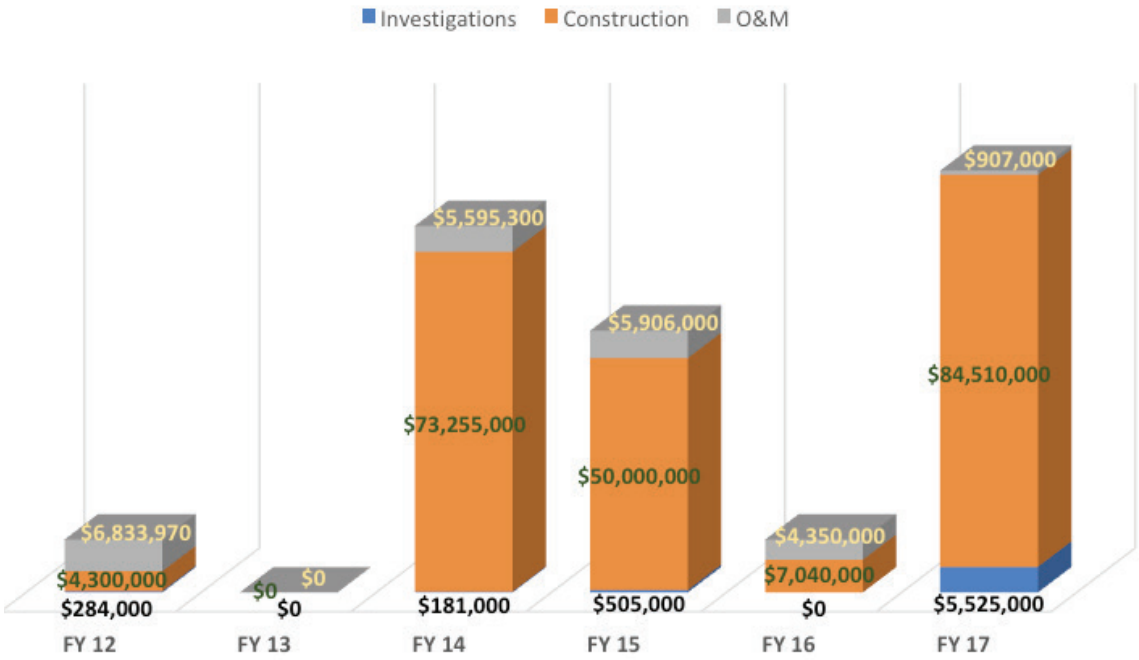
Operation and Maintenance (O&M) line items in the Federal budgets, shown in Figure 3, for FY 2012-FY 2018, showed slight increases for the Allegheny River Navigation System from $4 million to $12 million. The Monongahela River System remained relatively flat, going from $17 million in FY 2012 to nearly $23 million in FY 2015, then dropping to under $17 million in FY 2018. The Ohio River System experienced an increase from $23 million to nearly $48 million between FY 2012 and FY 2015, then saw a drop to just under $40 million in FY 2018.

FIGURE 3. TOTAL SPENT PER FISCAL YEAR – ALL PROJECTS



As shown in Figure 4, actual work history during this same period showed a large increase in spending on investigations from $284 thousand to $5.5 million. Similarly, construction spending rose from $4.3 million to $84.5 million. However, operations and maintenance funding during this same period dropped from $6.8 million to $900 thousand, which results in additional deferred maintenance and potential closures.

FIGURE 4. WORKPLAN HISTORY – ALL PROJECTS



The President's proposed $23 billion Civil Works Budget for FY 2019 includes only $70 million for O&M of the Pittsburgh District's navigation needs. This proposed FY 2019 construction budget would essentially halt the long-delayed work on the Lower Mon Project between Elizabeth and Charleroi. Delays on project funding for this critical project have caused costs to increase from the original 1992 estimate of $750 million to the current estimate of $1.2 billion. As of the time of this report, the House has passed the FY 2019 Energy and Water Development Appropriation that would provide a healthy increase to the Administration budget. The bill is now pending Senate action.

FUTURE NEED

The most pressing funding needs within the Pittsburgh District are to adequately fund the Lower Mon Project between Braddock and Charleroi and to complete the critical gate and lock chamber repair work at the Montgomery Locks and Dam. As mentioned above, the President's Proposed Budget for FY 2019 does not adequately address the Lower Mon Project, and reduced O&M budgets threaten to slow needed gate repairs at Montgomery Locks and Dam. Benefits of the Lower Mon Project are estimated to be $220 million/year. Costs to date have been $533 million of the total estimated $1.2 billion.

For the Upper Ohio River, there is an estimated cost of $2.7 billion to replace undersized and aging lock chambers at the Emsworth, Dashields, and Montgomery Locks and Dams. Funding allocations for the Upper Ohio River projects are competing with other dilapidated navigation structures on the Illinois and Upper Mississippi rivers. The President is calling for additional funding to be raised from the private sector shippers that use the waterways.

PUBLIC SAFETY

It has been estimated that loss of a key lock and dam, such as that at Elizabeth, could result in a major shift in the transportation of coal and coke to the local roadway and rail systems with significant impact, see Figure 2 for a cargo capacity comparison.

To place current tonnage levels onto local roadways would require one truck every 1.5 minutes and a continuous stream of trains carrying coal and coke through the region. Public safety could be severely impacted in the event of lock and dam closures for lengthy periods as more traffic is thrown on local roadways and additional rail crossing sites will pose increased danger to vehicular traffic.

RESILIENCE

Scheduled lock and dam maintenance operations are usually planned to minimize impacts upon river traffic. Failure of a lock for a long period of time would not severely cripple navigation since there are two chambers available. However, the Charleroi lock on the Monongahela River has had to operate with only one chamber for the past 14 years.

Failure of a river navigation dam would have devastating consequences on barge traffic. The potential for this is strong at the Elizabeth and at the Emsworth Lock and Dams facilities. As mentioned earlier in this report, the Montgomery Locks and Dam is subject to a potential lift gate failure which would result in loss of navigation from there well into the Pittsburgh navigation pool.

INNOVATION

The Pittsburgh District is incorporating several innovative concepts into the Lower Mon Project and Upper Ohio River Project. Innovations may include the use of high strength concrete and steel plating to repair cracks in the middle walls between lock chambers. Innovative design/build contracting methods are being considered to improve the commercial and technical delivery of the projects by contractors. It is critical that the construction operations be sequenced so as to not close navigation in that stretch of the river for any extended period of time.

RECOMMENDATIONS TO RAISE THE GRADE

- **Continue efforts by the Pennsylvania Congressional Delegation, the Port of Pittsburgh Commission and the USACE to promote, secure and effectively manage legislation and funding to operate and maintain the Pittsburgh Inland Navigation System.**
- **Congress should allocate sufficient funding in the FY 2019 Budget to complete the Lower Mon Navigation Project. They should also authorize additional funding of this project by increasing the barge fuel tax and user fees as needed.**
- **Congress, in conjunction of the USACE, should prioritize maintenance of federal assets, such as locks and dams on a national level, making resilience to natural disasters, increased flood frequency, and climate change a condition of spending.**

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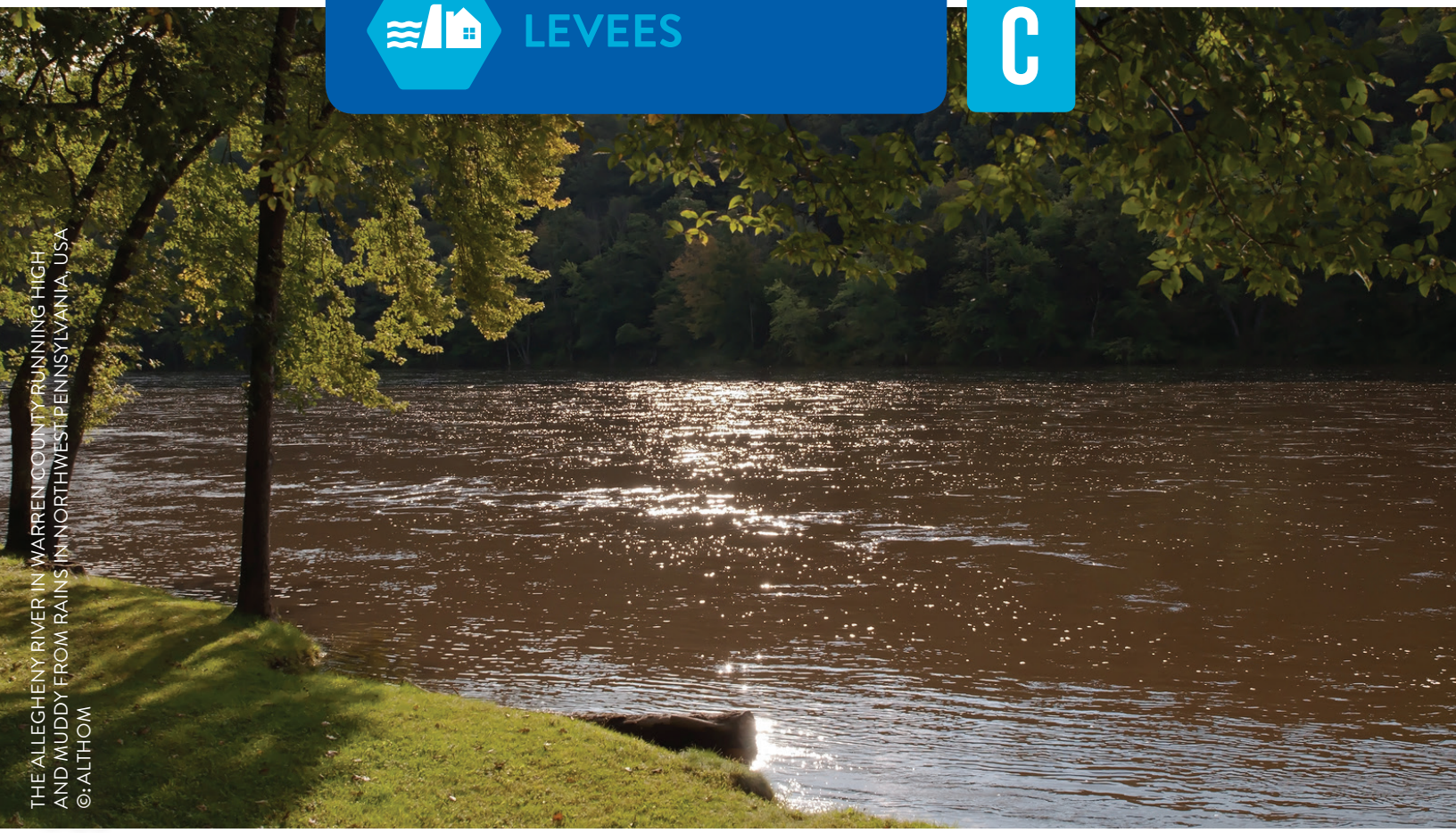

THE ALLEGHENY RIVER IN WARREN COUNTY RUNNING HIGH AND MUDDY FROM RAINS IN NORTHWEST PENNSYLVANIA, USA
©: ALTHOM

LEVEES

EXECUTIVE SUMMARY

With two new levee systems in Bloomsburg and Mt. Carmel constructed since 2014, and five new systems and seven rehabilitations currently under design, Pennsylvania is expanding and modernizing its levee infrastructure. Meanwhile, the US Army Corps of Engineers (USACE) substantially improved its online National Levee Database and over the past four years has expanded the National Levee Safety Program to include inspections of non-state, non-Federal levees and a hazard potential classification system. Yet, there is a growing need to rehabilitate aging levee systems, an often-underappreciated threat to flood-prone communities, and a need to re-evaluate levee designs based on outdated flood frequency statistics. In addition, municipalities that own and manage most levees often lack expertise needed to expedite needed rehabilitations. With the average age of levees in Pennsylvania approaching the typical design life of a levee system, further action is needed to keep Pennsylvanians safe from flooding.

BACKGROUND

Prior to the mid-20th century, much of Pennsylvania's population growth occurred in the floodplains of our state's 45,000 miles of rivers and streams. Early communities and industrial sites were built in floodplains before our predecessors fully recognized flood risk. As these communities grew, engineering solutions to flood protection arose, including the construction of levees.

FIGURE 1. BLOOMSBURG LEVEE SYSTEM COMPLETED IN 2015

A levee is a man-made embankment, built to provide flood protection from temporary high water. Flood levees are typically linear structures constructed adjacent to a river for the purpose of preventing water from overflowing the river channel and spreading into the flood plain. They are typically complex systems, which include pump stations, roadway gates, and relief wells (which help protect levees from damaging seepage during floods). The average age of the approximately 163 miles of levee systems in Pennsylvania is over 50 years, the typical design life of a levee system. The most recent system, Bloomsburg (Figure 1), was completed in 2015. The oldest system, Morrisville (Figure 2), was constructed in 1939.

The National Flood Insurance Program (NFIP) was established by the Flood Insurance Act in 1968 to provide insurance coverage to flood-prone properties, which private insurers would not cover. In 1973, the NFIP adopted the "100-year floodplain" as the basis for insurance. The 100-year flood (i.e., an average recurrence interval of 100 years) has a 1% probability of being exceeded in any given year.

From 1978 through January 2018, the NFIP paid $1.2 billion in flood loss claims in Pennsylvania out of $67 billion worth of claims paid nationally. Among non-coastal states, Pennsylvania ranks first in flood loss claims. Municipalities in Pennsylvania with the largest claims are Bloomsburg, Columbia County ($31 million – Susquehanna River); Harrisburg, Dauphin County ($28 million– Susquehanna River); West Pittston Borough, Luzerne County ($27 million – Susquehanna River); and Yardley Borough, Bucks County ($25 million – Delaware River).

FIGURE 2. THE MORRISVILLE LEVEE SYSTEM IS THE OLDEST CONSTRUCTED LEVEE IN PENNSYLVANIA.

CONDITION AND CAPACITY

Levees and associated features such as pump stations deteriorate over time due to erosion, corrosion, weathering, scour, settlement, deformation, and degradation. Regular maintenance and periodic rehabilitation are needed to ensure that they retain their design level of protection and function. These can become expensive as a levee system ages.

The USACE has authority under Public Law 84-99 to financially supplement local efforts to repair/rehabilitate qualified public levees whether it is federally constructed or not. To be eligible for assistance, the levee must meet criteria set forth by the USACE and must be inspected and evaluated on a regular basis (approximately every two years).

In Pennsylvania, there are 117 levee systems in the USACE Portfolio constructed via the Federal or State Flood Protection Programs:

LEVEE SYSTEM TYPE	NO. OF LEVEES
State Constructed, Locally Operated and Maintained *	74
Federally Constructed, Federally Operated and Maintained	13
Federally Constructed, Locally Operated and Maintained	30

There are also 64 levee systems within Pennsylvania not in the USACE Portfolio. These are mostly small and/or in poor condition. An exception is the new system in Bloomsburg, constructed by the municipality, using a variety of state and federal grants. The Bloomsburg Levee is in the process of being enrolled in the USACE Rehabilitation Program.

The status of the levee systems included in the USACE Portfolio are as follows:

PORTFOLIO LEVEE STATUS	NO. OF LEVEES
Acceptable	6
Minimally Acceptable	59
Unacceptable	43
Data Not Available	9

The terms "Acceptable" or "Minimally Acceptable" state a condition that means the levee meets engineering and maintenance standards. The term "Unacceptable" indicates a condition that would prevent the levee segment or system from performing as intended, due to poor maintenance or features that have deteriorated due to age. The results shown are not readily comparable to the 2014 Pennsylvania Report Card results partly because increased use of video inspection has allowed inspectors to find more defects than in previous years.

FUNDING AND FUTURE NEEDS

Capital funding for flood control projects in Pennsylvania comes primarily from four sources:

- Federal legislative appropriations administered by the USACE;
- State legislative appropriations administered by the Departments of Environmental Protection (PADEP) and General Services (DGS);
- Pennsylvania Act 13 grants; and
- Local matches from municipalities, counties, or authorities.

Since the maintenance/operation responsibilities for most systems are borne by municipalities or counties, comprehensive data on the extent of needs and estimated costs of such needs is not readily available. Funding and rehabilitation decisions for these locally-owned levees are handled independently. The main exceptions are federally-operated systems in York, Mansfield, and Johnstown.

Available information on legislative appropriations in coming years indicates significant rehabilitation on at least two federal levee systems ($2.5 million for Johnstown and Punxatawney) and five state-funded levee systems ($20 million programmed for state systems). Additionally, $50 million in state funding is programmed for five new or expanded systems.

Independent of legislative funding, state grants are available for capital projects under Pennsylvania Act 13 of 2012. Act 13 uses a portion of unconventional oil and gas well impact fees to provide grants up to $500,000 with a minimum 15% match from local sponsors. In general,

rehabilitation or major repairs of a flood protection system easily exceed the $500,000 grant limit. The average grant size falls shy of the grant limit at $240,000. At these funding levels, it is difficult to provide needed improvements efficiently. Larger grants would provide a better economy of scale and result in a better return on investment.

In addition, many municipalities lack the specialized expertise needed to plan, fund, design, obtain permits, acquire right-of-way, and administer construction contracts for major levee rehabilitations. Such projects could occur more quickly and efficiently if assistance were available either through a state agency such as the Department of Environmental Protection or through formation of a levee managers' association.

Adding to future flood risks are changing weather patterns and uncertainty in flood-frequency estimation. Unlike some parts of the country, statistics show flood magnitudes growing in eastern Pennsylvania while diminishing slightly in the western side of the state.

PUBLIC SAFETY & RESILIENCE

Emergency managers need accurate and early flood forecasting to protect citizens. Early warning depends on data collection and analysis performed by the National Oceanic and Atmospheric Administration, the U.S. Geologic Survey, and the USACE. It is imperative that these services continue to receive predictable, adequate funding. Local emergency managers also need periodic updates of complex Emergency Action Plans and training to be prepared for floods. Procedures to handle flooding emergencies should be addressed in Pennsylvania's municipal and county Emergency Operations Plans in coordination with the Pennsylvania Emergency Management Agency. PADEP publishes guidelines for levee-specific Emergency Action Plans (EAPs) but there is no requirement to keep them updated. About half of EAPs for state projects have not been updated in over five years.

Failure of a levee exposes the community to risk of flood catastrophe each day the levee is out of service. The magnitude of risk and potential for catastrophe determine the urgency of making repairs. Progress is being made to consider resiliency in community planning and zoning.

INNOVATION

Many approaches can be taken to address flood risk in addition to or in place of levees. Measures such as watershed-wide stormwater management, floodplain protection/restoration, buyout/relocation of properties with high flood insurance risk, enlargement of bridge openings, ice jam mitigation structures, raising of flood prone structures/mechanical/electrical systems, and smart growth strategies to encourage relocation out of the floodplain should all be considered comprehensively.

