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2014

REPORT CARD *FOR* PENNSYLVANIA'S INFRASTRUCTURE

ASCE AMERICAN SOCIETY OF CIVIL ENGINEERS

2014 REPORT CARD FOR PENNSYLVANIA'S INFRASTRUCTURE

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

Grades were assigned to each category based on the eight criteria. The grades break down as follows:

A
90–100%
Exceptional

B
80–89%
Good

C
70–79%
Mediocre

D
51–69%
Poor

F
50% or lower
Deteriorating

WASTEWATER

D-

Aging wastewater management systems discharge billions of gallons of untreated sewage into Pennsylvania's surface waters each year. In fact, Pennsylvania has the most combined sewer overflows (CSOs) of any state. The Commonwealth must invest $28 billion over the next 20 years to repair existing systems, meet clean water standards and build or expand existing systems to meet increasing demands. While investment needs are estimated to cost to 87 times the cost of the Pittsburgh Penguin's Consol Energy Center, funding has decreased. The Pennsylvania Infrastructure Investment Authority's (PENNVEST) budget in 2013 for grant and loan awards for sewer projects is $335 million dollars, less than 25 percent of the required annual investment. In 2013, Pennsylvania's appropriation from the federal Clean Water Act also decreased to $53 million.

BACKGROUND

Clean and safe water is critical for human health, a healthy environment, and the economy. Wastewater is any water that has been adversely affected in quality by human influence. Municipal wastewater is usually conveyed in a combined sewer or sanitary sewer and treated at a wastewater treatment plant. Treated wastewater is discharged into receiving water. Wastewaters generated in areas without access to centralized sewer systems rely on on-lot wastewater systems.. These typically comprise a septic tank, drain field, and optionally an on-site treatment system. Advances in wastewater treatment, initially made at the turn of the 20th century and greatly expanded in the 1970s, helped alleviate epidemics of typhoid, cholera, and other waterborne diseases and improved the environmental health of the Commonwealth's waters. To have a clean water, investments must address all the water system areas - wastewater, drinking water, and stormwater - to be effective. Today Pennsylvania needs an estimated $28 billion of investment to replace and upgrade its current aging wastewater infrastructure to meet state and federal regulations and address issues critical to public health and safety.

Why are we now facing such a large financial burden for wastewater treatment systems that have performed their functions for decades? One reason is Pennsylvania's wastewater infrastructure is aging and in need of replacement as they reach the end of their intended lifespan. Treatment plants typically have an expected useful life of 20 to 50 years before they have to be rehabilitated or upgraded. Pipes have life cycles ranging from 15 to 100 years depending on soil conditions, pipe material, and capacity requirements. In some Pennsylvania cities, the oldest pipes were constructed in the 1800s and are now approaching 200 years of use. This is occurring at a time when funding for wastewater has been continually decreasing. Nationally, the U.S. Environmental Protection Agency (EPA) indicates research and development expenditures on more efficient and affordable technologies in water and wastewater treatment have decreased by half since the early 1970s. Without adequate spending on

the state's wastewater infrastructure, we risk losing the environmental gains achieved over the last three decades.

CONDITIONS AND CAPACITY

Water Quality

Under Section 303(d) of the Clean Water Act, states are required to develop lists of impaired waters, meaning they are too polluted or otherwise degraded to meet the water quality standards set by the Commonwealth. Every two years, the Pennsylvania Department of Environmental Protection (PADEP) produces a monitoring and assessment report characterizing the condition of Pennsylvania's surface waters. The *2012 Pennsylvania Integrated Water Quality Monitoring and Assessment Report* assessed 98% of the state's approximately 86,000 miles of streams and rivers and found:

- Of these 16,644 miles (19%) were classified as impacted due to on-lot sewer systems, stormwater runoff, agricultural activities, abandoned mine drainage (AMD), and wastewater discharges.
- Of the state's 161,455 acres of lakes, 50% acres were assessed and 17,331 acres (21%) were reported to be impaired.

The Clean Water Act requires that each state establish priority rankings for waters on the impairment list and develop Total Maximum Daily Loads (TMDLs) for these waters. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive every 24 hours and still safely meet water quality standards. As of 2012:

- 9,801 miles of Pennsylvania's streams and rivers still require TMDLs in addition to the 6,490 miles that currently have approved TMDLs.
- 5,420 acres of the state's lakes still require TMDLs in addition to the 11,366 acres that currently have approved TMDLs.

Wastewater Treatment Systems

Pennsylvania has approximately 10,000 permitted wastewater systems treating municipal and industrial waste. Additionally there are numerous commercial and industrial facilities that treat their own waste and discharge directly into the Commonwealth's waterways. While a precise count of these facilities was not readily found, all are permitted and regulated by PADEP under the National Pollutant Discharge Elimination System (NPDES). The operations and conditions at these treatment facilities are routinely inspected by PADEP, however the conditions of the buried pipes that convey the sewage to these facilities is much more difficult to determine. Many of the pipes in PA's oldest cities remain brick or clay, having been constructed at the turn of the 20th century. There is no requirement for sewer systems to inspect and assess the condition of their pipes and to be able to quantify the total length of pipes that are need of rehabilitation.

There are 9,471 combined sewer outfalls (CSOs) in 32 states, 1,569 of which are in Pennsylvania—the most in any state across the U.S.! The PADEP has identified 152 communities in the Commonwealth that are currently operating with CSO discharges.

When sewers were first installed in Pennsylvania, combined sewage systems were used to convey sewage and stormwater to the nearest waterway. These systems provided a great convenience to cities and towns. Sewage and industrial waste was commonly disposed of into waterways as a matter of course. At the time, streams and rivers were not thought of as ecosystems or recreational areas, but instead were used for transport and waste removal. Since post WWII, wastewater systems were constructed to separately handle sewage and stormwater. It is only relatively recently that the public perception of waterways has changed to conceptualize waterways as recreation, conservation, and preservation areas. PADEP has reported that wastewater handling and treatment, which includes municipal point source discharges, on-site wastewater treatment, package plants, industrial point source discharge and combined sewer overflows, are implicated in the impairment of 937 stream miles.

Wastewater quality standards require the removal of containments from wastewater, and several industries such as agriculture, livestock, and pharmaceuticals result in higher levels of containments that must be removed from wastewater in order to reduce risk to the public water supply. Concentrated animal feed operations are growing in size and number in Pennsylvania. Economies of scale and modern technologies are driving the establishment of these new concentrated livestock and poultry operations.

Non-point Source Pollution and On-lot Septic Systems

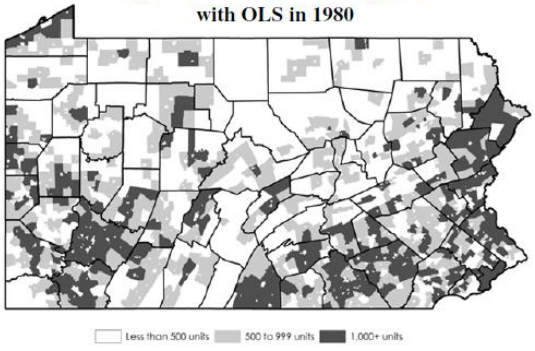
In addition to permitted wastewater systems, which are classified as point source discharges, the Commonwealth's waterways also receive pollution from non-point sources. Unlike point source pollution, which comes from pipes, the causes of non-point source pollution can be difficult to define or quantify. Sometimes referred to as "pollution runoff", non-point source pollution is generally caused by stormwater runoff across the land or infiltration of pollutants into the groundwater. Examples of non-point source pollution would be runoff from a farm field or from a highway.

PADEP has reported that runoff, including urban runoff and storm sewers, road runoff, and small residential runoff, is implicated in the impairment of 4,103 stream miles and 4,422 lake-acres in Pennsylvania. Additionally, abandoned mine drainage is responsible for the impairment of 5,596 stream miles and 377 lake-acres; non-point source discharges from agricultural activities are implicated in the impairment of an additional 5,705 stream miles and 14,313 lake-acres.

According to a 2008 study conducted by the Center for Rural Pennsylvania, more than 1.3 million homes or about 25 percent of all housing units in the state use on-lot septic systems (OLS). No statewide data are available on the percentage of these OLS that are failing to function as intended. Additionally, no data are available as to the associated remediation costs for homeowners. National failure rates for onsite sewage treatment and disposal systems are reported at 10 percent annually by USEPA; however, estimates of failure rates in Pennsylvania range upwards of 20 percent due to the frequent occurrence of soil conditions unsuitable for on-lot systems. PADEP has reported that onsite systems failures are implicated in 205 impaired stream miles and

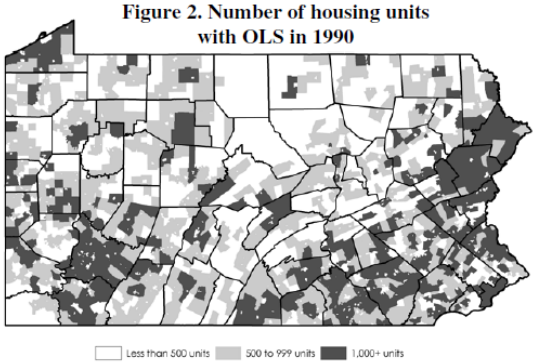
3,310 impacted lake–acres. Contamination of groundwater and surface water by failing or substandard septic systems is a considerable risk in much of Pennsylvania due to the state's geology, soils, land development patterns, and large number of aging systems. PADEP's Bureau of Point and Non-Point Source Management oversees the licensing for Sewage Enforcement Officers (SEOs) but no longer compensate the SEOs or municipality that employs them for required training. As shown in the figures below, the number of OLS has grown between the 1980 census and 1990 census. PADEP anticipates an increase in the number of OLS.

Figure 1. Number of housing units with OLS in 1980



Source: U.S. Census Bureau

Figure 2. Number of housing units with OLS in 1990



Source: U.S. Census Bureau

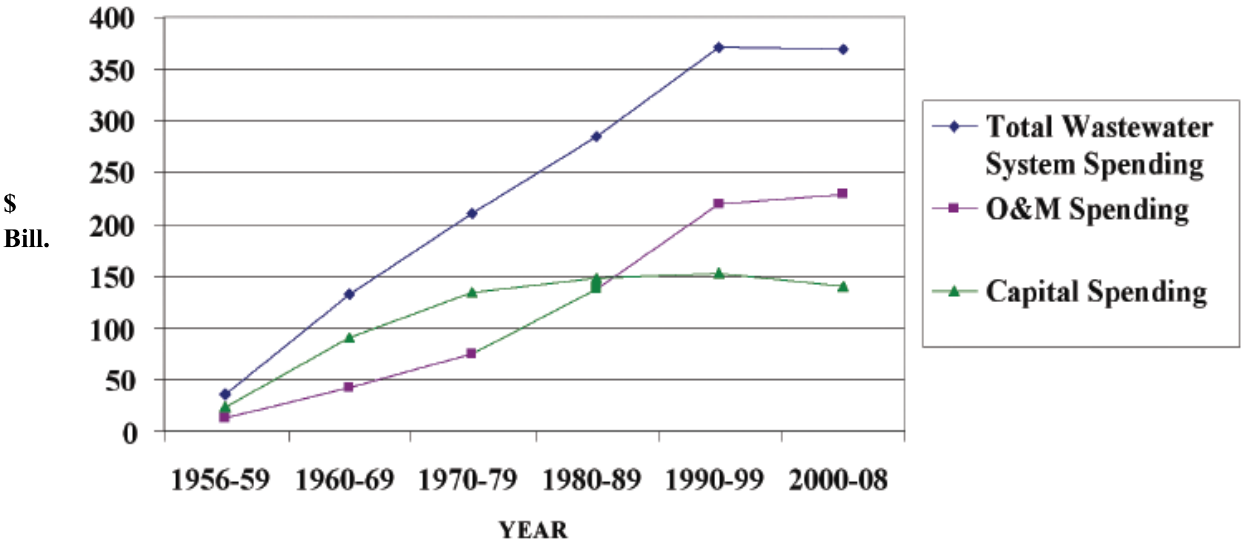
Gas Extraction

Pennsylvania is rich in natural gas, and water is used in the gas extraction process creating wastewater that must be treated in a new manner. Hydraulic fracturing is used to extract the gas and typically contains dissolved solids, and in 2009, DEP investigated sources of Total Dissolved Solids (TDS) and enacted statewide TDS limits. Since the majority of sewage treatment plants are not equipped to remove TDS, the new limits require new treatment technologies be identified, evaluated, and permitted for removal of TDS at sewage treatment plants if they are to receive waste products from the gas extraction industry.

Funding

Recent regulatory and fiscal pressure placed on communities throughout the Commonwealth by the USEPA and the PADEP to upgrade, repair, and replace aging CSO systems has often exceeded the financial abilities of many municipalities.

According to a 2010 report from The U.S. Conference of Mayors, local governments in the U.S. expended approximately $150 billion per year to address capital wastewater needs. Over the past 20 years, the operations and maintenance (O&M) portion of total local wastewater expenditures grew from 50 percent to 60 percent. This is an indication of the increasing O&M needs related to aging wastewater infrastructure and to



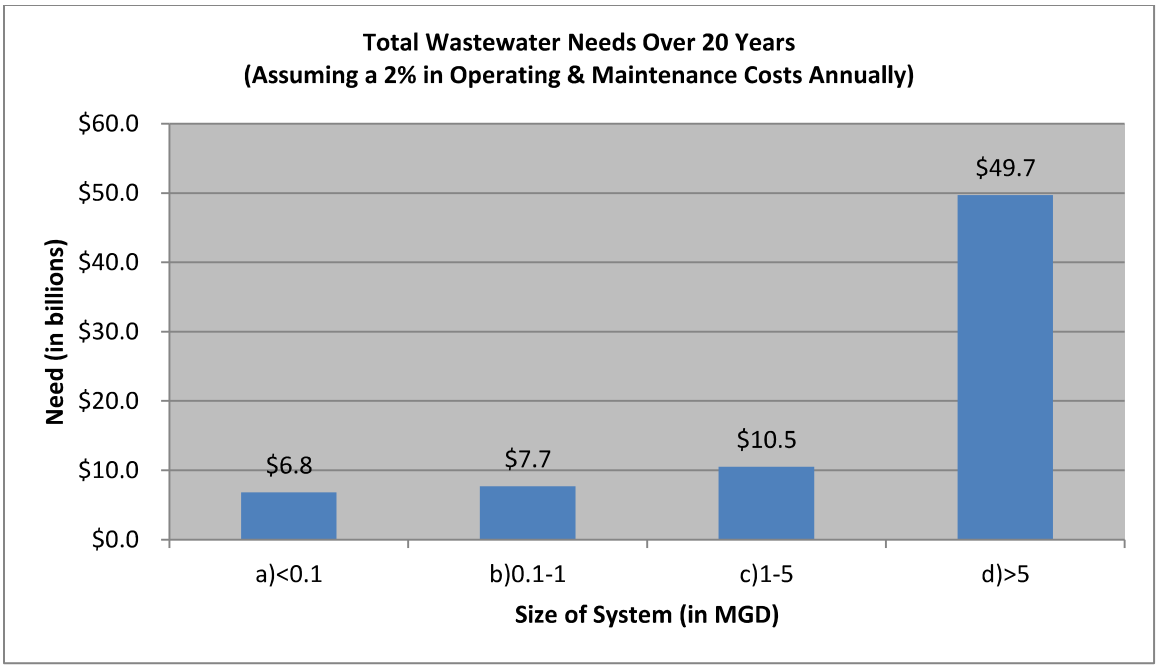
Local Government Spending on Public Wastewater Systems, 1956 – 2008, Constant Dollars (2008 = 100%)

Source: Trends in Local Government Expenditures on Public Water and Wastewater Services and Infrastructure: Past, Present and Future, The U.S. Conference of Mayors, 2010

increasing material and energy costs. Local capital expenditures have remained flat over the past 20 years. In general, capital renewal projects have not kept pace with the increasing need to rehabilitate or replace aging infrastructure.

According to the Commonwealth's *2008 Sustainable Infrastructure Task Force Report*, the capital investment for improvements to the state's 9,168 permitted wastewater systems is estimated to be $25 billion over the next 20 years (estimated in 2007 dollars). This estimate exceeds previous USEPA estimates which were last updated and released in 2008. The USEPA's 2012 Clean Watersheds Needs Survey is scheduled to be released in mid-2014 and will provide a more current estimate. With current operating costs and at current user rates, there is a total funding gap of $28.3 billion, assuming a modest 2% increase due to inflation. The figure below taken from the Sustainable Infrastructure Task Force Report indicated the total wastewater needs over the next 20 years based on the size of the system in Million Gallons per Day. It should be noted that the funding gap between projected water investment needs and current spending levels is dependent upon the growth of user rates. The gap largely disappears if Pennsylvania municipalities increase sewer rates at a rate of 2.5% over the rate of inflation.

While the gap analysis discussed above provides a starting point for the magnitude of Pennsylvania's wastewater infrastructure funding issues, it does not adequately take into account the combined sewer problems of urbanized areas like Philadelphia and Pittsburgh nor the nutrient reduction requirements in the Chesapeake Bay watershed. While the data available represents a reasonable effort to quantify the funding gap,



Source: Governor's Sustainable Infrastructure Task Force Report, 2008

more detailed statewide data would further assist in more accurately quantifying the problem and projecting the impact of potential remedies.

Wastewater is primarily funded by fees collected from the citizens and businesses benefiting from the system. However, many Commonwealth wastewater systems charge rates below their costs, generating insufficient revenue to finance needed investment. For many households, sewage treatment remains relatively inexpensive, comprising less than one percent of household income.

The federal government has directly invested more than $85 billion in the construction of publicly owned sewage treatment works (POTWs) and their related facilities since passage of the Clean Water Act in 1972. Nevertheless, the physical condition of many of the state's wastewater treatment systems is poor, due to a lack of investment in plant, equipment, and other capital improvements over the years.

Federal funding under the Clean Water Act State Revolving Loan Fund (CWSRF) program has been decreasing for the past decade. The American Recovery and Reinvestment Act of 2009 (ARRA) provided a one-time inflow of funding during 2009 and 2010. In 2012, federal funding for Pennsylvania's CWSRF was $56.5 million, which decreased to $53.4 million in 2013.

At the state level, Pennsylvania created the Pennsylvania Infrastructure Investment Authority (PENNVEST) in 1988 to help communities finance infrastructure investments. The PENNVEST CWSRF program provides funding to projects throughout Pennsylvania for the construction and maintenance of wastewater treatment facilities,

stormwater management projects, non-point source pollution controls, and watershed and estuary management. This program offers low-interest loans with flexible terms to assist a variety of borrowers, including local governments, municipalities, and privately owned entities, and to establish partnerships to leverage other funding sources.

In 2010, the last year for which full reporting is available, PENNVEST had disbursed $204 million in ARRA funds to 110 projects. A total of 93 projects were provided with $437 million in financing (taking into account all funding sources). Of this total, $330 million were in the form of low-interest loans, while $107 million were in the form of grants. In November 2008, Pennsylvania voters approved a $400 million bond issue on water and wastewater infrastructure. This grant program is being administered by the Commonwealth Financing Authority.

The *2010 Needs Survey* conducted by USEPA indicates that Pennsylvania's wastewater infrastructure needs a total of $17.9 billion of investment. The term "need" is defined by EPA as "a project, with associated costs, that addresses a water quality or public health problem existing as of January 2008." The breakdown of the needs is over $1.3 billion for treatment, $1.9 billion for separate sewer wet weather issues, sewer rehabilitation and new sewers, and $8.7 billion for (CSO) correction.

In November 2008, the Governor's Sustainable Infrastructure Task Force released a more detailed gap analysis, which assessed the difference between current spending for wastewater infrastructure and total funding needs. The Task Force's Gap Analysis estimated that, over the next two decades, Pennsylvania will have a funding gap of over $28.3 billion for Capital Project Costs and for O&M, Replacement and Repair, and Debt Retirement. The Task Force made the following recommendations for more efficient water infrastructure management:

- Increase user rates incrementally over time;
- Increase funding in federal and state assistance; and
- Reduce costs through effective management, asset management, efficient operations, regionalization and rightsizing of systems, and maximization of innovative and nonstructural solutions

Increased federal subsidies for clean water needs would help finance required investment, but federal support cannot address the entire need. The costs of O&M are not eligible for federal funding and are the responsibility of local utilities. The wastewater system customers must plan for and invest in the systems they use every day.

The increased efficiencies are necessary for Pennsylvania agriculture industry to stay competitive in U.S. and foreign markets. Rather than invest in additional facilities to treat the water, policy changes have been made by PADEP to address the potential pollution these facilities may produce. Low interest loans have been made available to farmers to implement best management practices for manure handling and storage and land management to protect water sources. Additionally, Pennsylvania is a national leader in implementing a watershed-based TMDL nutrient (i.e., nitrogen and phosphorus, which

are common in farm runoff) discharge limit program in the Susquehanna River watershed in a multistate attempt to stop the drastic decline in the ecological health of the Chesapeake Bay. The capital cost for nutrient removal is estimated at $1.4 billion, and the increase in annual O&M costs for nutrient removal is $61 million per year.

PADEP's Office of Water Management (OWM) plans, directs, and coordinates departmental programs associated with the management and protection of the Commonwealth's vast water resources. Since 2009, budget cuts and furloughs at PADEP have resulted in cutbacks to the Wastewater Operator Certification program and reductions in staffing in the Bureau of Point and Non-Point Source Management Sections of PADEP. The latter has reduced staffing in areas where an increase in staffing was already needed.

POLICY OPTIONS

If Pennsylvania fails to meet the investment needs of the next 20 years, it risks reversing the investment in public health and the environment over the past three decades.

Many national drinking water regulations have included opportunities for states to reduce costs by tailoring requirements to the conditions actually experienced by their drinking and wastewater systems, and approaching all three parts of the water triad (wastewater, drinking water, and stormwater) in an integrated watershed-based approach. States can only make use of this flexibility if they have adequate staff and administrative support to make the case-by-case determinations necessary to grant variances and exceptions available under USEPA’s rules. Funding shortfalls in state budgets are magnified at the local level by rigid one-size-fits-all prescriptions that often result in inefficient expenditures of capital when more affordable or new innovative and efficient technologies could have been used.

In many cases the approach toward public infrastructure is to build it and operate it with minimal maintenance until it wears out. Wastewater systems need to conduct a full accounting of the costs to manage their assets both for current operations and future investments needs. By appropriately managing its assets, an agency may be able to reduce overall investment needs.

Regulators, engineers, and wastewater operators tend to be conservative when it comes to adopting new technologies. Methods to clean and repair old pipes that provide low-cost alternatives to replacement of collection mains and sewers are already available. New pipe materials can reduce groundwater infiltration into sewers, and new-high efficiency fixtures can reduce water demand. These new technologies must be supported by full-scale demonstrations to gain acceptance by the clean water industry.

The case for increased federal investment to assist Pennsylvania and the other states is compelling. Needs are large and unprecedented; in many locations, local sources

cannot be expected to meet this challenge alone and, because waters are shared across local and state boundaries, the benefits of federal help will be enjoyed by the entire nation. Clean and safe water is no less a national priority than an adequate system of interstate highways. Many other highly important infrastructure programs enjoy sustainable, long-term sources of federal backing, often through the use of dedicated trust funds; under current policy, water and wastewater infrastructure unfortunately do not.

RECOMMENDATIONS

The four Pennsylvania Sections of the American Society of Civil Engineers believe the Commonwealth of Pennsylvania should develop a guaranteed source of federal-state-local shared investment and support watershed-based policies for the construction and repair of wastewater, drinking water and stormwater facilities. If funding needs are not met, the state risks reversing the public health, environmental and economic gains that have been made over the past four decades.

We support the following actions for wastewater infrastructure investment:

- Balance economic development and environmental protection endorsed in the Commonwealth's *Keystone Principles for Growth, Investment & Resource Conservation* and promote public education on the importance of infrastructure and its funding needs.

- Support the establishment of an evolving statewide environmental infrastructure needs inventory to be administered by the state's metropolitan planning organizations. This inventory would serve as a mechanism to differentiate between expenditures for current consumption and long-term investment, and would reduce major inefficiencies in the planning, design, and construction process for long-term investments. An infrastructure needs inventory would help to increase public awareness of the problems and needs facing the state's physical infrastructure, and would help the State legislature to focus on programs devoted to long-term growth and productivity. We recommend including a 5-year projection of future needs on the current permit renewals process in order to properly generate an accurate infrastructure needs inventory utilizing existing permitting processes.

- Develop mechanisms to fund critical water infrastructure. With the decreasing federal funding for the State Revolving Loan Fund (SRF) program, Pennsylvania should leverage the available federal funds that remain, using them as collateral for the issuance of State bonds, effectively doubling the amount of funds available for infrastructure investments.

- Provide funding to communities affected by the Chesapeake Bay Strategy requirements.

- Obtain sustainable funding for the Sewage Facilities Planning Grant Program (Act 537) and Pennsylvania Municipalities Planning Code (Act of 1968, P.L. 805, No. 247).

- Promote energy conservation, renewable energy, and environmental sustainability initiatives to close the funding gap by promoting better asset management techniques for reducing long-term costs and improving performance, promoting water efficiency, which reduces water consumption and the volume of wastewater to be treated; advocating full-cost pricing of water treatment; and supporting reduction of non-point source pollution of water sources.

- Support programs addressing water resource restoration projects and AMD cleanup. Pursue fair funding through the Federal Abandoned Mine Lands Program for Pennsylvania.

- Support innovative programs such as Growing Greener, Brownfield Redevelopment, and clean/green energy initiatives. Staff increases at the State level (PADEP) are required for evaluation/permitting of new technologies, as current staffing levels do not permit for enough manpower to effectively evaluate new technologies, including "Green" improvements.

- Support state-funded research at state-supported universities into wastewater, drinking water and stormwater treatment technology, which may reduce capital expenditures, as well as O&M costs, and create potential economic benefits through public-private partnerships licensing the new technologies.

- Support additional training for SEOs and installers.

- Encourage uniformity between the International Building Code and the Pennsylvania Department of Environmental Protection's Domestic Wastewater Facility Manual.

- Provide education to the general public to create awareness of the link between clean drinking water and suitable wastewater treatment facilities.

SOURCES

- "Transportation Leaders Introduce Bill to Create Jobs, Protect Water Quality" October 12, 2011. Available at http://democrats.transportation.house.gov/press-release/transportation-leaders-introduce-bill-create-jobs-protect-water-quality
- *An Examination of Failing Private Septic Systems in Pennsylvania*, Rick Day, Ph.D., Yuanhong Zhu, PhD., Stewart Bruce, and Amy Franklin, Pennsylvania State University, September 2008. Available at http://www.rural.palegislature.us/septic_systems2008.pdf

- Commonwealth of Pennsylvania *PA Infrastructure Investment Authority and PA Department of Environmental Protection Clean Water State Revolving Fund Intended Use Plan*. Available at http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/DrinkingWaterPortalFiles/watersupply/municipalfinance/CW_%20IUP_%202013_%20Draft.pdf
- *Commonwealth's Keystone Principles for Growth, Investment & Resource Conservation (October 2005).* Available at http://www.phmc.state.pa.us/bhp/pkp.pdf
- *EPA Clean Watersheds Needs Survey*, 2008, Report to Congress. Available at http://water.epa.gov/scitech/datait/databases/cwns/upload/cwns2008rtc.pdf
- *Legislative Budget and Finance Committee, Chesapeake Bay Tributary Strategy Compliance Cost Study*, 2008. Available at http://lbfc.legis.state.pa.us/reports/2008/25.PDF
- *PA Department of Environmental Protection Pennsylvania Integrated Water Quality Monitoring and Assessment Report*, 2012. Available at http://www.portal.state.pa.us/portal/server.pt/community/water_quality_standards/10556/integrated_water_quality_report_-_2012/1127203
- *PA Department of Environmental Protection*, *Governor's Sustainable Infrastructure Task Force Report*, 2008. Available at http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-71330/3800-BK-DEP4208.pdf
- *PENNVEST Annual Report 2010-2011*. Available at http://www.portal.state.pa.us/portal/server.pt/community/about_us/9320/publications/541430
- *Trends in Local Government Expenditures on Public Water and Wastewater Services and Infrastructure: Past, Present and Future*, The U.S. Conference of Mayors, 2010. Available at: http://www.usmayors.org/publications/201002-mwc-trends.pdf

ASCE POLICY STATEMENTS

- ASCE Policy Statement 243: Groundwater Management (PS 243)
- ASCE Policy Statement 299: Infrastructure Investment Policy (PS 299)
- ASCE Policy Statement 332: Wastewater and Greywater Reuse (PS 332)
- ASCE Policy Statement 362: Comprehensive Pollution Management (PS 362)
- ASCE Policy Statement 395: Control of Combined Sewer Discharges (PS 395)
- ASCE Policy Statement 403: Consultation on Environmental Regulations (PS 403)
- ASCE Policy Statement 418: Role of the Civil Engineer in Sustainable Development (PS 418)
- ASCE Policy Statement 420: Clean Water Act Reauthorization (PS 420)
- ASCE Policy Statement 422: Watershed Management (PS 422)
- ASCE Policy Statement 427: Regulatory Process for Infrastructure Development (PS 427)

- ASCE Policy Statement 429: Municipal Wastewater Biosolids (PS 429)
- ASCE Policy Statement 451: Life-Cycle Cost Analysis (PS 451)
- ASCE Policy Statement 453: Federal Capital Budgeting (PS 453)
- ASCE Policy Statement 480: Water Infrastructure and Facilities Construction Funding (PS 480)

TRANSIT

D

Public transportation providers are located in every county in Pennsylvania. In recent years, transit use has increased faster than any other mode of transportation more than 33 percent since 1995. Public transportation helps the environment by reducing pollution and smog as well as saving millions of gallons of gasoline each year for both commuters and freight carriers. In the past, the overall financial underpinning of the Commonwealth's transit program was weak and the program structure was dysfunctional. Act 89 of 2013 provides much needed stability for transit systems to operate, improve service and replace aging equipment with more efficient models. Maintaining the positive direction this new funding provides requires Congress to reauthorize MAP-21 (Moving Ahead for Progress in the 21st Century Act: P.L. 112-141) expeditiously in 2014. To increase capital expansion local funding sources should be utilized.

BACKGROUND

Americans are driving fewer miles less per person today than in 1996, yet Americans took ten percent more trips by public transit in 2011 than in 2005. Surveys have shown that the Millennial Generation, those born between 1982 and 2003, have a relative propensity for urban lifestyle components whether they live in cities or suburbs and desire multimodal transportation options that include driving, public transit, biking and walking.

Despite flat funding and cuts in service over the past two decades, the demand for transit service remains strong, and ridership on transit continues to increase. Rising costs of driving, congested roadways and increasing populations of both young people and "empty nesters" in central city neighborhoods where car ownership is not necessary have resulted in new demographics that are regularly using transit for their trips. Pennsylvania communities will have to respond to the changing demographics and the multimodal lifestyle that is favored to remain vibrant.

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 253,000 workers commuting into Philadelphia County every weekday, one of the highest levels of commuters coming from other counties in the nation. Likewise, a 2010 study by the Pittsburgh Downtown Partnership found more than 50 percent of Downtown workers take a bus or ride the light rail system. About 42 percent of the population in Pennsylvania commutes into or out of state on a daily basis. These trips include fairly long commutes from many of the state's eastern counties to the New York City area as well as many shorter trips.

Transit is a critical part of the State's transportation network. Besides the benefits of mobility to handicapped and elderly, increased public safety, and environmental

benefits, transit systems in dense urban cores permit per capita use of roadways without costly expansion of roadway capacity, saving transportation dollars to be used in rural areas where transit ridership is limited and hence less efficient. This ability to carry more people in less space makes transit an effective alternative in the busy urban centers of Pennsylvania's cities where new roadway capacity cannot realistically or financially be considered.

CONDITIONS AND CAPACITY

Public transit is available within all 67 counties of Pennsylvania, with nine systems having more than two million boardings per year each (Allentown, Erie, Harrisburg, Lancaster, Philadelphia, Pittsburgh, Reading, State College and Wilkes-Barre). Transit's prevalence throughout the commonwealth is partially due to vital mobility services provided for the growing senior citizen population and many others who lack other means of personal mobility. With senior citizen rides provided for free as a side benefit of the Pennsylvania Lottery, this is a funding source that is not dependent on users and a significant benefit for Pennsylvania seniors.

While new investment would bring badly needed transit service to more Pennsylvanians, existing systems have a backlog of required reinvestment to replace aging infrastructure due to historically unstable funding coupled with rising costs and deferred maintenance. Additionally, there remains infrastructure inherited by transit agencies from private operators, which did not, and often could not, sustain the infrastructure in top condition, and in many cases, these needs have become critical. For example, SEPTA, the largest transit provider in the state, has identified bridge, rail and railcar needs of $4.7 billion. These costs will continue to grow to $13.2 billion in the next 20 years if its capital needs are unmet, resulting in deteriorating vehicles, equipment, and infrastructure. These conditions, together with an uncertain Federal funding future, pose serious challenges for transit.

Meanwhile the second largest transit provider, Port Authority of Allegheny County cut service 15% in both 2007 and 2011, an almost 28% reduction. Despite cuts, ridership fell only 10% from 68 million riders in 2007 to 61 million in 2014 - suggesting demand for transit still continues to be strong. The passage of Act 89 will increase the Port Authority's operating funding from $198 million to $212 million and capital funding from $112 to $172 million. While Act 89 will help Port Authority address deferred maintenance, increase existing service, and hire workers, there will be little funds available to significantly recover cut services. More investment will be needed if the Port Authority is to recover service cuts from previous years, and expand service to meet growing demand.

Thus, Pennsylvania continues to have high transit usage, both in the cities and in rural areas, and the related infrastructure must be kept in good repair to be able to respond

to the needs of riders. The increasing cost of oil, environmental concerns, an aging population higher than the National average, and traffic congestion are ongoing quality of life problems that will continue to justify support for transit in Pennsylvania. A committed, long-term transportation funding mechanism is key to transit's ability to address these issues.

FUNDING AND FUTURE NEEDS

Dependable, modern transit is a necessity for mobility, particularly in the busy urban centers in Pennsylvania's cities where new roadway capacity cannot realistically or financially be considered, and transit is able to be an effective alternative due a comparatively high rider carrying capacity; transit can carry more people in less space. Historically the operating expenses for transit systems have been funded by a combination of farebox income, tax revenue and local general funds. Capital investments for transit systems have historically been funded outside of ridership generated income. Table 1 provides an overview of how communities of various sizes historically have funded both capital investment and operating expenses of transit systems.

Table 1: U.S. Local Public Transportation Funding By System Size (TCRP 2009)

Funding Sources	Percent Capital Investment			Percent Operating Expenses		
City population	> 1m	200k to 1 m	50k to 200k	> 1m	200k to 1 m	50k to 200k
Fares and Earned Income	-	-	-	58.20%	30.20%	37.80%
Sales taxes	35.5%	38.9%	51.1%	18.8%	25.8%	28.3%
Other directly generated local funds	33.7%	-	-	-	-	-
Local general funds	-	42.5%	32.7%	11.1%	26.9%	21.3%
Other Local Dedicated Funds	18.4%	-	-	-	-	-
Local Property Taxes	-	-	9.7%	-	-	-
Other local sources	-	8.2%	-	-	-	-

Source: Local Funding Options for Public Transportation, Victoria Transport Policy Institute

For many, the costs of driving, automobile ownership and upkeep, and related factors make transit a crucial service for getting to work, school, medical providers, and shopping. In cities such as Philadelphia and Pittsburgh, long-established and well-used rail lines avoid the highways altogether and can effectively compete with private autos as a mode of choice for commuting. The "renaissance" of downtowns in several larger Pennsylvania cities, with suburbanites relocating to city residences and younger people preferring city lifestyles, has led to many multi-car households reducing to a single vehicle or no car, with transit being used for mobility. For these reasons, it is imperative that Pennsylvania continue to fund public transit and create mechanisms to ensure adequate funding levels for the future.

The Pennsylvania Department of Transportation's (PennDOT) Bureau of Mass Transit is working with transit agencies to control costs through modernization, to make the best use of every tax dollar, and find more efficient deliverables and methods. It is estimated that the total projected annual savings from PennDOT's Next Generation modernization projects and related efficiency efforts are between $50 million to $75 million across Pennsylvania. Next Generation is a review of PennDOT's policies, processes, procedures, and programs. These fresh policies and/or procedures examine functions, create efficiencies, advance business practices and technology, and create continuous improvement. The potential Next Generation Savings are supposed to also aid transit agencies.

The Public Private Partnership (P3) Act 88 was passed by the Pennsylvania Legislature in July 2012 to authorize cooperation between public agencies/transit operators and private business/investors, opening the door for public-private funded transportation projects in Pennsylvania. This act will allow PennDOT and other transportation providers to enter into agreements with the private sector to participate in the delivery, maintenance, and financing of transportation-related projects that otherwise could not be advanced. It is innovative in that it opens an entirely new source of funding into the mix and will allow improvements to be advanced to construction in a more timely fashion than if the funding were from solely public sources, where projects often have to compete for the available dollars. P3 opportunities needed to be considered on a case by case basis. Permitting profitable routes to be selectively removed from already distressed transit agencies can further increase the fiscal burden such an agency has to meet to provide reliable service on less heavily traveled routes.

Act 89 of 2013, the $2.3 billion transportation bill that was approved in November 2013. Out of the $2.3 billion of the transportation bill, an estimated $495 million will be made available annually for public transit by 2018. Besides providing additional funding to the larger transit systems in the State, Act 89 provided critical support for some of the small systems serving suburban and rural Pennsylvania. An example is the Heritage Community Transportation system which serves the Mon Valley southeast of Pittsburgh. The Heritage Community Transportation system is a service that helped thousands of mostly lower-income residents get to their jobs, but whose continued operation was in doubt because Congress eliminated the program that funded it. The service has more than 3,000 registered riders and has provided more than 820,000 rides over the past decade. An estimated 994 jobs would have been lost had the service been discontinued.

The PennDOT Bureau of Fiscal Management's 2013 state transportation budget totals $6.9 billion. About 22.8 percent of the budget is used for public transportation, aviation, and rail freight. Federal funds provide 28 percent of this amount, while the remainder comes from state sources. With the transportation bill that was recently approved, plus Acts 88 and 89, the transit infrastructure sector will see increased revenue, but minimal investment in transit capital improvements .

PennDOT oversees the Pennsylvania Infrastructure Bank (PIB) designed to invest in transportation related infrastructure. Although marginally successful, there are significant shortfalls in PIB's ability to provide continued investment in transportation, and more specifically public transit. PIB's funding is unsustainable, relying on

appropriations and subsidies, most of which are directed toward highways. These stipulations placed on the funding control how the funding is allocated; minimizing the PIB's response to an increased need for transit. Over the lifetime of the PIB, only four transit projects have been or currently being funded. Additionally, the amount of money generated through this fund is not nearly enough to have a positive impact on transit statewide.

Table 2 provides an overview of potential funding options that cities, regions and Pennsylvania as a whole could utilize to provide additional revenue streams for transit capital improvement projects.

Traditional Tax- and Fee-Based Transit Funding Sources	Common Business, Activity , and Related Funding Sources	Revenue Streams from Projects (Transportation and Others)	New "User" or "Market-Based" Funding Sources
General revenues	Employer/payroll taxes	Transit-oriented development/joint development	Tolling (fixed, variable, and dynamic; bridge and roadway)
Sales taxes (variable base of goods and services, motor fuels)	Vehicle rental and lease fees	Value capture/beneficiary charges	Congestion pricing
Property taxes (real property, includes vehicles)	Parking fees	Special assessment districts	Emissions fees
Lease revenues	Realty transfer tax and mortgage recording fees	Impact fees	VMT fees
Vehicle fees (title, registration, tags, inspection)	Corporate franchise taxes	Tax-increment financing districts	
Advertising revenues	Room/occupancy taxes	Right-of-way leasing	
Concessions revenues	Business license fees	Community improvement districts/community facilities districts	
Contract or purchase-of-service revenues (by human service agencies, school/universities, private organizations, etc.)	Utility fees/taxes		
	Income taxes		
	Donations		
	Other business taxes		

Table 2: U.S. Local and Regional Public Transport Funding Options (TCRP 2009)

Source: Local Funding Options for Public Transportation, Victoria Transport Policy Institute

POLICY OPTIONS

It is often not recognized that transit provides a multitude of benefits to different population segments. A recognition of the distributed benefits of transit is a critical component of setting good public policy in regards to funding of public transportation. For example motorist benefit from reduced congestion and improved traffic safety by public transit's ability to remove vehicles from roads and highways. Table 3 provides a summary of the distributed benefits of transit. In addition, transit oriented development increases the efficiency of public service delivery by concentrating economic

development in specific corridors to reduce sprawl. This development also promotes walkable communities, increasing the health of residents.

	Transit Users	Motorists	Taxpayers	Businesses	Residents
Improved convenience and comfort	√				
Congestion reductions		√		√	
Roadway cost savings			√		
Parking cost savings	√		√	√	√
User savings and affordability	√				
Improved mobility for non-drivers	√	√			√
Improved traffic safety	√	√	√	√	√
Energy conservation	√				
Emission reductions	√	√			√
Improved public health	√		√	√	√

Table 3: Distribution of Transit Benefits

Source: Local Funding Options for Public Transportation, Victoria Transport Policy Institute

The funding provided by Act 89 was a critical lifeline for most of the Commonwealth's transit systems. The additional funding will be made available from 2014 to 2018. It is critical for Pennsylvania to continue the positive impact that this additional state funding has had by strongly advocating the federal government to reauthorize the federal transportation bill (MAP-21) in advance of its expiration on September 30th, 2014, and increase the federal support for transit systems amongst other transportation modes.

While any additional State funding appears unlikely during the roll out of Act 89's funding, there are numerous innovative policy options that are worth exploring to assist communities to increase capital expenditures for transit and reap the rewards of increased property values, higher densities and greater tax revenues that transit can provide. Brief overviews of some of these options are as follows:

- Public Banking - A public bank is a not-for-profit bank created from capitalized reserve funds of a local government, city, municipality, or coalition of any of the aforementioned. Public banking can benefit enterprises with little to no profit margins, such as transit, by allowing debt servicing costs to be reduced over time. Such precedent for a public bank is seen with the Bank of North Dakota. Without having branches, tellers, or advertising costs, a public bank significantly reduces internal operational expenses and partners with local community banks to set marginally small interest rates on loans and to bid down the interest on municipal bonds; lowering debt servicing costs and allowing municipalities to increase the amount of the bond issue. If applied in regions with significant transit

ridership within Pennsylvania, public banks could dramatically reduce debt and expand the amount of money available for transit. Furthermore, the interest paid back to the bank that is not used for operational costs is returned to the community within the jurisdiction of the bank. This "community carrot" incentivizes internal operating efficiencies and enables future local investment in transit and other infrastructure projects. In 2013, the Bank of North Dakota returned $94 million to a state with just under 700,000 residents. By comparison, Allegheny County alone has over 1.2 million residents.

- Value Capture (Land Trust/Land Tax) - Land trusts are established to capture revenues from increased property values when development occurs adjacent to transportation right of ways (ROWs). The adjacent land can be purchased either by the transportation authority that owns the right of way or another community-integrated non-profit or public government to lease the land rights. A portion of the revenue earned can be funneled to the transit system, partially paying for construction/operational costs. Transit entities and enabling legislature would have to be established to allow the purchase of land adjacent to transportation ROWs. This is the proposed strategy behind the Allegheny Valley Commuter Rail development proposed in Pittsburgh, and is a particularly good re-development strategy for urban brownfields, decimated communities, and communities that promote development typologies catered to transit in dense urban areas. Related to land trusts, land taxes can be assessed in transit oriented development districts to capture the increased land values for transit purposes. Unlike land trusts, land taxes do not require a non-profit or public government to retain land ownership, affording more freedom for land developers but less ability to control development and build equity.

- Station Shares - Anchor institutions are community-integrated non-profit institutions that drive local area GDP. To encourage investment from these institutions, stations or shares of a transit ROW can be sold to an institution in areas where the ROW will enable access to the institution.

- Advertising - Audio ads, station naming rights, etc. If applied in regions with significant transit ridership public banks could dramatically reduce debt and expand the amount of money available for transit.

- Referendums - Several states have used regional/county/ local referendums to very modestly raise taxes (such as sales, non-essential items) to fund transit. This is an equitable way to generate financing for transit in areas with the highest benefit. Denver's FasTracks program, a $4 billion expansion of their regional transit system, was partially funded through raising the regional sales tax rate by a mere 0.4 percent (4 pennies on every $10). Other examples of recent referendums include Los Angeles and Hillsborough County FL.

- Parking Benefit Districts – Parking Benefit Districts (PBD) are designed to improve parking availability and promote transit use by employing electronic meters to assess fees at a variable rate to encourage parking turnover; making finding open spaces more reliable. The *increased* revenues from the PBD can be dedicated locally to improvements that promote multimodal transportation. PBD's are an especially useful tool in dense urban areas where parking demand is high yet adequate access to transit can be provided.

- Traffic Impact Fees – Traffic impact fees are used to charge vehicular commuters during peak hours of travel to control congestion and encourage transit ridership in frequently gridlocked areas. When transportation is viewed holistically as a system, traffic impact fees are an effective tool in dense urban areas where commuting using public transit is more efficient. However, traffic impact fees should be confined to corridors where there is viable access to transit.

- Tax Increment Financing - Tax increment financing (TIF) is a financing tool that promotes economic development by earmarking property tax revenue to increases in assessed values within a designated TIF district. Public transit in transit oriented development corridors is often instrumental in driving increased property values.

RECOMMENDATIONS

The four Pennsylvania sections of ASCE support the following recommendations for improvement of transit in the Commonwealth:

- Use reliably generated transportation funds dedicated to maintaining and improving transit systems where transit can effectively increase the performance of our highway and bridge network.
- Increase the percentage in flexible funding transfer.
- Adequately fund maintenance of transit vehicles and facilities to expand or enhance the system to meet the future growth needs, which includes repair, ongoing rehabilitation and replacement.
- Require transit systems to adopt comprehensive asset management systems to maximize investments.
- Include transit in state and local project development processes and metrics to track performance of transportation systems.
- Include advertising on the transit provider's primary navigation website and offer appropriate advertising space at facilities and onboard equipment to provide an additional revenue stream.
- Include referendums to raise taxes by a percentage point to help raise money for transit.

- Encourage cooperation between existing systems or consolidation of services where efficiencies can be gained and, therefore, service improved.

SOURCES

- WGAL News 8. House Passes $2 Billion Transportation Bill, Gas Tax Increase: November 22, 2013. Available at: http://www.wgal.com/news/8-on-your-side/pa-senate-mulls-23-billion-transportation-bill/-/17986766/23068542/-/bwbxq/-/index.html#ixzz2rSwGt857
- American Society of Civil Engineers (ASCE). 2010 Report Card for America's Infrastructure: March 2010. Available at: http://pareportcard.org/PDFs/2010%20Transit%20FINAL-%20NATL.pdf
- Construction Equipment Guide. Obama Proposes Large Increase in the 2014 Transportation Budget: April 15, 2013. Available at: http://www.constructionequipmentguide.com/Obama-Proposes-Large-Increase-in-the-2014-Transportation-Budget/20196/
- Pennsylvania State Data Center. Pennsylvania Facts 2013: 2011. Available at: http://pasdc.hbg.psu.edu/sdc/pasdc_files/pastats/PA_Facts_2013.pdf
- Sutor, Dave. The Tribune-Democrat. Corbett brings pitch for highway funding to Johnstown plant: October 31, 2013. Available at: http://www.tribune-democrat.com/local/x2112910993/Corbett-brings-pitch-for-highway-funding-to-Johnstown-plant
- PA Commutes: Alternative Transportation in Pennsylvania. Census Bureau Reports 253,000 Workers Commute into Philadelphia County, Pa., Each Day: 2013. Available at: http://www.pacommutes.com/
- U.S. Department of Commerce. United States Census Bureau: March 5, 2013. Available at: www.census.gov/newsroom/releases/archives/american_community_survey_acs/cb13-r20.html
- Times Leader. Committee: PA Transport Bill 'In Flux': November 2, 2013. Available at http://timesleader.com/news/news/956171/Committee:-Pa.-transport-bill-in-flux
- Javsicas, Peter. The Patriot News. Getting $2.5 Billion in Transportation Funding for $2.50 a Week: November 7, 2013. Available at: http://www.pennlive.com/opinion/index.ssf/2013/11/transportation_funding_infrastructure_spending_highway_construction_structurally_deficient_bridges_t.html
- Southeastern Pennsylvania Transportation Authority (SEPTA). Revenue and Ridership Report 2013: December 2013. Available at: http://www.septa.org/reports/pdf/revenue-ride.pdf.
- Pennsylvania State Data Center. Penn State Harrisburg. Research Brief: The Commonwealth's Official Source for Population and Economic Statistics: May 23, 2013. Available at: http://pasdc.hbg.psu.edu/sdc/pasdc_files/researchbriefs/2012_Municipal_Est.pdf
- Giammarise, Kate and Karen Langley. Post-Gazette Harrisburg Bureau. PA House Passes Transportation Funding Bill: November 20, 2013. Available at:

http://www.post-gazette.com/local/2013/11/19/State-House-leaders-try-to-rebuild-support-for-transportation-bill/stories/201311190149
- CBS Philly. Philadelphia Leads Pack For Population Growth Out Of Pa. Cities: May 28, 2013. Available at: http://philadelphia.cbslocal.com/2013/05/28/philadelphia-leads-pack-for-population-growth-out-of-pa-cities/
- Victoria Transportation Policy Institute. Local Funding Options for Public Transportation. April 2014. Available at: http://www.vtpi.org/tranfund.pdf
- Pennsylvania Department of Transportation. Transportation Performance Report: Pennsylvania 2013. Available at: http://www.talkpatransportation.com/docs/TPR%20FINAL%202-7-13_sm.pdf
- Pennsylvania Turnpike Media and Public Relations. Pa. Turnpike Reminds Motorists of Toll Increase Starting Sunday Jan. 5th, 2014. December 31, 2013. Available at: http://www.paturnpike.com/toll/toll_info.aspx
- Pennsylvania Department of Transportation. PennDOT Next Generation. June 20, 2013. Available at: http://www.unece.org/fileadmin/DAM/trans/main/tem/temdocs/2013_Pennsylvania_Presentation.pdf
- Aubele,Michael. TRIB Total Media. Alle-Kiski Valley Link to Downtown Picks Up Steam. February 6, 2012. Available at: http://triblive.com/x/pittsburghtrib/news/roadwork/s_780168.html#axzz2mBWtvdW8
- FasTracks Regional Transportation District of Denver (RTD) Denver, Colorado. Financing FasTracks. 2014. Available at: http://www.rtd-fastracks.com/main_33
- Danielson, Richard. Buckhorn Calls for Hillsborough Transit Referendum by Fall 2016. March 25, 2014. Available at: http://www.tampabay.com/news/politics/local/buckhorn-calls-for-hillsborough-transit-referendum-by-fall-2016/2171854
- Bank of North Dakota 2013 Annual Report. Available at: http://banknd.nd.gov/pubs/annualreport13/index.html
- Schmitz, Jon. Pittsburgh Post-Gazette. Transit fares to hold for 2 years. May 15, 2014. Available at: http://www.post-gazette.com/news/transportation/2014/05/15/Port-Authority-s-proposed-budget-calls-for-a-modest-increase-in-service-on-busiest-routes/stories/201405150414#ixzz31usqfHW4

ASCE POLICY STATEMENTS

- ASCE Policy Statement 299: Infrastructure Investment Policy (PS 299)
- ASCE Policy Statement 451: Life-Cycle Cost Analysis (PS 451)
- ASCE Policy Statement 494: Public Transportation (494)
- ASCE Policy Statement 496: Innovative Financing for Transportation Projects (PS 496)
- ASCE Policy Statement 532:National Infrastructure Bank (PS 532)

STORMWATER

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Over the last several years economic turmoil brought residential and commercial development to a halt. This is significant because most stormwater management infrastructure is installed in new developments. At the same time, more frequent large storms, flooding, and episodes of drought are putting pressure on existing stormwater management infrastructure. Stormwater infrastructure should be designed to minimize the effects of drought and protect against flooding. Several new pieces of stormwater legislation were enacted in the last three years; however, no funding has been available for implementing those rules. Furthermore, the defunding of the 1978 watershed legislation (Act 167), which required the state to match funds with municipalities for the cost of writing comprehensive countywide stormwater plans, has offset the gains expected from the new legislation. Legislation promoting the formation of Stormwater Authorities to address the unfunded mandate of the National Pollution Discharge Elimination System (NPDES) seems like too little too late. The current and anticipated needs for stormwater infrastructure are too large for individual municipalities to fund, and the lack of funding and staff at PADEP makes the SWM regulatory environment unpredictable because too few staff are available to ensure that regulations are applied uniformly statewide. The lack of staff is likely to inhibit growth in construction in the near future because predictable review outcomes are central to attracting investment in the state. Whether Pennsylvania municipalities and the state will come together to address the problems caused by stormwater remains to be seen.

BACKGROUND

Stormwater management (SWM) is one of the three critical elements that protects our health, property, and the health of our streams, rivers, wetlands and lakes— those three critical elements are potable water/wastewater infrastructure, flood protection infrastructure, and SWM infrastructure. Stormwater infrastructure comprises a multifaceted system of ecological and engineering solutions that work together to mitigate the combined effects of development and climate change. Most SWM efforts are focused in urban areas, which represent only about 20 percent of Pennsylvania. Many factors in addition to residential and commercial development affect the quantity and quality of stormwater, including acid mine runoff, natural gas development (i.e., Marcellus Shale), and agriculture. Stormwater management is integrated with road, rail, and aviation infrastructure, and SWM affects other infrastructure such as dams, levees and inland waterways. Neighborhood drains that say, “This drain connects directly to the river” are stormwater infrastructure. Importantly, the huge quantity of stormwater runoff requires engineered structural and has recently included non-structural solutions.

The definition of stormwater management has evolved over time. Conventional SWM infrastructure includes facilities such as the stormwater ponds that regulatory agencies typically require to control stormwater runoff, which ultimately are owned and operated by a homeowners' association or a business. SWM generally is required for new communities and must include a component to mitigate the effects of adjacent older

communities that lack adequate stormwater infrastructure. Stormwater management also has become the common term for the good housekeeping and pollution control activities required of more than 940 urban communities under the Municipal Small Separate Storm Sewer (MS4) regulations prescribed by the NPDES, and the Combined Sewer Outfall (CSO) Long Term Control Plans of more than 150 communities in Pennsylvania. Other parts of the NPDES regulate stormwater flows from construction, agriculture, and industry, generally through County Conservation Districts.

Stormwater management infrastructure also includes the facilities that direct and detain flood flows before they reach our levees and dams. Levees are often operated by a municipal authority. The state, counties, conservation districts, municipalities, municipal authorities, and the U.S. Environmental Protection Agency (EPA) all are involved in SWM. Furthermore, the regulatory environment has changed considerably since the 1980s, requiring different kinds of structural stormwater infrastructure. Evaluating the efficacy and adequacy of SWM infrastructure, therefore, is complicated by the multitude of players and the diverse meanings of SWM to each of them.

CONDITION AND CAPACITY

Until recently, cities were not required to retrofit older communities with modern SWM infrastructure. Instead, state regulations and township ordinances required new development to include SWM infrastructure designed to mitigate the effects of adjacent older development. This approach has resulted in a gradual improvement in the capacity of SWM infrastructure; however, the lack of development in the past several years has slowed progress toward fixing the remaining deficiency in capacity. Now, MS4 regulations require retrofitting the SWM infrastructure in federally designated urban areas. Also, “green infrastructure” which uses strategically planted areas and open green space to manage stormwater is often employed to retrofit urban areas. These techniques are designed primarily to improve water quality but have the added ability to increase green space in a community while the amount of runoff is reduced. In general, green stormwater systems are designed to reduce overflows of combined sanitary systems and do not directly address flooding.

Beginning in the mid-1990s the national focus of SWM approaches shifted from slowing the rate of stormwater leaving a property during large storms and conveying it away from developed areas efficiently, to managing the quality of stormwater and reducing the volume of runoff associated with smaller, more frequent storms. In Pennsylvania, that shift began in the early 2000s with the advent of the Pennsylvania Stormwater Best Management Practices Manual. The anchor best management practice (BMP) for reducing the volume of stormwater runoff in that manual is infiltration (water soaking into the soil). The life cycle of infiltration facilities is short, however, and reliance on these facilities may present a risk to system capacity. It has taken nearly 20 years to recognize that the focus on rate control was near-sighted and change management practices accordingly; it may take another 20 years to determine whether the shift to volume control is the correct move or not.

Pennsylvania has made some strides in improving SWM infrastructure capacity. In response to the increasing frequency with which storm drain systems throughout the

state are flooding, the Pennsylvania Department of Transportation (PennDOT) recently updated the deffinition of the storm required to be accounted for in the design for storm drains. However, the change in requirements will take decades to affect areas with older systems. The recent passage of agricultural stormwater rules known as Concentrated Animal Feed Operation (CAFO) regulations will increase the capacity of SWM infrastructure on agricultural land.

Considering the age of various components is an important step in evaluating the condition of SWM infrastructure in Pennsylvania. Various designs of SWM infrastructure can be traced to different eras:

1.	Combined Sewer Systems	1850s to 1980s
2.	Roadway Storm Drain Systems	1920s to Present
3.	Detention and Retention Ponds	1980s to Present
4.	Low Impact Development	1990s to Present
5.	Infiltration Basins	2000 to Present (older systems exist)
6.	Green SWM Infrastructure	2010 to Present

Combined sewers are antiquated systems that collect wastewater from commercial and residential buildings and stormwater runoff from roadways and other impervious surfaces in the same drain pipes. They are prevalent in approximately 152 large urban areas in Pennsylvania and contribute significantly to overloading urban sanitary sewer systems. Some combined sewer systems are more than 150 years old, and they allow direct connection to groundwater through infiltration and leaking resulting from deterioration. These systems provide no treatment of stormwater during large storms, and they can release untreated sewage when stormwater exceeds their capacity. Most communities in Pennsylvania with combined sewer systems are in the process of preparing or implementing long-term control plans to address the effects of this aging infrastructure, but the improvement of the infrastructure is still years in the future and will cost billions of dollars.

Municipalities, counties, and PennDOT own between 130,000 and 200,000 miles of storm drain in the state. Many miles of storm drain are nearing the end of their design life. Roadway repairs generally do not include replacing storm drain pipes unless the road is to be realigned or reconstructed extensively. PennDOT replaces about 4.5 miles of storm drain pipe annually, or between 2.5 percent and 5 percent of the miles of pipe that need to be replaced annually. No reliable information is available about the frequency of replacement of storm drains owned by counties and municipalities. Older storm drain systems are not sized for storms of the intensity we have experienced over the past few years, and the intensity of storms are likely to only increase in the future due to climate change. These storm drain pipes are designed to accommodate the runoff from storms of the size that meteorologists predict to occur infrequently, but the capacity of the inlet grates generally is designed for much smaller storms. PennDOT's standard inlet grates generally have smaller capacity than other designs and are difficult to install properly to prevent by-pass of flow along a street. Even new systems suffer from inadequate inlet capacity.

Detention/retention basins were the backbone of SWM infrastructure for more than three decades. Many of these facilities are nearing the end of their design life, and no funding is budgeted for replacing them. These ponds often have small dams associated with them that are not inspected regularly, and the homeowners' associations that own these systems frequently have minimal understanding of how to maintain them. Recent changes in regulations include provisions for deed-restricting the maintenance of new facilities and inspecting 10 percent to 20 percent of the older ones every year, but clarity is still needed concerning maintenance requirements.

Current SWM regulations require a large amount of stormwater to be removed from the flow leaving a property over land. Generally, this is accomplished by constructing facilities that enable a portion of stormwater to be infiltrated into the soil. Reliance on infiltration to satisfy stormwater requirements has increased in recent years; however, infiltration facilities have a shorter life expectancy than detention/retention facilities, and many of Pennsylvania's infiltration facilities have passed their design life expectancy. Like other SWM facilities, new infiltration facilities will be protected by a deed restriction that is recorded and runs with the property, but no funds are dedicated for replacing or refurbishing the existing facilities.

Low-impact development is an aggregate of techniques such as reducing roadway width, clustering houses, and concentrating development in defined areas, all intended to preserve open space. Several other methods of preserving open land include deed-restricted ownership by a homeowners' association or business, dedication to a municipality, and donation to a non-profit. Fully evaluating the condition of preserved open space in Pennsylvania is outside the scope of this investigation, but the relatively recent advent of this approach to SWM suggests that the condition is likely to be adequate. To ensure continued adequate condition of preserved open space, the Pennsylvania Department of Environmental Protection (PADEP) and municipalities statewide need to consider the question of how to guarantee that a roadway width prescribed in the SWM design and other low-impact design techniques are perpetually maintained.

Green infrastructure is the most recent emerging trend in SWM technology. It uses vegetation and soil to manage rainwater where it falls. What is required for maintenance is still being evaluated. Current indications are that the cost of maintenance will be high, in part because this form of SWM infrastructure is often installed in highly urbanized areas. Green infrastructure is designed to manage smaller, more frequent storms. Its effectiveness for managing runoff during larger storms needs further investigation.

FUNDING AND FUTURE NEEDS

The number of new stormwater requirements introduced since the last American Society of Civil Engineers (ASCE) *2010 Report Card on Pennsylvania's Infrastructure* is impressive; however, not one of those requirements has come with adequate funding to address the mandate. The EPA began a renewed push to clean up the Chesapeake Bay by adopting new guidelines for total maximum daily loads (TMDLs) that required Pennsylvania to develop a Watershed Improvement Plan and spurred the development of several of the new regulations. Moreover, the EPA's 2010 "Needs Survey" indicates

that Pennsylvania's infrastructure needs include more than $900 million for separate sewer and wet-weather issues, $8.7 billion for combined sewer overflow correction, and $6 billion for other stormwater management. Several of Pennsylvania's new stormwater requirements rely on local municipalities to enforce them, and the cost is anticipated to be high. A few municipalities whose charter or code includes a provision for establishing a fee for funding SWM have enacted such a fee, but most of the state's nearly 2,600 municipalities lack the option to enact a fee without forming a stormwater authority. To pay for SWM these municipalities will likely need to find solutions for raising revenue, but the political viability of such efforts remains unclear.

New legislation allowing the municipalities to form stormwater authorities has been passed (SB-351), but it may not go far enough to enable a stormwater authority to charge a fee. This legislation shows that the state government recognizes the need to increase funding but also highlights that little assistance is available from the state's coffers. The defunding of Act 167 further illustrates the state government's lack of commitment to supporting SWM. Cuts in the PADEP's SWM staff compound the problems developing in this arena. As of publication of this Report Card, the position of lead stormwater engineer with PADEP is open in Harrisburg but is frozen by budget constraints.

Development has always been a major source of SWM funding for municipalities, however, the condition of the national economy over the past few years has reduced the investment in and revenue from development to its lowest level in decades. New regulations that constrain development may continue to limit the availability of funding for SWM. New regulations such as new riparian buffer rules that require developers to maintain vegetation along waterways and prohibit development within a buffer zone are making development more costly. These regulations will protect the waters of the Commonwealth better than almost any other BMP, but they could result in decreased development because of the high cost of compliance. The regulations by themselves may not inhibit development; however, an unpredictable regulatory environment can drive development away. The lack of funding and staff at PADEP makes the SWM regulatory environment unpredictable because too few managers are available to ensure that regulations are applied uniformly statewide. The lack of staff at DEP has necessitated a reduction in coordination with municipalities and reduced training for design engineers needed to facilitate better compliance with stormwater regulations. The lack of staff at DEP and lack of training for municipalities and design engineers has lead to an environment of uncertainty for builders that may inhibit growth in construction that is needed to restore the traditional funding of stormwater infrastructure, new development.

Pennsylvania municipalities have budgeted an estimated $230 million for stormwater improvements to be implemented during the next 5 years. Based on national levels of funding, this is about one-quarter of the amount needed during that time period, and the need will continue well into the future. No reliable estimate of the percentage of the average municipal public works budget ($500,000) that is spent on SWM is available, but it is estimated to be between 10 percent and 20 percent and will rise significantly in the near future. Improving combined sewer outfalls (CSO) could cost $20.8 billion based on applying reported costs from Pittsburgh, Philadelphia, and the City of Lancaster to

the remaining 151 cities with CSO. This cost is higher than the EPA estimated cost cited above. The source of those funds has yet to be determined.

Restoring waters that have been degraded by acid mine runoff will require about $1 billion according to PADEP. The Commonwealth has made slow but steady progress in treating acid mine runoff, but 5,500 miles of stream are still polluted. Federal money is available, but grants are the primary state funding participation offered. Currently, the state is offering acid-mine-polluted water to natural gas developers (for fracking water); stormwater runoff from gas developments is regulated differently than the rest of the state's stormwater.

Federal funding under the Clean Water Act State Revolving Loan Fund (CWSRF) program has decreased over the past decade. The American Recovery and Reinvestment Act of 2009 (ARRA) provided a one-time inflow of funding during 2009 and 2010. In 2012, federal funding for Pennsylvania's CWSRF was $56.5 million, which decreased to $53.4 million in 2013. This amount of funding is not likely to cover the gap of several billon that appears to exist.

Pennsylvania created the Pennsylvania Infrastructure Investment Authority (PENNVEST) in 1988 to help communities finance infrastructure investments. The PENNVEST CWSRF program provides funding to projects throughout Pennsylvania for the construction and maintenance of wastewater treatment facilities, SWM projects, nonpoint-source pollution controls, and watershed management. This program offers low-interest loans with flexible terms to assist a variety of borrowers, including local governments, municipalities, and non-profit entities, and to establish partnerships to leverage other funding sources. In 2010-2011, the last year for which full reporting is available, PENNVEST had disbursed $204 million in ARRA funds to 110 projects. For the fiscal year as a whole, taking all funding sources into account, a total of 93 projects were provided with $437 million in financing. Of this total, $330 million was in the form of low-interest loans and $107 million was in the form of grants. In November 2008, Pennsylvania voters approved a $400 million bond issue on water and wastewater infrastructure. This grant program is being administered by the Commonwealth Financing Authority. Few of the funded projects are focused solely on stormwater.

Other programs designed to aid municipalities to fund improvements of water quality include the offset program (stormwater quality trading) and nutrient trading. The latter has had a few participants, but the trading value appears to be too low to provide reliable funding. The former is suffering from the lack of PADEP staff to move it from conceptual development to final implementation, leaving an important part of the solution to SWM funding incomplete.

Pennsylvania's recently enacted SWM regulations range from a new comprehensive regulation to guidance for designing riparian buffers, and a new BMP manual is promised. The state completed the new Erosion Control Manual last year. Implementing these regulations will improve many aspects of SWM, including control of erosion and sediment (E&S) during construction and operation and maintenance of BMPs in the future. However, the regulated community needs to be educated about these new requirements to promote their effectiveness, and funding for that education has yet to be made available.

The accomplishments of the regulatory community will direct the future of SWM only if adequate funding is provided to enact the rules. For example, the effectiveness of the 1978 Act 167 regulations- which required a comprehensive SWM plan in every county—is historically mixed. To date, there are many counties without comprehensive plans due to a lack of funding. Simply, the emerging regulatory framework that is now in place could greatly improve SWM in Pennsylvania, if it were adequately funded.

OPERATION AND MAINTENANCE

For many years Pennsylvania had no formal policy or regulations requiring any entity to maintain SMW BMPs built to comply with state requirements. Like most things in Pennsylvania, the ultimate responsibility falls on the townships and boroughs, but detention/retention ponds often are owned by a private entity, such as a homeowners' association or business, that inherits a pond built years ago. State regulations now require deed restrictions over all BMPs that allow the state to inspect them, but municipalities still are likely to have to enforce operation and maintenance issues under their MS4 permits. MS4 regulations, however, cover only about one quarter of the state. There is no clarity in State rules regarding which agency will ensure that BMPs located outside of MS4 communities are operating effectively. The EPA has issued draft requirements for verification of the operation of BMPs in the Chesapeake Bay watershed, which covers about half of Pennsylvania. This new EPA mandate is likely to drive a change in policy at PADEP.

Many private-sector owners of SWM BMPs are ill-equipped to maintain them. Pennsylvania rules that allow SWM infrastructure on private lots exacerbate this problem because municipalities or the state cannot maintain BMPs on private land easily. Other states have had to step in to assist homeowners with maintenance and to educate them about proper operation of BMPs to ensure the continued functionality of SWM infrastructure on private property.

Many problems with operation and maintenance of SWM BMPs begin with improper construction. The new MS4 permits and other new regulations now require an engineer to monitor construction of new SWM BMPs. New post-construction SWM requirements include providing notes about proper operation and maintenance of BMPs on plans to help owners understand requirements better, but few owners ever read these plans, and few engineers understand the new requirements.

PUBLIC SAFETY

On August 20, 2012 flash flooding in Pittsburgh killing 3 people, and flooding along the Delaware has become a regular event. Generally, townships cannot resolve their flooding issues locally because many of the sources of flood waters originate outside their boundaries. A watershed-based approach (large scale such as by stream valley or for an entire river) is required to solve most flooding issues. Eliminating the Act 167 funding for comprehensive watershed planning has created the challenge of trying to address flooding by building a series of BMPs in individual townships without any

mechanism for coordination among them. The PADEP's focus on stream capacity in reviewing development plans can bridge the need for comprehensive watershed planning, but it will not address all of the problems that an Act 167 plan could solve.

National weather charts were updated to address the more frequent and intense storms Pennsylvania is experiencing, and PennDOT has adjusted its design rain depths as well; however, statewide townships have antiquated rainfall depths in their ordinances. To protect the public, a better system of mandating design rainfall depths is needed. National weather charts and PennDOT publications allow for regional variations in weather. Townships should simply adopt both in their ordinances, and eliminate the practice of including a depth in their ordinances.

Sinkholes, which are prevalent in Pennsylvania, are a danger to the public and a detriment to commerce. A sinkhole in a heavily travelled state highway in Chester County caused a major road closure and detoured traffic for more than a year. Many sinkholes are caused by improper SWM or poorly designed storm drains. Control of sinkholes in the state will require proper maintenance of BMPs and storm drains.

RESILIENCE

The resilience of a structure or system is dependent on its design life. Designers of SWM infrastructure generally do not consider the design life of BMPs. Pond designs include safe passage of the 1 percent probability storm and this protects them from damage due to high flows. Other BMPs (infiltration, bio-retention, bio-swales) are often designed for probability of a smaller storm, leaving them vulnerable to damage during larger storms. The newest BMPs include plants and soils as vital components, but plant secession and soil life often are not considered adequately in their design. Riparian buffers will be quite resilient over a time, and new regulations could result in increased use of buffers, which is likely to improve system resilience.

INNOVATION AND TECHNOLOGY

The state developed an innovative public/private partnership to revise its SWM BMP manual. The intent is to make the manual a “living document” that can be updated as better technology is proven. Similarly, the state is working with soil scientists to bolster site-specific infiltration investigations. The state's promotion of evapotranspiration (the use of water by plants) as a SWM technique is a progressive step. The new riparian buffer legislation has more generous widths than similar laws in other states and is likely to have a large positive effect on SWM in the future.

POLICY OPTIONS

The Federal Clean Water Act and the Pennsylvania Clean Streams Law set goals for the health of waters of the Commonwealth and waters of the United States. The difficulty in evaluating Pennsylvania’s adherence to these laws is entwined in the complex and decentralized web of rules, ordinances, acts, and guidelines meant to

enforce them and the many regulatory entities involved (i.e., EPA, PADEP, all 67 PA counties, 67 Conservation Districts, 2,600 municipalities).

This complex web of entities and regulations could be simplified if the state takes a more central role in SWM, such as increasing PADEP's educational efforts. Leaving Pennsylvania's municipalities to "go it alone" puts the state at a significant economic disadvantage compared with other states in the region. The EPA regulations that drive all SWM regulation envisioned countywide enforcement, which would provide a cost savings by virtue of the economy of scale.

RECOMMENDATIONS

Ultimately all efforts in stormwater management are judged by how well the Commonwealth protects our streams. Despite the lack of a significant decrease in the number of stream miles listed as impaired on the state reports to the EPA over the last few years, the health of the waters of the Commonwealth has noticeably improved over the last several decades. It is well-known, however, that as things get better, further improvement will cost more.

The four Pennsylvania sections of ASCE recommend that the following measures be taken to improve and promote SWM within Pennsylvania:

- To continue the improvement, the Commonwealth needs to better fund SWM, build PADEP staff, and increase training opportunities for the regulated community and regulators on the new rules that have been enacted. Additional personnel are needed to develop consistency in enforcement of the regulations by PADEP regional offices and to promote acceptance of new BMPs among regulators and the regulated.
- The Commonwealth must assume a more central role in the unification of the SWM infrastructure design community because the economic health of the state requires organization of the thousands of regulatory approaches to SWM enforced by municipalities and the varied interpretations of rules by the state itself.
- State funding for Act 167 needs to be restored to foster a regional approach to stormwater issues. In addition, legislation may be needed to reinforce the stormwater authority legislation in place.
- The Commonwealth must engage in monitoring and maintaining SWM BMPs. Municipalities are unlikely to be able to undertake maintenance of BMPs, which is likely to be the main issue in SWM for the foreseeable future.
- Funding must be found to address the change in rainfall patterns, increased flooding, sinkholes, and maintenance of SWM BMPs and to promote predictable regulatory enforcement that will foster development.
- The new regulations enacted will serve the Commonwealth well if adequate staff and support is provided to bring their promises to fix BMP operation, maintenance, and other SWM issues to fruition.

SOURCES

- American Council of Engineering Companies of Pennsylvania (ACEC/PA), *Environmental Investment in Pennsylvania*, January 2012.
- American Society of Civil Engineers, *Stormwater - 2010 Report Card for Pennsylvania's Infrastructure*, 2010. Available at: http://www.pareportcard.org/PDFs/Stormwater%20Final%20-%20NATL.pdf
- American Society of Civil Engineers, *Wastewater - 2010 Report Card for Pennsylvania's Infrastructure,* 2010.
- Carlisle Borough, *The Public Works Field Operations Division*, 2012. Available at: http://www.carlislepa.org/departments/public-works/field-operations/
- Erie County Sewer District No.6, *Stormwater Management Plan - Municipal Separate Storm Sewer System*, March 2013. Available at: http://www2.erie.gov/dsm/sites/www2.erie.gov.dsm/files/uploads/pdfs/swmp.pdf
- Green Infrastructure Network, *Position Statement on a Regional Stormwater Utility,* October 2013.
- Joseph, Tom, *PA Mid-Term Report Card on Clean Water Goals: Room for Improvement*, July 11, 2013. Public News Service.
- Lower Paxton Township Public Works Department. Notice from the Public Works Department - Wet Weather Recommendations. Available at: http://www.lowerpaxton-pa.gov/StormWaterRecommendations.htm
- McDonnell & Murin, *PADEP Perspectives-Current Issues for Stormwater Management in Pennsylvania*, PowerPoint Presentation, October 2013.
- *Mine Drainage Cleanup in Western PA, An Expensive, Slow Process*. Available at: http://triblive.com/news/allegheny/3273813-74/mine-drainage-run#axzz2naP9FGY5
- Natural Resource Defense Council (NRDC),*Rooftops to Rivers II - Pittsburgh, Pennsylvania*. Available at: http://www.nrdc.org/water/pollution/rooftopsii/files/RooftopstoRivers_Pittsburgh.pdf
- Newman, Barry, *DEP Planning to Protect Water Resources - Managing Stormwater Locally*. PowerPoint Presentation, October 29, 2008.
- Penn Environment *Protect Our Rivers and Streams*, Available at: http://pennenvironment.org/programs/pae/protect-our-rivers-and-streams.

- PennFuture, *Water - Clean Water Starts Here*, 2013. Available at: http://www.pennfuture.org/content.aspx?SectionID=319&MenuID=.
- Pennsylvania Department of Environmental Protection (PADEP), *2012 Pennsylvania Integrated Water Quality Monitoring and Assessment Report*. Available at:http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/WaterQualityPortalFiles/2012%20Integrated%20List/2012%20Pennsylvania%20Integrated%20Water%20Quality%20Monitoring%20and%20Assessment%20Report.pdf
- Pennsylvania Department of Environmental Protection (PADEP), *EXECUTIVE SUMMARY- Amendment to 25 PA. Code, Chapter 93 (Water Quality Standards) Triennial Review: January 11, 2012*. Available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&ved=0CD4QFjAD&url=http%3A%2F%2Fwww.votespa.com%2Fportal%2Fserver.pt%2Fgateway%2FPTARGS_0_532030_1234553_0_0_18%2F02%2520Executive%2520Summary.pdf&ei=6iirUpemIKeiyAHnkoG4BA&usg=AFQjCNHmPpk_216hjcx_w-wdKMNIc5xSLQ
- Pennsylvania Department of Environmental Protection (PADEP), *Fact Sheet - Stormwater Management in Pennsylvania*, November, 2001. Available at: http://www.water-research.net/Waterlibrary/Stormwater/erosioncontrol.pdf
- Pennsylvania Department of Environmental Protection (PADEP), *PADEP Biennial Report,* December 23, 2010. Available at: http://www.prnewswire.com/news-releases/biennial-dep-report-shows-80-percent-of-streams-rivers-attaining-use-designation-challenges-remain-112392009.html
- Pennsylvania Department of Environmental Protection (PADEP), *Pennsylvania Stormwater Management Act 167*, 1978. Available at: http://www.stormwaterpa.org/act-167.html
- Pennsylvania Department of Environmental Protection (PADEP),*Pennsylvania Combined Sewer Overflow CSO Policy - Status of PA CSOs by Region,* October, 17 2013. Available at: http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-8271
- Pennsylvania Department of Transportation (PennDOT),*PennDOT District 4-0 QA*. Available at: http://www.dot.state.pa.us/penndot/districts/district4.nsf/d4secondary?openframeset&frame=main&src=faq4.htmRevised?readform.

- Pennsylvania Department of Transportation (PennDOT),*PennDOT Maintenance First - Pipe Replacement& Cleaning Pamphlet,* 2012. Available at: ftp://ftp.dot.state.pa.us/public/PubsForms/Publications/PUB%20370C.pdf.
- *Pennsylvania Enforceable Provisions Applicable to Nonpoint Source Water Pollution. Discharge Prohibitions - Water Pollution Control Law*. Available at: http://scorecard.goodguide.com/env-releases/html/nps_law_42.pdf
- Philadelphia Water Department (PWD),*Our Commitment to Protecting Our Water Resource*, 2012. Available at: http://www.phila.gov/water/Protect_H2O.html
- Scranton Sewer Authority (SSA),*Combined Sanitary Stormwater Management Program Introduction,* October 31, 2013. Available at: http://www.scrantonsewer.org/docs/CSSMP.pdf
- Treadway, Elizabeth, Testimony Before the Pennsylvania Senate Majority Policy Committee and Senate Environmental Resources and Energy Committee, November 15, 2011. Available at: http://www.pasenategop.com/committees/policy/2011/111511/Treadway.pdf
- United States Environmental Protection Agency (EPA), *Green Infrastructure Strategic Agenda 2013*. Available at: http://water.epa.gov/infrastructure/greeninfrastructure/upload/2013_GI_FINAL_Agenda_101713.pdf
- Wilson, Thomas P., and Christoff, Robert J. *Successful Integration of Act 167 Stormwater Panning and Municipal NPDES Phase 2 MS4 Permitting Programs*". Available at: http://www3.villanova.edu/vusp/Outreach/pasym03/pdfs/1B3.pdf

ASCE POLICY STATEMENTS

- ASCE Policy Statement 441: Storm Water Management

SOLID WASTE

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Solid Waste Management (SWM) activities in Pennsylvania can be evaluated under three separate categories: waste collection, waste diversion and disposal. The portion of the waste stream that is targeted for disposal is primarily collected by private haulers and disposed at private facilities, with oversight provided by municipal and county staff. In 2012, "garbage" or "trash" (which can be defined as things that are no longer useful or wanted and which have been discarded) collection services were adequate in all but the most rural areas, and disposal capacity was adequate for anticipated future needs. Recycling, which accounted for a large percentage of waste diversion, can be subdivided into two major aspects: collection and processing. On the collection side, recycling faced challenges due to recent decreases in State funding and recycled commodity value (i.e., municipalities don't generate as much income from their recycled items as they have in the past). Additionally, recent court rulings have adversely affected the ability of local governments to fund programs. While recycling commodity processing is well established in urban areas, many rural areas continue to struggle with limited access to adequate processing facilities. (Limited accessibility to processing means that the cost of recycling increases dramatically, often to the point that it is considered uneconomical.)

BACKGROUND

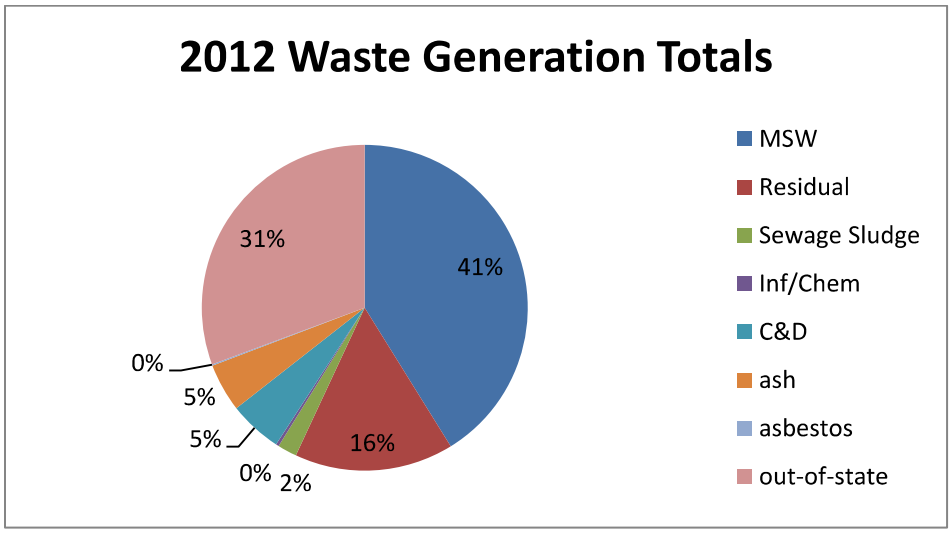
Everyone creates solid waste—residents, commercial entities, and industry. In general, municipal solid waste (MSW) can be seen as the collection, recycling and/or disposal of waste products. In Pennsylvania, MSW (which includes recyclables), is defined as: garbage, refuse, industrial lunchroom or office waste and other material, including solid, liquid, semisolid or contained gaseous materials. In short, MSW is all waste and sludge not meeting the definition of residual or hazardous waste according to the Solid Waste Management Act (SWMA). The Pennsylvania Department of Environmental Protection (PADEP) enforces regulations governing the handling and management of solid waste while responsibility for implementing municipal waste activities is vested in each of the 67 counties and more than 2,500 local governments in the Commonwealth.

Generally, residential and commercial waste is typically considered "municipal waste", whereas large quantity industrial waste products are typically categorized as "residual waste". Each of these entities may also generate "hazardous waste", in large or small quantities. A fourth category is "construction & demolition waste", which is frequently combined with municipal waste for disposal. Large volume residual waste materials generated by industrial entities are frequently disposed at the generation site (referred to as "captive facilities"), and are not included in the municipal waste disposal tonnage documentation. C&D waste can be disposed in designated C&D landfills, although a considerable tonnage of this material is routinely disposed in municipal landfills.

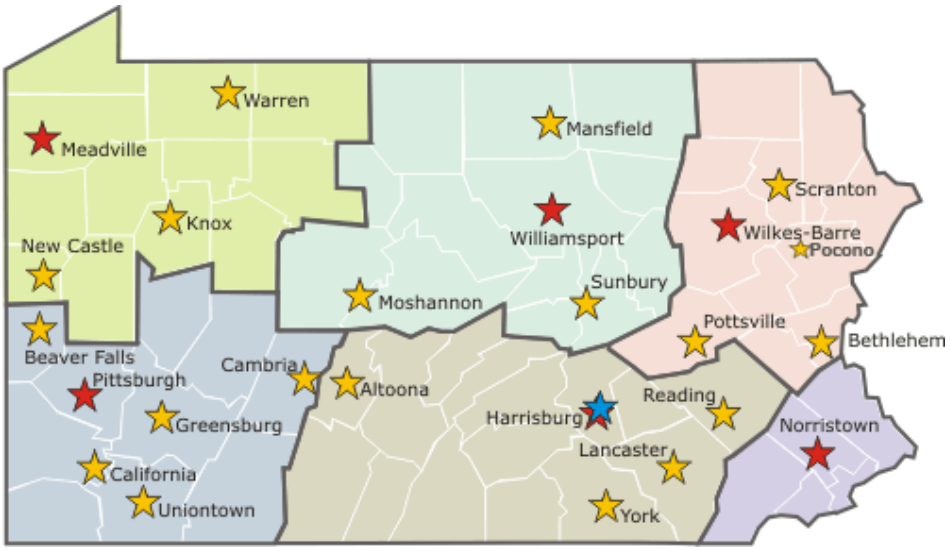
Infrastructure to handle solid waste includes on-site storage containers, collection/transportation vehicles and disposal facilities. Storage containers are supplied by the generating location, whether it is a residence, a commercial establishment or an industrial facility. Sufficient collection and transportation vehicles are supplied by either the public or the private sector. Critical elements of the infrastructure are disposal facilities, which include both landfills and incinerators, and material recycling facilities (MRFs), which separate recycled materials into specific material streams for distribution. Transfer stations may be utilized to reduce the cost of transportation to distant disposal or recycling facilities. Transfer stations are locations where the smaller trash trucks we see in our neighborhoods can drop off their loads and be picked up by large tractor-trailers for transport to the disposal facility. This is a more economical way to transport waste to the disposal facility. It also cuts down on the number of trucks going to the facilities, but is only cost-effective if there is a substantial haul distance to the disposal or processing facility.

CONDITION AND CAPACITY

In 2012, Pennsylvania generated and disposed 14.6 million tons of municipal waste within its borders. Of this total, 8.6 million tons was designated as MSW. The remainder consisted of residual waste (3.3 million tons), sewage sludge (0.4 million tons), infectious/chemotherapeutic waste (0.06 million tons), construction/demolition waste (1.1 million tons), ash (1.0 million tons), and asbestos (0.03 million tons). Another 6.4 million tons of municipal solid waste originated out-of-state, and was disposed in Pennsylvania. This resulted in a total of 21.0 million tons of municipal waste disposal (both landfilled and incinerated).

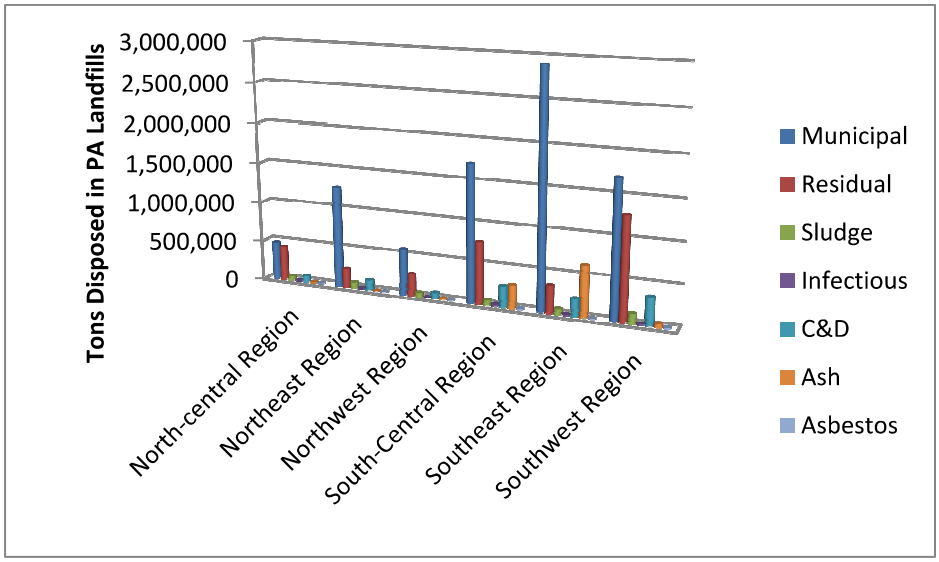


The 14.6 million tons of municipal waste generated and disposed in Pennsylvania in 2012 was generated regionally as follows:



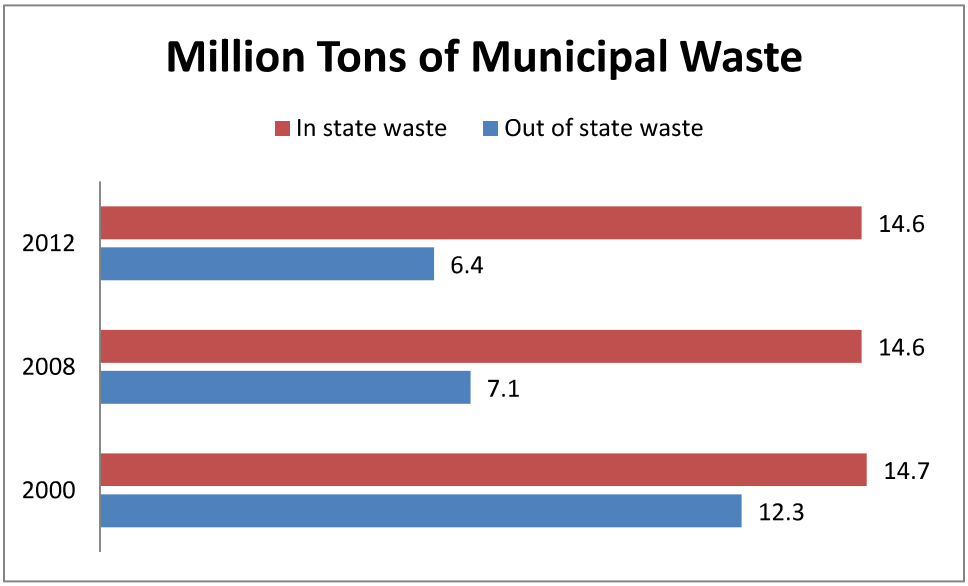
2012 Waste Tonnage Generated by Region

	Municipal	Residual	Sludge	Infectious	C&D	Ash	Asbestos	Total
North-central	473,350	426,195	49,064	1,292	71,471	3,524	2,127	1,027,021
Northeast	1,263,375	237,728	71,230	8,540	122,133	17	1,461	1,704,483
Northwest	575,304	269,488	45,286	0	71,322	10,976	1,779	974,155
South-Central	1,710,577	773,912	59,806	22,388	259,732	283,680	9,632	3,119,726
Southeast	2,897,202	338,909	65,249	15,673	219,474	632,892	3,409	4,172,808
Southwest	1,703,728	1,277,853	123,061	10,827	351,563	44,035	9,430	3,520,495
	8,623,535	**3,324,083**	**413,695**	**58,719**	**1,095,694**	**975,124**	**27,839**	**14,518,688**



Pennsylvania's total waste generation per capita in 2012 was 1.14 tons/capita. Using only MSW as a base, generation was 0.68 tons/capita. Based on these estimates, it takes fewer than 9 people to fill a standard garbage truck every year.