RECOMMENDATIONS TO RAISE THE GRADE

- State legislation to establish a statewide levee safety program, which would allow for non-structural alternatives.
- Continue real-time updates of the National Levee Database to include inspection data and new systems as they are added or discovered.
- Continue state and federal legislation to provide capital funding for rehabilitation and needed expansion of flood protection projects including restoration of a line item for such in the state budget. Current funding levels for levee rehabilitation need to increase to bring a significant portion of the state's levees into acceptable condition.
- Increase the size of Act 13 grants funding for levee engineering studies, improvements, upgrades, and non-routine maintenance.
- The Pennsylvania Emergency Management Agency should engage levee experts to help confirm that Emergency Action Plans are complete and up-to-date.
- Require operation/maintenance plans for non-state, non-federal levees. All aspects of levee systems should be addressed.
- The USACE 84-99 Rehabilitation Program and PADEP Completed Projects Section provides a critical public safety service to protect against extreme floods. State and Federal legislative bodies should seek comprehensive reporting from these agencies concerning long-term funding needs.
- Continue to implement the FEMA's new levee mapping and analysis program as outlined in the National Flood Insurance Program reform bill. This remains to be fully funded.
- To reduce the need for levees, the Department of Environmental Protection should limit placement of fill in floodplains under the waterways permitting program.
- Locally-owned levee rehabilitation often lags because local governments lack expertise needed to acquire right-of-way, obtain permits, select appropriate consultants, administer contracts, and manage construction. Creating a levee manager's association or making available staff from state agencies could help. It might also allow several owners to combine work into larger contracts to get better unit prices.

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PARKS & RECREATION

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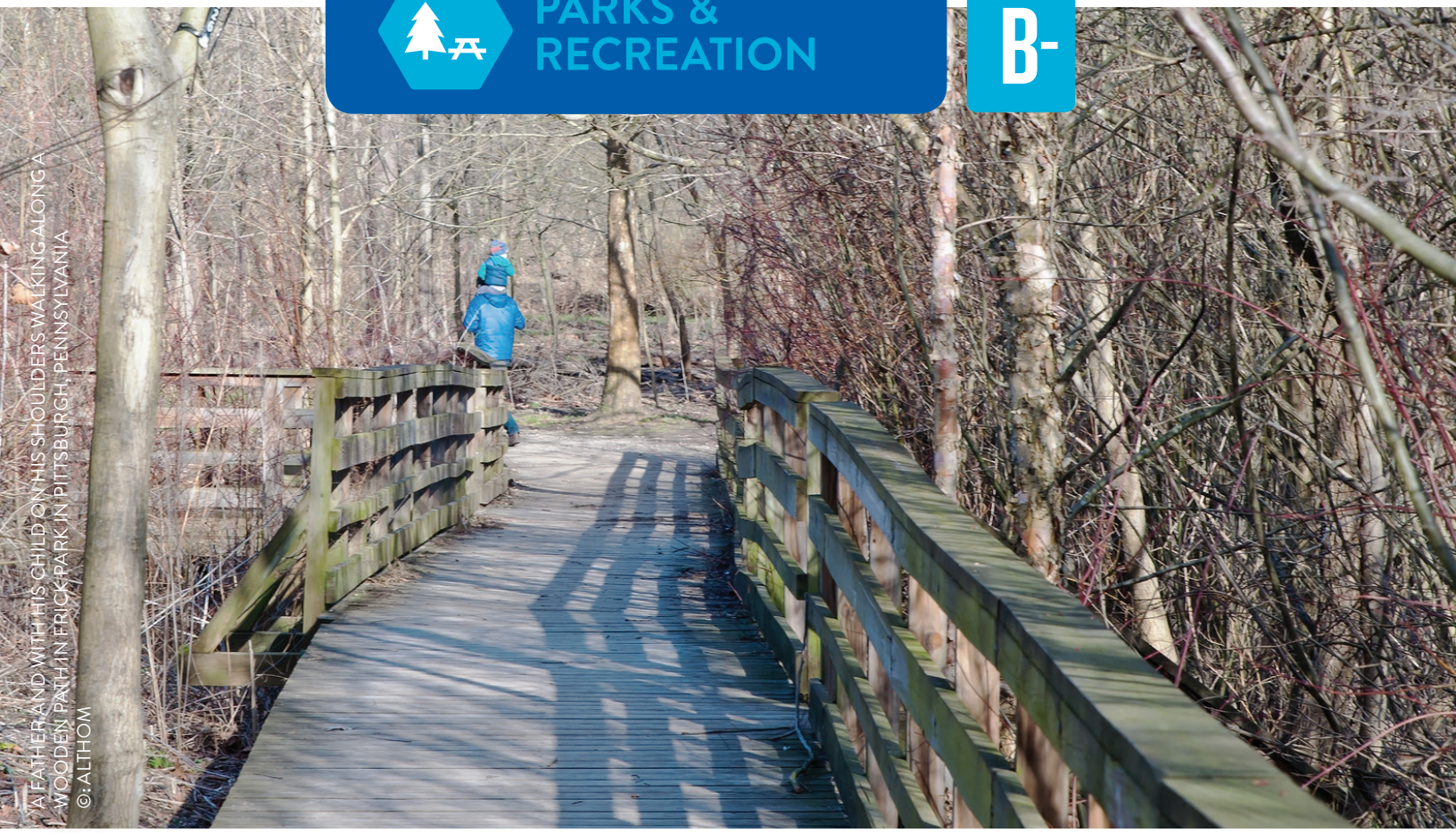

A FATHER AND WITH HIS CHILD ON HIS SHOULDERS WALKING ALONG A WOODEN PATH IN ERICK PARK IN PITTSBURGH, PENNSYLVANIA

©: ALTHOM

PARKS & RECREATION

EXECUTIVE SUMMARY

Pennsylvania is home to more than 3.75 million acres of dedicated parks and recreational areas, including national trails and areas, recreational reservoirs and numerous county, municipal, and city parks. Overall capacity grew to accommodate the 44.5 million parks visitors in 2017 and the Commonwealth ranked fifth in the nation for how much users spend on outdoor recreation. However, national, state and local parks have significant needs. The Statewide Comprehensive Outdoor Recreation Plan 2014-2019 found state parks require $783 million to bring the system back to a state of good repair. The Pennsylvania Department of Conservation and Natural Resources (DCNR) has embraced new funding methods, via the Marcellus shale gas operation, and implemented long-range planning strategies such as the PA Outdoor Recreation Plan. While overall state-wide funding may be holding strong, fluctuating budgets put some municipalities in a difficult position when trying to keep up with their increased needs.

BACKGROUND

Approximately 11% of Pennsylvania's land is dedicated to parks & recreation, and the Commonwealth is a national leader in usable outdoor spaces. This land is overseen by multiple large organizations, such as the Department of Conservation and Natural Resources (DCNR), the U.S. Army Corps of Engineers (USACE), and the U.S. National Park Service (NPS), as well as countless smaller municipalities and non-profit agencies. Pennsylvania is home to more than 3.75 million acres of dedicated parks and recreational areas. This includes five national trails, seven national heritage areas, 27 natural landmarks, 121 state parks, 20 state forests, 79 USACE recreational reservoirs and recreation areas, and numerous county, municipal, and city parks.

CAPACITY & CONDITION

In 2017, more than 44.5 million people visited Pennsylvania's park systems. 17% of Pennsylvania's $41 billion tourism industry is attributed to recreation. In 2017, the Commonwealth ranked fifth in the nation for how much users spend on outdoor recreation.

Since 2014, Pennsylvania has been working hard to increase the total length of trails available to its citizens, increasing to 12,000 miles of trails, over five times the length of the entire Appalachian Trail. Each year, the state sees a greater number of citizens flock to these outdoor spaces, such as the 300,000 people who visit the Elk Country Visitors Center to witness the largest elk herd in the Northeast each year. Attractions like this have great economic potential for the surrounding towns and are a wise return on investment.

Pennsylvania has made multiple long-term plans for its park systems. The Statewide Comprehensive Outdoor Recreation Plan 2014-2019 outlines ways the state can capitalize on its assets to the benefit of its citizens, via natural resource protection, increased park and facility funding, and heritage tourism. These recommendations include identifying and closing 10 priority trail gaps, utilize GIS to track conservation progress, and improve ADA Access and universal design when updating state facilities. This plan was put into place with assistance from over 10,000 citizens and their organizations throughout the state and included input from the National Park Service and the U.S. Department of the interior.

FUNDING AND FUTURE NEED

Pennsylvania parks have seen a small upturn in income sources after the relative downturn of the past decade, and parks & recreation assets are in need of this additional funding. Whether through traditional avenues like usage fees and taxes, or environmentally friendly land lease agreements, Pennsylvania must continue to invest in its plentiful natural resources.

State forests continue to face increased maintenance costs due to pest and invasive species control, forest fires, and capital costs for replacing service infrastructure. The average local parks and recreation director has only seven full time staff to serve the needs of their parks.

Funding across the commonwealth has fluctuated in recent years, decreasing in some areas of the state but growing in others. Since 2014, the majority of local parks saw their tax-supported budgets either maintained or decline up to 29%. In 2018, the City of Pittsburgh Department of Parks & Recreation saw a nearly 13% cut in their funding from the previous year, while the City of Philadelphia Department of Parks and Recreation realized an increase of only 1.5%. On the state level, annual DCNR grants have increased by 33% since 2014, due in part to the growth of their revenue resources. Pennsylvania's overall parks budget, however, has only increased 3.8% from the previous year, at least keeping ahead of inflation. While some larger government organizations have also had their funding reduced, the overall Parks and Recreation funding for the state has been relatively maintained.

However, these budgets do not necessarily match the needs of the State's park system as they continue to grow. The Statewide Comprehensive Outdoor Recreation Plan 2014-2019 indicates that there is a $783 million need in Pennsylvania for parks and recreation funding. Compared with the $142 million DCNR budget in 2018, this represents a serious underfunding of our infrastructure and outdoor space needs.

While state and federal parks both receive funding through entrance fees and taxes, additional income sources are needed to fully fund all of their expenses. The Land & Water Conservation Fund has been a consistent source of funding for Pennsylvania, with over $3 million going to Pennsylvania in 2016, but the Fund is set to expire in 2018. While the State's natural gas and timber reserves are already being

mined and harvested, Pennsylvania abounds with natural resources that could be monetized to fund Parks & Recreation efforts. However, much care needs to be taken to ensure that these income streams do not present negative environmental impacts to their surrounding areas, or the parks themselves.

The Marcellus shale development in western Pennsylvania is an example of a natural resource that can be harnessed for greater benefit. Natural gas activity takes place on approximately 700,000 acres of state forest, with DCNR Bureau of Forestry ecologists, botanists, geologists, and others working to minimize and mitigate any environmental impacts.

Pennsylvania timber is a sought-after commodity, with approximately 15,000 acres harvested each year across the state forest system, which both provides revenue for the state and enhances forest health and diversity, if done appropriately. Regulations must be maintained to ensure these resources are properly stewarded and environmentally harvested. To that end, timber harvest in Pennsylvania must be certified by the Forest Stewardship Council to be managed in an environmentally responsible manner.

There are also many funding sources that could be realized by Parks & Recreation organizations that are not necessarily allocated for outdoor spaces, such as the Rebuild Philadelphia project's $500 million program for revitalizing neighborhood parks, recreation centers, playground, and libraries across the city. Currently, the Rebuild program is to be funded by a tax on sweetened beverages enacted by the City, and while there was litigation slowing the release of these funds, the PA Supreme Court upheld the tax in July 2018.

As a leader in the nation's outdoor citizen participation, Pennsylvania needs to set the example for growth of its Parks & Recreation resources to the rest of the country. While deferred maintenance and replacement costs are expected to rise, capital improvement projects such, as The FDR Park Master Plan and subsequent implementation, should not be overlooked. They offer to revitalize the parks and their surrounding economies and offer health benefits to their users.

RESILIENCE & PUBLIC SAFETY

As a natural resource, many of Pennsylvania's parks are either resistant to many environmental hazards, like drought or hurricanes, via adaptable and diverse ecosystems, or their impact is part of the life-cycle of the resource. The state must remain cognizant of certain risks, such as invasive pest and wildlife species, forest fires, and the effects of climate change. In these areas, resources need to be allocated to ensure proper preventative maintenance is performed, and to study and anticipate changing conditions throughout Pennsylvania's forests and parks. Park infrastructure is also subject to resiliency issues, as many park assets are reaching the end of their expected design lives due to lack of funding and maintenance. Sustainable design both for these assets and the parks in general needs to be considered when making funding decisions across the state.

Invasive species pose a particular risk to the State. The Spotted Lanternfly is one such species, an insect native to China, India, and Vietnam. Pennsylvania's Department of Agriculture has issued quarantine zones across the state where the species has been identified, and many municipalities have campaigns to target and remove the Spotted Lanternfly and its eggs from trees and foliage.

These decisions also need to consider the safety of the public. While there are inherent dangers of the outdoors that users deal with on a regular basis, there are components of state and federal parks that are within the control of the state. Recreation infrastructure, such as the USACE reservoirs and park rental equipment, must be adequately maintained and inspected to ensure the public is not put at risk.

INNOVATION

Maintenance of existing programs and infrastructure is not enough to keep Pennsylvania as a leader in outdoor recreation. The state needs to embrace new ideas of income-generating unique services to offer its citizens. The utilization of new, sustainable construction materials, in order to reduce maintenance needs, is a scalable method of reducing long term costs. The state could also invest in renewable energy to power its park facilities and achieve a net zero electricity usage, such as Fort Washington State Park's recent addition of a ground-mounted solar array.

Finding new ways to minimize expenses that are not common among Parks & Recreation organizations is also worthwhile. Many large-scale funding issues might be solved by considering public-private partnerships for capital projects. This would gain some of the benefits of privatizing publicly owned assets while still maintaining ownership and final operating control.

RECOMMENDATIONS TO RAISE THE GRADE

- **Fully re-authorize the Land and Water Conservation Fund.**
- **Take advantage of public-private partnerships to complete large capital projects and decrease ongoing maintenance costs.**
- **Continue to market Pennsylvania outdoor spaces to attract PA citizens and out-of-state visitors to the many parks and forests throughout the state.**
- **Utilize and reinvigorate Pennsylvania's volunteer base by motivating communities to take ownership of their parks and take pride in their appearance.**
- **Increase state funding to DCNR and local Parks & Recreation groups, through state-funded capital investments, utilizing alternate funding sources like local grant programs, and investing in long-term cost saving measures like renewable energy and sustainable construction materials.**

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PASSENGER RAIL

EXECUTIVE SUMMARY

While safe to continue operations, much of Pennsylvania's passenger rail infrastructure is over 80 years old and is in need of on-going repairs and/or replacement. Passenger Rail agencies have demonstrated commitment to safety with advancement of Positive Train Control (PTC) installation within the federally mandated deadlines, which will help prevent major accidents and save lives. When Act 89 was passed in 2013, passenger rail agencies were quick to respond with additional construction to rebuild the system and explore longer term efforts to increase capacity. The demand for passenger rail service continues to grow across Pennsylvania and should be studied further, particularly in the western part of the state, to maximize ridership opportunities. Continued funding is needed to improve existing infrastructure and provide expanded service throughout the state.

BACKGROUND

Passenger rail existed in the United States as early as 1827 and originated in eastern Pennsylvania. Private railroads struggled to compete with the Interstate Highway System and commercial aviation and, in 1971, Amtrak took over passenger rail services across the United States. Amtrak is federally funded and remains the sole intercity passenger rail entity in the continental United States. Commuter rail systems have developed throughout the United States; in Pennsylvania, the most prominent of these regional agencies is the Southeastern Pennsylvania Transportation Authority (SEPTA) which was established in 1964 and assumed operation of passenger rail service in 1983. SEPTA operates passenger rail, along with a variety of other services, across five counties in and around the Philadelphia area and into New Jersey and Delaware. Passenger rail services outside of the Northeast Corridor (NEC), including most areas west of Harrisburg, are operated by Amtrak over rights of way owned and maintained by freight railroads. In 2008, the Northeast Corridor Commission (NECC) was created to develop coordinated strategies for improving the Northeast's core rail network between Virginia and Massachusetts, and on the Keystone Line between Philadelphia and Harrisburg. Figure 1 below highlights the various passenger rail lines in Pennsylvania and the NEC.

FIGURE 1. AMTRAK SERVICE MAP FOR PENNSYLVANIA

Source: Pennsylvania Department of Transportation Freight Rail Plan

CAPACITY

Railroad capacity is primarily driven by infrastructure limitations as well as train operations such as train size and speed, among other factors. Fifteen out of 67 counties are currently served by passenger rail services in Pennsylvania. Service is primarily concentrated in and around the Philadelphia area, but also include southern portions of the state through Harrisburg and towards Pittsburgh.

SEPTA passenger rail ridership in FY 2013 was just over 36 million trips served by 154 stations. This figure increased to 37.7 million trips in FY 2016, but decreased to 34.7 million in FY 2017. Overall however, SEPTA's passenger rail ridership increased by over 50% between

2000 and 2015.

In FY 2017 Amtrak served over 6.5 million passengers at over 24 stations in Pennsylvania alone, representing an 8% increase from Amtrak's FY 2016 Pennsylvania ridership. Over 4 million passengers use Philadelphia's 30th Street Station annually, making it the third busiest Amtrak station in the country; SEPTA's busiest station, Suburban Station, serves 13.4M passengers annually. The Senate Transportation Committee has recommended the possibility of adding two more trains on the Pittsburgh-to-Harrisburg route in western Pennsylvania. Should these additional trains be added, ridership is expected to double to over 400,000 riders and revenue will increase.

Specific projects are under design but lack guaranteed construction funding that will address capacity constraints, or choke points, along the NEC in Philadelphia at key interlockings. These choke points include "Zoo" interlocking just north of 30th Street Station, and "Phil" interlocking to the south of the station. Addressing these capacity constraints would reduce conflicts among trains and help improve performance and reliability for both Amtrak and SEPTA.

Operational limitations such as train size and speed also impact capacity. In 2016, Amtrak approved an investment of $2.4 billion to purchase 28 high-speed trainsets, which will initially operate at speeds of 160 mph, but have the capability of reaching speeds of 186 mph; current high-speed trains operate at speeds up to 150 mph. SEPTA initiated the procurement of 12 locomotives and 45 multilevel coaches in 2015 and 2017, respectively. This purchase will add about 6,000 seats for SEPTA. While these investments by SEPTA and Amtrak will not be completed until 2020 and 2021 respectively, they are expected to provide an increase to capacity across the passenger rail network while simultaneously improving performance and reliability. Planning for improved train speeds and increased train size, in conjunction with reducing the impacts of choke points will help to alleviate future capacity demands. As such, there appears to be adequate capacity for immediate and near-future demands. The potential for commuter rail service in the greater Pittsburgh area could be further investigated via a feasibility survey.

CONDITION

Approximately 60% of the short line and regional railroad physical infrastructure in the United States is in need of extensive rehabilitation. Nearly 60% of SEPTA's Regional Rail fleet is over 40 years old and replacing these cars will cost over $1 billion. Life expectancy of a rail car varies, but a general rule is they should be replaced every 25 to 30 years.

As Pennsylvania's rail infrastructure continues to age, numerous challenges emerge to keep rail at a State of Good Repair in order to maintain the system. In FY 2017, $1.5 billion in infrastructure was invested into the NEC (which does include work in states other than Pennsylvania), including $934 million in Special Projects and $562 million in basic infrastructure capital renewal. While the new spending is helpful, it does not meaningfully address the backlog of projects along the NEC, of which Pennsylvania is a key stakeholder. The NEC Commission has identified a $38 billion backlog in State of Good Repair needs to the NEC.

While much of Amtrak and SEPTA's infrastructure is safe to operate, it is outdated and beyond its useful life. Most of the infrastructure is in need of on-going repairs and/or replacement. Much of the electrified territory from Philadelphia to Harrisburg operates on infrastructure built over 80 years ago; likewise, many NEC passenger rail bridges have been in operation well beyond their expected useful life. SEPTA's rail system is heavily dependent on older bridges, with an average bridge age more than 84 years. SEPTA has rehabilitated or replaced five traction power substations since the previous report card, and while there are 12 more that are currently operating beyond their useful life, these substations are in design with long lead equipment in fabrication. Likewise, many station facilities are functionally obsolete, not ADA compliant or are otherwise beyond their useful life. Many stations are currently planned for reconstruction to meet current operational needs and accessibility requirements, but insufficient funding is a primary factor for delaying this work.

According to the NECC, the majority of engineering related delays on the NEC were from infrastructure failure, which encompassed over 20% of all delays; these include maintenance outages needed to complete repairs as well as speed restrictions imposed by the condition of infrastructure. By and large, the greatest challenge with maintaining the railroad network in a State of Good Repair is disrupting service to prioritize the necessary repair work. However, delaying maintenance could have an even larger impact on service and in the most extreme cases could result in derailments. Passenger rail infrastructure in Pennsylvania should continue to demonstrate good stewardship with maintaining rail infrastructure to continue to operate in a safe and reliable manner.

FUNDING & FUTURE NEED

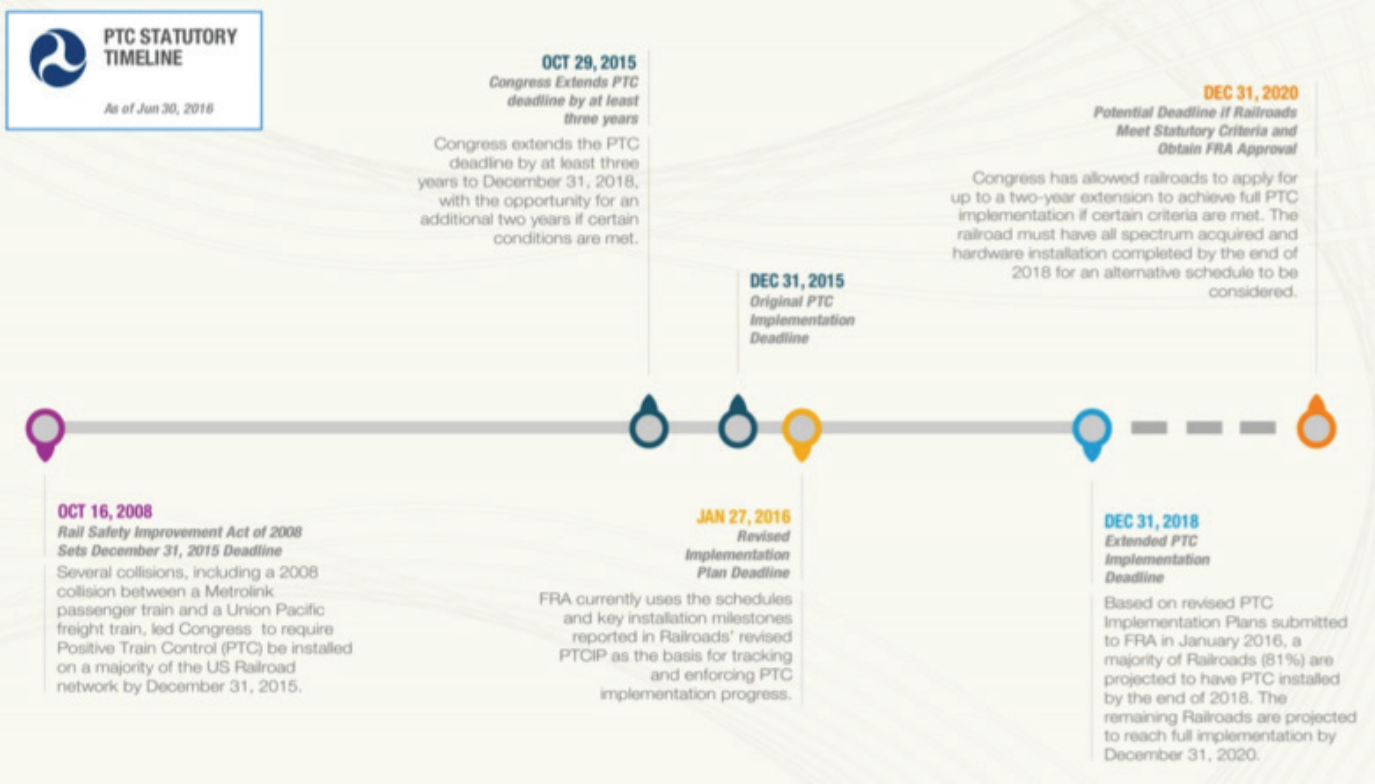
Amtrak revenues and ridership continue to grow year over year. Total growth for all Pennsylvania Amtrak stations is projected to grow 24% from 2019 to 2035, which would represent about a 36% overall increase from 2014 to 2035. Meanwhile, total growth for all SEPTA rail lines is projected to grow 9.1%from 2010 to 2040. Growing ridership rates will provide additional operational funding for both systems, but will not provide funding for infrastructure improvements. Additional funds from federal, state, and local agencies are necessary to meet the future needs of passenger rail and ensure a State of Good Repair. Major investment needs in the Commonwealth beyond the fleet overhauls noted earlier include bridge, station, and catenary replacement, as well as signal system upgrades and interlocking improvements, among other on-going replacements. Specifically, improvements to "Zoo" and "Phil" interlockings as well as installation of new overhead catenary from Zoo to Paoli will significantly bolster reliability on the Harrisburg Line. SEPTA has proposed a 12-year, $7.3 billion plan to "Rebuild the System" which is aided by the advent of Act 89 in November 2013. Act 89 funding allows PennDOT the ability to administer $38 million over five years towards passenger rail as well as up to $140 million in discretionary funds; much of these funds will allow SEPTA to play catch up on a growing $5 billion backlog of capital replacement needs.

Amtrak receives the bulk of its funding from federal appropriations. Amtrak requested funds of $1.7 billion to match the Fixing America's Surface Transportation (FAST) Act levels and was approved by Congress for $1.9 billion for FY 2019, which will allow Amtrak to advance capital improvements at numerous locations. Amtrak has also requested advance appropriations of $7.8 billion for use between FY 2020 & FY 2023. Since Amtrak operates nationally, state-specific funding needs information is not readily available; however, the NECC is spear-heading efforts to demarcate how and where specific dollars are spent within each state and locality. Cost sharing principles between states, commuter railroads and Amtrak—including both operating costs and capital costs were required in the Passenger Rail Investment and Improvement Act (PRIIA) of 2008. In 2015, the NECC adopted a framework for cost-sharing among the Corridor's owners and operators as set forth under PRIIA Section 212 of 2008.

PUBLIC SAFETY

To mitigate potential operator error, the FRA has mandated that Positive Train Control (PTC) be installed by December 31, 2018 on all rail lines carrying passengers. PTC is a signal technology designed to prevent collisions and ensure safe operating speeds. SEPTA has fully implemented PTC meeting all federal mandates. Amtrak has completed PTC implementation on the NEC and is on-schedule to complete its PTC implementation for the entire intercity network prior to the federally mandated deadline, as outlined in Figure 1 below. PTC has been and remains a focal point for improving passenger rail safety. Several passenger train accidents occurred within Pennsylvania in the last four years, some of which could have been prevented with PTC. Most notable of these accidents is the derailment of Amtrak Train 188 in May 2015 in Philadelphia, Pennsylvania killing eight and critically injuring 11 individuals of the over 200 injured. PTC was not in place at the time of this accident, and it was determined that PTC would have prevented the accident.

FIGURE 2. POSITIVE TRAIN CONTROL STATUTORY TIMELINE AS OF JUNE 2016



Source: https://www.fra.dot.gov/ptc

RESILIENCE AND INNOVATION

Addressing resiliency for rail infrastructure is critical to assure reliable transportation for passengers. Rail infrastructure is often tested by extreme weather events, such as Super Storm Sandy which severely damaged tunnels in New York and New Jersey and disrupted service for nearly two weeks. While no major events have disrupted service in Pennsylvania to this magnitude, there are several passenger rail facilities that could be at risk to a major event, including electric substations as well as rail lines in close proximity to flood plains. Passenger rail entities are including resiliency review as part of state of good repair and new project designs.

Amtrak noted in its FY 2017 Sustainability Report having reduced Greenhouse Gas (GHG) emissions by 2.9% as compared to FY 2016 statistics and saw a 2% decrease in FY 2016 as compared to FY 2015. In January 2018, SEPTA released its second Energy Action Plan outlining 15 initiatives to reduce energy consumption, increase energy efficiency, and reduce GHG emissions.

Both Amtrak and SEPTA have advanced fare collection systems and other, less visible technological improvements to operations. PTC is one example of a state-of-the-art signal system upgrade.

RECOMMENDATIONS TO RAISE THE GRADE

- Support a regulatory and financial environment that encourages continued private investment and maximizes public-private partnership opportunities.
- Increase investment in capital improvement and maintenance projects to support a healthy and sustainable railroad system and reduce the backlog of deferred maintenance.
- Identify strategies to harden rail infrastructure and facilities for extreme weather events to support a resilient and reliable rail network.
- Undergo a feasibility study to determine and confirm if additional passenger rail services in western Pennsylvania are necessary.

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PORTS

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PHILADELPHIA PENNSYLVANIA UNITED STATES SCHUYLKILL RIVER WITH PLATT BRIDGE AND INDUSTRIAL REFINERY © TUPUNGATO

PORTS

EXECUTIVE SUMMARY

With over 100 million tons of goods moving through Pennsylvania's ports, Pennsylvania ranks ninth in the country for volume of goods that move through ports, providing an annual economic benefit of nearly $50 billion to the Commonwealth. With substantial completion of the Delaware River Deepening scheduled in 2019, and $300 million in major infrastructure capacity investments committed in 2016, the Commonwealth has demonstrated its commitment to be competitive in the global and regional economy. This momentum will need to continue to address deteriorating conditions as numerous facilities have aged past their useful life and are in need of significant infrastructure improvements in order to prevent Pennsylvania facilities from becoming obsolete, which will result in cargo finding another route into the country.

BACKGROUND

With over 100 million tons of goods moving through Pennsylvania's three Ports of Erie, Pittsburgh and Philadelphia, Pennsylvania ranks 9th in the country for volume of goods that move through ports. This section of the Report Card focuses on the public ports in Erie (Port of Erie) and Philadelphia (PhilaPort, formally known as Philadelphia Regional Port Authority), and the Inland Waterways section will focus on Pittsburgh.

CAPACITY

The Erie Port currently handles about 600,000 ton of product annually. The majority of the commodities are sand, salt and aggregate. This port's storage capacity is adequate given the needs of the region and the adjoining navigation channels. There is additional property available for future expansion, if needed. As part of its Master Plan completed in April of 2018, the Port of Erie has performed a preliminary investigation of their properties and identified deficiencies in their utility access and shoreline conditions.

PhilaPort and the US Army Corps of Engineers (USACE) have secured funding to deepen the Delaware River Federal Navigation Channel, from 40 feet to 45 feet, from Philadelphia to the mouth of the Delaware Bay. Funding for this project stands to help Philadelphia's ports remain competitive in the global economy, and the project is expected to be completed by 2019. With the deeper channel and the potential for larger vessels, the facilities servicing those vessels must enhance their infrastructure to service these vessels and increase their throughput to stay competitive.

Understanding this need in anticipation of the deeper channel, the Commonwealth announced a $300 million Port Development Plan for PhilaPort in November of 2016 to expand and improve cargo operations through the Port's busiest areas. The money is designated to assist with improvements to items such as Ship-to Shore cranes and mooring equipment, as well as landside improvements to warehousing. The funding will also contribute to keeping PhilaPort's automobile business competitive by the addition of a new vehicle processing center and paving. In addition, in 2016, PhilaPort also received a PennDOT Rail Freight Assistance Program Capital Budget grant to rehabilitate the freight rail located on the Tioga Marine Terminal.

CONDITION

Each port agency has aging infrastructure at their facilities. While Erie's 300-ton stiff leg crane was recently rehabilitated, their mobile cranes are in need of replacement. Port Erie also has aging dock walls in need of rehabilitation and is in need of shore power upgrades; it could also benefit from additional covered warehouse space. PhilaPort also has infrastructure issues. With many of their piers and warehouses being built circa 1920, the Port is faced with considerable maintenance and repair needs in order to keep the facilities safe and suitable for cargo handling.

FUNDING

With the passage of Act 89 in 2013, the Pennsylvania Department of Transportation created a new Deputy Secretary for Multimodal Transportation. This position is responsible for overseeing and administering the allocation of state funds to Pennsylvania's ports. This department also advocates for public and privately owned/operated ports. An example of this department's efforts is the Ports Incentive Program that entices shippers to increase their shipping volume to help increase user revenue fees and spur economic development.

In addition to state grant funds, Erie has mainly utilized their own usage-based funds to make investments into their port. According to their Master Plan, most of their financial resources are allocated to operation and maintenance activities, as capital funds are generally limited.

PhilaPort has recently received major funding from the Commonwealth in the amount of $300 million to expand and improve cargo operations thorough the Ports' busiest areas. However, by comparison, PhilaPort spends an average of $20 million annually for facility maintenance and repairs. They routinely apply for grants to supplement their capital funding. In 2018, PhilaPort was awarded a $25.5 million Infrastructure for Rebuilding America (INFRA) grant to assist with the Packer Avenue Marine Terminal upgrades to accommodate the larger vessels.

FUTURE NEED

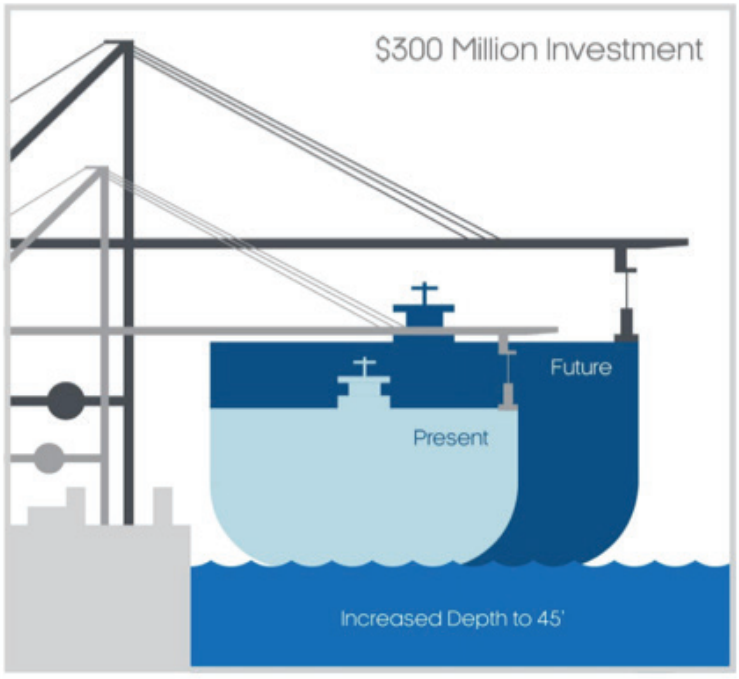
Erie's needs include rehabilitation to their dock structures, upgraded shore power, new mobile harbor cranes and covered warehousing. Their Master Plan also mentions the need to update utility infrastructure, as well as deficient seawall and shoreline stabilization infrastructure. A cost for these items was not immediately available.

A recent study performed by PhilaPort investigated the immediate needs at each of their waterfront facilities. This study identified approximately $59.5 million of repairs are needed immediately to address serious or critical issues for their landside operations, waterfront structures and in-water work that is not currently covered in the recently received $300 million. Landside improvements include roadway work, warehouse upgrades and rail infrastructure upgrades. Some of the needed projects include re-working and/or reconstruction of roadways and railyards adjacent to port facilities; the development of a new rail service; and an inland port to support anticipated growth at the Port. The waterfront and in-water work issues include damaged or distressed infrastructure that has or is threatening to collapse, which could lead to a particular asset being put out of service and forcing the cargo to relocate to a different port, as well as the continual need to dredged berths that become silted in.

Most of the piers and other waterfront structures are in constant need of maintenance repairs, and oftentimes emergency repairs and reconstruction are necessary due to their age and to their exposure to extreme conditions. Over the next 10 years, it is estimated that $124 million is needed to address these high priority items at their sites to maintain current operations. This estimate reflects known maintenance needs. Due to aging of the assets it can be expected that the needs will increase with each passing year. Although PhilaPort received an infusion of funds to expand and improve their cargo facilities, this money will not be used towards regular maintenance and repairs. Dredging of their facilities that are still serviced by vessels is a continual need, as well.

PhilaPort currently has adequate capacity at most of their facilities; however, expansion is required for container operations at Packer Avenue Marine Terminal and the automobile import business. Growth projections in both markets are requiring them to increase their capacity to handle additional cargo and will benefit from the $300 million in funds. Refer to Figure 1.

FIGURE 1. PHILAPORT PRESENT AND FUTURE STATS



	Present	Future
Containers	500,000 TEUs	900,000 TEUs
Jobs	10,341	17,020 65% increase
Clean Air	Diesel Operated	Diesel to Electric
Cars	155,000 Units	350,000 Units
Cranes	Small Panamax	Large Super Post-Panamax
Tax Benefit	$69.6m Annually	$108.4m Annually
Forest Products*†	465,000 mt	540,000 mt

* Number represents pulp moving through Tioga Marine Terminal as pertains to Plan.
† PhilaPort handles over 1m ton of Forest Products annually.