By comparison, Pennsylvania generated and disposed of 14.6 million tons of municipal solid waste in 2008 (virtually the same as noted in 2012). Another 7.1 million tons of solid waste originated out-of-state and was disposed in Pennsylvania, for a total of 21.7 million tons (again, roughly the same as in 2012). The 2008 results represented a reduction in the totals documented in 2000 (14.7 million tons generated in-state, 12.3 from out-of-state, for a total of 27 million tons). Most of this drop was the result of a reduction in the amount of waste imported from out-of-state. This trend is based on the availability of cheap disposal capacity in other states, as well as the general reduction in waste generation in the US NorthEast.



According to PADEP, Pennsylvania has 44 active municipal waste disposal landfills and six resource recovery (waste-to-energy) facilities. There are also four permitted C&D disposal facilities and three residual waste facilities, with the distribution of sites as shown in the following table.

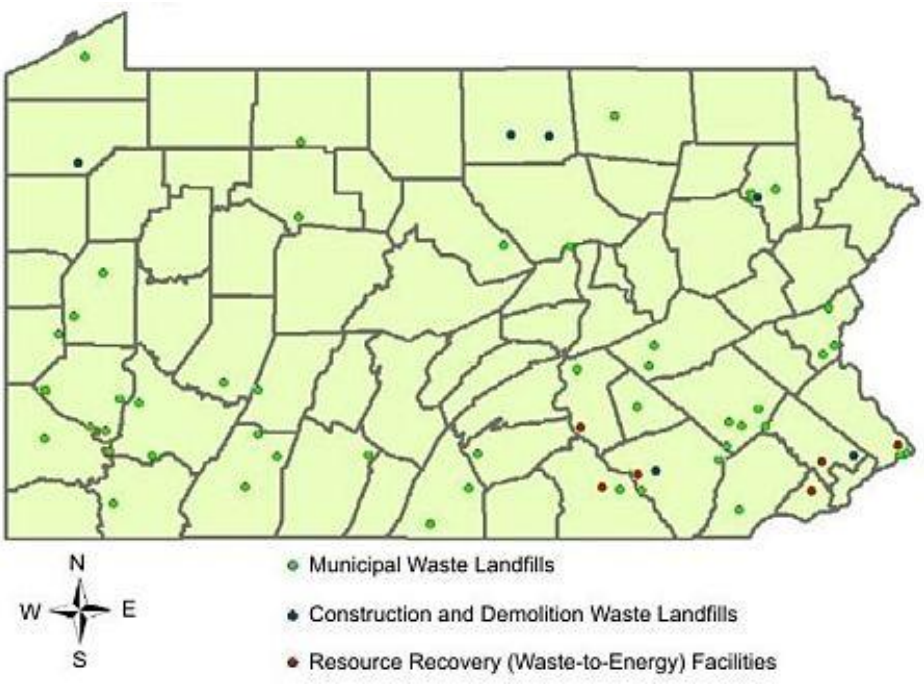
2013 PA Permitted Disposal Facilities

Region	Landfills	Waste-to-Energy	C&D	Residual	Transfer Stations
North-central	3		1	2	7
Northeast	6		1		11
Northwest	5		1		11
South-Central	12	3	1		14

Southeast	3	3			23
Southwest	15			1	10
Total	44	6	4	3	76

Note: totals do not include Captive Disposal Facilities

The map below from PADEP shows the location of municipal waste landfills and resource recovery facilities in Pennsylvania. In addition to these disposal facilities, there are 76 permitted transfer stations currently in operation.



Through July 2011, the PADEP listed 40 active operational methane gas-to-energy projects at Pennsylvania landfills and six candidate landfills under consideration. In gas-to-energy projects, the gas generated by natural waste breakdown processes is captured and used for power generation, either onsite or for distribution.

The map below from the PADEP shows operational gas-to-energy projects, pending projects, candidate landfills, and landfills of undetermined status.

Of the 50 municipal landfill and waste-to-energy facilities permitted in Pennsylvania, only 12 are publicly owned and operated. The remainder are privately owned, with permits for expansion issued periodically by the PADEP.

As part of their Solid Waste Planning, each County is required to document that sufficient permitted disposal capacity is available for all of the waste generated in Pennsylvania for the next 10 year period. Based on current County Plans, it appears that sufficient capacity is currently available.

Although seriously discussed in 2011 by the State Legislature, Pennsylvania currently has no State-mandated requirement for trash collection. Many municipalities, however, require trash collection by ordinance. In most urban and suburban areas, trash collection service is viewed by residents as a required service.

However, in many of the more rural parts of the state, there are no ordinances addressing this matter. Without a requirement for mandatory trash collection, the incidence of illegal disposal – dumping or burning – of trash increases. Although dumping may appear to be an inexpensive way to resolve a trash disposal problem, the cumulative effects of illegal disposal can result in uncontrolled fires, water pollution and tremendous expense for local governments for cleanup.

Recycling

According to the United States Environmental Protection Agency (USEPA), solid waste that can be recycled or reclaimed can be considered a valuable commodity, but only under some conditions. The material must provide a useful contribution to the recycling process, or to a product of the recycling process, must yield a valuable product or intermediate that is sold or used under specific conditions, and the product of the recycling process must not contain significant amounts of hazardous constituents.

Pennsylvania's Act 101 (1989) mandates that all municipalities with populations greater than 10,000, and those with at least 5,000 residents and a population density greater than 300 people per square mile, implement programs for the curbside collection of residential, commercial and institutional recyclables. The Act also encourages non-mandated municipalities to provide recycling services to residents, through drop-off facilities or curbside collection. Municipalities were encouraged to initiate recycling programs with State grants coordinated through the PADEP. According to the PADEP, 440 of Pennsylvania's 2,700 municipalities are mandated to recycle and provide curbside collection programs, and nearly 1,500 non-mandated municipalities have access to voluntary curbside or drop-off collection services.

This Act has resulted in a huge growth of municipal recycling programs over the last 25 years, but efforts to make recycling programs self-sufficient and sustainable through sale of recycled and reclaimed materials have been less successful. Variations in the market for such materials, as well as the rising costs for collection and transportation of the materials, means most recycling programs continue to be dependent on government grants in order to function.

Although many municipalities and counties provide recycling collection services (either through curb-side collection or drop-off boxes), most of the processing of recyclable materials is handled by private enterprises.

During periods of high recycling commodity value, local governments are able to cover their collection costs, and in some cases, make a capital investment necessary for the sustainability of their programs. However, many of the collected commodities (e.g. glass) have a low value compared to the costs associated with collection, transportation and processing. As a result, when the return on sales is low, municipal recycling programs have required a local government subsidy. In order to remain profitable, private industries that process recyclables require large volumes of the high value commodities, to justify working with the lower value items.

In 2009, Pennsylvania's legislature reauthorized the $2 per ton fee placed on all municipal waste disposed at landfills and incinerators, which has partially supported infrastructure capital investment at the local government level. This fee may be used to

fund a municipal grant program that complements the development of recycling infrastructure investment, although a significant percentage of the total has been used for other purposes. Grant funds are used to purchase storage and collection equipment, as well as equipment used to agglomerate and separate recycled materials for sale to end users. The program also provides some capital financing to the private sector for the same purposes. However, no grant program was established to cover operating and maintenance costs, and these expenses have historically been provided by the local government and private entities involved.

Prior to 2005, half of Pennsylvania's counties utilized county administrative fees collected on each ton of municipal waste generated in the county and disposed of in Pennsylvania facilities. However, a 2005 Commonwealth Court decision ruled that counties could not institute an administrative fee, based on their interpretation of Act 101. Since then, the PADEP has not approved county solid waste plans that require payment of a fee in order to participate in the plan.

In addition, the State grant program established under Act 101, which had provided $46 million in FY 2004-05 to initiate and sustain recycling programs, dropped to $35 million for FY 2012-13, in part due to the downturn in municipal landfill disposal throughout the Commonwealth. To make matters worse, there has been a drop in recycled commodity value as a result of the economic downturn and reduced exports overseas.

The combination of these factors has had a detrimental impact throughout the Commonwealth's county and municipal recycling programs. In 2012 and 2013, several Pennsylvania counties eliminated their recycling programs, shifting the burden of recycling costs fully onto the mandated municipalities, and those who chose to provide recycling services voluntarily. In October 2013, Commonwealth Court ruled that the City of Reading had no authority to impose recycling fees on residents, thus throwing into doubt the continued operation of the city's $2.7 million recycling program. The implication of this ruling on other municipalities throughout the Commonwealth is not currently known.

The PADEP collects recycling data from municipalities and counties on an annual basis, and publishes this information on their website. The PADEP website indicates that in 2011, Pennsylvanian's recycled over 5.85 million tons of resources, a 5.77% increase over 2010. However, the data received for the website comes from the individual municipalities, and is prone to typographic errors and incorrect data.

For instance, the PADEP recycling data shows that Adams County alone was responsible for recycling 908,865.3 tons of mixed metals in 2011. This is compared to a total of 1,495.7 tons by Adams County in 2010, for a 60,700% one-year increase in tonnage. It appears likely that this data was accidentally entered as "pounds" rather

than “tons”, and if that single change is made, the net result is a 10.64% decrease in state-wide recycling between 2010 and 2011.

E-Waste

Electronic waste (also known as e-waste) is a rapidly growing component of the solid waste stream. The growth of the electronics industry has multiplied the quantities of waste electrical and electronic equipment that will only increase. Most of this is discarded in landfills, though many electronic products contain toxic materials such as lead, mercury, and cadmium that may be hazardous when disposed of improperly. The Covered Device Recycling Act (CDRA, Act 108 of 2010) was implemented as an attempt to reduce the tonnage of e-waste being disposed in municipal landfills. This Act requires manufacturers of electronic devices to provide recycling programs for desktop computers, laptop computers, computer monitors, computer peripherals, and televisions (referred to as e-waste) sold to consumers in Pennsylvania beginning in January of 2012. However, collection of e-waste has far exceeded the ability of processing facilities to keep up with the expanding pace of e-waste discards. According to the USEPA, nationwide in 2009:

- 438 million new consumer electronics were sold;
- 5 million tons of electronics were in storage;
- 2.37 million tons of electronics were ready for end-of-life management; and
- 25% of these tons were collected for recycling

These statistics are bound to increase as the demand for electronics grows exponentially. Roughly half of the states (including Pennsylvania) currently have laws regarding e-waste recycling, but no program exists currently at a national level to deal with electronic wastes.

In an effort to deal with the growing electronic waste issue, localities have implemented e-waste recycling events for residents for disposal of unused products voluntarily. The PADEP reports that 44 of the 67 counties have implemented permanent e-waste drop-off locations, as well as periodic one-day events during the year. However, CDRA, Act 108 of 2010 did not provide increased funding for county and municipal governments to provide for collection and distribution of e-waste. In fact, the PADEP recently informed counties that they could not charge a fee for drop-off of e-waste if they were collecting revenue from disposal of the materials. This has led to a situation where the counties are forced to choose between a fee for drop-off and revenue from the collected materials, neither of which is sufficient to sustain the programs.

Composting

Leaf composting programs have been established in several counties, all mandated municipalities, and in a number of smaller non-mandated municipalities. Leaf composting sites are either county/municipally- or privately-owned and operated. In addition, the PADEP, and many of the counties, have developed a number of educational documents relating to backyard composting. Both the state and several educational/environmental entities offer seminars for residents anxious to pursue this type of activity.

With that in mind, the total recycling tonnage data presented by the PADEP, although useful, should not be accepted at face value.

FUNDING AND FUTURE NEEDS

Publicly-operated solid waste management groups have been struggling to become sustainable due to reduced grant funding, aging equipment, and recent lawsuits which have limited local government opportunities to generate revenue for recycling and education programs. It appears that there is sufficient capacity to meet the anticipated municipal waste disposal needs for the next 10 years. However, there is a future need for expanded waste collection services in rural areas of the Commonwealth. In addition, there is a considerable need for future funding sources to enable local governments to sustain recycling and solid waste education programs.

PUBLIC SAFETY

The reason that municipal waste collection programs were initiated by local and state governments was to protect the public from adverse conditions associated with dumping of trash. However, if the trend toward reductions in funding of recycling and solid waste education programs continues, there is a concern that illegal dumping of “hard to recycle” and household hazardous waste materials will increase. This will lead to numerous environmental problems for the State, and a general increase in public safety concerns.

RESILIENCE

The solid waste recycling system in use throughout the Commonwealth is a combination of publicly and privately operated facilities and programs. Since this is a rather complex cooperative operation, reductions in funding for the public segment of the system will tend to tip the balance toward private operations, which are focused on the more profitable components of the waste stream. As such, there is a danger that “hard to recycle” and household hazardous waste materials will be left out of the system, resulting in illegal dumping. The current public aspects of the system have taken many years to develop, and without the ability to become financially sustainable

through fees or funding contributions, it will be difficult to sustain. If these programs are removed, it will be very difficult to reestablish the momentum previously achieved.

INNOVATION AND TECHNOLOGY

There appears to be a resurgence of the use of "waste-to-energy" facilities across the Commonwealth. Although these facilities have received well-documented criticism in the past, state-of-the-art plants have the potential to significantly reduce the overall need for disposal tonnage, while generating electricity. Similarly, many locations across the State have been moving toward single-stream recycling methods, whereby a variety of recycled commodities can be combined into a single container, which is more attractive to residents. This method has been available for many years, but new technology is making this approach more viable for sorting at large, efficient consolidation centers, since single-stream tends to result in substantial increases in total recycling tonnages.

POLICY OPTIONS

With 67 counties, more than 2,500 local government units, and roughly 500 school districts existing in Pennsylvania, finding a one-size-fits-all approach to SWM and recycling is very difficult. Forty-two percent of Pennsylvania's population lives in townships where lack of population density per square mile is one of the single most critical issues affecting the cost of governance in general and collection of recyclable material specifically.

Recycling collection efficiency of certain materials cannot be achieved with limited population and density, especially when processing facilities for those materials are not local. Fluctuating unit pricing for recyclable commodities makes it extremely difficult to sustain recycling collection programs. A change in regulatory expectations regarding recycling percentages or the specific list of materials to be collected may be necessary to support collection in these more rural locations. Because of the need for larger quantities of marketable material to sustain recycling efforts, it is appropriate that local governments consider regionalization and intergovernmental cooperation to promote economies of scale.

Enforcement of the requirements established by local recycling ordinances adopted in accordance with county SWM plans differs from municipality to municipality across the state. Many of the smaller municipalities in Pennsylvania that offer curbside or drop-off recycling programs do so voluntarily and establish the requirements of these programs internally or by private sector collection contract.

The curbside collection of recyclable materials becomes easier to implement if the curbside collection of trash already exists. However, significant portions of

Pennsylvania utilize subscription trash collection, whereby each individual contracts separately with a trash hauler to provide services. This tends to work well in rural areas for trash collection, but is inefficient for urban areas, and is difficult to implement for recycling collection. Municipal collection by contract is typically more efficient, but many municipalities are hesitant to implement municipal contracts due to resistance from local haulers.

Since Pennsylvania's Act 101 was implemented in 1989, there have been several lawsuits which have adversely affected county and municipal efforts to create sustainable recycling and waste management education programs. This, coupled with an overall reduction in available grant funding from the PADEP, has resulted in many recycling programs being reduced in scope, or eliminated entirely. Modifications to Act 101 to address some of these issues have been proposed numerous times over the last few years, but substantial changes have not been implemented.

RECOMMENDATIONS

The four Pennsylvania sections of the American Society of Civil Engineers (ASCE) recommend the following measures be taken for the solid waste infrastructure of the Commonwealth:

- The PADEP process for reviewing and acting on landfill expansion permits should be reviewed with an eye toward assuring that timely action will be taken, so that counties will be able to negotiate for landfill space when undertaking plan updates. However, recent observations have been that available disposal capacity appears to exceed near-future demand in Pennsylvania.
- Consideration should be given to requiring mandatory waste collection (curbside or drop-off) in all but the most rural areas.
- PADEP should promote the establishment of rural trash transfer stations to accommodate trash drop-off containers.
- Pennsylvania should establish mandatory recycling requirements in all facilities receiving state funds (prisons, schools, governmental office buildings, etc.)
- PADEP should develop recommendations for regionalization of recycling efforts to accommodate those areas where collection does not take place and/or processing facilities are inadequate.
- PADEP should also reevaluate their method for collection of waste disposal and recycling data. It is recognized that staffing limitations (municipal, county and within the PADEP) make the data evaluation difficult, but it is also understood that the data is important for planning purposes.

- 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.
- The Commonwealth should reconsider the methods used to establish Grant Funding budgets, and subsequent grant request evaluation techniques. There is currently insufficient grant money available to create sustainable waste management programs throughout the State. In addition, the turn-around time between grant request submittal and receipt of notice of award is far too long.

SOURCES

- American Society of Civil Engineers (ASCE), *2010 Report Card for Pennsylvania's Infrastructure – Solid Waste Section*, May 2008. Available at: *2010 PA Solid Waste Section*
- Commonwealth of Pennsylvania, Department of Environmental Protection, *Municipal Waste Landfills & Resource Recovery Facilities.* Available at: *Municipal Waste Landfills & Resource Recovery Facilities*
- Commonwealth of Pennsylvania, Department of Environmental Protection, *Recycling Reports and Studies.* Available at: *Recycling Reports and Studies*
- Commonwealth of Pennsylvania, Department of Environmental Protection, *Pennsylvania`s "Municipal Waste Planning, Recycling and Waste Reduction Act", Act of July 1988.* Available at: *Municipal Waste Planning, Recycling and Waste Reduction Act*
- US Environmental Protection Agency, *Statistics on the Management of Used and End-of-Life Electronics*. Available at: *End-of-Life Electronics*

ASCE POLICY STATEMENTS

- ASCE Policy Statement 516: Municipal Solid Waste Management
- ASCE Policy Statement 331: Hazardous Waste Reduction and Management
- ASCE Policy Statement 527: Recycling of Electronic Wastes

SCHOOLS

C-

Current information on the infrastructure of our public and charter schools is not available. Act 59 of 2013 required the Pennsylvania Department of Education to conduct a statewide analysis of school facilities and future capital needs. Data collection of information on school buildings owned by school districts and charter schools throughout the Commonwealth was scheduled to be completed at the end of April 2014. The information collected will be publicly available and included in a preliminary report due to be submitted to the General Assembly in May 2014.

The Commonwealth has had a moratorium on approving new school construction projects since 2011 as there were more construction projects approved through the PlanCon process than there were funds available. Progress on addressing the findings of the pending report through streamlining of the PlanCon process and providing adequate, predictable and sustainable state funding for the repair, renovation and construction of school buildings is critical for school districts and charter schools to address their facility needs.

BACKGROUND

Formal education and schools have existed in the Commonwealth of Pennsylvania since the founding of Pennsylvania as a Province in 1682. Early schools were associated with churches and synagogues established by immigrant settlers. Not until 1831, by way of the Common School Fund Act, and shortly thereafter the Common School Law of 1834, were local and state funding mechanisms established, and local governments were provided a framework to administer free public education. When the 1834 law was enacted, the formula for educational funding required County taxes to provide at least twice the amount of revenue received from the State. Since then, the funding formula has changed many times, as have the state laws governing the administration of public education.

Beginning in 1973, Act 34 implemented the Planning and Construction Workbook (PlanCon) process as a safeguard against costly, elaborate school design plans.
In addition to codifying the Pennsylvania Department of Education approval requirements, Act 34 contains provisions that require new public school buildings and refurbishment of existing buildings to conform to standards established by the State Board of Education. Shortly after the passage of Act 34, the State Board of Education began promulgating a complex set of standards and regulatory requirements to which school construction projects must conform and comply. The Pennsylvania Department of Education developed the multi-step PlanCon process that exists today to carry out its duties as the regulatory agency charged by the General Assembly with the oversight of public school construction in the commonwealth. The PlanCon process is required to be followed for the Pennsylvania Department of Education to provide school districts partial reimbursements for construction costs. It has been very useful for districts which

may lack the ability to obtain resources to fully support educational needs, as the poorer the district is, the higher the level of reimbursement available from the state.

In 2005, the Legislature increased the reimbursement rate under PlanCon for the first time in twenty years. Districts also began receiving extra monies for environmentally conscious school designs, known as LEED-certified. Additionally the Legislature allowed charter schools to get partial lease reimbursements through the PlanCon fund. Those changes resulted in a backlog of payments to school districts. In 2011, the State cut the funds available for reimbursement payments by $20 million to $296 million and the Pennsylvania Department of Education placed a moratorium on approving new projects for reimbursement by essentially shutting down the program that funds the construction of facilities that require state assistance.

As of January 2014, the Pennsylvania Department of Education owes about $1 billion to numerous school districts, for about 350 state-approved renovation and construction projects.

CONDITION AND CAPACITY

Act 82 of 2012 authorized a moratorium on the acceptance of new PlanCon applications. The moratorium, which was effective October 1, 2012, was necessary because of the backlog and the appropriation amount. The moratorium is currently in place (until June 30, 2014) unless the Legislature extends it.

Act 59 of 2013 required the Pennsylvania Department of Education to conduct a statewide analysis of school facilities and future capital needs. The survey conducted by the Department requested the following information:

- Long-range facilities status
- Estimated costs based on long-range facilities plan
- Total number of buildings and construction types
- Years in which buildings were originally constructed
- Years when most recent additions or major renovations occurred
- Overall building assessments
- Primary sources of energy
- Number of pupils
- Energy efficiency certifications

The preliminary report due on the Department findings is scheduled to be submitted to the General Assembly in May 2014.

POLICY OPTIONS

The following is the current policy employed by the Division of School Facilities at the Pennsylvania Department of Education:

> "Section 7-731 of the Public School Code of 1949, as amended, requires Department of Education approval of plans and specifications for all public school construction or reconstruction, and for ordinary repairs or maintenance work of a value greater than $15,000 for any second, third or fourth class district. When a district initiates work involving maintenance, construction, or repairs, e.g., roof replacement, sidewalk repairs or the installation of new carpeting, Form PDE-3074, Self-Certification Application for Non-Reimbursable Construction Projects, is submitted to the Department. This form provides a brief description of the project and a certification by the school board and its design professional that the project complies with pertinent laws, regulations and standards.
>
> "When a school district undertakes a major school construction project and seeks reimbursement from the Commonwealth, a process known as PlanCon is initiated. PlanCon, an acronym for Planning and Construction Workbook, is a set of forms and procedures used to apply for Commonwealth reimbursement. The forms are designed to: (1) document a local school district's planning process; (2) provide justification for a project to the public; (3) ascertain compliance with state laws, regulations and standards; and (4) establish the level of state participation in the cost of the project.[1]
>
> "The Division of School Facilities in the Department of Education reviews proposed school building projects including their plans and specifications, enrollments, building utilization and building condition. The Division also calculates state reimbursement for qualified school construction projects, and reviews and approves the financing for reimbursable projects.[2]"

The primary funding of school construction is accomplished from short-term loans, grants and general obligation bonds managed by the Local School Districts, Career and Technical Centers and Charter Schools.

Additional assistance is provided by the Pennsylvania State Public School Building Authority. The Authority is a public corporation and a governmental instrumentality of

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[1] School Construction and Facilities Overview at the website of the Division of School Facilities at the Pennsylvania Department of Education http://www.pde.state.pa.us/portal/server.pt/community/school_construction_and_facilities/7457

[2] Pennsylvania Department of Education, Summaries of Annual Financial Report Data, Detailed, Miscellaneous Short and Long Term Debt, http://www.portal.state.pa.us/portal/server.pt/gateway/PTARGS_0_123706_702508_0_0_18/Finances_AFR_SOIN_9697-0708.xls

the Commonwealth of Pennsylvania, created by Act of the 1947 General Assembly for the purpose of financing the construction and improvement of public school facilities.

The Authority finances projects through the issuance of bonds; the principal and interest of which are paid by the annual lease/loan payments collected from public schools.[3]

Further assistance is provided to public schools by way of the following initiatives:

- Pennsylvania Governor's Green Government Council Green Schools Planning Grants. Since the inception of the program in 2005, 22 public schools have received grants.[4]

- Early Childhood Capital Investment Fund. Provides low-interest loans to school districts in order to increase the availability of early childhood educational learning opportunities. The loans may be used for construction costs, to renovate an existing facility, for needed equipment and furniture, or any combination of the former.[5]

- School Design Clearinghouse. Provides case study documentation of recent school construction projects which have met cost efficiency and design standards established by the Department of Education.[6]

RECOMMENDATIONS

Recommendations from ASCE National request the following actions be considered at the federal level:

- Publish regular updates of the Department of Education report following is 2014 release.
- Streamline the existing PlanCon process.
- Establish a state, multiyear capital budget goal for school infrastructure construction and rehabilitation to provide a predictable and sustainable funding stream for school districts and charter schools to plan capital projects.
- Expand federal tax credits to support increased use of school construction bonds
- Continue and increase federal grants for high-poverty, high-need school districts
- Encourage school districts to explore alternative financing, including lease financing and financing/ownership/use arrangements, to facilitate construction

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[3] Pennsylvania State Public School Building Authority website, http://www.phefa.org/index.htm

[4] Pennsylvania Governor's Green Government Council, Green Schools Initiative http://www.gggc.state.pa.us/portal/server.pt/community/schools/13838

[5] Pennsylvania Department of Education, Pennsylvania Accountability Block Grant Program http://www.portal.state.pa.us/portal/server.pt/community/early_childhood_education/8698

[6] Pennsylvania Department of Education, School Design Clearinghouse website http://www.sdcpublic.ed.state.pa.us/PublishScreens/wfSDCHome.aspx

- Encourage school districts to adopt regular, comprehensive construction and maintenance programs
- Increase the emphasis on research and development for design and construction to meet the rapidly changing teaching environment
- Encourage the use of life-cycle cost analysis principles to evaluate the total costs of projects

SOURCES

- Pennsylvania Department of Education Planning and Construction Workbook: A Report to the General Assembly – May 2013
- Pennsylvania Department of Education School Facilities Survey Instructions and Copy of Survey
- *Public Elementary and Secondary Schools in Pennsylvania, 1682-1969*, Historic Educational Resources of Pennsylvania, Pennsylvania Historical and Museum Commission, June 27, 2007. http://www.portal.state.pa.us/portal/server.pt/gateway/PTARGS_0_2_18731_2404_293092_43/http%3B/pubcontent.state.pa.us/publishedcontent/publish/cop_environment/phmc/communities/extranet/preservationprograms/schoolpreservation/phmcextschoolpreservationu_content/historic_educational_resources_of_pennsylvania.pdf
- The Morning Call, January 19, 2014 “School districts still waiting for $1 billion from state” http://articles.mcall.com/2014-01-19/news/mc-pa-school-construction-funding-20140119_1_districts-construction-workbook-plancon

ASCE POLICY STATEMENTS

- ASCE Policy Statement 452: Investing in America’s Schools

ROADS

D-

The Pennsylvania Department of Transportation (PennDOT) rated 44 percent of Pennsylvania's roads fair or poor in 2012. This is an increase of approximately 2 percent over the last year, a trend that has been consistent since 2009. If this trend continues, over half of Pennsylvania roadways will be rated fair or poor by the year 2015. Pennsylvania's highway network consists of 41,000 miles of state highways and 79,000 miles of local roads. Pennsylvania has the seventh largest number of state-owned highways in the nation. The state also ranks eleventh for total lineal miles of roadway. Pennsylvania's 8.8 million drivers travel nearly 100 billion miles on these roads every year. Over 34 percent of travel along Pennsylvania's 1,855 miles of interstate roads is truck traffic, more than double the national average.

Without construction of new roadways and lanes to increase capacity, Pennsylvania's roadways will continue to create congestion and delays. In major urban areas, traffic congestion costs the average commuter 182 hours of delay and 86 gallons of wasted fuel per year. That is equivalent to over 4 weeks of vacation time and a month's worth of fuel for a vehicle with average gas mileage. Statewide congestion is estimated to cost drivers over $3.7 billion per year in lost time and wasted fuel. Maintaining Pennsylvania's expansive roadway system is a constant challenge.

BACKGROUND

In 2010, the Pennsylvania State Transportation Advisory Committee estimated the state faced a $3.5 billion annual gap in total unfunded transportation needs. Of the $3.5 billion, $2.6 billion attributes to the unfunded annual transportation roadway and bridge needs. It was estimated that without additional funding, these gaps would grow to $6.7 billion and $4.7 billion respectively by 2020. Currently, the state funding gaps are estimated at $3 billion for roadway and bridge needs and $5.2 billion for total unmet transportation needs.

Pennsylvania's infrastructure deficit is the result of underfunding and a critical lack of long-term planning until Act 89 was signed into law in November, 2013. Inability of Pennsylvania's Legislative and Executive Branches to develop a workable funding program for the Commonwealth's infrastructure has resulted in an unsustainable roadway system. While the recently signed Act 89, was a good first step, long-term funding remains inadequate to meet the needs of Pennsylvania's families and businesses.

Due to recent economic challenges, vehicle travel through the State has remained constant since 2009. Based on the rate of population growth and the expected rise in number of licensed drivers, by 2030, vehicle travel in Pennsylvania is projected to increase by another 15 percent.

State traffic safety—as indicated by the traffic fatality rate—has been stable over the last five years. However, Pennsylvania's 1.3 fatalities per 100 million miles of travel is

significantly higher than the national average. Rural non-interstate routes are particularly concerning with fatality rates nearly 2.5 times higher than the state average. Roadway conditions on these rural routes contribute to approximately one-third of fatal and serious crashes. In 2011, the cost of serious crashes where roadway features were likely a contributing factor was approximately $2.7 billion; these costs included lost productivity, lost earnings, medical costs, emergency services, but, of course, no one can assign a dollar value to a life lost.

For decades, funding sources for Pennsylvania's transportation projects have remained stagnant as the purchasing power of these funds has been diminished by inflation and rising costs. Further, the amount of funding from the flat per-gallon taxes which provide much of the financial support for these projects is decreasing as fuel-efficient and alternative fuel vehicles reduce consumption—over 10 percent in the last decade. When compared to the price of gas, the average driver is paying less than half in terms of tax as a percent of fuel cost than they were a decade ago. However, on November 25, 2013, Act 89 passed and will phase in an additional $2.3 billion per year over the next five years. This plan will help to close some of the $3 billion gap between Pennsylvania's well documented highway and bridge needs and the current revenue available.

For these reasons, this committee has determined that the grade for Roads in Pennsylvania for the 2014 Report Card for Pennsylvania's Infrastructure is a D-. This grade is unchanged from our 2010 Report Card and is based on the continued deterioration in overall International Roughness Index (IRI) pavement condition rating, increasing congestion, and stagnant safety performance, but tempered by the promise of near-term improvement that the new transportation funding is expected to provide.

CONDITION AND CAPACITY

Chart 1 shows the percentage of roadway in the Poor and Fair Categories in each classification and their change from 2009 through 2012. The Interstate system has remained stable through the period; however, all other classifications are showing steady downward trends. Even the interstates, which have an overall average rating of excellent, still have 4 percent (over 100 miles) rated in poor condition. Imagine if it were all on a single roadway corridor - that would represent a trip from Harrisburg to Philadelphia on a 65 MPH Interstate all on a poor roadway. Statewide, including all state roadways of all classifications, the amount of poor-condition roadways has risen 7 percent (an additional 2,800 miles), bringing the total for poor condition roadways to 23 percent (nearly 9,800 miles). That could be considered as a trip across the state 25 to 30 times, or 3 to 4 trips across the country, all on poor state-owned roadways.

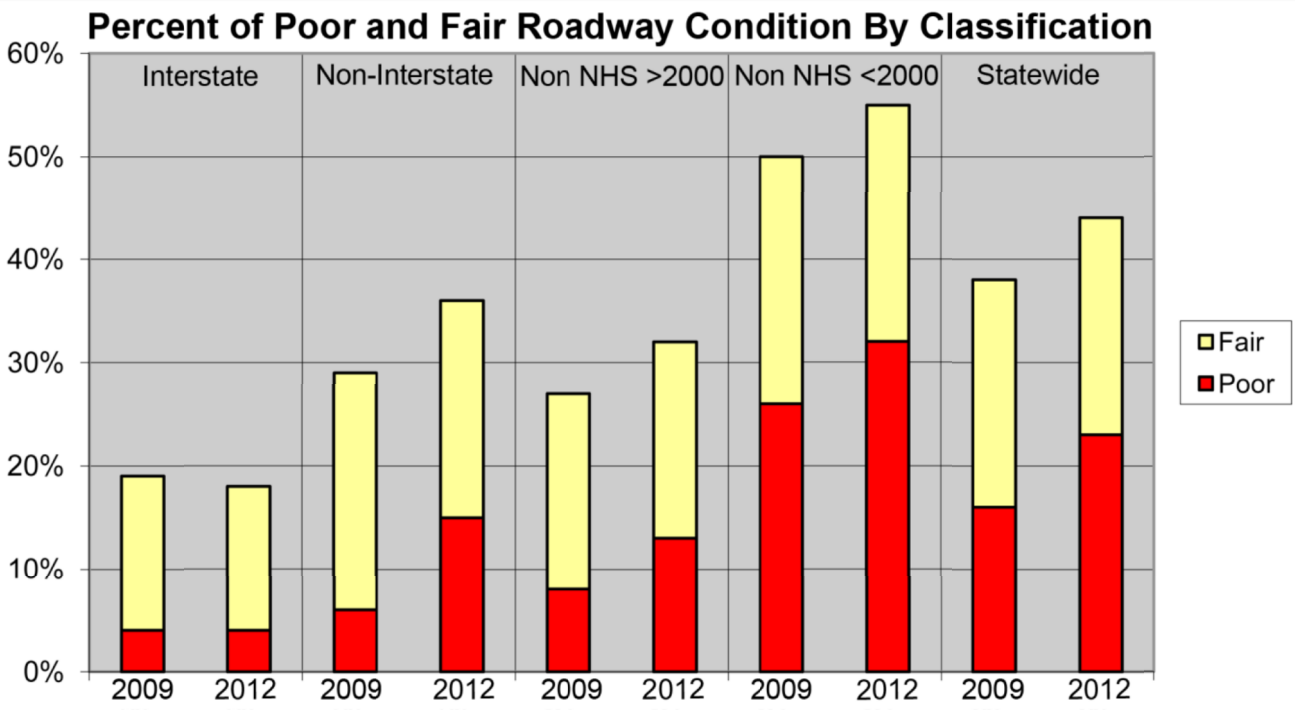


CHART 1

(Condition data from PennDOT Bureau of Maintenance and Operations)

NHS – National Highway System

>2000 or <2000 Average Daily Traffic (ADT) in vehicles/day

The 79,000 miles of roadway in Pennsylvania owned by local governments and other non-state entities are not rated by PennDOT for condition, but it is reasonable to assume they would be in equal or worse condition. This means an additional 18,000 miles of non-state owned roadway would also be rated as Poor for a total of 27,500 miles of poor roadway (virtually a trip around the world). Unfortunately, the total of roadway mileage rated Poor in Pennsylvania equals the total roadway mileage in Maryland and is greater than the total mileage of nine other states.

Over the prior decade (2000 – 2009), the condition discrepancy between the national average and Pennsylvania's roads had been reduced, even considering that Pennsylvania has some of the oldest highways in the nation. Since then, pavement condition has begun to worsen again, with the 2012 overall average condition rating equal to what it was in 2005. Pennsylvania has as many roadway miles as any state that experiences severe winters. Pavements are susceptible to cracking and expanding due to the temperature and weather changes (freeze/thaw cycles). Also, the chemicals used during snowy/icy conditions, while critical for safe travel, contribute to the decreased life of a pavement when compared to more temperate states.

One key to a successful roadway infrastructure program is to have sufficient funds to support roadway construction, maintenance, rehabilitation and emergency situations. PennDOT has shifted its focus to bridge replacement and rehabilitation, mainly to

address similar deteriorating conditions and critical needs in that area. This shift has taken funding away from roadway maintenance and its "Maintenance First" philosophy, drastically cutting the construction of new roadway miles to nearly nothing. The financial limitations have created a challenge to providing accessibility for roadway users while maintaining roadway structural integrity and safety.

POLICY OPTIONS

Federal funding has a significant impact on Pennsylvania's highway conditions, roadway safety, quality of life and economic development. In 2012, MAP-21 (the Moving Ahead for Progress in the 21st Century Act) was signed into law, and was the first federal highway authorization enacted since 2005. MAP-21 funds highway programs in Pennsylvania at an annual level of $1.6 billion through September 2014. Unfortunately the funding levels of MAP-21 are no different than the earlier funding levels, and MAP-21 will expire in September of 2014. MAP-21 allocates money to the states from the Highway Trust Fund, which is funded by the collection of the federal gas tax that has been stagnant at 18.4 cents per gallon since 1993. These funding levels are inadequate for maintaining and improving Pennsylvania's roadway system. Based on current spending and revenue trends, the U.S. Department of Transportation estimates that the Highway Account of the Highway Trust Fund will encounter a shortfall in August, 2014. To avoid a funding crisis, congress must take action.

However, the majority of funding for roadways and transportation in Pennsylvania comes from the Commonwealth. Funding sources such as the gas (liquid fuels) tax, vehicle registration, license fees, etc., are placed into the Motor License Fund, which is constitutionally protected for highway use only. Together they provide roughly $3.5 billion per year, approximately two-thirds of which is used for highway and bridge projects. The remainder is used mostly to support the State Police (16 percent) and subsidize local roadways (11 percent). The primary source of funding to the Motor License Fund comes from gas taxes which are from three sources: a flat tax of 12 cents per gallon (unchanged since 1987), the Oil Company Franchise Tax of 19.2 cents per gallon (unchanged since 2006), and a 1.1 cent per gallon fee for the Underground Storage Tank Indemnification fund for a total of 32.3 cents per gallon.

Act 88 of 2012, although it provides no funding, creates a legal mechanism to develop Public-Private Transportation Partnerships, which can act as an important tool in solving some of Pennsylvania's transportation needs. The act provides the ability for PennDOT and other public entities to enter into agreements with private partners to design, build, finance, operate, and/or maintain a transportation facility. This will allow PennDOT to leverage the financing power of the private sector to assist in solving Pennsylvania's transportation needs.

In response to the *Transportation Funding Advisory Commission Report* of August 2011, the State Senate passed Senate Bill 1 in June of 2013. This would provide $2.5 billion of the $5.2 billion needed to close the state's transportation funding gap and would phase out Act 44 over 8 years. The bill was passed on a vote of 45 to 5 with overwhelming bipartisan support. Finally, in November 2013, the Pennsylvania House was able to pass its version of the bill, providing $2.3 billion phased in over the next five

years. The Senate approved these revisions, and Act 89 of 2013 was signed into law on November 25, 2013. The funding provided by this Act is expected to help reverse the deterioration of Pennsylvania roadways and pay for new projects to increase capacity and safety improvements.

RECOMMENDATIONS

A new approach to road infrastructure funding is needed, one in which we think of the solution as a long-term investment, not merely a one-time cost. The long-term solution to maintaining and improving Pennsylvania's roads must be comprehensive and should include the following considerations:

- Fewer fatalities;
- Smoother, stronger and longer-lasting pavements;
- Better accommodations for commercial vehicles, including seamless intermodal freight movement;
- Reduced commuting time and congestion; and
- Road users paying for the roads they use

A well-considered and comprehensive transportation solution will position Pennsylvania to maintain a high quality of life for state residents, increase the number of jobs, attract high-tech industries, improve mobility of goods and services through Pennsylvania to support domestic commerce, and be more competitive in the global market.

Specific recommendations supported by the four Pennsylvania sections of the American Society of Civil Engineers are:

- Obtain stable highway funding through innovative programs that are more appropriately tied to economic conditions; Advocate the need for a reauthorized and long-term federal surface transportation program;
- Encourage the use of life-cycle cost analysis principles to evaluate the total cost of projects;
- Encourage the use of cost-benefit analysis principles in evaluating and prioritizing projects before they are undertaken;
- Continue to use PennDOT's Smart Transportation principles in road design;
- Support environmental review streamlining of transportation projects;
- Use creative financing and project delivery strategies to advance the program (such as public-private partnerships and design/build) and deliver projects more efficiently;
- Advocate for additional research and development funding;
- Tolling and/or mileage-based user fees must be considered in the development of revenues for the maintenance and improvement of the surface transportation system.

- A 25 cent per gallon increase in the motor fuels user fee
- The user fee on motor fuels should be indexed to the Consumer Price Index (CPI),
- The creation of a permanent commission to determine the levels at which motor fuel user fees should be set, and when those fees should be increasedUse
- Marcellus Shale extraction fees to help fund roadway improvements.

SOURCES

- PennDOT, *Highway Statistics,* 2012. Available at http://www.dot.state.pa.us/Internet/Bureaus/pdPlanRes.nsf/PlanningAndResearchHomePage?OpenFrameset&Frame=main&src=HomePageHighwayStatistics?readform
- Federal Highway Administration, *Highway Statistics,* 2008. Available at
- http://www.fhwa.dot.gov/policyinformation/statistics/2008/hm10.cfm
- U.S Dept. of Transportation, Research and Innovative Technology Administration, *State Transportation Statistics,* 2012. Available at
- http://gis.rita.dot.gov/StateFacts/StateFacts.aspx?StateName=Pennsylvania
- Pennsylvania State Transportation Advisory Committee, *Transportation Funding Study,* May 2010. Available at
- ftp://ftp.dot.state.pa.us/public/bureaus/Cpdm/TAC/Transportation_Funding_Study_May_2010_Final_Report.pdf
- Texas A&M Transportation Institute, *TTI's 2012 Urban Mobility Report,* December, 2012. Available at
- http://mobility.tamu.edu/ums/report/
- TRIP (A National Transportation Research Group), *Pennsylvania Transportation by the Numbers,* May 2013. Available at
- http://www.tripnet.org/docs/Pennsylvania_TRIP_By_The_Numbers_Report_May_2013.pdf
- PennDOT, *Annual Report*, *2012*. Available at
- ftp://ftp.dot.state.pa.us/public/AnnualReports/2012AnnualReport.pdf
- Governor's Transportation Funding Advisory Commission Report, *Final Report,* August 2011. Available at
- ftp://ftp.dot.state.pa.us/public/pdf/TFAC/TFAC%20Final%20Report%20-%20Spread%20Version.pdf

ASCE POLICY STATEMENTS

- ASCE Policy Statement 276: Integrated Truck and Highway Design (PS 276)
- ASCE Policy Statement 367: Highway Safety (PS 367)
- ASCE Policy Statement 382: Transportation Funding (382)
- ASCE Policy Statement 454: Intelligent Transportation Systems (PS 454)

- ASCE Policy Statement 496: Innovative Financing for Transportation Projects (PS 496)
- ASCE Policy Statement 497: Surface Transportation Research Funding (PS 497)
- ASCE Policy Statement 526: Public Private Partnerships (PS 526)

RAIL

B

Pennsylvania has 57 freight railroads covering 5127 miles across the state, ranking it 4th 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 percent over 2007 levels. Pennsylvania's railroad freight demand continues to exceed current infrastructure. Railroad traffic is steadily returning to near- World War II levels, before highways were built to facilitate widespread movement of goods by truck. Rail projects that could be undertaken to address the Commonwealth's infrastructure needs total more than $280 million. Annual state-of-good-repair track and bridge expenditures for all railroad classes within the Commonwealth are projected to be approximately $560 million. Class I railroads which are the largest railroad companies are poised to cover their own financial needs, while smaller railroads are not affluent enough and some need assistance to continue service to rural areas of the state.

BACKGROUND

A number of benefits result from using rail freight to move goods throughout the U.S. particularly on longer routes: congestion mitigation, air quality improvement, enhancement of transportation safety, reduction of truck traffic on highways, and economic development. Railroads also remain the safest and most cost efficient mode for transporting hazardous materials, coal, industrial raw materials, and large quantities of goods.