Source: PhilaPort

PUBLIC SAFETY

Port facilities are fairly secure in that they require anyone entering their facilities to have a Transportation Workers Identification Credentials (TWIC) card in their possession. TWIC is required by the Maritime Transportation Security Act for workers who need access to secure areas of the nation's maritime facilities and vessels. TSA conducts a security threat assessment (background check) to determine a person's eligibility and issues the credential. U.S. citizens and immigrants in certain immigration categories may apply for the credential. Most mariners licensed by the U.S. Coast Guard also require a credential.

RESILIENCE & INNOVATION

As part of its Master Development and Facility Plan, Erie Port has recently taken steps to develop a more complete asset Management System so that they can more effectively manage their assets and plan for the future. They have created an electronic property database that includes all parcels and associated data from Erie County tax records. The database includes web links connected to the Erie County web site and the subject parcel for current data.

To protect against future storm events, PhilaPort is building its new facilities at or above the 100-year flood plain. In addition, new designs implement features to limit flooding exposure to substations and electric equipment.

Every five years, PhilaPort conducts a comprehensive facilities assessment that serves as the foundation of their asset management plan.

PhilaPort is committed to sustainability and environmental stewardship and have plans to be more innovative in their approach to their operations at each of their facilities. One of their strategic planning goals is to expand green port initiatives. As part of this goal, PhilaPort works to reduce reliance on fossil fuels; establish green building standards for capital projects; and seek additional funding for sustainability projects.

In addition, PhilaPort is converting their port cranes from diesel to electric at their terminals. They have applied for funding under the Federal Diesel Emissions Reduction Program (DERA) program for Packer Avenue Cranes, as well as the state multimodal fund to convert cranes at Tioga Marine Terminal. PhilaPort has completed a baseline air emissions survey for the ship-to-shore cranes at Packer Avenue Marine Terminal (PAMT), and by the end of 2018, they will have a similar baseline for the yard container handling equipment at PAMT.

Clean dredge material for the channel deepening project has been used for beach replenishment at Broadkill Beach in Delaware. They are also working on other beneficial reuse projects for dredge material.

RECOMMENDATIONS TO RAISE THE GRADE

- Further investigation into the needs of Port of Erie should be conducted so that an approach can be developed to create a mechanism for funding to make necessary improvements. There may be opportunities with PA Department of Environmental Protection Coastal Resources Management Program (CRMP) and PA Department of Conservation and Natural Resources (DCNR).
- Port of Erie should update and add additional fields to their asset management plan to include infrastructure condition assessment information, needs and cost in order to help them prioritize future projects and help secure funding.
- Port of Erie needs to raise additional funds to support their infrastructure improvement needs. Some examples include updating leases with their tenants, pursuing additional grants such as the Transportation Infrastructure Finance and Innovation Act (TIFIA) and/or Railroad Rehabilitation & Improvement Financing (RIFF) low interest loans, and public-private partnerships and donations.
- Additional Commonwealth funding is necessary to add to the $300 million Port Development Plan investment to maintain a competitive advantage for PhilaPort.
- PhilaPort should also pursue additional rounds of local, state, federal grants to continue infrastructure investment.
- Both Erie and PhilaPort should take advantage of the Volkswagen settlement, which provides $118.5 million to the State of Pennsylvania for various types of diesel emission reduction projects. Shore power, truck and forklift replacement/upgrades and matching funds for DERA projects could all potentially qualify for funding from this settlement.

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ROADS

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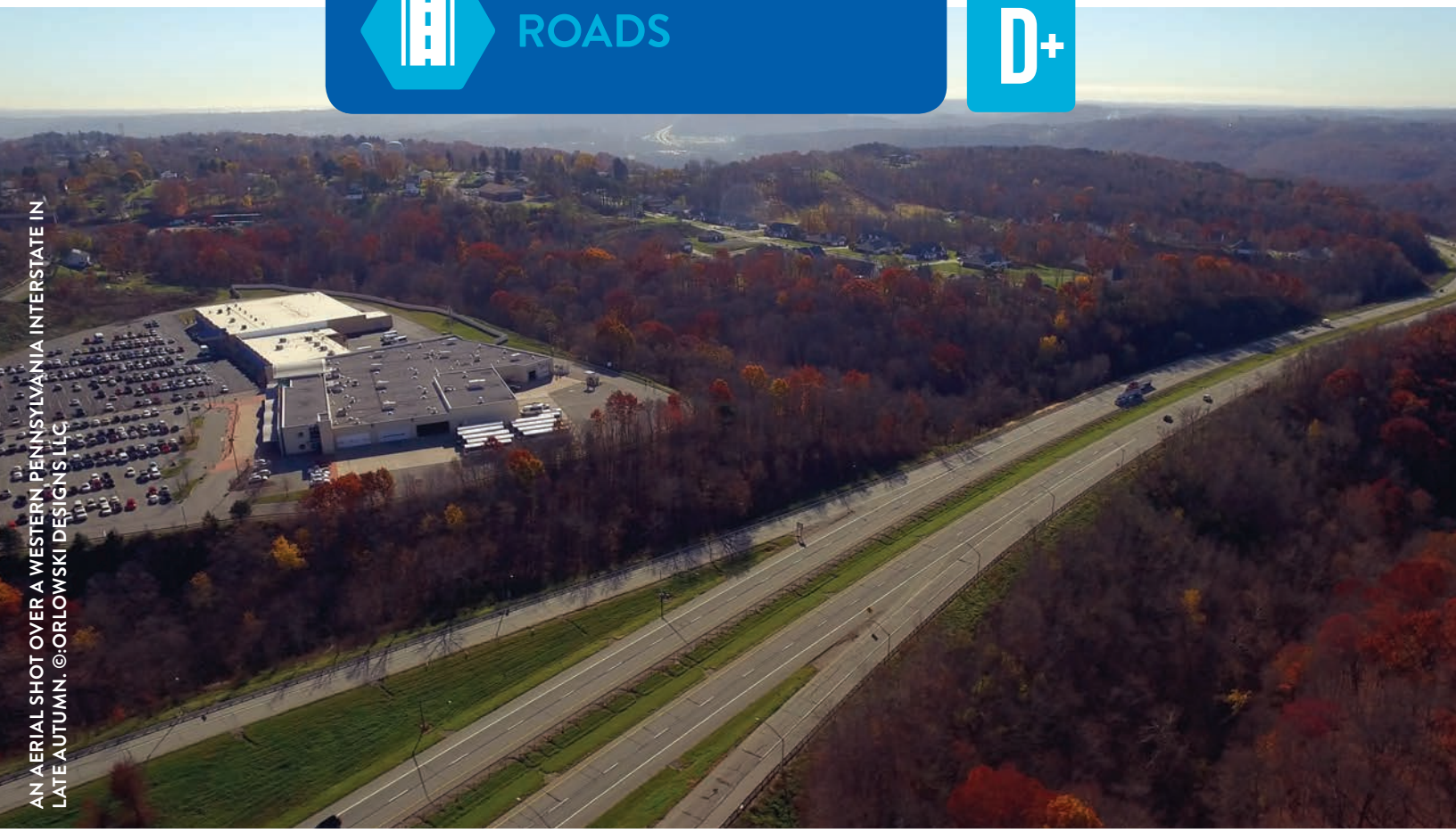


AN AERIAL SHOT OVER A WESTERN PENNSYLVANIA INTERSTATE IN LATE AUTUMN. ©:ORLOWSKI DESIGNS LLC

ROADS

EXECUTIVE SUMMARY

In 2013, Act 89 provided significant improvement funding increases, resulting in 2,600 projects that are currently in progress or have been completed. Although these funds have contributed to the advancement of reconstruction, rehabilitation, new roadway, and intersection improvement projects, there is a significant roadway backlog that still requires attention, as seen by 43% of PennDOT owned roadways having a fair or poor pavement surface. For motorists statewide, traffic congestion results in over $3.7 billion per year in lost time and wasted fuel, and deficient roadway conditions cost the average motorist over $500 in operating and maintenance outlays. In FY 2019, Act 89 funding will hit its maximum funding level and plateau. Thus, as Pennsylvania's roadway infrastructure ages, needs for increased capacity rise, and fuel economy increases, the funding gap will grow unless additional or alternative funding sources are identified.

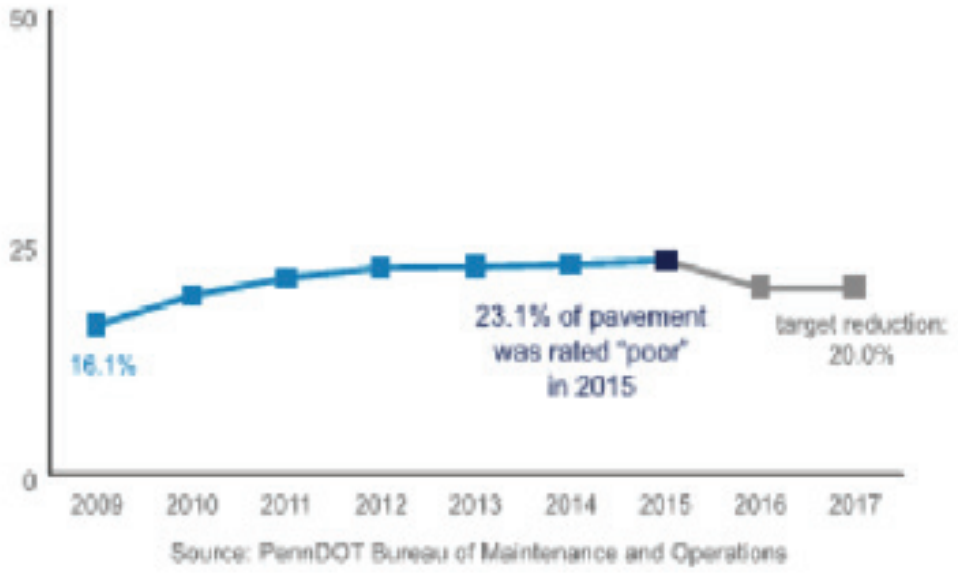
BACKGROUND

There are over 120,000 miles of roadway in the Pennsylvania highway system. The Commonwealth's 8.8 million drivers travel nearly 100 billion miles on these roads every year. Approximately one-third of the total (41,000 miles) is state-owned and maintained, the fifth-largest state highway system in the nation. This includes 1,855 miles of Interstate Highways. The state network has most of the higher-volume roadways and inter-jurisdictional routes in the Commonwealth. In late 2013, the Act 89 Transportation Plan became a law which included uncapping the wholesale oil company franchise tax to increase available funding for transportation. The funds raised as a result of Act 89 are used for maintenance and capital projects for highway and bridges, multimodal facilities as well as the state police budget.

CONDITION

In 2011, over 8,500 miles (21.2%) of the State Highway network had pavements rated as "poor" condition and needed rehabilitation or reconstruction. In 2015 this amount grew to over 10,000 miles (23.1%), as shown in Figure 1.

FIGURE 1. PERCENTAGEOF ROADWAYS STATEWIDE WITH PAVEMENT SMOOTHNESS RATING OF "POOR"



In 2017 the pavement, as based on the International Roughness Index, shows that 57% of state-maintained roadways are in "excellent" or "good" condition.

Approximately 60% of Pennsylvania's interstate system is over 40 years old and needs reconstruction. Figure 2 illustrates the fluctuation of total miles reconstructed, which falls considerably short of the 68 miles of reconstruction needed annually to improve the system. However, the influence of the increased funding is seen by the uptick of reconstruction in the years following the passing of Act 89.

FIGURE 2. MILES OF INTERSTATE RECONSTRUCTED
Actual funded vs. need

Truck traffic accounts for over 34% of the travel on Pennsylvania interstates, more than double the national average. Since trucks weigh more than passenger cards, they inflict higher levels of damage on roads. With truck traffic increasing, particularly in the home delivery area with on-line shopping becoming more popular, it is anticipated that roads will need to be built with higher cost, more durable materials or will need more frequent restoration and maintenance activity in the future.

Act 89 has facilitated the advancement and acceleration of over 2,600 capital projects that have been recently completed or are currently in progress. This, in addition to more intensive maintenance-type efforts and surface treatment projects, addressed many of the priority safety and mobility issues and conditions, allowing this Report Card's grade to increase over the 2014 grade (D-).

On the 540 miles of the Pennsylvania Turnpike Commission's network, a major reconstruction program has been underway for the past two decades to improve the older segments and widen many sections to 3 lanes in each direction. The program has completed the reconstruction of 140 miles of the roadway to date, with 38 miles finished since 2014.

CAPACITY

In the major urban areas in the Commonwealth, traffic congestion is a daily occurrence and it affects both pavement condition and mobility. This costs the average commuter over four weeks of time and a month's worth of fuel annually. Statewide congestion is estimated to cost drivers over $3.7 billion per year in lost time and wasted fuel. On the busy section of I-76 in the Philadelphia area alone, in 2017, there were a combined 3 million hours of delay with an associated $73 million in lost productivity.

Given PennDOT's backlog of maintenance, the majority of its program is directed to improving its existing facilities. For many years, PennDOT's policy was to not increase roadway capacity. With limited funds, results of urban sprawl, and environmental challenges, PennDOT has turned to alternative means to provide increased capacity than traditional means of adding lanes.

PennDOT is now in the preliminary stages of teaming up with transit agencies to use technology to encourage drivers to switch to public transportation in congested roadway areas. Additionally, innovative methods to increase roadway capacity are being explored. This is covered in the Resilience and Innovation section below. PennDOT continues to require land developers to make improvements to roadways, which may include adding lanes and signalized intersections/roundabouts if the anticipated amount of traffic warrants such improvements.

FUNDING

Pennsylvania's elected representatives took a bold move with the passage of Act 89 despite the backlash that could have resulted from the increased taxes and fees. As previously noted, the increased funding as a result of Act 89 facilitated the advancement of over 2,600 projects since its passage.

Act 89 also allowed counties to charge a $5 vehicle registration fee with the funds going to local transportation projects. Twenty-two counties are participating in this program. Montgomery County, for example, receives $3 million each year through this revenue source and allocates $1 million toward local matching funding for municipalities to participate in the Green Light Go program for improvements to traffic signals.

Act 89 funding will hit its maximum funding level and plateau by FY 2019. As PennDOT's infrastructure ages, needs for increased capacity rise, and fuel economy increases, the funding gap will resume. By 2020, this is estimated to be $7.2 billion. The continued funding gap will result in higher percentages of pavement surfaces in the fair/poor category. Additionally, PennDOT and a number of municipalities across the state leverage the available capital funding for major improvements to match federal transportation programs.

Federal policies for continuation of transportation programs at this level are not set at this time and infrastructure discussions at the federal level have not occurred as of this report, thus there is some anxiety and uncertainty on whether federal dollars will be available at previous levels for highway projects in the future.

Act 89 was beneficial to raise funds for state-owned roads and it provides counties with an opportunity to raise additional funds through registration fee increases and opportunities to receive grants for local improvements. However local municipalities that own and maintain roads have not been able to utilize increased funds from Act 89 for routine maintenance purposes. For example, Philadelphia's road maintenance budget has remained at nearly the same level for the past four years.

In 2016, to increase the amount of funding available for transportation efforts, administrative action was proposed to cap the expenditures from the Motor License Fund going toward the Pennsylvania State Police budget. Although action was proposed, no formal action was taken, causing the funds directed into the police budget to be determined by the annual budgeting process. Lowering the cap would direct more resources toward Act 89's Decade of Investment projects to be completed by 2028.

FUTURE NEED

Roadways will continue to age beyond their design service life and deteriorate, thus the previously-mentioned gap between needs and resources will continue to widen. Given improved fuel economy and increasing popularity of electric vehicles, reliance on any fuel-based taxes for continued revenue should be examined. One method available to properly assess all road users equally for highway travel and ensure that needed funding is available to fund future improvement efforts is a Vehicle Miles Traveled (VMT) tax. This will recognize continued improvement in vehicle fuel economy and an increased number of alternative-fuel vehicles. While this has been implemented on an experimental basis in several areas, Pennsylvania has not taken any direct steps on this, other than consideration as part of its involvement in the I-95 Coalition, which is advocating this.

While future transportation dollars will be limited, improvements could be formally proposed by PennDOT to stretch resources further such as life-cycle cost analysis methods, to properly evaluate and determine the total cost of projects, and the expanded use of cost-benefit analysis principles in the evaluation and prioritization of projects to address needs on a more objective basis.

PUBLIC SAFETY

Statewide traffic fatality rates have remained stable over the last five years with a slightly downward trend. For 2016, Pennsylvania's 1.18 fatalities per 100 million miles of travel is still slightly above the national average of 1.16. Safety has been a top priority of agencies and should continue to be a strong reason to address infrastructure deficiencies. A movement that is gaining traction in the transportation community is the concept of Vision Zero which aims to eliminate all traffic fatalities. As of January 2018, Bethlehem and Philadelphia have become Vision Zero Cities formally setting goals while other cities such as Harrisburg and Pittsburgh are considering it.

RESILIENCE AND INNOVATION

Advances in roadway design, construction, maintenance, and management technologies and techniques are constantly being developed and employed to extend the useful lives of facilities. The use of 3D engineered models for more accurate and efficient planning and construction are being undertaken. Automated management systems will help with asset management and permit reviews. New materials and technology are also helping roads become more sustainable and resilient, such as the use of warm-mix asphalt, which requires less energy to produce and install.

The use of highway shoulders on a part-time basis, mainly on expressway/freeway facilities ("hard shoulder running), is being explored to allow capacity expansion on several interstates. It allows part-time (usually peak-hour) use of the emergency shoulder/pull-off lanes for traffic and is an alternative to expensive widening. Other measures include adaptive traffic signal technology, variable lane assignment measures and coordination with transit agencies to encourage drivers to switch to public transportation in congested roadway areas. These will require investments in new technology and some physical changes and additions, such as signing, traffic observation cameras and detection equipment, but will result in enhanced traffic movement with relatively minimal cost.

The use of creative and non-traditional project delivery methods is increasing. Public-private partnerships (P3) have additionally been utilized to allow private capital and investment with public dollars to maximize project benefits and coverage. Several such efforts have been utilized for bridge projects to accelerate replacement and reduce the backlog of deficient structures, but a similar approach has not yet been formalized for highway improvement projects in Pennsylvania.

As the private an educational sectors are working to advance connected and autonomous vehicle (CAV) technology, primarily in Pittsburgh, PennDOT and the Pennsylvania Turnpike are also in the early phases to test and prepare the state for this technology. In 2018, PennDOT announced their partnership with Penn State to begin planning and designing a Pennsylvania Safety, Training and Research (PennSTART) facility.

RECOMMENDATIONS TO RAISE THE GRADE

- Establish stable sources of dedicated transportation funding including the highway trust fund and an increase in the federal gas tax as Act 89 will plateau in FY 2019.
- Encourage the use of life-cycle cost analysis methods to properly evaluate and determine the total cost of projects.
- Encourage the expanded use of cost-benefit analysis principles in the evaluation and prioritization of projects.
- Utilize innovative and creative project delivery strategies and methods to stretch existing dollars further.
- Advocate for additional research and development funding to further explore new materials and technology.

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SCHOOLS

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SCHOOLS

EXECUTIVE SUMMARY

Statewide, we are spending $500 million less than the recommended standard for public school facility operation and maintenance each year. Additionally, the school funding debt in Pennsylvania is double the national average and is the second highest in the country. Despite the funding gap, most schools are in good condition with some repairs needed and capacity is sufficient. However, reportedly half of Pennsylvania's schools do not have an asset management plan for their schools. Nevertheless, the Commonwealth remains a leader in the construction of energy efficient school facilities with over 100 LEED certified schools. More funding and focus on condition as well as on-going maintenance and operation of facilities is needed for school infrastructure to be considered fit for the future.

BACKGROUND

While educational activities have existed in the Commonwealth since its founding in 1682, formal education began to rise following the Common School Act of 1834. In 1837, the Department of Schools was created, which became known as the Department of Education in 1969. The Department of Education implemented a Planning and Construction Workbook (PlanCon) process in 1973 to standardize new and existing building designs and refurbishments, respectively, as well as mitigate expenditures on costly design plans. Beginning in 2005, districts were incentivized to design more environmentally conscious buildings through LEED-certification. This report specifically addresses the infrastructure related to grades K-12.

CAPACITY

The United States Green Building Council (USGBC) reported that the gross space of school district buildings across the Commonwealth add up to 325.7 million square feet, or nearly 7,500 acres. The Pennsylvania Department of Education reported there were 3,320 public schools housing a total enrollment of 1,800,337 students in School Year 2012-2013. While enrollment decreased slightly to 1,770,065 students across 3,253 public schools in School Year 2016-2017, the average number of students per school stayed about the same. While there was a reduction in schools over the past four years, this is a result of consolidating the student population.

The state mandates 58 and 78 square foot per student for elementary and secondary education facilities, respectively, resulting in more than adequate capacity for students. Anecdotally, about 50% of Pennsylvania school superintendents polled in 2018 indicated that their student enrollments would stay about the same over the next 5 to 10 years, while about 31% indicated that they expect a slight decrease in enrollment over the same time frame.

CONDITION

Although 2013's Act 59 required the Pennsylvania Department of Education to conduct a statewide analysis of school facilities and future capital needs, and the preliminary report was due to the General Assembly in May 2014, this report has not been published at the time of evaluating this category. In lieu of a state-specific evaluation of school facilities, alternative ways of evaluating the condition of schools were used.

A general industry standard for facility capital investments is to spend 4% of the Current Replacement Value (CRV) on capital construction projects annually. As shown in Figure 1, in Fiscal Year 2014, Pennsylvania schools have invested $2.1 billion, or 60% of the recommended value, on capital construction projects. Although 84% of school superintendents polled indicated that their school district facilities are in "Good" or "Excellent" condition, approximately half of these superintendents admitted their school district has not had a condition assessment of their facilities completed within the last four years.

A general industry standard for facility operations & maintenance is to spend a minimum of 3% of the CRV annually. As shown in Figure 2, in Fiscal Year 2014, the CRV of district facilities was $88.3 billion, resulting in a minimum recommended annual Operations and Maintenance spending of $2.65 billion. Yet, the average actual annual Operations and Maintenance spending was $2.16 billion. This represents almost a $500 million gap annually from recommended standards. Anecdotally, over a third of school superintendents polled in 2018 indicated that their district did not have an asset management plan, which would otherwise help to prioritize operations and minimize operational costs.

FIGURE 1. ACTUAL COMPARED TO RECOMMENDED CAPITAL CONSTRUCTION SPENDING (FY14)

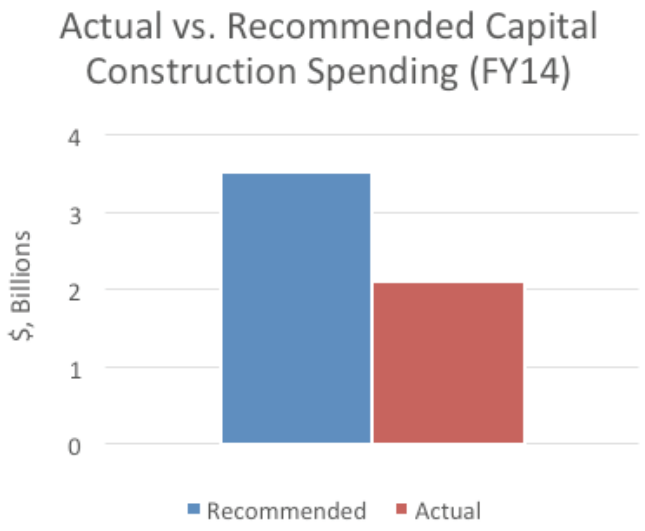
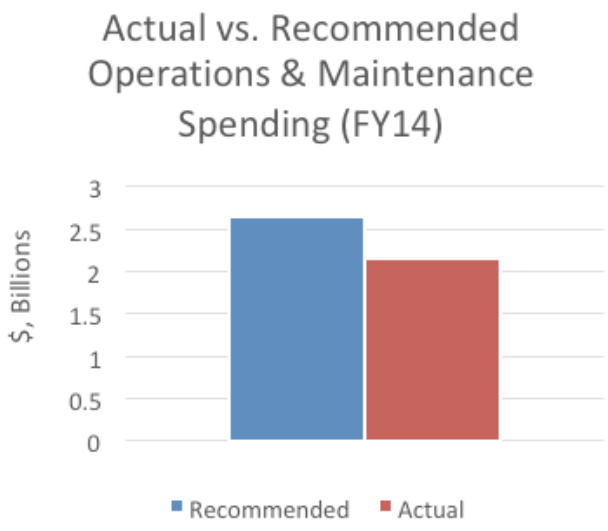


FIGURE 2. ACTUAL COMPARED TO RECOMMENDED OPERATIONS & MAINTENANCE SPENDING (FY14)

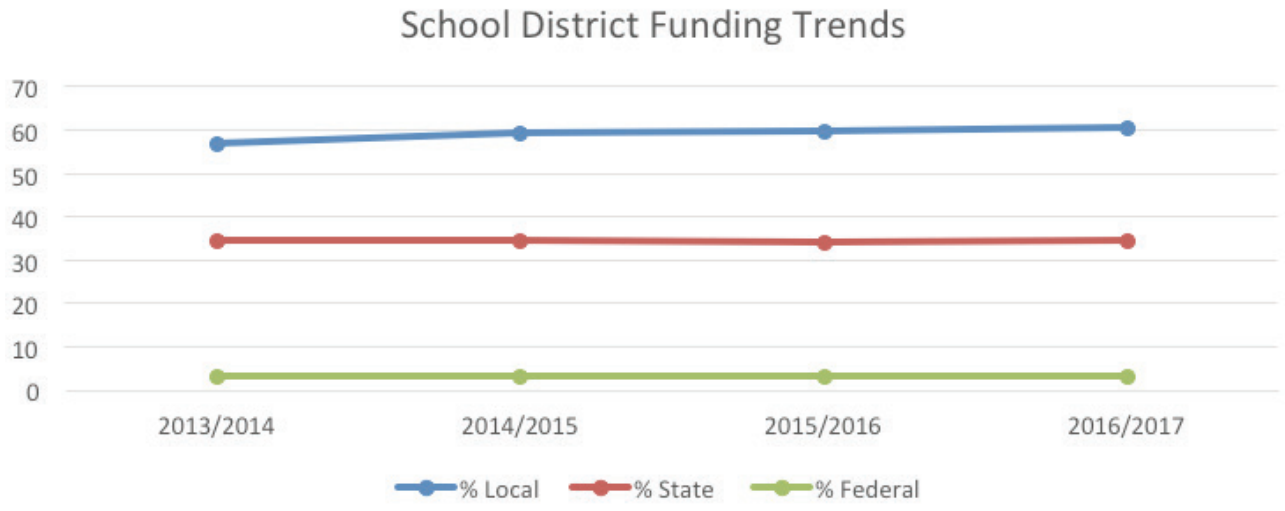


FUNDING

Between 1994 and 2013, Pennsylvania local school districts paid 85% of the costs for K–12 capital projects, while the state provided the remaining 15% share and there was no federal assistance. As a comparison, on average, a state provides 18% of funding for school district capital projects.

Long-term debt for school construction at the end of Fiscal Year 2013 was $15,638/student, compared to the national average of $8,465, nearly half that of the Commonwealth. This long-term debt is for financing capital improvements as well as operating, interest, and other expenses necessary to fund the districts. At the end of Fiscal Year 2013 the long-term debt value for the Commonwealth was $25.39 billion; the second highest debt/student in the country. Since 2013, state funding has increased as outlined in Figure 3 below as well as the introduction of federal funding. The approval of Act 59 of 2013 has allowed this increase to occur to help reduce the long-term debt. Continued funding is needed to reduce the long-term debt and sufficiently support ongoing operations and maintenance needs.

FIGURE 3. FUNDING TRENDS IN PENNSYLVANIA BY GOVERNMENT AGENCY FROM 2013 THROUGH 2017.



FUTURE NEED

Meeting the recommended CRV spending amount towards operations and maintenance would require an increase of nearly $500 million per year. Furthermore, if school districts were to spend the recommended 4% of the CRV on capital funds and improvements, then an increase of about $1.42 billion annually would be needed.

It is expected that through 2024, the Commonwealth will have a statewide enrollment increase of 1,023 students or 0.1%. Although this is a nominal increase, it will require an additional $4 million/year beyond fulfilling the current funding gap for operation and maintenance and capital construction projects. Over the next six years, in order for the Commonwealth to maintain the current condition and capacity of existing school infrastructure, schools would have to increase their spending to $6.2 billion annually on K-12 facilities, which would require an additional $1.8 billion statewide per year.

PUBLIC SAFETY AND RESILIENCE

PA law requires each political subdivision (township, borough, town, or city) to maintain an emergency plan. PEMA (Pennsylvania Emergency Management Agency) provides assistance for this effort; however, specific public policy for schools as community shelters in the case of a disaster is left to local jurisdictions. Anecdotally, about 75% of school superintendents polled within the Commonwealth indicated that some or all of the schools in their districts are designated as emergency shelters in the event of a natural disaster.

INNOVATION

Pennsylvania provides additional state funding for school buildings that receive United States Green Building Council's Leadership in Energy and Environmental Design Green Building Rating System (LEED-NC™) certification (Silver and greater) or Green Globes™ certification (Two and greater). As a result of these incentives, Pennsylvania is in the top six states for LEED certified schools with 107 LEED certified schools and there are at least six Green Globes schools certified in its "Green Schools" program. The Commonwealth is a partner with the US Department of Education Green Ribbon Schools program to recognize US Department of Education Green Ribbon Schools, District Sustainability Awards, and Postsecondary Sustainability Awards.

RECOMMENDATIONS TO RAISE THE GRADE

- Government agencies should annually assess the needs of their public school facilities and publish this data.
- Establish a state, multiyear capital budget goal for school infrastructure construction and rehabilitation, set at 4% of the current replacement value, to provide predictable and sustainable capital funding to schools.
- Expand federal tax credits to support increased use of school construction bonds and increase federal grants for high-poverty, high-needs school districts.
- Encourage school districts to explore alternative financing, including lease financing and financing/ownership/use arrangements, to facilitate construction.
- Incentivize school districts to adopt annual, comprehensive capital construction, and operations and maintenance programs to extend the life of school facilities.
- Government agencies should develop capital planning frameworks that can be nimble and responsive to changing technologies and changing demographics, to optimize learning environments and consider the holistic needs of the community.
- General Assembly to publish findings on the preliminary report Act 59.

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SOLID WASTE

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AN IMAGE OF BLUE WASTE TRANSFER BINS AT A LANDFILL FACILITY.
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SOLID WASTE

EXECUTIVE SUMMARY

Pennsylvania's solid waste consists of household trash as well as waste generated by construction, commerce and industry. The solid waste infrastructure including haulers, landfills, and transfer stations remains in fair condition. Landfill capacity is sufficient and counties are required by law to plan for a minimum of 10 years' worth of disposal. Although Pennsylvania's daily per person solid waste disposal is over half a pound of trash less than our nation's average, the rate of disposal is on the rise. To counteract the increase, funding is needed to strengthen and grow municipal recycling universally across the Commonwealth. Safety issues and illegal dumping incidents serve as reminders that funding for the Pennsylvania Department of Environmental Protection is necessary to protect the public and support safe handling, transport, disposal, and recycling practices.

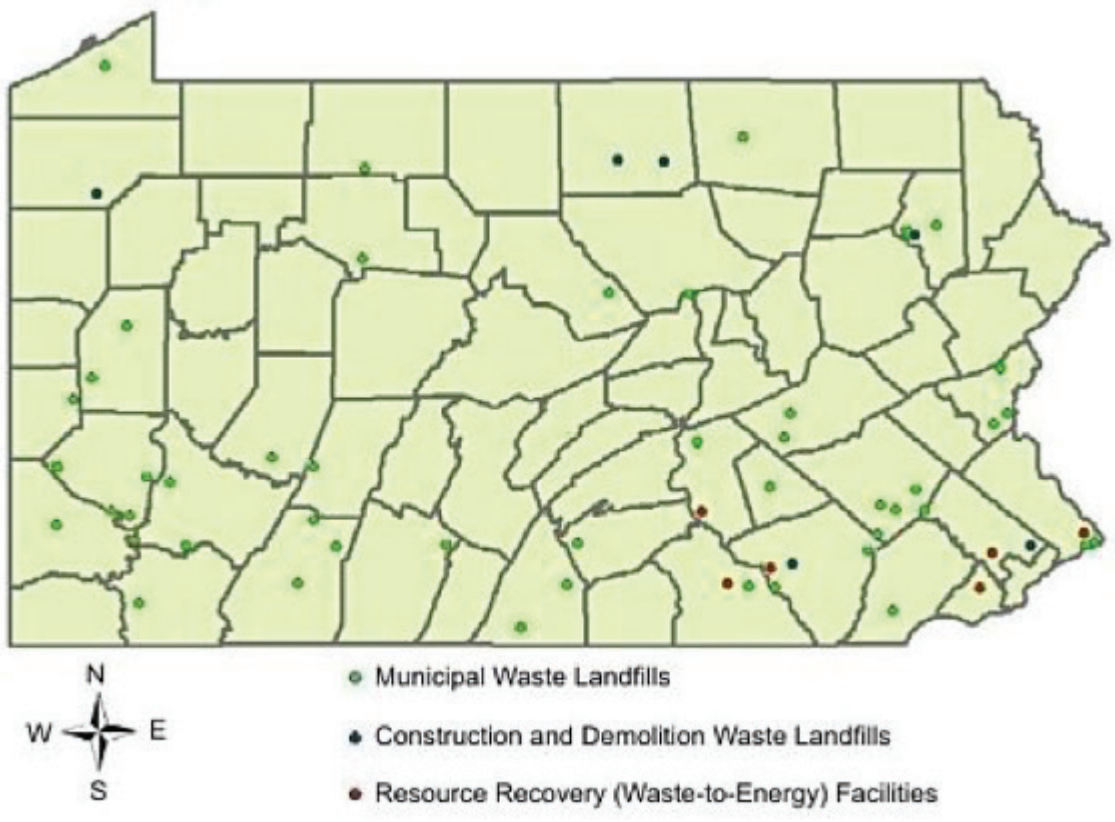
BACKGROUND

Solid waste (most commonly referred to as garbage or trash) is generated by residents, commerce, and industry. Solid waste is collected and most often disposed of in a landfill or recycled. In Pennsylvania, solid waste management operates largely on a local level. In general, residential and commercial wastes are considered municipal solid wastes (MSWs). Non-hazardous industrial wastes are considered residual waste. Pennsylvania commerce and industry generate over 20 million tons of residual waste each year compared to 14 million tons of MSW. The Pennsylvania Department of Environmental Protection (PADEP) is the primary regulatory agency with jurisdiction over how solid waste is handled, managed, disposed, or recycled in the Commonwealth.

According to the PADEP, there are 46 active landfills to handle MSW, three for construction/demolition waste, 71 for residual waste and six waste-to-energy (WTE) facilities (Figure 1).

Some solid waste is beneficially used, and Pennsylvania also exports solid waste for disposal. Beneficial Use is the use or reuse of residual waste for commercial, industrial or governmental purposes, or the use or reuse of processed municipal waste for any purpose. A larger amount of residual waste is generated in liquid or semi-liquid form. The largest residual waste generators are electric utilities, paper mills, foundries, printing and ink operations, and the iron/steel industry.

FIGURE 1: LANDFILL AND RESOURCE RECOVERY FACILITY LOCATIONS



CAPACITY

Since 2014, Pennsylvania's solid waste disposal tonnage has steadily increased despite stable population trends and a 22% increase in recycling over the past five years. An increase in MSW tonnage disposed is noted, with 21.41 and 22.69 million tons disposed in 2016 and 2017, respectively, as reported by the PADEP and depicted in Table 1. Statistics in the table include MSW as well as "additional wastes" disposed within MSW landfills in 2016 and 2017. "Additional wastes" included residual, sewage sludge, processed medical/infectious, construction, ash residue, and asbestos wastes.

TABLE 1: SOLID WASTE DISPOSAL QUANTITIES IN PENNSYLVANIA (2016 AND 2017)

	2016		2017	
	Municipal	Total (MSW+ "additional wastes")	Municipal	Total (MSW+ "additional wastes")
Total Tonnage	14,205,406	21,406,722	14,448,617	22,691,953
Total Million Tons	14.21	21.41	14.45	22.69
PA Tons	8,713,930	13,889,847	8,849,753	14,836,036
PA Pounds per person per day	3.73	N/A	3.79	N/A
PA Population was estimated at 12.81 million in 2016 and 2017				

Pennsylvania imports waste from outside the state, in addition to exporting wastes to other states. The total tonnage above also includes disposal imported from outside of Pennsylvania, 7.5 million tons in 2016 and 7.9 tons in 2017.

The above data indicates that approximately 35% of disposal in Pennsylvania comes from out of state. The total amount disposed of in Pennsylvania accounts for approximately 9% of the nation's MSW. In 2017, the reported national average of solid waste generated per person per day was 4.4 pounds, compared to Pennsylvania which reported 3.79 pounds.

Over 900 facilities in Pennsylvania have PADEP permits to process, beneficially use, or dispose residual wastes. These include: 452 beneficial use applications, 314 processing facilities, 71 residual waste landfills, 24 land application facilities (excluding beneficial use), 34 incinerators, 32 impoundments, and 2 composting facilities. In addition, almost all municipal waste landfills and resource recovery facilities accept residual waste. From review of Pennsylvania's 2016 and 2014 residual waste report, 20 million tons of residual waste were generated in 2016, which is a decrease from 2014's reported 60 million tons. The majority of residual waste generated in Pennsylvania is disposed of within the state, which indicates capacity is reasonably sufficient.