Since the mid-1800s, rail transportation has been the centerpiece of industrial production and energy movement. Specifically, in light of the events of September 11, 2001 and from a national security point of view, railroads are one of the best ways to produce a more secure system for transportation of dangerous or hazardous products. For example, the majority of spent nuclear fuel rods will likely be sent via rail to the newly established federal depository, and many of these shipments will pass through the Keystone State. By further improving the rail infrastructure, railroad operation can become even safer and more difficult to disrupt.

CONDITIONS AND CAPACITY

Pennsylvania 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. Class I and mid-sized railroads operating within the Commonwealth's borders are generally able to finance their own capital improvements. In addition to the larger railroads, the regional and short line railroads are the feeders and supporting players in Pennsylvania's overall transportation network. Problems arise with short line railroads, which have difficulty in making infrastructure investments to remain viable and competitive. The network is only as strong as its weakest link.

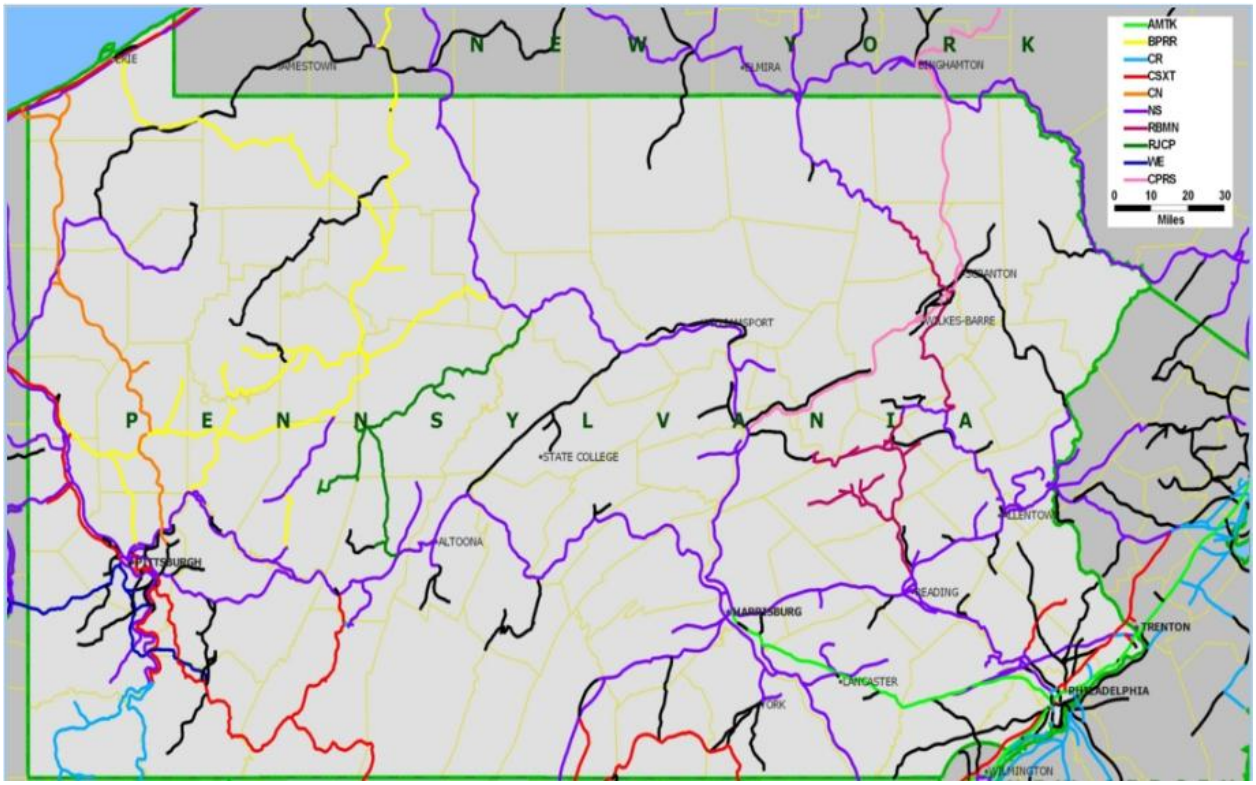
Pennsylvania has approximately 5,145 route-miles of freight railroad operated, and sixty-five freight railroads, more than any other state. They are summarized as follows:

- Four Class I Railroads: CSX, Norfolk Southern, Canadian Pacific (CP Rail), and Bessemer and Lake Erie Railroad Company (owned by Canadian National (CN))
- 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.

Pennsylvania has the 5th largest rail system in the United States. Philadelphia, as the largest city in the Commonwealth, is the only major city on the East Coast to have connectivity to three Class I railroads. Railroads are a vital component of the Commonwealth's transportation system and very important to the state's economy. Commodities coming into and going out of Pennsylvania by rail are dominated by coal and intermodal freight. Coal is 69 percent of the total tons originating in Pennsylvania and 35 percent of terminating tons. Other important commodities include primary metal products, petroleum, chemicals, and food products.

Pennsylvania's core or strategic rail lines include some of the highest volume routes in the nation, such as the Norfolk Southern (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 very 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; Norfolk Southern's Reading-Bethlehem-Easton-New Jersey line, 100 MGT; Norfolk Southern's Hagerstown, MD-Harrisburg line; and CSX's line from Chester to Yardley. Another important trunk line is Amtrak's Northeast Corridor, a portion of which passes through southeastern Pennsylvania, including Philadelphia. Some freight is moved on this predominantly passenger rail corridor. It should be noted that Pennsylvania is dominated by rail traffic moving through the state; more than half (approximately 57 percent) of all freight tons do not originate or terminate in the Commonwealth. See map below that illustrates all the freight rail lines that run through Pennsylvania.

Freight Rail Lines in Pennsylvania



Source: Federal Railroad Administration, 2006

At the other end of the spectrum, there are a number of rail lines in Pennsylvania considered at risk because of low traffic density (1). This means that these low traffic density lines may be abandoned because traffic revenue may not be sufficient to maintain the line. The rail lines at this end of the spectrum are normally the objects of publicly-funded rail preservation efforts when it is deemed that the rail line is capable of growth and development and where continuation of rail service provides public benefits. With annual traffic less than five MGT, 124 Pennsylvania rail lines are considered somewhat at risk of abandonment. Of these 124 lines, 96 rail lines are considered especially at risk because they carry annual traffic of less than one MGT.

Extrapolation of trends which characterize highway traffic over the past twenty-five years indicates an alarming increase of vehicle miles traveled, at a rate of four times population growth. In 2007, 201.6 million tons of freight and 4.2 million carloads passed through the Commonwealth. In 2035, that number is expected to be 246 million tons and 6.3 million respectively. The Pennsylvania Rail Network accounts for 10 percent of all freight tonnage and 13 percent of all carloads in the United States. Over the twenty-five year period spanning 2010-2035:

- State rail volume is expected to grow 1.2 percent annually
- State through rail freight is expected to grow 1.5 percent annually.

- State intermodal freight rail volume is expected to grow 1.8 percent annually.

Indicators of the health of the Commonwealth's existing rail freight infrastructure are as follows:

- **Physical infrastructure and bridge needs:** Approximately 60 percent of the short line and regional railroad physical infrastructure is in need of extensive rehabilitation, including 170 bridges. Bridge repairs are anticipated to be greater than $ 1 million apiece.
- **Choke points:** There are some forty-five rail traffic choke points throughout the state. Most notable of locations needing capacity improvements include Norfolk Southern's Port Perry Branch and its Lemoyne Connector (linking NS's Lurgan Branch with its Port Road / Enola Branch at Lemoyne on the west bank of the Susquehanna River near Harrisburg).
- **Ability to handle heavy loads:** 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 (286K) pound loads on only 70 percent of their infrastructure. In contrast, almost all new freight rail cars being manufactured today, outside of cars being manufactured for use in the transport of Powder River Basin (Wyoming) coal, many of which are the latest generation 315,000 pound capacity rail cars, are 286K capable.
- **Derailments:** Over the period from 2001 to 2005, there was an annual average of 80.4 derailments in Pennsylvania. In 2005, total derailments in the state were down 30.3 percent over the previous year (2004). It is estimated that more than 540,000 carloads of hazardous materials cross Pennsylvania's rail system each year.

KEY FREIGHT CORRIDOR STATUS

Central Corridor

The Central Corridor is the largest corridor in the state. It is operated by Norfolk Southern (NS) and extends the length of Pennsylvania, beginning at the western border near Midland and crossing east to Reading, where it splits northeast to Easton in the I-78 highway corridor and southeast to Philadelphia. There are four Norfolk Southern (NS) intermodal terminals on the corridor: Pittsburgh, Harrisburg, Bethlehem, and Morrisville. This corridor is double-stack cleared and 286K compliant.

Erie Corridor

The Erie Corridor consists of parallel mainline tracks operated by NS and CSX along Lake Erie in northwestern Pennsylvania for approximately 95 miles. This corridor is double-stack cleared and 286K compliant.

I-95 Corridor

The I-95 corridor, in southeastern Pennsylvania, contains the CSX mainline and parallels I-95 at Chester north through Philadelphia to the New Jersey/ Pennsylvania border at Yardley. The corridor contains the CSX intermodal terminal in South Philadelphia. While portions of the I-95 Corridor have been cleared for double-stack trains, sections of track have not, which causes the entire corridor to restrict regional transport. The main track in the corridor is 286K compliant, while feeder lines are not.

Southwest Corridor

This corridor, operated by CSX, crosses the southwestern portion of the state beginning at the Pennsylvania/Maryland border near Cumberland, Maryland, north through Pittsburgh to the Ohio border near New Castle. The Southwest Corridor is part of CSX's National Gateway Program to create an efficient rail route linking Mid-Atlantic ports to Midwestern markets. The corridor is 286K compliant but is not double-stack cleared. The corridor is also in need of additional intermodal yard capacity.

I-81 Corridor

This corridor, operated by NS, parallels I-81 in central Pennsylvania from the Pennsylvania/Maryland border near Hagerstown, Maryland, to Harrisburg. The NS Rutherford intermodal terminal in Harrisburg is on the I-81 corridor and is a part of the NS Crescent Corridor initiative. This corridor is double-stack cleared and 286K compliant. However, the corridor is in need of additional intermodal yard capacity, and track upgrades and speed improvements are needed.

Harrisburg-Binghamton Corridor

This corridor extends north from Harrisburg along the Susquehanna River to Scranton and turns north to Binghamton, New York. The Canadian Pacific Railway (CP Rail) has trackage rights between Harrisburg and Sunbury over NS tracks and operates on its own tracks between Sunbury and Binghamton. This corridor is double-stack cleared and 286K compliant. Track upgrades and speed improvements are needed.

National Gateway Project

The National Gateway project is an $850 million public-private partnership (P3) that will upgrade tracks, equipment, and facilities, and provide double-stack intermodal clearance. Specifically in PA, the state provided $35M in investment in 17 clearance projects in southwest PA. One of the 17 projects includes the J&L Tunnel project, located in Pittsburgh. This project will provide vertical clearance along the CSX rail lines through the Tunnel to allow trains carrying double-stack containers. In October of 2012, the project reached the midway point of the National Gateway Project Phase One.

After the completion of the J&L Tunnel, which will improve the access to the intermodal freight shipping options, there will be decrease in cost of doing business in and around the Pittsburgh region, and there will be a decrease of pressure on the regional highways. The J & L Tunnel is a very large part of the first phase of the National Gateway Project, and when it is finished it will help not only Pittsburgh freight traffic, but also freight movement throughout Pennsylvania.

CSX is exploring ways that the National Gateway Project can connect the ports in Virginia and North Carolina with manufacturing centers in the Midwest. The Project is a $700 million P3 that will upgrade tracks, equipment, and facilities, and provide double-stack intermodal clearance. CSX estimates it will provide more than $650 million in public benefits to Pennsylvania by:

- Reducing CO2 emissions by 250,000 tons;
- Expanding rail market access potential for the state;
- Enhancing rail transportation infrastructure, including new intermodal terminals in Chambersburg and Pittsburgh;
- Reducing the state's highway congestion by shifting freight from nearly one million trucks to rail, saving more than $40 million in highway maintenance costs; and
- Saving $35 million in logistics costs for the state.

Crescent Corridor

Norfolk Southern is focused on the development of its Crescent Corridor, stretching from the Northeast to New Orleans. The Corridor will include a series of infrastructure improvements which include straightening curves, adding passing tracks, improving signal systems, and building new terminals. Norfolk Southern estimates that the annual benefits to Pennsylvania from the Corridor will include:

- 700,000 long-haul trucks diverted to rail,
- 10 million gallons of fuel saved,
- Carbon dioxide reduction of 110,000 tons,
- More than $9 million in traffic congestion savings,
- Avoidance of an estimated $8.5 million in accident costs
- 26,000 jobs created or enhanced over the next 10 years.

In Pennsylvania there has been $65M invested, $45M in Franklin CO. and $20M in Harrisburg. One specific project is Norfolk Southern's major coal line through Pennsylvania's Monongahela Valley has received $22.6 million in improvements. The "Mon Line" moves millions of tons of coal to many electric utility plants and east coast export terminals. Because of such high use and the critical need for this line, work had

to be completed to keep the line safe and to make sure the rail line would be able to serve its customers efficiently.

The work that was completed along this 85-mile line includes:

- 26,904 ties
- 75,000 tons of ballast
- 13 miles of new rail
- Resurfaced 110 miles of rail
- Added 961 new bridge ties
- Replaced 22 culverts
- Cleaned and upgraded 40 road crossings
- Replaced a retaining wall
- Replaced a 140 foot timber bridge with a ballast deck structure
- Installed of new signals

As part of this project in Pennsylvania, Norfolk Southern's plans include:

- $95 million for a new intermodal facility in Franklin County, near Chambersburg,
- $52 million in improvements to its existing Harrisburg intermodal terminal, and
- $27 million in track and signal upgrades in Berks, Chester, Cumberland, Dauphin, Franklin, Lebanon, Lehigh, Montgomery and Northampton Counties

Rail and Natural Gas

Pennsylvania's short-line rail has allowed for efficient movement of supplies needed for drilling the Marcellus Shale. These supplies include frack sand (70% to 75% of which is transported by rail), pipe, machinery, and a variety of chemicals that are used in the hydrofracking of the Marcellus Shale. Because there is such high use of rail in this industry, railroads have been buying special freight cars that e specifically designed to move frack sand. For example, CSX has purchased about 900 cube hoppers that are used for this purpose. With the vast use of rail in this industry, railroads are investing in their infrastructure to support the heavy loads. Natural gas drilling has resulted in tremendous growth in the freight rail industry, which has led rail companies to continue to invest in their infrastructure.

FUNDING AND FUTURE NEEDS

The Pennsylvania Department of Transportation (PennDOT) has funded rail freight infrastructure by means of the Rail Freight Assistance Program (RFAP) Capital Budget

Grants for doublestack projects (freight containers that are stack two high on rail cars) and clearance projects. The doublestack projects were completed and funded between 1991 and 1996. RFAP was created by the Commonwealth's Rail Freight Preservation and Improvement Act of 1984, No. 119, which provides funds to preserve essential rail freight service and stimulate employment through generation of new or expanded rail freight service. Capital Budget Grants have also been funded annually to help pay for freight infrastructure improvements. Act 89 of 2013 has provided PennDOT with a consistent funding source for future RFAP projects. Fiscal year 2013 authorized $8M, with an increase to $10M in fiscal year 2014 and beyond. Capital Budget funding has remained consistent at $30M in 2012 and 2013. In 2011 XXXX(who added the funding??) added a recurring authorization of $1M each year from the collection of Marcellus Shale drilling impact fees. Funds provided by the Act are reinvested in rail freight projects in the Marcellus Shale regions of the commonwealth.

PennDOT also established the Pennsylvania Infrastructure Bank (PIB) for rail freight projects and provided $500,000 in initial seed capital to kick-start a program that provides low-interest loans to railroads and shippers for their use on railroad infrastructure projects. The PennDOT Freight Bureau periodically adds funds to PIB. Also, the bank does slowly grow its funding because when payments are made with interest they are able to provide a new loan with their slightly increased funds.

PennDOT is beginning to utilize other funding programs to complement their RFAP and capital budget programs. These include the Congestion Mitigation Air Quality (CMAQ), TIGER funding and various grants through the FRA. Additionally, Pennsylvania's Department of Community and Economic Development (PADCED) administers several economic development loan and grant programs that assist rail infrastructure expansions, including the Infrastructure and Facilities Improvement Program, the Tax Increment Financing Guarantee Program, the Business in Our Sites Program, and the Infrastructure Development Program.

As of the passing of a recent Capital Budget Act by the Pennsylvania Legislature (Act 40), statewide rail freight industry infrastructure need, as measured by projects contained in that legislation, totaled $15 million in 2009 State Capital Budget dollars requested. In another study, annual track and bridge expenditures for all railroad classes within the state are projected to be approximately $136 million. As stated earlier, the larger railroads are more able to cover their financial needs. Smaller railroads are not as affluent and need the most assistance. Clearly, increased state funding would be most helpful and a sound investment.

Much success has and can be accomplished with public-private innovative financing for maintenance and improvement of rail infrastructure. Following are some examples.

1. The Philadelphia Regional Port Authority (PRPA) received a large grant from the PennDOT Rail Freight Assistance Program for major improvements at Tioga Marine Terminal. Of the total project cost of $475,000, PRPA's grant was $332,500 or 30 percent. The rail improvements will allow larger and heavier rail cars to enter the facility and provide better at-grade crossings.

2. In November 2010, $32.5 million was announced would be invested in rail freight. This large investment will go toward upgrading infrastructure and adding capacity of rail freight across the state as well as creating up to 2,500 jobs in 28 counties.
3. In February 2012, through the Capital Budget/Transportation Assistance Program, $23 million in grants would help support 16 rail projects throughout the state. Most (if not all) of the 16 projects encompass the rehabilitation of infrastructure, which include rail track, bridges, and facilities improvements.
4. In 2012, the Pennsylvania State Transportation Commission approved almost $18.6 million in grants for 24 rail projects across the state. With Pennsylvania having the highest number of short line railroads in the country, this large sum of grant money will help rehabilitate rail infrastructure throughout the state. The projects include rail track rehabilitation, rail bridge replacement, and terminal expansion. Similarly, in 2013, the state approved $25.8 million in grants for freight rail.

Use of public funds to leverage private funding thought a public-private partnership (P3) is one method of financing where there are both public and private benefits. Pennsylvania's Conrail double-stack project of the 1990s is a prime example, in which the state funded $35.8 million of the $100 million project. Other Pennsylvania projects now under consideration or which have been recently completed, include:

1. A $30 million public/private initiative to improve 16 bridges in southeastern Pennsylvania to accommodate double-stack trains was announced in November 2009 with CSX.
2. $11 million has been committed by Pennsylvania and Norfolk Southern to the railroad's Philadelphia Navy Yard Intermodal Facility. The investment of $5 million by the state and $6 million by Norfolk Southern will expand track and parking, nearly doubling the size of the rail yard. The investment is part of Norfolk Southern's multistate Crescent Corridor Initiative is aimed at establishing a high-speed intermodal rail-freight route between the Gulf Coast and the Northeast.

   The state's $5 million investment is part of a $45 million commitment made by the Commonwealth in August 2009, which will be allocated over three years and will be matched with $79 million by Norfolk Southern and an anticipated $61 million in federal support. Pennsylvania partnered with Norfolk Southern and four other states in September to apply for $300 million in American Recovery and Reinvestment Act (ARRA) funds for the Crescent Corridor.
3. Two Beaver County projects that received grants show how the program helps to preserve existing rail service and ensures the retention of industries and jobs in the community. Aliquippa and Ohio Railroad will use its $357,000 grant to rehabilitate the seven-mile railroad on the former LTV Steel site outside Aliquippa to provide service to existing and new customers who are experiencing increased cargo volume. One of these new customers is Wolfpac Technologies, a manufacturer of extruded plastic products, which is receiving a grant of $82,527 to rehabilitate a rail siding to service its new facility.

4. In addition to grants that preserve existing service, many grants help establish new or expand existing rail freight service. In Huntingdon County, for example, New Enterprise Stone and Lime will receive $537,000 to reinstate rail service and expand rail infrastructure to increase aggregate shipments from its Union Furnace Quarry.
5. Another grant recipient is Kinder Morgan, the operator of the port at the Keystone Industrial Port Complex along the Delaware River in Bucks County. A $700,000 grant will be used to replace and repair existing track and for the relocation and new construction of an outbound train loading yard. The upgrades will ease the movement of cargo from ships to freight rail cars.

The following table summarizes the benefits of rail freight assistance.

Rail Freight Assistance Benefits 2008-2014

Fiscal Year	Grant Type	State Investment	Total Project Cost	Number of Projects Funded	Jobs Created	Trucks Removed
2012	RFAP	$6,122,099.00	$8,745,855.00	18	440	124796
2012	CB	$44,430,080.00	$63,471,542.00	21	2165	854136
2012	Act 13	$523,000.00	$747,143.00	1	0	6251
Total		**$51,075,179.00**	**$72,964,540.00**	**40**	**2605**	**985183**
2013	RFAP	$5,871,022.00	$8,440,895.00	15	848	64272
2013	CB	$27,442,141.00	$39,203,059.00	14	3615	138232
2013	Act 13	$1,307,000.00	$1,867,143.00	4	197	18604
Total		**$34,620,163.00**	**$49,511,097.00**	**33**	**4660**	**221108**

Key: **RFAP** = PA State Rail Freight Assistance Program

Capital Budget (CB) – Portion specifically for Rail Freight

A widely held and strongly felt opinion, recorded in a recent survey of Pennsylvania's Metropolitan Planning Organizations (MPOs) and public rail authorities, resulted in a finding that there is widespread approval of Pennsylvania's funding of rail freight programs and that more RFAP and Capital Budget funding is required. Also, most states regularly look to Pennsylvania as a leader with respect to rail freight government support and regularly seek its advice.

POLICY OPTIONS

Solutions that would ease the increasing demands on Pennsylvania's heavy rail transportation system and improve freight conditions, capacity, and safety are multi-faceted. The four Pennsylvania sections of the American Society of Civil Engineers (ASCE) urge the legislature to:

Continue its model of excellence. The Commonwealth must continue to build on its excellent model, increase transportation investment at all levels of government, and make use of the latest technology.

Support multi-modal transportation. Cities and communities should not be short-sighted concerning freight planning and should also look at statewide planning and connectivity to maximize their own intermodal options. Freight planning in the Commonwealth should include consideration of all transportation modes and should be developed as an outgrowth of the new Mobility Plan.

Link planning efforts. The Commonwealth's freight planning effort should dovetail with both the new National Freight Plan and the freight plans of Pennsylvania's neighbor states (New Jersey, New York, Ohio, Maryland, Delaware, Virginia, and West Virginia).

Recognize the connection between railroads and highways. There also needs to be awareness at the national and state levels that diverting freight movements from our highways can best be accomplished by expanding the rail infrastructure and by mitigating or eliminating existing choke points. Government entities must be able to accept the rationale that allocating more public funds will help reduce this pressure on the highway side.

RECOMMENDATIONS

The four ASCE sections in Pennsylvania recommend the following:

- Provide additional state and national rail funding to meet current needs. This includes being able to fund larger projects that can be supported over multiple contract years.
- Upgrade small railroads to 286,000-pound railcar capability where merited.
- Promote more double-stack intermodal clearance projects where required.
- Support freight movement projects facilitating intermodal growth such as transfer facilities.
- Mitigate existing congested areas to improve capacity.
- Support innovative, public-private financing agreements for freight projects.
- Help to preserve Rights-of-Way wherever possible and not allow rail property to be sold for non-commerce use.
- Inventory and aggressively market freight connections in land packages to prospective business owners looking to bring business to Pennsylvania.

- Facilitate the use of freight trackage to support passenger rail use where practical.
- Continue to advance the efforts to promote freight planning at the local/MPO level and, thereby, continue to improve coordination between local levels and the State planning agency, and add to the noteworthy inroads that have already been made in freight planning at many of Pennsylvania's MPOs/RPOs.
- 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.

SOURCES

- American Short Line and Regional Railroad Association. *Short Line Infrastructure Funding; We Aren't Chicken Waste:* November 2001. Available at: http://www.aslrra.org/news___publications/views___news/results.cfm?articleid=778
- Hauser, Edd, P.E., PhD Professor and Director, Center for Transportation Policy Studies, University of North Carolina, Charlotte. *Summary of Freight Planning and Policies – Selected States*; Prepared For The North Carolina Forum On Freight Mobility And Economic Prosperity: June 21, 2004.
- National Gateway, *Projects in Pennsylvania, J&L Tunnel*. Available at: http://www.nationalgateway.org/projects/project/36
- Pennsylvania Department of Transportation (PennDOT), Bureau of Rail Freight, Ports and Waterways. Available at: http://www.dot.state.pa.us/Internet/Bureaus/pdBRF.nsf/RailFreightHomepage?OpenFrameset
- Pennsylvania Department of Transportation (PennDOT), Executive Summary by R.L. Banks & Associates, Inc., Washington, D.C. and Linare Consulting Pittsburgh, *Comprehensive Rail Freight Study and 2003 Pennsylvania State Rail Plan*: June 16, 2003. Available at: http://www.dot.state.pa.us/Internet/Bureaus/pdBRF.nsf/Comprehensive%20Rail%20Freight%20Study?OpenForm
- Pennsylvania Department of Transportation (PennDOT), *Governor Rendell Announces $32.5 Million Rail Freight Investment to Boost Economy, Create Jobs in 28 Counties*, November 2010. Available at: http://www.dot.state.pa.us/penndot/districts/district11.nsf/7580f0e72f1809df852570a70047899b/f66ca7f61bf3ffd58525783f00618e3a?OpenDocument
- Pennsylvania Department of Transportation (PennDOT), *Pennsylvania Intercity Passenger and Rail Freight Plan*: February 2010. Available at: http://www.dot.state.pa.us/Internet/Bureaus/pdBRF.nsf/RailFreightHomepage?OpenFrameSet&frame=main&src=RailPlan2035?OpenForm
- Progressive Railroading, *Pennsylvania provides $23 million in grants for 16 freight-rail projects*, February 2012. Available at:

http://www.progressiverailroading.com/short_lines_regionals/news/Pennsylvania-provides-23-million-in-grants-for-16-freightrail-projects--30044

ASCE POLICY STATEMENTS

- ASCE Policy Statement 149: Intermodal Transportation Systems (PS 149)
- ASCE Policy Statement 496: Innovative Financing for Transportation Projects (PS 496)
- ASCE Policy Statement 521: Rail Infrastructure Investment (PS 521)
- ASCE Policy Statement 532: National Infrastructure Bank (PS 532)

PORTS

C+

Nearly one-third of America's Gross Domestic Product (the monetary value of all the finished goods and services produced within a country's borders) is derived from international trade, and 99 percent of that trade passes through the nation's ports. Thirty million jobs are related to international trade, and $200 billion in federal, state, and local tax revenue is generated by our ports each year. Transportation accounts for as much as ten percent of the total product cost for the food, clothing, and other goods we buy on a daily basis. The ports on the Delaware and Schuylkill Rivers handled 87 million tons of cargo in 2011 (the most recent available data), comprising 26.3 percent of the North Atlantic ports' market share. Most of the gasoline Pennsylvanians put in their cars, the food they eat and the clothes they wear passed through the port facilities on the Delaware River. The grade of C+ reflects the facts that 1) while the U.S. Army Corps of Engineers (USACE), Philadelphia District has been able to maintain (through dredging) the federal channels close to their authorized dimensions, there is not a stable funding stream and there is a shortage of confined dredged material disposal facilities on some portions of the channels and 2) the Delaware River Main Channel Deepening project, which will increase the river's channel depth from the existing 40 feet to 45 feet, from Philadelphia to the mouth of Delaware Bay, is only approximately 50 percent complete and does not have a stable funding stream for its completion. Extension of the current 2017 completion date for the Deepening project as a result of insufficient funding would delay the ability of the ports on the Delaware River to take advantage of the ongoing Panama Canal expansion which will allow the Port of Philadelphia to be competitive with other ports for oceangoing cargo.

BACKGROUND

This section of the report focuses on the Ports of the Delaware River and its tributaries in Pennsylvania. Inland Navigation, including the Port of Pittsburgh is addressed in a separate section ("Inland Waterways") of the 2014 Report Card on Pennsylvania's Infrastructure.

The Philadelphia District of the USACE maintains a 40-foot deep navigation channel in the Delaware River that extends from Fairless Hills, PA (just south of Trenton,NJ), to the mouth of the Delaware Bay. The upper portion of the navigation channel, the Philadelphia to Trenton Project, extends south from the Fairless Terminal and turning basin at the Port of Bucks County 23.1 miles downstream to Allegheny Avenue in Philadelphia. The lower portion of the project, the Philadelphia to the Sea Project, extends 96.5 miles south from Allegheny Avenue in Philadelphia to deep water in Delaware Bay. The Schuylkill River navigation project extends upstream 6.5 miles from its confluence with the Delaware River, to approximately Christian Street in Philadelphia. These channels serve three states—Pennsylvania, New Jersey and Delaware—and tie into other navigable waterways such as the Chesapeake and

Delaware Canal and the Christina River in Delaware, and the Salem River in New Jersey.

These federal navigation channels service numerous public and private port facilities, including the Port of Bucks County in Fairless, PA; the Tioga Marine Terminal, Packer Avenue Marine Terminal and numerous other piers owned by the Philadelphia Regional Port Authority (PRPA) in Philadelphia; the Broadway and Beckett Street Terminals owned by the South Jersey Port Corporation (SJPC) in Camden, NJ; petroleum terminals including Sunoco Logistics and Philadelphia Energy Solutions in Philadelphia, Marcus Hook, PA and West Deptford Township, NJ; Delta/Monroe Energy terminal in Trainer, PA; PBF petroleum terminals in Paulsboro, NJ and Delaware City, DE; the Port of Wilmington, DE; the Port of Salem, NJ; and Aker Shipbuilding Corporation in Philadelphia.

The publicly and privately owned port facilities are serviced by a comprehensive multi-modal transportation system. Highways including I-95, I-295, I-676, I-476 and the New Jersey Turnpike are easily accessible and provide convenient routes for the distribution of goods. In addition, the port complex is served by two major rail carriers, Norfolk Southern and CSX, and a number of short line systems.

Currently, SJPC is constructing a new port facility in Paulsboro, NJ. This facility, the Port of Paulsboro, will increase the port complex's capacity for the shipment of goods by water. Also, in anticipation of the completion of the deepening of the Delaware River channel to 45 feet (see Delaware River Deepening Project below), PRPA has developed a preliminary design and obtained state and federal approvals for the proposed Southport Marine Terminal in Philadelphia. This facility would greatly increase the port's capacity for containerized cargo, which is anticipated as a result of the expansion of the Panama Canal and the deepening of the Delaware River.

The combined ports of Philadelphia, Camden, NJ, and Wilmington, DE, comprise the second largest deep water port complex on the East Coast of the United States in terms of waterborne cargo tonnage. The facilities at these ports handled 87 million tons of cargo in 2011 (the most recent available data) comprising 26.3 percent of the North Atlantic ports' market share. The cargo shipped through the ports include crude oil and petroleum products, other liquid bulk cargoes, fruit, steel, frozen meat, paper products, cocoa, automobiles and sugar, with other commodities transported via bulk, break-bulk or container. Most of the gasoline Pennsylvanians put in their cars, the food they eat and the clothes they wear passed through the port facilities on the Delaware River.

CONDITION AND CAPACTIY

Delaware River - Philadelphia to Trenton

The Fairless Turning Basin, near the upstream terminus of the project, was deepened from 37 feet to 40 feet in 2011, which enabled ships calling at the facilities at the Port of Bucks to fully utilize the 40 foot depth of the federal channel. While funding for maintenance of the project channel has historically been less than required to maintain project dimensions, supplemental funding as a result of Tropical Storms Irene and Lee and Hurricane Sandy have resulted in dredging of the most significant shoals in the

channel for full use of the 40 foot project depth. Stable future funding is not guaranteed, and adequate Confined Disposal Facilities (CDFs) need to be provided by the local sponsors, Pennsylvania and New Jersey, for project maintenance. Currently Pennsylvania provides adequate CDFs for the maintenance of the upper reaches of the project, but adequate CDFs are not available for future maintenance of the lower reaches. The USACE is currently working with the State of New Jersey to secure CDFs in the lower reaches to provide adequate disposal capacity for long-term maintenance of the project.

Delaware River – Philadelphia to the Sea

The Delaware River – Philadelphia to the Sea project annually receives adequate funding (approximately $20 million) to maintain the project to its 40 foot authorized depth via contract dredges and the Corps' Hopper Dredge *McFarland* and to maintain the project's CDFs. The USACE has adequate capacity in these CDFs adjacent to the Delaware River and a subaqueous disposal area in Delaware Bay to maintain the project over the next 20 years.

Delaware River Deepening Project

This project to deepen the existing 40 foot federal navigation channel to 45 feet from Beckett Street Terminal in Camden, NJ 102.5 miles to the mouth of Delaware Bay was authorized by the Water Resources Development Act of 1992. The non-federal sponsor is PRPA.

After decades of study, debate, and lawsuits, the project began construction in March 2010 with the dredging of Reach C, a 12-mile stretch of the river downstream from the Delaware Memorial Bridge. This initial contract, which removed 3.6 million cubic yards of material, was completed in September 2010. Subsequent contracts have dredged an additional 29 miles of channel, removing approximately 3.6 million cubic yards of material.

To date approximately 50 percent of the areas that require deepening (portions of the project are already at or below 45 ft) have been addressed. A contract to deepen Lower Reach A, an approximate one-mile section of the channel in the vicinity of Essington, PA was awarded in January 2014. The deeper channel will provide for more efficient transportation of containerized, dry bulk (steel and slag), and liquid bulk (crude oil and petroleum products) cargo to and from the Delaware River ports, with estimated net annualized benefits of more than $13 million to the U.S. economy. It will also reduce the need for "lightering" of larger ships at the mouth of the Delaware Bay (transferring some cargo to barges or other ships) which is currently required to allow them to traverse the 40-foot channel. This operation is costly and inefficient and puts the Delaware River port facilities at a competitive disadvantage. Once the project is completed (target date for project completion is 2017), it will be able to take advantage of the benefits of the Panama Canal expansion currently scheduled for 2015.

To fully take advantage of the 45 foot channel and the Panama Canal expansion, numerous infrastructure upgrades to the existing terminal facilities will need to take

place. Necessary upgrades would include the dredging of the berthing areas to 45 feet, structural improvements to piers (some of which date back to the late 1800's or early 1900's) to accommodate the 45 foot depth of the berth and larger, heavier vessels, larger cranes for use on the larger, wider vessels, upgrades to the crane rails to increase their capacity, upgrades to the bollards and fendering systems, and upgrades to the terminals to allow for operational efficiencies and greater throughput. Funding for these upgrades is the responsibility of each facility owner/operator.

Schuylkill River

The project provides for a channel which extends 6.5 miles upstream from its intersection with the Delaware River-Philadelphia to the Sea project, with depths of 22 feet, 26 feet and 33 feet. As a result of decreased use of the upper portions of the channel for commercial navigation, currently only the 33 foot section of the lower Schuylkill River navigation project is maintained. While the project has adequate dredged material disposal capacity at its Fort Mifflin CDF, the project does not receive funding every year, which can result in shoaling, which in turn reduces the drafts of ships utilizing the channel.

FUNDING

The USACE, Philadelphia District navigation budgets over the last five years for projects on the Delaware and Schuylkill Rivers are included in Table 1. President Obama's Fiscal Year (FY) 2014 budget includes $20 million in Construction General Funds for continuation of the Delaware River Main Channel Deepening Project, and Operation and Maintenance funds totaling $19.7 million for the Delaware River – Philadelphia to the Sea Project and $4.7 million for the Philadelphia to Trenton Project.

Table 1. USACE Philadelphia District Budget Information

Corps of Engineers Work Plan Budgets ($ millions)					
	2010	2011	2012	2013	2014 (proposed)
Construction					
Delaware River Deepening	4.844	0.0	16.864	41.916	20.000
Operation & Maintenance					
Del River Philadelphia to the Sea	18.440	20.020	20.779	21.246	19.745
Del River Philadelphia to Trenton	0.771	0.820	1.683	0.820	4.735
Schuylkill River	0.188	0.250	0.243	0.089	0.0

POLICY OPTIONS

The Harbor Maintenance Trust Fund (HMTF) was established by the Water Resources Development Act of 1986 to fund the operation and maintenance of ports and harbors and is funded by the Harbor Maintenance Tax (HMT). The HMT is a federal tax imposed on shippers based on the value of the goods being imported into our ports. The tax is placed in the HMTF to be used by the USACE for maintenance dredging of federal channels and maintenance of dredged material disposal areas. HMT revenues are approximately $1.6 billion per year, with expenditures averaging $850-900 million per year. The resulting HMTF surplus was approximately $7 billion at the end of FY12 and continues to grow by hundreds of millions of dollars each year. The low appropriations have resulted in a system in which channels are not being maintained to their constructed depths and widths despite adequate taxes being collected. This can result in safety risks of ship groundings and cargo spills and economic risks of light-loading ships, which increase transportation costs, impacting the competitiveness of U.S. exports in the global marketplace and the cost of imported goods to U.S. consumers and manufacturers.

This problem was highlighted in the American Society of Civil Engineers (ASCE) report issued in the fall of 2012 entitled "Failure To Act: The Economic Impact of Current Investment Trends in Airport, Inland Waterways and Marine Ports Infrastructure." This report concluded that aging infrastructure for marine ports, inland waterways, and airports threatens more than one million U.S. jobs. ASCE's 2013 Report Card for America's Infrastructure rated Port infrastructure a 'C', which represents the averaging of the generally good state of infrastructure at port facilities with the inadequate condition of navigation channels and land-side connections due to federal underinvestment.

The logical vehicle to modify how the HMTF distributes the funds raised by the HMT is the pending Water Resources Development Act (WRDA), which is named the Water Resources Reform and Development Act (WRRDA) in the current House bill. The Senate passed WRDA 2013 (S 601) on May 15, 2013. It includes language for changing the scope of the HMTF to provide additional funding for maintenance of federal navigation projects. The language in the Senate bill would (1) require that funding be made available to USACE budgets at a level not less than the level of receipts plus interest credited to the HMTF for each fiscal year by 2020; 2) ensure that revenues collected into the HMTF are used for the intended purposes of those revenues; 3) increase investment in the operation and maintenance of U.S. ports, which are critical for the economic competitiveness of our country; 4) ensure U.S. ports are prepared to meet modern shipping needs, including the capability to receive large ships that require deeper drafts; and 5) prevent cargo diversion from U.S. ports.

The House of Representatives passed WRRDA of 2013 (HR 3080) on October 23, 2013, without any HMTF modification language. The differences in the two bills will need to be resolved in a Conference Committee comprised of members of the House and Senate. Conferees were designated by both the House and Senate, and the

Conferees set a goal of completing work on this legislation in December 2013. They were unable to resolve their differences including the HMT/HMTF issue prior to the end of 2013. It is anticipated that the Conference Committee will convene early in the next session of Congress in 2014.

RECOMMENDATIONS

The four Pennsylvania Sections of the American Society of Civil Engineers (ASCE) support the following recommendations:

- **Continue Pennsylvania's investment in Port Infrastructure.**

  The Commonwealth of Pennsylvania has invested significantly in improvements to port infrastructure on the Delaware River. To date Pennsylvania has provided approximately $55 million for the deepening of the Delaware River through PRPA, the non-federal cost-sharing partner for the project, funding for the development of the proposed Southport Marine Terminal on a portion of the former Philadelphia Naval Shipyard property, and capital funding for the upgrading of PRPA's many terminals on the Delaware River. This funding needs to be continued. Passage of Pennsylvania's $2.3 billion Transportation Funding Act in late November 2013, which includes funding for multimodal projects, including ports and waterways, and the establishment of a new Deputy Secretary for Multimodal Transportation, should greatly assist in providing some of the needed funding.

- **Revisions to the use of the Harbor Maintenance Trust Fund (HMTF).**

  Currently the HMTF collects more than it distributes to USACE budgets for navigation projects. Changes need to be made by Congress to the HMTF which will 1) require that funding be made available to the USACE budget at a level not less than the level of receipts plus interest credited to the HMTF for each fiscal year; 2) ensure that revenues collected into the HMTF are used for the intended purposes of those revenues; 3) increase investment in the operation and maintenance of U.S. ports, which are critical for our economic competitiveness; and 4) ensure U.S. ports are prepared to meet modern shipping needs, including the capability to receive large ships that require deeper drafts, as well as projected needs for the future.

SOURCES

- American Association of Port Authorities, *Harbor Maintenance Tax,* 2013. Available at http://www.aapa-ports.org/Issues/USGovRelDetail.cfm?itemnumber=891
- American Association of Port Authorities, *Letter to Ways and Means Committee on Tax Reform/Harbor Maintenance Tax*, April 12, 2013. Available at http://www.aapa-ports.org/files/Tax%20Reform%20%20Ways%20%26%20Means%2012APR2013.pdf
- American Society of Civil Engineers, *2013 Report Card for America's Infrastructure*, 2013. Available at http://www.infrastructurereportcard.org
- American Society of Civil Engineers, *Failure to Act – The Economic Impact of Current Investment Trends in Airports, Inland Waterways, and Marine Ports Infrastructure,* 2012. Available at
- Harbor Maintenance Trust Fund Fairness Coalition, *Realize America's Maritime Promise,* 2008. Available at http://www.ramphmtf.org/
- http://www.asce.org/uploadedFiles/Infrastructure/Failure_to_Act/Failure_to_Act_Report.pdf
- http://www.nap.usace.army.mil/Missions/Factsheets/FactSheetArticleView/tabid/4694/Article/6559/delaware-river-main-channel-deepening.aspx
- http://www.nap.usace.army.mil/Missions/Factsheets/FactSheetArticleView/tabid/4694/Article/7616/delaware-river-at-fairless-turning-basin-falls-township-bucks-county-pa.aspx
- United States Army Corps of Engineers, Philadelphia District, *Delaware River Main Channel Deepening factsheet*, 2013. Available at
- United States Army Corps of Engineers, Philadelphia District, *Delaware River at Fairless Turning Basin, Falls Township, Bucks County, PA factsheet*, 2013. Available at
- United States Army Corps of Engineers, Philadelphia District, *Delaware River, Philadelphia to the Sea fact sheet, 2013.* Available at http://www.nap.usace.army.mil/Missions/Factsheets/FactSheetArticleView/tabid/4694/Article/6574/delaware-river-philadelphia-to-the-sea.aspx
- United States Army Corps of Engineers, Philadelphia District, *Delaware River, Philadelphia to Trenton fact sheet,* 2013. Available at http://www.nap.usace.army.mil/Missions/Factsheets/FactSheetArticleView/tabid/4694/Article/7166/delaware-river-philadelphia-to-trenton.aspx
- United States Army Corps of Engineers, Philadelphia District, *Schuylkill River, Philadelphia, PA Fact Sheet*, 2013. Available at http://www.nap.usace.army.mil/Missions/Factsheets/FactSheetArticleView/tabid/4694/Article/7640/schuylkill-river-philadelphia-pa.aspx

- United States Army Corps of Engineers, Waterborne Commerce Statistics Center, *Tonnage for Selected U.S. Ports in 2011*, 2011. Available at http://www.navigationdatacenter.us/wcsc/porttons11.html
- United States House of Representatives, *Water Resources Reform and Development Act of 2013 HR 3080*, 2013. Available at http://www.gpo.gov/fdsys/pkg/BILLS-113hr3080ih/pdf/BILLS-113hr3080ih.pdf
- United States Senate, *Water Resources Development Act of 2013 - S 601*, 2013. Available at http://www.gpo.gov/fdsys/pkg/BILLS-113s601es/pdf/BILLS-113s601es.pdf

ASCE POLICY STATEMENTS

ASCE Policy Statement 218: Improvement and Maintenance of Ports, Harbors and Waterways (PS 218)

PARKS AND RECREATION

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Over the past few years, the Pennsylvania Department of Conservation and Natural Resources (DCNR) has seen its sources of federal and state funding reduced, yet at each of these levels, parks facilities managed to ensure adequate funding and consistent quality for the recreational life of the state. Moreover, the royalties that have been collected by DCNR from Marcellus shale gas operations have introduced a new and growing source of income for the agency. Despite the economic downturn and a significant reduction in state funding, DCNR succeeded in expanding its source of income, as well as managing its programs and facilities expertly, to further increase the appeal and reputation of state parks, forests, and recreational areas and continue Pennsylvania's tradition as a leader in this category. Municipal Parks and other public recreational facilities throughout the state experienced similar conditions as did the State Parks. These facilities were able to expand income sources and maintain their services as well.

BACKGROUND

Approximately 11 percent of Pennsylvania's land or 3.24 million acres is dedicated to parks and recreation. Pennsylvania is home to 15 national recreational areas, six national heritage areas, 26 natural landmarks, 120 state parks, 20 state forests, 23 U.S. Army Corps of Engineers (USACE) recreational reservoirs, and 180 county parks, as well as numerous city and municipal parks. More than 47 million people visit the state and federal parks each year.