Solid waste transport and disposal is mostly privatized in the state of Pennsylvania and operates on supply and demand. Local government planning also works to ensure capacity of transportation needs are met. Residual waste is largely exported to other states for disposal, but in general, Pennsylvania's capacity for solid waste transport and disposal is sufficient. As a result of the required County Solid Waste Planning, sufficient disposal capacity for waste generated in Pennsylvania over the next 10 years appears to currently be available.

CONDITION & PUBLIC SAFETY

Solid waste facilities are regulated by permit by the PADEP to help ensure safe operations. The onsite operations are internally and externally monitored and require routine reporting to the PADEP. Facilities that are determined to be noncompliant with the conditions outlined in their permits are subject to penalties including fines or potentially forced closure. Due to regulatory monitoring and reporting, most disposal sites are in good condition; however, exceptions do exist. In 2015, the PADEP not only assessed large civil penalties against one major waste disposal company for odor control and leachate storage violations at three of its disposal landfills, but also mandated that two of them cease waste disposal operations by 2017 and 2019, respectively. Lead time for the engineering and permitting of new disposal sites is extensive, so waste previously disposed of at these sites will need to be directed to alternative locations, which could mean longer waste transportation routes and, subsequently, an increase in overall disposal costs.

Some instances concerning public safety should be noted. The PADEP imposed fines against medical providers for violating waste disposal regulations. Also, a fatality occurred in 2017 after an MSW landfill slide caused a worker to be buried by over 40 feet of trash.

Transportation of solid waste is also regulated, with inspections by the PADEP and the Pennsylvania State Police. Solid waste transporters were found to have fewer instances of noncompliance as compared to other commercial transporters. Condition of waste transportation as a whole is also dependent upon roadway and other infrastructure condition. In Pennsylvania, all vehicles transporting municipal or residual waste to processing and disposal facilities are required to have a valid Waste Transporter Authorization to ensure safety. The PADEP manages the Solid Waste Program, which includes comprehensive permitting and inspections of facilities. Funding needs to continue to protect the public from the results of illegal dumping and to support safe handling, transportation, disposal, and recycling practices. The number of waste haulers across the state have increased annually by 3%; however, the number of inspections has not kept pace with this increase.

FUNDING

Publicly operated solid waste management programs experience difficulties in remaining sustainable. As a result, solid waste is typically transported by private haulers and disposed at private facilities, with state, municipal and county staff oversight and involvement.

Recycling programs are financed by an Act 101 Recycling fee ($2 per ton) on all waste disposed of in a municipal waste landfill. Tipping fees are used for grants for local recycling, planning, and environmental protection programs, while also subsidizing state programs for recycling market development, public education, technical assistance, and grants administration. Tipping fees in Pennsylvania are higher than most of the country, but consistent with the northeastern United States.

Funding sources to enable local governments to sustain recycling and solid waste programs are still needed, especially in rural areas.

FUTURE NEED

Major cities are creating zero-waste initiatives, such as increased recycling pickup frequency, pay-as-you-throw, food waste treatment systems, and composting programs, but need funding to implement in Pennsylvania.

RESILIENCE

There are numerous publicly and privately-operated transport, recycling and disposal facilities across the state. The participation of numerous companies and entities prevents the system from being significantly impacted as a result of one entity's individual performance or collapse. While some vulnerabilities still exist, PADEP regulations on the design of facilities, monitoring and reporting procedures provide for accountability that engineering practices and environmental controls are upheld.

INNOVATION

Pennsylvania has six municipal WTE facilities, mainly located in the southeast region. Combined, the facilities are capable of processing up to 10,000 tons of waste per day and generating 250 megawatts of electricity.

Pennsylvania currently supports 38 landfill methane projects, with nine candidate projects anticipated. The methane is either mixed directly into the natural gas supply or used to generate electricity on-site. Pennsylvania has the third highest number of landfill methane projects of any state.

Single-stream recycling encourages people to recycle, because it is convenient: They can place all of their recyclables in one bin, which is collected and sorted at the recycling facility. This process diverts approximately 30% more material to recycling facilities than multi-stream recycling (in which residents are required to sort their recyclables by type), and reduces burden on municipal waste landfills. Currently, 70 recycling facilities prepare material for resale in Pennsylvania; however, only one quarter of them support single-stream recycling.

In Pennsylvania, approximately 9.5% of organic material, such as yard trimmings, manure, and food waste, are diverted to composting facilities, which is higher than the national average (6.1%). Pennsylvania also has the most yard trimming composting facilities in the nation. However, composting legislation has not been updated since 1991, and no grants, loans, or diversion mandates promote further composting.

RECOMMENDATIONS TO RAISE THE GRADE

- **Legislation should be considered to modify Act 101 to permit county and/or local governments to establish various methods for generating revenue to sustain their solid waste management, recycling and education programs.**
- **Pass state legislation that would promote, enhance, or facilitate the development of resource recovery facilities, including those for recycling, composting, reuse, and energy recovery.**
- **Improve waste education programs on topics such recycling (with focus on preventing contamination) and reduction of waste generation.**
- **Improve funding to support municipal waste programs and promote safe transport and disposal practices universally across our largely rural state.**
- **Promote single-stream recycling.**
- **Continue inspections of solid waste generators, transporters and disposal facilities.**
- **Continue and improve data collection and publication so data is readily available for planning purposes.**

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STORMWATER

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ALONG I-95 IN PHILADELPHIA, PA. ©: AECOM

STORMWATER

EXECUTIVE SUMMARY

While generally performing adequately for higher-frequency lower-intensity rainfall events, the age of much of Pennsylvania's stormwater infrastructure exceeds 100-years, and needs on-going repairs, replacement, and capacity upgrades. There is also a lack of easily accessible critical information relating to the size, condition, capacity, and capital needs of all public and privately-owned stormwater assets. Sources of funding for these much-needed improvements are not consistently available for municipalities across the Commonwealth. The Pennsylvania Municipal Authorities Act was amended in 2013 by Act 68 to permit the creation of stormwater authorities, and Act 62 was signed into law in June 2016 authorizing second class townships to create stormwater utilities. Several other legislative bills are currently in the Pennsylvania Senate, and if enacted, will further empower local governments to apply a stormwater use-based revenue system to fund the operation, maintenance and upgrades of stormwater assets.

BACKGROUND

Stormwater management looks at how much and how quickly runoff enters our streams, rivers, wetlands and lakes, as well as the quality of said runoff water. Stormwater management involves the planning, design, construction, and maintenance of stormwater conveyance infrastructure and control facilities. It is comprised of Best Management Practices (BMPs) such as roadside swales, stormwater culverts and inlets, detention basins, and green infrastructure practices. Historically, stormwater infrastructure has been constructed to mitigate the additional stormwater runoff that occurs when land cover conditions are altered due to development. Stormwater management is an integral aspect of construction projects including roads, rail, and aviation infrastructure, and stormwater management affects dams, levees and inland waterways. Municipalities, government agencies, private businesses and homeowner associations own and maintain stormwater management facilities within the Commonwealth. For this report, the evaluation of combined sewer overflows (CSO) are covered in the Wastewater category.

The National Pollution Discharge Elimination System (NPDES) Phase II Program is a national program that sets procedures that must be followed for stormwater. In Pennsylvania under the NPDES program, most construction projects that disturb more than 1.00 acre of soil, require a separate permit that reviews the approach to handle stormwater. Typically, county conservation districts or the Pennsylvania Department of Environmental Protection (PADEP) perform these reviews and issue NPDES permit approval. Another program under NPDES is the municipal sperate stormwater systems (MS4s). This program is intended to look at municipal stormwater systems that are not combined with sanitary sewers. In Pennsylvania there are 955 municipalities with MS4 regulations. According to the Pennsylvania Department of Environmental Protection (PADEP), MS4s must apply for NPDES permit coverage or a waiver if they are in an urbanized area as determined by the latest Decennial Census by the U.S. Census Bureau, or if they are designated as needing a permit by the PADEP. Additionally, MS4s that discharge to impaired surface waters or within the Chesapeake Bay Watershed must prepare a Pollution Reduction Plan (PRP).

CONDITION & CAPACITY

Although public and private entities within Pennsylvania have been designing and building stormwater management assets for over 160 years, there is currently no statewide assessment of existing conditions and capacity. While agencies such as the Philadelphia Water Department and PennDOT have begun to create inventories and assess their stormwater management assets, more should be done on a statewide level to complete an assessment of conditions and capacity for all public and private-owned assets. Such an inventory, conducted in a similar fashion as the above-referenced agencies, could be used to help prioritize areas that are in the biggest need of maintenance or replacement.

Beginning to create an assessment of stormwater will have its challenges. One challenge is establishing a baseline performance of capacity. Much of the stormwater infrastructure within the Commonwealth was designed and constructed under very different design criteria than that what is used today. Stormwater conveyance systems installed pre-1950 were designed to convey stormwater as quickly as possible away from a site, with no focus on controls or regulatory compliance. Stormwater regulations began to take shape during the 1950's, with an emphasis on floodplain management, and evolved during the 1980's with rate control. Much of these systems, while modern at the time, are not capable of providing the level of service required in the modern day regarding rate control, volume management, and water quality. Without a statewide system assessment of desired and actual performance, many of these systems may continue to underperform, or perform in a manner that does not achieve the desired level of service within the Commonwealth.

The evaluation of the stormwater infrastructure systems within the Commonwealth is complicated by the multitude of agencies and jurisdictions that take ownership of and are responsible for maintenance of the assets. There are 2,560 municipalities in Pennsylvania with 955 communities that comply with the MS4 program and 152 that comply with combined sewer outfall (CSOs) long term control plans. The remaining municipalities are less than 10,000 persons and are currently exempted from MS4 requirements.

The condition of stormwater since the late 1990s has been expanded to further consider water quality with the advent of low-impact development (LID) strategies. Requirements for sediment and nutrient removal are built into the requirements of the NPDES permitting process, as well as local stormwater ordinances. However, systems that pre-date the LID movement provide very little, if any, water quality treatment of stormwater, and they can contribute to the degradation of Pennsylvania receiving waterways. Retrofits to these older systems, with the goal of improving the quality of discharge to receiving waterways, must become a priority within the Commonwealth.

The PADEP designated approximately 19,000 miles of rivers and streams impaired for water supply, aquatic life, recreation or fish consumption in 2016, with stormwater runoff pollution estimated to be one of the major contributors for this impairment. Large investments in green infrastructure and aging infrastructure in major cities like Pittsburgh and Philadelphia, as well as updates to state regulations, such as the PAG-13 General Permit, are expected to increase the quality of stormwater discharge from MS4s. The 2018 PAG-13 update includes increased regulations that should enhance stormwater quality.

FUNDING

Historically, costs for the upkeep, repair and replacement of stormwater systems have fallen to municipalities to fund using property tax-generated general funds. Tax exempt properties and large low valued impervious paved areas are examples of how this model does not equitably generate funds needed to maintain these systems. Other sources of funding include limited bonds and low-interest loans that are available through the Pennsylvania Infrastructure Investment Authority's (PENNVEST), Clean Water State Revolving Fund program.

The idea of implementing user-based stormwater fees is gaining interest across the Commonwealth as a revenue to be used to invest in aging infrastructure and create cost incentives for the deployment of green stormwater infrastructure (GSI). The Pennsylvania Municipal Authorities Act was amended in 2013 by Act 68 to permit the creation of stormwater authorities. Act 62 was signed into law in June 2016 authorizing second class townships to create stormwater utilities. At the time of this writing, legislation empowering local governments to apply a use-based revenue system to fund stormwater systems operation, maintenance and upgrade, if they so desire, are under consideration in the Pennsylvania legislature.

FUTURE NEED

Stormwater carries with it pollutants such as sediment, fertilizers, pesticides and automotive fluids. According to the Environmental Protection Agency (EPA), urban and suburban stormwater is the source of 15% of the total nitrogen entering the Chesapeake Bay, and is the only source that is still increasing. The Pennsylvania region in the Chesapeake Bay's watershed is leading the effort in the Commonwealth to control stormwater pollution. Some MS4 systems that discharge to the Chesapeake Bay watershed are required to develop a PRP that will reduce that load by 10% within five years. These efforts are good examples of blueprints for the rest of Pennsylvania to address stormwater pollution.

Pennsylvania retains its title as having the most combined sewer overflows (CSO) of any state in the country. CSOs convey both storm and sanitary sewer flows, resulting in the release of untreated human and industrial waste and other pollutants into the environment. The 1,608 CSOs systems across 39 counties also account for some of the highest occurrences of overflows in the country. Such occurrences can significantly impair water quality and impact public health and wildlife. The Philadelphia Water Department Office of Watersheds' hydraulic and hydrologic models estimate annual CSO discharge at about 16 billion gallons from 164 CSO point sources within the City of Philadelphia alone.

PUBLIC SAFETY AND RESILIENCE

While water quality degradations from inadequate stormwater management have a long-term effect on public health and safety, flooding can have immediate impacts on the safety and property of residents in the Commonwealth. Flash flooding is one of the greatest losses of property and has caused an estimated $91.6 million per year in losses from 1996 to 2014, according to National Oceanic and Atmospheric Association (NOAA). Torrential rains have contributed to the flooding of roadways, causing road closures and trapping motorists. These events require water rescues of residents from the rising floodwaters, though rescues are not always successful. Heavy flooding in Pittsburgh resulted in the death of one person in 2018 in the town of Bridgeville.

As improvements to stormwater modelling methodologies and software continue to develop, more regional models that rely on the EPA's Stormwater Management Model should be developed to model the quality and quantity of runoff within the watershed, while considering changes in rainfall intensity. Doing so may increase the resiliency of stormwater management to changing climate conditions.

INNOVATION

The Commonwealth has made little headway in the update of its 2006 Stormwater Best Management Practices (BMP) Manual. The development of this manual, which should incorporate changes in science and technology, is vital to advancing stormwater management in the Commonwealth. Preliminary developments of the revised manual are currently underway at Villanova University, but no timeline for public comment has been released as of the date of this report.

There have been technological and research advancements in stormwater management. Real-time control of stormwater assets such as outlet structures can allow for more efficient use of available storage during wet-weather events. Implementation of these systems through new installations or the retrofit of existing assets can be used to control wet-weather flows and reduce CSOs and downstream flooding through peak shaving strategies.

Besides renewing and expanding sewer capacities, communities with CSO systems are also beginning to deploy green infrastructure to reduce the impact of stormwater on these systems. In 2018, the City of Philadelphia met it's 5-year goal of "greening" 774 acres and removing 600 million gallons CSO discharges and has a goal of achieving 10,000 greened acres by 2036. The EPA has highlighted The City of Lancaster's Green Infrastructure Plan as a national model. The 25-year $140 million plan is expected to save the city $5 million annually and prevent over 1 billion gallons of CSO discharges from polluting the Conestoga River.

RECOMMENDATIONS TO RAISE THE GRADE

- Create a statewide system that inventories the size, condition, capacity, and capital needs of all public and privately-owned stormwater assets that is easily accessible.
- The Commonwealth must strive to improve the quality of stormwater runoff through the retrofit of older assets that provide little or no water quality benefit.
- The Commonwealth must strive to explore options to address the maintenance and monitoring aspect of assets within the public right-of-way, and those assets located on privately-owned land.
- Evaluate revising the MS4 program to be a watershed-based system, rather than the current municipality approach, to gain economy of scale efficiencies and the ability for smaller municipalities to benefit from sharing staff across a larger region.
- Provide additional funding to PENNVEST for stormwater and green infrastructure projects.
- Release an update to the 2006 Stormwater BMP manual incorporating advances in technology and stormwater research.
- Embrace innovative stormwater controls in future designs, as well as retrofits of older designs.
- The Commonwealth must strive to pass legislation empowering municipalities to charge user-based fees if they desire.
- Create a state-wide recommendation for water quality requirements.

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TRANSIT

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SEPTA'S MARKET FRANKFORD LINE IN PHILADELPHIA

TRANSIT

EXECUTIVE SUMMARY

Each of the 67 counties in Pennsylvania has transit service available and the state boasts high transit usage in both cities and rural areas. In addition to the benefits of enhanced mobility, increased public safety, and environmental stewardship, the transit system's ability to carry more people in less space makes this mode an effective alternative to building new roadways. However, challenges exist. The Southeastern Pennsylvania Transportation Authority has identified $5 billion of capital needs and the Port Authority of Allegheny County requires $175 million for capital improvements to its light rail network alone. Smaller transit operators need to invest in vehicle replacement, storage and maintenance facility upgrades, and expanding the number of transit centers. Act 89 provided much-needed funding for transit infrastructure, which has helped authorities address some capital needs, but in the future more funding will be needed to maintain and expand capacity.

BACKGROUND

Transit includes buses, subways, elevated trains, trolleys, and trackless trolleys; modes of travel that efficiently move large groups of people at one time and fits into a larger multi-modal picture that includes pedestrians and bicycles. It also includes 44 systems offering shared-ride services in all PA counties, and 67 counties with rural transportation for persons with disabilities, to name a few. The national trend toward driving less continues, as vehicle miles traveled per person has steadily and consistently decreased for the past 20-plus years, and much of this is resulting in gains in public transit usage. In addition, commuters to urban areas are increasing in Pennsylvania, with Philadelphia having the highest numbers of commuters in the state. The U.S. Census Bureau reports an estimated 270,000 workers commuting into Philadelphia County every weekday from surrounding counties. In Pittsburgh, approximately 50% of downtown workers commute by bus or light rail. Port Authority of Allegheny County (PAAC) has a substantial bus fleet of over 600 and Southeastern Pennsylvania Transportation Authority (SEPTA) has over 1,400.