Moreover, the total length of trails managed by state and federal agencies, as well as local municipalities and non-profit organizations, is approximately 10,800 miles which is 10-times more than Yellowstone National Park. The Allegheny National Forest alone comprises 513,000 acres of forested land. The state park and forest lands managed by DCNR together cover 2.5 million acres of preserved space, and since 2009, the agency has succeeded in conserving about 40,000 acres of additional land. The combined area of all the county parks in the state encompasses 67,000 acres. In addition, the Pennsylvania Game Commission preserves over 1.4 million acres of state game lands for the purposes of hunting and fishing in addition to that permitted in the parks and forests managed by DCNR.

The U.S. Department of Agriculture Forest Service oversees the Allegheny National Forest, the USACE oversees the recreational reservoirs and dams, and DCNR is the steward of the state parks and forests. Each of these agencies maintains its own policies, budgets, and staff. Among the 67 counties in Pennsylvania, approximately 31 have recreational departments supported through local taxes, state funding, and

philanthropy. Through various community partnership programs, DCNR assists counties in the planning, maintenance, and funding of county and local parks.

Pennsylvania has two coastal zone areas: 63 miles of coastline along Lake Erie and 57 miles of coastline along the Delaware Estuary. These coastal zones include residential, commercial, industrial, and beach/recreational areas. These coastal areas are managed as part of the state's Coastal Zone Management Plan under the Federal Coastal Zone Management Act of 1972.

In 2011, the state's five-year Statewide Outdoor Recreation Plan was honored as the best in the nation by the U.S. Department of the Interior National Park Service (NPS) and the National Association for Recreation Resource Planners. In 2009, Pennsylvania's State Parks were awarded the National Gold Medal Award for Excellence in Parks and Recreation Management jointly by the American Academy for Park and Recreation Administration and the National Recreation and Park Association, recognizing the state's parks as among the nation's best.

CONDITION AND CAPACITY

The U.S. National Park Service (NPS), USACE, DCNR, and the local municipalities are responsible for the operation and maintenance of infrastructure in recreational areas. These agencies also provide personnel and resources to manage, maintain, and protect the natural resources, with duties that include: preventing or controlling forest fires; managing mineral extraction; maintaining camp sites; providing outreach and educational programs; and managing the use of trees for timber as well as maintaining a tree nursery for new growth.

Capital Improvements

The infrastructure present in state parks and forests managed by DCNR include 3,720 miles of roads, 842 bridges, 121 dams, 68 wastewater treatment facilities, 172 public water supplies, 4,700 buildings, 4 ski areas, and 180 boat launches. For 2014, the state announced $38 million in 198 grants to local governments and nonprofit organizations throughout the state for recreation and conservation projects, which combined various sources of federal and state funding into one package. The current need associated with these projects is nearly three times the made available in 2014 at $100 million. Notable endowments from 2013 were providing more than $1.5 million to the City of Philadelphia, in coordination with other state agencies and nonprofit organizations, for the construction of two urban parks, the Hawthorne Park and the Sister Cities Park completed within that timeframe.

Energy efficiency has been a major focus on DCNR properties; therefore the agency has been promoting the use of green technology in construction and land use. A long term benefit of energy efficiency is reduced operation and maintenance costs as well as reduction of impacts to natural resources both within and outside of the park properties. This includes alternative energy sources, such as solar and wind, being harnessed by its facilities. Currently, there are a total of 11 buildings located on various state parks and forests which have been certified by the U.S. Green Building Council as demonstrating Leadership in Energy & Environmental Design (LEED). Notable examples of such projects are:

- the Penn Nursery facility in Centre County (2011),

- the new Resource Management Center in Weiser State Forest (2012),

- the new visitor center at the Jacobsburg Environmental Education Center (2013),

- and the new visitor center at Ohiopyle State Park (anticipated to open in 2014).

Operations and Maintenance

State forests have more than 2,500 miles of trails used for hiking, cross-country skiing, mountain biking, horseback riding, snowmobile riding, and ATV riding. Additional activities permitted in the state parks include camping, hunting, fishing, swimming, and boating. Picnic areas available at each state park are typically equipped with tables, fireplaces, potable water, and parking. Rental and user fees help finance the operation and maintenance of these facilities; however, other wide-scale maintenance issues such as fire, pest and invasive species control, and infrastructure upkeep require greater funding than the fees collected.

Protecting the environmental health of the state parks and forests is an important consideration in operation and maintenance activities. DCNR's Bureau of Forestry maintains a cadre of firefighters consisting of both its own staff as well as volunteers from municipal fire companies to help respond to forest fires and their effects on surrounding communities. Moreover, the agency trains approximately 4,500 local firefighters across Pennsylvania every year, in addition to deploying its manpower to other states that require assistance with extreme forest fire events, ranging as far as Alaska and Idaho, using funding from the U.S. Forest Service. The Bureau of Forestry also possesses a knowledgeable forest pest management staff that survey over 16 million acres of land throughout the state to detect and report pest damage and,

eventually, take measures to suppress them. Finally, DCNR's Bureau of Topographic and Geologic Survey has been monitoring certain revenue-producing critical natural resources found in state parks and forests such as oil, gas, coal, shale, aggregate, cement raw materials, and groundwater.

Income Sources

Pennsylvania's state forests contain some of the world's most valuable timber. The sale of timber products from state forests returns money to the Commonwealth and provides a stable resource base for the forest products industry. The timber cut from Pennsylvania's state forests can be marketed with a "green label", which means that the wood has been cut from a forest that is managed in an environmentally sensitive manner. In 2011, DCNR's Bureau of Forestry contracted harvesting over 12,000 acres of timber on state forest land, generating $29 million in revenue.

User fees are assessed for snowmobile, ATV, and cross-country skiing uses. These fees typically generate about $3.5 million per year of revenue to maintain the trails and other recreational services.

Land is leased in state forests for gas and oil well development, particularly that of Marcellus shale, with an 18 percent royalty generating revenue. The money generated from the oil and gas lease sales, rents, and royalties goes to the state's Oil and Gas Lease Fund. These funds have been used for projects such as land and mineral rights acquisition, infrastructure and trail improvements, habitat protection and restoration, and recreation equipment. Although this development started in 2008, by the end of 2013, there were 215 Marcellus shale gas wells operating on state forest lands, having generated approximately $80 million in revenue.

Finally, the growth of DCNR's own rental program on state parks and public-private partnerships in the form of concession contracts to enable local business to provide amenities to state park visitors have created another source of income for the agency. DCNR's combined revenue from cabin and campsite rentals as well as gift shop sales has almost doubled from $11 million in 2005 to $20 million in 2011. There are currently 145 concession contracts throughout all state parks, providing amenities ranging from food and refreshment sales to equipment rentals to even the operation of entire recreational facilities. For the past few years, the top five sources of income have usually come from parking, watercraft and marina rentals, golf courses, whitewater rafting, and swimming pools.

MUNICIPAL PARK HIGHLIGHTS

Philadelphia

Philadelphia, the largest city in the state with approximately 1.5 million residents, has a park and recreation system comprising 10,300 acres, being approximately 10 percent of its entire area, and hosting 10 million visitors annually. Most of that space consists of Fairmount Park, encompassing 9,200 acres, and is the nation's largest landscaped urban park. Due to this unique park, the recreational area per 1,000 residents is almost 7 acres, making it is more than twice that of New York City which has a little more than 3 acres.

Over a period of four years from 2010 to 2014, the annual Philadelphia operating budget for parks and recreation has expanded almost 30 percent from $46.7 million to $60.4 million. This increase has been targeted particularly to deal with stormwater management, invasive plant control, deer control, and streambank erosion, as well as improved routine grounds maintenance, horticulture, facility maintenance, ecological management, urban forestry management, and public safety.

Pittsburgh

The City of Pittsburgh has numerous parks that tally approximately 2,000 acres in all. The city is currently in the process of developing an Open Space, Parks and Recreation Plan with a three-pronged goal of: (1) ensuring fair use, distribution and connectivity of the city's parks and recreation trails system, (2) developing uses for vacant and surplus land, and (3) protecting environmentally sensitive natural resources to allow for growth and development in appropriate areas. The city has undertaken a broad storm drainage program, specifically geared towards improving water quality and reducing total volumes of stormwater runoff.

The Pittsburgh Parks Conservancy is a local non-profit group that acts in conjunction with the City of Pittsburgh to maintain, and in many cases restore, the city's Parks. The Conservancy has 8,000 volunteers. It is able to raise funds through its non-profit status. The City of Pittsburgh also has a program called the Civic LEAF Academy which gives Pittsburgh's high school and college students a behind-the-scenes look at the city government's role in developing a sustainable, green city.

Allentown

Allentown, the third-largest city in Pennsylvania with about 118,000 residents, is recognized nationally for both the quality and scope of its park system. Consisting of 26 major parks and 13 smaller parks, there are over 2,000 acres of active, passive, and natural parkland and open space. Therefore, the recreational area per 1,000 residents works out to be almost 17 acres, well over the national average of 12.4 acres. From 2010 to 2013, the annual operating budget increased by more than 70 percent from

$1.4 million to $2.4 million. This increase came from re-prioritizing of City budgets, not form additional income sources.

Harrisburg

Serving a regional area of about 1 million residents, the Harrisburg Department of Parks and Recreation manages 13 playgrounds, two sports fields (including the City Island Sports Complex), four large parks, and several community/recreation centers. Funding for its Parks and Recreational facilities has been in severe jeopardy for several years. No major upgrades are planned and only required maintenance items are being addressed at this time.

Several facilities, including the Reservoir Park and the City Island Sports Complex, have relatively high visitor volumes. The 20-mile Capital Greenbelt has moderately high usage. Each of these facilities has public-private partnerships and strong volunteer bases which have revenue-generating capabilities. The Reservoir Park is the largest in the city's system and covers approximately 85 acres, and its status as the home of the National Civil War Museum has increased its exposure and overall usage. The City Island Sports Complex is located on a one-mile long island in the Susquehanna River. The Complex is home to two professional sports teams, the Harrisburg Senators minor league baseball team and the City Islanders minor league soccer team.

FUNDING AND FUTURE NEEDS

A variety of funding sources provide support for Pennsylvania's green spaces. Generally, national parks and monuments are funded by the federal budget while state parks are funded by state taxes, federal grants, self-generated revenue, and donations. County and local parks are often funded by county and local taxes, state grants, self-generated revenue, and donations.

Federal Funding

Since 1965, the Federal Land & Water Conservation Fund (LWCF) has provided $165 million in funding for more than 1,500 projects in Pennsylvania. For the last few years, the state's yearly allocation has remained fairly consistent from $1.2 million to $1.4 million. Starting in 2009, the fund was augmented by royalties earned on oil drilling activities in the Gulf of Mexico, peaking at $8.1 million that year but greatly diminished to less than $100,000 in 2013.

State Funding

A major part of the success of Pennsylvania's parks and forests is the Keystone Recreation, Park, and Conservation Fund (Key 93), established in 1993. Since its inception, the fund has enabled the creation of 4,000 state park projects totaling $400 million, the preservation of 130,000 acres of land, 444 trail projects, and 2,000

community park development projects throughout the state. In late 2012, the state announced an ambitious program of grants to be awarded for 49 trail projects, 79 community park projects, five river conservation projects, land conservation projects that will conserve more than 3,000 acres of open space; and 37 statewide, park, heritage, greenway and trail initiative projects. These grants will satisfactorily meet those projects identified as absolutely critical. The total amount of funding needed for these types of preservation projects is approximately $70 million, which is slightly more than double that proposed in the 2012 grant program.

The state also owes some of the parks' success to the Growing Greener II (GGII) Act, or Act 45, through which it invested $625 million in agricultural and environmental resources in 2005. Of that amount, $217.5 million, including $90 million designated for community grants, was allocated to DCNR for the following five years. Moreover, $27.5 million went to the Pennsylvania Fish & Boat Commission to repair fish hatcheries and aging dams and $20 million to the Pennsylvania Game Commission for habitat-related facility upgrades and repairs. Although the GGII initiative was expected to have reached its terminus in 2010, the original amount of money has proven adequate for funding projects even until the end of 2013. Moreover, starting from that year, the fund has been receiving transfers from the revenue generated by royalties from Marcellus shale gas drilling operations amounting to $20 million.

However, in terms of its level of general government funding in the annual state budgets, DCNR has been experiencing a funding shortfall. The agency reached a zenith in terms of funding during 2009, when the Pennsylvania state government allocated $120 million from its general fund. By 2014, that amount was $30 million, about a quarter of what it was granted only a few years ago.

DCNR Budget from State Funding (2008 – 2014)

State Fiscal Year	Total State Funding	Change from Previous Fiscal Year
FY 2009	$120 million	---
FY 2010	$92 million	- 23.3%
FY 2011	$82 million	- 10.9%
FY 2012	$55 million	- 32.9%
FY 2013	$52 million	- 5.5%
FY 2014	$30 million	- 42.3%

Fortunately, the growth of DCNR's own sources of revenue, in the form of rental fees and gift sales, concession contracts, and Marcellus shale gas drilling royalties, offer

strong indicate that they may provide the future funding required to compensate for the lack of state funding required for the operation, maintenance, and further capital improvement of Pennsylvania's state parks, forests, and recreational areas. Currently, almost $150 million in revenue has been raised by DCNR itself from its own activities, which far exceeds the $63 million deficit between the funding that the agency received during 2010 and that it will receive during 2014.

RECOMMENDATIONS

The four Pennsylvania sections of ASCE recommend that the following measures be taken to maintain and enhance Pennsylvania's parks and recreation system and keep it in the forefront nationally:

- Given the general fund budget cuts that DCNR has been experiencing over the past few years, which are a result of general budget cuts to all agencies throughout the state, it is important that DCNR continue to grow its other sources of revenue. It is equally important to explore additional sources of income, particularly with respect to cabin and campsite rentals, gift shop sales, and concession contracts.
- DCNR should further promote and market its parks within and outside of Pennsylvania to generate more interest and visitors and, hence, more revenue in terms of more prospective campers and outdoor sportspeople staying and spending within the parks.
- With the growth in popularity of certain recreational activities, such as water sports, golf, whitewater rafting, and swimming within the state; it would be advisable for DCNR to further expand the facilities within its parks to take advantage of these growing sources of revenue from state park visitors.
- All of these facilities could have public private partnerships and strong volunteer bases with revenue generating capabilities. This added revenue for each has sustained, and in some cases substantially improved, the facilities.

SOURCES

- ASCE, *Parks and Recreation (2010 Report Card for Pennsylvania's Infrastructure)*. Available at http://www.pareportcard.org/PDFs/Parks%20and%20Rec%202010%20final%20-NATL.pdf.
- City of Allentown, *City Budget*. Available at http://www.allentownpa.gov/Government/City-Budget.

- City of Philadelphia, *Parks & Recreation*. Available at http://www.phila.gov/parksandrecreation/Pages/default.aspx.
- General Assembly of Pennsylvania, *House Bill No. 3*. Available at http://www.legis.state.pa.us/CFDOCS/Legis/PN/Public/btCheck.cfm?txtType=HTM&sessYr=2005&sessInd=0&billBody=H&billTyp=B&billNbr=0003&pn=2571.
- Pennsylvania Department of Conservation and Natural Resources (DCNR), *Community Recreation and Parks*. Available at http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_002280.pdf.
- Pennsylvania Department of Conservation and Natural Resources (DCNR), *ExplorePATrails.com*. Available at http://www.explorepatrails.com.
- Pennsylvania Department of Conservation and Natural Resources (DCNR), *News for Immediate Release (Dec. 5, 2013): Governor Corbett Announces $38 Million Investment in Recreation, Conservation and Community Revitalization Projects Statewide*. Available at http://www.dcnr.state.pa.us/cs/groups/public/documents/news/DCNR_20028590.pdf.
- Pennsylvania Department of Conservation and Natural Resources (DCNR), Bureau of Forestry, *Natural Gas Development and State Forests (Shale Gas Leasing Statistics, October 2013)*. Available at http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_20028362.pdf
- Pennsylvania Department of Conservation and Natural Resources (DCNR), Bureau of Recreation and Conservation (BRC), *Grants Interactive Database*. Available at http://maps.dcnr.pa.gov/brc/grants/.
- Pennsylvania Department of Conservation and Natural Resources (DCNR), Bureau of Recreation and Conservation (BRC), *Year 2012 Annual Report*. Available at http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_20027849.pdf.
- Pennsylvania Growing Greener Coalition. *Local Funding Guide: Pennsylvania Act 13 Conservation and Recreation Funding*. Available at http://pagrowinggreener.org/wp-content/uploads/2013/02/Act-13-Funding.pdf
- Pennsylvania Office of the Budget, *Current and Proposed Commonwealth Budgets*. Available at http://www.budget.state.pa.us/portal/server.pt/community/current_and_proposed_commonwealth_budgets/4566.
- Pennsylvania Office of the Budget, Performance Reports. Available at http://www.budget.state.pa.us/portal/server.pt/community/performance_reports/4677.

- Pennsylvania Office of the Budget, *Past Budgets*. Available at http://www.budget.state.pa.us/portal/server.pt/community/past_budgets/4571.
- The Trust for Public Land, *2011 City Park Facts*. Available at http://cloud.tpl.org/pubs/ccpe-city-park-facts-2011.pdf.
- U.S. Census Bureau, *Pennsylvania (State & County QuickFacts)*. Available at http://quickfacts.census.gov/qfd/states/42000.html.
- U.S. Department of Agriculture Forest Service, *National Visitor Use Monitoring: Allegheny NF*. Available at http://apps.fs.usda.gov/nrm/nvum/results/A09019.aspx/Round2.
- U.S. Department of the Interior National Park Service, *Land & Water Conservation Fund*. Available at http://www.nps.gov/ncrc/programs/lwcf.
- Wikipedia, *List of city parks and recreational facilities of Allentown, Pennsylvania*. Available at http://en.wikipedia.org/wiki/List_of_city_parks_and_recreation_facilities_of_Allentown,_Pennsylvania.

ASCE POLICY STATEMENTS

- ASCE Policy Statement 503: National Parks Infrastructure (PS 503)

LEVEES

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Floods are one of the most common and destructive hazards in the United States and Pennsylvania has historically been one of the most flood-prone states in the nation, having experienced billions of dollars in flood damages since the 1930s. The most commonly available protection against flooding in Pennsylvania is a levee. Over the last 100 years, 4,523 deaths have been attributed to levee failures nationwide. Flooding from Hurricane Agnes alone resulted in 48 fatalities in Pennsylvania and 122 deaths nationwide. During Hurricane Agnes, the Susquehanna River at Wilkes Barre crested at 40.9 feet, more than 18 feet above flood level. However, levees in the Wyoming Valley were built to provide protection to a maximum flood crest of only 37.0 feet above flood level. During Hurricane Agnes, the Susquehanna River was rising at more than one foot per hour, the rain continued to fall and flooding was inevitable. However, one day before the river crested, the levee in Forty Fort catastrophically failed sending 35 feet of water rushing through Kingston, where only 20 out of 6,600 houses remained above the flood waters. Large portions of both Kingston and Wilkes Barre were flooded. In Wilkes Barre and Kingston alone, 100,000 residents evacuated and 60 percent of Wilkes Barre was under water. In total, 250,000 Pennsylvania residents were forced to evacuate their homes during flooding from Hurricane Agnes, and many returned to find their homes gone or badly damaged. Damages were estimated at $2.119 billion including 68,000 homes and 126 bridges destroyed. The entire State of Pennsylvania was declared a disaster area due to flooding.

Pennsylvania's mountainous topography, more than 45,000 miles of rivers and streams and average annual rainfall of 42 inches, creates the potential for flooding to occur anywhere in the state at any time of the year. Levees were first constructed in Pennsylvania in 1939 to help prevent against flooding, and today, there are 64 recognized levee systems. Within these systems, there are 318 separate levee segments which provide a local protection length of about 151 miles and a total protected area of about 14,300 acres (22.3 square miles).

Flood protection projects are found along 115 separate creeks or rivers and are located in 51 of the 67 Pennsylvania counties. The average age of the flood protection systems is 48 years and more than one-third are older than 50 years. Levee systems are aging and deteriorating over time, with many of the systems approaching and/or exceeding their anticipated lifespan. The advanced age of the state's levee systems casts doubt on their ability to perform without incident or failure in an extreme flood event. The potential for the increasing frequency of flooding due to climate change results in an overall increase in the risk of flooding due to levee overtopping or failure.

The design level of flood protection for levees, as authorized by Congress, is based on the 100-year storm event. A 100-year storm refers to rainfall totals that have a one percent probability of occurring at that location in that year. Unfortunately, only a fraction of all earthen levees built with the level of flood protection at the established 100-year

storm event can be expected to provide protection for that event because of the uncertainties involved in establishing flood elevations; changing hydrologic conditions, and the possibility of levee failure before overtopping. A design level of flood protection at the 100-year storm event represents a 26 percent chance (1 in 4 chances) of flooding over the life of a 30-year home mortgage and represents a dangerously high level of flood risk, even in the presence of a properly designed and functioning levee system.

A grade of C- was assigned to the levee systems throughout the State of Pennsylvania. This grade reflects the benefit of the state effectively operating one of the few state-level comprehensive flood protection programs in the nation which requires a high level of standards for which levees are monitored and maintained. This grade also reflects the consequences resulting from the advanced age of the levee systems, the numerous flood-prone watersheds existing in Pennsylvania, the residual flood risk inherent in flood protection projects designed to the current flood protection standard, and the population at risk. Also considered is the ongoing struggle to obtain funds for the repair and maintenance of levee systems and the often under-appreciated threat to public safety resulting from flooding from catastrophic levee failure or overtopping.

BACKGROUND

Rivers and streams in Pennsylvania have been of great importance throughout its history. People have long elected to build in flood-prone river valleys because they sought access to waterways for easy access to water for drinking, transportation, farming, industry, etc. Many of these flood-prone sites continued to grow and became today's cities and towns. As these communities grew, engineering solutions to flood protection began to develop including the construction of flood control dams and levees.

A levee is defined as a man made embankment, usually an earthen structure built to provide flood protection from temporary high water (flooding). 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 and beyond. The construction of flood levees is the oldest, most widespread, and likely the most important method of flood protection provided to flood-prone communities in Pennsylvania.

Pennsylvania's climate and its steep and mountainous topography, which covers large areas of the state, have produced a long history of flooding. Portions of five major U.S. rivers flow through Pennsylvania, including the Delaware, Susquehanna, Potomac, Ohio, and St Lawrence rivers. Overall, there are approximately 45,000 miles of minor and major streams in Pennsylvania, and it is estimated that 10,000 to 15,000 miles of these streams are considered flood-prone. The Susquehanna River, which flows southward through the east-central part of the state, drains 20,888 square miles in Pennsylvania. The Susquehanna River Basin is the largest drainage system in the state and one of the most flood-prone watersheds in the nation, with more than 80 percent of the Basin's 1,400-plus communities having areas that are considered flood-prone. Roughly 30 percent of the Basin's population lives along its major rivers and streams.

There are currently 64 major levee systems located in Pennsylvania, according to the Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP) Database. Each levee system may contain one or more separate levee segments. Within the 64 levee systems, there are 318 separate levee segments which provide a local flood protection length of about 151 miles. It is important to note that levees do not provide full protection from the risk of flooding. Levees are designed to provide a specific level of flood protection and larger flood events can cause overtopping and possible failure of an entire levee system.

The National Flood Insurance Program was established by the Flood Insurance Act in 1968 to provide coverage to flood-prone properties, which private insurers would not cover. For the purposes of the insurance program, in 1973, the Senate Committee on Banking, Housing, and Urban Affairs adopted the ‘‘100-year floodplain’’ as the regulatory threshold. The 100-year flood (i.e., a return interval of 100 years as the annual maximum) has a one percent probability of occurring in any given year, so this is often termed the ‘‘one-percent’’ approach. The term “100-year flood” is misleading because it leads people to believe that it happens only once every 100 years. The truth is that an uncommonly large flood event can happen in any given year, particularly in Pennsylvania. The term “100-year flood” is really a statistical designation, which means that there is a 1-in-100 chance that a flood this size will happen during any year. A levee that is designed to withstand a 1-percent-annual-chance, or a 100-year flood, statistically has a roughly one-in-four likelihood of being overtopped by a flood during a 30-year period. And assuming the levee functions as designed and protects against the 100-year flood, there is still a residual risk of being flooded by overtopping of the levee by rainfall events that are larger than the design “100-year flood”. In addition to overtopping, residual risk is also present due to the potential of seepage and saturation, erosion and piping (internal erosion) occurring in the levee which may result in a catastrophic failure of the levee, even in rainfall events that are less than a “100-year flood”.

Floods produce damage through the immense power of moving water and through the deposition of dirt and debris when floodwaters finally recede. People who have not experienced a flood may have little or no appreciation for the dangers of moving water. Floodwaters typically contain suspended silt and potentially toxic microorganisms and dissolved chemicals. This means that floods usually compromise drinking water supplies, resulting in short-term shortages of potable water, with the additional long-term costs in restoring drinking water service to the residents of a flooded area. The debris left behind when floodwaters recede can be costly to clean up and also represent a human health hazard.

From a historical perspective, levees have long been constructed to protect property rather than people, a purpose expressed by the economic criteria controlling the engineering design of levees even today. Evacuation has been seen as the primary means for prevention of loss of life and the structural soundness of levees has traditionally been viewed in this context. However, over the past 100 years, there have

been 4,523 deaths recorded nationally caused by the failure of levees, compared to 816 fatalities recorded for dam failures over the same period. More than five times more fatalities have been caused by the failures of levees than dams over that time.

CONDITION AND CAPACITY

Levees and levee features deteriorate over time. Levees are constructed of materials subject to erosion, corrosion, weathering, scour, settlement, deformation and degradation. Depending on many factors, a levee may either deteriorate slowly or quickly, but every levee will always deteriorate over time. Regular maintenance and periodic upgrades are needed to ensure that they retain their design level of protection and function. Maintenance and upgrades can be a serious and expensive challenge as a levee system ages.

Levee systems in Pennsylvania includes various combinations of rolled earthen embankments; concrete L-walls, T-walls, and I-walls; plus 50 pump stations, 105 separate closure structures and approximately 200 separate relief wells. The average age of the federally authorized levee systems in Pennsylvania is approaching 50 years, which is the typical design life of a levee system. The average age of the non-federally authorized levee systems in Pennsylvania is 48 years, with the oldest system constructed in 1939 and the most recent system constructed in 2009. Approximately one-third of the non-federally authorized levee systems built in Pennsylvania are at least 50 years old and several were constructed almost 75 years ago.

The national levee Rehabilitation and Inspection Program is authorized by Public Law (PL) 84-99 and administered through 33 Code of Federal Regulations (CFR) Part 203. Public Law 84-99 provides discretionary authority given to the U.S. Army Corps of Engineers (USACE) to act and react to emergencies caused by floods, contaminated water sources, drought, or dam failures.

The USACE has authority under PL 84-99 to supplement local efforts in the repair of qualified levees which are damaged by a flood. This authority allows the Corps to repair and/or rehabilitate any qualified levee whether it is federally constructed or privately owned. To be eligible for rehabilitation assistance under PL 84-99, the levee must certain criteria and standards set forth by the U.S. Army Corps of Engineers and must be inspected and evaluated on a regular basis (approximately every two years).

In Pennsylvania, 109 levees are included in the Rehabilitation and Inspection Program, levee system types include:

Levee System Type	No. of Levees	Percentage of Total
Locally Constructed, Locally Operated and Maintained	77	71
Federally Constructed, Federally Operated and Maintained	7	6
Federally Constructed, Locally Operated and Maintained	25	23

The status of the levee systems included in the Rehabilitation and Inspection Program (RIP) are as follows:

RIP Levee Status	No. of Levees	Percentage of Total
Active	76	70
Inactive	22	20
Data Not Available	11	10

The term *Active Status* designates an Acceptable or Minimally Acceptable condition following an inspection, which means that the levee meets and maintains engineering and maintenance standards. The term *Inactive Status* designates an Unacceptable condition that would prevent the levee segment or system from performing as intended, likely due to poor maintenance or even from inadequate elevation or cross section in relation to the anticipated flood levels.

Within the 64 levee systems, there are 318 separate segments which provide a local protection length of about 151 miles and a total protected area of about 14,300 acres (22.3 square miles), including:

Flood Protected Areas		Percentage of Total
In Acres	In Square Miles	
<160	<0.25	75.0
>160 and <320	>0.25 and <0.5	12.5
>320	>0.5	12.5

Eight levee systems provide a protected area greater than 640 acres (one square mile). The largest protected area is the Kingston to Wyoming System located in the Wyoming Valley, which provides a protected area of more than 2,640 acres (4.6 square miles).

Levees have been constructed on 115 separate rivers or creeks and in all of the major river basins in Pennsylvania, including:

Major River Basin	No. of Levee Segments	Percentage of Total
Susquehanna River	181	57
Ohio River	85	27
Delaware River	47	15
Potomac River	4	1
St. Lawrence River	1	<1

Fifty-one (73 percent) of the 67 counties in Pennsylvania have levees. The Pennsylvania counties with the most levees are Luzerne with 32, Lackawanna with 25, and Lycoming with 23. These three counties account for approximately 25 percent of all Pennsylvania levee segments.

Despite the successful implementation of the Rehabilitation and Inspection Program and the fact that an effective levee inspection program is rigorously executed by both the Pennsylvania Department of Environmental Protection (PADEP) and the U.S. Army Corps of Engineers (USACE), a grade of “C-“ was assigned. This is attributed to the number of levees currently in an “*Inactive status*” in the Rehabilitation and Inspection Program (PL 84-99), the intrinsic uncertainty involved in establishing flood elevations, the changing hydrologic conditions, the advanced age of the levees, the numerous flood-prone watersheds existing in Pennsylvania, the residual flood risk inherent in flood

damage reduction projects designed to the current flood protection standard, the potential for the increasing frequency of flooding due to climate change, and the current low level of funding remaining for flood control projects in PA Act H2O. The possibility of catastrophic levee failure before overtopping is a constant and serious concern for every levee system. The consequences of a catastrophic levee failure or overtopping during a flood event are always devastating and include the potential for loss of life, property and commerce. The environmental and human health consequences of a levee failure are often an under-appreciated threat to public health and safety.

POLICY OPTIONS

Historically, PADEP has funded flood protection projects through the Flood Protection Grant Program, which has been superseded by the Pennsylvania H20 Act. The Pennsylvania H20 Act of 2008 currently provides single-year or multi-year grants to the Commonwealth, independent agencies, municipalities, or municipal authorities for flood control projects with $800 million designated to assist municipalities and authorities in paying for repairs to their water, sewer, and flood control projects. Flood control projects include construction, improvement, repair, or rehabilitation. Applicants must provide easements and rights of way, relocation of buildings and utilities, alterations or rebuilding of inadequate bridges, and operation and maintenance of the completed project. A minimum of $75 million was set aside for flood control projects, although current remaining funds available for flood control projects is low, with less than $1 million available. New flood control projects greater than $300,000 must be funded through the Capital Budget process. Act 13 of 2012 establishes the Marcellus Legacy Fund that allocates funds to the Commonwealth Financing Authority (CFA) for statewide initiatives to assist with flood mitigation projects. Limitations include 15 percent matching costs, maximum project cost of $1 million, and grants cannot exceed $500,000 per project. To date, 19 Act 13 projects have been reviewed by the CFA. In addition, the state funds its PADEP flood protection program through an annual line item in the budget. The line item was approximately $2.5 million for the FY11 budget year and $2.46 million for the FY12 budget year.

RECOMMENDATIONS

The four Pennsylvania sections of ASCE recommend that the following measures be taken to enhance and promote levee safety within Pennsylvania:

- Passage of state legislation to establish a statewide levee safety program, including legislation to allow for non-structural alternatives for flood damage reduction projects within the Commonwealth;
- Passage of state legislation to provide funding for levee certification for the 45 non-federal levee systems designed and constructed by PADEP;
- Continuation of state legislation to provide capital funding for new flood protection projects and legislative approval of flood protection funding through the annual PADEP flood control projects line item in the budget;

- Continuation of H20 Act program funding for levee improvements, upgrades, non-routine maintenance, or specialized equipment needs for the federal and non-federal (state) levee systems constructed in Pennsylvania;
- Establish a National Levee Safety Program that authorizes an entity to oversee a program for nonfederal levees, requires safety inspections, and maps flood-prone areas;
- Complete the National Levee Inventory for both federal and nonfederal levees;
- Adopt a levee hazard potential classification system;
- Complete levee mapping as outlined in the National Flood Insurance Program reform bill and implement FEMA's new levee mapping and analysis program;
- Increase funding at all levels of government and leverage private funds to address structural and nonstructural solutions that reduce flood risk to people and property;
- Require insurance where appropriate, and create emergency action plans for levee-protected areas; and
- Ensure that operation and maintenance plans cover all aspects of a complex levee system.

SOURCES

- American Society for Civil Engineers (ASCE) Central PA, Lehigh Valley, Philadelphia, Pittsburgh, *2010 Report Card for Pennsylvania's Infrastructure*: May 2010. Available at: http://www.pareportcard.org/
- American Society of Civil Engineers (ASCE), *2013 Report Card for American's Infrastructure*: March 2013. Available at: http://www.infrastructurereportcard.org/
- Pennsylvania Department of Environmental Protection (PADEP), *Flood Plain Management Act*, (1978).
- The *National Flood Insurance Program (NFIP)* regulations, 44 CFR 59 through 44 CFR 80.
- The *National Flood Insurance Act of 1968*, as amended, and the *Flood Disaster Protection Act of 1973*, as amended, 42 U.S.C. 4001 *et.seq.*
- The *National Flood Insurance Reform Act (NFIA)* of 1994.
- The *Flood Insurance Reform Act (FIRA)* of 2004.
- The Biggert-Waters *Flood Insurance Reform Act* (BW-12) of 2012.
- U.S. Army Corps of Engineers (USACE) Disaster Operations, Public Law 84-99, *Flood Control and Coastal Emergency Act (PL 84-99).*
- U.S. Army Corps of Engineers, (USACE) Department of the Army, *ER 500-1-1, Emergency Employment of Army and Other Resources* (September 2001). Available at: http://www.iwr.usace.army.mil/nfrmp/docs/USACE_Inspection%20Program_ER500-1-1.pdf
- Title 33, Code of Federal Regulations, Part 203 (33 CFR 203), *Navigation and Navigable Waters.* Available at: http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&tpl=%2Findex.tpl

- Title 44, Code of Federal Regulations, Section 65.10 (44 CFR 65.10), *Emergency Management and Assistance.* Available at: http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&tpl=%2Findex.tpl
- FEMA, NFIP database, http://www.fema.gov/national-flood-insurance-program.
- U.S. Army Corps of Engineers, National Levee Database, Available at: http://nld.usace.army.mil/egis/f?p=471:1:
- Schultz, C.H. ed. (2002) The Geology of Pennsylvania. Special Publication No. 1. Pennsylvania Geologic Survey and Pittsburgh Geological Society.
- Shank, W.H. (1972) Great Floods of Pennsylvania, A Two-Century History. American Canal and Transportation Center, York, PA.

ASCE POLICY STATEMENTS

- ASCE Policy Statement 529: *Levee Certification (PS 529)*
- ASCE Policy Statement 511: *National Levee Safety Program (PS 511)*

INLAND WATERWAYS

D+

Pennsylvania's inland waterway infrastructure, which connects the Commonwealth to the national waterway system, was built over the last 150 years. Many of its locks and dams are in a severe state of disrepair due to lack of maintenance and capital improvements funding over several decades. The grade of D+ reflects the fact that none of Pennsylvania's navigation dams and only 18 percent of the locks have a "satisfactory" condition assessment rating, and delays at the most degraded facilities are frequent. While American Recovery and Reinvestment Act (ARRA) funding provided a much needed boost to construction and operations and maintenance budgets, the ongoing and significant Federal funding limitations have greatly delayed completion of major rebuild projects. A catastrophic failure within the inland waterway system, like any major infrastructure failure, would have serious effects on the industries that rely directly on river transport of heavy bulk commodities.

BACKGROUND

Inland Waterways of Western Pennsylvania

The navigable waterways of western Pennsylvania comprise the major commercial inland waterway system in Pennsylvania. The U.S. Army Corps of Engineers (USACE) owns, operates and maintains approximately 200 miles of navigable waterways and 17 navigation locks and dams on the Ohio, Allegheny and Monongahela Rivers in western Pennsylvania. In 2012, the Port of Pittsburgh was the second busiest inland port in the nation and the 17th busiest port of any kind (1). At 35 million tons of cargo per year, it accounted for 50 percent of the Commonwealth's waterborne commerce (2). The Pittsburgh Port District encompasses a 12-county area in southwestern Pennsylvania and supports more than 200 river terminals and barge industry service suppliers. The life and success of the Port is directly dependent on the efficient operation of the navigable waterway transportation system.

The USACE has a major construction project underway to replace major components of the Lower Monongahela River infrastructure. Although originally scheduled to be completed in 2004, significant funding constraints have caused the USACE to conduct the work in small, fundable pieces; at the current funding rate, completion is anticipated by 2023. This work will ultimately improve the efficiency of waterborne traffic through the region. One major component of the project is the replacement of the 90-year old locks at Charleroi and Elizabeth with one set of modern locks at Charleroi.

Inland Waterways of Eastern Pennsylvania

There are no commercial inland waterways in eastern Pennsylvania. All of the former commercial waterways, e.g., the Schuylkill Canal, the Lehigh Canal, the Delaware Canal, and others stopped operating many decades ago. Commercial navigation on the Susquehanna River stops at the Conowingo Dam which is in Maryland, just below the

Pennsylvania state line. Therefore, there is no commercial navigation on the Susquehanna River in Pennsylvania.

The facilities on the navigable portions of the Delaware and the Schuylkill Rivers in Pennsylvania are an integral part of the Ports of Philadelphia, PA, Camden, NJ, and Wilmington, DE. The Delaware and Schuylkill River navigation channels are sea-level channels with no locks and dams and can accommodate sea-going vessels. The conditions of these navigable waterways as they relate to port operations are discussed in the Ports section of the 2014 Report Card for Pennsylvania's Infrastructure (PA Report Card).

CONDITIONS AND CAPACITY

Traffic through the region can be measured by overall traffic or by summing activity at individual locks. Overall commercial tonnage transported in 2012, the most recent year for which these data are available, is somewhat higher than 2010 levels, while remaining significantly lower than historic levels Figure 1. Clearly the region is capable of handling more river traffic than current levels.

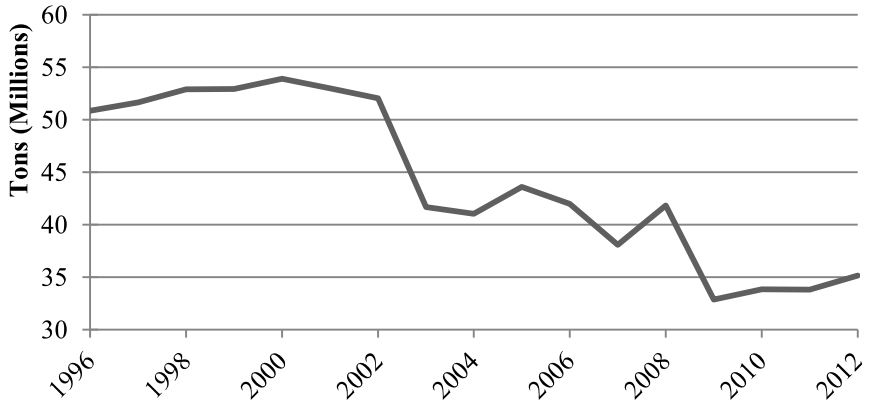


Figure 1. Waterborne commercial tonnage for the Port of Pittsburgh for 1996-2012 (3)

The capacity of the locks can also be characterized in terms of how many times the locks are used in a given year. The total number of lockages in all of the western Pennsylvania locks for each year from 2008 to 2012 is shown in Figure 2. Commercial lockages have been relatively steady at about 37,000 annual lockages over the past four years, and recreational lockages averaging about 12,000 lockages per year.

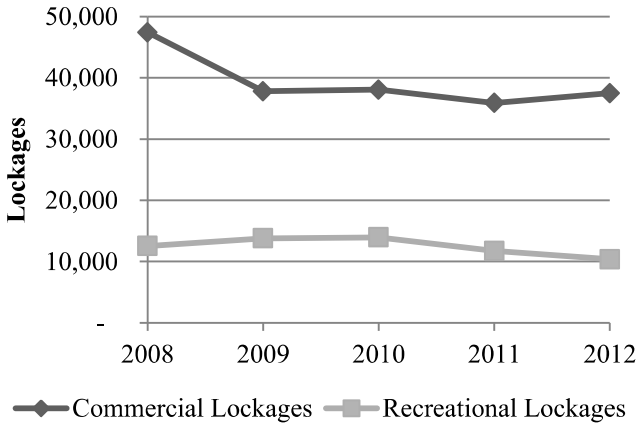


Figure 2. Port of Pittsburgh lockages for 2008-2012 (4)

Physical condition

The USACE has developed methods to measure reliability of components of the navigation infrastructure, as unscheduled maintenance closures of the locks are detrimental to the shipping industry and economic success of the inland waterways. Navigation dams and locks are evaluated separately.

The condition of navigation dams is evaluated in various ways, including ratings for the National Inventory of Dams (NID) condition assessment (5):

> SATISFACTORY - No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria or tolerable risk guidelines.
>
> FAIR - No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action.
>
> POOR - A dam safety deficiency is recognized for loading conditions which may realistically occur. Remedial action is necessary. This category may also be used when uncertainties exist as to critical analysis parameters which identify a potential dam safety deficiency. Further investigations and studies are necessary.
>
> UNSATISFACTORY - A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.
>
> NOT RATED - The dam has not been inspected, is not under state jurisdiction, or has been inspected but, for whatever reason, has not been rated.

According to the USACE Pittsburgh District Dam Safety Team (5), the 17 USACE navigation dams currently have the distribution of NID ratings shown in Table 1.

> Table 1. Distribution of NID Ratings for 17 USACE Navigation Dams in Western Pennsylvania (5)

NID Rating	Number of Navigation Dams
Satisfactory	0
Fair	7
Poor	7
Unsatisfactory	3

Thus, current condition assessment of the 17 navigation dams in the western Pennsylvania inland water system reveals that none of the dams has a satisfactory rating.

The current operational condition of the 17 locks in the western Pennsylvania system, as assessed by the USACE Pittsburgh District Asset Management Team (6), is shown in Table 2.

Table 2. Distribution of Ratings for 17 USACE Locks in Western Pennsylvania (6)

Rating	Number of Locks
Satisfactory	3
Fair	4
Poor	4
Unsatisfactory	6

Thus, the current condition assessment of the locks indicates that only 18 percent of the locks have a satisfactory rating.

The condition of the locks is reflected in measures of their efficiency in processing vessels and tonnage. The locks on the Ohio River and the first lock on the Monongahela River are the largest in the Port of Pittsburgh, and thus can process more tonnage per lockage than the smaller up-river locks. The second and third locks on the Monongahela River are both almost 100 years old and are being replaced with a new set of larger locks at Charleroi. Completion of this project is significantly behind the original USACE schedule due to funding shortfalls. The locks on the Allegheny are the smallest of all the locks in the Port of Pittsburgh.

One measure of capacity and efficiency is the average tonnage per lockage over time. Figure 3 illustrates this metric, showing that the four largest capacity locks have similar average tonnage per lockage, with a slight downward trend in efficiency over the past five years. The Charleroi locks, when replaced, will have a capacity equal to the Maxwell locks, providing a 50 percent increase in efficiency as measured by tonnage per lockage. This improvement, however, may not be completed until 2023 under the current funding stream.

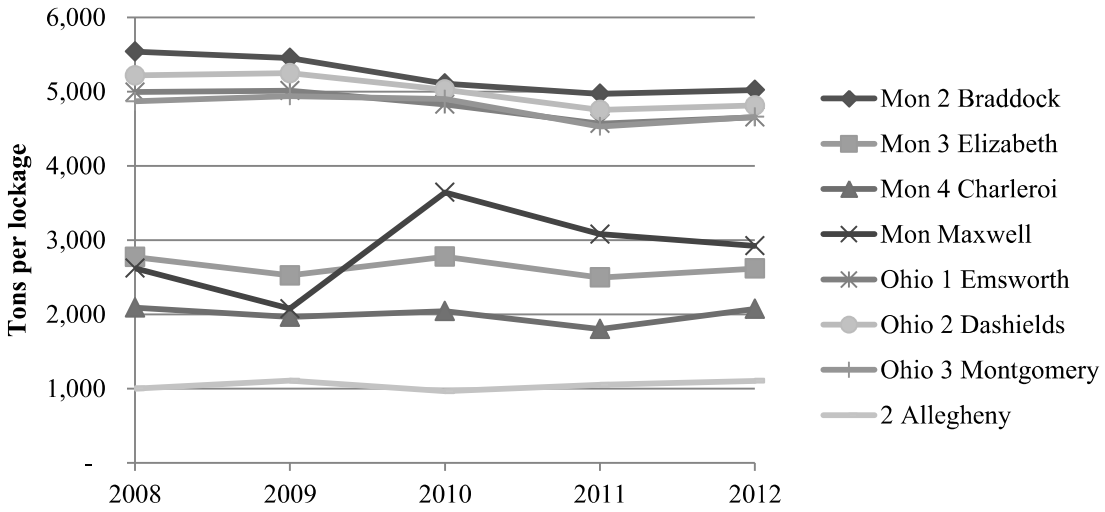


Figure 3. Commercial tonnage per lockage by lock in the Port of Pittsburgh for 2008-2012 (4)

The condition of the infrastructure is also measurable in terms of the number of closures that occur each year. Since the 2010 PA Report Card, there have been no instances of complete failure of major navigation facility components. However, regular, planned closures for maintenance and renovation have often restricted access to commercial and recreational users. The USACE tracks the number of closures that occur at each lock, as summarized in Figure 4. Some closures are short in duration for minor repairs, while others may last a month or more for major repairs. Scheduled closures are announced ahead of time; unscheduled closures may occur due to navigational accidents or equipment failure. Without differentiating between scheduled and unscheduled closures, Figure 4 shows that the number of closures varies from year to year and lock to lock, with the busiest locations (Montgomery, Dashields, Emsworth) generally being subject to the most closures. Closures appear to be markedly down in 2012, likely as a result of completion of ARRA-funded projects.

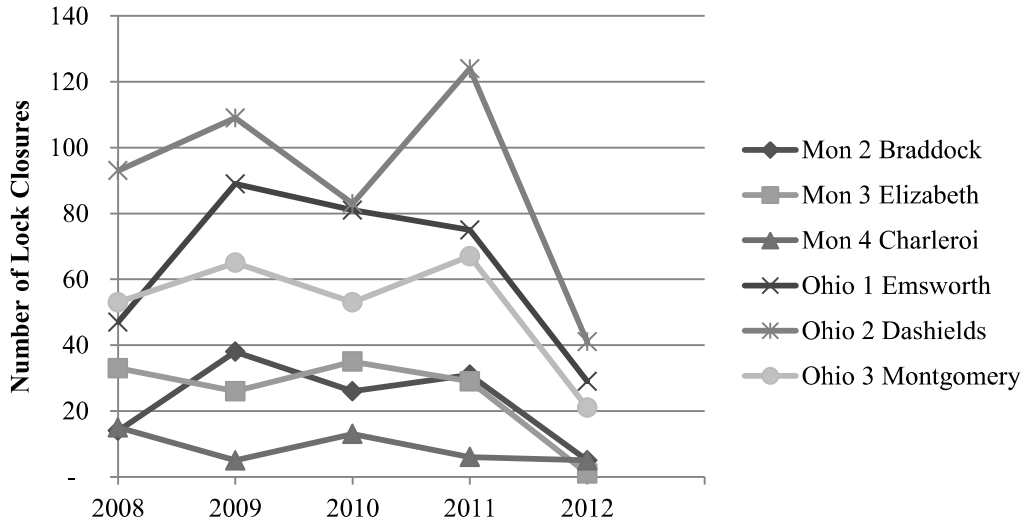


Figure 4. Number of lock closures at the six busiest locks in Port of Pittsburgh for 2008-2012 (4)

The USACE tracks data on the efficiency of the locks in terms of the amount of time delayed before passing through a lock chamber. Delays can be due to the operational status of the lock or traffic congestion. Figure 5 shows the percentage of commercial tows that were delayed from 2008-2012. The frequency of delays on the Ohio and Monongahela Rivers was higher than on the Allegheny River, reflective of their heavier traffic and tonnage patterns. All three rivers show an increase in the frequency of delays over the past four years, which likely resulted in additional costs borne by the regional economy.

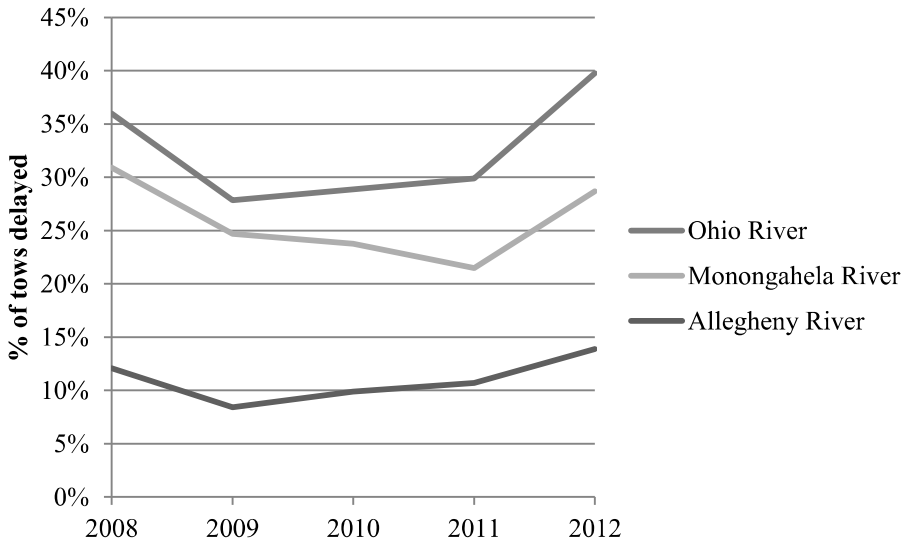


Figure 5. Percent of tows delayed in the Port of Pittsburgh for 2008-2012 (4)

When a tow is delayed at the six busiest locks, the typical hold up is between 20 and 80 minutes (see Figure 6). The spike in delays at Emsworth in 2010 was due to a major repair project that detoured all tows through Emsworth's auxiliary chamber for three

weeks (7). Delays in 2012 however were markedly higher at Elizabeth, Charleroi and Emsworth. During 2012, each of these three facilities had maintenance work done (8). The work required closure of one of the chambers and this would have increased the delay at each of these facilities.

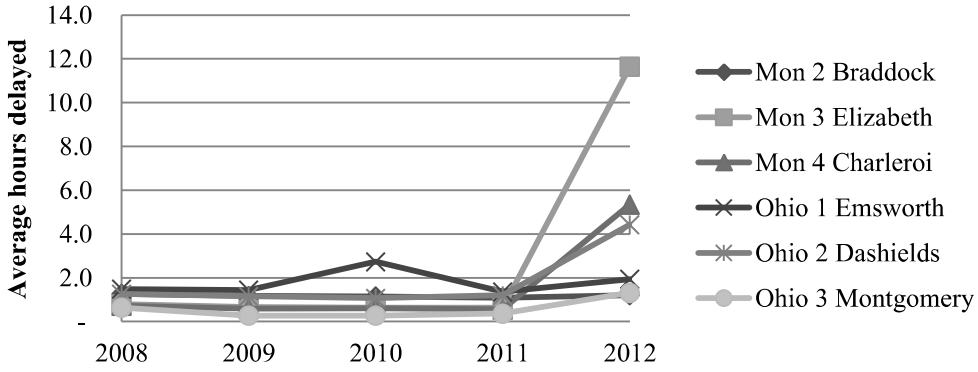


Figure 6. Average length of delay for delayed tows (hours) at six busiest Port of Pittsburgh locks for 2008-2012 (4)

Operation and Maintenance

The day-to-day operations of the Port of Pittsburgh's inland navigation system is funded through the USACE Operations and Maintenance (O&M) budget. Figure 7 summarizes funding over the past five years. Funding for O&M for the Monongahela and Allegheny River locks is currently reduced compared to 2010 levels. The USACE has accordingly reduced the level of service at the upriver locks as a means of stretching O&M dollars. The uppermost locks on both rivers have limited hours of operation, creating significant constraints on the ability of the local communities to use these stretches of river. The Pittsburgh District has been working with the communities to provide some level of service despite these funding constraints (9).

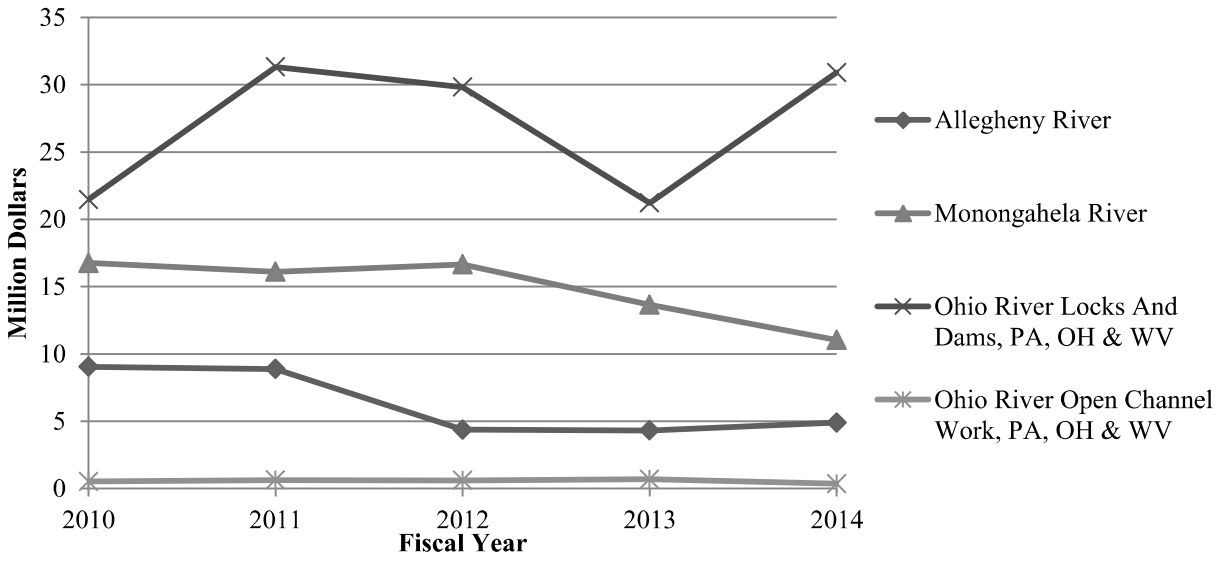


Figure 7. USACE O&M Budget for Port of Pittsburgh Projects for 2010-2014 (10) (11)

Public Safety

Data on commercial and recreational accidents that occur within the Port of Pittsburgh are not published by the U.S. Coast Guard. Several recreational fatalities, however, have occurred over the past five years in accidents near fixed-crest dams; these low profile dams do not project above the navigation pool water surface and can be difficult for boaters to see when approached from upstream.

Funding

The USACE budget for water resources infrastructure comprises three major components: Investigations, Construction, and O&M. USACE Pittsburgh District budgets over the past five years are summarized in Table 3.

The Upper Ohio Navigation Study was completed in 2013. This feasibility study examined the best ways to update the three Ohio locks and dams in the Port of Pittsburgh, all of which are at the end of their useful lives and subject to significant deterioration (12). The study will be incorporated into the Corps' annual Report to Congress; Congress then will determine whether to fund rehabilitation of these facilities.

President Obama's Fiscal Year (FY) 2014 budget includes $110 million in new federal funding for the Pittsburgh District Civil Works Program, including $47.1 million for O&M funds (10). The President’s budget also includes $1.9 million for the Lower Monongahela River Project, where the USACE continues the construction of new locks at Charleroi Locks and Dam.

Table 3. USACE Pittsburgh District Budgets (10) (11)

Corps of Engineers Work Plan Budgets ($ millions)					
	2010	2011	2012	2013	2014 (proposed)
Investigations					
Upper Ohio Navigation Study, PA	1.255	1.347	1.588	0.998	
Construction					
Emsworth Locks and Dam, Ohio River	25.0	9.806	0	6.285	
Locks and Dams 2, 3 and 4, Monongahela River	6.21	8.1	1.2	22.2	1.96
Southeastern Pennsylvania			2.3		
O&M					
Allegheny River	9.039	8.874	4.367	4.308	4.892
Monongahela River	16.758	16.1	16.648	13.658	11.035
Ohio River Locks and Dams, PA, OH & WV	21.470	31.320	29.862	21.221	30.905
Ohio River Open Channel Work, PA, OH & WV	0.516	0.625	0.607	0.681	0.359

In addition, ARRA funds were used for a number of Pittsburgh District projects: $0.49 million was allocated for completion of the Upper Ohio Navigation Study; $34.3 million was allocated for construction projects at Emsworth; $63.8 million for completion of river and guard walls at Charleroi; and $10.1 million for operations and maintenance funds for the Pennsylvania locks (13).

The 2013 Work Plan allocated $6.34 million from the construction budget to the long-delayed Lower Monongahela River Project. Funding for possible work at Charleroi is restricted due to depletion of available non-federal cost-share funds. After taking into account the ARRA investment, at the current low funding rate, the USACE plans completion of this work in 2024 (14).

Resilience

Scheduled repair work can be planned for by users of the inland waterways, but this is not the case for catastrophic failure. Potential failure of the navigation dams at Elizabeth and Emsworth are of particular concern. These dams have been given the worst rating possible by USACE inspectors (14); their failure would result in loss of the navigation pools that they create and in consequence cause a complete halt of barge traffic through those stretches of river for an extended amount of time (15).

Barring catastrophic failure, the three Ohio River locks and three of the four busiest Monongahela River locks have two lock chambers, allowing for continued, albeit reduced, operation during repairs of one chamber. The Charleroi lock, however, has only had one functioning chamber since 2004 due to the ongoing (and delayed) construction of the replacement lock chambers.

Innovation

The USACE is incorporating several innovative design components to the ongoing Charleroi lock replacement project; the project is designed and sequenced to keep one chamber open throughout the replacement process (16).

POLICY OPTIONS

The Inland Waterways Trust Fund (IWTF) was created in 1978 to provide funds for major lock and dam construction and rehabilitation projects. The fund is generated by a 20 cent-per-gallon tax on diesel fuel used by the tow industry. The tax rate has not changed since 1995 (12). The IWTF and matching federal funds are significantly insufficient to meet the current and backlogged requirements for construction and rehabilitation of the current inland waterways infrastructure (16).

A recent report prepared by the National Research Council, the research division of the National Academies, for the USACE (17) identified the following limitations and realities associated with funding the needed operations, maintenance and rehabilitation of the inland waterways:

- "Funding from Congress for project construction and rehabilitation has been declining steadily.
- Lockage fees on users/direct beneficiaries could be implemented. These are resisted by users and others.
- Parts of the system could be decommissioned or divested and the extent of the system decreased.
- The status quo is a likely future path, but it will entail continued deterioration of the system and eventual, significant disruptions in service. It also implies that the system will be modified by deterioration, rather than by plan."

As of March 2014, a new version of the Water Resources Development Act (known as the Water Resources Reform and Development Act (WRRDA)) is being finalized in a conference committee by the U.S. Congress. The House and Senate versions both have provisions for inland waterways construction and rehabilitation, including some funding for projects in western Pennsylvania but with emphasis on the important Olmsted Locks and Dam project on the Lower Ohio River between Illinois and Kentucky. It remains to be seen which provisions will be ultimately included, and if WRRDA will be passed.

RECOMMENDATIONS

Recognizing that funding of the operation, maintenance and rehabilitation of the inland waterways is determined and prioritized by the U.S. Congress, the four Pennsylvania sections of the American Society of Civil Engineers (ASCE) recommend the following:

- Continue efforts by the Pennsylvania Congressional delegation to shape and promote effective WRRDA legislation to fund operation, maintenance and rehabilitation of the Western Pennsylvania inland waterway system appropriately. This is of great importance to the continued viability of the State's inland waterway infrastructure.
- Congress should enable additional financing for inland waterway projects, e.g., by increasing the barge fuel tax and/or implementing user fees.
- Congress should develop a coherent set of principles to prioritize capital projects, with consideration of risk, reliability, and economic benefits. As recommended by the National Research Council (17), decommissioning of parts of the system on the Allegheny River that no longer have commercial justification should also be considered, to enable limited funds for operation, maintenance and rehabilitation to be more effectively deployed.

SOURCES

1. **U.S. Army Corps of Engineers, Navigation Data Center.** Tonnage for Selected U.S. Ports in 2012. *Waterborne Commerce Statistics Center.* [Online] http://www.navigationdatacenter.us/wcsc/porttons12.html.

2. —. CY 2012 Waterborne Tonnage by State. *Waterborne Commerce Statistics Center.* [Online] 2012. http://www.navigationdatacenter.us/wcsc/statetnm12.htm.

3. —. Waterborne Tonnage for Principal U.S. Ports and all 50 States and U.S. Territories. [Online] various. http://www.navigationdatacenter.us/publications.htm.

4. **U.S. Army Corps of Engineers.** Lock Use, Performance, and Characteristics. *Navigation Data Center.* [Online] various. http://www.navigationdatacenter.us/lpms/pdf/2011%20&%202012.pdf.

5. **Hoey, Jeanine.** Email from Jeanine Hoey, Chief, Programs and Program Management, USACE Pittsburgh District, to David Dzombak, Carnegie Mellon University. *National Inventory of Dams condition assessment ratings for 17 USACE navigation dams in Pennsylvania.* November 15, 2013.

6. —. Email from Jeanine Hoey, Chief, Programs and Program Managment, USACE Pittsburgh District, to David Dzombak, Carnegie Mellon University. *Operational condition assessment ratings for the 17 USACE locks in Pennsylvania.* December 4, 2013.

7. **Pittsburgh Post-Gazette.** Repairs Reflect Dire Need to Replace River Locks. *Upper Monongahela River Association.* [Online] May 15, 2010. [Cited: November 7, 2013.] http://www.uppermon.org/news/Pgh-Alleg/PPG-Repairs-15May10.html.

8. **Hoey, Jeanine.** Email from Jeanine Hoey, Chief, Programs and Program Management, USACE Pittsburgh District, to David Dzombak, Carnegie Mellon University. *Additonal information about delay times experienced at busiest locks in 2012.* December 11, 2013.

9. **U.S. Army Corps of Engineers, Pittsburgh District.** Lock Service Levels. [Online] [Cited: November 11, 2013.] http://www.lrp.usace.army.mil/Missions/Navigation/LockServiceLevels.aspx.

10. —. President's 2014 Budget: $110 Million for regional Corps projects. *News Releases.* [Online] April 10, 2013. http://www.lrp.usace.army.mil/Media/NewsReleases/tabid/11552/Article/12674/presidents-2014-budget-110-million-for-regional-corps-projects.aspx.

11. **Hoey, Jeanine.** Email from Jeanine Hoey, Chief, Programs and Program Management, USACE Pittsburgh District, to David Dzombak, Carnegie Mellon University. *Pittsburgh District inland waterway budget information, 2011-2013.* November 6, 2013.

12. **U.S. Army Corps of Engineers, Pittsburgh District.** Upper Ohio Navigation Study. [Online] [Cited: November 11, 2013.] http://www.lrp.usace.army.mil/Portals/72/docs/UpperOhioNavStudy/Upper%20Ohio%20River%20Navigation%20Study.pdf.

13. **U.S. Army Corps of Engineers.** Civil Works Project Lists. *Projects funded by the American Recovery and Reinvestment Act of 2009.* August 11, 2010.

14. **U.S. Army Corps of Engineers, Pittsburgh District.** Monongahela River Locks and Dams 2, 3, and 4 Project Fact Sheet (Lower Mon). [Online] June 2013. http://www.lrp.usace.army.mil/Portals/72/docs/HotProjects/LMPJune2013.pdf.

15. —. Emsworth Locks & Dams Major Rehabilitation Project. [Online] 2014. http://www.lrp.usace.army.mil/Missions/Planning,ProgramsProjectManagement/HotProjects/EmsworthLocksDamsMajorRehabilitationProject.aspx.

16. **Stolz, Steve R, Lisa R. Pierce, Dave A. Stensby.** Replacing Existing Lock 4 - Innovative Designs for Charleroi Lock . [Online] http://www.canarysystems.com/papers/CharleroiLD_Stoltz.pdf.

17. **National Academy of Science, Water Science and Technology Board.** *Corps of Engineers Water Resources Infrastructure: Deterioration, Investment, or Divestment? .* Washington, D.C. : National Academies Press, 2012.

ASCE POLICY STATEMENTS

- ASCE Policy Statement 299: Infrastructure Investment Policy (PS 299)
- ASCE Policy Statement 302: Cost Sharing in Water Resources Infrastructure Programs (PS 302)
- ASCE Policy Statement 526: Public-Private Partnerships (PS 526)

HAZARDOUS WASTE

B-

Over the last ten years, Pennsylvania has made steady progress in reducing the amount of EPA-regulated hazardous waste generated, in cleaning up and redeveloping sites that are contaminated with historic releases of hazardous waste, and in addressing other potential environmental impacts such as storage tanks, abandoned mines, and oil and gas drilling and production practices. From 2001 to 2011, the amount of hazardous waste generated annually in the Commonwealth has decreased by 23 percent. In addition, there has been some progress on the remediation of historic contamination.

In 2013 there were 97 Federal National Priority List (NPL) sites in Pennsylvania that have been listed by the U.S. Environmental Protection Agency (EPA) under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); remediation construction has been completed at three quarters of these Superfund sites. Pennsylvania's Land Recycling Program has approved 4,841 cleanups from 1995 to 2013, with another 1,220 in progress. Pennsylvania's waste-related environmental challenges extend beyond the boundaries of the Resource Conservation and Recovery Act (RCRA) Subtitle C definition of hazardous waste and include wastes associated with recent oil and gas drilling and production activities, historic coal mining, and the management of coal combustion residuals.

CONDITION AND CAPACTIY

Hazardous Waste Generation

The annual quantity of hazardous waste generated in Pennsylvania has declined by approximately 23 percent over the past ten years (Figure 1). The Pennsylvania Department of Environmental Protection (PA DEP) attributes this decline to a number of factors: cost savings to those that generate hazardous waste, reducing potential future liability, avoiding regulations, growing commitment to environmental protection, and negative economic conditions impacting the chemical manufacturing and primary metals industries (1).

Figure 1. Tons of Hazardous Waste Generated in Pennsylvania

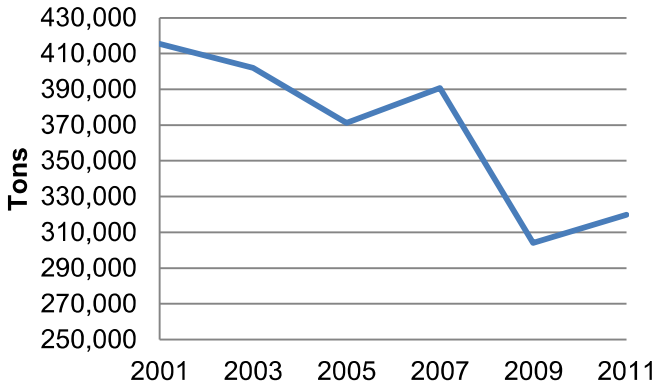


Figure source: (2)

This downward trend can be assessed in terms of other state-wide and national trends. Figure 2 compares normalized trends in hazardous waste generation to normalized trends in the State's Gross Domestic Product (GDP, normalized to 2001 dollars) (3), and enacted environmental protection budget (4), as well as national hazardous waste generation (also normalized to the 2001 generation rate). Pennsylvania's hazardous waste generation rate has exhibited a greater decline than the national rate (2) and has trended downward despite the increase in the state GDP and greatly reduced state funding for environmental protection.

Figure 2. Normalized Trends in Hazardous Waste Generation

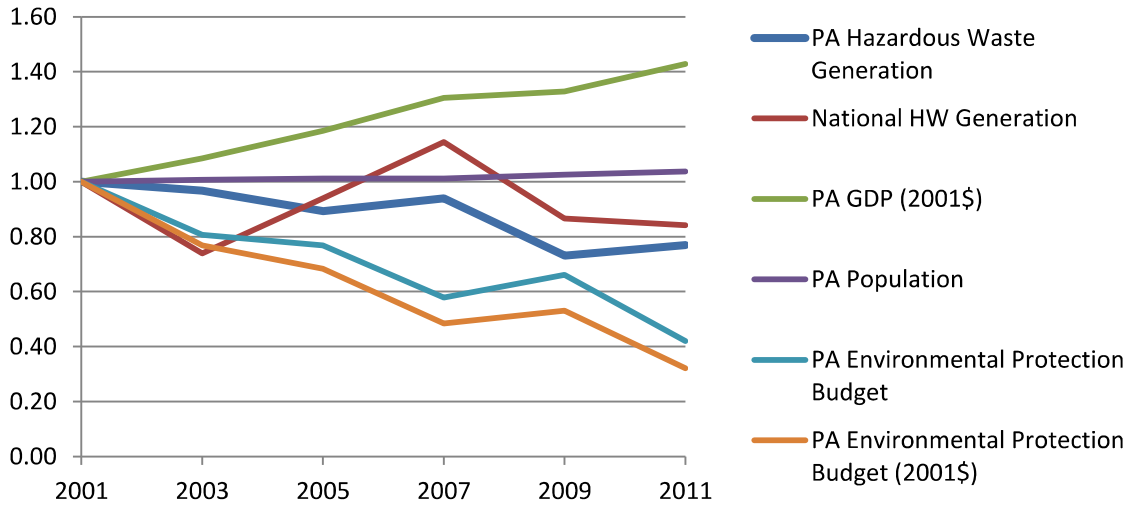


Figure sources: (1-5)

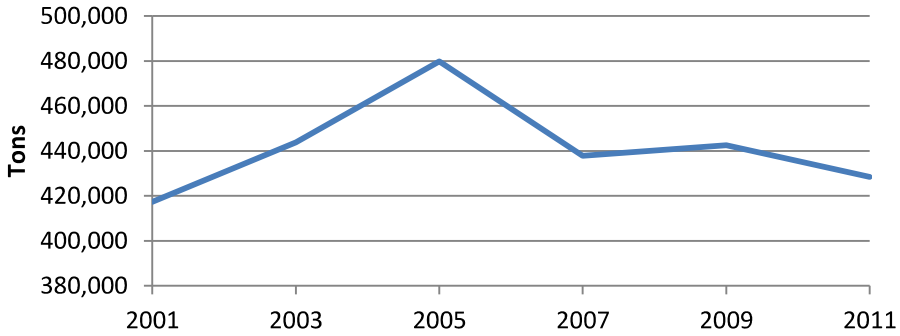
PA DEP conducted 481 inspections of the 1,100 large quantity hazardous waste generator sites, significantly more than the target of 280 inspections set in the state's Hazardous Waste Grant Work Plan Agreement with the EPA. Similarly, PA DEP conducted many more compliance evaluation inspections at the 4,400 small quantity

generator sites than required in the Work Plan (578 actual versus 260 planned) (5). Despite the noted budget constraints, PA DEP has exceeded its target inspection goals at hazardous waste generating facilities.

Hazardous Waste Management

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 (Figure 3) (2) and also how much hazardous waste is imported from other states or exported into the Commonwealth. Over the past decade, an annual average of 440,000 tons of hazardous waste was managed in Pennsylvania TSDFs (varying less than 5 percent on an annual basis). Pennsylvania shipped 154,000 tons of hazardous waste out of state and received 288,000 tons of waste from out of state for management in 2011 (2). Outgoing shipments to other states are trending somewhat lower over the past ten years, reflective of state-wide reductions in generation rates over the same period.

Figure 3. Tons of Hazardous Waste Received by Hazardous Waste TSDFs



Hazardous waste management practices and oversight by PA DEP appear to be well established and stable. For example, PA DEP conducted 78 compliance evaluation inspections at the 40 permitted hazardous waste management facilities, more than the 68 targeted in the Work Plan (5). The Commonwealth's hazardous waste generation and management regulations also appear to be consistent with American Society of Civil Engineers' (ASCE's) Policy Statement 331 regarding hazardous waste reduction and management.

CLEANUP OF HISTORICAL CONTAMINATION

A major component of Pennsylvania's management of hazardous waste is the remediation of past releases. There are a range of programs to address these releases, including the Federal CERCLA Superfund program, the state's Hazardous Sites Cleanup Act (HSCA) program, RCRA Corrective Action cleanups, and Pennsylvania's Act 2 Program.

Federal Superfund Sites in Pennsylvania

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 and federal facilities. Pennsylvania currently has 97 Federal National Priority List (NPL) sites, the third highest number in the nation behind New Jersey and California (6) (7). NPL sites are addressed through a sequential process of site studies to determine the extent of contamination and options, the completion of construction of remedial action and finally, removal from the NPL list (also known as "delisting").

Progress can be assessed in terms of the percentage of NPL sites with completed remediation construction; this completion rate has increased from 63 percent to 76 percent over the past years, as illustrated in Table 1. While Pennsylvania has the third highest number of NPL sites, the high rate of remediation construction completion is an indication that the immediate threats to human health and the environments at these sites has been addressed. The high number of NPL sites is largely an artifact of the Commonwealth's rich industrial history.

Table 1. Progression of Pennsylvania NPL Sites through Remediation

Year	Percent of sites		
	proposed to be added	completed studies	completed construction
2013	1%	23%	76%
2012	2%	23%	76%
2011	2%	30%	68%
2010	2%	33%	65%
2009	3%	33%	64%
2008	2%	35%	63%

Progress can also be assessed in terms of the rate of NPL site delisting. As of 2008, a total of 27 Pennsylvania sites had been delisted; one additional site was removed in 2009. The slow pace of delisting is a reflection of the complexity of the sites and the level of available funding. To fund remediation of these NPL sites, the federal government initially established a fund called the Hazardous Substance Superfund, or simply Superfund, with monies provided from federal excise taxes on chemical feedstock and petroleum and a tax on all corporate income. However, Congress allowed the taxes to expire in December 1995, and since then Superfund is financed from general Treasury appropriations, private-party contributions and cost recoveries from the parties responsible for the contamination. Annual congressional appropriations for the Federal Superfund program have steadily declined in recent years after peaking at $2 billion in 1998. The appropriation for 2010 was $1.2 billion (8). The declining federal budget limits EPA and the states' implementation of the Superfund program and the subsequent removal of sites from the Federal NPL.

The Commonwealth is responsible for funding some portion of the remedial actions at 19 Pennsylvania NPL sites; for the 2012-2013 budget year, estimated costs were $1.7 million. Annual expenditures fluctuate from year to year ($1.2 to $9.6 million over the past seven years), which would be expected as the remedial actions at these diverse

sites progress. Data were not available to determine whether remediation progress has been limited by funding availability.

State Hazardous Site Cleanup Projects

Many contaminated sites in Pennsylvania do not pose enough risk to be included on the NPL list, but are still contaminated enough to require clean up. These sites, and specifically those that involve bankrupt facility owners, abandoned facilities and inappropriate disposal of hazardous substances, are managed under the Commonwealth's HSCA Program. Pennsylvania spent $16.2 million in 2012-13 on cleanup at 127 non-NPL HSCA sites (7). As with the NPL sites, funding for remediation at these non-NPL sites fluctuates from year to year ($10.0 to $19.8 million over the past seven years).

RCRA Corrective Action of Hazardous Waste Releases

Active facilities in the Commonwealth with contamination that warrants remediation are subject to the federal Resource Conservation and Recovery Act (RCRA) Subtitle C Corrective Action (RCRA CA) process. As of mid-2013, Pennsylvania had 355 high, medium and low priority sites subject to RCRA CA (7) (9). The number of high priority sites in Pennsylvania has decreased from 161 to 156 over the past six years and human exposure to contaminants is controlled at 153 of these. Twenty-eight (28) percent of these high priority sites have achieved final cleanup, an increase from 21 percent six years ago.

About 200 of the RCRA CA sites are medium and low priority, approximately 24 percent of which have achieved final cleanup. This is a significant improvement over the sole final cleanup tallied in 2009 for these sites.

Act 2 Remediation and Brownfields Sites

Not all contaminated sites fall into the NPL, state HSCA or RCRA CA programs. These remaining sites, which generally include spills, releases, underground storage tank (UST) closures and underutilized industrial sites (commonly known as "Brownfields") are addressed in PA DEP's Land Recycling Program (familiarly known as "Act 2", referencing the enabling 1995 legislation).

Brownfields is a term used to describe land parcels that have some level of environmental contamination but are not subject to the formal requirements of the Superfund, HSCA, or RCRA CA programs. Uncertainty about long-term liability and remediation costs associated with these properties deter potential developers from cleaning them up and returning them to productive use. To address the redevelopment hurdles and streamline the general remediation process, Pennsylvania enacted the Land Recycling Program legislation in 1995, providing uniform cleanup standards, liability relief, financial assistance, and regulatory support.

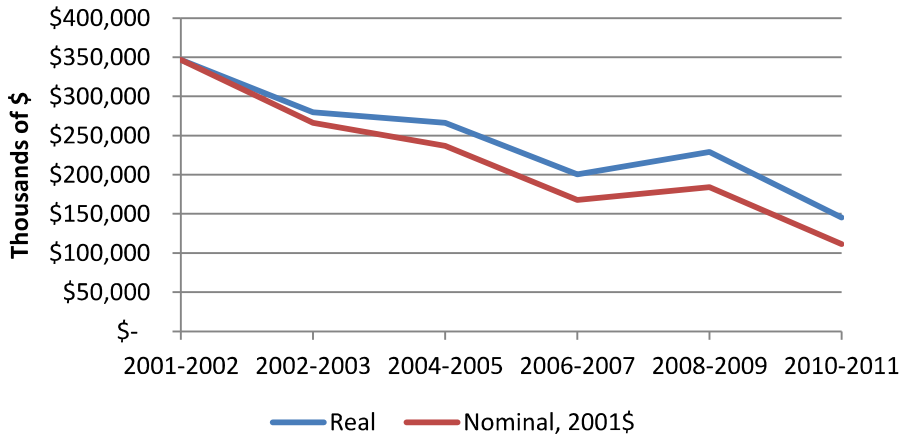
Since its enactment in 1995, the Act 2 Program has overseen the completion of cleanup at 4,841 sites (as of December 2013), with another 1,220 sites in the process of being remediated (10) (11). PA DEP also provides an on-line inventory of available Brownfield properties identified voluntarily by property owners and community redevelopment

organizations. The inventory currently contains 71 Brownfield properties (12). Programmatic features such as Pennsylvania's Act 2 Program and the Brownfield database are examples of how the Commonwealth has been innovative and forward-thinking when it comes to impaired environmental properties.

FUNDING AND FUTURE NEEDS

The Commonwealth of Pennsylvania's budget for environmental protection has steadily declined over the past decade. The 2010-2011 budgets are 42 percent of 2001-2002 levels (Figure 4). Over this time period, PA DEP has witnessed the clean-up of thousands of sites and an overall reduction in the quantity of waste generation, but has also taken on significant new responsibilities with regard to the booming unconventional oil and gas industry in the Marcellus shale formation. It is to Pennsylvania's credit that the pace of environmental stewardship across the Commonwealth has not slowed further in light of these budget reductions and new environmental challenges.

Figure 4. Pennsylvania Enacted State Budget for Environmental Protection



The Hazardous Waste program is funded by a combination of EPA grant dollars and 25 percent PA DEP match. For the past three years, the EPA contribution has remained steady at $4.7 million. Funding for a majority of the remaining PA DEP programs comes from the Growing Greener Program (signed into law in 1999 and reauthorized in 2002). Growing Greener funds come largely from a permanent $4/ton municipal waste disposal fee; the annual dollar commitment to PA DEP has been $94 million through 2012 (13). However, the total tonnage of disposed municipal waste has been decreasing, which is a factor in the overall reduction in PA DEP funding.

To provide additional funding to PA DEP as well as other programs, Growing Greener II was signed into law in 2005. Growing Greener II provided another $230 million to PA DEP to clean up rivers and streams, address environmental problems at abandoned mines and contaminated industrial sites, finance the development and deployment of advanced energy projects and restore funding in the short term for the HSCA Fund,

specifically providing $50 million over two years to shore up the HSCA Program (14). This short-term funding was a significant improvement as compared to recent HSCA annual expenditures (e.g., 11-12 of $20.3 million); however, this appears to be a temporary stop-gap measure with little long-term assurance of future funding.

RELATED WASTE ISSUES

There are other waste-related issues in Pennsylvania that do not fit under the formal RCRA definition of hazardous waste. These issues are worthy of discussion in this Report Card because of their potential impact on human health and the environment and include: wastes from unconventional oil and gas drilling and production operations, storage tanks, coal combustion residuals, and abandoned mine lands.

Hydraulic Fracturing Industry Wastes

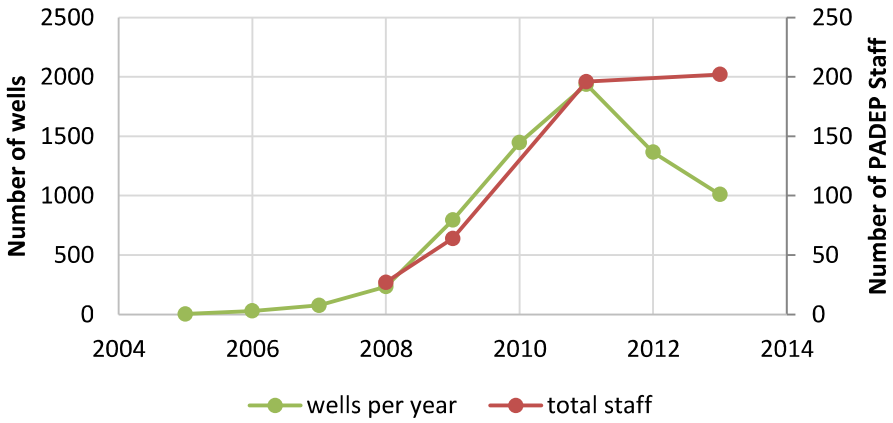
Wastes generated during the exploration and production of oil and natural gas are categorized by the EPA as "special wastes" and are exempt from federal hazardous waste regulations. Unconventional drilling and production operations have increased significantly in Pennsylvania in the past few years, due mostly to recent developments and improvements in shale energy production techniques. These techniques, including hydraulic fracturing, have resulted in a new waste stream (known as "frac water" or "flow-back water"). In the second half of 2010, over 5.5 million barrels of liquid wastes and 0.20 million tons of solid wastes were reported from these operations; in the first six months of 2013, these quantities increased to 15 million barrels of liquids and 0.56 million tons of solid waste.

At the onset of the surge in unconventional drilling in 2008, Pennsylvania's infrastructure was inadequately prepared to deal with the unique challenges of this new drilling technique. This resulted in frac water disposal at wastewater treatment facilities not equipped to handle the high total dissolved solids (TDS) in the waste stream. If left unaddressed, this load has the potential to impact drinking water sources, especially during low flow conditions (15) (16). On April 19, 2011, PA DEP issued a "Call to Action" letter to all gas drilling operators to cease, within 30 days, delivering this wastewater to facilities that had been accepting the water under special provisions of the Commonwealth's regulations that exempted these facilities from TDS treatment requirements (17). Since this Call to Action, the percentage of wastewater going to treatment facilities has decreased from 57 to 16 percent and the amount of on-site reuse of frac water has increased from 31 to 74 percent (18).

In 2008, PA DEP substantially increased fees for drilling permit applications. The application fee was raised from $100 to a sliding scale based on total wellbore length, with the average well permit application costing more than $3,200 (19)**Error! Reference ource not found.**. All revenue was invested to increase oversight. To support new staffing levels in the future, PA DEP has proposed new rulemaking to increase permit fees to a flat fee of $5,000 (20). The permit fee increases have allowed PA DEP's Bureau of Oil and Gas to increase its staff significantly, from 64 in 2009 to 202 in 2013 (Figure 5). The proposed rule was presented to Pennsylvania's Oil and Gas Technical Advisory Board in April 2013 and was presented to the EQB in July 2013, which

approved the proposed rulemaking. PA DEP is proceeding to move the rulemaking through the remainder of the regulatory development process. (21). Figure 5 demonstrates an increase in PADEP staff commensurate with the increase in Marcellus wells installed between 2008 and 2013. Recommendations from an independent peer review group indicate that PA DEP should conduct a workload analysis to determine the need for additional staff to meet current and future needs (20).

Figure 5. Marcellus Wells vs. PADEP Staff



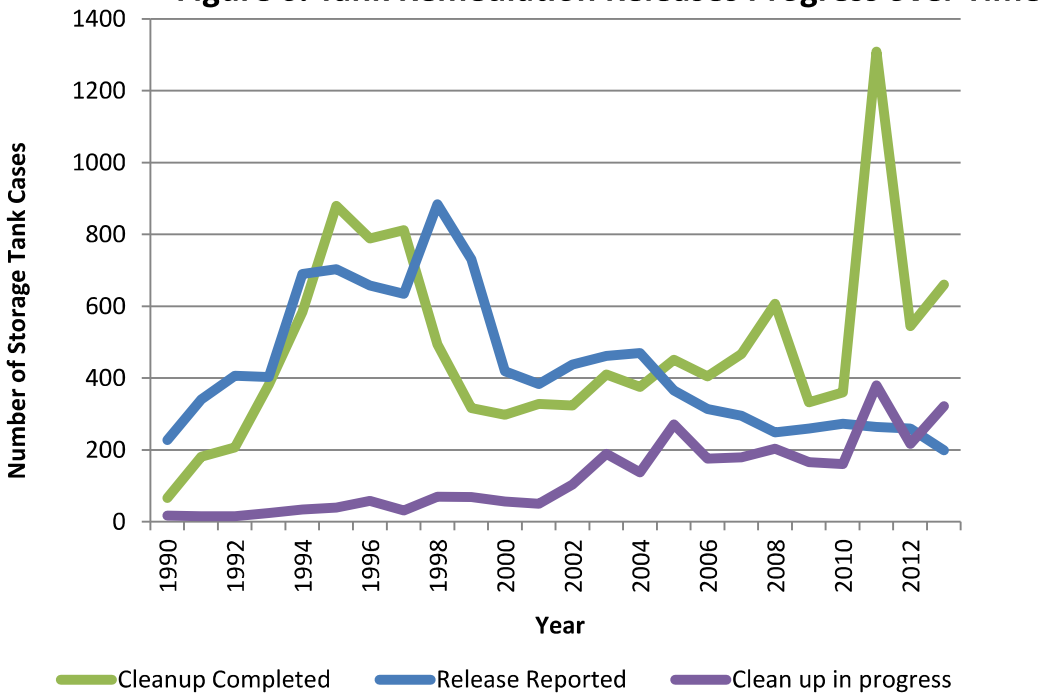
To minimize the impairment of groundwater used for drinking water purposes, PA DEP in February 2011 amended its regulations regarding well design and construction to provide enhanced casing and cementing standards for new well construction (20). Additionally, PA DEP instituted requirements for mechanical integrity testing of all operating oil and gas wells, including Marcellus Shale wells, effective the fourth quarter of 2013 (22). The 2012 Oil and Gas Act includes a provision that Marcellus Shale operators are presumed responsible for any drinking water well impacts that occur within 2,500 feet of an unconventional gas well and within 12 months of drilling, stimulation, completion or alteration activities (22). Recent independent research of drinking water wells in the vicinity of unconventional gas wells has provided conflicting results, including "…statistical analyses…did not suggest major influences from gas well drilling or hydro-fracturing…" (23) and "…data suggest that some homeowners living <1 km from gas wells have drinking water contaminated with stray gases" (24). Based on the wide range of results, the PA DEP needs to diligently monitor industry developments and research to ensure they are protecting human health and the environment and meeting the policies established by ASCE for groundwater management in Policy Statement 243 (PS 243).

Storage Tanks

PA DEP has jurisdiction over more than 13,000 aboveground and 19,000 underground storage tanks. All of these tanks are regulated under the Storage Tank and Spill Prevention Act of 1989 which follows a storage tank through its lifecycle (tank installation and design, tank registration, tank permitting, tank inspections and maintenance, spill reporting and spill corrective actions) (25).

Approximately 17,000 tank releases have been reported since program initiation in 1989. Almost 68 percent of these releases have been cleaned to applicable cleanup standards. The remaining 5,300 releases are either in the process of being remediated or are classified as low priority by the PA DEP. As shown in Figure 6, every year since 2005 the number of releases cleaned up has exceeded the number of new releases (26).

Figure 6. Tank Remediation Releases Progress over Time



Annually the Commonwealth receives $50 to $300 for registration of each storage tank equating to over $3 million to run its oversight program. Approximately 30 corrective action sites are led by the PA DEP and are funded by the Underground Storage Tank Indemnification Fund ($2 million annually) (27) (28).

To encourage tank owners to close their tanks, the PA DEP initiated its “Pump and Plug” program. The program has $1 million in grant money to reimburse small business owners up to $2,500 per tank for the costs of pumping, cleaning, and plugging their tanks. The PA DEP also implemented a grant program to assist owners with heating oil underground storage tank corrective actions ($500,000 annually) (27) (28).