CAPACITY

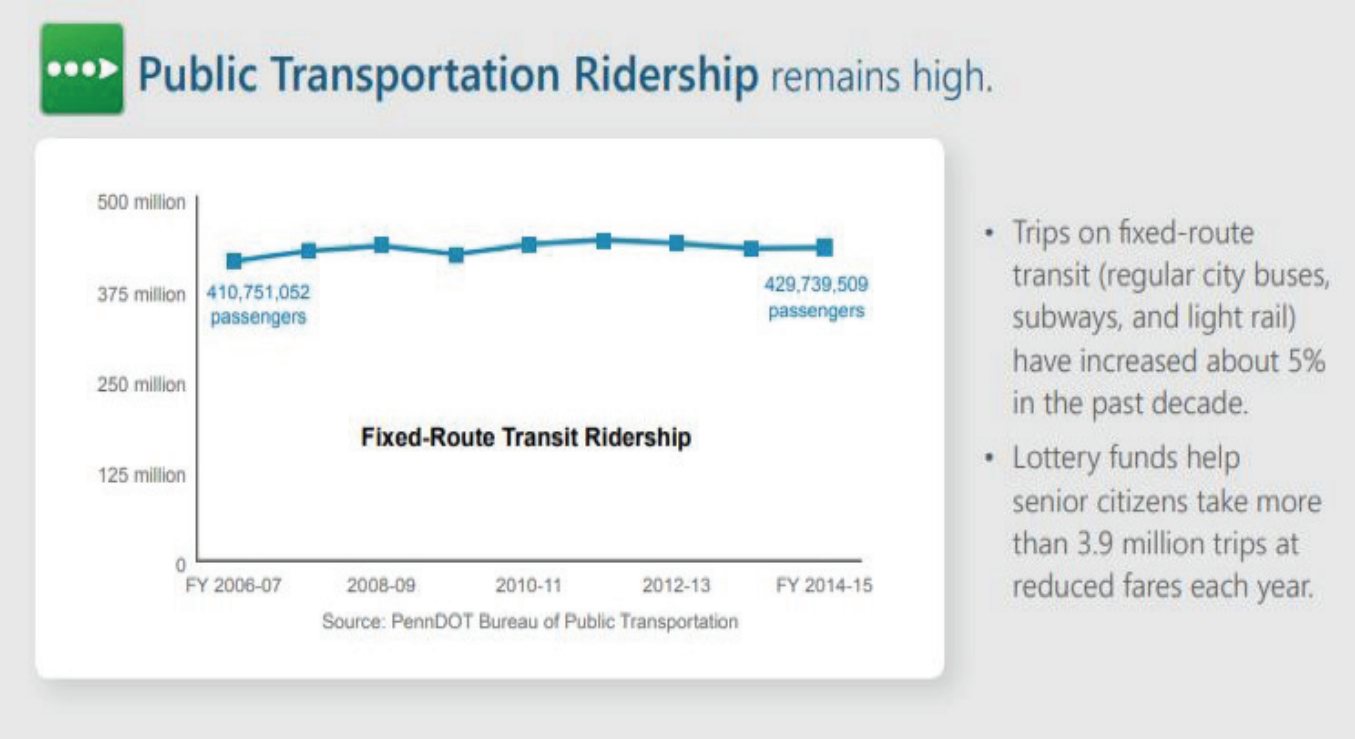
With 74 public transit authorities across Pennsylvania, transit services are available in each of the 67 counties in the state, including fixed-route (prescribed route, fixed schedule) transit service in Philadelphia, Pittsburgh, 21 small urban areas, 22 rural areas, 44 systems offering shared-ride services in all counties, 13 intercity bus networks, and 67 counties offering rural transportation solutions for persons with disabilities. Both SEPTA and PAAC are included in the National Transit Database's *Top 50 Reporting Agencies for 2016 report*, with some of the key capacity metrics included in Table 1. Additionally, demand-responsive service is offered in many localities, which provides transit service to those who make advance arrangements for it, such as for medical appointments.

TABLE 1. SEPTA & PAAC KEY CAPACITY METRICS

	SEPTA (Philadelphia Metro)	**PAAC (Pittsburgh Metro)**
Service Area Total Square Miles	2,200 Square Miles	775 Square Miles
Service Area Population	3,816,641	1,415,244
Available Modes of Transport	Commuter rail demand responsive, heavy rail, bus, street car rail, trolleybus	Demand responsive, inclined plane, light rail, bus
Annual Passenger Miles Traveled (PMT)	1,583,279,549	271,913,440
Vehicles Operated & Available in Maximum Service	Vehicles Operated in Max. Service: 2,339 Vehicles Available for Max. Service: 2,843	Vehicles Operated in Max. Service: 939 Vehicles Available for Max. Service: 1,174
System Wide Fixed Guideway Directional Route Miles (across all modes)	637.7 miles	92.9 miles

Public transportation agencies are challenged with providing consistent, efficient, and effective service to the public while contending with aging infrastructure, outdated equipment and technology, and limited capacity. Transit usage remains high in the state, with Philadelphia ranking eighth (67.4 ridership per capita) of the top 50 metropolitan areas and Pittsburgh ranking sixteenth (39 ridership per capita).

FIGURE 1. FIXED-ROUTE TRANSIT RIDERSHIP



Congestion continues to be one of the biggest challenges statewide, as transit vehicles that use public roadways must sit in traffic just the same as passenger cars. Opportunities for advancing and implementing connected and autonomous technology will provide better chains of communication between vehicles and the physical infrastructure.

CONDITION

SEPTA has identified a $5 billion identified needs for state of good repair (prior to Act 89 and includes regional rail). In order to continue to operate safely it is imperative that the Authority continues to prioritize efforts to bring the system to a state of good repair. This includes programs to overhaul legacy rail infrastructure, maintain the portfolio of bridges built in the 19th and early 20th centuries and overhaul the fleet. Some examples include the Bridgeport viaduct (built in 1912), and bridges on the Route 101/102 lines built in the early 1900s.

PAAC has two designated busways serving the east and west of Pittsburgh and a segment of Liberty Avenue downtown is undergoing a pilot project using red designated bus lanes and raised bus bulbs on a two-block section to provide priority service to buses. PAAC has identified over $175 million in capital needs for its light rail network alone. The fleet must be maintained and has capital needs such as service and garage facilities.

Figure 2 indicates the average age of transit vehicles in Pennsylvania for transit agencies with more than 2 million boardings per year. As a whole, Pennsylvania transit vehicles have an average bus fleet age of 18 years and rail/street car/trolley age of 24 years; falling behind the national standard to replace vehicles every 10 to 12 years.

FIGURE 2. AVERAGE AGE OF TRANSIT VEHICLES

	Average Age (Years)		
Transit Agency	Bus	Light Rail / Street Car/Trolley	Vanpool
PAAC (Pittsburgh)	7.2	24.6 Light Rail	-
SEPTA (Philadelphia)	8.8	39.3 Street Car/8.0 Trolley	-
EMTA (Erie)	9.8	-	-
LNTA (Lehigh and Northampton)	21.8	-	-
RRTA (Lancaster)	17.7	-	-
CDHTA (Cumberland Dauphin-Harrisburg)	18.3	-	-
BARTA (Berks)	23.6	-	-
CATA (Centre Area)	43.8	-	8.2
MT (Wilkes-Barre)	13.5	-	-

FUNDING AND FUTURE NEED

Pennsylvania's state funding for transportation is 11% of the 2018-2019 State Budget. It has continuously grown since 2012 as a direct result of Act 89. See Figure 3 for the graphic for 2016-17 and see Figure 4 for trends.

FIGURE 3.

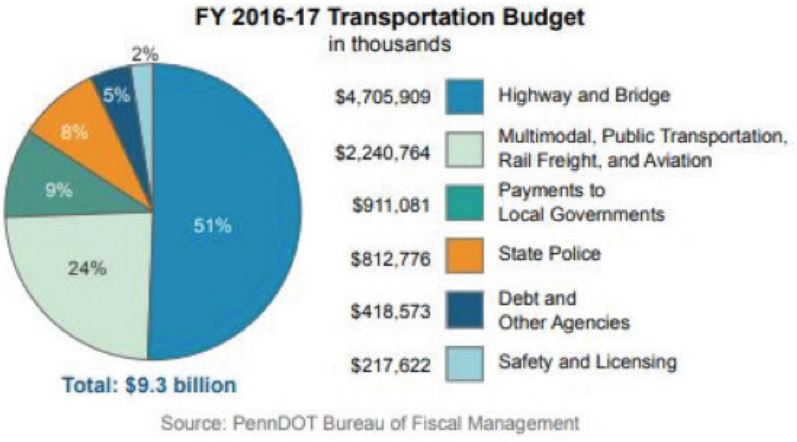
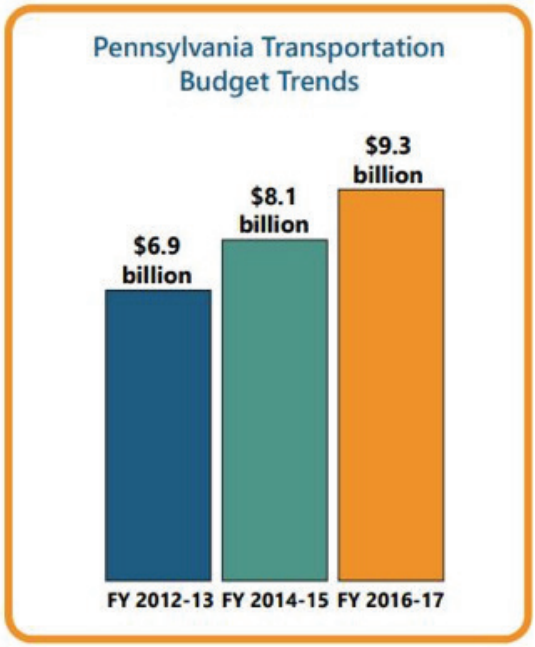


FIGURE 4.



When Act 89 was established in 2013, the Multimodal Fund and Local Use Funds were created to provide funding to capital projects supporting the improvement of all transportation modes. Funding for transit projects is also provided through the State's Liquid Fuels Program. The liquid fuels tax has been the largest revenue contributor to the state motor license fund since it was established in 1984.

Act 44, approved in 2007, expanded the PA Turnpike's mandate from one focused entirely on improvements to the Turnpike to one that also provides annual funding contributions for broader Pennsylvania transportation needs, including transit. This funding will significantly decrease in 2023. In addition, there is a pending lawsuit challenging the use of Pennsylvania Turnpike tolls to pay for non-turnpike expenses including transit.

While new investment would expand transit service to more Pennsylvanians, existing systems have great needs for required reinvestment to replace aging infrastructure, due to historically unstable funding coupled with rising costs and deferred maintenance, representing over $5 billion in needs. Additionally, infrastructure inherited from private operators, which often could not sustain the infrastructure in top condition, caused many of these needs to become critical.

PAAC has identified over $175 million in capital needs for its light rail network alone. The fleet must be maintained and has capital needs such as service and garage facilities.

Although many smaller transit operators throughout the state provide bus service, similar needs have been identified for vehicle replacement, storage and maintenance facility upgrades, and expanding the number of transit centers. Act 89 brought a healthy "dose" of transit assistance, which has helped properties catch up on capital needs, but in the future more funding will be needed to maintain and expand capacity.

Looking to the future, several transit agencies are looking to address unmet transit needs and service issues to allow better mobility access. The South Central Transit Authority (SCTA) is developing a plan to respond to the anticipated future demands and needs for fixed-route bus and paratransit services in Berks and Lancaster Counties, coordinating services currently provided by the Berks Area-Reading Transit Authority (BARTA) and the Red Rose Transit Authority (RRTA).

PUBLIC SAFETY

Transit operators around the state have focused on the provision of a state of good repair for facilities and vehicles, in order to provide the safest possible environment for riders. Statistically, transit tends to be among the safest modes of transportation, especially compared to automobiles. Other transit agencies, including Erie MTA, LANTA (Allentown/Bethlehem), and CAT (Harrisburg), are taking steps forward to improve their public safety campaigns and additional funds could enable them to do more. For public safety, SEPTA has an ongoing campaign with regular Safety Days at various train stations and transit centers and should be considered a model program for other transit agencies in the state. Transit operators have added interactive communication systems and video cameras to enhance security and provide a safe environment for users.

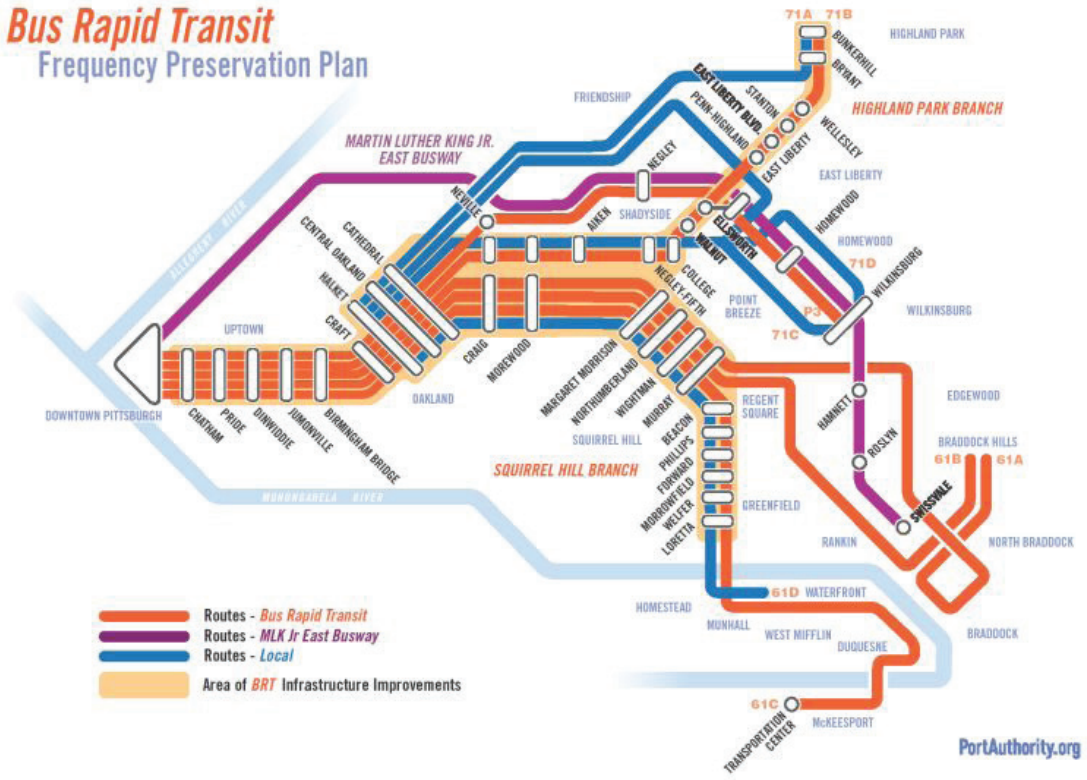
RESILIENCE AND INNOVATION

Pennsylvania transit agencies have been making strides to be more resilient to extreme weather events. An example of this includes the Port Authority Transit Corporation (PATCO) placing employees at other regional command centers in advance of extreme storms. SEPTA is also looking across modes to address extreme weather events such as deploying buses during region-wide power outages when their rail services are unavailable.

SEPTA's infrastructure program includes several projects to harden its infrastructure and provide flood mitigation. To reduce carbon footprints and emissions, both SEPTA and PAAC are increasing the number of hybrid and electric buses in their fleets.

PAAC will be creating exclusive lanes for electric buses between Downtown and Oakland to reduce travel time. The City of Pittsburgh will also be investing in the addition of 8 miles of dedicated Bus Rapid Transit (BRT) lanes. This will deliver faster and more reliable service See Figure 5 for a map of the BRT line in Pittsburgh.

FIGURE 5. PAAC'S PROPOSED BRT SYSTEM



SEPTA is providing regenerative braking capability on the DC traction power system on the Market-Frankford Line. This utilizes batteries, which provide an electrical supply from train acceleration and braking. This provides an incremental frequency regulation service within the grid, providing cost savings.

To expand passenger-carrying capacity, larger vehicles are being obtained. Both SEPTA and PAAC have expanded their bus fleets to include more 60-foot articulated coaches, which will offer additional passenger-carrying capacity without having to have more operating personnel.

On the procurement/service provision side, both SEPTA and the PAAC are exploring alternate contracting methods, such as design-build, to allow projects to be delivered more quickly and efficiently for capital needs.

Transit agencies in the state are incorporating technology to announce the location of their vehicles and arrival time, however more can be done to communicate it to enhance the passenger experience such as next to arrive times at major stops. Technology also allows for the use of a single form of payment between modes of transportation and this should be considered in the Commonwealth.

RECOMMENDATIONS TO RAISE THE GRADE

- **Encourage additional investment at all levels of government and in relevant areas that focus on reducing the backlog of rehabilitation needs and on increasing ridership.**
- **Budget for and fund maintenance and improvements critical to sustaining performance, maintaining reliability and meeting service expectations.**
- **Expand multimodal funding at the local level through the encouragement of tax resources, use of the additional $5 fee that a county can add to vehicle registration for its use.**
- **Expand the number of low/no emission and alternative energy transit vehicles.**
- **Foster and encourage better coordination among transit agencies efforts, particularly crossing county lines, to provide greater access to PA residents.**
- **Explore alternate contracting methods to allow projects to be delivered more quickly and efficiently for capital needs.**
- **Allocate funds toward developing a public safety education campaign and improving public safety for transit users.**

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WASTEWATER

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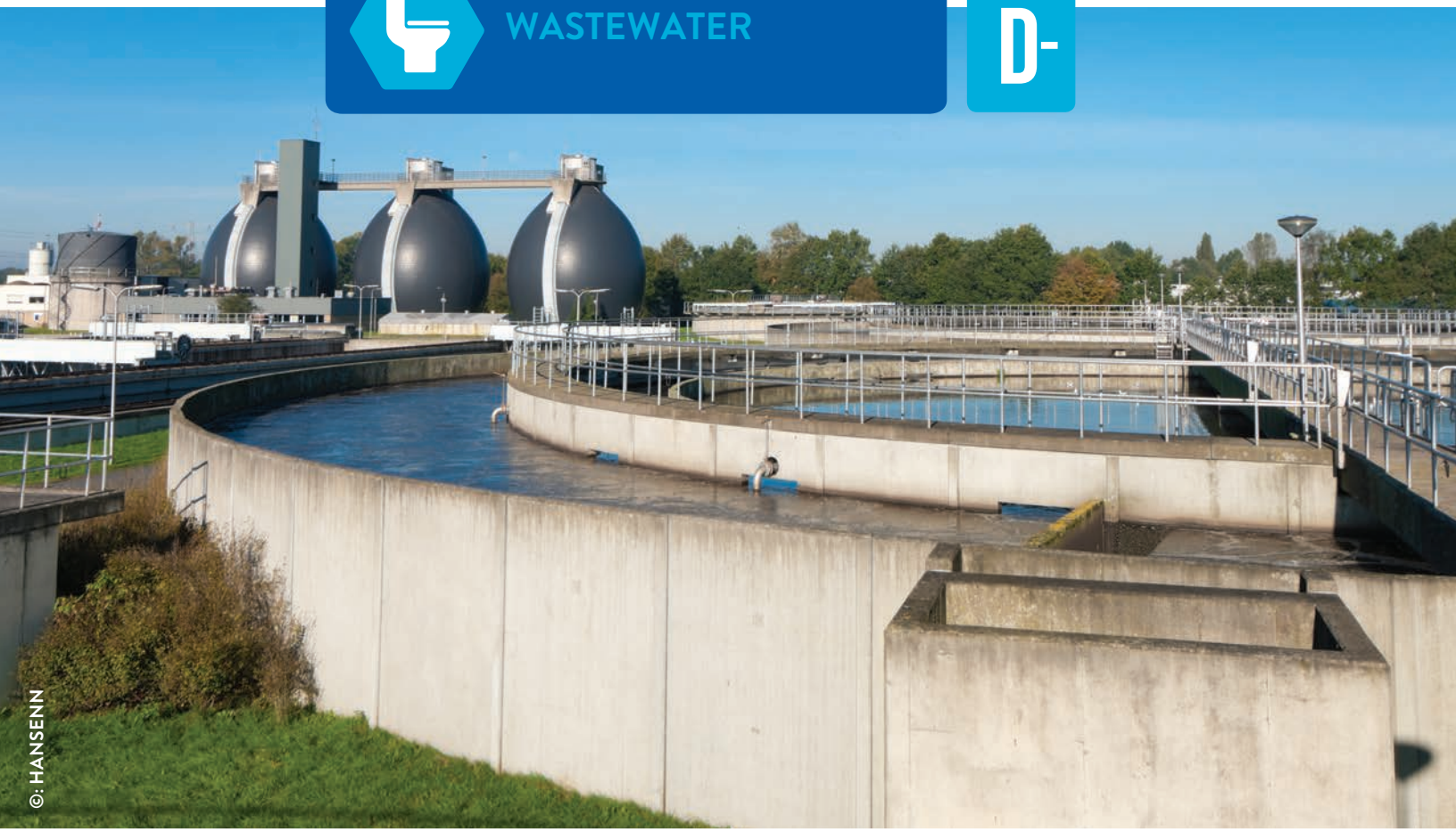

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WASTEWATER

EXECUTIVE SUMMARY

Aging wastewater management systems discharge billions of gallons of raw sewage into Pennsylvania's surface waters each year. The average age of most sewer systems is approaching 70 years with many having pipes over 100 years old. 1.6 million homes in PA are served by on-lot systems with failure rates of nearly 20%. Half of the State's Sewage Facilities Plans are over 20 years old. It is estimated that the Commonwealth has a funding gap of $8.4 billion over the next 10 years to repair existing systems, upgrade existing systems to meet regulatory requirements, control Combined Sewer Overflows, address illicit Sanitary Sewer Overflows, and construct new or expand existing systems to meet increasing demands. Available funding over that time is estimated to be $900 million, approximately 10% of the required annual investment.