Coal-fired Utilities Waste

Residuals from the combustion of coal to make electricity are currently exempt from hazardous waste classifications (29). Pennsylvania depends on coal-fired utilities to generate over 49 percent of its electricity (30). Conversion of coal into electricity resulted in over 9.3 million tons of coal combustion residuals (CCR) in 2010, including fly ash (46%), bottom ash (19%), and flue gas desulfurization gypsum (34%) (31). Pennsylvania ranks third in the nation in terms of total generation of CCR. The EPA has proposed to change the exempt status of these materials when landfilled or managed in

surface impoundments because of documented risk to human health and the environment (32). While 65 percent of CCR are recycled or reused in Pennsylvania, the remaining 3.3 million tons of CCR may be subject to additional regulatory oversight if the EPA proposal is finalized. Managing this material as regulated hazardous waste will require PA DEP to expand its oversight capabilities (more staffing and budget).

Abandoned Mine Lands

Coal mining began in Pennsylvania in the mid-1700s in support of various industries and continues today, primarily in support of electricity generation. For the first 200 years, coal was extracted and the mines abandoned with little thought of environmental consequences and without formal regulation. This abandoned (and frequently physically unstable) condition created numerous public health, safety and environmental issues, such as loss of life, property damage and polluted waterways from abandoned mine drainage (AMD) (33). Restoration (also called reclamation) of these abandoned mine lands (AML) is necessary to mitigate and prevent ongoing environmental pollution.

The protection of public health and safety from AML is prioritized by PA DEP. The highest priority sites (which pose the most extreme danger) have been inventoried by PA DEP; the estimated cost to reclaim these high priority sites exceeds $1 billion. Pennsylvania accounts for one-third of the country's AML problem and 43 of Pennsylvania's 67 counties have identified abandoned mine problems. PA DEP estimates that acid mine drainage discharges into the Commonwealth's streams and rivers have resulted in 5,596 miles of impacted water as of 2012 (34) (35) (36).

Funding for AML cleanup is provided to Pennsylvania through grants from the federal Office of Surface Mining (OSM) under the authority of the Surface Mining Control and Reclamation Act (SMCRA). SMCRA requires that active coal operators throughout the nation pay an AML fee on each ton of coal mined. OSM collects the fee and distributes it through annual grants to the AML states and tribes according to a distribution formula established in the law. In 2013, PA received an AML grant award of $61.7 million. Collection of the AML fee is currently authorized by SMCRA through federal fiscal year 2021. Pennsylvania expects to receive future AML grants through 2022. Based on current levels of active coal mining, annual AML grants to Pennsylvania over the next few years are projected to be in the range of $50 to 60 million (37). Given the current funding level, a significant amount of the $1 billion need for reclamation at the high priority sites in Pennsylvania will not be addressed when the AML fee collection ends in 2021. Extension of the AML funding mechanism past 2021 will be necessary to ensure a long-term solution to Pennsylvania's AML legacy.

RECOMMENDATIONS

The four Pennsylvania sections of ASCE recommend that the following measures be taken to promote safe and efficient hazardous waste management within Pennsylvania:

- Assess overall PA DEP funding to assess whether recent reductions are preventing the Department from achieving its intended objectives or if the reductions are commensurate with the overall improvement in the Commonwealth's environmental condition and reduced hazardous waste generation.
- Reauthorize the federal Superfund taxes on chemicals, petroleum, and corporations to remove the cost burden of cleanup from the general fund as stated in ASCE's Policy Statement 305 (PS 305). This would be of direct benefit to Pennsylvania and would accelerate the remediation and ultimate delisting of the Commonwealth's long list of NPL sites.
- Increase program funding and establish a long-term funding mechanism to address the many hundreds of AML, RCRA CA, and HSCA sites in Pennsylvania. While acute risks have been eliminated at most of these sites, the long remediation periods and reduced funding prevent the return of these sites to beneficial and productive re-use.
- Diligently monitor the Commonwealth's oil and gas industry to ensure the protection of human health and the environment (see the ASCE policy statement for groundwater management in Policy Statement 243 (PS 243)). Additionally for the oil and gas industry, conduct a PA DEP workload analysis to determine the need for additional staff to meet current and future needs.

SOURCES

- Pennsylvania Department of Environmental Protection. Pennsylvania's Hazardous Waste Facilities Plan. [Online] September 2011. http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-86174/2510-RE-DEP4348%20combined.pdf.
- U.S. Environmental Protection Agency. National Analysis: The National Biennial RCRA Hazardous Waste Report. [Online] various. http://www.epa.gov/waste/inforesources/data/br11/national11.pdf.
- U.S. Department Commerce, Bureau of Economic Analysis. Regional Data: GDP & Personal Income. [Online] http://www.bea.gov/iTable/iTable.cfm?ReqID=70&step=1#reqid=70&step=10&isuri=1&7007=-1&7036=-1&7090=70&7035=-1&7006=42000&7001=1200&7002=1&7003=2.
- Pennsylvania Office of the Budget. [Online] http://www.budget.state.pa.us/portal/server.pt/community/office_of_the_budget_____home/4408.

- Womer, Dwayne. Chief, Division of Hazardous Waste Management, PA DEP. Email communication with Salah Abdelhamid, CH2MHill. November 15, 2013.
- U.S. Environmental Protection Agency. National Priorities List Sites in Pennsylvania. [Online] http://www.epa.gov/superfund/sites/npl/pa.htm.
- Pennsylvania Department of Environmental Protection. HSCA Annual Report. [Online] 2012.
- ASCE. Policy Statement 305 - Superfund Reauthorization (PS 305). [Online] http://www.asce.org/Public-Policies-and-Priorities/Public-Policy-Statements/Policy-Statement-305---Superfund-Reauthorization/.
- Mitzel, Glenn. Environmental Group Manager, Bureau of Waste Management, PA DEP. Email communication with Salah Abdelhamid, CH2MHill. December 13, 2013.
- Pennsylvania Department of Environmental Protection, Land Recycling Program. Program Results (Act 2 – Site Lists, Completed Sites). [Online] December 11, 2013. http://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/LRP/LandRecycling_Sites_Complete.
- —. Program Results (Act 2 – Site Lists, Sites in Progress). [Online] http://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/LRP/LandRecycling_Sites_Progress.
- Pennsylvania Department of Environmental Protection. Pennsylvania Brownfields Inventory. [Online] [Cited: December 11, 2013.] http://brownfields.pasitesearch.com/bfSearch.aspx.
- —. Growing Greener, What is Growing Greener? . [Online] . www.portal.state.pa.us/portal/server.pt/community/growing_greener/13958/what_is_growing_greener_/588899.
- —. Growing Greener, What is Growing Greener II? [Online] . www.portal.state.pa.us/portal/server.pt/community/growing_greener/13958/what_is_growing_greener_ii_/588900.
- —. PA DEP Oil & Gas Reporting Website. [Online] . https://www.paoilandgasreporting.state.pa.us/publicreports/Modules/Welcome/Agreement.aspx.
- *Oil and Gas Produced Water Management and Surface Drinking Water Sources in Pennsylvania.* Wilson, Jessica M. and VanBriesen, Jeanne M. National Association of Environmental Professionals, Environmental Practice, Vol. 14, pp. 288–300.
- Pennsylvania Department of Environmental Protection. Call to Action letter. [Online] April 19, 2011.
- —. PowerPoint information from Joe Adams (PA DEP O&G). November 22, 2013.
- —. Marcellus Shale: Tough Regulations, Greater Enforcement Fact Sheet (0130-FS-DEP4288) . Rev. 5/2013.
- STRONGER. State Review of Oil and Natural Gas Environmental Regulations, Inc. Pennsylvania Follow-up State Review. September 2013.
- Pennsylvania Department of Environmental Protection. Permits Issued and Wells Drilled Maps. 2011, 2012, and 2013.
- —. Marcellus Shale Development Fact Sheet (0100-FS-DEP4217). Rev. 10/2013.

- *The Impact of Marcellus Gas Drilling on Rural Drinking Water Supplies.* Boyer, Elizabeth W., et al., et al. March 2012.Pennsylvania Department of Environmental Protection. Permits Issued and Wells Drilled Maps. 2011, 2012, and 2013.
- *Increased Stray Gas Abundance in a Subset of Drinking Water Wells Near Marcellus Shale Gas Extraction.* Jackson, Robert B., et al., et al. 28, July 9, 2013, Proceedings of the National Academy of Sciences, Vol. 110.
- Pennsylvania Department of Environmental Protection. Regulated Tank List. [Online] http://www.depweb.state.pa.us/portal/server.pt/community/registration/20606/regulated_tank_list/1054359.
- —. Storage Tank Release and Cleanup Locations. [Online] http://www.depweb.state.pa.us/portal/server.pt/community/storage_tank_cleanup_program/20605/storage_tank_cleanup_locations/1053538.
- —. Storage Tank. [Online] http://www.depweb.state.pa.us/portal/server.pt/community/storage_tanks/20538.
- Hartenstein, George. PA DEP, Director, Bureau of Environmental Cleanup and Brownfields. Email communication with Salah Abdelhamid, CH2MHill. December 16, 2013.
- U.S. Environmental Protection Agency. Special Wastes. [Online] http://www.epa.gov/wastes/nonhaz/industrial/special/index.htm.
- U.S. Energy Information Administration. Electricity Browser. [Online] http://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vvg&geo=g&sec=8&linechart=ELEC.GEN.ALL-US-1.A~ELEC.GEN.COW-US-1.A~ELEC.GEN.NG-US-1.A~ELEC.GEN.NUC-US-1.A~ELEC.GEN.HYC-US-1.A&columnchart=ELEC.GEN.ALL-US-1.A~ELEC.GEN.COW-US-1.A~ELEC.GEN..
- —. Survey EIA-923, Section 8 results for 2012. [Online] http://www.eia.gov/electricity/data/eia923/.
- U.S. Environmental Protection Agency. Coal Combustion Residuals - Proposed Rule. [Online] http://www.epa.gov/solidwaste/nonhaz/industrial/special/fossil/ccr-rule/index.htm.
- Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation. PA's Mining Legacy and AML. [Online] . Available at http://www.portal.state.pa.us/portal/server.pt/community/aml_program_information/21360/pa%E2%80%99s_mining_legacy/1463.
- Pennsylvania Department of Environmental Protection. 2012 Pennsylvania Integrated Water Quality Monitoring and Assessment Report. [Online] http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/WaterQualityPortalFiles/2012%20Integrated%20List/2012%20Pennsylvania%20Integrated%20Water%20Quality%20Monitoring%20and%20Assessment%20Report.pdf.
- Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation. Acid Mine Drainage Set-Aside Program, Program Implementation Guidelines, Revised Draft July 15, 2009. [Online] 2009. http://files.dep.state.pa.us/Mining/Abandoned%20Mine%20Reclamation/Abandoned

MinePortalFiles/AMD_Set_Aside_Program_Guidelines_Revised_Draft_07_15_2009.pdf.

- Eric Cavazza, Bureau of Abandoned Mine Reclamation, PA DEP. Email communication with Salah Abdelhamid, CH2MHill. December 16, 2013.
- Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation. AML Program Information. [Online] http://www.portal.state.pa.us/portal/server.pt/community/aml_program_information/21360.
- ASCE. Policy Statement 331: Hazardous Waste Reduction and Management (PS 331).
- —. Policy Statement 243 - Groundwater Management (PS 243). [Online] http://www.asce.org/Public-Policies-and-Priorities/Public-Policy-Statements/Policy-Statement-243---Groundwater-Management/.
- Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamatio. PA's Mining Legacy and AML. [Online] http://www.portal.state.pa.us/portal/server.pt/community/aml_program_information/21360/pa%E2%80%99s_mining_legacy/1463284.

ASCE POLICY STATEMENTS

- ASCE Policy Statement 331: Hazardous Waste Reduction and Management (PS 331).
- ASCE Policy Statement 305: Superfund Reauthorization (PS 305).
- ASCE Policy Statement 243: Groundwater Management (PS 243).

ENERGY

C

Pennsylvania benefits from having diverse, reliable and affordable energy resources, and utilizes those resources to rank second in the country in terms of electrical generation. Pennsylvania is the number one exporter of electricity in the United States. The majority of the electricity generated in Pennsylvania relies upon coal, nuclear and natural gas for fuel, although there is a clear trend over recent years that is changing the energy sector within the Commonwealth. The policy focus of increasing energy efficiency, reliability and development of renewable energy resources coupled with the recent expansion of natural gas resources from the Marcellus Shale regions have had significant impact on the energy infrastructure of the Commonwealth.

Pennsylvania has a solid foundation of energy, electrical generation and transmission infrastructure that is continuing to transform and react to market forces. The infrastructure appears to be reasonably well positioned to meet the current and 20-year planning horizon needs of the Commonwealth, although it is clear that energy and environmental policy will likely have a significant impact on the direction of the Energy Infrastructure in Pennsylvania.

BACKGROUND

In the development of this Report Card for Pennsylvania's Energy Infrastructure, the authors were cognizant of the massive network of infrastructure related to the Energy sector, and have attempted to focus this report and corresponding report card grades on the significance of the Commonwealth's primary energy resources (coal and natural gas), the electrical generation capacity, and the electrical transmission and distribution network.

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 completely driven by market forces, while the electrical transmission and distribution market is regulated by the Pennsylvania Public Utility Commission (PUC) which provides a guaranteed rate of return for their services.

PRIMARY ENERGY RESOURCES

Coal

Pennsylvania is the fourth leading coal producing state, mining 55.03 million short tons in 2012. The Northern Appalachia Coal Basin located in Western Pennsylvania accounts for over 12,000 million tons of recoverable coal reserves. With this amount of coal reserves, Pennsylvania can sustain the current production rate for over 200 years.

Pennsylvania's coal is mainly utilized as a source of electrical power, accounting for 49.5 % of the total amount of electricity produced.

Natural Gas

Marcellus shale underlies NY, PA, OH, and WV. Most Marcellus drilling and development in Pennsylvania takes place in the western, central and northern areas of the Commonwealth. Development began in 2005 followed by substantial activity since 2007 and now Marcellus production has reached 12 billion cubic feet a day. That's the energy equivalent of about 2 million barrels of oil a day, and more than six times the 2009 production rate. Putting this in perspective, if the Marcellus Shale region were a country, its natural gas production would rank third in the world, after Russia and the rest of the U.S. Current estimates show that the Marcellus contains 141 trillion cubic feet (TCF) of natural gas that is classified as unproved technically recoverable reserves.

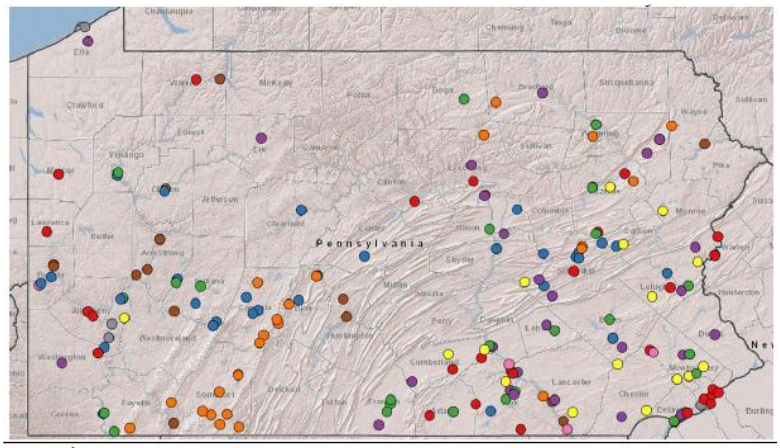
By 2017 Pennsylvania is expected to produce 1.2 trillion cubic feet of natural gas, equating to almost eight times the volume produced in 2000. In the same period, national production is only expected to increase 27%. The impact of Marcellus Shale on pipeline infrastructure is apparent in pipeline capacity trends. Since 2000, pipeline flows in Pennsylvania have reversed from an inflow of 0.3 billion cubic feet per day (bcfd) to an outflow in 2011 estimated at 1.3 bcfd. Pennsylvania's pipeline infrastructure is expected to increase capacity significantly as natural gas production continues in Marcellus, Utica, and other unconventional shale formations. The development of new gathering pipelines is expected to accelerate to connect drilling sites with the larger network of interstate/intrastate pipelines. It is estimated that anywhere from 500 to 1,250 miles of gathering pipeline will be needed over the 20-year period from 2010 to 2030.

Renewables

Pennsylvania's primary sources of renewable energy are hydroelectric, wind, and solar power. Historically, the number of large dams on the Susquehanna River that were constructed in the early 1900's presented the bulk of the available capacity for hydroelectric power, which has been an important component of renewable energy in PA. Development of renewable power utilizing wind and solar has been spurred in recent years due to the Alternative Energy Portfolio Standards Act of 2004 (AEPS).

ELECTRICAL GENERATION CAPACITY

The map below depicts the locations of the generating facilities in the state that, together, have a combined generating installed capacity in excess of 45,000 Megawatts.



Source: Electric Power Generation Association

Figure 1: Electrical Generating Facilities in Pennsylvania

Coal has been the dominant fuel for electrical generation within Pennsylvania for many years, followed by Natural Gas and Nuclear as other primary fuels. The pie chart to the right depicts the amount of installed generating capacity for Pennsylvania separated by fuel type.

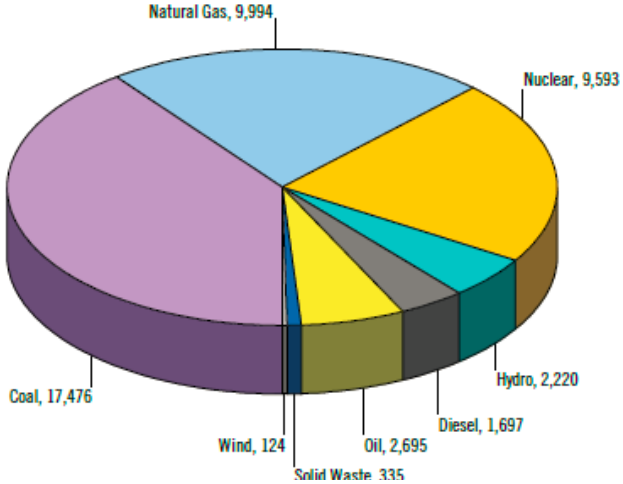
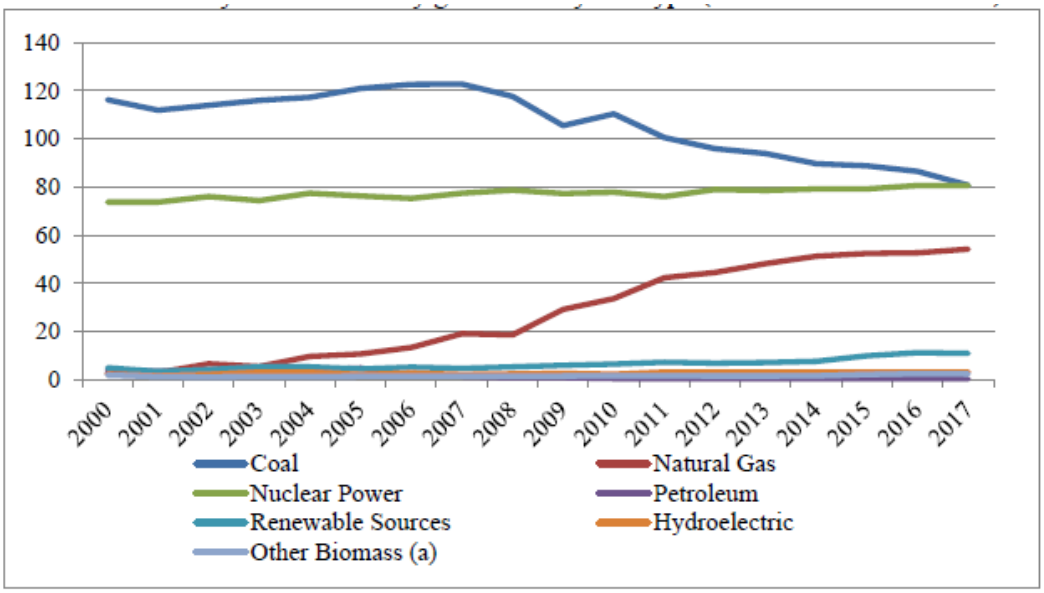


Figure 2: Generating Capacity in Megawatts by Fuel Type

As shown in the chart below, there is a trend that started in the late 2000's and is projected to continue into the near future. The steady decline in coal generating capacity and steady increase in natural gas generation is a function of environmental policy hurdles for the aging fleet of 78 coal-fired generating units. The average age of Pennsylvania's coal-fired plants in 2015 will be 46 years old. These older units tend to require routine maintenance and have a limited amount of emissions control. The cost of performing emission control upgrades on some older plants outweighs the benefit. As such, a large amount of coal-fired plants have begun to retire. By 2015, 31 of the 78 coal-fired generating units are scheduled to retire, a 29% decrease in the total amount of electricity produced by coal.

Natural gas fired facilities are the second largest in terms of generating capacity in the state, with the vast majority of the facilities being constructed within the past 15 years. These newer facilities typically achieve greater operational efficiencies than the older coal generators.

The generation from Pennsylvania's 5 nuclear plants (9 reactors) makes up the third largest portion of the electricity created in the state. The plants were mostly put into service in the 1970s and 1980s, and are all licensed for commercial operation until at least 2024. As the commercial licenses begin to expire, the operations and base-load generating capacity of the facilities will need to be evaluated.



Source: Pennsylvania Public Utility Commission, Energy Information Administration

Figure 3: Electrical Generating Capacity by Fuel Type

Overall, electricity generation in Pennsylvania averaged an annual growth rate of 1.3% from 2000 to 2010, but the growth rate is projected to slow in the near term due to continued efficiency gains and modest increases in demand for electricity in nearly all sectors of the state economy.

Electrical Transmission Network

Pennsylvania's electric generation, transmission and distribution infrastructure is part of the highly interconnected electric system that extends beyond state boundaries and is actively managed by regulatory agencies and commissions who enforce performance criteria, standards, and requirements to ensure reliability of the electric power system.

Pennsylvania is within the boundaries of the PJM RTO that covers 214,000 square miles (See Figure 4) and coordinates the operation of more than 59,750 miles of transmission lines and 185,600 MW of generating capacity.

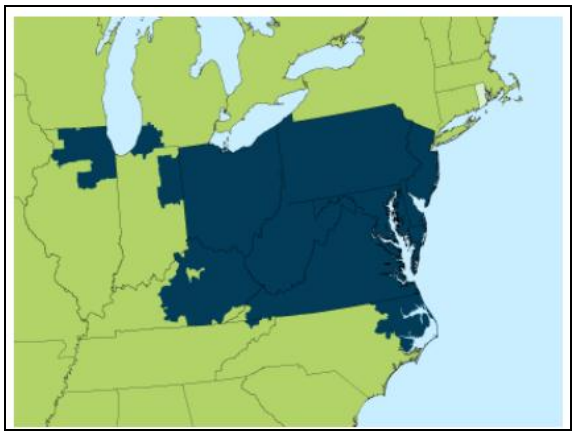


Figure 4: PJM Service Territory

Current Long-Term Reliability Assessments performed by NERC continue to project that PJM will have adequate Planning Reserve Margins[1] throughout the 2019 summer season.

Transmission expansion plans and the electric power outlook for Pennsylvania are based on regional forecast data from PJM, as the bulk electric system is planned on a regional basis rather than a state basis. Currently in Pennsylvania, 14,979 MW of proposed additional generating capacity is under active study by PJM. This proposed capacity is attributed to both new generating plants and increased capacity to existing plants. PJM continually evaluates transmission congestion and implements transmission construction and enhancements when congestion costs become too high. Congestion concerns within the PJM territory have most recently been addressed by the following 2 transmission infrastructure projects in Pennsylvania:

- TrAIL: The 500kV Trans Allegheny Interstate Line (TrAIL) was constructed in three segments, connecting substations in southwestern Pennsylvania, northern West Virginia and northern Virginia to alleviate congestion and improve reliability in Washington, D.C., Baltimore, and northern Virginia. The line was placed in service on May 23, 2011.
- Susquehanna-Roseland: A 500kV line approved by the PJM Board in order to resolve overloads on a critical 230kV circuit across eastern Pennsylvania and northern New Jersey. Expected in-service date is June 1, 2015.

CONDITIONS AND CAPACITY

Affordability

The United States Energy Information Administration publishes summary statistics in a State Electricity Profile to provide a comparative understanding of the US electricity

[1] Planning Reserve Margins = metrics used to measure the ability of a system's resources to meet customer demands based on current capacity plans and load forecasts (NERC)

market. The average retail price of 10.31 cents/kWh for electricity in Pennsylvania ranked 16th nationally.

Reliability

PJM has implemented numerous smart grid programs that may enhance future reliability.

While the high-voltage transmission system (nominally >100kV) is regulated by the Federal Energy Regulatory Commission (FERC), the electric distribution system in Pennsylvania is under the purview of the Pennsylvania Public Utility Commission (PUC or Commission). The PUC, as mandated by the Electricity Generation Customer Choice and Competition Act, is responsible for ensuring the reliability of the electric distribution system. In response to the mandate, the PUC has implemented reporting requirements designed to monitor safety, adequacy, and reliability of the system and thus, has established reliability standards to measure the performance of each electric distribution company (EDC). In Pennsylvania, 11 jurisdictional electric distribution companies (EDCs) serve the majority of the state's electricity needs for homes, businesses, and industries.

The PUC monitors the reliability of these 11 EDCs through the assessment of reliability performance metrics adopted from the Institute of Electrical and Electronic Engineers. These metrics, reported by the EDCs on a rolling 12-month average, are considered the minimum level of EDC reliability performance. In 2012, all 11 EDCs achieved compliance with two of the three reliability performance metrics and 10 EDCs achieved compliance with the third metric. All three reliability performance metrics experienced improvements in 2012 compliance compared to 2011 compliance. Note that reliability performance metrics include outages only during normal event periods; abnormal events, such as major storms are not captured in the calculations of reliability metrics.

While not included in the reliability metrics, major storms have brought to light the vulnerability of Pennsylvania's distribution infrastructure. Hurricane Sandy represented a major storm event that ranked as the worst storm for numerous Pennsylvania EDCs, causing more than 1.9 million electric outages in Pennsylvania, with many affected customers experiencing outages greater than 72 hours. These weather-related events are the leading cause of power outages in the US and have increased significantly since 1992. While transmission system outages do occur during these storm events, approximately 90 percent of outages occur along distribution systems. This highlights the need for EDCs to implement and/or have active plans in place to harden their infrastructure against storm events.

Diversity

The Commonwealth of Pennsylvania is fortunate to have multiple options for energy resources, and electrical generating capabilities. The infrastructure required for the resources and generating facilities is quite diverse, leaving the opportunity for the energy market to be responsive to market forces.

POLICY OPTIONS

Pennsylvania is a leader within the energy market in the United States, and has been on the forefront of proactive policy that shapes the direction of the energy sector in the Commonwealth. Recent legislation of note is as follows:

Act 129 - Signed into law in 2008, this legislation expanded responsibilities of the PA Public Utility Commission (PUC) to create an overall program to oversee and work with electricity distribution companies to implement electricity efficiency and peak load reduction measures in an incremental manner. Since the Act was signed into law, it is estimated that 3,383,465 MWh of electricity has been saved in Pennsylvania.

Act 13 - Signed into law in 2012, this legislation provided an update to the Oil and Gas Act (Act 223 of 1984), and established new rules and regulations for the Natural Gas Industry, including an unconventional gas well fee (also called an impact fee) for any bore holes being drilled in the production of natural gas from a geological shale formation.

Act 213 - Signed into law in 2004, this legislation requires electric generation and distribution companies to supply 18% of PA's electricity using alternative energy resources by 2021. The percentages required are escalating on an annual basis. The result of this has been a significant increase in solar power within the state. Solar is currently projected to increase within PA to meet the 2021 AEPS targets. It is important to note that the AEPS does not require generating projects to be located in PA and that targets can be met using alternate energy sources from anywhere within the PJM grid.

RECOMMENDATIONS

Electric Transmission and Distribution System

A recent electric grid resilience report released in August 2013 by the Executive Office of the President of the United States, identified hurricane-force winds as the primary cause of damage to electric infrastructure systems, recommending the upgrade of poles and structures with stronger material as a cost-effective storm hardening strategy. For distribution system upgrades, it was recommended that woods poles be replaced by concrete, steel, or composite material, and installing support wires / structural supports. Similarly, recommended transmission upgrades included replacing aluminum structures with galvanized steel lattice or concrete.

Distribution Systems should be designed to the same level of resiliency as Transmission System Structures, as well as comply with the ASCE minimum weather loading recommendations even if the structure does not exceed 60ft in height.

Although there is widespread agreement on the high strategic importance of transmission infrastructure, a comprehensive and consistent methodology for collecting transmission information does not exists. Data is typically non-comparable between regions, as each RTO/ISO has its own definition, methodologies, and formats for

calculating and publishing LMPs (locational marginal pricing) and congestion cost. By establishing universal definitions, methodologies, and data reporting requirements for transmission information, it would provide regulatory agencies with clearer information regarding the condition within and between regions.

SOURCES

- U.S. Energy Information Administration, State Electricity Profiles 2010, January 2012. Available at http://www.eia.gov/electricity/state/pdf/sep2010.pdf
- Commonwealth Economics, LLC, Energy in Pennsylvania: Past, Present, and Future, February 2013. Available at http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-96943/Final%20PA%20Comprehensive%20Energy%20Analysis.pdf
- United States Department of Energy, Energy Sector-Specific Plan An Annex to the National Infrastructure Protection Plan, 2010. Available at www.dhs.gov/xlibrary/assets/nipp-ssp-energy-2010.pdf
- Executive Office of the President, Economic Benefits of Increasing Electric Grid Resilience to Weather Outages, August 2013. Available at http://energy.gov/sites/prod/files/2013/08/f2/Grid%20Resiliency%20Report_FINAL.pdf
- North American Electric Reliability Corporation (NERC), 2012 Long-Term Reliability Assessment, November 2012. Available at http://www.nerc.com/files/2012_LTRA_FINAL.pdf
- Pennsylvania Public Utilities Commission (PUC), Electric Power Outlook for Pennsylvania 2012-17, August 2013. Available at http://www.puc.pa.gov/General/publications_reports/pdf/EPO_2013.pdf
- Pennsylvania Public Utilities Commission (PUC), Electric Service Reliability in Pennsylvania 2012, August 2013. Available at http://www.puc.pa.gov/general/publications_reports/pdf/Electric_Service_Reliability2012.pdf
- Pennsylvania Public Utilities Commission (PUC),Act 129 Statewide Evaluator Quarterly Report, November 2012. Available at www.puc.pa.gov/pcdocs/1196576.pdf
- Pennsylvania Public Utilities Commission (PUC),2012 Annual lReport Alternative Energy Portfolio Standards Act of 2004, October 2013. Available at www.puc.pa.gov/electric/pdf/AEPS/AEPS_Ann_Rpt_2012.pdf
- US Department of Energy, 2012 National Electric Transmission Congestion Study, Preliminary Findings. Available at: http://energy.gov/sites/prod/files/Updated%20webinar%20presentation.pdf

ASCE POLICY STATEMENTS

- ASCE Policy Statement 484: Electricity Generation and Transmission Infrastructure (PS 484)
- ASCE Policy Statement 489: Energy Policy (PS 489)
- ASCE Policy Statement 539: Hydraulic Fracturing (PS 539)
- ASCE Policy Statement 379: Hydropower (PS 379)
- ASCE Policy Statement 490: Nuclear Power (PS 490)

DRINKING WATER

D

Drinking water infrastructure in Pennsylvania faces a required investment of $13.9 billion over the next 20 years to replace aging facilities and comply with safe drinking water regulations. Although waterborne outbreaks are low, the number of incidents has been on the rise. Encouragingly, the number of drinking water systems in violation of clean water regulations has seen improvement. Funding research into new water treatment technology as well as reducing waste and consumption will help reduce costs, but construction and repair of drinking water facilities will require a steady source of funding. Drinking water systems must adopt full-cost pricing in water billing to reflect operational and maintenance costs as well as raising funds for eventual replacement. If funding needs are not met, the state risks reversing the public health, environmental and economic gains that have been made over the past three decades.

BACKGROUND

In 1900, the average residential usage of potable water in Pennsylvania was five gallons per day per person; today that number is 62 gallons per day per person. One million Pennsylvania households rely on 450,000 individual wells, and more than nine million people rely on the Commonwealth's 323 largest community drinking water systems alone. The Pennsylvania Department of Environmental Protection (PADEP) regulates nearly 10,000 community drinking water systems which serve more than 10 million people. While the majority of the public water systems draw from ground water sources, the 575 public water systems that use surface water serve more than 75 percent of the 12 million residents of the Commonwealth. Currently, for many households, water remains relatively inexpensive, comprising less than one percent of household income. Because most water systems do not adequately account for investment needs, residents are receiving water at rates that are greatly below cost, and the systems are not generating sufficient revenue to finance investment.

CONDITIONS AND CAPACITY

In 2013, the U.S. Environmental Protection Agency (EPA) updated its national survey of drinking water infrastructure needs on a state-by-state basis. The survey results concluded that approximately $13.9 billion would be needed over 20 years to repair, replace and upgrade the Commonwealth's community drinking water systems.

Improved water quality regulations were enacted under the 1984 Safe Drinking Water Act (SDWA) and have reduced the occurrence of waterborne outbreaks of disease to nearly zero, the number of community drinking water systems in violation of the regulations is trending upwards. According to Pennsylvania Department of Environmental Protection's (PADEP) *2012 Public Water System Compliance Report*, PADEP staff completed 7,237 enforcement actions across the state with over $360,000 in penalties being assessed.

FUNDING AND FUTURE NEED

Federal assistance has not kept pace with demand for drinking water infrastructure improvements. Since 1997, Congress has averaged between $700 million and $850 million annually for the SDWA's State Revolving Loan Fund (SRF) program, enacted in 1987. The FY 2012 allocations for the SRF included a $26.3 million designation for Pennsylvania, while the amount dropped to $24.67 million in 2013.

According to a report issued by the Sustainable Task Force on Infrastructure published in 2008, the estimated capital investment for improvements to Pennsylvania's drinking water system is estimated to be $11.5 million over the next 20 years (estimated in 2007 dollars). This estimate falls in line with the USEPA's estimates listed above.

When the current water usage rates are compared with the available funding from state and Federal agencies over the next 20 years, a funding gap of $8.1 billion appears, with over half of the gap being for systems serving less than 3,300 people. It should be noted that the funding gap between projected water investment needs and current spending levels is dependent upon the growth of user rates. The gap would be approximately $3.7 billion if rates are raised to a level comparable to 1.5 percent of median household income (MHI).

The gap analysis provides a starting point for the magnitude of Pennsylvania's drinking water infrastructure funding issues. While the data available represents a reasonable effort to quantify the funding gap, more detailed statewide data would further assist in more accurately quantifying the problem and projecting the impact of potential remedies.

In 1988, Pennsylvania created the Pennsylvania Infrastructure Investment Authority (PENNVEST) to help communities finance infrastructure investments. PENNVEST serves as the financing agency for the Federal drinking water SRF authorized by the 1996 Safe Drinking Water Act Amendments. Since 1988, PENNVEST has funded more than $1.5 billion in water supply infrastructure improvement projects.

Increased Federal subsidies for drinking water needs would help finance required investment, but Federal support cannot be expected to address the entire program. Operation and maintenance (O&M) costs are not eligible for Federal funding and must be borne entirely by local utilities. Therefore, water system customers will be forced to pay for the vast majority of the needed investments not funded by the Federal or state governments.

Clean and safe water is provided for the public good; therefore, the central question becomes, to what extent can and will ratepayers pay for needed investment? While rate increases will not adversely affect most households, many low-income families may not be able to afford the added expense.

POLICY OPTIONS

Clean and safe water is no less a state priority than are adequate roadway systems and a

safe and efficient aviation system. New solutions are needed for what amounts to more than $13.9 billion in critical drinking water investments that Pennsylvania will require over the next two decades. If investment needs are not met, the state risks reversing the public health, environmental and economic gains that have been made over the past three decades.

Without a significantly enhanced Federal role in providing assistance to drinking water infrastructure, the role of critical investments will fall to Pennsylvania. The case for state assistance to address the unprecedented needs is compelling. In many locations, public water systems cannot be expected to meet this challenge alone, or these communities face losing competitive economic advantage to neighboring communities, other regions and states due to inordinately high utility rates. Additionally, because source waters are shared across local boundaries, the benefits of state help will be realized by entire regions of Pennsylvania.

Equally compelling is the case for flexibility in the forms of state investment, including grants, loans and other forms of assistance. Increasingly, grants will be needed for many communities that simply cannot afford to support the cost to meet public health, environmental and/or service-level requirements. Loans and credit enhancements may be sufficient for public water systems in communities with greater economies of scale, wealthier populations, and/or fewer assets per capita to replace. Other possible investment solutions include trust funds and incentives for private investment.

RECOMMENDATIONS

The four Pennsylvania Sections of the American Society of Civil Engineers (ASCE) encourage the Commonwealth to support much needed water Infrastructure funding going forward. By increasing state and/or Federal funding on drinking water infrastructure improvements, the demand of usage rate increases can be lessened. While the Governor's Report Card has gone further to catalog the need than the USEPA's previous studies and management improvements have been made as a result of the Capacity Enhancement Program, there are still significant improvements needed.

In addition, the Sections support the following recommendations:

Focus on technology

State government can play an essential role in promoting research, development, testing and evaluation of new technologies and the dissemination of information about proven technologies. ASCE supports state-funded research into water and wastewater treatment technology, which may reduce capital expenditures as well as O&M costs. By creating research partnerships with universities throughout the state, Pennsylvania may reap additional economic benefits through public-private partnerships and licensing of new technologies.

Regulators, engineers and drinking water operators tend to be conservative when it

comes to adopting new technologies which exist to clean and repair old pipes, providing low-cost alternatives to replacement of distribution mains. New pipe materials can also reduce water leaks, thereby reducing demand. In order to gain acceptance by the drinking water industry, these new technologies must be supported by full-scale demonstrations. A further example is the adoption of Smart Technology in water metering. Water meters are the direct link between the distribution system, the consumer, and the billing department. Over time, the aging meters begin to wear down and allow un-billed water to pass by the meter without being read. Estimates from meter replacement programs show that providers could be under-billing the customers by as much as 35 percent because of meter reading issues. With the advances in metering technology, and the introduction of no-moving-parts meters, customers can be more accurately billed for the water they actually use and the water systems can be better able to track water usage to determine the presence of a leak in near real time. Proper billing can help to reduce the funding gap without an official rate increase.

Promote sustainable infrastructure initiatives

In many cases, the approach towards public infrastructure is reactive. Systems are built and operated with minimal maintenance until they wear out. Water systems need to conduct a full accounting of the costs to manage their assets both for current operations and future infrastructure needs. By appropriately managing its assets, a system may be able to reduce the overall investment required. In order to close the funding gap, state governments can take several actions. They must support programs that will make infrastructure more sustainable and promote better asset management techniques that will reduce long-term costs and improve performance, including water reuse. They must encourage strides in water efficiency, which will reduce drinking water consumption and the volume of wastewater to be treated, and advocate for full-cost pricing of water and wastewater treatment. Finally, they must support the reduction of non-point-source pollution of water sources.

Full-cost pricing

Advocating for full-cost pricing on water billing to ensure that future repairs, distributions needs, and future treatment are accounted for in current water rates.

Provide reduced rates to the disadvantaged

In order to cushion the impact of rate increases on low-income households, the State should either: a) encourage municipalities to use lifeline rates for low-income households or b) develop a rate reduction program similar to the Federal low-income Energy Assistance Program.

Issue state bonds

With decreasing Federal funding for the SRF program, Pennsylvania should leverage the remaining Federal dollars as collateral for the issuance of state bonds — effectively doubling the amount of capital available for infrastructure investments.

Protect water sources in farming communities

Continue to fund low-interest loans to farmers, so that they may implement best management practices for land management and manure handling and storage to protect drinking water sources.

Develop Standards for Private Water Wells

Currently, no standards exist for private wells. These wells are a potential access point for contamination of the state's groundwater supplies. Standards for private well construction would mandate best practices so private wells protect the Commonwealth's resource from potential contamination.

Environmental Infrastructure Needs Inventory

Support the establishment of an evolving statewide environmental infrastructure needs inventory to be administered by the state's municipal planning organizations. This inventory would serve as a mechanism to differentiate between expenditures for current consumption and long-term investment, and would reduce major inefficiencies in the planning, design and construction process for long-term investments. An infrastructure needs inventory would help to increase public awareness of the problems and needs facing the state's physical infrastructure, and would help the state legislature to focus on programs devoted to long-term growth and productivity. We would recommend including a 5-year projection of future needs on the current permit renewals process in order to accurate generate an accurate infrastructure needs inventory utilizing a an existing permitting process.

SOURCES

- United States Environmental Protection Agency, *Drinking Water Infrastructure Needs Survey and Assessment*" 2013
- United States Department of Homeland Security, *Water Sector-Specific Plan*, 2010
- Edward Rendell, Governor's Sustainable Infrastructure Task Force Report, *Creating a Sustainable Solution for Pennsylvania*, 2008
- Pennsylvania Department of Environmental Protection (PADEP), *Governor's Report on the Capacity Enhancement Program*, 2011
- PADEP, *Pennsylvania Public Water System Compliance Report for 2012, 2013*

ASCE POLICY STATEMENTS

- ASCE Policy Statement 299: Infrastructure Investment Policy
- ASCE Policy Statement 361: Implementation of Safe Drinking Water Regulations
- ASCE Policy Statement 420: Clean Water Act Reauthorization
- ASCE Policy Statement 422: Watershed Management

- ASCE Policy Statement 453: Federal Capital Budgeting
- ASCE Policy Statement 480: Water Infrastructure and Facilities Construction Funding

DAMS

C-

There are a total of 3,358 state-regulated dams in Pennsylvania, including 768 high hazard potential dams (23 percent); 297 significant hazard potential dams (9 percent); and 2,293 low hazard potential dams (68 percent). High hazard potential dams are those whose failure would cause probable loss of human life and substantial property damage. Of the 776 high hazard potential dams in Pennsylvania, 518 (67 percent) are considered as "deficient." A "deficient" dam is any dam where the existing condition of the dam has been rated as less than satisfactory, a portion of which have deficiencies that if not corrected could result in the failure of the dam with subsequent loss of life or substantial property damage. The estimated cost to repair all Pennsylvania dams projected to be found deficient over the next five years is more than $1.4 billion. Due to the establishment of the Pennsylvania Department of Environmental Protection's (PADEP's) Dam Safety Program in the late 1970s and recent updates to the program in 2011, Pennsylvania has remained ahead of most states in dam safety. Pennsylvania's dam safety program, in terms of funding, staffing and efficacy, generally ranks well above national averages. For Pennsylvania dams, a grade of C- reflects the positive benefits of Pennsylvania's dam safety program, balanced against the high number of dams in need of repair, the $1.4 billion needed for repair and rehabilitation of deficient high hazard potential dams, and the significant threat a dam failure would pose to public health, safety and property, the environment and to local, county and state economies.

BACKGROUND

Compared to other parts of the U.S., Pennsylvania has ample surface water resources. Man-made reservoirs exist throughout the Commonwealth and provide substantial benefits to the public including: water supply, irrigation and industrial uses, flood control, hydroelectric power, fire protection, recreation, and navigation. However, Pennsylvania's dams are aging and deteriorating while downstream populations are increasing. The dams that impound these reservoirs represent a significant risk to public safety, local and regional economies and the environment if they are not well managed and maintained. This situation demands greater attention to and investment in measures that reduce risks to public safety and economic assets.

Historically, some of the worst disasters in the U.S. have resulted from dam failures. In 1889, more than 2,200 lives were lost when the South Fork Dam above Johnstown, Pennsylvania failed. During the 1970s, the failures of the Buffalo Creek Dam in West Virginia, Teton Dam in Idaho, and the Toccoa Falls Dam in Georgia resulted in a combined loss of 175 lives and more than $1 billion in damages.

These 1970s dam failures spurred the federal government into action and led to the enactment of PL 92-367 the National Dam Inspection Act of 1972. In 1978, the U.S. Army Corps of Engineers (USACE) began the national dam inspection program. In

1979, federal guidelines for dam safety were prepared and published by the Federal Emergency Management Agency (FEMA 93, 1979).

After the National Dam Inspection Program inspections were completed, Pennsylvania's Dam Safety Program (DSP) moved forward quickly, making $100 million in funding available for repairs through low-interest loans from the Water Facilities Loan Board and its successor, the Pennsylvania Infrastructure Investment Authority (PENNVEST), with an additional $140 million for upgrades financed by other sources. As a result, Pennsylvania's DSP made significant progress earlier than most states. However, the absence of a dam rehabilitation grant or loan program for dams other than those for public water supply limited the pace at which Pennsylvania's Dam Safety Division could address dam safety issues through the 1980s and early 1990s.

One of the underlying national problems at this time was that Pennsylvania did not have an established group with regulatory authority or experience on dam safety issues. To address this problem, Pennsylvania enacted the Dam Safety and Encroachments Act in 1978. The Department of Environmental Resources (DER), which was the predecessor to the Pennsylvania Department of Environmental Protection (PADEP), established the Bureau of Dams and Waterway Management (now known as the Bureau of Waterways Engineering and Wetlands) shortly thereafter. The Bureau operates one of the few state-level comprehensive flood protection programs in the U.S. and has an active dam removal program with approximately 25 dams removed per year. Dams are removed for a variety of reasons, including ecological, social and economic. Many dams no longer serve the function for which they were constructed. On average, it costs 3 to 5 times more to repair a dam than to remove it.