BACKGROUND

One of the most vital, though possibly most frequently overlooked, systems of our society is the sanitary handling of wastewater. While treatment of wastewater may seem paramount, collection and conveyance are equally important to protect water quality and safeguard human health.

Pennsylvania has an enormous inventory of wastewater infrastructure. There more than 5,300 sanitary sewer facilities that operate under the National Pollution Discharge Elimination System (NPDES) in Pennsylvania. As time passes, more and more of these facilities are passing into private hands. At last count, according to the Pennsylvania Department of Environmental Protection (PADEP), more than 2,200 facilities are publicly owned with nearly 4,300 privately owned.

While not faced with explosive population growth that is applying pressure to wastewater systems in other portions of the country, Pennsylvania is facing the threat of infrastructure reaching the end of its useful life. Unfortunately, this is often not realized until failure occurs. And when failure occurs, the environment and public health are exposed to great danger.

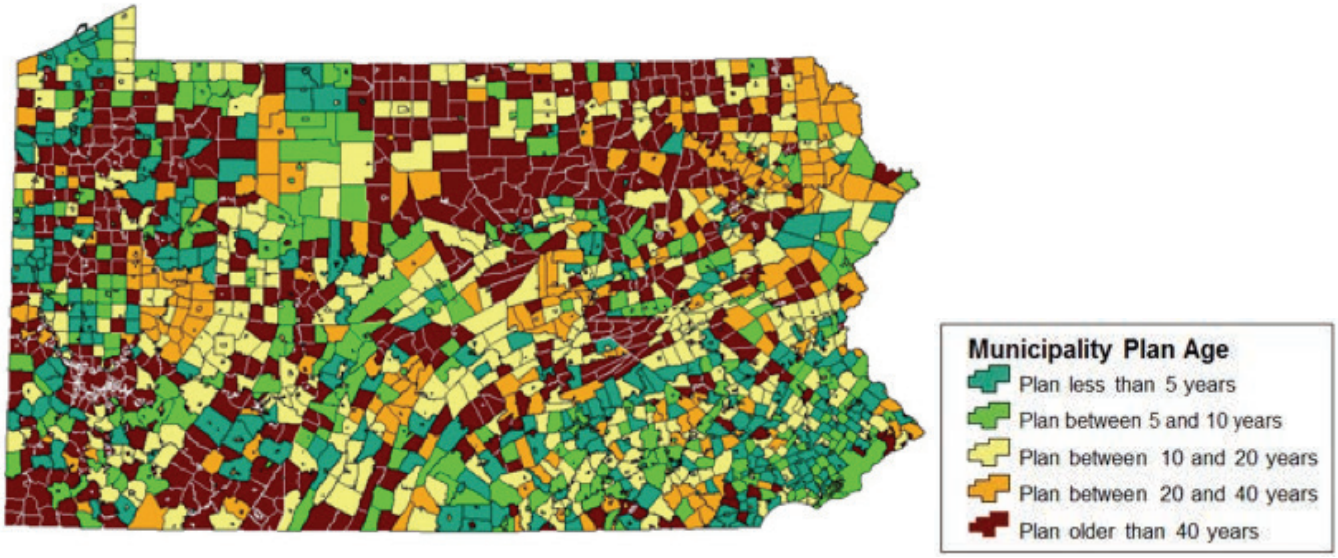
CONDITION AND CAPACITY

The sheer number of NPDES permitted facilities exerts substantial demand on PADEP staff when it comes to regulating these facilities. This is particularly apparent when reviewing the number of periodic inspections conducted over the years. In 2014, 966 inspections were conducted on major treatment plants (flows exceeding 1 MGD), resulting in 296 violations. In 2017, the number of inspections fell by nearly a third to 689. Despite the sharp drop in inspections, reported violations fell disproportionately by only 21%. A greater reduction in violations should have been expected. On a positive note, facilities treating more than 5 MGD saw more than a 50% reduction in violations compared to the 35% reduction in frequency of inspections.

According to a 2015 study conducted by the Center for Rural Pennsylvania, more than 1.6 million homes, or greater than 30% of the state, is served by on-lot septic systems (OLS). No statewide data is available on the percentage of these OLS that are failing to function as intended, nor remediation costs for homeowners. National failure rates for onsite sewage treatment and disposal systems are reported at 10% annually by the United States Environmental Protection Agency (EPA); however, estimates of failure rates in Pennsylvania range upwards of 20% due to the frequent occurrence of soil conditions unsuitable for OLS. PADEP's report from 2016 shows that OLS failures are associated with degrading the quality of 202 miles of streams and 3,304 lake-acres. Contamination of groundwater and surface water by failing or substandard septic systems is a considerable risk. PADEP's Bureau of Clean Water Management oversees the licensing for Sewage Enforcement Officers (SEOs), but since 2011, no longer compensate the SEOs or municipalities that employ them for required training. The number of OLS has grown between the 1990 - 2010 censuses, and PADEP anticipates this number continuing to increase.

The Pennsylvania Sewage Facilities Act (Act 537) requires that all municipalities develop and implement Act 537 Plans that provide for the resolution of existing sewage disposal problems, provide for the future sewage disposal needs of new land development, and provide for the future sewage disposal needs of the municipality. These plans are required to consider growth for 10-

FIGURE 1 – PENNSYLVANIA'S ACT 537 PLAN AGE



Source: Pennsylvania Department of Environmental Protection, 2015

20 year periods and are to be updated to stay current and relevant. However, as of the beginning of 2015, of the 2,575 Act 537 Plans in existence, as shown in Figure 1, 50% are at least 20 years old and over 33% are more than 40 years old. For many years, municipalities were able to apply for grants through PADEP to cover 50% of the costs to develop Act 537 Plans. Unfortunately, this assistance was eliminated in 2014. Consequently, the high cost associated with updating Act 537 Plans serves as a significant deterrent to municipalities.

The average age of sanitary sewers varies by community with industrial age cities having pipes dating back to the turn of the 19th century and sewers in communities developed post-World War II now approaching 70 years old. Philadelphia has reported the average age of sewers there is 100 years old. The rate of pipe replacement remains below that of what is required to meet a sewer pipe's life cycle, meaning these facilities will be kept in operation longer than designed, putting public health at risk and increasing the likelihood of more expensive costs in the event of complete failure.

While the condition of wastewater infrastructure is of paramount concern, inadequate capacity of infrastructure is a growing issue in and around metropolitan areas. As a whole, population growth within Pennsylvania has waxed and waned in recent years. However, metropolitan areas, particularly in southeastern Pennsylvania is taxing already stressed infrastructure. Attention is required to ensure that infrastructure capacity keeps up with anticipated growth rates. For this reason, up-to-date Act 537 Plans are imperative to ensure future needs are met.

Pennsylvania retains its title as having the most combined sewer overflows (CSO) of any state in the country. CSOs which convey both storm and sanitary sewer flows, resulting in the release of untreated human and industrial waste and other pollutants into the environment. The 1,608 CSOs systems across 39 counties also account for some of the highest occurrences of overflows in the country. Such occurrences can significantly impair water quality and impact public health and wildlife. Although measuring the volume of CSO discharge is difficult to estimate given that the quantity, frequency and impact are unique for each CSO system, municipalities are trying to reduce the frequency and volume of CSO overflows. One example is the Philadelphia Water Department, that estimates between 2011-2016 their CSO discharges were reduced by 600 million gallons per year. Although this number may sound large, considerable work is still needed given it is estimated that there is an annual CSO discharge of 16 billion gallons annually in Philadelphia alone.

FUNDING & FUTURE NEED

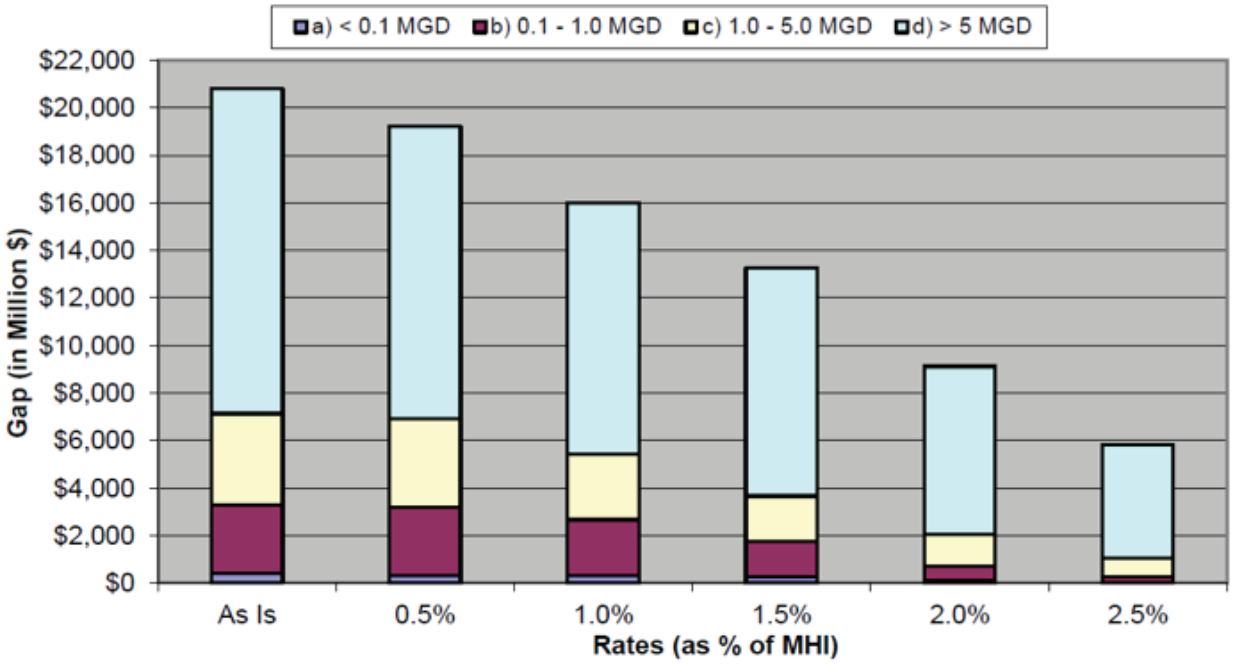
The most common source of funding for Pennsylvania's aging wastewater infrastructure are user fees, which are charged by most public sewer authorities and all private sewer companies. User fees are typically based on a percentage of the service area's median household income (MHI). Certain grants are also scaled to recognize through additional funding those authorities that have higher percentage user fees of MHI. Even with these funding sources, the total wastewater funding gap over the next 10 years in Pennsylvania is estimated at $8.4 billion. Most user rates paid by customers today do not reflect the long-term costs of maintaining and repairing wastewater infrastructure; often they are just a reflection of short-term capital improvement costs and operational costs. Some public and private systems incorporate asset management programs as a tool to prioritize infrastructure improvement and optimize the operation of their systems. This results in proactive infrastructure improvement as opposed to emergency repairs, which greatly reduces costs.

While sewer ratepayers are the primary source of funds for operation, maintenance and some capital improvements, federal and state funding are also major sources for capital improvements to Pennsylvania's aging wastewater infrastructure. The main source of federal funding is the Federal Clean Water State Revolving Fund (CWSRF), which is managed by the Pennsylvania Infrastructure Investment Authority (PENNVEST). PENNVEST is expected to provide $500 to $600 million over the next 10 years in grants and loans for wastewater projects. The most significant additional source besides PENNVEST, is loan and grant monies from the United States Department of Agriculture, Rural Development (USDA RD).

If user charges were increased to 1.5% of MHI the wastewater funding gap would be reduced. Use of 1.5% as an affordability standard is based on experience in several national financial assistance programs over the past 50 years, and is considered a reliable indicator of what the affordable ceiling should be for the customers of a wastewater system.

Figure 2 shows that wastewater systems need a total of $20.8 billion more to satisfy 20-year needs than is provided at the current wastewater user rates being charged. Many systems will not be able to meet their needs through increasing user rates without funding assistance. The largest gap dollars are in the largest wastewater systems.

FIGURE 2 – PENNSYLVANIA'S WASTEWATER FACILITIES – GAP VS. RATE



PUBLIC SAFETY

Inadequate collection, conveyance, and treatment of wastewater can have dire consequences on human health and the environment. The release of raw sewage in to the environment has the potential to impair our drinking water, spread disease, and decimate waterways. In Pittsburgh for example, sewer overflows into the cities rivers affect nearly half of the 140-day boating season (May 15-October1) making water unacceptable for recreational contact.

RESILIENCE & INNOVATION

Climate change poses a significant challenge to wastewater systems throughout Pennsylvania. Per the USEPA, precipitation from extremely heavy storms has increased 70% in the Northeast United States since 1958. These storms intensify flooding and, can overwhelm sanitary sewers and treatment plants, resulting in the release of untreated sewage into the environment. Significant steps are needed to increase the resiliency of our wastewater systems from flooding risks especially as annual precipitation and the frequency of heavy downpours are anticipated to continue to rise.

Besides renewing and expanding sewer capacities, communities with CSO systems are also beginning to deploy green infrastructure to reduce the impact of stormwater on these systems. In 2018, the City of Philadelphia met it's 5-year goal of "greening" 774 acres and removing 600 million gallons CSO discharges and has a goal of achieving 10,000 greened acres by 2036. The EPA has highlighted The City of Lancaster's *Green Infrastructure Plan* as a national model. The 25-year $140 million plan is expected to save the city $5 million annually and prevent over 1 billion gallons of CSO discharges from polluting the Conestoga River.

Pennsylvania has made great strides in the innovative disposal of biosolids (e.g., wastewater treatment sludge) and resource recovery using biogas (e.g. fuel produced from sludge). Instead of disposing of the nutrient rich biosolids in valuable landfill space, land application has increased. This has benefited farmers by allowing them to save money on commercial fertilizers and improving the quality and structure of the soil. Additionally, land application of biosolids has been used to aid reclamation at mining sites and forestry.

The American Biogas Council ranks Pennsylvania ninth among U.S. states for methane production potential from biogas sources, a majority of which are wastewater treatment plants. There are 173 operational biogas systems in the state with the potential for more than 348 more. If the potential were fully realized, enough electricity could be generated to power more than 150,000 homes while reducing greenhouse gas emission by the equivalent of 18.1 trillion tons of carbon dioxide.

RECOMMENDATIONS TO RAISE THE GRADE

- Implement the use of infrastructure Asset Management programs on a larger scale. Through Asset Management, detailed inventories of system components, operation and maintenance tasks, and long-range financial planning can be developed. Effective Asset Management programs can save money by timing the replacement of infrastructure/assets so that useful life is maximized and expensive catastrophic failures are minimized.
- Implement reasonable increases in what customers pay for wastewater services to reflect real costs of service. User fees should be evaluated for increases greater than 1.5% MHI in communities that can tolerate higher rates based on income, since there is still a projected funding gap even with rates set at 1.5% MHI.
- Provide more state and federal sources of grant funding to subsidize the projected funding gap that cannot be met with reasonable rate increases and for communities with below average income levels.
- Evaluate consolidation of smaller wastewater systems into regionalized systems to spread the capital and operating costs across a larger customer base, streamline management, and increase cost-effectiveness for customers.
- Increase funding for PADEP to maintain a level of inspections adequate to protect human health and the environment, provide funding for the training of SEOs, and increase grants for Act 537 Plan updates.

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COMPARISON OF PREVIOUS GRADES AND AMERICA'S GRADES

PENNSYLVANIA					
Category	2006	2010	2014	2018	National
Aviation	C+	-	-	C+	D
Bridges	C	C	D+	D+	C+
Dams	C-	C-	C-	C	D
Drinking Water	D+	D+	D	D	D
Energy	-	-	C	C	D+
Freight Rail	B	B	B	B	B*
Hazardous Waste	-	-	B-	B-	D+
Inland Waterways	D-	D+	D+	D	D
Levees	-	C-	C-	C	D
Parks & Recreation	-	B-	B-	B-	D+
Passenger Rail	-	-	-	C-	B*
Ports	-	D+	C+	C+	C+
Roads	D	D-	D-	D+	D
Schools	-	B-	C-	C-	D+
Solid Waste	-	B-	C+	C+	C+
Stormwater	-	D-	D+	D	-
Transit	D+	D-	D	D	D-
Wastewater	D-	D+	D-	D-	D+

** Freight and passenger rail are in one combined category*

2018 REPORT CARD FOR PENNSYLVANIA'S INFRASTRUCTURE

GET INVOLVED

FIND
Use your zip code to find your Elected Officials.

KNOW
Check the PA Legislative Tracker to find legislation that you care about (hint... infrastructure)

DISCUSS
Now that you know who your Elected Officials are, EMAIL THEM and let them know that you care about Pennsylvania's infrastructure

BE SOCIAL
Use our hashtag #ASCEPAReportCard or tag us to show your support of Pennsylvania's Infrastructure

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