Pennsylvania Dam Safety regulations were significantly updated in 2011. A majority of the changes clarified existing regulations to reflect policy under which the program had been operating for many years. This assisted owners and engineers in understanding the regulations. The 2011 regulations provide four hazard potential categories, as opposed to three under the previous regulation. A requirement to provide financial responsibility (bond) for all existing hazard potential category 1 and 2 dams (high hazard potential and significant hazard potential) was added. Clarification of activities that constitute a dam permit action or an amendment to an existing permit was added. Additional details regarding structural stability requirements were added, specifically citing minimum acceptable factors of safety for relevant loading conditions. Incremental dam breach analysis was established as the preferred method to determine the acceptable spillway design flood for dams. Details for construction oversight, completion documentation, and reservoir filling/refilling rates were added. Outlet works requirements, including sizing and location of controls, were revised. Emergency Action Planning (EAP) criteria and details were revised and strengthened to better address revisions and plan updates. EAP updates are required every five years for Category 1 and 2 dams.

The federal government provided some assistance with program improvements through the National Dam Safety Act of 1996. This act was re-authorized as the National Dam

Safety and Security Act of 2002, and subsequently as the National Dam Safety Program Act in 2006. This provided funding through grants ranging from $6.5 million in 2007 to $9.2 million in 2011, for distribution among state dam safety programs. The Act expired in 2012 however, it is included in the Water Resources Reform & Development Act of 2013 (WRRDA) that is currently working its way through Congress. This funding would not available for dam repairs or upgrades. The National Dam Repair and Rehabilitation Act was introduced in both the House and Senate in previous legislative sessions and, if passed, would have provided grant funding to public dam owners.

CONDITIONS

There are a total of 3,358 state-regulated dams in Pennsylvania: including 768 high hazard potential dams (23 percent); 297 significant hazard potential dams (9 percent); and 2,293 low hazard potential dams (68 percent). Dam hazard rating refers strictly to the potential for downstream flooding and not 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 can cause economic loss. Of the 768 high hazard potential dams in Pennsylvania, 518 (67 percent) are considered as "deficient". This represents a 41 percent increase in the number of deficient dams in Pennsylvania since 2010, when 367 were identified as deficient. This dramatic increase in the number of deficient dams in Pennsylvania is largely due to the inclusion of dams with poor maintenance, as well as reclassification of existing dams from a lower hazard potential classification to a high hazard potential classification due to an increase in the Population at Risk (PAR) resulting from population encroachment, updates to Pennsylvania's dam safety criteria, and increased inspection efforts by state dam safety officials. A "deficient" dam is defined as any dam where the existing condition of the dam has been rated as less than satisfactory, a portion of which have deficiencies that if not corrected could result in the partial or complete failure of the dam or any appurtenant structure or facility with subsequent loss of life or substantial property damage. Pennsylvania is continually finding new dams and reclassifying others as downstream conditions and development change.

While the estimated repair costs can vary significantly based upon a number of factors, estimated average repair costs can often range from $1.5 million to $4 million per dam. The total estimated cost for upgrading Pennsylvania's 518 deficient high hazard potential dams could likely exceed $1.4 billion. In addition, many of the structures that were upgraded in the early to mid-1980s may soon reach a point where additional upgrades and/or repairs are necessary to meet current state dam safety standards.

The National Inventory of Dams (NID) is a database which documents dams in the U.S. and its territories. The NID includes all high and significant hazard potential classification dams and all low hazard potential dams that meet specific height and reservoir storage requirements. The current NID, published in 2013, includes data on 87,359 U.S. dams. State Dam Safety Offices regulate 77 percent of the dams listed in

the NID. Pennsylvania currently has 1,552 dams included in the NID database, a summary of Pennsylvania dams included in the NID are as follows:

Hazard Potential	No. of Dams	Percentage of Total
High	819	53
Significant	342	22
Low	388	25
Undetermined	3	<1

Dams by Height	No. of Dams	Percentage of Total
<25 ft	837	55
26-50 ft	458	30
51-100 ft	175	11
>100 ft	68	4

Dams by Owner Type	No. of Dams	Percentage of Total
Privately Owned	959	62
Local Government	355	23
State Owned	155	10
Federal Owned	69	4
Public Utilities	14	<1

Primary Purpose	No. of Dams	Percentage of Total
Recreation	800	51
Water Supply	243	15
Flood Control	217	14
Other	87	6
Tailings	57	4
Fire Protection	43	3
Irrigation	29	2
Hydroelectric	23	2
Navigation	17	1
Fish and Wildlife	16	1
Unknown	13	<1
Debris Control	7	<1

Dam Type	No. of Dams	Percentage of Total
Earth	1353	87
Concrete	49	3

Gravity	47	3
Stone	34	2
Rockfill	25	2
Masonry	11	1
Timber Crib	10	1
Other	10	1
Unknown	6	<1
RCC	5	<1
Arch	1	<1
Buttress	1	<1

In Pennsylvania, approximately 48 percent of dams are greater than 50 years old and approximately 14 percent are greater than 100 years old.

With its early start on the investigation and rehabilitation of its seriously deficient dams, Pennsylvania remains ahead of most other states in terms of condition of dams statewide. A large number of Pennsylvania's high hazard dams have been upgraded to the current dam safety criteria. Pennsylvania ranks second nationally, behind only California, in terms of annual funding for dam safety—approximately $2.5 million in 2012. Pennsylvania ranks third nationally, behind only California and Texas, in terms of the number of full-time employees in their dam safety program with 27, including 8 full-time dam safety inspectors. Pennsylvania compares very favorably with the national average in terms of the number of regulated dams per full-time dam safety employee with 118 dams per full-time employee in Pennsylvania versus the national average of 192 dams per full time employee. Pennsylvania also compares favorably with the national average of regulated high hazard potential dams per full-time dam safety employee, each with about 28 high hazard potential dams per full-time dam safety employee.

Pennsylvania ranks well above the national average in terms of funding per state regulated dam with $735 per state regulated dam versus the national average of $518 per state regulated dam. However, it ranks below the national average in terms of funding per state regulated high hazard potential dam with approximately $3,200 per state regulated high hazard potential dam versus the national average of approximately $3,900 per state regulated high hazard potential dam.

Pennsylvania ranks well above the national average with approximately 91 percent of its high hazard potential dams having an Emergency Action Plan (EAP) compared to a national average of approximately 74 percent. Pennsylvania also ranks above the national average with approximately 54 percent of Pennsylvania's significant hazard potential dams having an Emergency Action Plan (EAP), compared to a national average of approximately 45 percent. An Emergency Action Plan is a formal document that identifies potential emergency conditions at a dam and specifies actions to be followed to minimize loss of life and property damage.

For these reasons, Pennsylvania dams have an assigned a grade C- for the condition of its dams. The grade for Pennsylvania's dams reflects in large part, the efficacy of its commitment to dam safety, including its recent (2011) updates to Pennsylvania's Dam Safety regulations, as well as the successful execution of its dam safety program. Despite the fact that Pennsylvania operates a model dam safety program, a grade of only a C- was assigned because there is still a great deal of dam safety work that remains to be done in the Commonwealth. Pennsylvania is one of the top ten states in the nation with the number of state regulated high hazard potential dams in need of repair. Regrettably, the number of dams identified as deficient is increasing at a faster rate than those being repaired.

POLICY OPTIONS

The main issue preventing the PADEP Division of Dam Safety from achieving its goals and many owners from improving their dams is a lack of funding for dam rehabilitation projects. In 2012, the Association of State Dam Safety Officials (ASDSO) estimates that approximately $54 billion is needed to rehabilitate dams across the nation, based on the current national inventory of non-federally owned dams. This statistic highlights the need for a national dam rehabilitation program, a goal that is the driving force behind the formation of the Dam Safety Coalition. This coalition is comprised of a number of national associations and agencies, including ASCE, ASDSO, the National Society of Professional Engineers, the National Watershed Coalition, and the U.S. Society on Dams. The Dam Safety Coalition supports the creation of a federal funding program to repair the nation's unsafe dams, addressing the critical issue of deteriorating dam structures that pose a severe threat to many communities throughout the country.

In addition to federal funding, the H2O PA Act was passed in 2008, establishing funding of up to $800 million for water infrastructure projects, including a minimum of $50 million for unsafe, high hazard potential dams and a minimum of $75 million for flood control projects of which a portion has been used to repair flood control dams. To date, approximately $90 million has been awarded for rehabilitation or removal of 24 of these dams.

RECOMMENDATIONS

The four Pennsylvania sections of ASCE recommend that the following measures be taken to promote dam safety within Pennsylvania:

- Passage of state legislation to provide additional funding for rehabilitation of Pennsylvania dams, which will be needed for leverage of any federal funding programs that may be enacted, and low-interest loans for private dam owners;

- Passage of the Dam Rehabilitation and Repair Act which was introduced in 2012 in the 112th Congress (2011-2013) but was not enacted. The Act would establish a program to provide grant assistance to states for the repair,

rehabilitation and maintenance of non-federal publicly-owned, non-Federal, high-hazard potential deficient dams; and

- Re-authorization and full funding of the National Dam Safety Program Act (P.L. 109-460).

SOURCES

- American Society of Civil Engineers (ASCE) Central PA, Lehigh Valley, Philadelphia, Pittsburgh, *2010 Report Card for Pennsylvania's Infrastructure*: May 2010. Available at: http://www.pareportcard.org/
- American Society of Civil Engineers (ASCE), *2013 Report Card for American's Infrastructure*: March 25, 2013. Available at: http://www.infrastructurereportcard.org/
- Association of State Dam Safety Officials (ASDSO), *State and Federal Oversight of Dam Safety Must Be Improved,* news media document, November 2008.
- Northeast Region Council for Safe Dams, Funding for Dam Rehabilitation – *Pennsylvania Dams Needs Statement.*
- Pennsylvania Department of Environmental Protection (PADEP), *Dam Safety and Encroachments Act* (1978).
- Pennsylvania Department of Environmental Protection (PADEP), *H2O PA Act* as it relates to Dam Rehabilitation Projects (July 2008).
- Pennsylvania Department of Environmental Protection (PADEP), *The Inspection, Maintenance and Operation of Dams in Pennsylvania* (1999).

ASCE POLICY STATEMENTS

- ASCE Policy Statement 470: *Dam Repair and Rehabilitation (PS 470)*
- ASCE Policy Statement 280: *Responsibility for Dam Safety (PS 280)*

BRIDGES

D+

Of Pennsylvania's more than 22,660 bridges, 23 percent are considered structurally deficient, which is the highest percentage in the nation. While safety is the most important concern, a bridge closure or weight restriction can impact both local and regional traffic and the economy of the region. The Commonwealth's bridges are 10 years older than the national average and are in dire need of repair and modernization. In November of 2013, the Pennsylvania legislature passed Transportation Funding Bill Act 89, an unprecedented transportation funding package that will bring much needed investment to the Commonwealth's transportation system. However, it will not be fully funded until 2019, so cannot yet have an effect on the current bridge report card. Unfortunately, even with the additional funding fully in place, it is estimated that approximately 40 percent of the needs for bridges in the Commonwealth will not be met in 2019. As noted in this report, the ASCE recently adopted a more robust set of criteria in assigning infrastructure grades nationally, and this section reflects this new methodology.

BACKGROUND

Weight Restriction on a Structurally Deficient Bridge Picture Courtesy of Gannett Fleming, Inc.

The economy and the quality of life in the Commonwealth of Pennsylvania (the Commonwealth) require a transportation system that provides a safe, reliable and efficient driving environment. The Commonwealth's transportation system includes over 22,660 bridges, the third highest number of bridges in the nation, and over 114 million drivers pass over these bridges every day. These bridges are inspected a minimum of every other year and given numeric condition ratings based on the observed condition of the components (i.e. beams, deck slab, abutments, piers, etc.) to determine their physical condition.

If the main components of the bridge exhibit high levels of deterioration, the bridge is classified as **Structurally Deficient** (SD). While not unsafe, these bridges may require significant maintenance and rehabilitation, or replacement, and the owner must post limits for both speed and the weight of vehicles permitted to cross these bridges.

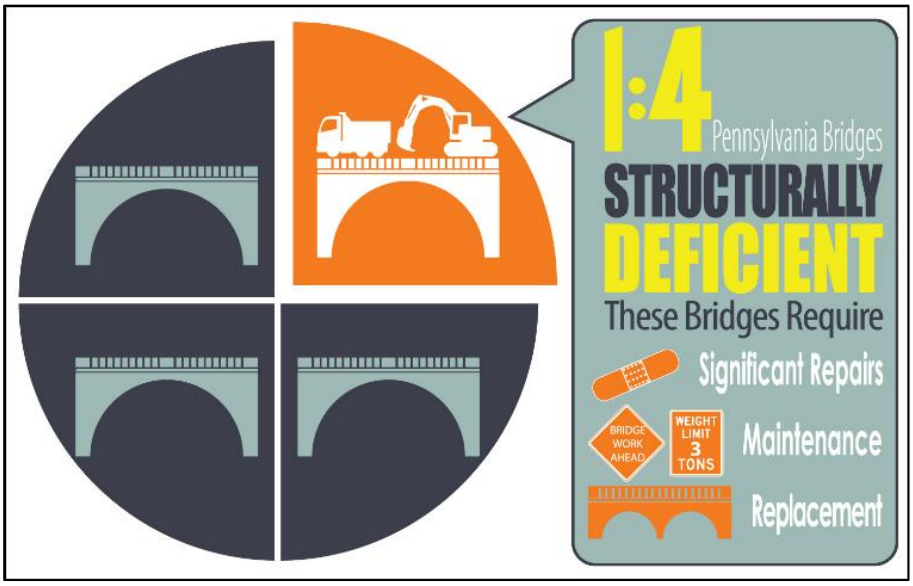
The bridges are also evaluated in terms of outdated design features such as low traffic capacity, narrow lane and shoulder widths, lack of bicycle lanes or pedestrian accommodation, and low overhead or under-clearances. If the bridge does not meet the current standards for such features, the bridge is classified as **Functionally Obsolete** (FO). FO bridges are not automatically rated as SD, nor are they inherently unsafe;

however, traffic congestion may result due to their inability to meet the demands of today's traffic and/or their susceptibility to flooding.

CONDITION AND CAPACITY

Currently, of the Commonwealth's 22,660 bridges[1], nearly one in four (23 percent) is categorized as SD. This is the highest percentage compared to the national average of 11 percent. In addition, nearly one in five (19 percent) of Pennsylvania's bridges is categorized as FO, compared with a national average of 14 percent. State, county, local, private, and authority (Pennsylvania Turnpike) bridges are included in these percentages. Moreover, on average more than 16 million vehicles cross the Commonwealth's SD bridges every day, which makes the Commonwealth the fourth state with the highest number of vehicles travelling on SD bridges in the nation.

The total percentage of SD bridges has decreased by 4 percent since the 2010 report card, largely due to a short-term increase in funding. Funding increased due to the Accelerated Bridge Program that the Pennsylvania Department of Transportation (PennDOT) undertook between 2008 and 2010, as well as the Pennsylvania Act 44 of 2007 and the federal American Reinvestment and Recovery Act of 2009 (ARRA). Although the Commonwealth still has the highest percentage of SD bridges in the nation, investment and attention to this statistic is having a positive impact on bridge safety across the Commonwealth.

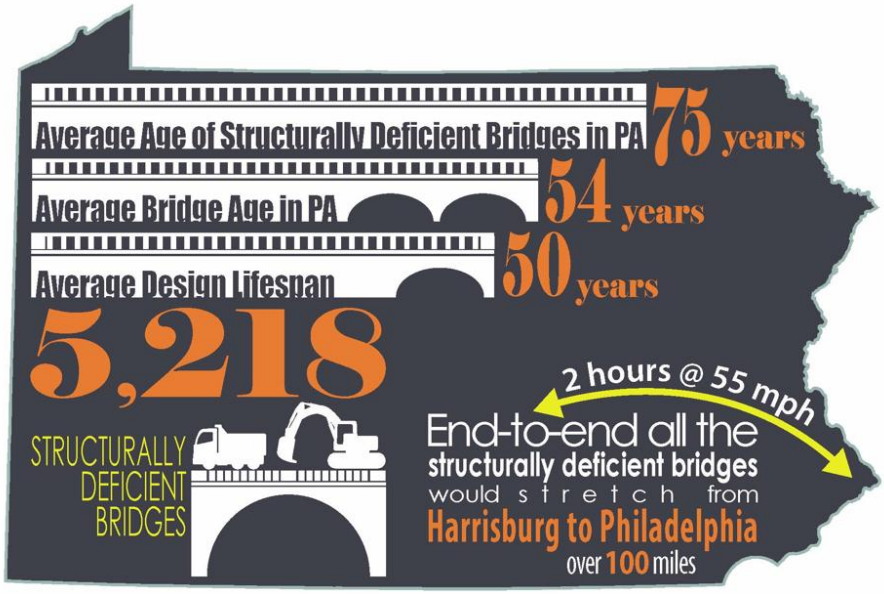


Still, approximately 300 bridges are added to the SD category each year due to age and deterioration. The Commonwealth has nearly 6,400 locally owned bridges and approximately one-third are SD.

To reach the national average of SD bridges, PennDOT and other local jurisdictions in the Commonwealth need to reduce the total number of SD bridges to approximately

[1] Only bridges with 20-foot or longer span were considered, as this is consistent with the Federal Highway Administration's (FHWA) definition of a "bridge".

2300. This equates to more than 400 bridges each year for the next 23 years that must be taken off the SD list (keeping in mind that 300 per year are added to this list due to age and deterioration). PennDOT also has an active maintenance and preservation program including painting, deck joint repair or replacement, deck overlays, and other rehabilitation actions. In the long run, investment in bridge preservation saves money by extending bridge service life, thus deferring the need for major bridge rehabilitation.



Historically known as the Keystone State, the Commonwealth serves as a key link in the nation's infrastructure in the Mid-Atlantic region, connecting people and commerce north-to-south and east-to-west. As a result, the Commonwealth's bridges suffer from disproportionately high truck loads, both in terms of the weight of trucks and the percentage of trucks in traffic. A recent study performed for PennDOT revealed that on average 15 percent of the trucks traversing the bridges in the Commonwealth were "overweight" according to both federal and state limits. This high quantity of overweight trucks is exposing the Commonwealth's bridges to much higher loads than they were designed to handle, leading to faster deterioration of a large population of bridges. In addition, the surge in drilling activity in the Marcellus Shale in Western Pennsylvania since 2008 has increased heavy truck traffic on many of the Commonwealth's bridges. Also, in this area, many of these bridges are on rural roads and were not designed for the number or weight of trucks currently being carried.

Adding to the difficulty of keeping up with maintenance needs is the toll that harsh winter weather takes on the many bridges throughout the Commonwealth. Deicing chemicals, such as road salt, applied to the Commonwealth's roads and bridges cause corrosion of steel members and deterioration of bridge concrete decks that shorten the service life of a bridge. Bridges in southern states, for example, are not exposed to such conditions and, thus, it is less costly to preserve them.

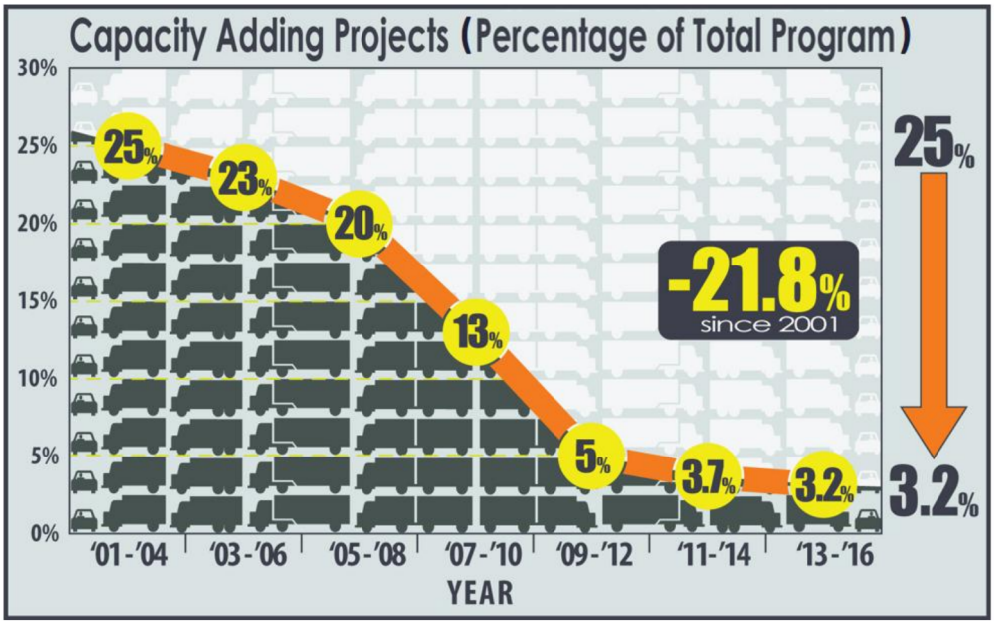
In addition, the Commonwealth has some of the oldest and most heavily travelled highways and bridges in the nation. While on average, typical highway bridges were designed for a 50-year lifespan when most of PA bridges were constructed (as opposed to 75-year lifespan for more modern bridges), the average age of highway bridges in the

Commonwealth is now approximately 54 years. This is more than ten years older than the national average. Also, the average age of the SD bridges in the Commonwealth is 75 years.

SD bridges can lead to weight restrictions, or “bridge postings”, particularly if the bridge is deemed to be incapable of carrying legal truck loads. These weight restrictions contribute to traffic disruptions, such as detours and traffic congestion, and pose inconveniences for commercial vehicles and school buses which may be forced to take lengthy detours. When Pennsylvania’s bridges are posted, the economy of the region is directly impacted since lengthier transportation routes cost both drivers and businesses more. In addition to load capacity issues, the high percentage of functionally obsolete bridges in the Commonwealth indicates that the capacity for traffic (bridge width) or under-clearance of many bridges in the state is inadequate. The only practical way to solve this problem is through bridge replacement or major rehabilitation.

At current and projected levels of state funding, more than 95 percent of transportation dollars are exhausted in keeping the existing system functional, leaving very little funding for capacity-adding projects. In addition, funding level for capacity-adding projects has dropped significantly over the past few years as shown in Figure 1.

Figure 1: Funding Levels for Capacity Adding Projects
SOURCE: Pennsylvania Transportation Performance Report 2013



Capacity-adding projects include wider highways and bridges as well as new highways, bypasses and bridges. As is the case with many states, the focus has shifted to maintenance of the existing bridges in the Commonwealth, as PennDOT struggles to the maintain highway mileage that currently exists with limited funding. Over time, this unsustainable trend will result in a highway system that is unable to meet the demands of continued increase in the traffic volumes.

FUNDING AND FUTURE NEEDS

Pennsylvania's aging transportation infrastructure has suffered from decades of under-investment, due to rising construction costs and limited tax revenues associated with fuel consumption. The revenue to operate, maintain and preserve the Commonwealth's roads and bridges comes primarily from state and federal taxes on motor fuel. Unlike other states, contrary to public perception, income and sales taxes are not used to pay for roads and bridges in Pennsylvania. Funding in the Commonwealth comes from these resources:

- General funds
- The liquid fuels (gasoline) tax
- Vehicle registration fees
- Driver license fees

Cars today are more fuel efficient due to the new federal Corporate Average Fuel Economy (CAFE) standards. Vehicles are now using less gasoline per mile travelled; therefore, the Commonwealth now collects less fuel tax revenue per mile traveled than it has at any time in the past. While providing environmental benefits, the increase of hybrid and alternative fuel vehicles has also inadvertently hurt the revenue stream to repair roads and bridges. These vehicles contribute the same level of wear and tear as a gas powered vehicle, but they are not paying an equal share since they are purchasing less gasoline. When adjusted for inflation, the total gas tax paid by the average driver has decreased more than 60 percent since about 1970 (as shown in Figure 2), while the cost of construction and maintenance continues to increase with inflation.

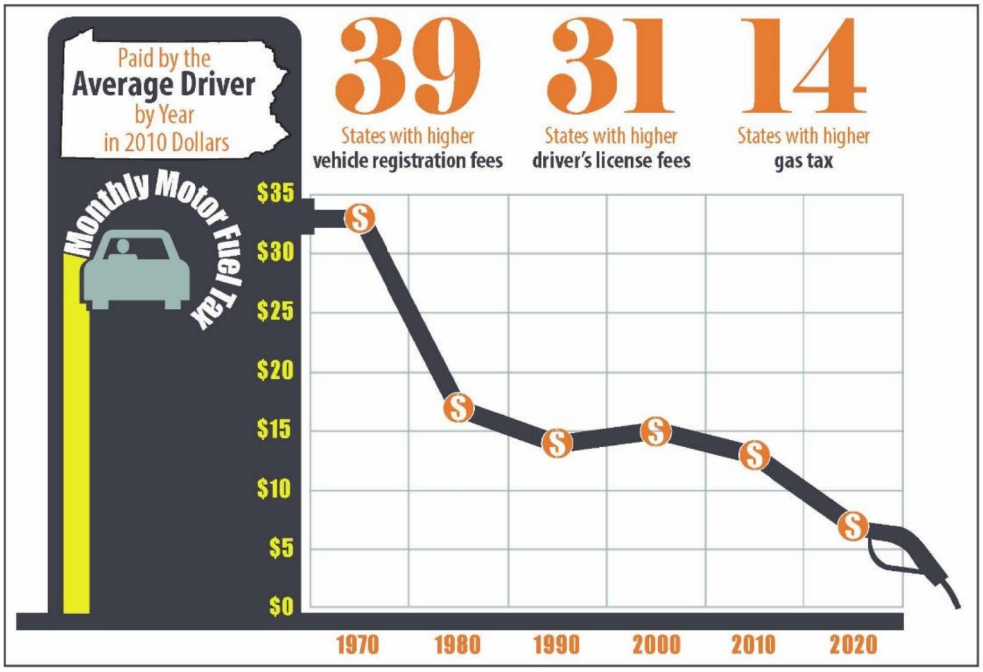


Figure 2: Monthly Motor Fuel Tax Paid by the Average Driver by Year in 2010 Dollars
Source: Transportation Funding Advisory Commission Report, August 2011

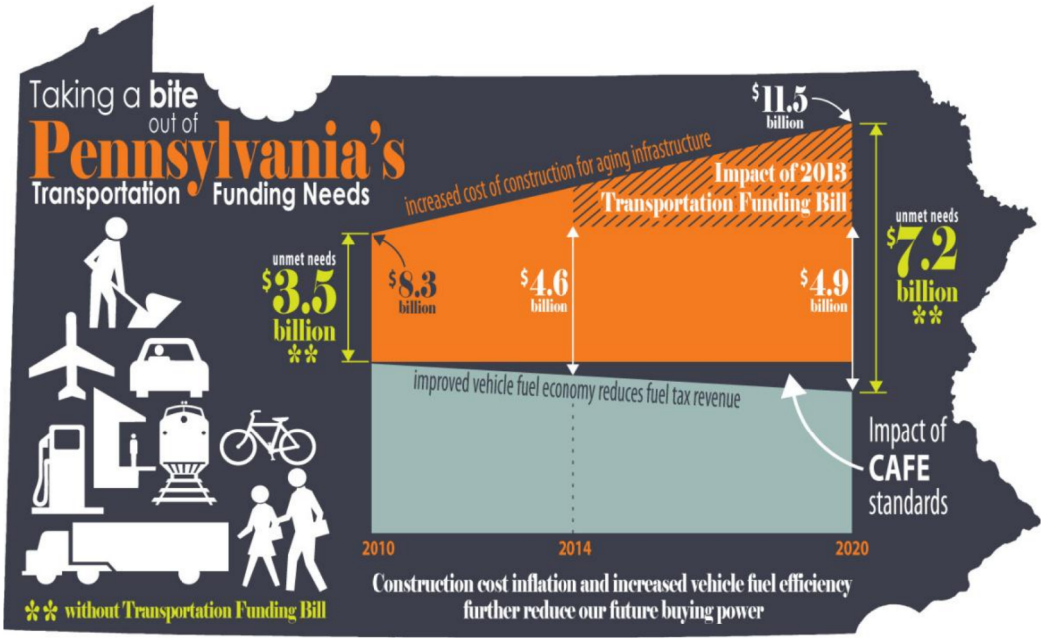
This has led to a serious decline in the amount of money available for improvements to the transportation system, leading to a growing funding gap as shown in Figure 3.

The Commonwealth has the fifth-largest state-owned roadway network in the nation, but transportation fees and taxes that fund the highways and bridges are considerably lower compared to the other states and have not increased since 1970s:

- 39 other states have vehicle registration fees higher than Pennsylvania,
- 31 other states have higher driver's license fees, and
- 14 other states have higher gas taxes.

Some temporary increases in funding were experienced through the Accelerated Bridge Program as well as Act 44 and ARRA, but these all had been short-term increases. Funding for bridges in the Commonwealth has generally been on the decline. As a result, money spent on bridge construction projects has dropped from a high of $1.02 billion in 2009 to $619 million in 2012. The continued underinvestment in transportation systems for so many years has posed a serious threat to PennDOT's ability to maintain bridges in a state of good repair.

Figure 3: Pennsylvania's Transportation Funding Needs
Source: Transportation Funding Advisory Commission Report, August 2011



In June 2013, the State Senate approved a bipartisan transportation spending plan of $2.3 billion, and the House passed an amended version of the bill in November 2013. The new transportation funding plan (Transportation Funding Bill Act 89) was signed into law by Governor Corbett on November 25, 2013. The plan will provide an additional $2.3 billion (for all modes of transportation) by 2019. In 2019, the additional amount to be allocated specifically for improving state roads and bridges is estimated to grow to $1.3 billion plus an additional $237 million for local roads and bridges and limited budget for gravel and dirt roads. With the passage of this historic funding bill, Pennsylvania will experience a significant improvement in the long term and a comprehensive and sustainable funding for its transportation system. However, it should be stated that, even with the Transportation Funding Bill Act 89 fully in place, it is estimated that approximately 40 percent of the funding needs for bridges in the Commonwealth will still not be met in the fifth year of the plan (2019).

The evidence suggests that there is high return for transportation investments. According to a Federal Highway Administration (FHWA) study in 2008, each dollar spent on road, highway, and bridge improvements results in an average benefit of $5.20 in the form of reduced vehicle maintenance costs, reduced delays, reduced fuel consumption, improved safety, reduced road and bridge maintenance costs, and reduced emissions as a result of improved traffic flow.

Road and Bridge Construction Workers Picture from PennDOT Local Technical Assistance Program

Increasing investments in Pennsylvania's roads, highways, and bridges will also boost the state's economy by creating jobs. A 2007 analysis by FHWA found that every $1 billion invested in highway and bridge construction would support approximately 27,800 jobs. The additional $2.3 billion investment in the Commonwealth's transportation system is expected to generate 50,000 new jobs, in addition to preserving 12,000 existing jobs. As a result, Pennsylvania will remain economically competitive with the other states in the region which have already made investments in their transportation system, such as New Jersey, Maryland and Virginia.

In addition, PennDOT is also seeking ways to stretch limited dollars. The agency is going through a transformation to improve efficiency through its "Next Generation" processes, which is anticipated to save $1 billion. In addition, Act 88, the Public and Private Partnerships (P3) for Transportation Act, was signed into law in July 2012 by Governor Corbett. This law allows PennDOT to partner with private companies to finance and maintain transportation-related projects. With the P3 approach, PennDOT is now pursuing replacement of more than 500 SD bridges in the Commonwealth with similar design, bundled into a Rapid Bridge Replacement Project. In this approach, design and construction costs are expected to be reduced since the design and construction will be standardized for all the bridges in the bundle. This means less traffic interruption, fewer lane closures, and safer and more reliable connection of people to their homes, workplaces, schools, and communities.

OPERATION AND MAINTENANCE

Bridge Closed for Repair and Maintenance Picture Courtesy of Intelligent Infrastructure Systems (IIS)

The ability of an owner to effectively maintain infrastructure in compliance with government regulations is dependent on the processes and funding streams. The major bridge owners in the Commonwealth include PennDOT (with 80.6 percent of bridge population) and the Pennsylvania Turnpike Commission (with 3.2 percent of bridge population). The remainder of bridges in the Commonwealth are locally owned by cities and municipalities.

The major bridge owners in the Commonwealth have identifiable maintenance programs and funding sources. PennDOT has instituted excellent policies and procedures for prioritizing maintenance needs. Maintenance needs are identified and prioritized through routine bridge inspections. Likewise, the Pennsylvania Turnpike Commission has a different yet equally disciplined system for determining maintenance needs for a relatively small population of bridges. The Turnpike Commission has an established budget for "contracted maintenance" at $5,000,000 per year using the mechanism of unit price contracts and other "routine maintenance items" which are programmed through an internal computerized system. Maintenance needs are evaluated with each inspection cycle. Based on available budgeting information, the major bridge owners spend within a range of $2,000 to $5,000 per bridge per year on routine maintenance.

The minor bridge owners include significant population center owners (Pittsburgh/Philadelphia with 2.3 percent of bridge population) and other local bridge owners (comprising various cities, counties and other municipalities with 13.9 percent of bridge population in aggregate), accounting for 16.2 percent of the bridge population. These owners are underfunded with respect to maintenance allotments. They most likely defer maintenance until load postings, closures or capital improvements are made. Based on available budgeting information, minor bridge owners spend less than $800 per bridge per year on routine maintenance.

PUBLIC SAFETY

All bridges must conform to Federal and Pennsylvania bridge design specifications. These regulations ensure all bridges are designed to meet a minimum level of safety for the bridge to serve at least 75 years based on the more modern design and construction practices (as opposed to 50 years effective lifespan for bridges designed prior to 1980s).

Comparing to some other states, the bridge inspection system in the Commonwealth is robust. PennDOT has developed its own bridge inspection training course, and it

requires inspectors to take a “refresher” course every two years. This training goes above and beyond Federal requirements. PennDOT also has a rigorous quality assurance program for its inspection efforts where a sample of structures in each maintenance district is ”re-inspected,” and the condition ratings are compared to the original inspection to ensure that assigned condition ratings are well within tolerance. For state-owned bridges, PennDOT performs an inspection for all structures 8 feet or greater in length even though Federal guidelines only require inspections for highway bridges of 20 feet or longer on a biennial basis.

In an effort to extend the life of bridges throughout the Commonwealth, and because of the uncertainty in bridge repair funding, PennDOT authorized new or added weight restrictions on 1,000 SD bridges across the Commonwealth according to the new Risk Based Posting program. This was necessary because the lack of funding had diminished PennDOT’s ability to repair or replace these bridges. The program implements more strict weight restriction criteria which recently resulted in the posting of 530 state-owned and 470 locally-owned bridges.

Closed or posted bridges have contributed to a statewide average detour length of 12 miles for this group of bridges. This means that school buses and delivery vehicles have to travel longer distances, leading to more expensive transportation of goods and longer commutes. However, when gauging the outcomes of the new weight restrictions, it should be noted that restricting the weight of trucks on a bridge does not improve the condition of the bridge, but it extends the life of the bridge in its current condition. In other words, it helps with preservation efforts by reducing the deterioration of the bridge due to heavy trucks.

Based on the records of significant bridge failures since 1950 in the US, no death has occurred as a result of the collapse of highway bridges in Pennsylvania. However, in 2005 a 50-feet section of concrete beam carrying Lakeview Drive in Washington County collapsed onto I-70 and some motorists suffered minor injuries when their minivan slid into the beam moments after it fell. This incident prompted PennDOT to set more strict inspection criteria for this type of concrete beam, not allowing this system to be used for new designs and adding the existing bridges with this system to the list of SD bridges.

Although the Commonwealth still ranks highest in the nation in terms of SD bridges, this may not directly compromise the public safety, since the deficient bridges are inspected routinely and posted at a lower load capacity as required by PennDOT. Nevertheless, this still is an indication of an aging system where potential safety problems must be closely monitored.

RESILIENCE

Resilience can be defined as the ability of a bridge to stay in service during or after a catastrophic event or disruption of service in the bridge network. The Commonwealth ranks in the top 14 states in the nation for the number of Fracture Critical (FC) bridges. FC bridges may not pose a significant risk directly, but they have at least one member whose failure would cause a portion of the bridge or the entire bridge to collapse. These structures were used for long span bridges during the expansion of the interstate highway system in the 1960s and 1970s, prior to the widespread recognition of the

vulnerability of such systems. This represents a lack of redundancy in the bridge network that makes the Commonwealth's bridge system less resilient.

Because 19 percent of the Commonwealth's bridges are FO, the bridge network's ability to handle major traffic incidents is decreased. As stated previously, the Commonwealth has the highest percentage of SD and posted bridges in the nation, and when bridges are posted, getting emergency equipment to the location where help is needed to recover from incidents is difficult.

Damage to a Bridge due to Flood
Picture Courtesy of PennDOT

The Commonwealth also has a significant number of waterways that are prone to flooding. In the past 5 to 10 years, the Commonwealth has seen significant damage to bridges due to floods. Some flooding has also caused scour issues where supporting foundation material is removed from the bridge, and damage has been caused from trees and other debris impacting structures during a flood. The Commonwealth is in a low earthquake risk area compared to other portions of the U.S., but there has been seismic activity within the Commonwealth. Due to the age of the system, many of the Commonwealth's bridges were not designed for extreme events like floods and earthquakes. Some critical bridges in major metropolitan areas are also vulnerable to terrorist attacks and should be structurally strengthened to resist this possibility. All of these factors reduce the resilience of the bridge network in the Commonwealth.

INNOVATION AND TECHNOLOGY

In recent years, bridge owners, including federal and state governments, are beginning to see value in supplementing of traditional bridge engineering practices with the implementation of various technologies in certain situations. These technology-based applications, such as structural health monitoring, non-destructive evaluation, sensing and simulation, as well as geometry capturing and image processing, may lead to cost savings in some situations while assuring the efficiency, effectiveness and reliability of aging infrastructure. However, these technologies are not appropriate in all situations or even in the majority of situations. Technology should be implemented when needed, and only when the cost of technology is balanced by the potential benefit of the information obtained.

In recent years, PennDOT has started utilizing a number of advanced testing and monitoring methods to optimize inspection, evaluation, and rehabilitation of its bridges. Examples of these are laser sensors (or so called LiDAR) to monitor movement of walls and bridges, as well as infrared thermo graphic technologies to detect splitting under the surface of the deck which will eventually lead to surface cracks, spalls or even potholes.

In addition, PennDOT, in conjunction with other federal, state agencies and universities, has continuously supported high profile research projects such as FHWA Long Term Bridge Performance Program (LTBP) and funded other academic research projects to improve bridge design, construction and preservation practice in the Commonwealth.

The Commonwealth has also taken a significant lead in the development of sophisticated bridge design software. The construction practice in the Commonwealth employs state-of-the-practice methods and approaches in order to save time and money in construction projects, such as Accelerated Bridge Construction (ABC). In addition, PennDOT is one of a few state DOTs with a robust Transportation Asset Management practice. If the Commonwealth continues to adopt modern planning, design, construction and monitoring techniques, it will be one of the pioneers in technology applications for design, construction, maintenance and management of transportation assets in the nation.

RECOMMENDATIONS

With this information in mind, the Bridges Committee, with the concurrence of the four Pennsylvania ASCE sections, has the following recommendations:

- Continue to target the most critical Structurally Deficient bridges by prioritizing the maintenance, repair, and replacement projects.
- Improve efforts to enforce State and Federal truck weight limits to minimize unnecessary damage to bridges due to unpermitted overweight vehicles.
- Advocate for additional long-term federal and state funding programs for bridges to deliver consistent, reliable funding that is adjusted for inflation. This additional funding is needed to maintain and improve the condition of bridges in the Commonwealth. Transportation funding should also be coordinated with all available Local, State and Federal sources to leverage total funding and investments. Also, owners and agencies should advocate for a user fee that is not based on fuel consumption, but instead based on vehicle miles travelled (VMT).
- Improve maintenance record transparency for more effective allocation of maintenance funds.
- Continue strict risk-based weight limitation policies to maintain public safety in light of the aging population of bridges.
- Continue the rigorous bridge inspection program that is in place. Consider national initiatives to put more inspection effort into aging and vulnerable structures, while putting less effort into simpler structures that are in better condition.
- Increase resilience of the Commonwealth's bridge population by gradually replacing or strengthening the fracture-critical bridges and by replacing aging bridges with structures that are less vulnerable to catastrophic events.
- Encourage and continue supporting innovative and efficient project delivery methods such as Public Private Partnership (P3) projects, or bundling of multiple bridge projects to increase efficiency in design and construction.

- Continue investigating the latest technological advancements in Structural Health Monitoring (SHM), Non-Destructive Evaluation (NDE), Sensing and Simulation or other PennDOT-approved innovations to better evaluate the current condition and capacity of the bridge population and supplement the conventional bridge design, inspection and maintenance practice in the case of major, long-span, movable, or complex system bridges. These technologies can also be utilized in identifying of and programming for maintenance needs.
- Investigate prequalifying contractors based on their ability to handle new technologies and by their familiarity with new construction techniques, in addition to awarding construction projects based on the lowest bid.

SOURCES

- American Society for Civil Engineers (ASCE), *2010 Report Card for Pennsylvania's Infrastructure:* 2010. Available at http://www.infrastructurereportcard.org.
- City of Philadelphia, PA, *The Mayor's Operating Budget in Brief for Fiscal Year 2012:* 2012. Available at http://www.phila.gov/finance/pdfs/Mayors%20Operating%20Budget%20in%20Brief%20FY%202012%20App%20%206-11%20(2).pdf.
- City of Pittsburgh, PA, Dept. of Public Works, Bureau of Operations, *Budget 2012:* 2012. Available at http://www.city.pittsburgh.pa.us/main/assets/budget/2012/2012-Budget.pdf
- County of Allegheny, PA, *2012 County Budgets Report:* 2012. Available at http://www.county.allegheny.pa.us/budget/2012/2012Operating.pdf
- FHWA*, 2008 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance:* 2008. Available at http://www.fhwa.dot.gov/policy/2008cpr/
- FHWA, *Employment Impacts of Highway Infrastructure Investment*: 2012. Available at http://www.fhwa.dot.gov/policy/otps/pubs/impacts/index.htm.
- FHWA, *Fracture Critical Inspection Techniques for Steel Bridges. Publication No. FHWA-NHI-11-051*
- FHWA, *National Bridge Inventory (NBI) Highway Bridge Database:* 12/31/2012. Available at http://www.fhwa.dot.gov/bridge/nbi/ascii.cfm.
- PennDOT, *2012 Annual Report:* 2012. Available at http://www.dot.state.pa.us.
- PennDOT, *Office of Policy & Public Private Partnerships:* 2013. Available at http://www.p3forpa.pa.gov.
- PennDOT, *PennDOT Next Generation:* 2013. Available at http://www.moderndot.pa.gov.
- PennDOT, *Publication 238: Bridge Safety Inspection Manual:* 2010. Available at ftp://ftp.dot.state.pa.us/public/PubsForms/Publications/PUB%20238.pdf
- PennDOT, *Secretary Schoch's Presentation on Risk Based Postings:* 2013. Available at ftp://ftp.dot.state.pa.us/public/pdf/InfoBridge/RiskBasedPostingspresentation.pdf.
- Pennsylvania Governor's Budget Office, *Governor's Executive Budget 2012-13:* 2012. Available at http://www.budget.state.pa.us/portal/server.pt/community/past_budgets/4571

- Pennsylvania State Transportation Advisory Committee, *Transportation Funding Study*: May 2010. Available at http://pasenategop.com/committees/transportation/PDF/2010/TAC-report.pdf.
- Pennsylvania State Transportation Commission (STC), *Pennsylvania Transportation Performance Report:* 2013. Available at http://www.talkpatransportation.com/docs/TPR%20FINAL%202-7-13_sm.pdf.
- Transportation Funding Advisory Commission, *Final Report:* August 2011. Available at http://www.tfac.pa.gov.
- TRIB Live News, *Bridge over I-70 Collapses; Section of Highway Closed:* Wednesday, Dec. 28, 2005. Available at http://triblive.com/x/valleyindependent/news/s_408248.html#axzz2lljV6Amv

ASCE POLICY STATEMENTS

- ASCE Policy Statement 208: Bridge Safety (PS 208)
- ASCE Policy Statement 382: Transportation Funding (PS 382)
- ASCE Policy Statement 400: Design-Build Procurement (PS 400)
- ASCE Policy Statement 404: Endorsement of Infrastructure Projects (PS 404)
- ASCE Policy Statement 434: Transportation Trust Funds (PS 434)
- ASCE Policy Statement 451: Life Cycle Cost Analysis (PS 451)
- ASCE Policy Statement 496: Innovative Financing for Transportation Projects (PS 496)
- ASCE Policy Statement 497: Surface Transportation Research Funding (PS 497)
- ASCE Policy Statement 526: Public-Private Partnerships (PS 526)

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